

School of Electrical Engineering and Computer Science

59 Research Faculty

9 Adjunct Research Faculty

Graduate Students

CS: 98 PhD 71 MS 57 MEng

ECE: 107 PhD 55 MS 69 Meng

Research Expenditures = \$12M

Hiring 5+ faculty this year

- Data Science & Engineering
- Robotics
- Energy Systems
- Materials and Devices

**So far, very little interaction with
College of Public Health!**

Core EECS Research Areas

1. Data Science and Engineering
2. Artificial Intelligence and Robotics
3. Electronic Materials and Devices
4. Integrated Circuits and Systems
5. Energy Systems
6. Security
7. Communications and Signal Processing
8. Networking and Computer Systems
9. Software Engineering, Design, and Usability
10. Theoretical Computer Science
11. Health and Ecological Engineering
12. Computer Graphics and Visualization



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Data Science and Engineering

- Sensors
- Signal Processing
- Databases
- Data Security and Privacy
- Machine Learning and Data Mining
- Data Visualization and Graphics
- Bioinformatics and Computational Biology
- Ecosystem Informatics
- Computational Sustainability

25 EECS Faculty

Artificial Intelligence and Robotics

- Automated Decision Making and Control
- Machine Learning and Data Mining
- Computer Vision
- Natural Language Processing
- Robotics

13 EECS Faculty

Data Mining and Exploration of Large Data Sets

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Data Mining and Exploration

- Find non-obvious and interesting regularities in large data sets
 - Need to scale to large volumes of data
 - Interfaces for “user-in-the-loop” exploration of statistical patterns
- Solving prediction/estimation problems using state-of-the-art machine learning techniques
- Search for “anomalies” in data
 - Sometimes these are errors
 - Sometimes these are interesting

Sensing the State of Elderly People

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Sensing and Computer Vision

- Knowing the “state” of an elderly person in their home has many applications
 - Where are they?
 - Are they behaving “normally”?
 - Are they taking their medications?
 - What is their mood distribution?
 - Have they fallen?
- Computer vision could be used to monitor activity and state of an individual in their home using cheap cameras
- Other existing and new sensing technology can also be used, including more detailed physical signals (bio-sensors, RFID tags)

Simulation-Based Intelligent Decision Making

Data Science and Engineering

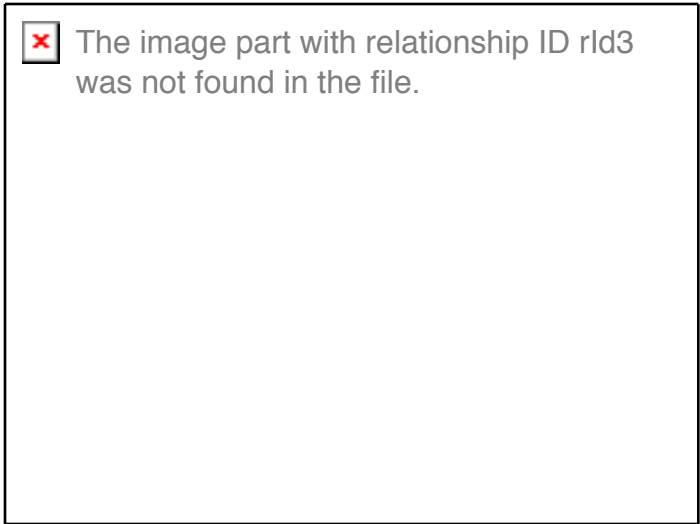
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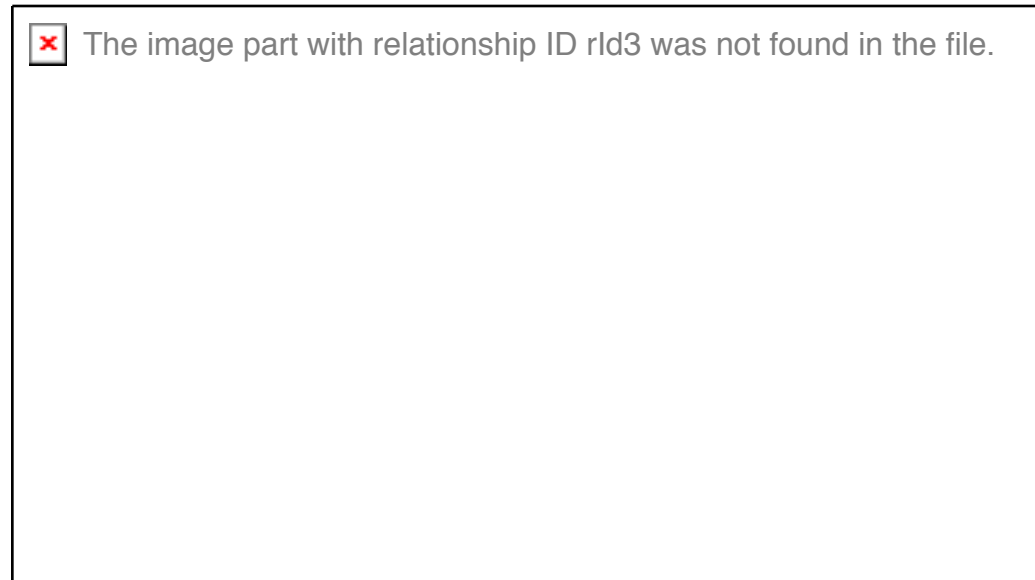
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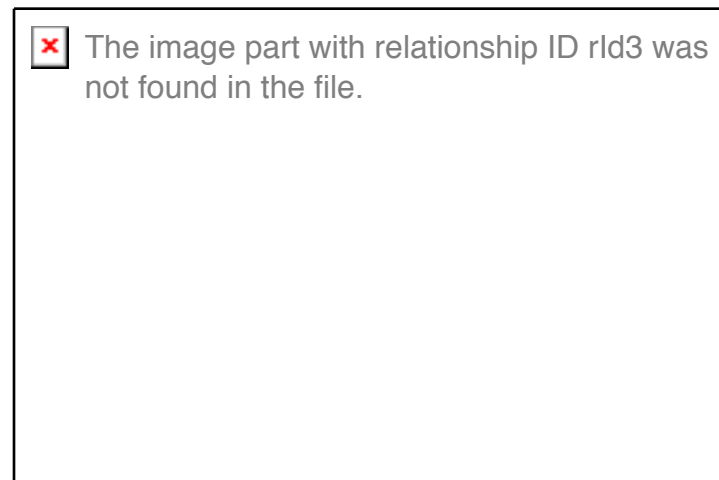
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Garry Kasparov vs. Deep Blue
(1997)



