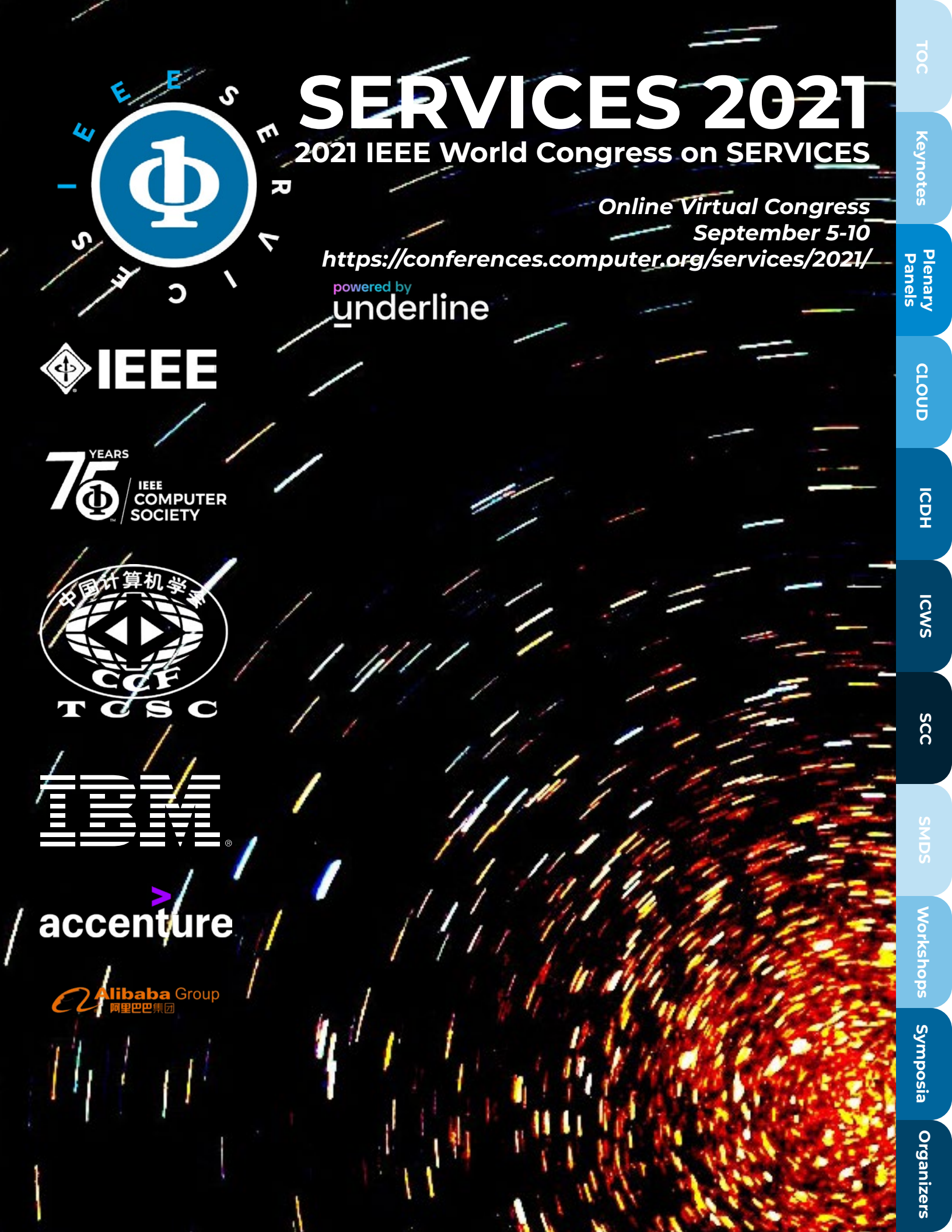
SERVICES 2021
2021 IEEE World Congress on SERVICES
Online Virtual Congress
September 5-10
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Message from the Chair of the Steering Committee
Carl K. Chang, Iowa State University

Welcome to the 2021 edition of The IEEE World Congress on Services (SERVICES). It has been a privilege to serve as the Chair of the Steering Committee since summer 2017. After having completed three rounds in 2018, 2019 and 2020, we continue to experiment with new ideas and have launched new initiatives in the 2021 edition. First, I am very pleased to announce that SERVICES and IEEE Trans. on Services Computing (TSC) has signed a multi-year agreement to phase in the Journal-First-Conference-Second (J1C2) cooperation mode, the first of its kind in the Computer Society. We also launched the inaugural edtion of the IEEE International Conference in Digital Health (ICDH) to join the set of conferences already affiliated with SERVICES, namely CLOUD, ICWS, SCC, and SDMS. Due to logistics reason we decided to move 2021 IEEE EDGE to December, still considered as part of the 2021Congress. Rapid advances of Digital Health (DH) technologies, in conjunction of the pervasive and revolutionary nature of entering an Internet of Things (IoT) era, made us believe that we ought to engage digital healthcare technologies as an integral part of SERVICES. We are fortunate to be able to recruit well known DH pioneers and seasoned researchers in this emerging domain, and have developed a highly robust program with the strong support from US National Science Foundation and National Institutes of Health, and private industry, including IBM. The Steering Committee has been keen in undertaking such an approach to always be on the outlook to timely plan for a new international forum as a new conference, a symposium or a workshop, should any emerging service-centric technologies emerge on the horizon outside our current technology coverage and offerings.

Again in this year, due to the obstacles caused by the global pandemic, which has not subsided yet, we decided to continue holding the Congress in the digital format. Our experience indicates that the preparation workload has not been lessened at all due to virtualization. 2021 SERVICES will be the second year we partnered with Underline Science as our virtual conferencing vendor with the support of Computer Society staff. Based on our 2020 experience Underline made quite significant improvements of their service features, and they promised to provide better UX. You are asked to please do return your feedback through the survey, as there is always room for improvement.

Our long-range plan is to continue the rotation pattern between the Americas, Europe and Asia Pacific. Due to the pandemic, we had to modify the rotation plan by developing the digital edition two years in a row from 2020 to 2021. However, we are still optimistic that the current plan to return to Europe will still be possible. As you may have observed, SERVICES is a large and complex professional event. Each year we need to mobilize a large number of volunteers to serve in various roles to make this event possible. We invite all of you reading this message to consider helping organize the Congress. Contact any key organizer of your choice and volunteer your service. Last but not the least, I regret to inform this community that Mikio Aoyama, a long-time and solid contributor to SERVICES, passed away on May 13 this year. Aoyama-san was a dear friend and colleague to many of us. We have missed him greatly!

To conclude, although we cannot physically meet in Chicago as originally planned, we do hope that you can still enjoy the technical program and various interaction opportunities with the community in the digital format. It is also time to begin preparation to make contributions to the 2022 Congress. With some luck, we may see each other in Barcelona, Spain, the chosen city to host the next edition of IEEE SERVICES in July 2022.

Message from the Technical Committee Chair on Services Computing of IEEE Computer Society
Rong N. Chang, IBM TJ Watson Research Center

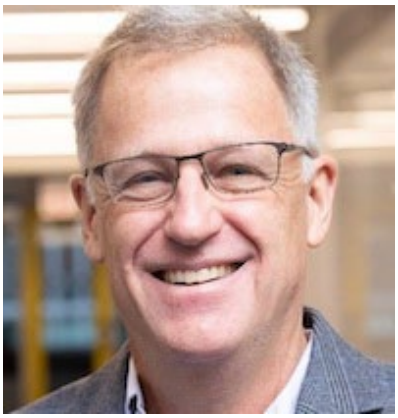
IEEE Computer Society (IEEE-CS) Technical Committee on Services Computing (TCSVC), http://tab.computer.org/tcsvc, has endorsed the affiliated technical conferences of IEEE World Congress on Services (SERVICES) since 2004. Over the past 17 years, IEEE-CS has provided 100% financial co-sponsorship for the annual events with the exception of 2014 to 2017 (during which, IEEE-CS provided 60% financial co-sponsorship). Many innovative growth initiatives have been delivered for the best interests of the worldwide services computing community, a fast-growing R&D community with more than 12,000 active participants. In terms of the total number of IEEE Xplore downloads, IEEE SERVICES is ranked in the top 5% in recent years.

For the past four years, TCSVC has been collaborating with IEEE SERVICES on transforming the planning and execution of the technical conferences affiliated with IEEE SERVICES. Noteworthy changes include establishing IEEE compliant bylaws, institutionalizing a two-year conference planning process, and selecting non-US venues for IEEE SERVICES. Financial health of the annual events also enables TCSVS to provide cash prizes in support of the compreheive awards program of IEEE SERVICES 2021. Despite various unexpected challenges (e.g., COVID-19 pandemic), the transformation has been progressing well with contributions from many committed volunteer leaders. Besides the organizing committee of IEEE SERVICES 2021, I thank all members of the TCSVC committees listed at the end of this message. They are pivotal to the services provided by TCSVC.

Aiming at curating young leaders and advocating diversity and inclusion (D&I), the inaugural IEEE Symposium on Young Experts in Services Computing (YESC) is held this year based upon the success of the inaugural IEEE Symposium on Women in Services Computing (WISC) last year. More than 40 women students applied for the inaugural WISC Scholarship, sponsored jointly with IEEE SERVICES and CCF TCSC. Moreover, the inaugural hackathon on quantum computing is organized with cash prizes for teams of students and professionals. The annual IEEE TCSVC “Rising Star Award” and “Women in Services Computing Award” have received many quality nominations since 2018. Finally, a three-year first-of-its-kind J1C2 (Journal 1st, Conference 2nd) pilot starts from this year jointly with IEEE TSC and IEEE SERVICES. We look forward to your proactive effort in growing the services computing community. IEEE-CS TCSVC website has information on free membership subscription and sponsored social media groups.

One important ongoing initiative of TCSVC is advancing the scientific foundations for service science and engineering, making “services computing” or “serviceology” as a first-class discipline in academia and service verticals. You are encouraged to participate in the first joint panel of ICWS and SCC, titled “New Forms of Services and New Approaches of Serviceology”, which continues last year’s two panels on this important theme.

I am grateful for the trust and support of the community and IEEE-CS for my chairperson role of IEEE-CS TCSVC since 2014. I believe the community will keep growing under the new leadership team from the beginning of next year. I wish everyone to enjoy participating in IEEE SERVICES 2021.



Message from the Congress General Chairs
Rong N. Chang, IBM TJ Watson Research Center
Ian Foster, University of Chicago; Argonne National Laboratory

A warm welcome to the 2021 IEEE World Congress on Services (SERVICES), an all-virtual event due to the COVID-19 pandemic. Based upon the digital conference experiences we had for IEEE SERVICES 2020, we aim at providing a safe, productive, and engaging forum for all attendees of the event.

Compared with past IEEE SERVICES events, this year features many thought leadership efforts for the services computing community. First, we created a new International Conference on Digital Health (ICDH) in terms of the impact-making opportunities of related R&D efforts. It is our first vertical service conference and IEEE Computer Society's first technical conference on digital health.

We started a three-year first-of-its-kind J1C2 (Journal 1st, Conference 2nd) pilot with IEEE Transactions on Services Computing (TSC) and with monetary sponsorship from IEEE-CS Technical Committee on Services Computing (TCSVC). 20 accepted, but not yet published, papers of IEEE TSC will be presented and be available for free download at IEEE SERVICES 2021. Complimentary registration is provided for the presenter and the one-page presentation abstract of each of the invited papers.

For each of the affiliated conferences, we created a few special tracks (with special paper awards and cash prizes) to advocate and promote the emerging and/or important R&D themes listed below.

- [CLOUD] "AI in Cloud Software Engineering and Operation (AI-CloudSEO)", "Cloud Edge", "Cloud HPC (High-Performance Computing)", and "Cloud Programming"
- [ICWS] "Quantum Software and Services (QSAS)" and "Software Service Engineering (SSE)"
- [SCC] "Future of Financial Services (FFS)" and "Industrial Internet (Industry 4.0)".
- [SMDS] "Blockchain", "Causal Learning", and "Graphs, Knowledge Graphs, and AI"

Several of the conference special tracks are jointly organized with cross-conference symposia in terms of the transdisciplinary nature of the R&D themes. Examples are Symposium on Cloud HPC (CloudHPC), on QSAS, on SSE, on FFS, and on Blockchain.

Aiming at curating young leaders and advocating diversity and inclusion (D&I), the inaugural IEEE Symposium on Young Experts in Services Computing (YESC) is held this year based upon the success of the inaugural IEEE Symposium on Women in Services Computing (WISC) last year. More than 40 women students applied for the inaugural WISC Scholarship, sponsored jointly with IEEE-CS TCSVC and CCF TCSC. Finally, the inaugural hackathon on quantum computing is organized with cash prizes for teams of students and professionals.

We would like to thank the researchers who submitted their papers to the affiliated conferences, symposia, and workshops as well as the program committee members for reviewing the submissions rigorously under challenging circumstances. Finally, we would like to take this opportunity to express our appreciation to the organizing committee members of IEEE SERVICES 2021 for their dedication to the event.

Message from the Congress Program Chairs in Chief
Ernesto Damiani, University of Milan
Jia Zhang, Southern Methodist University

It is our great pleasure to welcome you to the 2021 edition of the IEEE World Congress on Services (SERVICES 2021) featuring five top conferences: CLOUD, EDGE ICWS, SCC, SMDS and the new International Conference in Digital Health (ICDH). It is our privilege to serve as the Program Chairs-in-Chief for this Congress, whose success recognizes the strong research communities around the world that focus on foundations, methodologies and applications of computing-based services. The Congress program provides a comprehensive view of research advances as well as novel applications and industry perspectives in the aftermath of the COVID pandemics.

The services research field, which includes cloud/edge computing, Internet-of-Things, and Smart Data Services, is a key enabler of the new wave of digital transformation affecting businesses, communities and individuals worldwide. Over the years, the SERVICES Congress has become the leading venue for whoever, from academia and industry, is interested in a multi-disciplinary view of the services computing field.

In the line of the previous edition, all Congress conferences have followed a rigorous and highly competitive scientific review process, as result of which we have an excellent set of regular research papers. The program of each conference is complemented by carefully selected invited papers by world-renowned researchers. In today's rapidly changing research landscape, timeliness is essential. We believe that it is part of the Congress' mission to include early reports of novel ideas; for this reason, the program also includes short Work-in-Progress (WIP) papers highlighting promising preliminary research results. To further broaden the perspective offered to participants, the Congress also includes several workshops and symposia on emerging research topics.

Putting together the program of a multi-conference event like the SERVICES Congress is a challenging task, and needs to be a team effort to succeed. Specially, we would like to acknowledge the collaboration of several colleagues. First, we would like to recognize the Program co-Chairs of the five conferences: Claudio Ardagna, Rjiv Ranjan and Wensheng Zhang (IEEE CLOUD 2021), Qiang He and Tao Zhang (IEEE EDGE 2021), Giuseppe De Piero, Lin Liu and Farhan Zulkernine (ICDH 2021), Jing Fan, Parisa Ghodous and Michael Maximilien (IEEE ICWS 2021), Barbara Carminati, Shuiguang Deng and Wei Tan (IEEE SCC 2021), Min Fu, George Spanoudakis, and Mudhakar Srivatsa (IEEE SMDS 2021). They all recruited PC members for strong research tracks, who provided thoughtful reviews, and enforced our Congress' double-blind review policy. We also would like to thank Zhongie Wang, Senior Publication Chair, Nimanthi Atukorala, Publication Chair, and Robert Ward, Vice Publication Chair, who accomplished the important task of coordinating the preparation of the Congress Proceedings with the Program Chairs.

We are particularly grateful to Rong Chang and Ian Foster, IEEE Services General Chairs and to Carl Chang, Chair of the IEEE Services Steering Committee, for their tireless work and wise advice. Finally, we would like to thank all the colleagues worldwide who submitted their best research work to our Congress. It is their work that makes the IEEE Services Congress such a strong research venue. We hope that the revised online formula of the Congress will increase opportunities to network with other researchers and get interesting and novel directions for your research work. Enjoy the program!!

Congress Opening Session

Tuesday September 7
15:00 - 15:30 UTC

Welcome Remarks from 2021 IEEE Computer Society President

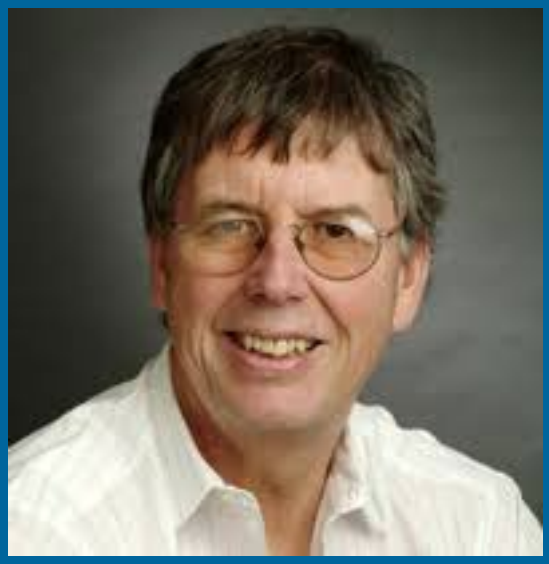
Dr. Forrest Shull is the Lead for Defense Software Acquisition Policy Research at the Carnegie Mellon University Software Engineering Institute (SEI). He leads the SEI technical response to the Department of Defense (DoD) in support of several important activities, including Congressionally mandated initiatives, to improve acquisition by incorporating modern software development practices. This work culminated in the development of the Department's first software-specific acquisition policy in 2020, which is supporting rapid and iterative delivery of software capabilities to the operational environment to meet the highest priority user needs.

Shull joined SEI after 15 years at Fraunhofer USA, a nonprofit research and technology transfer organization, where he established and was Director of the Measurement and Knowledge Management Division. He has been a lead researcher on projects for the DoD, the NASA Office of Safety and Mission Assurance (OSMA), the NASA Safety Center, the Defense Advanced Research Projects Agency (DARPA), the National Science Foundation, and commercial companies. His research work for NASA won a Group Achievement Award "in recognition of the significant impact on NASA software products and for advancing the state-of-the-art of the software industry." He is the author of over 100 peer-reviewed publications.

Shull is the current president of the Institute of Electrical and Electronics Engineers (IEEE) Computer Society. He has served on the Society's Board of Governors and Executive Committee since 2015. In these roles he has led and been a key participant in initiatives aimed at instituting more data-driven decision making and transforming the Society to better address the current needs of its members. From 2011 to 2014, he served as Editor in Chief of IEEE Software, the premier publication for bridging software research and practice, during which time he oversaw the launch of a new digital edition of the magazine and broadened the magazine's reach into multimedia.

Keynote 1: Michael Stonebraker
DBOS: A Database-Oriented Operating System

Tuesday September 7
15:30 - 17:00 UTC



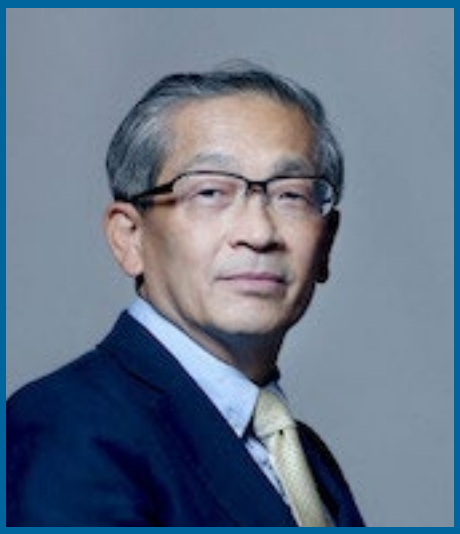
Dr. Stonebraker has been a pioneer of data base research and technology for more than forty years. He was the main architect of the INGRES relational DBMS, and the object-relational DBMS, POSTGRES. These prototypes were developed at the University of California at Berkeley where Stonebraker was a Professor of Computer Science for twenty five years. More recently at M.I.T. he was a co-architect of the Aurora/ Borealis stream processing engine, the C-Store column-oriented DBMS, the H-Store transaction processing engine, the SciDB array DBMS, and the Data Tamer data curation system. Presently he serves as Chief Technology Officer of Paradigm4 and Tamr, Inc.

Professor Stonebraker was awarded the ACM System Software Award in 1992 for his work on INGRES. Additionally, he was awarded the first annual SIGMOD Innovation award in 1994, and was elected to the National Academy of Engineering in 1997. He was awarded the IEEE John Von Neumann award in 2005 and the 2014 Turing Award, and is presently an Adjunct Professor of Computer Science at M.I.T.

Current operating systems are complex systems that were designed long before today's computing environments. This makes it difficult for them to meet the scalability, heterogeneity, availability, and security challenges in current cloud and parallel computing environments. To address these problems, we propose a radically new OS design based on data-centric architecture: all operating system state should be represented uniformly as database tables, and operations on this state should be made via queries from otherwise stateless tasks. This design makes it easy to scale and evolve the OS without whole-system refactoring, inspect and debug system state, upgrade components without downtime, manage decisions using machine learning, and implement sophisticated security features. We discuss how a database OS (DBOS) can improve the programmability and performance of many of today's most important applications, propose a plan for the development of a DBOS proof of concept, and give results on a pilot that suggest the approach has merit.

Keynote 2: Jay Lee
Recent Advances of Industrial AI in Smart Service Transformation: Case Studies and Lessons Learned

Wednesday September 8
18:10 - 19:30 UTC



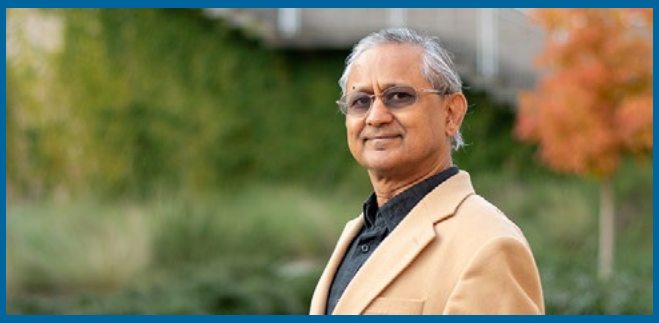
Industrial AI, Big Data Analytics, Machine Learning, and Cyber Physical Systems are changing the way we design product, manufacturing, and service systems. It is clear that as more sensors and smart analytics software are integrated in the networked industrial products and manufacturing systems, predictive technologies can further learn and autonomously optimize service productivity and performance. This presentation will address the trends of Industrial AI for smart service realization. First, Industrial AI systematic approach will be introduced. Case studies on advanced predictive analytics technologies for different maintenance and service operations will be demonstrated. In addition, issues on data quality for high performance and real-time data analytics in future digital service will be discussed.

Currently, Jay Lee is vice chairman and board member of Foxconn Technology Group. Prior to this position, he served as vice chairman of Foxconn Industrial Internet. Dr. Jay Lee is also an Ohio Eminent Scholar and L.W. Scott Alter Chair Professor of the Univ. of Cincinnati, and is the founding director of National Science Foundation (NSF) Industry/University Cooperative Research Center (I/UCRC) on Intelligent Maintenance Systems (www.imscenter.net) as well as the Founding Director of Industrial AI Center (www.iaicenter.com). Currently, he serves as a member of Board of Governors of the Manufacturing Executive Leadership Council of National Association of Manufacturers (NAM), as well as a member of the Global Future Council on Advanced Manufacturing and Production of the World Economics Council (WEF) to engage the global leaders for the development of collaborative activities in smart manufacturing. Previously, he served as senior advisor to McKinsey & Company. Prior to his academic career, he served as Director for Product Development and Manufacturing at United Technologies Research Center (UTRC) as well as Program Directors for a number of programs at NSF. He was selected as 30 Visionaries in Smart Manufacturing in by SME in Jan. 2016 and 20 most influential professors in Smart Manufacturing in June 2020. Dr. Jay Lee's new book on Industrial AI was published by Springer in Feb. 2020. For more publications, see ResearchGate https://www.researchgate.net/profile/Jay_Lee10 Google Scholar https://scholar.google.com/citations?user=g9GtqgQAAAAJ&hl=en&oi=ao

Knowledge representation as expert system rules or using frames and variety of logics, played a key role in capturing explicit knowledge during the hay days of AI in the past century. Such knowledge, aligned with planning and reasoning are part of what we refer to as Symbolic AI. The resurgent AI of this century in the form of Statistical AI has benefitted from massive data and computing. On some tasks, deep learning methods have even exceeded human performance levels. This gave the false sense that data alone is enough, and explicit knowledge is not needed. But as we start chasing machine intelligence that is comparable with human intelligence, there is an increasing realization that we cannot do without explicit knowledge. Neuroscience (role of long-term memory, strong interactions between different specialized regions of data on tasks such as multimodal sensing), cognitive science (bottom brain versus top brain, perception versus cognition), brain-inspired computing, behavioral economics (system 1 versus system 2), and other disciplines point to need for furthering AI to neuro-symbolic AI (i.e., hybrid of Statistical AI and Symbolic AI, also referred to as the third wave of AI). As we make this progress, the role of explicit knowledge becomes more evident. I will specifically look at our endeavor to support human-like intelligence, our desire for AI systems to interact with humans naturally, and our need to explain the path and reasons for AI systems' workings. Nevertheless, the variety of knowledge needed to support understanding and intelligence is varied and complex. Using the example of progressing from NLP to NLU, I will demonstrate the dimensions of explicit knowledge, which may include, linguistic, language syntax, common sense, general (world model), specialized (e.g., geographic), and domain-specific (e.g., mental health) knowledge. I will also argue that despite this complexity, such knowledge can be scalability created and maintained (even dynamically or continually). Finally, I will describe our work on knowledge-infused learning as an example strategy for fusing statistical and symbolic AI in a variety of ways.

