# Artificial Intelligence

## Course Presentation

# Summary



- Motivations
- Course Plan
- Resources
- Exam Methods

# Motivations



Artificial Intelligence:

Machines that think and act like humans do

*Voight-Kampff* test in blade-runner

# Motivations



## Artificial Intelligence:

Machines that solve complex problems


*Google Self Driving car*

# Related areas



AI highly interdisciplinary

- Probability and Statistics
- Robotics
- Logics
- Algorithms
- Game Theory
- Pattern Recognition and Machine Learning

Key distinctive element: **Interaction with the environment**

# Practical applications: Overview



- **Agile manufacturing**
- **Service Robots**
- **Environmental monitoring**
- **Games, entertainment and education**
- Medical Diagnosis
- Hardware/Software Verification
- Search and Rescue operations
- Smart Transportation
- Smart energy Management
- ...

# Agile Manufacturing: The Kiva robots



Coordinate movements of a large number of robots for indoor logistic operations

# Service Robots: Cleaning robots

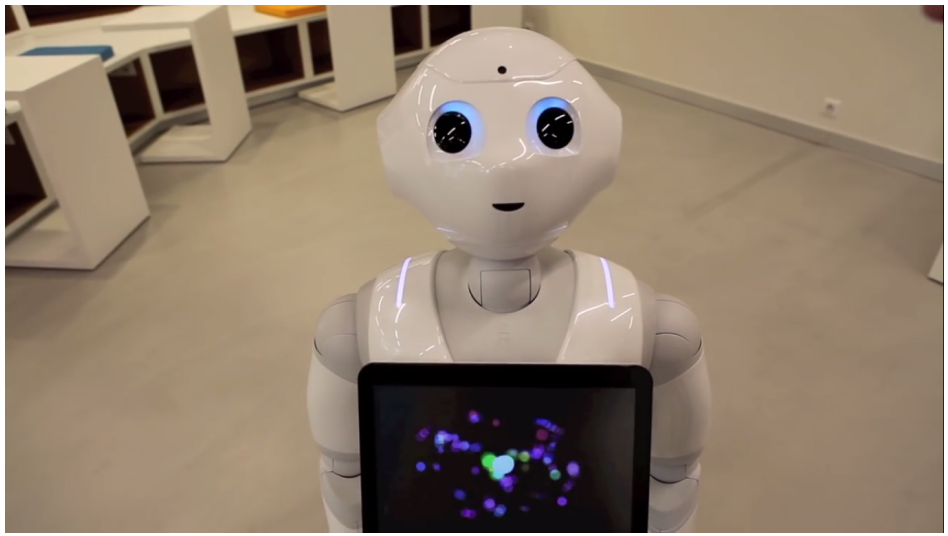


Robots that can help for daily activities

# Service robots: robot companions



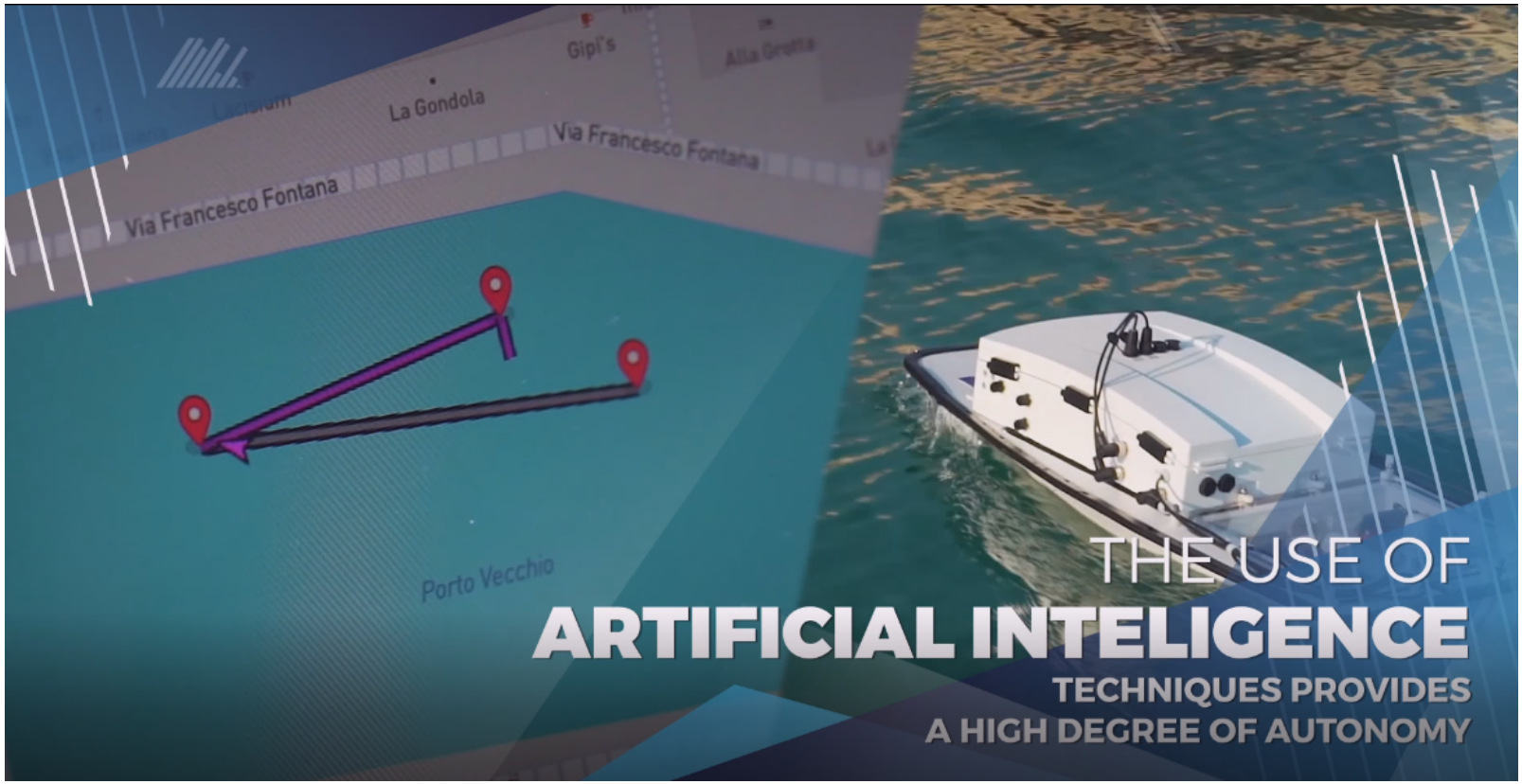
Robot that can interact with humans and assist them in various tasks



# Environmental Monitoring: Water Monitoring



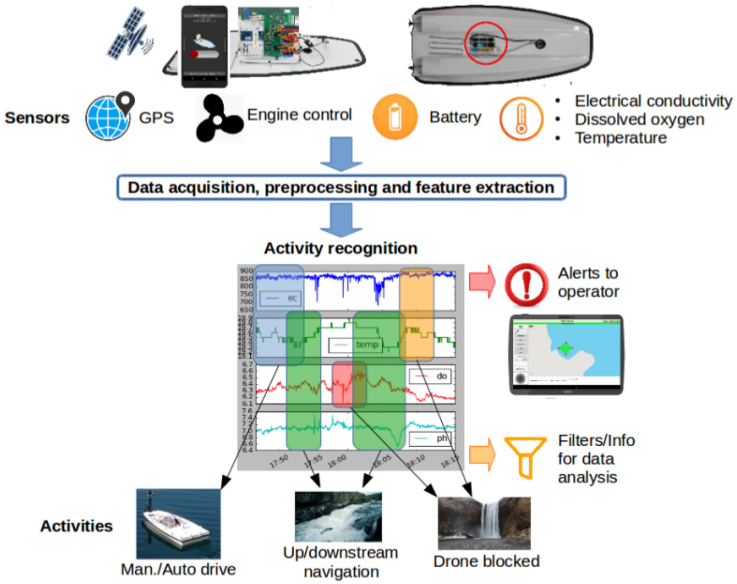
Autonomous drones for water quality monitoring

