Automated Reasoning

Course Presentation

Summary

- Motivations
- Course Plan
- Resources
- Exam Methods

Motivations

Automated reasoning

- **mechanising** the **reasoning** process.
- **reasoning**: manipulate knowledge through deductive processes:
  We know: All men are mortals, Aristotele is a man
  Reasoning we can infer: Aristotele is a mortal
- **mechanising**: develop techniques that can be used by machines:
  Write a computer program that performs the above inference.

Related areas

Subfield of Artificial Intelligence, related to:

- **Mechanical Theorem Proving**
- **Constraint Processing**
- Logic programming
- Automated Program Verification
- Planning

Practical applications: Overview

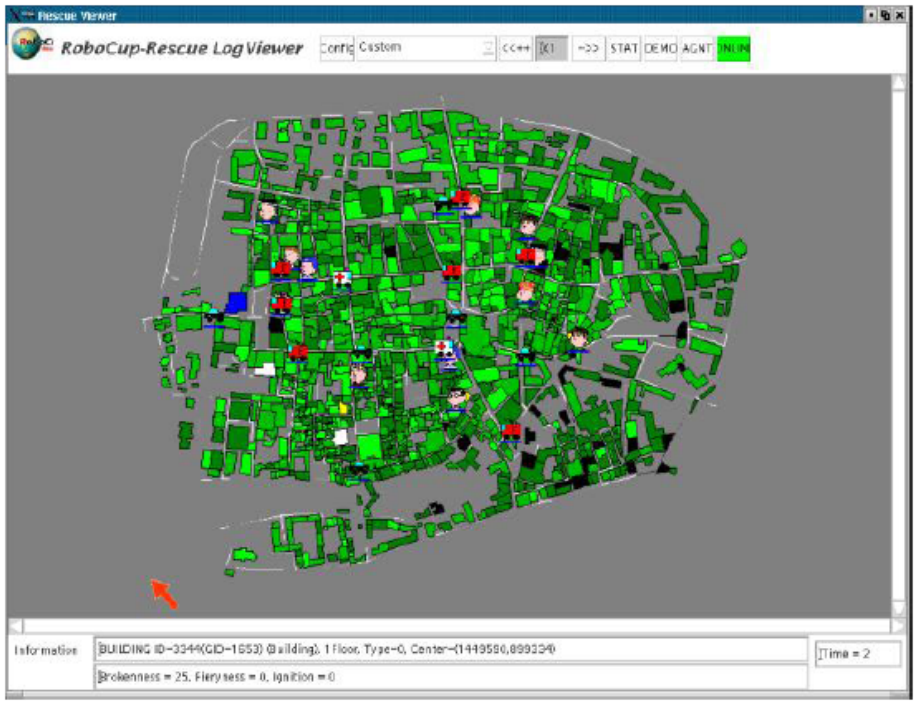
- **Task assignment and scheduling**
- **Autonomous agent technology**
- **Robotic systems (Cognitive robotics)**
- Machine vision
- Diagnosis Systems
- Program Synthesis
- Hardware/Software Verification
- Question answering, problem solving, scheduling

