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Dieter W. Fellner, Werner Hansmann, Werner Purgathofer, François Sillion
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Keynote

Object-Centric Machine Learning

Leonidas Guibas
Stanford University

Abstract
Deep knowledge of the world is necessary if we are to have autonomous and intelligent agents and artifacts that can assist us or even carry out tasks entirely independently. One way to factorize the complexity of the world is to associate information and knowledge with stable entities, animate or inanimate, such as a person or a vehicle, etc. In this talk I'll survey a number of recent efforts whose aim is to create and annotate reference representations for objects based on 3D models with the aim of delivering such information to new observations, as needed. In this object-centric view, the goal is to use these reference representations for aggregating information and knowledge about object geometry, appearance, articulation, materials, physical properties, affordances, and functionality. We acquire such information in a multitude of ways, both from crowd-sourcing and from establishing direct links between models and signals, such as images, videos, and 3D scans – and through these to language and text. The purity of the 3D representation allows us to establish robust maps and correspondences for transferring information among the 3D models themselves – making our current 3D repository, ShapeNet, a true network. Information transport and aggregation in such networks naturally lead to abstractions of objects and other visual entities, allowing data compression while capturing variability as well as shared structure. Furthermore, the network can act as a regularizer, allowing us to to benefit from the "wisdom of the collection" in performing operations on individual data sets or in map inference between them. This effectively enables us to add missing information to signals through computational imagination, giving us for example the ability to infer what an occluded part of an object in an image may look like, or what other object arrangements may be possible, based on the world-knowledge encoded in ShapeNet and other repositories. I will also briefly discuss current approaches in designing deep neural network architectures appropriate for operating directly on irregular 3D data, as well as ways to learn object function from observing multiple action sequences involving objects.

Short Biography
Leonidas Guibas obtained his Ph.D. from Stanford University under the supervision of Donald Knuth. His main subsequent employers were Xerox PARC, DEC/SRC, MIT, and Stanford. He is currently the Paul Pigott Professor of Computer Science (and by courtesy, Electrical Engineering) at Stanford University. He heads the Geometric Computation group and is part of the AI Laboratory, the Graphics Laboratory, the Bio-X Program, and the Institute for Computational and Mathematical Engineering. Professor Guibas' interests span geometric data analysis, computational geometry, geometric modeling, computer graphics, computer vision, robotics, ad hoc communication and sensor networks, and discrete algorithms. Some well-known past accomplishments include the analysis of double hashing, red-black trees, the quad-edge data structure, Voronoi-Delaunay algorithms, the Earth Mover's distance, Kinetic Data Structures (KDS), Metropolis light transport, heat-kernel signatures, and functional maps. Professor Guibas is a member of the National Academy of Engineering, an ACM Fellow, an IEEE Fellow and winner of the ACM Allen Newell award and the ICCV Helmholtz prize.

Keynote

Some Recent Developments in 3D Shape Acquisition and Analysis

Daniel Cremers
Technical University, Munich

Abstract
The reconstruction and understanding of the 3D world from images is among the central challenges in computer vision. Starting in the 2000s, researchers have pioneered algorithms which can reconstruct camera motion and sparse feature points in real-time. In my talk, I will introduce spatially dense methods for camera tracking and 3D reconstruction which do not require feature point estimation, which exploit all available input data and which recover dense or semi-dense geometry rather than sparse point clouds. In addition, I will present algorithms to analyze 3D shapes, including the computation of shape descriptors and shape correspondence.

Short Biography
Daniel Cremers obtained a PhD in Computer Science from the University of Mannheim, Germany. Subsequently he spent two years as a postdoctoral researcher at UCLA and one year as a permanent researcher at Siemens Corporate Research in Princeton, NJ. From 2005 until 2009 he was associate professor at the University of Bonn, Germany. Since 2009 he holds the chair for Computer Vision and Pattern Recognition at the Technical University, Munich. His publications received numerous awards, including the 'Best Paper of the Year 2003' (Int. Pattern Recognition Society), the 'Olympus Award 2004' (German Soc. for Pattern Recognition) and the '2005 UCLA Chancellor's Award for Postdoctoral Research'. For pioneering research he received a Starting Grant (2009), a Proof of Concept Grant (2014) and a Consolidator Grant (2015) by the European Research Council. In 2010 he was listed among "Germany's top 40 researchers below 40" (Capital). Prof. Cremers received the Gottfried-Wilhelm Leibniz Award 2016, the most important research award in German academia.