Watson vs. Ken Jennings
(2011)




Deep Mind's AlphaGo vs. World Go Champion
(2016)

Fire & Emergency Response Policies

w/ Prasad Tadepalli

Fire & Emergency Response Simulator

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“Fire Chief Roy Emery explained that closing one of the city’s six fire stations was the only way for his department to generate any significant cost savings.

Two other stations — Station 2 on Southwest 35th Street and Station 4 on Southwest Tunison Avenue — were also considered for closure. But after analyzing data on calls for fire and emergency medical service citywide, Emery said it was clear that closing Station 5 would have the least negative effect.” **Gazette Times**

How good are our current dispatch policies?

Can we do better using simulation-based policy optimization?

Simulators + AI = Rational Decisions

- What systems/policies could be optimized for healthy aging?
- Simulators can be data driven.

Personalized Healthy Aging

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Example: Optimizing Exercise and Therapy Routines

- Suppose we want to design effective exercise schedules for the elderly
 - When to exercise?
 - What type of exercise?
 - What types of motivations?
- Best answers vary across individuals!
- **Goal:** create most effective routine for each individual (adapt as we learn more about individual).
- **Hypothesis:** there are a relatively small number of types of individuals w.r.t. the most effective routine
- **Approach:** use AI and data science to
 - Safely guide data collection of routine variations across individuals
 - Discover the types of individuals and the most effective routines
 - Infer the type of a new individual and suggest most appropriate routine

Personalized Healthy Aging

What other personalization applications are there?

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Electronic Materials and Devices

- Novel Electronic Materials
- **Sensors and Biomedical Devices**
- Advanced Nano-Electronic Devices
- Magnetic Materials and Spintronics
- Photonics and Optoelectronics

What bio-sensors/devices would be most beneficial?

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Point-of-care diagnostics



Rapid (minutes - < 1 hour)

All users

Portable equipment

No specific setup required

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Software Systems, Design, and Usability

- Human-Computer Interaction
- Programming Languages
- Software Engineering

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- What would be the killer new mobile apps and web-sites?
- What hurdles do the elderly currently face when interfacing to computers/technology?
- **Example:** How could an elderly person easily “program” a household robot or other assistive device to perform a desired service?

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Security

- Computer and Network Security
- Data Security
- Cryptography
- Privacy
- Cyber-Physical System Security

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- Tele-medicine and tele-monitoring introduce many privacy and security concerns
- Are there special computer security concerns for the elderly?
- How aware are the elderly of security and privacy of the internet?