HCC 2016

INTERNATIONAL SCHOOL

LECTURES | TUTORIALS | KEYNOTES

SEPTEMBER 4–10 2016. UNIVERSITY OF BREMEN

http://hcc.uni-bremen.de/school2016

ARTIFICIAL INTELLIGENCE

VISUO-SPATIAL COGNITION

HUMAN-COMPUTER INTERACTION

COGNITIVE SCIENCE AND PSYCHOLOGY

HUMAN-CENTRED COMPUTING

MINDS | EXPERIENCES | TECHNOLOGIES

SPONSORS

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MINTernational | University of Bremen . http://www.uni-bremen.de/en/international/

STEERING AND ORGANISATION

Human-Centred Cognitive Assistance Lab. http://hcc.uni-bremen.de
The DesignSpace Group. http://www.design-space.org
University of Bremen, Germany. http://www.uni-bremen.de/en/international.html

CHAIR

Prof. Dr. Mehul Bhatt
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ORGANISATIONAL SUPPORT

Jakob Suchan | Vasiliki Kondyli | Rocío Varela
University of Bremen

HCC 2016 | INTERNATIONAL SCHOOL. BREMEN

The International School on Human-Centred Computing (HCC 2016) is organised and hosted by the Human-Centred Cognitive Assistance Lab., and The DesignSpace Group of the University of Bremen. HCC 2016 is located in the immediate vicinity of the Hanseatic city of Bremen, Germany.

HCC 2016 participants include young researchers, senior and early career faculty, and industry participants. The event is supported and sponsored by industry partners, related research centres, and the University of Bremen.

RESEARCH-BASED EDUCATIONAL AGENDA

The research-based educational agenda of HCC 2016 broadly encompasses the areas of:

- Artificial Intelligence
- Visuo-Spatial Cognition and Computation
- Cognitive Science and Psychology
- Human-Computer Interaction

The key topical pillars that drive HCC 2016 at the content level as part of the scientific programme include:

- computational cognitive systems
- commonsense reasoning
- cognitive vision
- visuo-spatial computing
- embodied visuo-auditory cognition
- declarative spatial reasoning
- relational learning
- deep semantics, question-answering
- reasoning about space, actions, and change
- computational models of narrative

APPLICATIONS The school directly addresses and emphasises applications of basic research toward the development of human-centred cognitive assistive technologies and novel computer-human interaction paradigms in areas such as:

- architecture design cognition, evidence-based design & the built environment
- cognitive robotics, commonsense reasoning for high-level control
- cognitive film studies, moving image studies, media design
- computer-assisted learning
- AI and the arts: design, creativity, visual arts

Significant emphasis is also devoted to empirical methods in visuo-auditory perception (eye-tracking, FMRI, EEG) aimed at studying the (embodied) reception and interpretation of dynamic visuo-spatial imagery in humans, and its implications in designing assistive technologies concerned with analysis and synthesis of user experience in the application areas of interest.

FORMAT | LECTURES. TUTORIALS. KEYNOTES. YOUNG RESEARCHER FORUM.

Invited lecturers and tutorial presenters, and highlight keynote speakers are leading international experts in the respective topics of focus. HCC 2016 will also feature a Young Researchers Forum consisting of a graduate mentoring and research colloquium for participating research students. Also colocated is an event focussing on Artificial Intelligence and the Performing Arts.

SPEAKERS

HCC 2016 SPEAKERS

LECTURERS

1. Mehul Bhatt (University of Bremen)
2. Ulrich Furbach (University of Koblenz)
3. Daniel Levin (Vanderbilt University)
4. David Vernon (University of Skövde)
5. Stella Yu (ICSI Berkeley)

TUTORIAL PRESENTERS

1. Hannah Dee (Aberystwyth University)
2. Kristian Kersting (Technical University of Dortmund)

KEYNOTES

1. Elisabeth André (Augsburg University)
2. Michael Beetz (University of Bremen)
3. Kristian Kersting (Technical University of Dortmund)
4. Helge Ritter (University of Bielefeld)

SPEAKER PROFILES

ELISABETH ANDRÉ

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BIOGRAPHY

Professor Elisabeth André is a Full Professor of Computer Science at Augsburg University, Germany, and Chair of the Research Unit Human-Centered Multimedia. She received her Diploma and Doctoral Degrees in Computer Science from Saarland University. Before joining Augsburg University, she has been working as a principal researcher at the German Research Center for Artificial Intelligence (DFKI) in Saarbr cken. In addition, she has held various visiting appointments,most recently an invited professorship at Universit Paris-Sud, France.

Elisabeth André has a long track record in multimodal human-machine interaction, embodied conversational agents, affective computing and social signal processing. She is on the editorial board of various renowned international journals, such as ACM Transactions on Intelligent Interactive Systems (TIIS), IEEE Transactions on Affective Computing (TAC), Journal of Autonomous Agents and Multi-Agent Systems (JAAMAS), and AI Communications. Currently, she is serving as a General Co-Chair of the I8th ACM International Conference on Multimodal Interaction (ICMI).

In 2007 Elisabeth André was nominated Fellow of the Alcatel-Lucent Foundation for Communications Research. In 2010, she was elected a member of the prestigious German Academy of Sciences Leopoldina, the Academy of Europe and AcademiaNet. She is also an ECCAI Fellow (European Coordinating Committee for Articial Intelligence).