Keynote 3: Amit Sheth Don't Handicap AI Without Explicit Knowledge

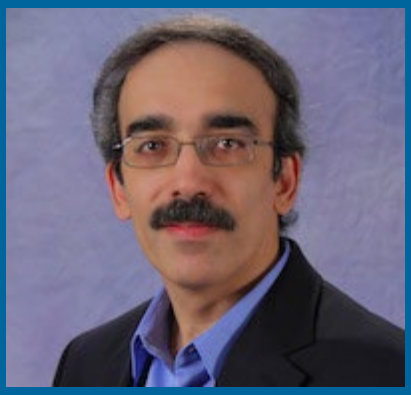
Thursday September 9
15:00 - 16:20 UTC



Prof. Amit Sheth (Home Page, LinkedIn) is an Educator, Researcher, and Entrepreneur. He is the founding director of the AI Institute (#AIISC) at the University of South Carolina. Current areas of his research includes knowledge-infused learning and explainable AI, and applications to personalized and public health, social good and preventing social harm, future manufacturing, and disaster management. He is a fellow of the IEEE, AAAI, AAAS, and ACM. His awards include IEEE TCSVC Research Innovation Award, University Trustee Award, 10-year award (Intl Semantic Web Conf), OSU Franklin College Alumni award, and Ohio Faculty Commercialization Award (runner up). For several years through 2018, he was listed among the top 100 most cited computer scientists. Three of the four companies he has (co)founded involves licensing his university research outcomes, including the first Semantic Web company in 1999 that pioneered technology similar to what is found today in Google Semantic Search and Knowledge Graph, and the fourth company (http://cognovilabs.com) at the intersection of emotion and AI.

Keynote 4: Ruchi Puri
Engineering the Future of AI for the Enterprises

Friday September 10
15:00 - 16:20 UTC



Recent advances in AI are starting to transform every aspect of our society from healthcare, manufacturing, environment, and beyond. Future of AI for enterprises will be engineered with success along three foundational dimensions. We will dive deeper along these dimensions - Automation of AI; Trust of AI; and Scaling of AI - and conclude with the opportunities and challenges of AI for businesses.

Dr. Ruchir Puri is the Chief Scientist of IBM Research, an IBM Fellow, and Vice-President of IBM Technical Community. He led IBM Watson as its CTO and Chief Architect from 2016-19 and has held various technical, research, and engineering leadership roles across IBM's AI and Research businesses. Dr. Puri is a Fellow of the IEEE, and has been an ACM Distinguished Speaker, an IEEE Distinguished Lecturer, and was awarded 2014 Asian American Engineer of the Year. Ruchir has been an adjunct professor at Columbia University, NY, and a visiting scientist at Stanford University, CA. He was honored with John Von-Neumann Chair at Institute of Discrete Mathematics at Bonn University, Germany. Dr. Puri is an inventor of over 70 United States patents and has authored over 100 scientific publications on software-hardware automation methods, microprocessor design, and optimization algorithms. He is the chair of AAAI-IAAI conference that focused on industrial applications of AI. Ruchir's technical opinions on the adoption of AI by society and businesses have been featured across New York Times, Wall Street Journal, Forbes, Fortune, IEEE spectrum among other.

Plenary Panel 1
Cloud HPC: Exploring the Growing Synergy Between Cloud and High Performance Computing

Tuesday September 7
17:10 - 18:30 UTC

Cloud computing is traditionally defined in terms of data and compute services that support on-demand applications that scale to thousands of simultaneous users. High Performance Computing (HPC) is associated with massive supercomputers that run highly parallel programs for small groups of users. However, over the last five years, the demands of the scientific and engineering research community have created an evolutionary pressure to merge the best innovations of these two models. HPC centers have started to use cloud-native technologies like data object stores and cloud tools and processes to develop and deploy software. On the other side, cloud data centers are integrating advanced accelerators on each node and deploy high-performance interconnects with latency optimizations known from HPC. Furthermore, the AI revolution that was initially nurtured by the public cloud companies with their hyperscale datacenters, is increasingly finding adoption in the scientific and engineering applications on supercomputers.

Moderator
Dennis Gannon
Indiana University

Panelist
Kethy Yelick
UC Berkeley

Panelist
Ian Foster
University of Chicago
Argonne National Lab

Panelist
Geoffrey Fox
University of Virginia

Panelist
Kate Keahey
University of Chicago
Argonne National Lab

Plenary Panel 2
The Future of Digital Health: Bridging Behavioral Science & Engineering with Intensive Longitudinal Assessment

Wednesday September 8
15:00 - 16:20 UTC

Advances in health behavior theories and the efficacy of health behavior interventions are limited by difficulties in invoking sustained health behavior changes within person across time. The Intensive Longitudinal Health Behavior Network (ILHBN) is a cooperative agreement network funded jointly by seven participating units within the National Institutes of Health to collaboratively study factors that influence key health behaviors in the dynamic environment of individuals, and ways to leverage intensive longitudinal data (ILD) collection and analytic methods to introduce innovations into long-standing behavioral theories and theory-driven behavior change interventions. The seven studies utilize a rich array of intensive longitudinal designs, data collection technologies (e.g., smartphones, wearables, video diaries), data types (e.g., ecological momentary assessments, location, accelerometry, physiological data, videos, images, and phone usage data), and analytic tools to study health behavior changes. This panel addresses several of the challenges in collecting and utilizing ILD.

The Temporal Influence of Movement and Exercise (TIME) Study is collecting phone and smartwatch data from over 250 people, each for a year, to investigate predictors of adoption and maintenance of behaviors related to physical activity, sedentary behavior, and sleep. Some of the methods being used will be described, along with challenges that have been encountered when interpreting and integrating sensor data for intensive longitudinal behavior measurement. The Dynamic Models of Behavior Study is a Micro-Randomized trial to increase physical activity in overweight but otherwise healthy adults. The project is collecting FitBit and phone data from 60 people for a year. A major challenge for this project, as well as all of the projects in the Network, is keeping participants engaged. We will address why engagement is key, and how it can be measured or captured using paradata, and how to tag and share this data across multiple projects.

The Bipolar Longitudinal Study (BLS) leverages smartphone technologies and data from recorded interviews, to establish robust behavioral markers associated with mania, depression, and psychosis experienced by collecting 100 person-years of multimodal data from at-risk individuals followed for up to 5 years. Our final speaker will address the challenges, benefits, and impact of utilizing ILD in a clinical setting. Finally, we will describe efforts to establish more robust approaches for translating domain knowledge about processes into computational models that account for theorized dynamics, and highlight some ways in which the cross-disciplinary collations from these projects have helped advance the field of digital health. increasingly finding adoption in the scientific and engineering applications on supercomputers. This panel brings together four acknowledge leaders with experience in both cloud computing and high performance scientific computing.

Moderator
Sy-Miin Chow
Penn State University

Panelist
Donna Spruijt-Metz
University of Southern California

Panelist
Stephen Intille
Northeastern University

Panelist
Misha Pavel
Northeastern University

Panelist
Justin T. Baker
McLean Hospital
Harvard University

Plenary Panel 3
Advances & Challenges in Software Service Engineering

Thursday September 9
5:40 - 7:00 UTC

As we have entered the Internet-of-Things (IoT) era, further blessed with rapid advances in several key technological areas including DevOps, AI/ML, 5G/6G/, neurocomputing, to name a few, it is imperative we think big and aim high. This new venture will require professionals in both software engineering and services computing to collaborate with an unprecedented intensity, and jointly develop the new interdisciplinary field hereby named Software Service Engineering (SSE). In SSE, the ever-deepening system dynamics emerging from both environments and humans in varying contexts are imposing steep challenges to both researchers and practitioners. Humans, both developers and the vast number of end users, are embedded ever closer to IoT environments, and are being afforded ample opportunities to continuously inject inputs during system development and after deployment. In fact, humans are increasingly playing the roles of both sensor and actuator. Traditional requirements engineering researchers are being lured more than ever into exploiting the IoT environments where human users are deeply embedded, to gather contextual information that inevitably introduces lots of ambiguity and uncertainty. Provisioning of highly adaptable and scalable microservices would be key to timely meeting ever-changing human desires and ever-evolving system requirements in the nimblest manner. As such, an ultra-agile and field-programmable development methodology and environment will be imperative to achieving such ultra-fine grained microservices provisioning. The ultimate goal in pursuit of such a noble dream will be to provide genuinely individualized and trustworthy service, possibly enabled by AI, but it should be both explainable and ethical. Facing such grand challenges, this panel is prepared to share with the audience their observations of some burning issues in SSE, and intends to bring heightened attention to an assorted array of existing, barely emerging or non-existent services computing and software engineering methods for all of us to assess, research and explore.

Panel Chair
Moderator
Carl K. Chang
Iowa State University

Panel Chair
Moderator
Zhi Jin
Peking University

Panelist
Paolo Ceravolo
University of Milan

Panelist
Rong N. Chang
IBM Research

Panelist
Sumi Helal
University of Florida

Panelist
Xuanzhe Liu
Peking University

Panelist
Hua Ming
Oakland University

Plenary Panel 4
Quantum Software & Services

Thursday September 9
16:30 - 17:50 UTC

Quantum computing is a new and emergent computation parading, and we need to understand how it is going to be used and impact in the current software and services. Furthermore, it is necessary explore how connect quantum and conventional computation to take advantage in both sides. Understanding that one of the key components of this technology is the quantum hardware (Quantum Processing Units or QPUs), the software and algorithm need to cover from the core hardware to the final user. This software stack from one side need to help to new quantum developers to have better tools to handle and improve the quantum hardware, also create new algorithms and models, and finally how we are going to integrate all these pieces with the current conventional applications. In this journey we are going to need to discover use the powerful of this quantum computation and how the users can connect and develop new kind of software and services around of it.

This panel is going to help to understand the current state of the art in the Quantum field, from the software near to the quantum hardware to services integrated on the cloud. The panel is moderated by Frank Leymann and Ismael Faro.

Frank Leymann
University of
Stuttgart

Panel Chair
Moderator
Ismael Faro
IBM Research

Panelist
Anne Matsuura
Intel Labs

Panelist
Blake Johnson
IBM Quantum

Panelist
Denise Ruffner
IonQ

Panelist
Matthias
Rosenkranz
CQC

Panelist
Sam Stanwyck
NVIDIA

Plenary Panel 5
Future Trends of Strategic Advances of Services Computing Using AI Technologies

Friday September 10
16:30 - 17:50 UTC

It is obvious that AI will be one of the most influential driving forces to advance the services computing technologies in various application domains. Recent research progress in these areas has been very rapid due to many important accomplishments in computing paradigms and systems, smart and big data, internet and mobile networks. sensing devices, and semiconductor technologies. With the continuing rapid progress in these areas and emerging technologies, such as quantum computing, it is expected that effective applications of AI technologies will dominate the advances of services computing.

In this session, we will have a group of distinguished panelists to discuss a number of aspects of this topic, including effective incorporation of AI in smart resilient manufacturing, development of secure web services against dynamic and powerful attacks, and some real-world examples.

Panel Chair
Moderator
Stephen Yau
School of Computing & Augmented Intelligence (SCAI)
Arizona State University

Panelist
Ruchi Puri
IBM Research

Panelist
Jay Lee
Foxconn Technology Group

Panelist
Bhavani Thuraisingham
University of Texas at Dallas

Panelist
Doo-Hwan Bae
KAIST

IEEE SERVICES Congress Awards Ceremony

Friday September 10
19:40 - 21:00 UTC

IEEE Computer Society Presidential Initiative Award

Best Paper Awards of IEEE CLOUD/ICDH/ICWS/SCC/SMDS
Award Chair: Program Chairs of IEEE CLOUD/ICDH/ICWS/SCC/SMDS

Best Student Paper Awards of IEEE CLOUD/ICDH/ICWS/SCC/SMDS
Award Chair: Program Chairs of IEEE CLOUD/ICDH/ICWS/SCC/SMDS
Cash Prize: USD 300.00 in total for each winning paper

Special Paper Awards of IEEE CLOUD/ICDH/ICWS/SCC/SMDS
Award Chair: Chairs of the associated CFP Special Tracks
Cash Prize: USD 300.00 in total for each winning paper

- [CLOUD] Cloud Edge
- [CLOUD] Cloud HPC (High Performance Computing)
- [CLOUD] AI in Cloud Software Engineering and Operations
- [CLOUD] Cloud Programming
- [ICWS] Quantum Software and Services
- [ICWS] Software Service Engineering
- [SCC] Future of Financial Services
- [SCC] Industrial Internet
- [SMDS] Blockchain
- [SMDS] Causal Learning
- [SMDS] Graphs, Knowledge Graphs, and AI

Hackathon Award of IEEE SERVICES 2021
Award Chair: Hackathon Committee Chair
Cash Prize: USD 500.00 for the winning team

WISC Scholarship Awards
Award Chair: General Chair of IEEE International Symposium on Women in Services Computing (WISC)

YESC Presentation Award of IEEE SERVICES 2021
Award Chairs: General Chairs of IEEE YESC Symposium
Cash Prize: USD $200/00 (one for each affiliated conference of IEEE SERVICES 2021)

IEEE TCSVC Research Innovation Award
Award Chair: IEEE TCSVC Awards Chair

IEEE TCSVC Rising Star Award
Award Chair: IEEE TCSVC Awards Chair

IEEE TCSVC Women in Services Computing Award
Award Chair: IEEE TCSVC Awards Chair

CLOUD 2021
IEEE INTERNATIONAL CONFERENCE ON CLOUD COMPUTING

Welcome to the 2021 IEEE International Conference on Cloud Computing (CLOUD 2021)! IEEE CLOUD, held since 2009, is a top-ranked, flagship international conference focusing on innovative cloud computing across all "as a service" categories, including Network, Infrastructure, Platform, Software, and Function. IEEE CLOUD brings together a diverse community to share ideas, present research results, and discuss experiences in building some of the world's most challenging cloud system and applications.

IEEE CLOUD 2021 is the 13rd IEEE International Conference on Cloud Computing. As the most prestigious academic conference in the field of Cloud Computing, IEEE CLOUD conference has proven to be an important venue for enabling research and collaboration, and we expect that IEEE CLOUD 2021 will continue this trend.

Cloud Computing has been an elastic pay-as-you-go service creation, delivery, consumption, and management platform in Services Computing, and has recently met modern distributed systems based on edge computations and 5G/6G communications to implement novel services and architectures. The technical foundations of Cloud Computing include service-oriented architectures, hardware and software virtualization, process and workflow optimization, data management and storage, usage-based accounting and billing, and mobile cloud-edge systems. The goal of Cloud Computing is to cost-effectively manage the lifecycle of quality-assured and trustworthy services and to share resources among service consumers, partners, and vendors in the cloud value chain. The resource sharing at various levels results in different cloud offerings, such as infrastructure clouds (e.g. hardware, IT infrastructure management), software clouds (e.g. SaaS focusing on middleware as a service, or traditional CRM as a service), application clouds (e.g. application as a service), and business clouds (e.g. business process as a service).

This year's conference has been organized in 4 regular tracks, namely, Track on Cloud as a Service, Track on Infrastructures, Systems, and Architectures, Track on Cloud Operations Management, and Track on Trust, Security, and Privacy, focusing on the main pillars that traditionally characterized the conference topics. It also added 4 special tracks, namely, Special Track on Cloud Edge, Special Track on Cloud HPC, Special Track on Cloud Programming, Special Track on AI in Cloud Software Engineering and Operations, discussing hot topics and research trends in the cloud community. The conference attracted 105 submissions for the normal tracks and 46 submissions for the special tracks. Each paper was reviewed by at least three program committee members. After initial review, rebuttal and follow-up discussions, the program committee selected 25 articles to appear as full papers (resulting in an acceptance rate of 23.8%) and 19 articles as short papers for presentation in the normal tracks. Another 19 articles were selected as full papers (resulting in an acceptance rate of 41%) and 7 articles as short papers in the special tracks. We also had a work-in-progress track that consisted of recent works on many emerging cloud computing research challenges. The selected papers covered a variety of topics within the themes of the normal and special tracks. In addition, the conference program also included six exciting invited research papers that were contributed by renowned researchers in the field of cloud computing.

The organization of a conference like IEEE CLOUD requires the collaboration of many individuals. First of all, we would like to thank the authors for submitting their work to the conference. We express our gratitude to the program track chairs, program committee members and external reviewers for their efforts in reviewing the papers, engaging in active online discussion during the tough selection process and providing valuable feedback to authors. Meanwhile, we want to thank the Services Congress Steering Committee led by Carl K. Chang, the Services Congress Honorary General Chairs Stephen S. Yau and Peter Chen, the Services Congress General Chairs Rong Chang and Ian Foster, the Services Congress Program Chairs in Chief Ernesto Damiani and Jia Zhang, and the CLOUD Conference General Chairs Dennis Gannon, Gopal Pingali and Tao Zhang for their help in putting together such an exciting program. Finally, we thank all of you who (virtually) come to the conference. We hope you find the meeting both stimulating and enjoyable, and we hope we will be able to meet you in person next year!

General Chair: Dennis Gannon, Indiana University
General Chair: Gopal Pingali, Accenture
General Chair: Tao Zhang, NIST
Program Chair: Claudio Ardagna, University of Milan
Program Chair: Rajiv Ranjan, Newcastle University
Program Chair: Wensheng Zhang, Iowa State University

Monday September 6 - All Times in UTC

15:00 - 16:20
CLD 1: Cloud Security 1
Session Chair: Alptekin Küpçü, Koç University

CLD_REG_134
TRIGLAV: Remote Attestation of the Virtual Machine's Runtime Integrity in Public Clouds
Wojciech Ozga, Do Le Quoc and Christof Fetzer

CLD_SHT_095
Cloud Property Graph: Connecting Cloud Security Assessments with Static Code Analysis
Christian Banse, Immanuel Kunz, Angelika Schneider and Konrad Weiss

CLD_REG_149
Secure k-Anonymization over Encrypted Databases
Manish Kesarwani, Akshar Kaul, Stefano Braghin, Naoise Holohan and Spiros Antonatos

16:30 - 17:50
CLD 2: Edge Analytics
Session Chair: Rajiv Ranjan, Newcastle University

CLD_REG_108
AI Multi-Tenancy on Edge: Concurrent Deep Learning Model Executions and Dynamic Model Placements on Edge Devices
Piyush Subedi, Jianwei Hao, In Kee Kim and Lakshmish Ramaswamy

CLD_REG_135
The Case for Adaptive Deep Neural Networks in Edge Computing
Francis McNamee, Schahram Dustdar, Peter Kilpatrick, Weisong Shi, Ivor Spence and Blesson Varghese

CLD_REG_147
Primitives Enhancing GPU Runtime Support for Improved DNN Performance
Aditya Dhakal, Sameer G Kulkarni and K. K. Ramakrishnan

18:10 - 19:30
CLD 3: Privacy Preserving for Deep Learning
Session Chair: Wensheng Zhang, Iowa State University

CLD_SHT_159
Non-interactive Privacy Preserving Recurrent Neural Network Prediction with Homomorphic Encryption
Robert Podschwadt and Daniel Takabi

CLD_SHT_175
Image Disguising for Protecting Data and Model Confidentiality in Outsourced Deep Learning
Sagar Sharma, A K M Mubashwir Alam and Keke Chen

CLD_SHT_204
Origami Inference: Private Inference Using Hardware Enclaves
Krishna Giri Narra, Zhifeng Lin, Yongqin Wang, Keshav Balasubramanian and Murali Annavaram

Tuesday September 7 - All Times in UTC

1:00 - 2:00
CLD 4: Edge Applications I
Session Chair: BaekGyu Kim, DGIST

CLD_REG_072
ChatCache: A Hierarchical Semantic Redundancy Cache System for Conversational Services at Edge
Lanyu Xu, Arun Iyengar and Weisong Shi

CLD_REG_125
Into Summarization Techniques for IoT Data Discovery Routing
Hieu Tran, Son Nguyen, I-Ling Yen and Farokh Bastani

CLD_SHT_201
Dynamic Edge-Twin Computing for Vehicle Tracking
Yuanda Wang, Shigang Chen, Ye Xia, Dimitrios Melissourgos and Haibo Wang

2:30 - 3:50
CLD 5: AI for Cloud I
Session Chair: Dimitris Apostolou, University of Piraeus

ACS_REG_059
A system for proactive risk assessment of application changes in cloud operations
Raghav Batta, Michael Nidd, Larisa Shwartz, Amar Prakash Azad and Harshit Kumar

ACS_REG_106
Causal Modeling based Fault Localization in Cloud Systems using Golden Signals
Pooja Aggarwal, Seema Nagar, Ajay Gupta, Larisa Shwartz, Prateeti Mohapatra, Amit Paradkar, Qing Wang and Atri Mandal

ACS_REG_191
AI-Assisted Security Controls Mapping for Clouds Built for Regulated Workloads
Vikas Agarwal, Roy Bar-Haim, Lilach Eden, Nisha Gupta, Yoav Kantor and Arun Kumar

4:10 - 5:30
CLD 6: Cloud Programming
Session Chair: Joao Pedro Barreto, Universidade de Lisboa

CLD_REG_055
Performance Evaluation of Asynchronous FaaS
David Balla, Markosz Maliosz and Csaba Simon

CLD_REG_057
Efficient Processing of Streaming Data using Multiple Abstractions
Abdul Qadeer and John Heidemann

CLD_REG_062
Optimizing Cloud Function Configuration via Local Simulations
Johannes Manner, Martin Endreß, Sebastian Böhm and Guido Wirtz

18:50 - 20:10
CLD 7
Invited I
Session Chair: Claudio Ardagna, Università degli Studi di MIlano

CLD_INV_217
Supporting Real-Time T-Queries on Network Traffic with A Cloud-based Offloading Model
Yuanda Wang, Haibo Wang, Chaoyi Ma, Shigang Chen and Ye Xia

CLD_INV_218
Privacy-Preserving Decentralized Edge Caching in 5G Networks
Yiming Zeng, Yaodong Huang, Zhenhua Liu, Ji Liu and Yuanyuan Yang

CLD_INV_220
A Generalized Nesterov-accelerated Hessian-vector-based Latent Factor Analysis Model for QoS Prediction
Weiling Li, Xin Luo and Mengchu Zhou

CLD_INV_223
Polaris Scheduler: Edge Sensitive and SLO Aware Workload Scheduling in Cloud-Edge-IoT Clusters
Stefan Nastic, Thomas Werner Pusztai, Andrea Morichetta, Victor Casamayor Pujol, Schahram Dustdar, Deepak Vij and Ying Xiong

20:20 - 21:40
CLD 8: Invited II
Session Chair: Wensheng Zhang, Iowa State University

CLD_INV_221
EdgePS: Selective Parameter Aggregation for Distributed Machine Learning in Edge Computing
Yangming Zhao, Yunfei Hou and Chunming Qiao

CLD_INV_222
HPTMT: Operator-Based Architecture for Scalable High-Performance Data-Intensive Frameworks
Geoffrey Fox, Supun Kamburugamuve, Chathura Widanage, Niranda Perera, Vibhatha Abeykoon, Ahmet Uyar, Thejaka Amila Kanewala and Gregor von Laszewski

CLD_INV_219
A Deep Reinforcement Learning Approach to Resource Management in Hybrid Clouds Harnessing Renewable Energy and Task Scheduling
Jie Zhao, Maria A. Rodriguez and Rajkumar Buyya

Wednesday September 8 - All Times in UTC

1:00 - 2:20
CLD 9: Machine/Federated Learning Security
Session Chair: Liqiang Want, University of Central Florida

CLD_REG_153
Federated or Split? A Performance and Privacy Analysis of Hybrid Split and Federated Learning Architectures
Valeria Turina, Zongshun Zhang, Flavio Esposito and Ibrahim Matta

CLD_REG_148
Knowledge and Learning-based Adaptable System for Sensitive Information Identification and Handling
Akshar Kaul, Manish Kesarwani, Hong Min and Qi Zhang

CLD_SHT_146
LEGATO: A LayerwisE Gradient AggregaTiOn Algorithm for Mitigating Byzantine Attacks in Federated Learning
Kamala Varma, Yi Zhou, Nathalie Baracaldo and Ali Anwar

2:30 - 3:50
CLD 10: Cloud Security II
Session Chair: Wensheng Zhang, Iowa State University

CLD_REG_048
Prof-gen: Practical Study on System Call Whitelist Generation for Container Attack Surface Reduction
Sungjin Kim, Byoung-Joon Kim and Dong Hoon Lee

CLD_REG_116
Integrity Protection for Kubernetes Resource Based on Digital Signature
Ruriko Kudo, Hirokuni Kitahara, Kugamoorthy Gajananan and Yuji Watanabe

