

Invited Talks

Link Analysis: AI Applications and Research

Ted Senator, *DARPA / IPTO*

Various AI techniques are used and being developed to “connect the dots”—that is, to find interesting patterns in, from, and of linked data. These techniques augment traditional “link analysis” methods used in intelligence analysis and law enforcement. They require an ability to represent and reason about structured data, for which traditional processes and techniques are not well suited. Using examples from several domains, this talk discusses the distinct requirements, technical challenges, and research issues of analyzing relational data to find instances of complex structured patterns in linked data. It covers methods for data preparation; processes and techniques for pattern discovery, evaluation, and management; and detection strategies. It also presents mathematical models of the problems and potential solutions.

Did Renaissance Masters ‘Cheat’ Using Optics? Computer Image Analysis and Computer Graphics Address a Bold Theory in the History of Art

David Stork, *Ricoh Innovations and Stanford University*

In 2001 artist David Hockney and scientist Charles Falco stunned the art world with a controversial theory that, if correct, would profoundly alter our view of the development of image making. They claimed that as early as 1420, Renaissance artists employed optical devices such as concave mirrors to project images onto their canvases, which they then traced or painted over. In this way, the theory attempts to explain the newfound heightened naturalism of painters such as Jan van Eyck, Robert Campin, Hans Holbein the Younger, and others. This talk for general audiences, lavishly illustrated with Renaissance paintings, will present the results of the first independent examinations of the projection theory. The analyses rely on sophisticated computer vision and image analysis algorithms as well as computer graphics reconstructions of Renaissance studios. While there remain some loose ends, such rigorous technical analysis of the paintings, infrared reflectograms, modern reenactments, internal consistency of the theory, and alternate explanations allows us to judge with high confidence the plausibility of this bold theory. You may never see Renaissance paintings the same way again.

Biognostic Systems

Lawrence Hunter, *University of Colorado Health Sciences Center*

Revolutionary change is afoot in all aspects of molecular biology, from the advent of instruments capable of molecular resolution at genomic scale to the broad adoption of Open Access publishing models. The challenges in exploiting this overwhelming explosion of information to best serve the needs of human health can only be addressed by computational systems. The science itself has driven bioinformaticians to many classical AI technologies, including machine learning, frame-based knowledge representation, and natural language processing. Biognostic (“life knowing”) computer systems intended to integrate and communicate humanity’s growing knowledge of life have the potential to be genuine partners in a grand voyage of discovery.

Intelligent Technology for an Aging Population: The Use of AI To Assist Elders with Cognitive Impairment

Martha Pollack, *University of Michigan*

Today, approximately 10 percent of the world's population is over the age of 60; by 2050 this proportion will have more than doubled. Moreover, the greatest rate of increase is amongst the oldest old, people aged 85 and over. While many older adults remain healthy and productive, overall this segment of the population is subject to physical and cognitive impairment at higher rates than younger people. In this talk, Pollack will survey new technologies that incorporate artificial intelligence techniques to support older adults and help them cope with the changes of aging, in particular with cognitive decline. Her focus will be on the use of automated planning, reasoning under uncertainty, and machine learning in systems that support extended autonomy, and she will use the Autominder cognitive orthotic system as an example of this type of system.