MICHAEL BEETZ

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BIOGRAPHY

Michael Beetz is a professor for Computer Science at the Faculty for Mathematics & Informatics of the University Bremen and head of the Institute for Artificial Intelligence (IAI). IAI investigates AI-based control methods for robotic agents, with a focus on human-scale everyday manipulation tasks. With his openEASE, a web-based knowledge service providing robot and human activity data, Michael Beetz aims at improving interoperability in robotics and lowering the barriers for robot programming. Due to this the IAI group provides most of its results as open-source software, primarily in the ROS software library.

Michael Beetz received his diploma degree in Computer Science with distinction from the University of Kaiserslautern. His MSc, MPhil, and PhD degrees were awarded by Yale University in 1993, 1994, and 1996 and his Venia Legendi from the University of Bonn in 2000. Michael Beetz was a member of the steering committee of the European network of excellence in AI planning (PLANET) and coordinating the research area robot planning. He is associate editor of the AI Journal. His research interests include plan-based control of robotic agents, knowledge processing and representation for robots, integrated robot learning, and cognitive perception.

MEHUL BHATT

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BIOGRAPHY

Mehul Bhatt is Professor within the Faculty of Mathematics and Informatics at the University of Bremen, Germany; and Stiftungs Professor at the German Research Center for Artificial Intelligence (DFKI Bremen). He leads the Human-Centred Cognitive Assistance Group at the University of Bremen, Germany (hcc.uni-bremen.de), and is director and co-founder of the research and consulting group DesignSpace (www.design-space.org).

Mehul's research encompasses the areas of artificial intelligence, cognitive science, and human-computer interaction. Of particular focus are basic topics on reasoning about space, action, and change, and visuo-spatial cognition and computation. The research translates to applications in building architecture design, geoinformatics, cognitive vision & robotics, and medical informatics.

Mehul obtained a bachelors in economics (India), masters in information technology (Australia), and a PhD in computer science (Australia). He has been a recipient of an Alexander von Humboldt Fellowship, a German Academic Exchange Service award (DAAD), and an Australian Post-graduate Award (APA).

Mehul has edited / reviewed for journals such as: Spatial Cognition and Computation, Artificial Intellijence Journal (AIJ), Journal of Cognitive Systems Research, Journal of Cognitive Systems Research, Journal of Experimental and Theoretical Artificial Intelligence (JETAI), Human-Centred Computing and Information Sciences, Ambient Intelligence and Smart Environments, Automation in Construction. Mehul is Senior Program Committee member (SPC) for the International Joint Conference on Artificial Intelligence (IJCAI 2016), and frequently serves as reviewer for major AI conferences such as IJCAI, KR, and ECAI. He has initiated and co-steered initiatives such as: Workshop series on Spatio-Temporal Dynamics (STeDy); Space, Time, and Ambient Intelligence (STAMI); SHAPES – The Shape of Things; and the International Association for Ontology and its Applications (IAOA) SIG on 'Design Semantics'. Mehul also served as co-chair for the fourth International Workshop on Artificial Intelligence and Cognition (AIC), the DFG-NSF symposium on Spatial Cognition for Architecture Design (SCAD 2011, USA); and the DFG sponsored 27th Qualitative Reasoning Workshop (QR-2013, Germany).

HANNAH DEE

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BIOGRAPHY

Hannah has a BSc in Cognitive Science (1996), an MA in Philosophy (1998) and a PhD in Computing (2005) all from the University of Leeds. Her research areas are applied computer vision; the detection of shadows and reasoning about shadows; and student attitudes to the study of computer science. She has held postdoctoral positions in Grenoble (France), Leeds, and Kingston upon Thames. She is also a women in computing activist: she runs the BCSWomen Lovelace Colloquium, a national conference for women undergraduates in computer science, and has been on the committee of BCSWomen since 2007.

ULRICH FURBACH

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BIOGRAPHY

Ulrich Furbach is a Senior Research Professor of Artificial Intelligence at the University of Koblenz. His research interests include knowledge management, automated reasoning, multiagent systems, and cognitive science.

After his officer training in the German Federal Armed Forces he served as an lieutenant in the tank forces. Ulrich Furbach obtained his Diploma and Habilitation in informatics from the Technical University of Munich and his PhD from the University of Bundeswehr. He directed the Automated Reasoning Group at the TU Munich from 1987 to 1990 and the Institute for Knowledge Media in Koblenz from 2000 to 2003. He was president of CADE Inc., he was a board member of the European Coordinating Committee for Artificial Intelligence and he was speaker of the German AI Society.

He is co-founder and owner of the spin-off company wizAI (www.wizai.com), which develops knowledge management systems, information systems and solutions for digital signage.

He is also teaching yoga in the tradition of Prof. Rocque Lobo as a sort of Marma-Yoga. Ulrich Furbach is ECCAI- and GI-Fellow.

