Session: Humans and Interactions: HCI, VR/AR, Cognitive aspects

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"Human-Machine Interactions Through Explanations"

The emerging field of Explainable AI (XAI) aims to bring transparency to today's powerful but opaque deep learning models. This talk will present Concept Relevance Propagation (CRP), a next-generation XAI technique which explains individual predictions in terms of localized and human-understandable concepts. Other than the related state-of-the-art, CRP not only identifies the relevant input dimensions (e.g., pixels in an image) but also provides deep insights into the model's representation and the reasoning process. This makes CRP a perfect tool for human-machine interaction. In the talk we will demonstrate on multiple datasets, model architectures and application domains, that CRP-based analyses allow one to (1) gain insights into the representation and composition of concepts in the model as well as quantitatively investigate their role in prediction, (2) identify and counteract Clever Hans filters focusing on spurious correlations in the data, and (3) analyze whole concept subspaces and their contributions to fine-grained decision making. By lifting XAI to the concept level, CRP opens up a new way to analyze, debug and interact with ML models, which is of particular interest in safety-critical applications and the sciences.

Short V: *Wojciech Samek* is a professor in the Department of Electrical Engineering and Computer Science at the Technical University of Berlin and is jointly heading the Department of Artificial Intelligence at Fraunhofer Heinrich Hertz Institute (HHI), Berlin, Germany. He studied computer science at Humboldt University of Berlin, Heriot-Watt University and University of Edinburgh and received the Dr. rer. nat. degree with distinction from the Technical University of Berlin in 2014. During his studies he was awarded scholarships from the German Academic Scholarship Foundation and the DFG Research Training Group GRK 1589/1, and was a visiting researcher at NASA Ames Research Center, Mountain View, USA. Dr. Samek is associated faculty at the BIFOLD - Berlin Institute for the Foundation of Learning and Data, the ELLIS Unit Berlin and the DFG Graduate School BIOQIC, and member of the scientific advisory board of IDEAS NCBR. Furthermore, he is a senior editor of IEEE TNNLS, an editorial board member of Pattern Recognition, and an elected member of the IEEE MLSP Technical Committee. He is recipient of multiple best paper awards, including the 2020 Pattern Recognition Best Paper Award, and part of the expert group developing the ISO/IEC MPEG-17 NNR standard. He is the leading editor of the Springer book "Explainable AI: Interpreting, Explaining and Visualizing Deep Learning" (2019) and co-editor of the open access Springer book "xxAI – Beyond explainable AI" (2022). He has co-authored more than 150 peer-reviewed journal and conference papers; some of them listed as ESI Hot (top 0.1%) or Highly Cited Papers (top 1%).

Session: Humans and Interactions: HCI, VR/AR, Cognitive aspects

Stavroula Ntoa
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"Interactive Visual Exploration of Big Relational Datasets"

Motivated by the explosion of information, big data has developed into a prominent business and academic area. Given the wide applicability of the field, big data should no longer be considered a domain that pertains only to data scientists. Driven by the potential of graph analytics for data visualization and by the need for tools that do not require programming skills or database management knowledge, this presentation will introduce the HIFUN visualization tool, aiming to assist any potential user to explore datasets interactively and formulate queries easily. The tool constitutes a unified environment producing queries in HIFUN—a high-level query language for defining analytic queries over big datasets—but also in SQL. Based on the HIFUN model, the tool produces a graph visualization of the dataset, allowing the analyst to easily define a particular context of interest by simply selecting graph nodes. Then, the tool guides the analyst toward formulating the HIFUN and SQL queries and visualizes the query results. In a nutshell, the user can execute queries to the underlying database through a series of clicks, without needing to understand how these queries have been formed, as they are being created automatically by the tool according to the user interaction.

Short CV: Dr. *Stavroula Ntoa* holds a Ph.D. in "Information Systems and Human-Computer Interaction", from the Computer Science Department of the University of Crete. She is a member of the Human-Computer Interaction (HCI) Laboratory of ICS-FORTH since 2000. She is experienced in the design, development and evaluation of accessibility software for motor-impaired users, and accessible web applications. She has expertise in UX research, design and evaluation in a number of projects in various contexts and application domains, including responsive web, big data, mobile, as well augmented and virtual reality applications. Her current work focuses on user experience and accessibility in intelligent environments.