CLD_SHT_129
Secure Offloading of Intrusion Detection Systems from VMs with Intel SGX
Tomoharu Nakano and Kenichi Kourai

4:10 - 5:30
CLD 11: Cloud Infrastructure Services
Session Chair: Saurabh Garg, University of Tasmania

CLD_REG_115
Flexible and Efficient Blockchain-Based Cloud Storage
Ying-Yu Pan, Yi Li, Ce-Yu Gao, Li Fang and Ping Chen

CLD_REG_100
An Evaluation of Serverless Computing on X86 and ARM platforms: Performance and Design Implications
Dong Xie, Yang Hu and Li Qin

CLD_REG_179
Agile and Dynamic Virtualized Network Functions Wiring in Network Services
Nour El Houda Nouar, Sami Yangui, Noura Faci, Khalil Drira and Said Tazi

5:40 - 7:00
CLD 12: Cloud HPC I
Part of the Cloud HPC Symposia
Session Chair: Christoph Hagleitner, IBM Zurich

CHP_REG_137
A Case for Function-as-a-Service with Disaggregated FPGAs
Burkhard Ringlein, Francois Abel, Dionysios Diamantopoulos, Beat Weiss, Christoph Hagleitner, Marc Reichenbach and Dietmar Fey

CHP_REG_123
T2FA: A Heuristic Algorithm for Deadline-constrained Workflow Scheduling in Cloud with Multicore Resource
Zaixing Sun, Chonglin Gu, Honglin Zhang and Hejiao Huang

16:30 - 17:50
CLD 13: Cloud Platform Services I
Session Chair: Chirine Ghedira Guegan, IAE-Jean Moulin Lyon 3 University

CLD_REG_183
Towards Consistent VNF Forwarding Graph Reconfiguration in Multi-domain Environments
Josue Castañeda, Sami Yangui, Saul Pomares, Julio César Pérez Sansalvador, Lil María Rodríguez and Khalil Drira

CLD_REG_049
Impact of Distributed Rate Limiting on Load Distribution in a Latency-sensitive Messaging Service
Chong Li, Jiangnan Liu, Chenyang Lu, Roch Guerin and Christopher Gill

CLD_REG_158
Oasis: Performance Matching IoT System Emulation
Navid Alipour, Mea Wang and Diwakar Krishnamurthy

19:40 - 21:00
CLD 14: Cloud Performance
Session Chair: Rajiv Ranjan, Newcastle University

CLD_REG_068
Cost-Effective Dynamic Optimisation for Multi-Cloud Queries
Damien T. Wojtowicz, Shaoyi Yin, Franck Morvan and Abdelkader Hameurlain

CLD_SHT_109
An Empirical Analysis of VM Startup Times in Public IaaS Clouds
Jianwei Hao, Ting Jiang, Wei Wang and In Kee Kim

CLD_SHT_118
Theta-Scan: Leveraging Behavior-Driven Forecasting for Vertical Auto-Scaling in Container Cloud
Josep Lluis Berral-García, David Buchaca, Claudia Herron, Chen Wang and Alaa Youssef

Thursdsay September 9 - All Times in UTC

1:00 - 2:00
CLD 15: Cloud Middleware & Platforms
Session Chair: Nabil El Ioini, Free University of Bozen

CLD_REG_165
A Novel Middleware for Efficiently Implementing Complex Cloud-Native SLO
Thomas Werner Pusztai, Stefan Nastic, Andrea Morichetta, Víctor Casamayor Pujol, Schahram Dustdar, Xiaoning Ding, Deepak Vij and Ying Xiong

CLD_SHT_074
Energy and Expenditure Aware data Replication Strategy
Morgan Séguéla, Riad Mokadem and Jean-Marc Pierson

CLD_SHT_167
A Mechanism Design and Learning Approach for Revenue Maximization on Cloud Dynamic Spot Markets
Asterios Tsiourvas, Constantinos Bitsakos, Ioannis Konstantinou, Dimitris Fotakis and Nectarios Koziris

2:30 - 3:50
CLD 16: Cloud Infrastructures I
Session Chair: Hui Lu, Binghamton University

CLD_REG_169
SODA: A Semantics-Aware Optimization Framework for Data-Intensive Applications Using Hybrid Program Analysis
Bingbing Rao, Zixia Liu, Hong Zhang, Siyang Lu and Liqiang Wang

CLD_REG_078
Characterizing Loop Acceleration in Heterogeneous Computing
Saman Biookaghazadeh, Fengbo Ren and Ming Zhao

CLD_REG_096
HPKS: High Performance Kubernetes Scheduling for Dynamic Blockchain Workloads in Cloud Computing
Zhenwu Shi, Chenming Jiang, Landu Jiang and Xue Liu

4:10 - 5:30
CLD 17: Cloud Infrastructures II
Session Chair: Rodrigo N. Calheiros, Western Sydney University

CLD_REG_092
Optimizing VMs across Multiple Hosts with Transparent and Consistent Tracking of Unused Memory
Soichiro Tauchi, Kenichi Kourai and Lukman Ab Rahim

CLD_SHT_131
Architecture-Specific Perfrmance Optimization of Compute-Intensive FaaS Functions
Mohak Chadha, Anshul Jindal and Michael Gerndt

CLD_SHT_142
Exploiting Sub-page Write Protection for VM Live Migration
Yosuke Ozawa and Takahiro Shinagawa

CLD_SHT_162
Performance Evaluation of Data-Centric Workloads in Serverless Environments
Anna Maria Nestorov, Jordà Polo, Claudia Misale, David Carrera and Alaa S. Youssef

18:10 - 19:30
CLD 18: Cloud Platform Services II
Session Chair: Javier Espinosa, University of Lyon

CLD_REG_075
Real-time task scheduling in a FaaS cloud
Mark Szalay, Peter Matray and Laszlo Toka

CLD_SHT_197
RDOF: Deployment Optimization for Function as a Service
Lulai Zhu, Giorgos Giotis, Vasilis Tountopoulos and Giuliano Casale

CLD_SHT_099
Fast and Efficient Performance Tuning of Microservices
Vahid Mirzaebrahim Mostofi, Diwakar Krishnamurthy and Martin Arlitt

CLD_SHT_139
Understanding Flash-Based Storage I/O Behavior of Games
Adnan Maruf, Zhengyu Yang, Bridget Davis, Daniel Kim, Jeffrey Wong, Matthew Durand and Janki Bhimani

19:40 - 21:00
CLD 19: Cloud Resource Management I
Session Chair: Nabil El Ioini, Free University of Bozen

CLD_REG_121
Skynet: Performance-driven Resource Management for Dynamic Workloads
Yannis Sfakianakis, Manolis Marazakis and Angelos Bilas

CLD_REG_170
Fundy: A Scalable and Extensible Resource Manager for Cloud Resources
Xiaodi Ke, Cong Guo, Siqi Ji, Shane Bergsma, Zhenhua Hu and Lei Guo

CLD_SHT_132
QoS-Aware Memory Bandwidth Allocation for Multi-Socket Cloud Servers
David Gureya, João Barreto and Vladimir Vlassov

Friday September 10 - All Times in UTC

1:00 - 2:20
CLD 20: AI for Cloud II
Session Chair: Xin Luo, Chinese Academy of Sciences

ACS_REG_145
Detecting Causal Structure on Cloud Application Microservices Using Granger Causality Models
Qing Wang, Larisa Shwartz, Genady Ya. Grabarnik, Vijay Arya, and Karthikeyan Shanmugam

ACS_SHT_050
NL2Vul: Natural Language to Standard Vulnerability Score for Cloud Security Posture Management
Muhammed Bulut and Jinho Hwang

ACS_SHT_157
Ensemble of Unsupervised Parametric and Non-Parametric Techniques to Discover Change Actions
Anup Kalia, Raghav Batta, Jin Xiao and Maja Vukovic

ACS_SHT_160
Energy-Aware Learning Agent (EALA) for Disaggregated Cloud Scheduling
Nicholas Nordlund, Vassilis Vassiliadis, Michele Gazzetti, Dimitris Syrivelis and Leandros Tassiulas

2:30 - 3:50
CLD 21: Mobile Edge
Session Chair: Adel N. Toosi, Monash University

CLD_REG_113
Latency-aware Batch Task Offloading for Vehicular Cloud: Maximizing Submodular Bandit
Hao Li, Haitao Huang and Zhuzhong Qian

CLD_SHT_102
Quality-Aware Video Offloading in Mobile Edge Computing: A Data-Driven Two-Stage Stochastic Optimization
Weibin Ma and Lena Mashayekhy

4:10 - 5:30
CLD 22: Cloud Resource Management
Session Chair: Nabil El Ioini, Free University of Bozen

CLD_REG_168
A Cost-Efficient Resource Provisioning and Scheduling Approach for Deadline-Sensitive MapReduce Computations in Cloud Environment
Amir Jabbari, Farzaneh Masoumiyan, Shuwen Hu, Maolin Tang and Yu-Chu Tian

CLD_REG_181
RunWild: Resource Management System with Generalized Modeling for Microservices on Cloud
Sunyanan Choochotkaew, Tatsuhiro Chiba, Scott Trent and Marcelo Amaral

CLD_SHT_143
Rightsizing Clusters for Time-Limited Tasks
Venkatesan T Chakaravarthy, Padmanabha Venkatagiri Seshadri, Pooja Aggarwal, Anamitra R Choudhury, Ashok Pon Kumar Sree Prakash, Yogish Sabharwal and Amith Singhee

5:40 - 7:00
CLD 23: Cloud Analytics
Session Chair: Prem Jayaraman, Swinburne University

CLD_REG_122
Para: Harvesting CPU time fragments in Big Data Analytics
Yuzhao Wang, Junqing Yu and Zhibin Yu

CLD_REG_184
Towards A Robust Meta-ReinforcementLearning-Based Scheduling Framework for Time Critical Tasks in Cloud Environments
Hongyun Liu, Peng Chen and Zhiming Zhao

CLD_SHT_044
DLB: Deep Learning Based Load Balancing
Xiaoke Zhu

CLD_SHT_186
A Holistic Approach to Data Access for Cloud-Native Analytics and Machine Learning
Panos Koutsovasilis, Srikumar Venugopal, Yiannis Gkoufas and Christian Pinto

18:10 - 19:30
CLD 24: Edge Applications II
Session Chair: Ming Zhao, Arizona State University

CLD_REG_119
Pogonip: Scheduling Asynchronous Applications on the Edge
Thomas Werner Pusztai, Fabiana Rossi and Schahram Dustdar

CLD_REG_190
Air-to-Air Collaborative Learning: A Multi-Task Orchestration in Federated Aerial Computing
Uchechukwu Awada, Jiankang Zhang, Sheng Chen and Shuangzhi Li

CLD_SHT_199
Distributing Intelligence for Object Detection Using Edge Computing
Imen Chakroun, Tom Vander Aa, Roel Wuyts and Wilfried Verachtert

Saturday September 11 - All Times in UTC

1:00 - 2:20
CLD 25: Cloud HPC II
Part of the Cloud HPC Symposia
Session Chair: Andrew Lumsdaine, University of Washington

CHP_REG_210
Usage Trends Aware VM Placement in Academic Research Computing Clouds
Mohamed Elsakhawy and Michael Bauer

CHP_REG_207
Neon: Low-Latency Streaming Pipelines for HPC
Pierre Matri and Robert Ross

2:30 - 3:50
CLD 26: WIP I
Session Chair: Prem Jayaraman, Swinburne University

CLD_WIP_150
ACA: Application Containerization Advisory Framework for Modernizing Legacy Applications
Anup Kalia, Raghav Batta, Jin Xiao, Mihir Choudhury and Maja Vukovic

CLD_WIP_103
Edge Service Deployment via Online Learning
Ahmad Almansoor and Lena Mashayekhy

4:10 - 5:30
CLD 27: WIP II
Session Chair: Joao Pedro Barreto, Universidade de Lisboa

ACS_WIP_105
Insights into Multi-Layered Fault Propagation and Analysis in a Cloud Stack
Dhanya R. Mathews, Mudit Verma, Pooja Aggarwal and J. Lakshmi

CLD_WIP_126
Konveyor Move2Kube: Automated Replatforming of Applications to Kubernetes
Padmanabha Venkatagiri Seshadri, Harikrishnan Balagopal,
Pablo Salvador Loyola Heufemann, Akash Nayak, Chander Govindarajan,
Mudit Verma, Ashok Pon Kumar Sree Prakash and Amith Singhee

CLD_WIP_188
Exploring the Network-Sensitive Scheduling on Distributed Shared Memory
Xing Wei, Huiqi Hu and Aoying Zhou

5:40 - 7:00
CLD 28: WIP III
Session Chair: Nabil El Ioini, Free University of Bozen

CLD_WIP_194
An Automata–based Profit Optimization of Cloud Brokers in IaaS Environment
Jakub Gąsior and Franciszek Seredynski

CLD_WIP_155
Acceleration-as-a-microService: A Cloud-native Monte-Carlo Option Pricing Engine on CPUs, GPUs and Disaggregated FPGAs
Dionysios Diamantopoulos, Raphael Polig, Burkhard Ringlein, Mitra Purandare, Beat Weiss, Christoph Hagleitner, Mark Lantz and Francois Abel

CLD_WIP_144
Performance Analysis of Zero-Trust multi-cloud
Simone Rodigari, Donna O'Shea and Sean McSweeney

ICDH 2021
IEEE INTERNATIONAL CONFERENCE ON DIGITAL HEALTH

The organizing committee cordially welcomes you to the 2021 IEEE International Conference on Digital Health (ICDH) at the reputed 2021 IEEE World Congress on Services, which is being held online virtually from September 5-10, 2021. Sponsored by the IEEE Computer Society under the auspice of the Technical Committee on Services Computing (TCSVC), the Congress brings together researchers working on various systems and networking research pertaining to cloud, edge and Internet-of-Things (IoT), intelligent computing, learning, Big Data and blockchain applications, and security through the co-located conferences on 2021 IEEE Cloud, Edge, ICWS, SCC and SMDS. As a part of the Congress, ICDH offers a venue for visionaries, researchers, and practitioners to share knowledge and present novel research in digital health services to ensure sustainable health and social care transformations. Specifically, ICDH aims to bring together researchers from computer science, communication, biology, medical science, and public health under the general umbrella of digital health to advance the future of health care service provisioning and improve the quality of care. A complete program description is available online on the conference website along with the registration information for authors and participants.

The technical program of ICDH 2021 has been carefully designed to cover a wide range of topics on the advances of the state-of-the-art research and practices in digital health technologies, and the future of digital health. Distinguished researchers and leaders from the academia, multinational industry, leading healthcare, and government organizations will get together, giving talks and attending panel discussions. Foci of discussions include recent advances in models, tools and architectures of digital and integrated digital health care systems and services, therapeutic algorithms and disease/condition-specific intervention service design, health education, ethics of digital health, and patient/user-side design for digital health care. With advances in 5G network, cybernetic and mediatic digital health platforms are enabling assisted living, remote real time patient monitoring, and round the clock global mobile health (mHealth) services. Crowd-sourcing and social media analysis are allowing prediction and monitoring of infectious disease outbreaks. The accepted papers in 2021 ICDH encompass the above topics and will set a rich and exciting stage for the participants to engage in invigorating discussions.

This year we have accepted 15 regular, 13 short, 12 invited and 10 work-in-progress papers submitted by authors around the globe. The program also includes panel discussions, distinguished talks, and work in progress papers. Due to COVID-19, 2021 ICDH is being held virtually with the other collocated conferences at the 2021 IEEE World Congress on Services. The program organizers have tried their best to offer an accessible time window for the audiences from Asia, Europe, and America in scheduling the event to have live presentations of the research papers with follow up questions from the audience. Please join the virtual 2021 ICDH conference to become a member of our vibrant research community and contribute to its success.

General Chair: Jaques Demongeot, Grenoble Alpes University
General Chair: Ajay Royyuru, IBM Research, TJ Watson Research Center
General Chair: Daqing Zhang, Peking University/Telecom SudParis
Executive Program Chair: Sheikh Iqbal Ahamed, Marquette University
Program Chair: Guiseppe De Pietro, ICAR CNR
Program Chair: Lin Liu, Tsinghua University
Program Chair: Farhana Zulkernine, Queens University

Monday September 6 - All Times in UTC

15:00 - 16:20
Regular Papers - Session 1
Session Chair: Farhana Zulkernine, Queen's University

CHD_REG_3
Architecture of an Intelligent Personal Health Library for Improved Health Outcomes
Hasan Jamil

CHD_REG_24
Lung Cancer Prediction using Curriculum Learning based Deep Neural Networks
Jackson Zhou, Matloob Khushi, Mohammad Ali Moni, Shahadat Uddin and Simon Poon

CDH_REG_27
Grading Diabetic Retinopathy Severity Using Image Processing and Ensembled Convolution Neural Networks
Andrew Lee, Matloob Khushi, Patrick Hao, Shahadat Uddin and Simon Poon

16:30 - 17:50
Regular Papers - Session 2
Session Chair: Hasan Jamil, University of Idaho

CDH_REG_28
Risk and Compliance in IoT-Health Data Propagation : A Security-Aware Provenance based Approach
Fariha Tasmin Jaigirdar, Carsten Rudolph and Chris Bain

CDH_REG_36
Secure Cloud EHR with Semantic Access Control, Searchable Encryption and Attribute Revocation
Redwan Walid, Karuna Joshi and Seung Geol Choi

18:10 - 19:30
Regular Papers - Session 3
Session Chair: Carson Leung, University of Manitoba

CDH_REG_37
BIOCAD: Bio-inspired Optimization for Classification and Anomaly Detection in Digital Healthcare Systems
Nur Imtiazul Haque, Alvi Ataur Khalil, Mohammad Rahman, M. Hadi Amini and Sheikh Iqbal Ahamed

CDH_REG_45
Do You Brush Your Teeth Properly? An Off-body Sensor-based Approach for Toothbrushing Monitoring.
Zawar Hussain, David Waterworth, Murtadha Aldeer, Wei Emma Zhang, Quan Z Sheng and Jorge Ortiz

CDH_REG_48
A Digital Health System for Disease Analytics
Carson Leung

19:40 - 21:00
Regular Papers - Session 4
Session Chair: Mohammad Rahman, Florida International University

CDH_REG_49
Passive COVID-19 Assessment using Machine Learning on Physiological and Activity Data from Low End Wearables
Atifa Sarwar and Emmanuel Agu

CDH_REG_50
An IoT System for Autonomous, Continuous, Real-Time Patient Monitoring and Its Application to Pressure Injury Management
Sam Mansfield, Eric Vin and Katia Obraczka

CDH_REG_61
Exploring Relationships between Cerebral and Peripheral Biosignals with Neural Networks
Alexander Hatteland, Ričards Marcinkevičs, Thomas Frick, Ilona Hubbard, Julia E. Vogt, Renaud Marquis, Thomas Brunschwiler and Philippe Ryvlin

Tuesday September 7 - All Times in UTC

1:00 - 2:20
Regular Papers - Session 5
Session Chair: Emmanuel Agu, Worcester Polytechnic University

CDH_REG_63
Deep Learning Anomaly Detection Methods to Passively Detect COVID-19 from Audio
Shreesha Narasimha Murthy and Emmanuel Agu

CDH_REG_64
Smartphone TBI Sensing using Deep Embedded Clustering and Extreme Boosted Outlier Detection
Srinarayan Srikanthan, Florina Asani, Bhoomi Kalpesh Patel and Emmanuel Agu

CDH_REG_69
Remote Photoplethysmography Heart Rate Variability Detection Using Signal to Noise Ratio Bandpass Filtering
Lin He, Kazi Shafiul Alam, Jiachen Ma, Eric Burkholder, William Cheng Chung Chu, Anik Iqbal and Sheikh Iqbal Ahamed

2:30 - 3:50
Short Papers - Session 1
Session Chair: Richie Oyeleke, Stevens Institute of Technology

CDH_SHT_6
Preictal Onset Detection Through Unsupervised Clustering for Epileptic Seizure Prediction
Alessio Quercia, Thomas Frick, Fabian Egli, Nick Pullen, Isabelle Dupanloup, Jianbin Tang, Umar Asif, Stefan Harrer and Thomas Brunschwiler

CDH_SHT_16
Physical Exercise Recommendation and Success Prediction Using Interconnected Recurrent Neural Networks
Arash Mahyari and Peter Pirolli

CDH_SHT_26
Putting Process (BPMN) and Decision (DMN) Models to Work: a Pediatric Surgery Case Study
Anna Maria Bianchi, Matteo Mortari, Claudio Pintavalle and Giuseppe Pozzi

4:10 - 5:30
Short Papers - Session 2
Session Chair: Giuseppe De Pietro, CNR

CDH_SHT_30
Multi-task Learning Based on Multi-type Dataset for Retinal Abnormality Detection
Linna Zhao, Jianqiang Li, Zerui Ma, Yu Guan, Xi Xu, Li Zhang and Li Li

CDH_SHT_31
Engineering Continuous Monitoring of Intrinsic Capacity for Elderly People
Valerio Bellandi, Ioannis Basdekis, Paolo Ceravolo, Matteo Cesari, Ernesto Damiani, Eleftheria Iliadou, Mircea Marzan and Samira Maghool

CDH_SHT_33
An Adaptable LSTM Network Predicting COVID-19 Occurrence Using Time Series Data
Anthony Li and Nikhil Yadav

CDH_SHT_34
A Novel Pre-processing Method for Classification Problems in Medical Intelligent Tasks
Haochen Jiang, Ziqi Wei and Jun Chen

18:50 - 19:30
Distinguished Talk
Session Chair: Sheikh Iqbal Ahamed, Marquette University

Wendy Nilson, National Science Foundation
The Future of Smart Health in the Wake of a Pandemic

Wendy Nilsen, Ph.D. is the Acting Deputy Division Director in the Information and Intelligent Systems Division of the Computer and Information Science and Engineering Directorate at NSF. She is also the lead Program Director in the NSF-NIH joint initiative Smart Health and Biomedical Research in the Era of Artificial Intelligence and Advanced Data Science program. Her work has focused on the intersection of computing and human functioning. Her interests span the areas of sensing, analytics, cyber-physical systems, information systems, machine learning, artificial intelligence and robotics. She also serves as cochair of the Health Information Technology Research and Development working group of the Networking and Information Technology Research and Development Program and, serving on numerous federal technology

initiatives. Prior to joining NSF, Wendy was at the National Institutes of Health.

19:30 - 20:10
Panel Discussion: The Future of Digital Health - Vision & Challenges
Moderator: Sheikh Iqbal Ahamed

Digital Health (DH) provides a bridge between technology and healthcare. At first, in 1960s computers or digital platform were introduced in the healthcare system; and from then this digitalization in healthcare system had been started. In 2000 the launch of the da Vinci robotic system in surgery and sophisticated CT scan system has increased the revaluation of digitalization in healthcare system. After spreading the Corona virus as a COVID-19 pandemic, the Digital Health has been propelled in the global stages with a leverage technology and visions. The main vision of the Digital Health after spreading the COVID-19 pandemic is to leverage technology for the global to combat with the human health related crisis. For example, digitalization of medicine and consolation, mobile-based (mHealth) patients screening, tracking or monitoring, deploying internet of things (IoT) to tracking human fitness or illness, computerized-based diagnosis or smart electronic health records (EHRs) system using machine learning or artificial intelligent. To fulfil these visions, the future Digital Health system will be segmented into: Health Information Systems (HIS), Interconnected domains, Mobile Health (mHealth), Monitoring and Diagnostics (Telehealth), Predicting or analysing diseases using Artificial Intelligent or Machine Leaning, Robotics in Digital Health. So, the future revolution of Digital Health will be based on Multidisciplinary, Big data and public health, MedTech, Self-Management, and Personalized Care, mHealth and Global Health Interventions. The most common challenges during the implementation of digital health are the proper legal or regulatory framework with the innovation of the technology in health-care system, appropriate policy to implement a digital health technology in the globe, ethical questions to adapt a new technology especially in monitoring and tracking a person, competing motivation and implementation a technology based project in a mass population, sometimes lack of interest in stockholders to develop a digital health project in an area In this panel, speakers will talk about their vision and challenges.