KRISTIAN KERSTING

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BIOGRAPHY

Kristian Kersting is an Associate Professor in the Computer Science Department at the Technical University of Dortmund, Germany. He received his Ph.D. from the University of Freiburg, Germany, in 2006 and moved to the Fraunhofer IAIS and the University of Bonn using a Fraunhofer ATTRACT Fellowship in 2008 after a PostDoc at MIT, USA. Before moving to the TU Dortmund University in 2013, he was appointed Assistant Professor for Spatio-Temporal Patterns in Agriculture at the University of Bonn in 2012. Additionally, he was Adjunct Assistant Professor at the Medical School of the Wake Forest University, USA, in 2012.

His main research interests are data mining, machine learning, and statistical relational artificial intelligence, with applications to medicine, plant phenotpying, traffic, and collective attention. He has published over 110 peer-reviewed papers, and his contributions received the ECCAI Dissertation Award 2006 for the best AI dissertation in Europe, the Best Student Paper Award of the European Conference on Machine Learning (ECML) in 2006, the Best Poster Award of the ACM SIGSPATIAL Advances in Geographic Information Systems (GIS) in 2011, the Outstanding PC Member Award of the AAAI Conference on Artificial Intelligence in 2013, and the Best Paper Presentation Award of the New Challenges in Neural Computations (NC2) workshop in 2015. He gave several tutorials at top conferences and co-chaired BUDA, CMPL, CoLISD, MLG, and SRL as well as the AAAI Student Abstract track and the Starting AI Research Symposium (STAIRS). Together with Stuart Russell (Berkeley), Leslie Kaelbling (MIT), Alon Halevy (Goolge), Sriraam Natarajan (Indiana) and Lilyana Mihalkova (Google) he cofounded the international workshop series on Statistical Relational AI. He served as area chair/senior PC for several top conference and co-chaired ECML PKDD 2013, the premier European venue for Machine Learning and Data Mining. Currently, he is an action editor of JAIR, AIJ, DAMI, and MLJ as well as on the editorial board of NGC.

DANIEL LEVIN

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BIOGRAPHY

Research in the Levin lab is focused on the interface between concepts and visual perception. To this end, we have been exploring the concepts associated with a variety of object categories, and the knowledge that drives visual selection during scene and event perception. Some of our research explores how knowledge and other basic cognitive constraints affect scene and event perception. For example, we are currently exploring how people perceive the sequence of natural visual events, and how they represent space while viewing films. In a related line of research, we are exploring adults' and childrens' concepts about agency, and testing how these concepts affect event perception, human-computer interaction, and learning from agent-based tutoring systems. This line of research represents an interdisciplinary collaboration with our lab, Meg Saylor's lab (Cognitive Development), and labs in engineering (Julie Adams and Gautam Biswas), and has recently been supported by a grant from the NSF.

In another current project, we are collaborating with the McCandliss lab to explore how natural events shape reasoning about number and theory of mind. To do this, we have created a narrative film depicting these sorts of events and have collected fMRI data from children while they view this film.

Currently, the lab includes Lewis Baker (grad student), and Chris Jaeger (graduate student). Grad student alumni include Bonnie Angelone, Melissa Beck, Jonathan Herberg, Stephen Killingsworth, Yukari Takarae, Alex Varakin, and Joe Wayand.

I received by BA from Reed College in 1990, and my Ph.D. at Cornell University in 1997, then moved to a faculty position Kent State University. Starting in 2003, I have been here at Vanderbilt where I am Professor of Psychology in the Peabody's department of Psychology and Human Development.

HELGE RITTER

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BIOGRAPHY

Helge J. Ritter studied physics and mathematics at the Universities of Bayreuth, Heidelberg and Munich and received a Ph.D. in Physics from the Technical University of Munich in 1988. Since 1985, he has been engaged in research in the field of neural networks. In 1989 he moved as a guest scientist to the Laboratory of Computer and Information Science at Helsinki University of Technology. Subsequently he was assistant research professor at the then newly established Beckman Institute for Advanced Science and Technology and the Department of Physics at the University of Illinois at Urbana-Champaign. Since 1990, he is professor at the Department of Information Science, University of Bielefeld.

In 1995, Helge Ritter spent one year as a fellow at the Institute of Advanced Studies in Berlin. His main interests are principles of neural computation, in particular self-organizing and learning systems, and their application to robot cognition, data analysis and interactive man-machine interfaces. In 1999, Helge Ritter was awarded the SEL Alcatel Research Prize and in 2001 the Leibniz Prize of the German Research Foundation DFG. Helge Ritter is co-founder and one of the directors of the Bielefeld Institute of Cognition and Robotics (CoR-Lab) and coordinator of the excellence cluster "Cognitive Interaction Technology".

DAVID VERNON

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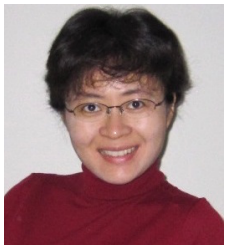
BIOGRAPHY

David Vernon studied engineering and computer science in Trinity College Dublin. He is a Professor of Informatics at the University of Sk vde, Sweden, where he works on cognitive robotics and computer vision, focusing mainly on cognitive architectures and modeling autonomy. He is presently the Research Director of DREAM (www.dream2020.eu), a project funded by the European Commission to deliver the next generation robot-enhanced therapy (RET) for children with autism spectrum disorder (ASD). In the past, he coordinated two cognition- and vision-related research networks (www.eucognition.org and www.ecvision.org) and he was a leading member of the team that created the iCub, an open-source cognitive humanoid robot (www.icub.org). He was the chair of the sixth European Conference on Computer Vision (ECCV) in 2000. Over the past 37 years, he has held positions at Westinghouse Electric, Trinity College Dublin, the European Commission, the National University of Ireland, Maynooth, Science Foundation Ireland, Khalifa University, University of Genoa, and the Technical University of Munich.