Session: Emerging hybrid worlds, transitions and transformations

Theophanis Tsandilas
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"Reflecting on how extended reality supports creative tasks"

Fiction writers have dreamed of future worlds where immersive technologies extend people's reality in imaginative ways. But despite their successful use in games, visual arts, and training applications, it is still uncertain whether such technologies will radically change our everyday interactions within the next 10 or 20 years. Will they become as widespread as mobile phones and portable computers are today? My talk will focus on tasks in which people create artifacts, distinguishing them from tasks that require people to be spectators or simply consume information. I will present observations and lessons from applying novel interactive technologies to creative activities such as prototyping 3D objects, creating an illustration, or composing music. I will discuss both successes and failures of these technologies, and then reflect on how mixed reality environments could support such creative tasks. In particular, I will examine their potential in extending the visual space of workers, as well as braking distances, bringing remote collaborators closer together.

Short CV: *Theophanis Tsandilas* is researcher at Inria, member of the Ex)Situ team, and faculty member at the Université Paris-Saclay. His research lies in the area of human-computer interaction. He has developed expertise in sketching user interfaces, creativity-support and computer-assisted design tools, gesture-based and pen-based interaction, and visualization authoring tools. He holds a Ph.D. from the Department of Computer Science at the University of Toronto and received his Habilitation in 2020.

Keynote 1

Anatole Lecuyer
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"Shaping the future of 3D interaction with virtual worlds"

Virtual reality (VR) spontaneously evokes a set of high-end technologies designed to "immerse" its users in synthetic 3D environments simulated in real time by a computer. Thanks to dedicated interfaces such as head-mounted displays, VR applications allow users to have powerful experiences such as being in a different place or interacting with characters that are not physically present for real. The first VR systems date back to the 1950s or 1960s, but a media and economic craze has recently developed, especially with the buzz around "metaverses", these massively shared virtual worlds often presented as the "Internet of the future", in which we may one day be able to perform many human activities such as working, training, visiting, meeting, shopping, etc. Such an extraordinary promise has motivated colossal investments of the tech giants over the last 10 years. We are therefore living in a pivotal and historic moment for this field, which is progressively moving towards mass applications. In this talk, we will question the next steps for VR technologies. We will first argue that VR is progressively bringing more physical engagement in 3D human-computer interactions, for example through "haptic" technologies (tactile or force feedback) or virtual embodiment in "self-avatars" (anthropomorphic representation of oneself in a virtual environment). We will also focus on the current hybridization of VR technologies with physiological and neural interfaces, suggesting future interactive systems directly exploiting users' cognitive states, and paving the way for even more compelling and holistic experiences. We will illustrate our talk with some of our latest scientific results, showing a glimpse of what could be "the future of our 3D interactions with virtual worlds"!

Short CV: *Anatole Lécuyer is Director of Research and Head of Hybrid research team, at Inria, the French National Institute for Research in Computer Science and Control, in Rennes, France. His research interests include: virtual reality, haptic interaction, 3D user interfaces, and brain-computer interfaces (BCI). He served as Associate Editor of "IEEE Transactions on Visualization and Computer Graphics", "Frontiers in Virtual Reality" and "Presence" journals. He was Program Chair of IEEE Virtual Reality Conference (2015-2016) and General Chair of IEEE Symposium on Mixed and Augmented Reality (2017) and IEEE Symposium on 3D User Interfaces (2012-2013). He is author or co-author of more than 200 scientific publications. Anatole Lécuyer obtained the Inria-French Academy of Sciences "Young Researcher Prize" in 2013, the IEEE VGTC "Technical Achievement Award in Virtual/Augmented Reality" in 2019, and was inducted in the inaugural class of the IEEE Virtual Reality Academy in 2022*.

Session: Emerging hybrid worlds, transitions and transformations

Ferran Argelaguet
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"Creating Rich Tactile Virtual Reality Experiences using Electrotactile Feedback"

Creating mobile and wearable tactile stimulation systems that provide high-fidelity feedback and natural like sensations has the potential to revolutionise VR industry, but it also offers unparalleled opportunities to innovate across many well-established, emerging as well as completely new markets. Electrotactile feedback is a promising technology to deliver rich tactile experience for Virtual Reality, which have the advantage of being highly portable and wearable due to their reduced actuators' size, as well as their lower power consumption and manufacturing cost. This talk presents a summary of the achievements of the Horizon 2020 Tactility project aiming to create a new generation of electrotactile feedback devices to provide rich tactile feedback on the hand. In addition to provide an overview of the technology developed in the project, a focus will be given to the design and rendering of rich tactile feedback to augment user interaction during manual interactions in virtual reality.