Panelists
Wendy Nilson, National Science Foundation
Kathy Chang, The University of New Mexico
Ajay Royyuru, IBM
Santosh Kumar, The University of Memphis

20:20 - 21:40
Short Papers - Session 3
Session Chair: Maria Valero, Kennesaw State University

CDH_SHT_42
Finding Similar Tweets in Health Related Topics
Danny Villanueva and Manuel Rodriguez

CDH_SHT_55
PyDPLib: Python Differential Privacy Library for Private Medical Data Analytics
Sana Imtiaz, Philipp Matthies, Francisco Pinto, Máté Maros, Holger Wenz, Ramin Sadre and Vladimir Vlassov

CDH_SHT_62
COVID-19 Mortality Prediction Using Machine Learning Techniques
Lindsay Schirato, Kennedy Makina, Dwayne Flanders, Seyedamin Pouriyeh and Hossain Shahriar

CDH_SHT_68
A Decision Support System for Rehabilitation
Mauro Maria Baldi, Bruno Giovanni Galuzzi, Fabrizia Mantovani, Petar Aleksandov Mavrodiev, Enza Messina and Olivia Realdon

Wednesday September 8 - All Times in UTC

1:00 - 2:20
Work-in-Progress - Session 1
Session Chair: Shahrear Iqbal, National Research Council - Canada

CDH_WIP_17
A Software Simulator for Optimizing Ambulance Location and Response Time: A Preliminary Report
David La Barbera, Kevin Roitero, Stefano Mizzaro, Vincenzo Della Mea and Francesca Valent

CDH_WIP_18
A Framework for Secure Logging in Precision Healthcare Cloud-based Services
Shahrear Iqbal, Parisa Moghaddam and Issa Traore

CDH_WIP_32
A Wireless Single Lead ECG Module for Cloud-Computing Based Postoperative Monitoring of Cardiac Surgical Patients
Ravi Durbha and Valencia Koomson

CDH_WIP_43
Deep Learning-based Prediction of Cognitive Function Using Basic Blood Test Data and NIRS-measured Cerebral Hemodynamics
Katsunori Oyama and Kaoru Sakatani

2:30 - 3:50
Panel Discussion: Advances in Biomedical Sciences & Engineering for Digital Healthcare
Moderator: Li-Shan Chou, Iowa State University

Advancements in technology such as biomedical image processing, rehabilitation and assistive devices, and biomedical robotics for healthcare have aided in significant strides in the biomedical engineering research field. Together with recent advances in flexible hybrid electronics for wearable sensors and emerging attempts of Machine

Learning and Artificial Intelligence applications, it revolutionizes the transformation of traditional healthcare to digital healthcare. In this panel, we have experts from universities, research institutions, hospitals, government agencies and private sectors to discuss their experience and vision in integrating and employing these biomedical technologies, materials/sensors, and data science algorithms for the infrastructure development and delivery of digital health care.

Panelists:
Fong-Chin Su, National Cheng Kung University
Tishya Wren, Children's Hospital Los Angeles; University of Southern California
Rick Greenwald, Simbex; iWalk; National Institute for Sports Science & Safety; Dartmouth College
Joe Bonner, NIH
Yoshiyuki Kobayashi, National Institute of Advanced Industrial Science & Technology

4:10 - 5:30
Work-in-Progress - Session 2
Session Chair: Lin Liu, Tsinghua University

CDH_WIP_52
An ABAC Break-Glass to Access Medical Records in Case of Emergency Based on Blockchain
Mohammad Ali Saberi, Mehdi Adda, Hamid Mcheick

CDH_WIP_56
A Machine Learning Approach to Predict Length of Stay for Opioid Overdose Admitted Patients
Jiawei Wu, Priyanka Annapureddy, Zach Farahany and Praveen Madiraju

CDH_WIP_57
A Portable Microfluidic Immuno-biochip Platform for Oral Cancer Biomarker Detection
Hua En Chueh

CDH_WIP_70
Non-Invasive Monitoring of Human Hygiene using Vibration Sensor and Classifiers
Shashank Trivedi, Maria Valero, Hossain Shahriar and Liang Zhao

CDH_WIP_71
Framework for Collecting Data from specialized IoT devices - An application to enhance Healthcare Systems
Md Saiful Islam, Shahriar Sobhan, Maria Valero, Hossain Shahriar, Liang Zhao and Sheikh Iqbal Ahamed

5:40 - 7:00
Invited Papers - Session 1
Session Chair: Lin Liu, Tsinghua University

CDH_INV_1
An Investigation of Containment Measure Implementation and Public Responses to the COVID-19 Pandemic in Mainland China
Ji Liu, Haoyi Xiong, Xiakai Wang, Jizhou Huang, Qiaojun Li, Tongtong Huang, Siyu Huang, Haifeng Wang and Dejing Dou

CDH_INV_4
Intelligent Health Information Services Requirements Revisited from an Actor Perspective
Zhangqiang Cao and Jianmin Wang

CDH_INV_29
Enabling Tiered and Coordinated Services in a Health Community of Primary Care Facilities and County Hospitals Based on HL7 FHIR
Jingwen Nan, Li-Qun Xu, Qingsong Wang, Changyu Bu, Jianjun Ma and Feng Qiao

16:30 - 17:50
Distinguished Talk
Session Chair: Sheikh Iqbal Ahamed, Marquette University

Dana Wolff-Hughes
Leveraging Digital Technologies for Population Surveillance: Opportunities And Challenges

Dr. Dana Wolff-Hughes is a Program Director in the Risk Factor Assessment Branch (RFAB) of the Epidemiology and Genomics Research Program (EGRP) in NCI's Division of Cancer Control and Population Sciences (DCCPS). In this capacity, she supports work which validates and utilizes digital technology for cancer risk factor assessment (including physical activity, sedentary behavior, and sleep) in research and population surveillance. Dr. Wolff-Hughes's scientific interests include novel methods and analytical approaches for risk factor assessment using digital technology, health information technology, and temporally linked contextual data. She is particularly interested in how the accuracy of physical activity measures influence dose response relationships, with a focus on methods to better interpret and understand data from digital technology.

19:40 - 21:00
Invited Papers - Session 1
Session Chair: Farhana Zulkernine, Queen's University

CDH_INV_38
Knowledge Graph Building from Real-world Multi-source "Dirty" Clinical Electronic Medical Records for Intelligent Consultation Applications
Xinlong Liu and Li-Qun Xu

CDH_INV_58
Clinical de-identification using sub-document analysis and ELECTRA
Rosario Catelli, Francesco Gargiulo, Emanuele Damiano, Massimo Esposito and Giuseppe De Pietro

CDH_INV_66
Which Usability Assessment for Digital Therapeutics and Patient Support Programs?
Mario Bochicchio, Lucia Vaira, Andrea Mortara and Renata De Maria

Thursday September 9 - All Times in UTC

1:00 - 2:20
Panel Discussion: Education for Digital Health
Moderator: Lin Liu, Tsinghua University

Digital Health, as an emerging multi-disciplinary field, encourages novel research and applications of "digital technologies" for public health and medical services. The ultimate goal is to help the world population achieve a high standard of life, health and well-being.

The revaluation of digital health in many countries is spurred by series of national and international initiatives. For example, more than 90% of hospitals and 70% of physician offices utilized an electronic health record (EHR) to digitize the patients' records. Due to the COVID-19 pandemic, more countries have increased the use of telemedicine to replace face-to-face consultations. Digital health solutions include mobile health (mHealth), wearable devices, telehealth and telemedicine, health information technology (HIT), and personalized medicine. Together with emerging attempts of Machine Learning (ML) and Artificial Intelligence (AI) applications, it aims to reduce service errors and cost, improve the quality and accessibility of health services, make service decisions more accurate and personalized. Successful development and deployment of digital health solutions require multi-disciplinary expertise. The importance of digital health education is well recognized as an enabler to better prepare the workforce and the public to face future needs and challenges.

In this panel, we invite experts from different universities and research institutes. Some have established formal education programs on digital health to engage in interprofessional education (IPE) opportunities, and some have schools of computing and business in collaboration with medicine to address health care problems by digital solutions. Some has been involved in Healthcare Information and Management Systems Society (HIMSS) certificates programs on health informatics. How would a formal education program or professional certificate promote the training of multi-disciplinary professionals in digital health-related area? What are the challenges to face for educators when digital health is still a fast-developing area? What are the levels of certainty we have that will be a part of global health care education in the future? What are the courses, laboratories and exercises to include in a digital health programs' curriculum? This panel discusses the current state of digital health education, the challenges and potential directions of digital health education.

Paneilsts:
Sheikh Iqbal Ahamed, Marquette University
Carl Chang, Iowa State University
Giuseppe De Pietro, CNR
Benjamin Kwan, Queen's University
Sweta Sneha, Kennesaw State University

2:30 - 3:50
Invited Papers - Session 3
Session Chair: Hossain Shahriar, Kennesaw State University

CDH_INV_67
Analyzing Security and Privacy Concerns of Contact Tracing Applications
Lorna Migiro, Hossain Shahriar and Sweta Sneha

CDH_INV_72
A Statistical Summary Analysis of Window-Based Extracted Features for EEG Signal Classification
Mohammad Masum, Hossain Shahriar, Hisham Haddad and Wenzhan Song

CDH_INV_73
Towards Blockchain-based Secure Data Management for Remote Patient Monitoring
Jobair Hossain, Hossain Shahriar, Maria Valero, Sweta Sneha, Sheikh Ahamed and Mohammad Rahman

18:10 - 19:30
Invited Papers - Session 4
Session Chair: Hossain Shahriar, Kennesaw State University

CDH_INV_74
A Novel Telemedicine System to Traditional Tongue Examination for Chinese Medical Applications
Lisa Li-Chuan Chen, Shen-Kai Wang, Tse-Yu Lin, Ling-Feng Huang, Men-Tzung Lo and Chien-Chang Chen

CDH_INV_75
Use of Musculoskeletal Modeling to Examine Lower Limb Muscle Contribution to Gait Balance Control: Effects of Overweight
Hyun Kyung Kim and Li-Shan Chou

CDH_INV_76
Minimizing Epidemic Viral Total Exposure under the Droplet and Aerosol Models
Abdalaziz Sawwan and Jie Wu

19:40 - 21:00
Panel Discussion: Industry
Moderator: Rajesh Subramanyan, Amazon

Digital health aims at bring efficiency of healthcare delivery using communication technologies and make medicine more personalized and precise. It has a broad scope of hardware and software solutions and services and and includes the use of wearable devices, mobile health, telehealth, augmented reality, and virtual reality, health information technology, and telemedicine. The stakeholders include clinicians, researchers and scientists with a wide expertise from healthcare, economics, engineering, public health to social sciences.

It is gaining momentum with envisioned goals: improving access to healthcare,

reducing inefficiencies in the healthcare system, improving quality of care, reducing healthcare costs, and increase personalized health care for patients. Issues and concerns include: potential privacy violations of personal health data, health data ownership, data misinterpretation, digital divide, regulation, and bio-surveillance risks. In 2020, telemedicine became vitally important as it provided expanded healthcare access, reduced contact, provided care for many urgent non-covid conditions, and allowed means for continuity of care. The underlying technology behind telemedicine, IoT devices and healthcare apps did not appear suddenly in 2020, but existed long before. But it took the pandemic to push healthcare forward, and for health institutions, providers, and patients to embrace digital health trends and new technology. There is a realization on the value of digital health among providers, patients, along with increased and investment activity.

Total funding for digital health initiatives hit an all-time high of $26.5 billion in 2020, with COVID-19 catalyzing investment growth. Funding for telemedicine was $4.3 billion, higher than before. In 2020, six digital health companies raised over $6 billion on their IPOs and the trend likely continuing in 2021. There is still massive scope for improvement. But the healthcare industry is taking innovation seriously, focusing on creating a better future and greater health equity for everyone. Covid 2020 brought a significant change to the pace and trajectory of digital health.

Panelists: Khan Siddiqui, Hyperfine
Ashutosh Banerjee, GE Healthcare
Rhonda Rhyne, Prevencio, Inc
Srinivasan Krishnan, Greenway Health
Hiroki Takakura, Nagoya University

Friday September 10 - All Times in UTC

1:00 - 2:20
Panel Discussion: Digital Health Priorities
Session Chair: Zeno Franco, Medical College of Wisconsin

Panelists:
Maria Valero, Kennesaw State University
Hyunkyoung Oh, University of Wisconsin Milwaukee
Farhana Zulkernine, Queen's University

2:30 - 3:50
Distinguished Talks
Session Chair: Lin Liu, Tsinghua University

WiFi-based Contactless Human Sensing: Theory and Healthcare Applications
Daqing Zhang, Peking University

From Personalized Medicine to Population Health: An mHealth Sensing Approach
Haoyi Xiong, Big Data Laboratory, Baidu Research

ICWS 2021
IEEE INTERNATIONAL CONFERENCE ON WEB SERVICES

IEEE International Conference on Web Services (ICWS) has been a prime international forum for both researchers and industry practitioners to exchange the latest fundamental advances in the state of the art and practice of Web-based services, identify emerging research topics, and define the future of Web-based services. All topics regarding Web-based services lifecycle study and management align with the theme of ICWS. In 2021, we will gather to strive to advance the largest international professional forum on Internet/Web based services.

From a technology foundation perspective, Services Computing has become the default discipline in the modern services industry. As a major implementation technology for modernizing services industry, Web services are Internet-based programmable application components published using standard interface description languages and universally available via uniform communication protocols. The program of ICWS 2021 continues to feature research papers with a wide range of topics, focusing on various aspects of Internet and web-based services. Some of the topics include Web services discovery, selection and recommendation, Web services composition, Web services QoS, Web services security, privacy and trust, Microservices, Semantic services, Web services-based applications and solutions, Web services management, Web services supporting edge and mobile computing, IoT services. Two new special tracks, Quantum Software and Services, and Software Service Engineering, are also included in ICWS 2021.

The conference was made possible by the contributions from the research community. The conference received a total of 194 submissions spanning over the early and regular submission stages. Following a rigorous double-blind review process, each submission was reviewed by at least three experts in the relevant areas for each paper, based on their significance, novelty, technical quality, presentation, and practical impact. After an intense post-review discussion by the program committee, the conference accepted 46 papers as regular-length papers (i.e., acceptance rate was 23.7 for regular length papers). The conference also accepted 25 papers as short-length papers, 3 papers among the submitted WIP papers. In addition to these submitted contributions, the conference invited 6 papers to be included in the program as invited papers.

The 2021 IEEE Web Services Conference was also made possible by the efforts of the many who volunteered their time and energy for the success of the conference. We would like to thank the excellent work of the program committee members for their great efforts in reading, reviewing, discussing, and finally selecting the papers. Our appreciation extends to all the external reviewers for assisting the program committee.

We would also like to acknowledge the generous guidance and support of all Members of the Organizing Committee, in particular Carl K. Chang, Steering Committee Chair, Rong N. Chang and Ian Foster, SERVICES Congress General Chairs, Ernesto Damiani and Jia Zhang, SERVICES Congress Program Chairs in Chief, Laurel Ming, Web Chair.
We wish you all a productive and enjoyable conference and hope you find the program a valuable source of information on Web Services research.

General Chair: Athman Bouguettaya, University of Sydney
General Chair: Elena Ferrari, University of Insubria
General Chair: Xiaofei Xu, Harbin Institute of Technology
Program Chair: Jing Fan, Zhejiang University of Technology
Program Chair: Parisa Ghodous, University of Lyon
Program Chair: Michael Maximilien, IBM, USA

Monday September 6 - All Times in UTC

15:00 - 16:20
CWS 1
Invited Papers I
Session Chair: Elena Ferrari, University of Insubria

CWS_INV_236
Hybrid Quantum Applications Need Two Orchestrations in Superposition: A Software Architecture Perspective
Benjamin Weder, Johanna Barzen, Frank Leymann and Michael Zimmermann

CWS_INV_237
Services for Zero Trust Architectures - A Research Roadmap
Elisa Bertino and Kenneth Brancik

CWS_INV_238
SLO Script: A Novel Language for Implementing Complex Cloud-Native Elasticity-Driven SLOs
Thomas Werner Pusztai, Stefan Nastic, Andrea Morichetta, Victor Casamayor Pujol, Schahram Dustdar, Xiaoning Ding, Deepak Vij and Ying Xiong

16:30 - 17:50
CWS 2
Invited Papers II
Session Chair: Elena Ferrari, University of Insubria

CWS_INV_240
A Uniform Quantum Computing Model based on Virtual Quantum Processors
Georg Gesek

CWS_INV_241
Crowd-Powered Hybrid Classification Services:Calibration is all you need
Burcu Sayin, Evgeny Krivosheev, Jorge Ramírez, Fabio Casati, Ekaterina Taran, Veronika Malanina and Jie Yang

CWS_INV_242
Deserv: Decentralized Serverless Computing
Samuel Christie, Amit Chopra and Munindar Singh

18:10 - 19:30
CWS 3
Services Composition I
Session Chair: Chouki Tibermacine, LIRMM, CRNS, Montpellier

CWS_REG_117
R-CASS: Using Algorithm Selection for Self-Adaptive Service Oriented Systems
Niranjana Deshpande, Naveen Sharma, Qi Yu and Daniel Krutz

CWS_SHT_114
Towards an Adaptive Curation Services Composition Based on Machine Learning
Firas Zouari, Chirine Ghedira Guegan, Nadia Kabachi and Khouloud Boukadi

Tuesday September 7 - All Times in UTC

1:00 - 2:20
CWS 4
Services Discovery, Selection & Recommendation I
Session Chair: Xiaolin Zheng, Zhejiang University

CWS_REG_061
TWLR: A Novel Truth Inference Approach based on Worker Representations for Crowdsourcing in the Low Redundancy Situation
Qianli Xing, Weiliang Zhao, Jian Yang, Jia Wu and Qi Wang

CWS_REG_071
SRaSLR: A Novel Social Relation Aware Service Label Recommendation Model
Yeqi Zhu, Mingyi Liu, Zhiying Tu, Tonghua Su, Xiaofei Xu and Zhongjie Wang

CWS_REG_089
ServeNet-LT: A Normalized Multi-head Deep Neural Network for Long-tailed Web Services Classification
Jing Zhang, Yang Chen, Yilong Yang, Changran Lei and Deqiang Wang

2:30 - 3:50
CWS 5
Services Discovery, Selection & Recommendation II
Session Chair: Xiaolin Zheng, Zhejiang University

CWS_REG_094
Intention-oriented Hierarchical Bundle Recommendation with Preference Transfer
Meng Tan, Wei Chen, Weiqing Wang, An Liu and Lei Zhao

CWS_REG_145
Sequence and Distance Aware Transformer for Recommendation Systems
Runqiang Zang, Meiyun Zuo, Jilei Zhou, Yining Xue and Keman Huang

CWS_REG_149
Time-aware User Modeling with Check-in Time Prediction for Next POI Recommendation
Xin Wang, Xiao Liu, Li Li, Xiao Chen, Jin Liu and Hao Wu

4:10 - 5:30
CWS 6
Services Discovery, Selection & Recommendation III
Session Chair: Bin Cao, Zhejiang University of Technology

CWS_REG_157
WSGCN4SLP: Weighted Signed Graph Convolutional Network for Service Link Prediction
Yong Xiao, Guosheng Kang, Jianxun Liu, Buqing Cao and Linghang Ding

CWS_REG_165
MatTrip: Multi-Functional Attention-based Neural Network for Semantic Travel Route Recommendation
Chenxiao Yang, Jiale Zhang, Xiaofeng Gao and Guihai Chen

CWS_SHT_047
To Wait or To Buy: A Recommendation Service for Airline Ticket Purchase Timing
Jian Cao and Yuchang Xu

18:50 - 20:10
CWS 7
Services Discovery, Selection & Recommendation IV
Session Chair: Paris Ghodous, University of Lyon

CWS_SHT_084
WorP: A Novel Worker Performance Prediction Model for General Tasks on Crowdsourcing Platforms
Qianli Xing, Weiliang Zhao, Jian Yang, Jia Wu and Qi Wang

CWS_SHT_148
Relational Graph Neural Network with Neighbor Interactions for Bundle Recommendation Service
Xin Wang, Xiao Liu, Jin Liu and Hao Wu

CWS_SHT_167
Alleviating the Matthew Effect in O2O Service Matching Process
Yuying Yang, Xiao Xue, Fozhi Hou, Shizhan Chen, Zhiyong Feng and Lejun Zhang

20:20 - 21:40
CWS 8
Services Discovery, Selection & Recommendation V
Session Chair: Michael Maximilien, IBM

CWS_SHT_174
Heterogeneous Graph Attention Network-Enhanced Web Service Classification
Mi Peng, Buqing Cao, Jianxun Liu, Junjie Chen, Guosheng Kang and Yiping Wen

CWS_SHT_195
Transfer Learning for Web Services Classification
Yilong Yang, Zhaotian Li, Jing Zhang and Yang Chen

CWS_SHT_198
Proactive Composition of Mobile IoT Energy Services
Abdallah Lakhdari and Athman Bouguettaya

Wednesday September 8 - All Times in UTC

1:00 - 2:20
CWS 9
Services Applications Beyond the Web I
Session Chair: Zhongjie Wang, Harbin Institute of Technology

CWS_REG_066
NETR-Tree: An Efficient Framework for Social-Based Time-Aware Spatial Keyword Query
Xiuqi Huang, Yuanning Gao, Xiaofeng Gao and Guihai Chen

CWS_REG_079
CUBIST: High-Quality 360-Degree Video Streaming Services via Tile-based Edge Caching and FoV-Adaptive Prefetching
Dongbiao He, Teng Ma, Jinlei Jiang, Cedric Westphal, Guangwen Yang, Shutao Xia and Jose Garcia-Luna-Aceves

CWS_REG_082
Energy-effective IoT Services in Balanced Edge-Cloud Collaboration Systems
Zhengzhe Xiang, Shuiguang Deng, Yuhang Zheng, Dongjing Wang, Javid Taheri and Zengwei Zheng

2:30 - 3:50
CWS 10
Service Applications Beyond the Web II
Session Chair: Zhongjie Wang, Harbin Institute of Technology

CWS_REG_085
Provider-centric Allocation of Drone Swarm Services
Balsam Alkouz and Athman Bouguettaya

CWS_REG_091
SiaSL: A Siamese Neural Network for Service Level Prediction
Chenyu Hou and Bin Cao

CWS_REG_124
An API Learning Service for Inexperienced Developers Based on API Knowledge Graph
Hang Yin, Yuanhao Zheng, Yanchun Sun and Gang Huang

4:10 - 5:30
CWS 11
Service Applications Beyond the Web III
Session Chair: Zhangbing Zhou, China University of Geosciences

CWS_REG_133
CONFECT: Computation Offloading for Tasks with Hard / Soft Deadlines in Edge Computing
Xin He, Jiaqi Zheng, Qiang He, Haipeng Dai, Bowen Liu, Wanchun Dou and Guihai Chen

CWS_REG_171
Optimal User Migration Upon Server Failures in Edge Computing Environment
Wei Du, Qiang He, Yuan Ji, Chenran Cai and Xiaoyong Zhao

CWS_REG_184
Lightweight and Context-aware Modeling of Microservice-based Internet of Things
Zhen Wang, Chang-ai Sun and Marco Aiello

5:40 - 7:00
CWS 12
Service Applications Beyond the Web IV
Session Chair: Jian Cao, Shanghai Jiao Tong University

CWS_REG_189
Mixed Priority Queue Scheduling Based on Spectral Clustering in Spatial Crowdsourcing
Yue Ma, Runbo Ni, Xiaofeng Gao and Guihai Chen

CWS_REG_192
Conflict Detection in IoT-based Smart Homes
Bing Huang, Hai Dong and Athman Bouguettaya

CWS_REG_196
GHTRec: A Personalized Service to Recommend GitHub Trending Repositories for Developers
Yuqi Zhou, Jiawei Wu and Yanchun Sun

16:30 - 17:50
CWS 13
Service Applications Beyond the Web V
Session Chair: Francis Charoy, University of Lorraine

CWS_REG_217
QoE-aware Data Caching Optimization with Budget in Edge Computing
Ying Liu, Yuzheng Han, Ao Zhang, Xiaoyu Xia, Feifei Chen, Mingwei Zhang and Qiang He

CWS_SHT_098
DGPF: A Dialogue Goal Planning Framework for Cognitive Service Conversational Bot
Bolin Zhang, Zhiying Tu, Yangqin Jiang, Shufan He, Guoqing Chao, Dianhui Chu and Xiaofei Xu

CWS_SHT_101
Game Theory-Based Task Offloading and Resource Allocation for Vehicular Networks in Edge-Cloud Computing
Qinting Jiang, Xiaolong Xu, Qiang He, Xuyun Zhang, Fei Dai, Lianyong Qi and Wanchun Dou

19:40 - 21:00
CWS 14
Semantic Services I
Session Chair: Nicolas Figay, Airbus

CWS_REG_211
Dealing with Label Uncertainty in Web Service Anti-patterns Detection using a Possibilistic Evolutionary Approach
Sofien Boutaib, Maha Elarbi, Slim Bechikh, Chih-Cheng Hung and Lamjed Ben Said

CWS_SHT_052
Combining Label-wise Attention and Adversarial Training for Tag Prediction of Web Services
Qunbo Wang, Wenjun Wu, Yongchi Zhao, Yuzhang Zhuang and Yanni Wang

CWS_SHT_136
A Generic Method to Rapidly Release Internet Services on Commercial Platforms
Xinyue Zhou, Zhiyong Feng, Jianmao Xiao, Shizhan Chen, Xiao Xue and Hongyue Wu

Thursday September 9 - All Times in UTC

1:00 - 2:20
CWS 15
Services Composition II
Session Chair: Xiao Liu, Deakin University

CWS_REG_075
Service Composition Considering QoS Fluctuations and Anchoring Cost
Haomai Shi, Hanchuan Xu, Xiaofei Xu and Zhongjie Wang

CWS_REG_092
CTL-Based Dynamic IoT Service Composition
Deng Zhao, Zhangbing Zhou, Xiao Xue, Zhuofeng Zhao, Walid Gaaloul and Wenbo Zhang