He has authored five books and published over 100 papers. He is a Senior Member of the IEEE, a Chartered Engineer of the Institution of Engineers of Ireland, and a past Fellow of Trinity College Dublin. He is co-chair of the IEEE Robotics and Automation Technical Committee for Cognitive Robotics (www.ieee-coro.org), survey & review editor of Cognitive Systems Research, and associate editor of the IEEE Transactions on Cognitive and Developmental Systems.

STELLA YU



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BIOGRAPHY

Stella Yu received her doctorate degree in 2003 from the School of Computer Science at Carnegie Mellon University, where she studied robotics at the Robotics Institute and vision science at the Center for the Neural Basis of Cognition. She continued her computer vision research as a postdoctoral fellow at UC Berkeley and then studied art and vision as a faculty member at Boston College, during which time she received a Clare Booth Luce Professorship and an NSF CAREER award. She joined ICSI as a senior research scientist in 2012 and began leading the Vision Group in 2015. She is also an adjunct professor with the Department of Computer and Information Science at the University of Pennsylvania. Her research interests include spectral graph theory, perceptual organization, brightness perception, visual attention, shape matching, and non-photorealistic rendering.

LECTURES

HCC 2016 LECTURES

SPATIAL COGNITION AND COMPUTATION

Mehul Bhatt
University of Bremen, GERMANY

AUTOMATED REASONING AND COGNITIVE COMPUTING

Ulrich Furbach
University of Koblenz, GERMANY

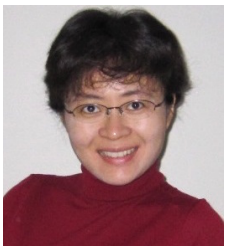
LIMITS AND METALIMITS OF VISUAL ATTENTION

Daniel Levin
Vanderbilt University, UNITED STATES

ARTIFICIAL COGNITIVE SYSTEMS

David Vernon
University of Skövde, SWEDEN

IMAGE SEGMENTATION BY LEARNING AND INTEGRATING LOCAL RELATIONS WITH SPECTRAL GRAPH THEORY



Stella Yu
UC Berkeley, UNITED STATES

SPATIAL COGNITION AND COMPUTATION

MEHUL BHATT

University of Bremen
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ABSTRACT.

This lecture will focus on the foundational significance of *visuo-spatial cognition and computation* for the design and implementation of computational cognitive systems, and multimodal interaction & assistive technologies where people-centred perceptual sensemaking and interaction with cognitively founded conceptualisations of *space, events, actions, and change* are crucial.

Part I – Visuo-Spatial Thinking. We explore the nature of analytical and creative visuo-spatial thinking and forms of human-centred cognitive assistance applicable in a wide-range of domains where *perceptual sensemaking* —e.g., abstraction, reasoning, learning— with dynamic visuo-spatial imagery is a central. The lecture presents use-cases from ongoing projects at the HCC Lab in Bremen concerned with the *processing and interpretation* of (potentially large volumes of) highly *dynamic visuo-spatial imagery*; domains explored are: (a). architecture design cognition; (b). cognitive film studies; (c). geoinformatics; (d). cognitive vision and robotics.

Part 2 – Deep Semantics for Space, Dynamics, and Cognition. In the backdrop of the domains introduced in Part I, we present the concept of *deep (visuo-spatial) semantics* denoting: *"the existence of declarative models (e.g., for spatio-temporal knowledge) and systematic formalisation that can be used to perform reasoning and query answering, relational learning, embodied grounding and simulation etc"*. The broader agenda of deep visuo-spatial semantics encompasses methods for declarative reasoning about *space, events, action, and change* within frameworks such as constraint logic programming, answer-set programming, inductive logic programming, and other specialised forms of commonsense reasoning based on expressive action description languages for modelling *dynamic spatial systems*. Deep semantics, founded on declarative representation, inference & learning in KR, serves as basis to externalise explicit and inferred knowledge, e.g., using modalities such as diagrammatic representations, natural language, complex (dynamic) data visualisation etc.

With an equal emphasis on applications and industrial outreach of basic research, the lecture will also showcase methods and tools developed to perform perceptual narrativisation or sensemanking with multi-modal, dynamic human-behaviour data (e.g., visuo-spatial imagery such as video, eye-tracking) in the chosen application areas.

SELECT PUBLICATIONS

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Bhatt, M., Lee, J. H., Schultz, C. (2011). CLP(QS): A Declarative Spatial Reasoning Framework. Proceedings of the 10th International Conference on Spatial Information Theory (COSIT 11). Belfast, Maine.

Bhatt, M. (2012). Reasoning about Space, Actions and Change: A Paradigm for Applications of Spatial Reasoning. in: Hazarika, S. (editor). Qualitative Spatio-Temporal Representation and Reasoning: Trends and Future Directions. IGI Global (PA, USA). DOI: 10.4018/978-1-61692-868-1. ISBN13: 9781616928681.