Task Assignment: Cooperative Foraging

Decide who is in the best position to execute a task

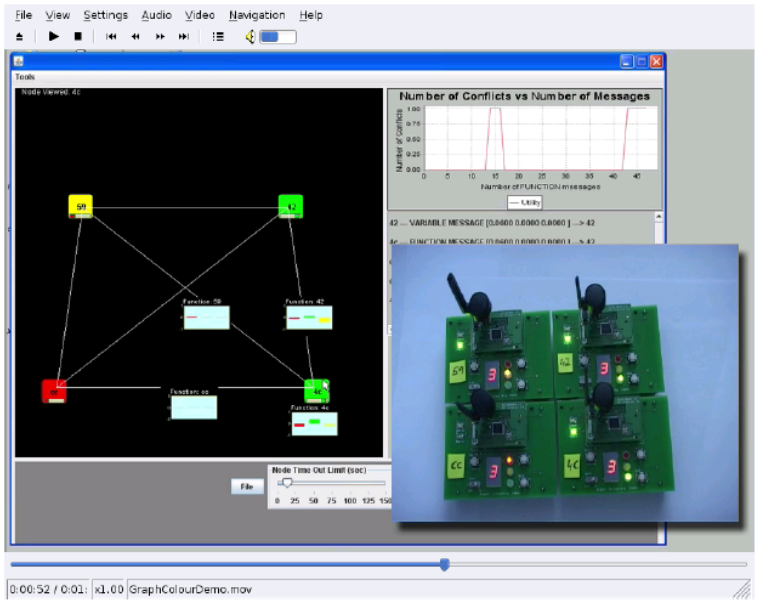
Coalition Formation: Search and Rescue

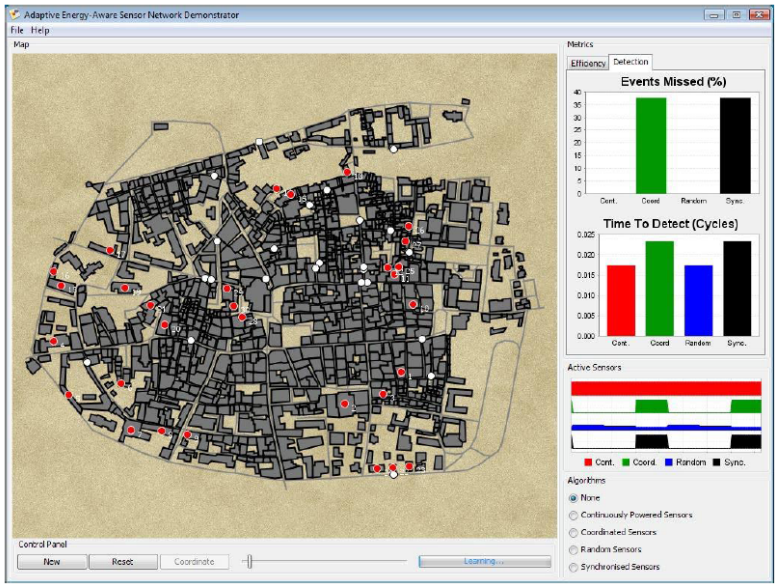
Decide wich coalition to form to rescue civilians



Decentralised Coordination: Wireless Sensor Networks

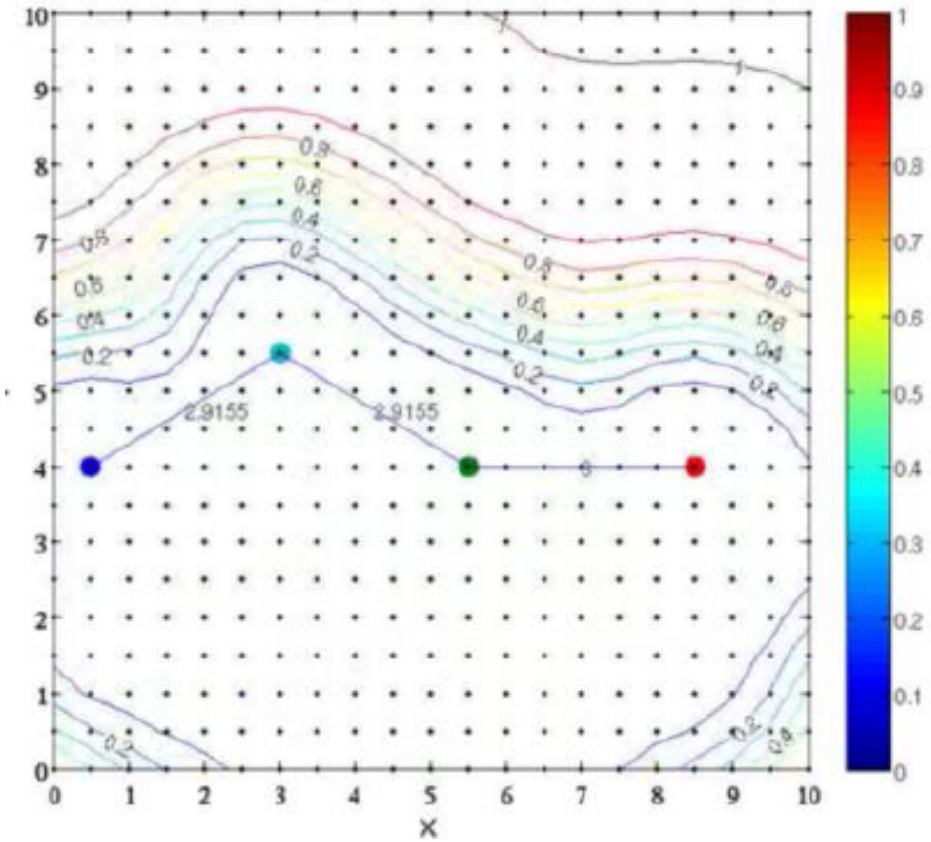
Find best sense/sleep schedule to optimise event detection