CWS_REG_118
Data & Computation-Intensive Service Re-Scheduling In Edge Networks
Xiaocui Li, Zhangbing Zhou, Zhuofeng Zhao, Sami Yangui and Wenbo Zhang

2:30 - 3:50
CWS 16
Services Composition III
Session Chair: Xiao Liu, Deakin University

CWS_REG_150
Service Recommendation for Composition Creation based on Collaborative Attention Convolutional Network
Ruyu Yan, Yushun Fan, Jia Zhang, Junqi Zhang and Haozhe Lin

CWS_REG_214
Alliance-Aware Service Composition with Efficient Matching Search
Yanmei Zhang, Chong Zhu, Xiaoyi Tang and Hengyue Jia

CWS_REG_068
COPA: A Combined Autoscaling Method for Kubernetes
Zhijun Ding and Qichen Huang

4:10 - 5:30
CWS 17
Services QoS Management I
Session Chair: Qiang He, Swinburne University of Technology

CWS_REG_077
An Efficient Algorithm for Service Function Chains Reconfiguration in Mobile Edge Cloud Networks
Biyi Li, Bo Cheng and Junliang Chen

CWS_REG_113
Sieve: Attention-based Sampling of End-to-End Trace Data in Distributed Microservice Systems
Zicheng Huang, Pengfei Chen, Guangba Yu, Hongyang Chen and Zibin Zheng

CWS_REG_139
User Allocation in Mobile Edge Computing: A Deep Reinforcement Learning Approach
Subrat Prasad Panda, Ansuman Banerjee and Arani Bhattacharya

18:10 - 19:30
CWS 18
Services QoS Management II
Session Chair: Bin Cheng, NEC Laboratories Europe

CWS_SHT_185
LETO: An Efficient Load Balanced Strategy for Task Offloading in IoT-Fog Systems
Chittaranjan Swain, Manmath N. Sahoo and Anurag Satpathy

CWS_REG_116
QoA4ML – A Framework for Supporting Contracts in Machine Learning Services
Hong-Linh Truong and Minh-Tri Nguyen

CWS_SHT_161
QoS-based Trust Evaluation for Data Services as a Black Box
Senda Romdhani, Genoveva Vargas-Solar, Nadia Bennani and Chirine Ghedira-Guegan

19:40 - 21:00
CWS 19
Services Security, Privacy & Trust I
Session Chair: Yang Zhang, CISPA Helmholz Center for Information Security

CWS_REG_158
An Assurance-Based Risk Management Framework for Distributed Systems
Marco Anisetti, Claudio Ardagna, Nicola Bena and Andrea Foppiani

CWS_SHT_228
PRADA-TF: Privacy-Diversity-Aware Online Team Formation
Yash Mahajan and Jin-Hee Cho

CWS_SHT_183
An Edge based Federated Learning Framework for Person Re-identification in UAV Delivery Service
Chong Zhang, Xiao Liu, Jia Xu, Tianxiang Chen, Gang Li, Frank Jiang and Xuejun Li

Friday September 10 - All Times in UTC

1:00 - 2:20
CWS 20
Semantic Services II
Session Chair: Bin Lee, Wuhan University

CWS_REG_093
Multiple Features Driven Author Name Disambiguation
Qian Zhou, Wei Chen, Weiqing Wang, Jiajie Xu and Lei Zhao

CWS_REG_095
Incremental Update of Knowledge Graph Embedding by Rotating on Hyperplane
Yuyang Wei, Wei Chen, Zhixu Li and Lei Zhao

CWS_SHT_160
Efficient Grammatical Error Correction with Hierarchical Error Detections and Correction
Fayu Pan and Bin Cao

2:30 - 3:50
CWS 21
Services QoS Management III
Session Chair: Xiao Xue, Tianjin University

CWS_REG_121
A Holistic Auto-Scaling Algorithm for Multi-Service Applications Based on Balanced Queuing Network
Jingwan Tong, Mingchang Wei, Maolin Pan and Yang Yu

CWS_REG_168
Online Cost-effective Edge Service Renting for Content Providers in Cloud and Edge Environments
Zizhe Jin, Li Pan and Shijun Liu

CWS_REG_201
QoS Prediction for Web Services via Combining Multi-component Graph Convolutional Collaborative Filtering and Deep Factorization Machine
Linghang Ding, Guosheng Kang, Jianxun Liu, Yong Xiao and Buqing Cao

4:10 - 5:30
CWS 22
Services QoS Management IV
Session Chair: Xiao Xue, Tianjin University

CWS_REG_215
Instance-Frequency-Weighted Regularized, Nonnegative and Adaptive Latent Factorization of Tensors for Dynamic QoS Analysis
Hao Wu and Xin Luo

CWS_REG_216
Microservice Pre-Deployment Based on Mobility Prediction and Service Composition in Edge
Jiale Deng, Bing Li, Jian Wang and Yuqi Zhao

CWS_REG_231
GoDeep: Intelligent IoV Service Deployment and Execution with Privacy Preservation in Cloud-edge Computing
Wentao Liu, Xiaolong Xu, Lianyong Qi, Xuyun Zhang and Wanchun Dou

5:40 - 7:00
CWS 23
Services Security, Privacy & Trust II
Session Chair: Shouling Ji, Zhejiang University

CWS_REG_138
Incentive-driven Edge Cooperation for Service Provision
Yishan Chen, Shuiguang Deng and Jianwei Yin

CWS_REG_172
MemTrust: Find Deep Trust in Your Mind
Yanwei Xu, Zhiyong Feng, Xiao Xue, Shizhan Chen, Hongyue Wu, Xian Zhou, Meng Xing and Hongqi Chen

CWS_REG_173
Blockchain-based Trust Information Storage in Crowdsourced IoT Services
Mohammed Bahutair and Athman Bouguettaya

18:10 - 19:30
CWS 28
QSS Special Track Papers
Session Chair: TBA

QSS_REG_164
Quantum Token for Network Authentication
Huimin Chen, Hengyue Jia, Xia Wu, Xiuli Wang and Maoning Wang

QSS_REG_233
Best-approximation Error for Parametric Quantum Circuits
Lena Funcke, Tobias Hartung, Karl Jansen, Stefan Kühn, Manuel Schneider and Paolo Stornati

Saturday September 11 - All Times in UTC

1:00 - 2:20
CWS 24
Services Security, Trust & Privacy III
Session Chair: Shouling Ji, Zhejiang University

CWS_REG_203
NPS-AntiClone: Identity Cloning Detection based on Non-Privacy-Sensitive User Profile Data
Ahmed Alharbi, Hai Dong, Xun Yi and Prabath Abeysekara

CWS_SHT_127
Trust Management for Reliable Cross-Platform Cooperation Based on Blockchain
Chao Wang, Shizhan Chen, Shiping Chen, Xiao Xue, Hongyue Wu and Zhiyong Feng

CWS_SHT_212
A Certificateless Searchable Public Key Encryption Scheme for Multiple Receivers
Xiaozhuo Gu, Ziliang Wang and Maomao Fu

2:30 - 3:50
CWS 25
Work-in-Progress
Session Chair: Junhao Wen, Chongqing University

CWS_WIP_099
A Visualization Interface for Exploring Similar Brands on a Fashion E-Commerce Platform
Natsuki Hashimoto, Marie Katsurai and Ryosuke Goto

CWS_WIP_156
Automatic Control Network Anomaly Detection Based on Behavior Understanding
Jianhui Luo

CWS_WIP_209
Video Quality and Popularity-aware Video Caching in Content Delivery Networks
Yijun Sun, Zehua Guo, Songshi Dou and Yuanqing Xia

4:10 - 5:30
CWS 26
Service Applications Beyond the Web VI
Session Chair: Liang Zhang, Fudan University

CWS_SHT_103
A Privacy-aware Stackelberg Game Approach for Joint Pricing, Investment, Computation Offloading and Resource Allocation in MEC-enabled Smart Cities
Hualong Huang, Kai Peng and Peichen Liu

CWS_SHT_104
Mining Temporal Dependency among Proactive Data Services and Its Delivery to System-level Anomaly Prediction
Chen Liu and Xiaoqi Li

CWS_SHT_119
Adaptive Priority-based Conflict Resolution of IoT Services
Dipankar Chaki and Athman Bouguettaya

5:40 - 7:00
CWS 27
Service Applications Beyond the Web VII
Session Chair: Liang Zhang, Fudan University

CWS_SHT_187
A Holistic Service Provision Strategy for Drone-as-a-Service in MEC-based UAV Delivery
Liju Chu, Xuejun Li, Jia Xu, Azadeh Ghari Neiat and Xiao Liu

CWS_SHT_197
Robust Composition of Drone Delivery Services under Uncertainty
Babar Shahzaad, Athman Bouguettaya and Sajib Mistry

CWS_SHT_199
Web Page Information Extraction Service Based on Graph Convolutional Neural Network and Multimodal Data Fusion
Mingzhu Zhang, Yang Zhongguo, Sikandar Ali and Weilong Ding

SCC 2021
IEEE INTERNATIONAL CONFERENCE ON SERVICES COMPUTING

IEEE International Conference on Services Computing (SCC) is a flagship conference on services lifecycle, including enterprise and vertical services modeling, microservices-based solutions, services optimization, services marketing, and business process and scientific workflow management.

Services account for a major part of the IT industry today. Companies increasingly like to focus on their core expertise area and use IT services to address all their peripheral needs. Services Computing is a new science which aims to study and better understand the foundations of this highly popular industry. It covers the science and technology of leveraging computing and information technology to model, create, operate, and manage business services. Like its predecessors, SCC 2021 will contribute in building the pillars of this important science and shaping the future of Services Computing.

Services Computing currently shapes the thinking of business modeling, business consulting, solution creation, service delivery, and software architecture design, development and deployment. The global nature of Services Computing leads to many opportunities and challenges and creates a new networked economic structure for supporting different business models. SCC 2021 will help in bridging the gap between business services and information technology by driving research in technologies such as service-oriented architecture (SOA), business process integration and management, service engineering, cloud computing and Web 2.0.

General Chair: Kumar Bhaskaran, IBM Research, TJ Watson Research Center
General Chair: Valerie Issarny, INRIA
General Chair: Jay Lee, Foxconn Technology Group & U. of Cincinnati
Program Chair: Barbara Carminati, University of Insubria
Program Chair: Shuiguang Deng, Zhejiang University
Program Chair: Wei Tan, Citadel

Monday September 6 - All Times in UTC

4:10 - 5:30
SCC 1
Panel: New Forms of Service & New Approaches of Serviceology
Moderators: Kumar Bhaskaran, IBM Research; Xiaofei Xu, Harbin Institute of Technology

We are in the midst of rapid advances in information technologies, e.g. A (Artificial Intelligence), B (Block Chain), C (Cloud Computing), D (Big Data), E&F (Edge Computing and Forge Computing), G (5G/6G), I (Internet of Things), and Q (Quantum Computing). This is spawning many new forms of services and has promoted the development of new approaches to produce these services. This joint panel of ICWS-SCC will explore the hyperconvergence of new technologies and how it is unleashing innovation in everything-as-a-service (XaaS) and service computing to meet the challenges of zero-trust architectures and service ecosystems. Additionally, the panel will highlight R&D challenges leading to recommendations for enhancing education of Serviceology. The themes of this panel include:

(1) New forms of services: There is an explosion of new services and service ecosystems that is transforming industries, driving digital economies and the next-generation internet. Examples include IoT Services, Edge Services, Cloud Native Services, and AI-driven Intelligent Services, Internet of Services, Big Services, etc. What service computing platforms are likely to enable these new forms of services?

(2) New approaches to produce services: The hyperconvergence of new technologies, ABCDEFG + IQ, are shaping the digital service platforms that drive social, technical, economic and industrial transformations. How will collaborative intelligence (Human + AI), Zero-Trust Cybersecure digital fabric, crowd sourcing and micro-services driven API economy drive the evolution of infrastructure, platform and software as-a-service?

(3) New education program of serviceology: Serviceology is a trans-disciplinary scientific foundation for modern digital services and social-technical ecosystems. Education on service science and engineering, or serviceology, is developing for the future modern service industry and service-oriented economy. How should Serviceology pedagogy, practice and the advancement of service computing to bridge Business and IT keep pace with the technology and service innovations?

Panelists:
Rong N. Chang, IBM Research, TJ Watson Research Center
Athman Bouguettaya, University of Sydney
Schahram Dustdar, Technical University of Wien
Zhiyong Feng, Tianjin University

Monday September 6 - All Times in UTC

4:10 - 5:30
SCC 1 - Plenary Panel: New Forms of Service & New Approaches of Serviceology
Session Chair/Moderator: Kumar Bhaskaran, IBM Research

We are in the midst of rapid advances in information technologies, e.g. A (Artificial Intelligence), B (Block Chain), C (Cloud Computing), D (Big Data), E&F (Edge Computing and Forge Computing), G (5G/6G), I (Internet of Things), and Q (Quantum Computing). This is spawning many new forms of services and has promoted the development of new approaches to produce these services. This joint panel of ICWS-SCC will explore the hyperconvergence of new technologies and how it is unleashing innovation in everything-as-a-service (XaaS) and service computing to meet the challenges of zero-trust architectures and service ecosystems. Additionally, the panel will highlight R&D challenges leading to recommendations for enhancing education of Serviceology. The themes of this panel include:

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Panelists:
Xiaofei Xu, Harbin Institute of Technology
Rong N. Chang, IBM Research
Athman Bouguettaya, University of Sydney
Schahram Dustdar, TU Wien
Feng Zhiyong, Tianjin University

15:00 - 16:20
SCC 2
Serviceology & Foundations of Services Computing
Session Chair: Leila Bhari, KTH Royal Institute of Technology

SCC_REG_024
Regulation-as-a-Service: Model Checking for Decision-Making Behaviors in Price-Sensitive Service Systems
Sixuan Dang and Sheng Cao

SCC_REG_025
Clams: A Cloud Application Modeling Solution
Otto Bibartiu, Frank Dürr and Kurt Rothermel

SCC_REG_091
DCrowd: A Decentralized Service Model for Credible Crowdsourcing based on Game Theory and Smart Contracts
Huajian Wang, Huan Zhou, Guogui Yang and Tao Xiao

16:30 - 17:50
SCC 3
Serviceology & Foundations of Services Computing
Session Chair: Barbara Carminati, University of Insubria

SCC_REG_082
Word Embedding-based Web Service Representations for Classification and Clustering
Xiangping Zhang, Jianxun Liu, Min Shi and Buqing Cao

SCC_REG_085
Challenges and Opportunities in Space Service Computing
Yan Guo and Shangguang Wang

SCC_REG_070
P-DecSerFlow: A Conceptual Framework to Model Services Interactions for Standardized Service Oriented Architecture
Malik Khalfallah and Parisa Ghodous

18:10 - 19:30
SCC 4
Servicology & Foundations of Services Computing
Session Chair: Barbara Carminati, University of Insubria

SCC_REG_071
Relaxing the Sky: Handling Hard User Constraints in Skyline Service Selection
Karim Benouaret, Sayda Elmi and Kian-Lee Tan

SCC_REG_080
Modeling Multi-Attribute and Implicit Relationship Factors for Collaborative Filtering Recommender System

Hanwen Zhang, Wei Zhou, Junhao Wen, Jun Zeng and Min Gao
SCC_REG_038
Towards Representing Time-Cost Tradeoffs for Service Compositions
Franziska Hollauf, Marco Franceschetti and Johann Eder

Tuesday September 7 - All Times in UTC

1:00 - 2:20
SCC 5
Scientific Workflows & Business Process Integration & Management
Session Chair: Honghao Gao, Shanghai University

SCC_REG_068
Analyzing GDPR Compliance in Cloud Services' Privacy Policies using Textual Fuzzy Interpretive Structural Modeling (TFISM)
Ronak Razavisousan and Karuna P. Joshi

SCC_REG_083
DCAB: An Effective Data Collection and Analysis Service for Blockchain
Jian Yang, Zhihui Lu, Rui Xu, Jie Wu, Xiaohua Xuan and Jie Cheng

SCC_REG_059
Deep Reinforcement Learning for Dynamic Workflow Scheduling in Cloud Environment
Tingting Dong, Fei Xue, Chuangbai Xiao and Jiangjiang Zhang

2:30 - 3:50
SCC 6
Scientific Workflows & Business Process Integration & Management
Session Chair: Honghao Gao, Shanghai University

SCC_REG_094
Definition and Induction of a Specification Order Relation between Capabilities
Imen Jerbi and Sami Bhiri

SCC_REG_092
Constructing a Creative Software with Services
Faisal Fahmi, Pei-Shu Huang, Feng-Jian Wang and Hongji Yang

SCC_REG_055
Toward an Enterprise-ready Composable Infrastructure as a Service
Lorraine Herger, Kaoutar El Maghraoui, I-Hsin Chung, Chekuri Choudary, Kim Tran and Todd Deshane

4:10 - 5:30
SCC 7
Service QoS, Lifecycle Management & DevOps
Session Chair: Zhengze Xiang, Zhejiang University

SCC_REG_095
Ensemble Learning-based Fake News and Disinformation Detection System
Lumbardha Hasimi and Aneta Poniszewska-Maranda

SCC_REG_037
A Constraint-aware Ridesharing Service Guaranteeing Quality-of-Service for Smart Cities
Yueshen Xu, Yuqiao Liao, Jianbin Huang and Ying Li

SCC_REG_052
A Hybrid Approach to News Recommendation Based on Knowledge Graph and Long Short-Term User Preferences
Yumin Sun, Fangzhou Yi, Cheng Zeng, Bing Li, Peng He, Jinxia Qiao and Yinghui Zhou

18:50 - 20:10
SCC 8
Service QoS, Lifecycle Management & DevOps
Session Chair: Wei Tan, Citadel

SCC_REG_039
EPF4M: An Evolution-Oriented Programming Framework for Microservices
Teng Wang, Xiang He, Hanchuan Xu, Zhiying Tu and Zhongjie Wang

SCC_REG_033
Dual-Target Cross-Domain Bundle Recommendation
Tao Zhang, Yani Han, Xuewen Dong, Yang Xu and Yulong Shen

SCC_REG_041
Dialogue-based Continuous Update of User Portraits
Min Liu, Zhiying Tu, Xiaofei Xu and Zhongjie Wang

20:20 - 21:40
SCC 9
Service QoS, Lifecycle Management & DevOps
Session Chair: Anna C. Squicciarini, Pennsylvania State University

SCC_REG_063
Security Certification Scheme for Content-centric Networks
Marco Anisetti, Claudio Ardagna, Filippo Berto and Ernesto Damiani

SCC_REG_086
A Resilient Fog-IoT Framework for Seamless Microservice Execution
Md Whaiduzzaman, Alistair Barros, Ahmedur Rahman Shovon, Md Razon Hossain and Colin Fidge

Wednesday September 8 - All Times in UTC

1:00 - 2:20
SCC 10
AI@Scale in Services Computing and Human-Centered Service
Session Chair: Ao Zhou, BUPT

SCC_REG_088
Task Offloading and Resource Allocation for Container-enabled Mobile Edge Computing
Ao Zhou, Sisi Li and Shangguang Wang

SCC_REG_076
A Text Mining based Method for Policy Recommendation
Zhang Tong, Liu Mingyi, Ma Chao, Tu Zhiying and Wang Zhongjie

SCC_REG_061
Distributed Service Placement and Workload Orchestration in a Multi-access Edge Computing Environment
Hadi Tabatabaee Malazi and Siobhan Clarke

2:30 - 3:50
SCC 11
Invited Papers
Session Chair: Guobing Zou, Shanghai University

SCC_INV_101
Edge Intelligence as a Service
Philipp Raith and Schahram Dustdar

SCC_INV_099
Service Ecosystem: A Lens of Smart Digital Society
Xiao Xue, Zhiyong Feng, Shizhan Chen, Zhangbing Zhou, Chengzhi Qin, Bing Li, Zhongjie Wang, Shufang Wang, Hongyue Wu, Lu Zhang and Yufang Zhang

SCC_INV_103
Distributed Service Composition in Internet of Services
Xiaofei Xu, Xiao Wang, Hanchuan Xu and Zhongjie Wang

4:10 - 5:30
SCC 12
Future of Financial Services
Session Chair: Hongyue Wu, Zhejiang University

FFS_REG_057
Code Will Speak: Early detection of Ponzi Smart Contracts on Ethereum
Yanmei Zhang, Siqian Kang, Wei Dai and Shiping Chen

FFS_REG_090

Dynamic Transaction Storage Strategies for a Sustainable Blockchain
Xiongfei Zhao and Yain-Whar Si

5:40 - 7:00
SCC 13
Industrial Internet
Session Chair: Xiao Xue, Tianjin University

SCC_REG_028
An SRAM Optimized Approach for Constant Memory Consumption and Ultra-fast Execution of ML Classifiers on TinyML Hardware
Bharath Sudharsan

SCC_REG_047
Remote Attestation as a Service for Edge-Enabled IoT
Miguel Calvo and Marta Beltran

SCC_INV_102
Toward Mobile Application of Cyber Argumentation with Social Networking
Bhargav Thota, Xiaoqing Liu and Md Mahfuzer Rahman

SCC_INV_104
Adaptive Alternating Stochastic Gradient Descent Algorithms for Large-Scale Latent Factor Analysis
Wen Qin, Xin Luo and Mengchu Zhou

16:30 - 17:50
SCC 14
Industrial Internet
Session Chair: Barabara Carminati, University of Insubria

SCC_REG_087
A Framework for Enabling Cyber Twins-based Industry 4.0 Application Development
Dinithi Bamunuarachchi, Dimitrios Georgakopoulos, Prem Prakash Jayaraman and Abhik Banerjee

SCC_REG_054
On Analysis of Security and Elasticity Dependency in IIoT Platform Services
Rohit Raj and Hong-Linh Truong

19:40 - 21:00
SCC 15
Panel Discussion: Industry 4.0 & Lean Operations
Moderator: Haixia (Suzy) Wang, MIT Lincoln Laboratory

The phrase “fourth industrial revolution” (i.e., Industry 4.0) was introduced a decade ago and has been enthusiastically explored thereafter in both academia and industry. Although there are challenges on data readiness, technologies such as the internet of things, cloud computing, cognitive computing, and cyber-physical systems have been progressing over the years.

While new technology opens up new opportunities, the majority of pioneer companies were challenged with questions like “what’s the return on investment?” and “when?”

The history of industrialization has shown that every revolution is driven by for-profit companies. For Industry 4.0, despite some pioneer companies persevering for further investment, sustainment of the momentum entails a strong value-generating process.

In this panel discussion, four industry experts are invited to discuss their insights on Industry 4.0 and Lean operations. The following questions are to be initially addressed in the discussion:

- What does Industry 4.0 mean to you and your business?
- What were the Industry 4.0 challenges you experienced? What’s the future like?
- What are different Industry 4.0 opportunities and challenges across industries?
- What’s fundamental lean thinking? How could industry 4.0 initiatives be integrated into an organization’s business operations to bring benefit and, in turn, speed up the industrial revolution?