Short CV: Dr. *Ferran Argelaguet* is an Inria research scientist at the Hybrid team (Rennes, France). He received his PhD in computer science from the Universitat Politècnica de Catalunya in 2011. He is regularly involved in the organization and program committees of the major VR and 3DUI conferences (IEEE VR, IEEE ISMAR). His research activity is devoted to the research field of 3D User Interfaces and virtual reality which aims at providing seamless interaction between users and 3D virtual content through natural and expressive interfaces.

Session: Social Computing and Simulations

George Margetis
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"Empowering prosumer communities for interactive media content creation"

Interactive media are nowadays compelled by the need to deliver high-quality unprecedented experiences to the audience. In this respect, a combination of social media, technological evolution, as well as new habits and preferences of content consumers, led to a new value chain where user-generated content plays a key role in professional productions, leveraging consumers into active content contributors, also known as prosumers. Hence, creating a vibrant and self-sustained contributors' community requires a balance of reciprocal rewards with self-motivating factors ushering in high-quality and quantity user contributions and efficient collaboration. Furthermore, in order to create rich storytelling experiences fostering community building, innovative tools should be in place, harnessing user-generated content, compelling graphics, and content from social media. This presentation will elaborate on the factors that motivate content contributions by the audience and will demonstrate a platform designed to assist the transmedia production of content based on the users' contributions.

Short CV: *George Margetis* is a Postdoctoral Researcher with the Human-Computer Interaction Laboratory, of ICS-FORTH. He holds a BSc, MSc and PhD in networks and telecommunications, information systems and human-computer interaction from the University of Crete, Greece. He is a member of the Human-Computer Interaction (HCI) Laboratory of ICS-FORTH since 2005. His current research interests include multimodal interaction in Ambient Intelligence environments, X-Reality, Universal Access, adaptive Intelligent User Interfaces, Human Centered AI, visual analytics, and social computing.

Keynote 2

Dr. rer.nat. Dr. phil. Norbert A. Streitz
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"The Future is Hybrid, Cooperative and Citizen-Centered"

This keynote presents a reflection and evaluation of the 'Smart-Everything' Paradigm. 'Smart' services exploiting data collected by various sensors as part of an IoT-infrastructure and controlled by AI/ML-based software result in an increasing degree of importunate automation, lack of transparency and accountability, and privacy infringements. It happens beyond on-line activities more and more in real, physical spaces, respectively hybrid urban environments. Humans are removed from being the 'operator' and in control of their environment and decisions under the guise of being the cause of errors, e.g., in automated driving, smart cities, manufacturing processes.

Our proposal is to redefine the 'Smart-Everything' Paradigm via a human-/citizen-centred and participatory design approach, keeping the human in the loop, addressing the shift from human-computer interaction towards human-environment interaction, facilitating human-technology symbiosis and urban sustainability guided by the SDGs of the UN. The goal is to develop a shared vision and common purpose of all stakeholders for moving beyond 'smart-only' cities towards Humane, Sociable, Cooperative, Self-aware Hybrid Cities by considering various design trade-offs: complete automation vs. human control and empowerment, importunate smartness vs. privacy-by-design. Application examples: 'self-aware' cities, urban spies, automated driving, and rethinking 'smart-only' islands by exploiting their three dimensions of being hybrid.

Short CV: Dr. Dr. *Norbert Streitz* (Ph.D. in physics, Ph.D. in cognitive science), Founder and Scientific Director of the Smart Future Initiative launched in 2009. During 1987-2008, Division Manager and Deputy Director at Fraunhofer Institute IPSI (previously GMD-IPSI), Darmstadt, Germany and Lecturer at Computer Science Department, Technical University Darmstadt. Before 1987, Assistant Professor at Technical University Aachen (RWTH). At different times of his career, post-doc fellow at University of California, Berkeley, visiting scholar at Xerox PARC, Palo Alto, and Intelligent Systems Lab, Tsukuba Science City, Japan. He published/co-edited 35 books/proceedings and authored/coauthored more than 165 peer-reviewed papers. He is an elected member of the CHI Academy, the prestigious ACM SIGCHI award. (https://www.smart-future.net/norbert-streitz/)

Session: Social Computing and Simulations

Monica Divitini
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"Social computing and data sharing everywhere: Using games to promote users' awareness"

Through social computing users share an unprecedented amount of data about themselves and their contacts, with other users as well as large companies. Data is collected everywhere and seamlessly, leaving people unaware of what data they share, with whom and what it is used for. It is paramount for social computing to address this issue. In this presentation we discuss how games can be used to increase people's awareness about privacy and, at the same time, help researchers to better understand decision-making processes around data sharing. This presentation will address the approach developed by ALerT, a multi-disciplinary project aiming at developing serious games and research tools for privacy awareness. The presentation will briefly introduce the challenges to social computing connected to data sharing, sketch some of the games that are under development, and reflect on the lessons learned.