Decentralised Coordination: Mobile Sensor Exploration

Decide which sensor should move to optimise information gain



Energy Management

Find best schedule for energy appliances to reduce peak demand

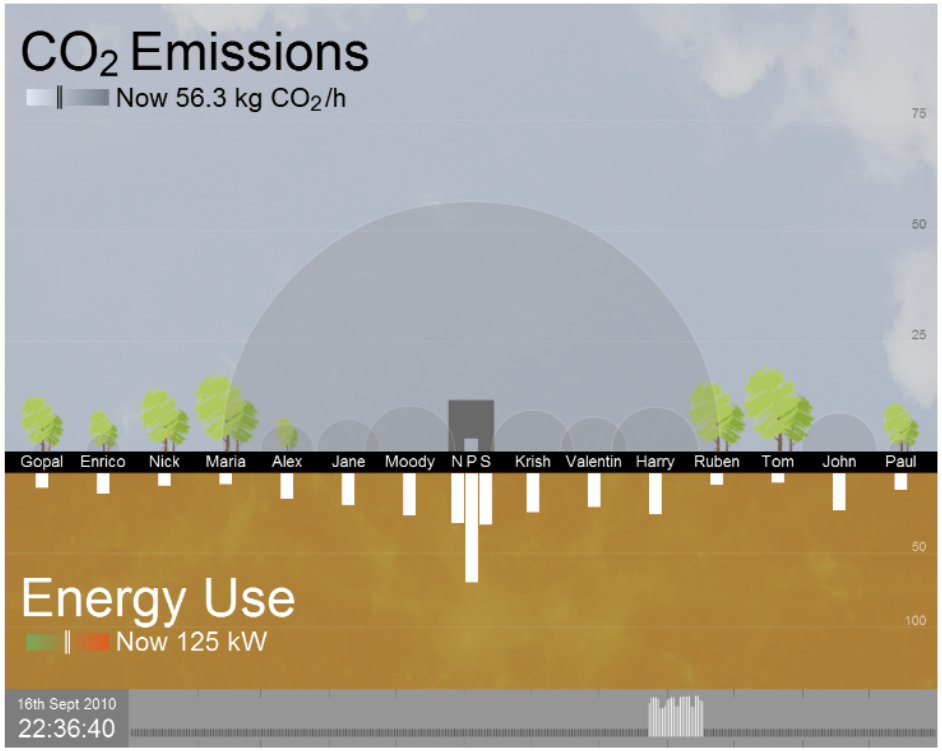


Image Courtesy of Alex Rogers

Ideas project `http://www.ideasproject.info/`

Course Plan

- Logic Based Automated reasoning
  - Proof procedures in Propositional and First Order Logic
  - Skolemisation, Herbrand's Theorem
  - The DPLL procedure
  - Resolution and ordered Resolution
  - Orderings for inference rules and redundancy
- Constraint Processing
  - Contraint Satisfaction Problems, Constraint Network and Graphical models
  - Basic techniques for CSP (Consistency enforcing, Backtracking, Local Search)
  - Tree-Decomposition
  - Constraint Optimisation Problems
  - Constraint Processing in Multi-agent Systems
  - Distributed Constraint Optimisation

Resources

- Text Books
  - Symbolic Logic and Mechanical Theorem Proving *C. Chang, R. C. Lee*
  - Deduction Systems, *R. Socher-Ambrosius, P. Johan*
  - Constraint Processing *R. Dechter*
- Further readings
  - Strutture Logica Linguaggi, *L. Aiello, F. Pirri*
  - Sfidare l'indecidibile, *S. Ghilardi*
  - Intelligenza Artificiale: un approccio moderno, *S. Russel, P. Norvig*
- Other Material
  - Scientific Papers, Slides, etc.
  - Will be available on web site
- Web Page link

  `http://profs.sci.univr.it/~farinelli`
- Go to the *Teaching* section of the web page

Exam modalities

- Partial tests mode:
  - only to the exams right at the end of the class (two sessions in Febbruary)
  - written test (C) and an individual project (P) to be developed at home
  - the final grade is given by 50% C + 50% P
- Single-test mode
  - Single written test E (difficulty equivalent to C + P)
  - This mode applies to all sessions.
- Notes: the partial test C is administered on the same date, time and place as test E (of course contents and duration of C and E will be different)

Projects

- Project
  - Instructor will propose a set of projects
  - Students can: choose among the set of proposed projects or propose other projects
  - Projects proposed by students must be validated by the instructor
  - Have a look at past projects and past exams on the course web site