Panelists:
Mark Maybury, CTO, Stanley Black & Decker
Pamela Wiseman, VP Supply Chain Operations, Baylor Scott & White
Wesley Mukai, Chief Software Architect for Rockwell Automation, Software & Controls
Mark C. DeLuzio, Pioneer of Danaher Business Systems; Founder of Lean Horizons Consulting

Thursday September 9 - All Times in UTC

4:10 - 5:30
SCC 16
Work-in-Progress
Session Chair: Honghao Gao, Shanghai University

SCC_WIP_049
Sliceable Monolith: Monolith First, Microservices Later
Fabrizio Montesi, Marco Peressotti and Valentino Picotti

SCC_WIP_069
Smart Journey Mining for Improved Service Quality
Ragnhild Halvorsrud, Felix Mannhardt, Einar Broch Johnsen and S. Lizeth Tapia Tarifa

19:40 - 21:00
SCC 17
Short Papers
Session Chair: Barbara Carminati, University of Insubria

SCC_SHT_043
Formal Modeling and Verification of Property-based Resource Consumption Cycles
Rania Ben Halima, Kais Klai, Mohamed Sellami and Zakaria Maamar

SCC_SHT_007
A SOAF Model Extension for Incorporating User Feedback and Preference to Improve Social Service Discovery
Amal Hafsi, Youssef Gamha, Cheyma Ben Njima and Lotfi Ben Romdhane

SCC_SHT_048
A Constraint Satisfaction Service Composition Method Supporting One to Many Task Pattern
Weijie Chu, Yuxuan Wang, Tong Mo and Weiping Li

Friday September 10 - All Times in UTC

1:00 - 2:20
SCC 18
Short Papers
Session Chair: Qiang He, Swinburne University of Technology

SCC_SHT_051
Context-aware Artificial Internet-of-Things Application Deployment in Edge-Cloud Systems
Zengwei Zheng, Yuhang Zheng, Dongjing Wang, Hailiang Zhao, Cheng Zhang and Zhengzhe Xiang

SCC_SHT_060
Scaling up Mobile Service Selection in Edge Computing Environment with Cuckoo Optimization Algorithm
Ming Zhu, Feilong Yu, Xiukun Yan, Jing Li and Yaoting Wang

SCC_SHT_065
ATeDLW: Intelligent Detection of Abnormal Trajectory in Ship Data Service System
Tao Zhang, Shuai Zhao, Bo Cheng and Junliang Chen

2:30 - 3:50
SCC 19
Short Papers
Session Chair: Qiang He, Swinburne University of Technology

SCC_SHT_017
Hire Me Fairly:Towards Dynamic Resource-binding with Smart Contracts
Tiphaine Henry, Nassim Laga, Julien Hatin, Roman Beck and Walid Gaaloul

SCC_SHT_019
An Accountability-Oriented Generation approach to Time-Varying Structure of Cloud Service
Xiaojian Li, Jing Chen, Yiyi Jiang, Hangping Hu and Haopeng Yang

SCC_SHT_053
Evaluation of API Request Bundling and its impact on Performance of Microservice Architectures
Amine El Malki and Uwe Zdun

4:10 - 5:30
SCC 20
Short Papers
Session Chair: Shiping Chen, CSIRO

SCC_SHT_062
Semi-automated Modelling of Optimized BPMN Processes
Ylies Falcone, Gwen Salaun and Ahang Zuo

SCC_SHT_005
Enabling Cross-Jurisdiction Digital Asset Transfer
Rafael Belchior, André Vasconcelos, Miguel Correia and Thomas Hardjono

SCC_SHT_040
SRAUT: Service Resource Availability Analysis Method with User Tolerance Concern
Kaiqi Zhang, Zhiying Tu, Dianhui Chu and Chunshan Li

5:40 - 7:00
SCC 21
Short Papers
Session Chair: Jun Chen, University of Wollongong

SCC_SHT_079
Cloud as Platform for Monetizing Complementary Data for AI-driven Services: A Two-Sided Cooperative Game
Ahmed Saleh Bataineh, Jamal Bentahar, Omar Abdel Wahab, Rabeb Mizouni and Gaith Rjoub

SCC_SHT_020
Multi-objective Sparrow Search Optimization for Task Scheduling in Fog-Cloud-Blockchain Systems
Thieu Nguyen, Thang Nguyen, Quoc-Hien Vu, Thi Thanh Binh Huynh and Binh Minh Nguyen

SMDS 2021
IEEE INTERNATIONAL CONFERENCE ON SMART DATA SERVICES

We are delighted to welcome you to the IEEE International Conference on Smart Data Services (IEEE SMDS'21), part of the 2021 IEEE World Congress on Services (IEEE SERVICES'21). IEEE SMDS'21 is the flagship theme-topic conference for data-driven applications and smart data-aware solutions under the as-a-service model, including analytic & learning-based services, smart data infrastructures, big data management, data quality and trustworthiness, data computing at the edge/IoT systems, and case studies of smart data services. IEEE SMDS'21 brings together researchers and practitioners working on AI, Systems, Data Science, and Services Computing to provide a dynamic and interactive forum to present and discuss their latest research findings, results, and challenges in this emerging area of mutual interest.

IEEE SMDS'21 hosts an exciting technical program, including a research papers track, Smart Data Trustworthiness track, Data Computing at the Edge track, Applications and Case Studies track, and Special tracks on Causal Learning, Blockchains and Knowledge Graphs and AI. Additionally, SMDS'21 hosts two panels: Blockchain panel organized by Dragan Boscovic and the Smart Data and Building Energy panel organized by Jin Wen and Zheng O'Neill. We are immensely grateful to the many researchers who have shaped the conference program. We thank the authors, presenters, panelists, and the IEEE SMDS'21 program committee. We also extend our appreciation to local organizers and the student volunteers. We also acknowledge the members of the IEEE Services General Chairs, Rong Chang and Ian Foster and IEEE Services Program Chairs, Ernesto Damiani and Jia Zhang, the Organizing Committee members, and the IEEE Services Steering Committee. The steering committee chair Carl Chang deserves special thanks for providing us with his advice at all stages of the conference organization.

We are also grateful to the EasyChair team for their extremely prompt and helpful support throughout the complex conference reviewing process. We used the EasyChair platform for the submission and reviewing of research papers. We also give our most sincere thanks to the IEEE CPS team for their immense help in preparing the proceedings for publication. We thank IEEE SMDS'21 supporters, IBM Research, and the IEEE Computer Society's Technical Committee on Services Computing (TCSC), for their many contributions.

General Chair: Selcuk Candan, Arizona State University
General Chair: Amit Sheth, University of South Carolina
General Chair: Zibin Zheng, Sun Yat-Sen University
Program Chair: Min Fu, Lizhi
Program Chair: George Spanoudakis, City, University of London
Program Chair: Mudhakar Srivatsa, IBM Research, TJ Watson Research Center

Monday September 6 - All Times in UTC

16:30 - 17:50
Joint Panel with Blockchain Symposium
Panel Discussion: Digital Twin & Digital Threading - Current Practice & Future Trends
Moderator: Dragan Boscovic, Arizona State University

A digital twin, being an exact digital replica of a given tangible physical asset or process, a digital twin is expected to play a vital role in Industry 4.0. Capturing and integrating the asset, production, and performance data into a corresponding digital twin is commonly referred to as digital threading.

Today's methods for enabling digital twins are based on centralized architectures and do not natively provide trusted data provenance, audit, and traceability. In contrast, blockchain-based digital threading ensures secure and trusted traceability, accessibility, immutability of transactions, logs through data provenance, which is native to the blockchain protocols. In addition to the blockchain, several other technologies such as the Internet of Things, artificial intelligence, big and streaming data analytics are commonly used to enable seamless synchronization between digital twins and the processes they represent. The panel session will discuss ongoing innovations and further research efforts needed to resolve blockchain-based digital threading challenges associated with scalability, data privacy, interoperability, energy consumption, and integration with legacy systems.

Panelists:
Jan Veuger, Saxion University
Khaled Salah, Kalifa University
Mic Bowman, Intel

18:10 - 19:30
SMD 13
Causal Learning Special Session
Session Chair: RuoCheng Guo, Arizona State University

Tuesday September 7 - All Times in UTC

1:00 - 2:20
SMD 1: Graphs, Knowledge Graphs and AI I
Mudhakar Srivatsa, IBM TJ Watson Research Center

SMD_REG_14
Towards a Reinforcement Learning-based Exploratory Search for Mashup Tag Recommendation
Richard Anarfi, Benjamin Kwapong and Kenneth Fletcher

SMD_SHT_36
Chinese Stock Trend Prediction Based on Multi-feature Learning and Model Fusion
Shanyan Lai, Chunyang Ye, Hongyu Jiang and Hui Zhou

SMD_REG_39
Graph Convolutional Network-Strengthened Topic Modeling for Scientific Papers
Jia Zhang, Junhao Shen, Beichen Hu, Nivedha Rajaram, Rahul Ramachandran, Tsengdar Lee, Kwo-Sen Kuo, Manil Maskey and Seungwon Lee

2:30 - 3:50
SMD 2: Smart Data Management I
Session Chair: Huawei Huang, Sun Yat-Sen University

SMD_INV_42
Federated Process Mining: Exploiting Event Data Across Organizational Boundaries
Wil van der Aalst

BLK_SYM_25
AC2M: An Automated Consent Management Model for Blockchain Financial Services Platform
Zhiyu Xu, Tengyun Jiao, Ziyuan Wang, Sheng Wen and Shiping Chen

SMD_REG_20
Data Readiness Report
Shazia Afzal, Rajmohan C, Manish Kesarwani, Sameep Mehta and Hima Patel

Wednesday September 8 - All Times in UTC

1:00 - 2:20
SMD 3: Data Computing at Edge
Session Chair: Shiping Chen, CSIRO

SMD_WIP_26
Cognitive Advisory Agent
Shubhi Asthana and Shikhar Kwatra

BLK_SYM_32
Using Blockchain for Enhancing Collaboration among Independent Enterprises:A Knowledge-based Approach
Niranjan Marathe, Haan Johng, Tom Hill and Lawrence Chung

SMD_REG_30
Here, There, Anywhere: Profiling-Driven Services to Tame the Heterogeneity of Edge Applications
Manish Pandey, Breno Cruz, Minh Le, Young-Woo Kwon and Eli Tilevich

2:30 - 3:50
SMD 4: Data Computing at Edge
Session Chair: Yucong Duan, Hainan University

SMD_REG_37
Ship Trajectory Anomaly Detection Based on Multi-feature Fusion
Guanbin Huang, Shanyan Lai, Chunyang Ye and Hui Zhou

19:40 - 21:00
SMD 12
Panel Discussion: The Role of Smart Data and IoT in Building Energy Automation
Moderators: Zheng O'Neill, TAMU; Jin Wen, Drexel University

This panel focuses on the current state-of-the-arts and international trends surrounding the emerging question of what is the Role of Smart Data and IoT in Building Energy Automation for smart buildings. The panel is formed with diversified panelists that include experts from major building automation industry, government research laboratories, and academia. Needs, gaps, and challenges from data schema, data analytics, and real field application perspectives are will be discussed.

Panelists:
Steve White, CSIRO
Youngchoon Park, Healing LLC
Jan Drgnoa, PNNL
Young M. Lee, Johnson Controls

Thursday September 9 - All Times in UTC

1:00 - 2:20
SMD 5: Edge AI
Session Chair: Youngchoon Park, Healing LLC

SMD_WIP_13
ML Model Change Detection and Versioning Service
Shubhi Asthana, Shikhar Kwatra and Sushain Pandit

SMD_REG_38
Why Did You Turn On That Light?
Supratik Mukhopadhyay, Alimire Nabijiang, Chanachok Chokwitthaya, Yimin Zhu, Girish Rentala and Qun Liu

SMD_REG_23
From Big Data to Smart Data-centric Software Architectures for City Analytics: The Case of the PELL Smart City Platform
Mubashir Ali, Patrizia Scandurra, Fabio Moretti, Laura Blaso, Mariagrazia Leccisi and Fabio Leccese

2:30 - 3:50
SMD 6: Smart Data Trustworthiness
Session Chair: Katsunori Oyama, Nihon University

SMD_REG_28
Turning a Curse into a Blessing: A General Approach to Resolve Endogeneity Problem in Data-Rich Environment
Xiliang Lin, Tho Le, Carlos Carrion and Zenan Wang

SMD_SHT_21
Improving Knowledge Based Detection of Soft Attacks Against Autonomous Vehicles with Reputation, Trust and Data Quality Service Models
Sergey Chuprov, Ilia Viksnin, Iuliia Kim, Timofey Melnikov, Leon Reznik and Igor Khokhlov

18:10 - 19:30
SMD 7: Smart Data Management II
Session Chair: Supratik Mukhopadhyay, Louisiana State University

SMD_REG_11
Assessing the Effectiveness of the Shared Responsibility Model for Cloud Databases: The Case of Google's Firebase
Biniam Fisseha Demissie and Silvio Ranise

SMD_REG_40
Targeted VAE: Variational and Targeted Learning for Causal Inference
Matthew J. Vowels, Necati Cihan Camgoz and Richard Bowden

SMD_REG_6
Track Before Detect: A Novel Approach For Unsupervised Anomaly Detection In Time Series
Ralph Bou Nader, Nour Assy, Walid Gaaloul, Yehia Taher and Rafiqul Haque

19:40 - 21:00
SMD 8: BlockChain
Session Chair: Mengchu Zhou, New Jersey Institute of Technology

BLK_SYM_24
Blockchain Based RAN Data Sharing
Andreas Heider-Aviet, Danny Roswin Ollik, Van Thanh Le, Nabil El Ioini, Claus Pahl, Hamid R. Barzegar, Silvio Ranise, Roberto Carbone and Stefano Berlato

BLK_SYM_31
An Analysis of Transaction Handling in Bitcoin
Befekadu Gebraselase, Bjarne Emil Helvik and Yuming Jiang

SMD_REG_27
Semantic Data Integration to Support Prosecutors in their Investigations: Lessons Learned and Challenges
Carlo Batini, Valerio Bellandi, Paolo Ceravolo, Federico Moiraghi, Matteo Palmonari and Stefano Siccardi

Friday September 10 - All Times in UTC

1:00 - 2:20
SMD 9: Graphs, Knowledge Graphs and AI II
Session Chair: Sachiko Yoshihama, IBM Research

SMD_SHT_34
DynGraphTrans: Dynamic Graph Embedding via Modified Universal Transformer Networks for Financial Transaction Data
Toyotaro Suzumura, Shilei Zhang and Li Zhang

SMD_INV_41
An Auxiliary Learning Task-Enhanced Graph Convolutional Network Model for Highly-accurate Node Classification on Weakly Supervised Graphs
Zengmei Zhuo, Xin Luo and Mengchu Zhou

2:30 - 3:50
SMD 10: Graphs, Knowledge Graphs and AI III
Session Chair: Toyotaro Suzumura, University of Tokyo

SMD_REG_12
HOPE-Graph: A Hypothesis Evaluation Service Considering News and Causality Knowledge
Futoshi Iwama, Miki Enoki and Sachiko Yoshihama

SMD_REG_22
Nonnegative Latent Factor-Incorporated Fuzzy Double c-Means Clustering for Incomplete Data
Ming Li and Yan Song

SMD_REG_7
Efficient Mobility Support Services for Highly Mobile Devices in 5G Networks
Zohar Naor

DIKWN 2021
IEEE INTERNATIONAL WORKSHOP ON DATA, INFORMATION, KNOWLEDGE & WISDOM NETWORKS

Everything as a Service (EaaS or XaaS) has followed the development of Software-Defined Everything as stakeholders determine the ultimate culmination of human production of both tangible and intangible services and solutions inner or inter Data, Information, Knowledge and Wisdom (DIKW) modals, which empirically answer 5W (What, Where, When, How and Why). However, in the light of the overall trend of AI driven conversion from traditional services to intelligent or smart services, prevailing challenges arise for both conceptual foundations and technical preparation on DIKW modals, especially involving semantic understanding and utilization. As Knowledge Networks including Data Network, Information Network, Knowledge Network and Wisdom Networks, is short (DIKW Networks), are increasingly adopted for alleviating semantic understanding beyond various question and answering systems, various solutions focusing on DIKW Networks have been proposed in the background of Relationship Defined Everything of Semantics (RDXS) towards solving essence oriented computation and reasoning activities in the common background of incomplete and uncertainty prevailing resources with time and workload constrains. These approaches cover DIKW Networks creation, understanding, searching, reasoning, modification and especially and most recently embedding technologies in the form of various crossing multiple modals integration Machine Learning extensions. A foreseeable AI as a Service (AIaaS) landscape with explainable and interactive human interactions is becoming feasible based on DIKW Networks. The capability of DIKW Networks as a Service (DIKWNaaS) usages are constantly expanding, but there are also open questions especially in the era of rapid growing of crossing multiple modal processing demands. Recently we have also seen the emergence of various applications and models of DIKWNaaS) as a gradual acceleration towards an era of strong AI solutions in processing multiple modals, multiple dimensional multiple scale, multiple scales or even mesoscale content/resources.

This workshop aims to bring together researchers and industrial practitioners to discuss and exchange innovative ideas, results, work-in-progress and case studies in the Knowledge Graph, DIKW architecture and Knowledge Network. We received 9 submissions among which 7 papers are accepted for oral presentations at the workshop. The accepted papers cover the emergent topics in the area of including models and frameworks of DIKW, Knowledge Graph, application of ontology, semantic models, federated learning and service recommendation.

We believe that this workshop will bring the key technologies to the art of service computing by discussion among the researchers and practitioners from various fields, not only service computing. We are looking forward to your participation in a successful, engaging and rewarding event.

Program Chairs:
Yucong Duan, Hainan University
Katsunori Oyama, Nihon University
Jia Zhang, Southern Methodist University

Monday September 6 - All Times in UTC

15:00 - 16:20
KWN 1
Panel Discussion: Challenges and Opportunities in Fusion of Data, Information, Knowledge & Wisdom
Moderators: Yucong Duan, Hainan University and Zhao Li, Alibaba -Zhejiang University Frontier Technology Joint Research Center

This panel aims to bring together researchers and industrial practitioners to exchange new findings and ideas on methodological crossing of Data, Information, Knowledge and Wisdom modeling, reasoning, computation and validation research and experimentation. Contributors and organizers also seek to explore potential theoretical challenges and industrialization concerns during their research and practice towards crossing models fusing Data, Information, Knowledge and Wisdom.

Panelists:
Victor Tang, MIT
Jia Zhang, Southern Methodist University
Ji Zhang, University of Southern Queensland
Mykola Nikitchenko, Taras Shevchenko National University of Kyiv
Xuanting Cai, Facebook

16:30 - 17:50
KWN 2
Modeling of Data, Information, Knowledge & Wisdom
Session Chair: Katsunori Oyama, Nihon University

KWN_INV_062
Modeling and Measuring for Emotion Communication based on DIKWTing Hu, Yucong Duan, Ke Fan, Yue Huang and Yuxiao Lei

KWN_INV_066Towards Purpose Driven Content Interaction Modeling and Processing based on DIKW
Yue Huang, Yucong Duan, Yuxiao Lei and Ting Hu

KWN_INV_042
ASMaaS: Automatic Semantic Modeling as a Service
Zaiwen Feng, Wolfgang Mayer, Markus Stumptner, Georg Grossmann, Da Ning, Keqing He and Selasi Kwashie

18:10 - 19:30
KWN 3
Knowledge Networking
Session Chair: Jia Zhang, Southern Methodist University

KWN_INV_056
Modeling and Performance Analysis on Federated Learning in Edge Computing
Qiang Duan and Maryam Roshanaei

KWN_INV_060
A Novel Method for Network Traffic Prediction Using Residual Mogrifier GRU
Ji-yu Tian, Jing Qin, Li-Ming Chen, Hui Fang and Zu-Min Wang

KWN_INV_039
Service Recommendation based on Smart Contract and DIKW
Haiyang Zhang, Lei Yu and Yucong Duan

IWIOS 2021
THE IEEE INTERNATIONAL WORKSHOP ON INTERNET OF SERVICES

The cloud, the Internet of Things (IoT), and various virtualization technologies have sharply increased the number of available services. Services are flourishing drastically both on the Internet and in the real world, including Web APIs, IoT services, O2O services, cloud and edge services, and so on. Additionally, services have become much more interconnected to facilitate transboundary business collaboration to create and deliver distinct new values to customers.

As a new phenomenon that has quickly dominated many modern service industries but lacks sufficient theoretical foundations and a complete technical stack, Internet of Services and service ecosystems have drawn considerable attention from the academic community of Services Computing in recent years. It is necessary to keep continuous research on fundamental theories, reference architectures, business and technical metrics, models and modeling approaches, construction and customization methods, technical infrastructure and platforms, run-time quality assurance of IoS, and the applications of various emerging technologies (such as AI, blockchain, cloud, edge, and big data) into IoS. Besides, real-world practices of IoS in a variety of business domains are hot topics in service industries.

IEEE IWIOS 2021 aims to bring together scholars and students, researchers and managers of Internet of Services and service ecosystem related areas and industries for intellectual exchanges, research cooperation, education and professional development. IWIOS 2021 features a unique mix of academic, industrial, and cross-discipline topics, and provides a platform for the presentation and exchange of research results and practical experiences.

There are 14 papers accepted by the workshop, and they are organized into four sessions: IoS Composition and Recommendation, IoS Modeling and Design, IoS Infrastructure and Tools, and IoS Scheduling and Optimization. It is a great opportunity for all of these authors to present their latest work on IoS and share with audiences all over the world. Thanks for their great contributions!

Besides, we would like to express our thanks the Workshop Program Committee who devoted significant time to organizing this event to meet the challenges of our times.

We wish IEEE IWIOS 2021 to be a successful event and look forward to meeting you online!

General Chairs
Carl K. Chang, Iowa State University
Xiaofei Xu, Harbin Institute of Technology
Jianwei Yin, Zhejiang University

Program Chairs:
Michael Q. Sheng, Macquarie University
Zhongjie Wang, Harbin Institute of Technology

Tuesday September 7 - All Times in UTC

1:00 - 2:20
IOS 1
IoS Composition & Recommendation
Session chair: Shuangxi Huang, Tsinghua University

Opening Ceremony

IOS_REG_006
An End-to-end Attention Transfer Network for Cross-domain Service Recommendation
Ruyu Yan, Yushun Fan

IOS_REG_008
Abstraction Refinement Approach for Web Service Selection using Skyline Computations
Zhiyong Wu, Ke Meng, Xiukun Yan, Dayin Shi, Benjia Hu

IOS_REG_029
A Fast Real-Time QoS-aware Service Selection Algorithm
Chunshan Li, Xiao Guo, Zhiying Tu, Chu Dianhui, Chengrong Wang

2:30 - 3:50
IOS 2
IoS Modeling & Design
Session Chair: Zhiying Tu, Harbin Institute of Technology

IOS_REG_015
A Modeling and Engineering Methodology for Developing Internet of Services from Scratch
Jianan Li, Jingying Wang, Hanchuan Xu, Zhongjie Wang, Xiaofei Xu

IOS_REG_003
Identification of Product Service Common and Individual Demands based on Online Reviews
Lin Huang, Liya Wang, Xinguo Ming

IOS_REG_004
Research on Service Aggregation Driving Mechanism of “Virtual Nursing Home” Based on Evolutionary Game
Zongwei Ren, Guangmin Zhou

IOS_REG_005
Multi-view Scenario-based Service Resource Description Modeling and Application Method
Zhengzuo Li, Zhiying Tu, Bo Liu, Chunshan Li, Dianhui Chu

4:10 - 5:30
IOS 3
IoS Infrastructure & Tools
Session Chair: Guiling Wang, North China University of Technology

IOS_REG_012
A Decentralized Runtime Environment for Service Collaboration: the Architecture and a Case Study
Jing Gao, Guiling Wang, Zhongguo Yang, Zhuofeng Zhao

IOS_REG_018
A Blockchain-based Infrastructure for Distributed Internet of Services
Yuxin Wang, Zhiying Tu, Yu Bai, Haochen Yuan, Xiaofei Xu, Zhongjie Wang

IOS_REG_025
A Cache-based Executive Request Dispatching Method in the Distributed Workflow System
Bo Lv, Weilong Ding, Ji Liu

IOS_REG_032
A Data-driven Exploratory Service Composition Tool for Data Scientists
Gaojian Chen, Jing Wang, Qianwen Li, Yunjing Yuan

5:40 - 7:00
IOS 4
IoS Scheduling & Optimization
Session Chair: Hanchuan Xu, Harbin Institute of Technology

IOS_REG_007
Multi-Tenant Cloud-Edge Workflow Scheduling With Priority and Deadline Constraints
Dongyuan Pan, Long Chen, Xiaoping Li

IOS_REG_016
Hybrid Cloud Resource Scheduling With Multi-dimensional Configuration Requirements
Zhaokun Qiu, Long Chen, Xiaoping Li

IOS_REG_023
Research on Evolutionary Game of Service Value Chain Considering the Supervision of Service Platform
Fengjiao Sun, Ting He, Chuanming Jin

Closing Ceremony

J1C2 2021
IEEE SERVICES
JOURNAL FIRST/CONFERENCE SECOND TRACK

We are delighted to welcome you to the inaugural edition of the Journal First-Conference Second (J1C2) Track at the 2021 edition of the IEEE World Congress on Services (SERVICES 2021). The J1C2 track is organized jointly with the IEEE Transactions on Services (TSC) and the IEEE Technical Committee on Services Computing (TCSVC) and will be held online from Thursday 9 September 2021 to Saturday 11 September 2021.

The track includes 20 presentations that have been selected from articles that have received final approval from the Editor-in-Chief of the IEEE TSC and have been published on IEEE Explore as Early Access papers but have not appeared in a regular issue of the IEEE TSC Journal. We have selected 4 papers each corresponding to the themes of five flagship conferences of SERVICES 2021: CLOUD, ICWS, ICDH, SCC and SDMS. We would like to acknowledge the help of the Conference Chairs in helping us select high-quality papers for presentation. We also thank the authors of the selected papers for agreeing to present their work at this inaugural edition of the J1C2 track.

We would like to acknowledge the role of Carl Chang (Steering Committee Chair of IEEE SERVICES) and James Joshi (EIC of IEEE TSC) in initiating and realizing the J1C2 Track. We would also like to extend our special thanks to Rong N. Chang (General Chair, SERVICES 2021) and Nimanthi Atukorala (Publication Chair, SERVICES 2021) for providing advice, help and support at all stages of the process.

We cordially invite you to join us in this first J1C2 Track and hope that you will enjoy all the presentations.

We look forward to meeting you online!