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Bhatt, M., Schultz, C., Freksa, C. (2013). The 'Space' in Spatial Assistance Systems: Conception, Formalisation, and Computation. in Thora Tenbrink, Jan Wiener, Christophe Claramunt (editors). Representing space in cognition: Interrelations of behavior, language, and formal models. Series: Explorations in Language and Space. Oxford University Press, 2012. 978-0-19-967991-1.

Bhatt, M., Suchan, J., Schultz, C. (2013). Cognitive Interpretation of Everyday Activities - Toward Perceptual Narrative Based Visuo-Spatial Scene Interpretation. Computational Models of Narrative (CMN) 2013., a satellite workshop of CogSci 2013: The 35th meeting of the Cognitive Science Society., Editors: M. Finlayson., B. Fisseni., Benedikt Löwe., J. C. Meister. OASIcs proceedings volume. OpenAccess Series in Informatics (OASIcs). Dagstuhl, Germany

Bhatt, M., Wallgruen, J. O. (2014). Geospatial Narratives and their Spatio-Temporal Dynamics: Commonsense Reasoning for High-level Analyses in Geographic Information Systems, ISPRS International Journal of Geo-Information (ISSN 2220-9964); Special Issue on: Geospatial Monitoring and Modelling of Environmental Change IJGI., 3(I), 166-205, 2014.

Walega, P., Bhatt, M., Schultz, C. (2015). ASPMT(QS): Non-Monotonic Spatial Reasoning with Answer Set Programming Modulo Theories. LPNMR: Logic Programming and Nonmonotonic Reasoning - 13th International Conference, LPNMR 2015., Lexington, KY, USA September 27-30, 2015.

Dubba, K., Cohn, A., David Hogg, D., Bhatt, M., and Dylla, F. (2015). Learning Relational Event Models from Video, in: Journal of Artificial Intelligence Research (JAIR). Vol 53. Pages 41-90.

Suchan, J., Bhatt, M. (2016). The Geometry of a Scene: On Deep Semantics for Visual Perception Driven Cognitive Film Studies., in: WACV 2016: IEEE Winter Conference on Applications of Computer Vision (WACV 2016)., Lake Placid, NY, USA, IEEE.

Suchan, J., Bhatt, M. (2016). Semantic Question-Answering with Video and Eye- Tracking Data ? AI Foundations for Human Visual Perception Driven Cognitive Film Studies. IJCAI 2016: 25th International Joint Conference on Artificial Intelligence, New York City, USA.

Suchan, J., Bhatt, M., and Schultz, C. (2016). Deeply Semantic Inductive Spatio-Temporal Learning, in ILP 2016: 26th International Conference on Inductive Logic Programming. London, UK, LNAI Springer.

AUTOMATED REASONING AND COGNITIVE COMPUTING

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ABSTRACT.

In this lecture we discuss the use of first order automated reasoning in question answering and cognitive computing. We will depict the state of the art in automated reasoning and the special constraints for its use within cognitive computing systems. Furthermore some attempts to model commonsense and human reasoning are presented.

Part I – Automated Reasoning and Question Answering. In this part we will discuss the state of the art in first order theorem proving and we will give a very coarse description of the calculus used in the Hyper reasoning system. Based on this, we will discuss the use of Hyper within the deep question answering system LogAnswer. We will demonstrate that various AI techniques have to be combined such that natural language question answering can be tackled. This includes a treatment of query relaxation, web-services, large knowledge bases and co-operative answering.

Part 2 – Commonsense Reasoning Benchmarks and Human Reasoning. In recent years various sets of benchmark problems for commonsense reasoning have been proposed. There is the Winograd Schema Challenge and the Choice Of Plausible Alternatives (COPA) Challenge, both sets are based on natural language processing. Another benchmark set, the TriangleCopa problems are already given in first order logic. All of these benchmark problems have in common, that they can only be tackled with the help of background knowledge. We will discuss the use of general knowledge bases like Cyc and Wordnet within a reasoning system to tackle these benchmarks. In a last part a bridge to human reasoning as it is investigated in cognitive psychology is constructed by using standard deontic logic.

SELECT PUBLICATIONS

Furbach, Ulrich, Björn Pelzer, and Claudia Schon. "Automated Reasoning in the Wild." Automated Deduction-CADE-25. Springer International Publishing, 2015. 55-72.

Furbach, Ulrich, and Claudia Schon. "Deontic logic for human reasoning." Advances in Knowledge Representation, Logic Programming, and Abstract Argumentation. Springer International Publishing, 2015. 63-80.

Furbach, Ulrich, Andrew S. Gordon, and Claudia Schon. "Tackling Benchmark Problems of Commonsense Reasoning." Bridging the Gap between Human and Automated Reasoning (2015): 47.

Maslan, Nicole, Melissa Roemmele, and Andrew S. Gordon. "One hundred challenge problems for logical formalizations of commonsense psychology." Twelfth International Symposium on Logical Formalizations of Commonsense Reasoning, Stanford, CA. 2015. Levesque, Hector J., Ernest Davis, and Leora Morgenstern. "The Winograd schema challenge." AAAI Spring Symposium: Logical Formalizations of Commonsense Reasoning. 2011.

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LIMITS AND METALIMITS OF VISUAL ATTENTION

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ABSTRACT.