Short CV: *Monica Divitini* is Professor at the Department of Information and Computer Science, Norwegian University of Science and Technology (NTNU), Trondheim, Norway. She holds a PhD from Aalborg University, Denmark. She is member of the management team of Excited, the Norwegian Centre for Excellence in IT education, with responsibility for the cluster on tools and infrastructure. Prof. Divitini has more than 20-year active experience in research with focus on HCI, technology enhanced learning, user centered design. She investigates innovative learning methods enhanced by technology, with focus on training outside the classroom and in the workplace through e.g., game-based and reflective learning.

Session: Real World Applications

Irene Viola
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"Experiencing Cultural Heritage in Social VR"

Social virtual reality (VR) allows multiple remote users to join a shared space, unveiling new possibilities for communication and interaction in immersive environments. Thanks to its advanced 3D visualization technology and commercially affordable hardware, VR technology has recently evolved into a suitable solution for displaying cultural objects, supporting interactive exhibits and sharing knowledge in playful representations. For cultural heritage, this means making cultural artifacts accessible to its visitors in ways that would be impossible within common museum experiences. In this talk, I will present Mediascape XR, a social VR experience that teleports 3D representations of remote users, using volumetric video, to a virtual museum. It enables visitors to interact with cultural heritage artifacts while allowing social interactions in real time between them. I will show the challenges in designing and enabling such a system, and illustrate the possibilities that social VR offers for an interactive, educating, and entertaining experience.

Short CV: *Irene Viola* is a tenure-track researcher at Centrum Wiskunde & Informatica (CWI). She received her MSc in Computer Engineering from the Polytechnic University of Turin, Italy, in 2015, and her PhD in Electrical and Electronic Engineering from the Swiss Federal Institute of Technology in Lausanne (EPFL), Switzerland, in 2019. Her research interest lay in compression, transmission, and QoE metrics and methodologies for immersive multimedia systems.

Session: Real World Applications

Fabio Paterno
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"Humanations for End-User Creation and Control of Daily Automations in Intelligent Environments"

The main technological trends of recent years have been the Internet of Things and Artificial Intelligence. Their combination has made it possible to introduce numerous automations that can manifest themselves in different ways in our daily environments, such as home, industry, and stores. Many new possibilities and opportunities have been created, but also risks and problems, in terms of transparency and user control. This has stimulated interest in approaches aiming to provide methods and tools that allow people to obtain "humanations": automations that users can understand and modify.

This talk aims to help understand and address the issues involved in end-user development for daily interactive smart spaces in order to allow people to control and configure dynamic sets of interconnected devices, objects, and appliances. I discuss possible approaches to supporting users in understanding, creating, debugging, executing and monitoring personalised automations described in terms of trigger-action rules in such Internet of Things scenarios. The discussion will indicate some conceptual dimensions useful to assess possible approaches with different composition paradigms for presenting and manipulating the relevant information, report concrete experiences in real-world deployments from recent projects, and analyse the main current challenges.

Short CV: *Fabio Paternò* is Research Director at CNR-ISTI, in Pisa, where he leads the Human Interfaces in Information Systems Laboratory. His research activities are in the human-computer interaction field, with the goal to provide computational support for improving the interaction between people and digital technologies in the various possible contexts of use. He has been the scientific coordinator of several interdisciplinary international and national projects. He has published about three hundred papers in refereed international conferences or journals. His main current research interests are in Interactive Smart Spaces, Accessibility, End-User Development, Human-centered Artificial Intelligence. He is an ACM Distinguished Scientist and a member of the SIGCHI Academy.