J1C2 CHAIRS:
Surya Nepal, CSIRO
Munindar P. Singh, North Carolina State University
Mohan Baruwal Chhetri, CSIRO
Jamal Bentahar, Concordia University

Thursday September 9 - All Times in UTC

19:40 - 21:00
J1C2 1 - Mixed
Session Chair: Munindar Singh, North Carolina State University

Opening Remarks
James Joshi, Carl K Chang, Rong N Chang, Surya Nepal, Munindar Singh

SVC_J1C2_058
Distributed Redundancy Scheduling for Microservice-based Applications at the Edge
Hailiang Zhao, Shuiguang Deng, Jianwei Yin, Zijie Liu and Schahram Dustdar

SVC_J1C2_072
Tracking GDPR Compliance in Cloud-based Service Delivery
M. Barati and O. Rana

Friday September 10 - All Times in UTC

1:00 - 2:20
J1C2 2 - SMDS
Session Chair: Omar Abdul Wahab,University of Quebec

SVC_J1C2_053
SPESC-Translator: Towards Automatically Smart Legal Contract Conversion for Blockchain-based Auction Services
E Chen, Bohan Qin, Yan Zhu, Weijing Song, Shengdian Wang, William Chu and Stephen Yau

SVC_J1C2_046
Enabling Fast Public Auditing and Data Dynamics in Cloud Services
Changhee Hahn, Hyunsoo Kwon, Daeyeong Kim and Junbeom Hur

SVC_J1C2_086
Constrained App Data Caching over Edge Server Graphs in Edge Computing Environment
Xiaoyu Xu; Feifei Chen; John Grundy; Mohamed Abdelrazek; Hai Jin; Qiang He

2:30 - 3:50
J1C2 3 - ICWS
Session Chair: Jamal Bentahar, Concordia University

SVC_J1C2_050
Scheduling Real Time Security Aware tasks in Fog Networks
Nitin Auluck; Omer Rana; Surya Nepal; Andrew Jones; Anil Singh

SVC_J1C2_061
Dynamic Trust Enforcing Pricing Scheme for Sensors-as-a-Service in Sensor-Cloud Infrastructure
Aishwariya Chakraborty, Ayan Mondal, Arijit Roy and Sudip Misra

SVC_J1C2_045
Temporal-Perturbation aware Reliability Sensitivity Measurement for Adaptive Cloud Service Selection
Lei Wang, Qiang He, Demin Gao, Jing Wan and Yunqiu Zhang

4:10 - 5:30
J1C2 4 - ICDH
Session Chair: Kamal Karlapalem, Indian Institute of Infrastructure & Construction

SVC_J1C2_051
Lightweight Privacy-preserving Medical Diagnosis in Edge Computing
Zhuoran Ma, Jianfeng Ma, Yinbin Miao and Ximeng Liu

SVC_J1C2_081
A Learning Automata-based Scheduling for Deadline Sensitive Task in The Cloud
Sampa Sahoo, Bibhudatta Sahoo, Ashok Kumar Turuk

SVC_J1C2_059
Efficient and Anonymous Authentication for Healthcare Service with Cloud based WBANs
Xu Yang, Xun Yi, Surya Nepal, Ibrahim Khalil, Xinyi Huang and Jian Shen

18:10 - 19:30
J1C2 5 - CLOUD
Session Chair: Anup Kalia, IBM

SVC_J1C2_063
Microservices Monitoring with Event Logs and Black Box Execution Tracing
Marcello Cinque, Raffaele Della Corte and Antonio Pecchia

SVC_J1C2_071
Secure V2V and V2I Communication in Intelligent Transportation using Cloudlets
M. Gupta; J. Benson; F. Patwa; R. Sandhu

SVC_J1C2_105
Towards Green Service Composition Approach in the Cloud
S. Wang, Ao Zhou, Ruo Bao, Chou Wu, Stephen S. Yau

Saturday September 11 - All Times in UTC

1:00 - 2:20
J1C2 6 - SCC
Session Chair: Karuna Joshi, University of Maryland Baltimore County

SVC_J1C2_040
Value Entropy: A Systematic Evaluation Model of Service Ecosystem Evolution
Xiao Xue, Zhaojie Chen, Zhiyong Feng, Shufang Wang and Yucong Duan

SVC_J1C2_073
Edge-based Runtime Verification for the Internet of Things
C. Tsigkanos; M. M. Bersani; P. A. Frangoudis; S. Dustdar
SVC_J1C2_101

Quantitative Assessment of Service Pattern: Framework, Language, and Metrics
M. Xi; J. Yin; J. Chen; Y. Li; S. Deng

2:30 - 3:50
J1C2 7 - Mixed
Session Chair: Jamal Bentahar, Concordia University

SVC_J1C2_093
Delegated Authorization Framework for EHR Services using Attribute Based Encryption
Maithilee Joshi, Karuna Pande Joshi, Tim Finin

SVC_J1C2_065
Privacy-preserving Diverse Keyword Search and Online Pre-diagnosis in Cloud Computing
Jiangyu Wang, Jianfeng Ma, Yinbin Miao, Ximeng Liu and Ruikang Yang

SVC_J1C2_078
SenSchedule: Scheduling Heterogeneous Periodic Sensing Resources with Non Uniform Performance in IoT
S. Bose; N. Mukherjee

WISC 2021
IEEE INTERNATIONAL SYMPOSIUM ON WOMEN IN SERVICES COMPUTING

Last year marked the inaugural year of the IEEE Symposium on Women in services Computing (WISC). In an uncertain time, our program committee banded together to deliver a cohesive and interesting program that covered current technical topics from experts in the field, as well as professional and career discussions. As I look back on the wealth of information and insights shared, I am inspired and grateful to my colleagues and friends who made it possible.

In 2021 the Symposium on Women in Services Computing (WISC) will be held in two consecutive sessions (September 6-7, 2021, depending on where you are in the world). The format will be different from last year. All of the invited speaker talks will be pre-recorded and available in advance of the symposium sessions. During the symposium, the invited speakers will attend and provide a short recap of their talks and take questions. We hope this will make it easier for attendees in all geographies to access the content and attend the sessions.

New this year will be the awarding of five scholarships ($300USD-$500USD) to undergraduate and graduate female students. I would like to express my thanks the Symposium Steering Committee, the Symposium Program Co-Chairs and special thanks to Yuki Abe, Writer/Designer, who designed the beautiful WISC Logo.

General Chair
Lorraine M. Herger, IBM Research, TJ Watson Research Center

Program Chairs
Mari Abe, IBM Cloud and Cognitive Software
Jing Fan, Zhejiang University of Technology
Kaoutar El Maghaouri, IBM Research

Tuesday September 7 - All Times in UTC

1:00 - 2:20
Opening Session
Session Chairs: Lorraine Herger, IBM Research; Jing Fan, Zhejiang University of Technology; Mari Abe, IBM Cloud & Cognitive Software; Chen Wang, IBM Research

Opening Welcome from the General Chair
Presentation & Acceptance Speech of the 2021 TCSVC WISC Awardee
Announcement of WISC Scholarship Winners

1:20 - 1:40
Keynote 1: A Capable Platform for Convergence of HPC and AI
Yutong Lu, Professor, School of Computer Science, Sun Yet-san University, China; Director, National Supercomputing Center in Guangzhou, China

Supercomputing technology has been developing very fast, impacting both science and society, deeply and broadly. Compute-driven and Bigdata-driven scientific discovery has become a necessary research approach in global environmental research, life science, nanomaterials, high energy physics and other fields. Furthermore, the rapidly increasing compute requirements from both the economic and social spheres also call for the power of next generation supercomputing systems. Currently, the development of computer science, data science and intelligent science has brought new changes and challenges in systems, technology, and application of HPC. The usage mode and delivery mode of cloud computing also attracts supercomputer users. The future supercomputing system design faces many challenges, such as architecture, system software, application environment, etc., to accommodate the many demands of various computing approaches. This talk will analyze HPC, Big Data and AI application use cases and usage models in current Supercomputing Centers, then discuss the design of a platform capable of converging the requirements of HPC, Big Data and AI on a future supercomputing system.

1:40 - 2:00
Keynote 2: Integrating Cyber Security and Data Science for Cloud-based Information Sharing Services + The Role of Mentoring to Support Diversity, Equity and Inclusion (DEI) in Cyber Security and Data Science

Bhavani Thuraisingham, University of Texas at Dallas, Fellow of the ACM, IEEE, AAAS, NAI; Founders Chair Professor of Computer Science; Founding Executive Director of the Cyber Security Research and Education Institute (CSI); Co-Director of the Centers for Women in Cyber Security (WiCyS) and Women in Data Science (WiDS); Erik Jonsson School of Engineering and Computer Science

Data Science and Cyber Security are being integrated to solve many of the security and privacy challenges. For example, machine learning techniques are being applied to solve security problems such as insider threat detection. Furthermore, the machine learning techniques are being adapted to handle adversarial attacks. In addition, privacy of the individuals is also being violated through these machine learning techniques as it is now possible to gather and analyze vast amounts of data. The first part of the presentation will examine the developments on applying Data Science

techniques for detecting cyber security problems such as insider threat detection as well as the advances in adversarial machine learning. In addition, it will discuss the developments on securing the cloud and discuss how the techniques for integrating cyber security and data science could be applied for cloud-based information sharing services.

The second part of the presentation will focus on the Role of Mentoring to Support Diversity, Equity and Inclusion (DEI). We are living in a complex world that is rapidly evolving due to technology. While there are numerous career opportunities in Computer Science in general and Cyber Security, Artificial Intelligence/Data Science and Cloud/Services Computing in particular, the competition is also extremely intense around the globe. It is almost impossible for a person to succeed in his/her career without the advice and mentorship of the senior researchers, developers and technologists. I will discuss the importance of mentoring to support DEI and give examples of my personal story on how lack of mentoring was initially tough on my career and how I chose mentors who have then supported me and helped me to thrive in my career.

2:00 - 2:20
Keynote 3: AI for Code: Transforming Application Modernization
Maja Vukovic, IBM Fellow, IBM Research

Enterprises that want to take advantage of the Cloud are looking to modernize their legacy, yet mission critical applications. In this talk, I will introduce the application modernization process, and focus on several key areas where AI applied to Code, can play a significant role in simplifying and accelerating it. The talk will address how AI can transform the application portfolio assessments and automate recommendations for application modernization to automatic refactoring of the monolithic to microservices. Furthermore, I will discuss several areas where AI for Code can further play a role in transforming software engineering.

2:30 - 3:50
WIS 2 - Professional & Organizational Talks
Session Chairs: Kaoutar El Maghaouri, IBM Research; Shubhi Asthana, IBM Research

2:30 - 2:50
Professional Talk: From Digitization to Digital Transformation - Are We There Yet?
Houda Chakiri, Assistant Professor of Computer Science, Akhawayn University Ifrane, Morocco

In this talk Houda will share her 15+ experience in overseeing digitization of local government in her country. She will discuss various challenges and successes while explaining that technology is not 'one fits all' and should be adapted to the socio-cultural environment where it is deployed and utilized. Houda will also explain how agility and agile principles helped in her work. She will explain how the partnership among academia, government and the private sector leads to success stories.

2:50 - 3:10
Organizational Talk: WORM (Women in OR/MS)-An INFORMS (Institute for Operations Research and Management Science) Forum
Banafesheh Behzad, California State University - Long Beach

In this presentation, Banafsheh will give an overview of INFORMS, its vision and its subdivisions. Furthermore, she will talk about WORMS, its history, and its current activities.

3:10 - 3:30 (3:10 - 3:30 UTC)
Organizational Talk: Santa Clara Valley Society of Women Engineers
Allison Wright, SCV SWE President, Engineer at Lawrence Livermore National Lab

In this speech, Allison will share the focus and activities of the Santa Clara Valley Society of Women Engineers organization. This will include SWE Santa Clara's outreach and professional development activities, opportunities for leadership development, and information about the parent organization, Society of Women Engineers.

3:30 - 3:50
Acceptance Speech of WISC Scholarship Awardees
Session Chair: Shubhi Asthana, IBM Research

YESC 2021
IEEE INTERNATIONAL SYMPOSIUM ON YOUNG EXPERTS IN SERVICES COMPUTING

The inaugural IEEE International Symposium on Young Experts in Services Computing (YESC) aims to facilitate the communication and collaboration among worldwide students and young professionals in services computing and to curate rising stars in services computing. It is a cross-conference event at IEEE SERVICES 2021. It is sponsored jointly by IEEE SERVICES, IEEE Technical Committee on Services Computing (TCSVC), and CCF (China Computer Federation) Technical Committee on Service Computing (TCSC).

Services computing technologies have become essential in all aspects of IT, including modern distributed systems, web-enabled information and API services, cloud IoT/edge environment, AI and ML platforms, and impactful consumer and enterprise XaaS. Young experts in services computing are crucial to the ongoing transdisciplinary evolution of the IT industry and the digital world. The IEEE YESC Symposium provides a unique forum for students and young professionals to get engaged with the IEEE SERVICES community and to sharpen their soft skills.

Besides paper presentation sessions, the Symposium will feature acceptance speech of the annual IEEE TCSVC Rising Star Award, distinguished speeches, panels, recording-based presentation award competition, and Hackathon.

General Chairs
Claudio Agostino Ardagna, University of Milan
Vaijayanthi Desai, IBM GTS Labs, Bangalore
Shangguang Wang, BUPT

Hackathon Chairs
Jinjun Xiong, IBM Research, TJ Watson Research Center
Xuanzhe Liu, Peking University
Salvador de la Puente, IBM Systems

Tuesday September 7 - All Times in UTC

4:10 - 5:30
YES 1
Session Chairs: Kenneth Fletcher, University of Massachusetts Boston; Shangguang Wang, BUPT

Opening Remarks

Distinguished Speech
2021 IEEE TCSVC Rising Star Awardee

Panel Discussion

Panelists:
Rajiv Ranjan
Shuiguang Deng
Karuna P. Joshi

5:40 - 7:00
YES 2
Session Chairs: Claudio Ardagna, Università degli Studi di Milano; Marco Anisetti, Università degli Studi di Milano

Opening Remarks

Distinguished Speech
Gopal S. Pingali, Accenture
An Intelligent Cloud Continuum to Take on the Biggest Challenges of This Decade
Abstract: We are at the beginning of what appears to be an epochal decade in the history of humankind. In a change that has been triggered and accelerated by the global pandemic, the world is now being redefined into a hyper-digital model that is essential for both survival and growth of all businesses. Every industry – spanning Healthcare, Manufacturing, Energy, Media, Communications, Banking, Insurance, Public Services, Agriculture, Education, and Travel – is moving faster than ever to an intelligent cloud continuum spanning private clouds, multiple clouds, 5G, and the Edge that is powered by AI and the Internet of Things. This transformation is also fundamentally changing people's lives – how they work, live, learn, play, socialize, and grow. In this talk, we will give an overview of the evolving intelligent cloud continuum, compelling use cases in different industries, and the opportunities for rising stars in services computing to take on the biggest challenges of this decade ranging from new cloud programming models to achieving sustainable development goals.

Panel: Growth of YESC Community
Panelists:
Claudio Ardagna, Università degli Studi di Milano
Shangguang Wang, Beijing University of Posts and Telecommunications
Vaijayanthi Desai, IBM GTS Labs
Marco Anisetti, Università degli Studi di Milano
Kenneth Fletcher, University of Massachusetts Boston

FFS 2021
IEEE INTERNATIONAL SYMPOSIUM ON FUTURE OF FINANCIAL SERVICES

he IEEE World Congress on Services, a major professional event sponsored by the IEEE Computer Society, is hosting the third Future of Finance Symposium. This signature symposium will be held all day September 9th (UTC), featuring insightful discussions on forward-looking technology and business-related industry topics among accomplished experts from academia, established corporations, innovative startups, and government agencies across different geographies. The IEEE World Congress on Services is being held again virtually covering a wide array of topics.

The financial services industry is a forward-looking industry that has always been in the lookout to leverage new technologies to increase profits. Digitalization is a double edge sword that is sweeping the pillars of financial institutions creating new players: FinTechs, InsurTechs, RegTech, and other industries offer financial services. The industry is rapidly undergoing a digitalization process on which business and technology blend. The primary objective of this symposium is to bring academia and industry domain experts together to define the innovation opportunities in this new environment.

The program will start with a panel discussion on Innovation in ethical sustainable finance at 1.00 am UTC, by the subject experts from BMO, KeyBank, PNC Bank, Promontory, and The World Bank. It will be followed by a discussion on the Technology enablers for financial instruments at 2.30 am UTC, by the subject experts from Ant Group, Columbia university, IBM Research, Rensselaer Polytechnic, and SMU. Finally, at 4.10 am UTC we will have two invited speakers from SMU and IBM Research presenting their papers on forward looking technologies such as Artificial Intelligence and Quantum Computing. Finally, at 18.10 UTC a distinguished speaker from a quantum computing company will join me in a discussion and presentation on how to adopt disruptive technologies in finance, discussing the case of quantum computing.

The experts will discuss different trends and technologies that are shaping the future of financial services: machine learning, blockchain, climate-responsible finance, cryptocurrencies, IoT, AML, financial crimes, financial modeling, and analytics, amongst other topics.

I would like to recognize the contributions of the program co-chairs (Jorge Sanz, and Yanmei Zhang) and the advisory committee (Andreas Kind, Aparna Gupta, Locknie Hsu Sing, Marcelo Labre, Mirjana Pejić Bach, Natalie Gil, Nikhil Aggarwal, Nitin Gaur, Ping Li, KP Subbalakshmi, and Xiao-Ping Zhang) to the successful organization of the Symposium.

Last, I would also like to thank the Symposium Honorary General Chair, Kumar Bhaskaran, for his guidance and the Congress General Chair, Rong N. Chang for driving the whole event.

Welcome to Future of Finance Symposia, I hope you enjoy it!

General Chair:
Elena Yndurain, IE Business School

Program Chairs:
Prasenjit Dey, IBM Research, IBM TJ Watson Research Center
Jorge Sanz, IBM Research
Yanmei Zhang, Central University of Finance & Economics, Beijing

Thursday September 9 - All Times in UTC

1:00 - 2:20
FFS 1 - Panel Discussion: Innovation in Climate-Responsible Finance, Financial Inclusion and Financial Crimes Compliance
Session Chair: Elena Yndurain, IE Business School

The industry is rapidly undergoing a digitalization process on which business and technology blend. The primary objective of this symposium is to bring academia and industry domain experts together to define the innovation opportunities in this new environment. The panel discussion focuses on drivers that are shaping the future of how finance is done and innovation in ethical sustainable finance done by subject experts from BMO, KeyBank, PNC Bank, Promontory, and The World Bank. The topics to be covered: include: AML/financial crimes, Climate-responsible finance, financial inclusion, and AI.

Panel Moderator: Nikhil Aggarwal, Promontory Financial Group
Panelists:
Conchi Aisa, The World Bank
Kim Lacey, Key Bank
Meera Das, BMO
Michael P. O'Malley, PNC Bank
Manju Seal, Bank of Montreal

2:30 - 3:50
FFS 2 - Panel Discussion: Technology Enablers for Financial Instruments
Session Chair: Elena Yndurain, IE Business School

The industry is rapidly undergoing a digitalization process on which business and technology blend. The primary objective of this symposium is to bring academia and industry domain experts together to define the innovation opportunities in this new environment. The panel discussion focuses on the foundational technologies enabling industry changes and enablers for financial instruments done by subject experts from Ant Group, Columbia university, IBM Research, Rensselaer Polytechnic, and SMU. The topics to be covered include: Blockchain, Quantum Computing, IoT, Cryptocurrencies, and Fintech.

Panel Moderator: Nitin Guar, IBM Research
Panelists:
Agostino Capponi, Columbia University
Chaochao Chen, Ant Group
Paul Griffin, SMU
Oshani Seneviratne, Rensselaer Polytechnic

4:10 - 5:30
FFS 3 - Invited Papers
Session Chair: Elena Yndurain, IE Business School

FFS_INV_024
Quantum Computing for Supply Chain Finance
Paul Griffin, SMU

FFS_INV_035
Toward Scalable Artificial Intelligence in Finance
Jorge Sanz, IBM Research

18:10 - 19:30
FFS 4 - Distinguished Speaker
Session Chair: Elena Ydurain, IE Business School

Distinguished Speaker: Román Orús, Multiverse
Disruptive Technologies in Finance: Quantum Computing
Román Orús is Ikerbasque research professor at the Donostia International Physics Center (DIPC) in San Sebastián, Spain, and co-founder and CSO of Multiverse Computing. After obtaining his degree and PhD in Physics at the University of Barcelona in 2006, he worked as a research fellow at the University of Queensland, Australia, and the Max Planck Institute of Quantum Optics, Germany, as well as a junior professor at Johannes Gutenberg-Universität in Mainz, Germany. He was also visiting professor at the Universitè Paul Sabatier – CNRS, France, and at the DIPC. Dr Orús has achieved several awards for his work, including a Marie Curie Incoming International Fellowship, and the Early Career Prize (2014) by the European Physical Society. He has written more than 80 scientific articles about quantum research cited more than 5000 times, and is member of the Steering Board of the journal Quantum, member of the 'Quantum for Quants' (Q4Q) commission of the Quantum World Association, partner at Entanglement Partners, and president of the Specialized Group on Quantum Information at the Spanish Royal Society of Physics.

Joined by Elena Yndurain, IE Business School
Elena Yndurain is a technology strategist and professor specialized in operationalizing innovation. She has global experience driving high-tech initiatives into the market in Quantum Computing, Artificial Intelligence, IoT, Cloud, and Mobile. Elena is currently QunaSys Inc Quantum Computing Software executive advisor leading go-to-market activities to boost the company's growth to chemistry related industries and leading the international expansion to Europe and North America.

Elena has more than 20 years' experience working with major technology and consulting corporations like IBM, Microsoft, Nokia, Oliver Wyman, and EY, where she launched digital products with their supporting business units and ecosystems. She created IBM global finance quantum computing business, Nokia Spain's innovation and R&D unit, Microsoft Europe's Telco cloud offering, and launched 3G carriers worldwide. She has worked internationally living in Europe, USA, Africa, and Asia.

Elena holds a PhD in EECS (Telematics Engineering), an Executive MBA, and has graduate certificates in Quantum Computing, Innovation, and Artificial Intelligence. She holds a B.Sc. is in Mathematics and Computer Science. Dr. Yndurain is also an adjunct IE Business School, and a visiting professor UC3M Engineering School, where she teaches quantum computing for finance, business, and engineering students as well as Digital Business Transformation.

ISASSE 2021
IEEE INTERNATIONAL SYMPOSIUM ON ADVANCES IN SOFTWARE SERVICES ENGINEERING

Welcome to the inaugural edition of the IEEE International Symposium on Advances in Software Services Engineering (ISASSE). Software as a Service provides a general framework to encapsulate the underlying software functionalities as products to fulfill various requirements on the customer side. This general framework allows for modular service requirements decomposition and modular service composition during the development, operation and maintenance and evolution of the encapsulated software functionalities instantiated as services. Next generation of software services will become more context/situation-aware, self-aware and autonomous, ultra-mobile, ultra-fine-grained, ultra-trustworthy and driven by behaviors observed and captured from both the environment and humans of concern. Entering the Internet of Things (IoT) era, data of a variety of modalities can be conveniently and rapidly collected for applying the state-of-the-art techniques cutting across the areas of machine learning, software engineering, pervasive computing, dependable computing, psychophysiological or brain science, autonomics, to name a few, to support cutting-edge applications. Moreover, human-centric concerns are of paramount importance in rendering software services in the IoT era, and must be continually addressed before, during and after deployment of the applications in view of the emergent and unavoidable ambiguities and uncertainties in the environments and from the end-users. Such a service-centric software endeavor brings about a new field of study hereby named Software Services Engineering (SSE), which can benefit from the prevalent body of knowledge and professional practice of software engineering methods and tools, as well as advances in other disciplines.

The Symposium on Advances in Software Services Engineering (SSE) will feature two paper presentation sessions for six papers selected through a rigorous peer review process. We also look forward to two distinguished invited talks, i.e. “EDGE Intelligence” delivered by Prof. Schahram Dustdar, and “Service Defined Software in E-SBOT” delivered by Prof. Xiaofei Xu. In addition, we will have a lively plenary panel among several colleagues from both academia and industry. All the organizers welcome participation from all the time zones of the world. We wish everyone find the symposium interesting into the coming years. Enjoy reading it and you are cordially invited to join us to develop this emerging engineering discipline.

ISASSE ORGANIZERS
Zhi Jin, Peking University - ISASSE General Chair
Paolo Ceravolo, University of Milan - ISASSE Program Chair
Hua Ming, Oakland University - ISASSE Program Chair
Xuanzhe Liu, Peking University - ISASSE Program Chair
Carl K. Chang, Iowa State University - ISASSE Advisory Board
Rong N. Chang, IBM Research - ISASSE Advisory Board
Sumi Helal, University of Florida - ISASSE Advisory Board

Monday September 6 - All Times in UTC

4:10 - 5:30
SSE 1
Session Chair: Hua Ming, Oakland University

SSE_REG_208
Attaining Meta-self-awareness through Assessment of Quality-of-Knowledge
Abdessalam Elhabbash, Rami Bahsoon, Peter Tino, Peter Lewis and Yehia Elkhatib

SSE_REG_186
MinerRepu: A Reputation Model for Miners in Blockchain Networks
Akram Alofi, Rami Bahsoon and Robert Hendley

SSE_SHT_049
Efficient Penetration of API Sequences to Test Stateful RESTful Services
Koji Yamamoto

5:40 - 7:00
SSE 2
Session Chair: Xuanzhe Liu, Peking University

SSE_REG_109
A Measurement Study on Serverless Workflow Services
Jinfeng Wen and Yi Liu

SSE_SHT_073
An Empirical Study on Underlying Correlations between Runtime Performance Deficiencies and ''Bad Smells'' of Microservice Systems
Lei Liu, Zhiying Tu, Xiang He, Xiaofei Xu and Zhongjie Wang

SSE_SHT_062
Monolith to Microservice Candidates using Business Functionality Inference
Shivali Agarwal, Raunak Sinha, Giriprasad Sridhara, Pratap Ch. Das, Utkarsh Desai, Srikanth Tamilselvam, Amith Singhee and Hiroaki Nakamuro

Tuesday September 7 - All Times in UTC

4:10 - 5:30
SSE 3
Session Chair: Xuanzhe Liu, Peking University

SSE_INV_075
EDGE Intelligence
Schahram Dustdar

SSE_INV_098
Service Defined Software in E-SBOT
Xiaofei Xu

QSS 2021
IEEE INTERNATIONAL SYMPOSIUM ON QUANTUM SOFTWARE & SERVICES

This year as part of the IEEE World Congress on Services we are proud to introduce the first Quantum Software and Services symposium (QSAS symposium). This symposium is aimed to connect students, researchers, and practitioners from industry around the world to share the latest advances in the emerging field of software and services around Quantum Computing. This year the symposium be held online from Tuesday September 7th to Friday 10th 2021.