A long tradition of research in visual attention has explored how focusing attention on one thing lessens awareness of other things. Although this seems like a commonsense description of visual experience, the pattern of awareness induced by attention often conflicts dramatically with intuition, necessitating empirical research that can apply general models of visual attention in specific situations. This issue is particularly acute in HCI where designers often rely on ad hoc intuitions about the relationship between available visual information and user's awareness of action affordances in visually rich (and often cluttered) displays.

Part I – Visual Attention and Metacognition. In the first session, I describe basic research in visual attention and visual metacognition that document limits to awareness and people?s failures to appreciate those limits. This section will focus on research documenting phenomena such as change blindness, inattention blindness, some of the traditions in research on visual attention that preceded this work, and research demonstrating failures of visual awareness in HCI. We will end by asking how this basic research provokes important questions about visual attention in an HCI context, and by considering what needs to be added to this research to make it useful in answering these questions.

Part 2 – Visual Attention in Naturalistic Contexts (HCI to Cinema). In the second session we will discuss how research can meet the challenges posed in the first session. Some of this discussion will introduce more recent work that explores visual attention in naturalistic contexts ranging from HCI to cinema. This work makes clear the need to develop theories that describe how meaningful events dynamically structure attention not only spatially but also temporally. This work takes two main approaches. First, it describes how broadly applicable meaningful structures constrain visual attention. For example, much of this work explores how attention and awareness change at the boundaries between events. The other main approach is to explore how more specific forms of knowledge affect attention. The key to this work is that some forms of knowledge provide specific guidance for visual attention, but that this guidance applies to broad classes of situations. The key example of this form of attentional guidance derives from people?s understanding of intentional agents.

I will introduce basic research on these topics, and hope to use these examples to guide creative brainstorming of new research ideas to explore the interrelationship between HCI and visual attention. One of my key goals is to encourage a two-way interaction between basic attention research and HCI such that work on attention can inform HCI and that work on HCI can inform theories of visual attention.

SELECT PUBLICATIONS

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ARTIFICIAL COGNITIVE SYSTEMS

DAVID VERNON

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SWEDEN

ABSTRACT.

This lecture provides an overview of the emerging fields of artificial cognitive systems and cognitive robotics. Inspired by artificial intelligence, developmental psychology, and cognitive neuroscience, our aim is to build systems that can act on their own to achieve goals: perceiving their environment, anticipating the need to act, anticipating the actions and intentions of people, interacting with them effectively, learning from experience, and adapting to changing circumstances.

Part I – Foundations of Cognitive Systems. The term cognition is often understood in different ways so we begin by walking through a definition of cognitive system. This definition strikes a balance between being broad enough to do justice to the many views that people have on cognition and deep enough to help in the formulation of theories and models. We then survey the different paradigms of cognitive science to establish the full scope of the subject, taking in cognitivism and artificial intelligence, emergent systems, connectionism, dynamical systems, and enaction. We follow this with a brief discussion of two key issues: autonomy and embodiment. Like cognition, both terms can be interpreted in several ways depending on the paradigm we adopt. With these foundations, we can then proceed to Part 2 to look at how people design and build cognitive systems.

Part 2 – Cognitive Architectures. We begin this part by explaining what is meant by a cognitive architecture and what it entails from the perspective of the different paradigms of cognitive science. We consider the general features of a cognitive architecture, highlighting those associated with systems that are capable of development. We then look at a few example cognitive architectures before proceeding to consider some of the key components of a typical architecture. We address the various types of memory and we focus in particular on episodic memory and the role it plays in providing a capacity for prospection, one the hallmarks of cognition, through internal simulation and mental imagery. We then proceed to look briefly at social cognition: how cognitive systems interact with people. To do this we introduce the issues of intentionality, theory of mind, instrumental helping, collaboration, joint action, shared intention, shared goals, and joint attention.

Finally, we finish by looking again at the importance of development and consider some of the many interesting challenges that we face in modeling, designing, and building cognitive systems.

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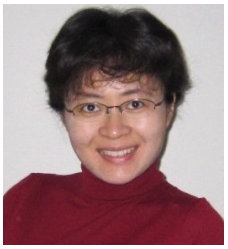
IMAGE SEGMENTATION BY LEARNING AND INTEGRATING LOCAL RELATIONS WITH SPECTRAL GRAPH THEORY



STELLA YU

UC Berkeley
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ABSTRACT.

In this lecture, we will study an image segmentation approach that is not by classifying the appearance of a patch with respect to training data and labels, but by learning pixel-centric pairwise local relations and integrating these relations in a spectral graph-theoretic framework. That is, we take the view that object segments emerge not from what training instances they resemble, but from the field of pairwise actions on feature similarity, contrast, and ordering relations among visual elements in the entire image. We will start with the seminal normalized cuts approach to image segmentation, extend it to pairwise repulsion cues and regularization, give a concrete application on finding dots and textons in the image, generalize to a new spectral embedding criterion called angular embedding, and conclude with its modern fast solver version integrated with deep learning.