Session: Ethical and Legal Aspects

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"Metaverse: legal and ethical issues"

The Metaverse may change the architecture and operation of the Internet towards WEB3 in which individuals will not only interact but they will be actively and involved in the creation of virtual world(s). Through the use of a range of technologies including virtual, mixed and augmented reality and the connectivity (empowered by wireless technologies, IoT etc) an immersive experience can be generated. However, this "new world" may reproduce and magnify the issues raised already with regard to online markets and services, which include competition, content moderation, liability (illegal and harmful content , IPR) and last but not least privacy and security issues . The multitude and diversity of actors active in metaverse will result in a "web of relationships" that makes difficult to identify the responsible, accountable and liable entities. These issues will be discussed in our paper. Emphasis is given on data protection issues. The opportunity to collect and monetize personal data, including biometric data and sensitive data, such as data on emotional and physiological responses, will be immense as Metaverse will give operators expanded data sources to track and mine, which result in opportunities but also in high risks for rights and interests.

Short CV: Dr. *Lilian Mitrou* is Professor at the University of the Aegean-Greece and Visiting Professor at the Athens University of Economics and Business and the University of Piraeus. She teaches information law and data protection law. L. Mitrou holds a PhD in Data Protection (University of Frankfurt-Germany). She was Member of the Hellenic Data Protection Authority (1999-2003) and since November 2016 she is member of the Greek National Council for Radio and Television (NCRTV). Her professional experience includes senior consulting and researcher positions in a number of private and public institutions and projects on national and international level. L. Mitrou is President of the Institute for Privacy Law, Data Protection and Technology (IPL- European Public Law Organisation).

Short CV: Dr *Anna-Maria Piskopani* is a legal scholar working on human rights issues in digital ecosystems. She is postdoctoral research fellow in IT law at the Horizon Institute of Digital Economy at the University of Nottingham. She holds a Phd in constitutional law (University of Athens). She has participated as a researcher in interdisciplinary projects related to processing data for research purposes, disinformation and e-government. She is currently working on ethical, legal and RRI issues in projects related to social robots used in museums and health care sector, moderation in social networking sites, encrypted communication, audio captre AI technologies and mobile applications

Session: Ethical and Legal Aspects

Emma Teodoro Martínez and **Andrea Guillén**
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"Ethical and legal aspects of human-centricity in smart factories: The OPTIMAI approach"

While Industry 4.0, is focused on technological development, Industry 5.0 embraces the societal and environmental factors of the future of work at factories. This transition from digitalization and automation to Industry 5.0 relies on three aspects: human-centricity, sustainability, and resilience. This Session will discuss what is required to effectively implement a human-centric approach.

The human-centric approach of Industry 5.0 aims at promoting the wellbeing of industry workers by placing workers needs and interests at the core of the production processes and preserving their fundamental rights. This raises the question of how to achieve human-centricity in smart factories, where digitalization and automation have introduced new ethical concerns and exacerbated existing ones. In particular, due to the deployment of data-driven technologies, including Artificial Intelligence, Internet of Things, Digital Twins, Augmented Reality and Blockchain in the workplace.

Lessons learned from the industry EU-funded project OPTIMAI (Optimizing Manufacturing Processes through Artificial Intelligence and Virtualization) will be presented and can be a starting point for further discussions.

Short CV: Dr. *Emma Teodoro* received her PhD degree in Political Science and Public Law in 2015 from the Autonomous University of Barcelona (UAB), Spain. Currently, she is a senior researcher at the Institute of Law and Technology (IDT-UAB) housed at the UAB Law Faculty. She has a wide expertise assessing ethical and legal implications of data-driven technologies of European Projects in the field of Security, Justice and Industry projects. Her participation in EU projects focuses on identifying EU/National ethical and legal applicable frameworks; assessing the potential risks posed by the research activities from an ethical, legal and societal perspective; setting up a monitoring and enforcement strategy to ensure that the outcomes project comply with the legal, ethical and societal requirements identified for the project; and providing continuous legal and ethical advice and support to the project's Consortium. She also serves as independent ethics advisor of the Ethical Advisory Boards in EU Security projects.

Short CV: Ms. *Andrea Guillén* holds an LLM. in Innovation, Technology and the Law from the University of Edinburgh (2020) and is currently a PhD law student at the Autonomous University of Barcelona. She joined the Institute of Law and Technology of the Autonomous University of Barcelona in 2020 where she has participated in several European Projects as ethical partner: SPIRIT (686993-SEC-12-FCT-2016-2017), ITFLOWS (882986-H2020-SU-BES 01-2018-2019-2020) (ongoing) and OPTIMAI - Optimizing Manufacturing Processes through Artificial Intelligence and Virtualization (H2020-(IA) DT-FOF-11-2020) (ongoing). She is the Secretary of the IEEE Standards Association program 'Meta Issues in Cybersecurity'.