The symposium will include invited keynotes, presentations, discussion panels, tutorials, and a hackathon to create a forum for academia and industry to exchange the latest innovations and research advancements in quantum software and services. Also, it includes a plenary panel within the main congress, where industry leaders are going to discuss the status of quantum software and services, and how it can evolve, extended, and impact the IT industry for the next years. Because the current pandemic, all the symposium and plenary panel is going to happen online, and all the content is going to be accessible on the IEEE website, but all participants may interact in each session with the speakers.

We cordially invite you to join us in this first QSAS symposium and we look forward to welcoming you online.

General Chairs
Ismael Faro, IBM Research, TJ Watson Research Center
Frank Leymann, University of Stuttgart

Program Chairs
Sebastian Feld, TU Delft
Stefan Wörner, IBM Research, TJ Watson Research Center
Elena Yndurain, IE

Tuesday September 7 - All Times in UTC

18:50 - 20:10
QSS 1 - Distinguished Speaker
Session Chair: Schahram Dustdar, Technical University of Vienna

Jay Gambetta, IBM Research
Current & Future of Quantum Software & Services

Jay Gambetta is the Vice President in charge of IBM's overall Quantum initiative. He leads the strategy and execution of IBM Quantum. He was named as an IBM Fellow in 2018 for his scientific work on superconducting qubits, quantum validation techniques, implementation of quantum codes, improved gates and coherence, and near-term applications of quantum computing—in addition to establishing IBM's quantum strategy.

Under his leadership, the IBM Quantum team has made a series of major breakthroughs in the quantum industry: starting with launching the IBM Quantum Experience – the world-first cloud-based quantum computing platform for users to access real quantum computers, the IBM Quantum team released Qiskit – an open source software development kit for developing quantum programs, and deployed the IBM Quantum System One, a family of quantum processors for clients that now includes the 27 qubit Falcon and 65 qubit Hummingbird quantum processors. IBM Quantum continues to expand in the market by providing 38 quantum systems opened for service over the cloud from anywhere in the world, building the foundations of the quantum industry with a community of partners advancing quantum science and applications via the IBM Quantum Network.

Dr. Gambetta received his Ph.D. in Physics from Griffith University in Australia. In 2014, he was named as a Fellow of the American Physical Society and has over 130 publications in the field of quantum information science with over 23000 citations.

20:20 - 21:40
QSS 2 - Panel Discussion: Quantum Applications
Session Chair: Stefan Worner, IBM Research

This panel is focused on the main industry areas where quantum computing can bring more impact. The panel is formed by experts in industries like Chemistry, Finance, and other exploratory fields, and how to use the quantum computer to apply new algorithms based in quantum approach like optimization, machine learning or chemistry simulations to improve the current solutions and create the next generation of computer application based in quantum computation.

Panelists:
Valeria Bartsch, fraunhofer ITWM
Alberto Di Meglio, CERN
Dimitar Trenec, ExxonMobile
William Zeng, Goldman Sachs

Wednesday September 8 - All Times in UTC

4:10 - 5:30
QSS 3 - Talk: Thomas Alexander, IBM Quantum
Session Chair: Luciano Bello, IBM Quantum

Qiskit and Open QASM3: Towards Dynamic Circuits in the Cloud
Thomas Alexander, IBM Quantum
In this presentation, we will introduce IBM's vision for near and real-time quantum computing. We will discuss the importance of considering a hierarchy of latencies within our system and how we provide quantum systems as an accelerator coprocessor through the Qiskit runtime. Following this, we will introduce OpenQASM3 - a new version of the quantum programming language, OpenQASM, that provides the features required for a near-term quantum system to pursue quantum advantage and explore quantum error correction. We will then demo performing quantum teleportation through Qiskit and OpenQASM3 on our next-generation real-time control systems. Following the demonstration, we will end with a brief overview of the compiler technologies that support OpenQASM3 and hardware code-generation within our backend services.

Thomas Alexander is a software developer at IBM Quantum, which is a market leader in quantum systems and services. At IBM, Thomas helps design and build the software platforms and computer architectures that wrap the control electronics that power a quantum computer. This includes modeling and compiling quantum programs at the levels of circuits, pulses, and proprietary hardware platforms. Thomas enjoys contributing to the quantum computing community and leads the effort to open-source control of IBM Quantum systems through Qiskit Pulse. Prior to joining IBM Quantum, Thomas studied quantum computing at the Institute for Quantum Computing at the University of Waterloo where he performed experiments in solid-state NMR, NV centers, and developed software for experiment design systems.

5:40 - 7:00
QSS 4
Session Chair: Stefan Worner, IBM Research

Michael Behrendt, IBM Germany
Quantum & Classical Computation
This talk is going to review the potential of combining quantum and classical computation provided via cloud infrastructure. This includes how to use technologies like Qiskit as a quantum open-source framework and how to combine it and quantum hardware. This is coordinated by running the code on IBM Cloud Code Engine, which – in integration with the open source framework lithops – takes both care of the execution of the actual driver code and also the execution of large classical compute jobs for big data analytics and other (embarrassingly) parallel jobs.

Michael Behrendt is a Distinguished Engineer in the IBM Cloud development organization. He is responsible for IBM's technical strategy around serverless & Function-as-a-Service. Before that, he was the Chief Architect of IBM's core cloud platform and was one of the initial founding members incubating it, led the development of IBM's Cloud Computing Reference Architecture, was a worldwide field-facing cloud archi-

tect for many years, and drove key product incubation & development activities for IBM's cloud portfolio. Michael has been working on Cloud Computing for more than 15 years and has 37 patents. He is located in the IBM Research & Development Laboratory in Boeblingen, Germany

16:30 - 17:50
QSS 5
Session Chair: Manuel Wimmer, University Linz

19:40 - 21:00
QSS 6 - Panel: Quantum Startups
Session Chair: Ismael Faro, IBM Quantum

In this panel we are going to talk with Quantum Startups and their role in the current and future of Quantum, and all the impact in the software and services that they use.

Panelists:
Shai Machnes, Qrise
Albert Frisch, AQT
Yudong Cao, Zapata Computing
Tennin Yan, QunaSys

Thursday September 9 - All Times in UTC

4:10 - 5:30
QSS 7 - Talk, Quantum Compilation Steps, Kevin Krsulich, IBM Research

Kevin Krsulich, IBM Research
Quantum Compilation Steps
Kevin Krsulich is a lead research software engineer and manager of the Quantum Compiler group at IBM. He leads development of the Qiskit transpiler, an open-source tool for translating and optimizing quantum programs to target current and future quantum hardware. Kevin received a B.S. in physics from MIT, a Ph.D. in nuclear science from MIT, and was a visiting scholar at the Institute for Quantum Computing (IQC) at the University of Waterloo, Canada.

18:10 - 19:30
QSS 8: Panel Discussions
Session Chairs: Sebastian Feld, TU Delft; Carmen Recio Valcarce, IBM Quantum

Panel: Quantum Software Ecosystem
Panelists: Fabio Scafirimuto
Alba Cervera
Jacob Friis Sherson
William Hurley, Strangeworks
Gabriele Rainò, ETH Zürich

Panel: Software for Quantum Hardware Design
Panelists: Zlatko K. Minev, IBM Quantum

19:40 - 21:00
Tutorial - Creating Quantum Services on the Cloud
Session Chair: Jessie Yu, IBM

This tutorial is a hands-on session using the latest quantum technologies and programming concepts, during which we are going to explore how to use quantum programs in a near-time-compute regime, especially for quantum variational algorithms such as VQE. This near-time-compute method aims to reduce latency in each loop between classical and quantum computation that happens near the quantum device. In this tutorial we are going to work with Qiskit Runtime, a new architecture offered by IBM Quantum that streamlines computations requiring many iterations. At the end of the tutorial you are going to understand the process to create, deploy and use quantum programs near to the quantum computer.

Jessie Yu is a senior software developer and prolific inventor at IBM. She has a M.S in Computer Science from Marist College. Prior to working on quantum computing, Jessie's career was mainly in the area of IBM mainframe kernel development and analytics software. Her experience in IBM Quantum began in 2018 where she first worked on systems and infrastructure support and later took over as maintainer for qiskit-ibmq-provider, a framework that provides access to IBM Quantum devices and services. To each aspect of the IBM Quantum systems, she brings design thinking, systems architecture, and a mainframe sense of quality, reliability, availability, and serviceability, balanced with the agile and community focused approaches of open source software development.

CLOUD HPC 2021
IEEE INTERNATIONAL SYMPOSIUM ON CLOUD HPC

This is the inaugural symposium for the Congress on Services Symposium on Cloud HPC. Cloud computing is traditionally defined in terms of data and compute services that support on-demand applications that scale to thousands of simultaneous users. High Performance Computing (HPC) is associated with massive supercomputers that run highly parallel programs for small groups of users. However, over the last five years, the demands of the scientific and engineering research community have created an evolutionary pressure to merge the best innovations of these two models. HPC centers have started to use cloud-native technologies like data object stores and cloud tools and processes to develop and deploy software. On the other side, cloud data centers are integrating advanced accelerators on each node and deploy high-performance interconnects with latency optimizations known from HPC. Furthermore, the AI revolution that was initially nurtured by the public cloud companies with their hyperscale datacenters, is increasingly finding adoption in the scientific and engineering applications on supercomputers.

As this is a new symposium we decided to raise its visibility in the community by having both submitted and refereed papers but also a large number of invited speakers. There are two special sessions in the IEEE Cloud conference HPC that contain the refereed papers. We are indebted to our program chairs Christoph Hagleitner, IBM Research, TJ Watson Research Center and Andrew Lumsdaine, University of Washington for selecting and leading a special program committee to review those submissions. For the symposium we have six sessions of three invited speakers in each. Together with the program chairs and the honorary general chairs we put together an exciting program of cloud experts from academia and the private sector.

General Chairs
Dennis Gannon, Indiana University
James Sexton, IBM Research, TJ Watson Research Center

Program Chairs
Christoph Hagleitner, IBM Research, TJ Watson Research Center
Andrew Lumsdaine, University of Washington

Tuesday September 7 - All Times in UTC

17:10 - 18:30
Services Congress Plenary Panel: Cloud HPC: Exploring the Growing Synergy Between Cloud and High Performance Computing
Session Chair: Dennis Gannon, Indiana University

Panelists:
Katherine Yelick, UC Berkeley and Lawrence Berkeley National Laboratory
Ian Foster, Argonne National Laboratory, University of Chicago
Geoffrey Fox, University of Virginia
Kate Keahey, Argonne National Laboratory, University of Chicago

18:50 - 20:10
CLDHPC 1
Cloud & Heterogeneous Architectures & Opportunities for HPC
Session Chair: Ian Foster, Argonne National Laboratory; University of Chicago

Advancing Hybrid Cloud HPC Workflows Across State of the Art Heterogeneous Infrastructures
Steve Hebert, Nimbix Founder and CEO

The Impact of the Rise in Cloud-based HPC
Brent Gorda, ARM Director HPC Business

HPC in a Box: Accelerating Research with Google Cloud
Alexander Titus, Google Cloud

20:20 - 21:40
CLDHPC 2
HPCI in Biology & Medicine in the Cloud
Session Chair: Dennis Gannon, Indiana University

Computational Biology at the Exascale
Katherine Yelick, UC Berkeley and Lawrence Berkeley National Laboratory

HySec-Flow: Privacy-Preserving Genomic Computing with SGX-based Big-Data Analytics Framework
Judy Fox, Professor, University of Virginia

An Automated Self-service Multi-cloud HPC Platform Applied to the Simulation of Cardiac Valve Disease with Machine Learning
Wolfgang Gentzsch, UberCloud, Founder & President

Wednesday September 8 - All Times in UTC

5:40 - 7:00
CLOUD HPC 1 (CLD 12 - Part of the IEEE CLOUD Conference)
Session Chair: Christoph Hagleitner, IBM

CLD_REG_123
T2FA: A Heuristic Algorithm for Deadline-constrained Workflow Scheduling in Cloud with Multicore Resource
Zaixing Sun, Chonglin Gu, Honglin Zhang and Hejiao Huang

CLD_REG_137
A Case for Function-as-a-Service with Disaggregated FPGAs
Burkhard Ringlein, Francois Abel, Dionysios Diamantopoulos, Beat Weiss, Christoph Hagleitner, Marc Reichenbach and Dietmar Fey

16:30 - 17:50
CLDHPC 3
Using HPC to Enable AI at Scale
Session Chair: Dennis Gannon, Indiana University

Grand Challenges for Humanity: Cloud Scale Impact and Opportunities
Debra Goldfarb, Amazon, Director HPC Products & Strategy

Enabling AI at Scale on Azure
Prabhat Ram, Microsoft, Azure HPC

Benchmarking for AI for Science in the Cloud: Challenges and Opportunities
Jeyan Thiyagalingam, STFC, UK, Head of SciML Group

19:40 - 21:00
CLDHPC 4
Applications of Cloud Native Technology to HPC in the Cloud
Session Chair: Christoph Hagleitner, IBM

Serverless Supercomputing: High Performance Function as a Service
Kyle Chard, Professor, University of Chicago

Minding the Gap: Navigating the Transition from Traditional HPC to Cloud Native Development
Bruce D'Amora, IBM Research

Composable Systems: An Early Application Experience
Ilkay Altintas, SDSC, Chief Data Science Officer

Thursday September 9 - All Times in UTC

18:10 - 19:30
CLDHPC 5
Distributed Computing Issues for HPC in the Cloud
Session Chair: Geoffrey Fox, University of Virginia

Challenges of Distributed Computing for Pandemic Spread Prediction based on Large Scale Human Interaction Data
Haiying Shen, Professor, University of Virginia

GreenDataFlow: Minimizing the Energy Footprint of Cloud/HPC Data Movement
Tevfik Kosar, Professor, University of Buffalo & NSF

IMPECCABLE: A Dream Pipeline for High-Throughput Virtual Screening, or a Pipe Dream?
Shantenu Jha, Professor, Rutgers University

19:40 - 21:00
CLDHPC 6
Cloud HPC Barriers & Opportunities
Session Chair: Bruce D'Amora, IBM

The Future of OpenShift
Carlos Eduardo Arango Gutierrez, Red Hat, HPC OpenShift Manager

Scientific Computing On Low-cost Transient Cloud Servers
Prateek Sharma, Indiana University

HW-accelerated HPC in the Cloud: Barriers and Opportunities
Christoph Hagleitner, IBM Research

Saturday September 11 - All Times in UTC

1:00 - 2:20
CLOUD HPC 2 (CLD 25 - Part of the IEEE CLOUD Conference)
Session Chair: Andrew Lumsdaine, University of Washington

CLD_REG_207
Usage Trends Aware VM Placement in Academic Research Computing Clouds
Mohamed Elsakhawy and Michael Bauer

CLD_REG_210
Neon: Low-Latency Streaming Pipelines for HPC
Pierre Matri and Robert Ross

BLOCKCHAIN 2021
IEEE INTERNATIONAL SYMPOSIUM ON BLOCKCHAIN

The inaugural IEEE International Symposium on Blockchain at IEEE SERVICES 2021 provides a forum for leading scientists, researchers, community leaders and visionaries from both academia and industry to share their cutting-edge research findings, practical experiences, and particularly the visions of the future roadmap in the area of blockchain.

This forum is dedicated to submissions that promote visionary ideas and blue-sky thinking that will spark transdisciplinary discussions and cutting-edge insights in the major field of blockchain. We aim at exploring breakthrough and innovative ideas which the R&D community should look at when solidifying its key research agenda for the next 10 years, e.g.,

Smart data for Blockchains
Blockchain for smart data services
Blockchain-based solutions for smart data services
Blockchain for smart data management
Blockchain-assisted smart data platforms/architectures
Blockchain intelligence for data computing

General Chairs:
Sachiko Yoshihama, IBM Research-Tokyo
Zibin Zheng, Sun Yat-Sen University

Program Chairs:
Ting Chen, University of Electronic Science and Technology of China
Hong-Ning Dai, Macau University of Science & Technology
Vinayaka Pandit, IBM Research - India

Monday September 6 - All Times in UTC

16:30 - 17:50
BLK 3 - *a Joint Panel with ICWS*
Panel Discussion: Digital Twin & Digital Threading: Current Practice & Future Trends

A digital twin, being an exact digital replica of a given tangible physical asset or process, a digital twin is expected to play a vital role in Industry 4.0. Capturing and integrating the asset, production, and performance data into a corresponding digital twin is commonly referred to as digital threading.

Today's methods for enabling digital twins are based on centralized architectures and do not natively provide trusted data provenance, audit, and traceability. In contrast, blockchain-based digital threading ensures secure and trusted traceability, accessibility, immutability of transactions, logs through data provenance, which is native to the blockchain protocols. In addition to the blockchain, several other technologies such as the Internet of Things, artificial intelligence, big and streaming data analytics are commonly used to enable seamless synchronization between digital twins and the processes they represent. The panel session will discuss ongoing innovations and further research efforts needed to resolve blockchain-based digital threading challenges associated with scalability, data privacy, interoperability, energy consumption, and integration with legacy systems.

Panelists:
Jan Veuger, Saxion University
Khaled Salah, Kalifa University
Mic Bowman, Intel

Wednesday Sestpember 8 - All Times in UTC

1:00 - 2:20
BLK 1
Invited Talks
Session Chair: Huawei Huang, Sun Yat-Sen University

BLK_SYM_014
Enhancing Scalability of Trusted Blockchains through Optimal ShardingPeiyun Zhang, Mengchu Zhou and Licui Wang

BLK_SYM_027
Decentralized Collaborative Learning with Probabilistic Data Protection
Tsuyoshi Ide and Rudy Raymond

4:10 - 5:30
BLK 2
Invited Talks
Session Chair: Hong-Ning Dai, Macau University of Science & Technology

Toward Scaling Blockchain: Challenges and New Approaches
Song Guo

BLK_SYM_034
An Elasticity Framework for Smart ContractsSchahram Dustdar, José María García, Pablo Fernandez and Antonio Ruiz-Cortés

5:40 - 7:00
BLK 4
Panel Discussion: Blockchain Interoperability
Moderator: Vinayaka Pandit, IBM Research

Panelists:
Rafael Belchior, INESC-ID & Técnico Lisboa
Hart Montgomery, Fujitsu Research of America
Venkatraman Ramakrishna, IBM Research
Bill Laboon, Web3 Foundation

AI-CLOUD SEO 2021
IEEE INTERNATIONAL SYMPOSIUM ON AI IN CLOUD SOFTWARE ENGINEERING & OPERATIONS

With the advent of artificial intelligence and cloud computing, new generation of applications are being conceived, responding to ever growing demands of the market space. In parallel, artificial intelligence is becoming an essential enabler for successful business enterprise. With such importance being placed on AI enabled applications, the management of these applications becomes a key issue both for the providers and users.

The challenge facing management of AI enabled computing lies in the complexity of the environment, comprising as it does a multiplicity of network technologies, competing and cooperating cloud and traditional computing providers. There is work done by some researchers and practitioners that laid the foundation for handling this complexity. There is a considerable set of problems to be solved, e.g., (1) designing management architecture and appropriate algorithmic support for such end-to-end management; (2) modeling management information and establishing shared management knowledge; and (3) achieving security. The main goal of this symposium is to present research and experience results in the area of artificial intelligence and machine learning for service management of hybrid applications, possibly employing AI themselves. Approaches such as statistical analysis, data mining, and machine learning are promising mechanisms to harness observability data and to improve operations and management such systems.

The inaugural IEEE International Symposium on AI in Cloud Software Engineering and Operations (AI-CloudSEO) aims to bring academia and industry subject matter experts together to discuss advances in this area.

General Chairs:
Fausto Bernardini, Google
Laura Shwartz, IBM Research, TJ Watson Research Center

Program Chair:
Genady Grabarnik, St. John's University

Tuesday September 7 - All Times in UTC

18:50 - 20:10
ACS 1
Panel Discussion: AI for Operations Management: Frontiers of Real World Applications & Future Opportunities
Moderator: Fausto Bernardini, Google

The application of AI to the automation and optimization of operations management of IT production environments holds great promise. However, real world applications have proven difficult to scale to demonstrate general advantages over simpler approaches. In this panel we'll hear from three experts in the field who have seen successes as well as current limits and lay out a set of directions for future work.

Panelists:
Adam Iwanicki, Google
Matt Lyteson, IBM
Jorge Cardoso, University of Coimbra

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Laurel Ming

In Memorium

NANZAN UNIVERSITY

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2021 年 5 月 17 日

Press Release
報道関係・教育担当記者 各位

訃報連絡（故 青山 幹雄 南山大学理工学部ソフトウェア工学科・教授）

南山大学理工学部ソフトウェア工学科教授 青山 幹雄（あおやま・みきお）氏は、5 月 13 日（木）に死去いたしました。享年 66 歳。

通夜、葬儀・告別式は、近親者のみで執り行われました。

なお、理工学部ソフトウェア工学科主催にてお別れ会の開催を予定しております。

青山 幹雄 教授 略歴

1954 年 6 月 15 日生まれ。1978 年 3 月岡山大学工学部電子工学科卒業。1980 年 3 月岡山大学大学院工学研究科修士課程修了、2013 年 1 月東京工業大学博士課程修了。
1995 年 4 月に南山大学非常勤講師、2001 年 4 月南山大学数理情報学部（現・理工学部）教授となる。
専攻分野は「ソフトウェア工学」。国際会議録ならびに関連学会論文誌への掲載論文多数。

以上

We are sad to announce the passing of our good friend and colleague Professor Mikio Aoyama who left us on May 13, 2021.

Many of us who worked with Aoyama-san, both as a dear member of the COMPSAC family (since 1985) and an impactful contributor to IEEE SERVICES for many years. All of us in both services computing and software engineering will greatly miss him.

Professor Aoyama was born on June 15, 1954. In March 1978 he graduated from the Department of Electronic Engineering, Faculty of Engineering, Okayama University. He completed his master's program at Okayama University's Graduate School of Engineering in March 1980. In January 2013 he completed his doctoral program at the Tokyo Institute of Technology. In April 1995, Aoyama-san became a part-time lecturer at Nanzan University, and in April 2001, professor in the Faculty of Mathematics and Information Sciences (currently Faculty of Science and Engineering). Professor Aoyama's articles on software engineering include more than four dozen archived in IEEE's digital library, Xplore.

2022
IEEE World Congress on SERVICES
July 10 - 16 Barcelona

CLOUD/ICDH/ICWS/SCC/SMDS

The 2022 IEEE World Congress on Services (SERVICES) will return to a face-to-face event. SERVICES is the premier international forum for presenting and discussing the most recent and significant technical research contributions in the field of services computing. Centered around web-based services, SERVICES 2022 covers various systems and networking research pertaining to cloud, edge and IoT, as well as technologies for intelligent computing, learning, Big Data, blockchain, and digital healthcare applications, addressing critical issues such as knowledge network, high performance, security, privacy, dependability, trustworthiness, and cost-effectiveness. Particularly, the 2022 Congress will welcome papers on the aftermath and the impact of COVID-19 on services and the world infrastructure. In addition to co-located theme-topic conferences, the Congress will also include symposia and workshops supporting deep-dive discussions on emerging topics, and complement the SERVICES 2022 program with industry and application presentations and panels. Authors are invited to prepare early and submit original and unpublished papers to any of these conferences at www.easychair.org. All submitted manuscripts will be peer-reviewed by at least three reviewers. Accepted and presented papers will appear in the conference proceedings published by the IEEE Computer Society Press. SERVICES 2022 is the only premier professional event for the services computing field offered by IEEE, under the auspice of the Technical Committee on Services Computing (TCSVC).

Important Dates

Early Paper Submission: January 1, 2022
Improvement Suggestions to Early Papers: February 15, 2022
Normal Paper Submission due: March 1, 2022
Final Notification to Authors: April 15, 2022
Camera Ready Papers Due: May 1, 2022

Send inquiries to ieeecs.services@gmail.com
Detailed information will be available on the website
http://conferences.computer.org/services/2022