Part I – Image Segmentation and Graph Partitioning. We consider image segmentation as a graph partitioning problem, which aims at extracting the global impression of an image based on pairwise local grouping cues, instead of a sliding window classification problem which focuses on local features and their consistencies in the image data. The normalized cut criterion measures both the total dissimilarity between the different groups as well as the total similarity within the groups, and there is an efficient solution through generalized eigen-decomposition. On modeling perceptual pop-out, we identify feature similarity and local contrast as two independent grouping forces, and we generalize normalized cuts to multi-way partitioning with these dual measures. We demonstrate its application to segmenting dots of a wide variety as well as detecting textons in natural scenes.

Part 2 – Robustness and Applications. Given the size and confidence of pairwise local orderings, angular embedding (AE) finds a global ordering with a near-global optimal eigensolution. AE advances spectral clustering methods by covering the entire size-confidence measurement space and providing an ordered cluster organization. As a quadratic criterion in the complex domain, AE is remarkably robust to outliers, unlike its real domain counterpart, the least squares embedding. We show that AE's robustness is due not to the particular choice of the criterion, but to the choice of representation in the complex domain. We show its application to figure-ground organization with a modern fast solver and a deep learning component which learns to predict pairwise relations directly from images, without manual design of features or grouping cues.

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Normalized Cuts and Image Segmentation Jianbo Shi and Jitendra Malik IEEE Transactions on Pattern Analysis and Machine Intelligence, 22(8):888-905, 2000

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Multiclass Spectral Clustering Stella X. Yu and Jianbo Shi International Conference on Computer Vision, 2003

Finding Dots: Segmentation as Popping out Regions from Boundaries Elena Bernardis and Stella X. Yu IEEE Conference on Computer Vision and Pattern Recognition, 2010

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Angular Embedding: A Robust Quadratic Criterion Stella X. Yu IEEE Transactions on Pattern Analysis and Machine Intelligence, 34(1):158-73, 2012

Progressive Multigrid Eigensolvers for Multiscale Spectral Segmentation Michael Maire and Stella X. Yu International Conference on Computer Vision, 2013

Affinity CNN: Learning Pixel-Centric Pairwise Relations for Figure/Ground Embedding Michael Maire and Takuya Narihira and Stella X. Yu IEEE Conference on Computer Vision and Pattern Recognition, 2016

TUTORIALS

HCC 2016 TUTORIALS

COMPUTER VISION IN REASONING AND INTERACTION

Hannah Dee
Aberystwyth University, UNITED KINGDOM

STATISTICAL RELATIONAL AI: LOGIC, PROBABILITY, COMPUTATION

Kristian Kersting
TU Darmstadt, GERMANY

COMPUTER VISION IN REASONING AND INTERACTION

HANNAH DEE

Aberystwyth University
UNITED KINGDOM

ABSTRACT.

This tutorial will look at computer vision techniques and toolkits for interaction: automatically extracting meaningful information from images and more usefully video. Three broad topics will be covered:

1. Detection:

   Edges, lines, and other structures. What makes a good feature to find? What kind of real-world objects can we detect? Practical illustrations: Canny, KLT, Viola-Jones

2. Tracking:

   You've found it, now how can you find it again? Motion and cues for motion. Tensions and synergies between tracking, learning and detection. Why not just track every frame? Practical illustrations: Mosse tracker, CamShift tracker

3. Conceptual knowlege:

   Deriving higher-order concepts from visual information: left-of, right-of, trajectories, bounding boxes, segmentations and connectivity relations.

The tutorial will provide practical illustrations of combining Viola-Jones with Mosse to work out simple hand / face relations from a webcam.

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Hannah M. Dee, Anthony G. Cohn, David C. Hogg: Building semantic scene models from unconstrained video. Computer Vision and Image Understanding 116(3): 446-456 (2012)

Juan Cao, Fr d ric Labrosse, Hannah M. Dee: An Evaluation of Image-Based Robot Orientation Estimation. TAROS 2013: 135-147

Lu Lou, Suzana Barreto, Rokas Zmuidzinavicius, Mark James Neal, Hannah M. Dee, Fr d ric Labrosse: Vision-Aided IMU Estimation of Attitude and Orientation for a Driverless Car. TAROS 2012: 465-466

STATISTICAL RELATIONAL AI: LOGIC, PROBABILITY, COMPUTATION

KRISTIAN KERSTING

TU Darmstadt
GERMANY

ABSTRACT.

Our minds make inference that appear to go far beyond machine learning. Whereas people can learn richer representations and use them for a wider range of functions, machine learning has been mainly employed in a stand-alone context, constructing a single function from a table of training examples. In this talk, I shall touch upon computational models that can capture these human learning aspects by combining relational logic and statistical learning. However, as we tackle larger and larger relational learning problems, the cost of inference comes to dominate learning time and makes performance very slow. Hence, we need to find ways to reduce the cost of inference both at learning and at run time. One promising direction to speed up inference is to exploit symmetries in the computational models. I shall illustrate this for probabilistic inference, linear programs, and convex quadratic programs.

This is based on joint works together with Martin Mladenov, Amir Globerson, Martin Grohe, Sriraam Natarajan, Aziz Erkal Selman, and many more.

SELECT PUBLICATIONS

Luc De Raedt, Kristian Kersting, Sriraam Natarajan, David Poole, Statistical Relational Artificial Intelligence: Logic, Probability, and Computation. Morgan and Claypool Publishers,Synthesis Lectures on Artificial Intelligence and Machine Learning, ISBN: 9781627058414, 2016.

KEYNOTES

HCC 2016 KEYNOTES

SOCIALLY SENSITIVE TECHNOLOGIES FOR HUMAN-CENTERED COMPUTING

Elisabeth André
Augsburg University, GERMANY

CLOUD-BASED AUTONOMOUS INTELLIGENT ROBOTS

Michael Beetz
University of Bremen, GERMANY

LIFTED MACHINE LEARNING

Kristian Kersting
Technical University of Dortmund, GERMANY

FROM PHYSICAL TO COGNITIVE INTERACTION

Helge Ritter
University of Bielefeld, GERMANY

SOCIALLY SENSITIVE TECHNOLOGIES FOR HUMAN-CENTERED COMPUTING

ELISABETH ANDRE

Augsburg University
GERMANY

ABSTRACT.

Recent years have initiated a paradigm shift from pure task-based human-machine interfaces towards socially-sensitive interaction. In addition to what users explicitly say or gesture at, socially-sensitive interfaces are able to sense more subtle human cues, such as head postures and movements, to infer psychological user states, such as attention and affect, and also to enrich system responses with social signals. However, most approaches focus on offline analysis of previously recorded data limiting the investigation to prototypical behaviors in laboratory-like settings.

In my presentation, I will focus on challenges that arise when integrating social signal processing techniques into interactive systems designed for real-world applications. From a technical perspective, this requires effective tools able to synchronize, process, and analyze relevant signals in online mode. From a user perspective, appropriate strategies need to be defined to respond to social signals at the right moment in time without disturbing the flow of interaction. The talk will be illustrated by applications enabled by socially sensitive technologies, such as robotic companions for the elderly, computer-enhanced social and emotional learning and socially augmented interfaces for people with disabilities.

CLOUD-BASED AUTONOMOUS INTELLIGENT ROBOTS

MICHAEL BEETZ

University of Bremen
GERMANY

ABSTRACT.

Recently, we witness the first robotic agents performing everyday manipulation activities such as loading a dishwasher and setting a table. While these agents successfully accomplish specific instances of these tasks, they only perform them within the narrow range of conditions they have been carefully designed for. They are still far from the human ability to autonomously perform a wide range of everyday tasks reliably in a wide range of contexts. In other words, they are far from mastering everyday activities. Making the transition from performing everyday activities to mastering them, requires us to equip the robots with comprehensive knowledge bases and reasoning mechanisms. Robots that can master everyday activities have to perform natural language instructions such as ”flip the pancake” or ”push the spatula under the pancake”. To perform such tasks adequately, robots must, for instance, be able to infer the appropriate tool to use, how to grasp it and how to operate it. They must, in particular, not push the whole spatula under the pancake, i.e. they must not interpret instructions literally but rather recover the intended meaning.

In this talk, I will present some of our ongoing research that investigates how such knowledge can be collected and provided, using a cloud-based knowledge service. We propose openEASE, a remote knowledge representation and processing service that provides its users with unprecedented access to knowledge of leading-edge autonomous robotic agents. It also provides the representational infrastructure to make inhomogeneous experience data from robots and human manipulation episodes semantically accessible, as well as a suite of software tools that enable researchers and robots to interpret, analyze, visualize and learn from the experience data. Using openEASE users can retrieve the memorized experiences of manipulation episodes and ask queries regarding to what the robot saw, reasoned, and did as well as how the robot did it, why, and what effects it caused.

LIFTED MACHINE LEARNING

KRISTIAN KERSTING

Technical University of Dortmund
GERMANY

ABSTRACT.

Our minds make inference that appear to go far beyond machine learning. Whereas people can learn richer representations and use them for a wider range of functions, machine learning has been mainly employed in a stand-alone context, constructing a single function from a table of training examples.

In this talk, I shall touch upon computational models that can capture these human learning aspects by combining relational logic and statistical learning. However, as we tackle larger and larger relational learning problems, the cost of inference comes to dominate learning time and makes performance very slow. Hence, we need to find ways to reduce the cost of inference both at learning and at run time. One promising direction to speed up inference is to exploit symmetries in the computational models. I shall illustrate this for probabilistic inference, linear programs, and convex quadratic programs.

This is based on joint works together with: Martin Mladenov, Amir Globerson, Martin Grohe, Sriraam Natarajan, Aziz Erkal Selman, and many more.

FROM PHYSICAL TO COGNITIVE INTERACTION

HELGE RITTER

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ABSTRACT.

A grand challenge at the heart of human-centered computing is the realization of cognitive interaction between a human and a technical agent. In contrast to now familiar concepts of interaction between physical constituents of matter – which were central to the successes of physics in the previous centuries – cognitive interaction involves constituents that are much more complex by being active agents, endowed with perception, a rich embodiment, and capabilities such as memory and learning. Compared to physics, an analogous, deep analysis of the resulting, extremely rich spectrum of cognitive interaction patterns and their replication in technical artefacts is still a rather young scientific endeavor that connects human-centered computing and robotics with disciplines such as cognitive psychology, the brain sciences, social science and linguistics. The talk will point out pertinent research questions and challenges in this emerging field and describe current approaches with examples from work carried out at the Bielefeld CoE "Cognitive Interaction Technology".

HUMAN-CENTRED COMPUTING

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