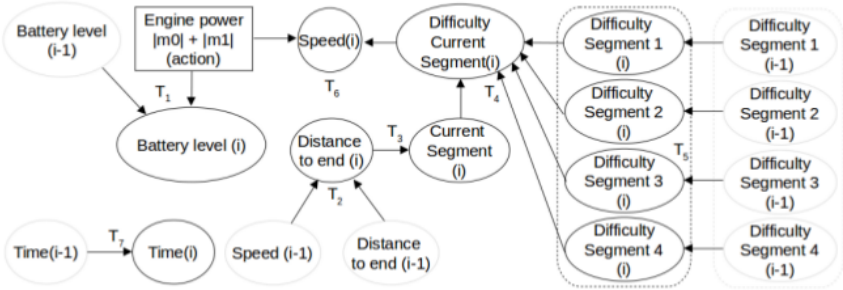


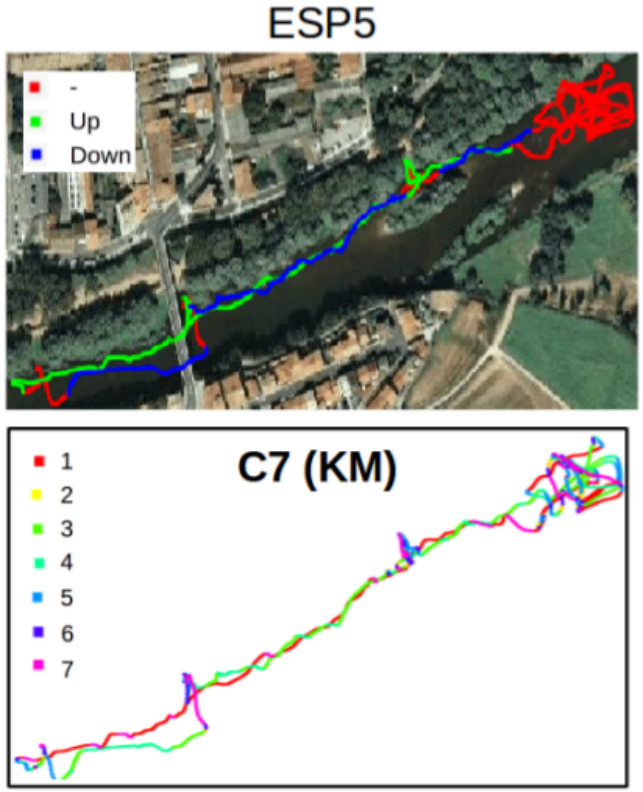
# Planning and situation awareness for drones



Analyse data coming from sensors to understand the situation and decide what is the best possible action



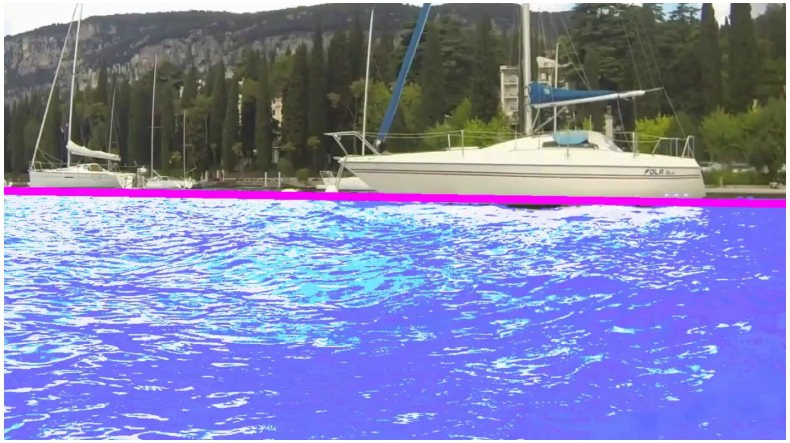



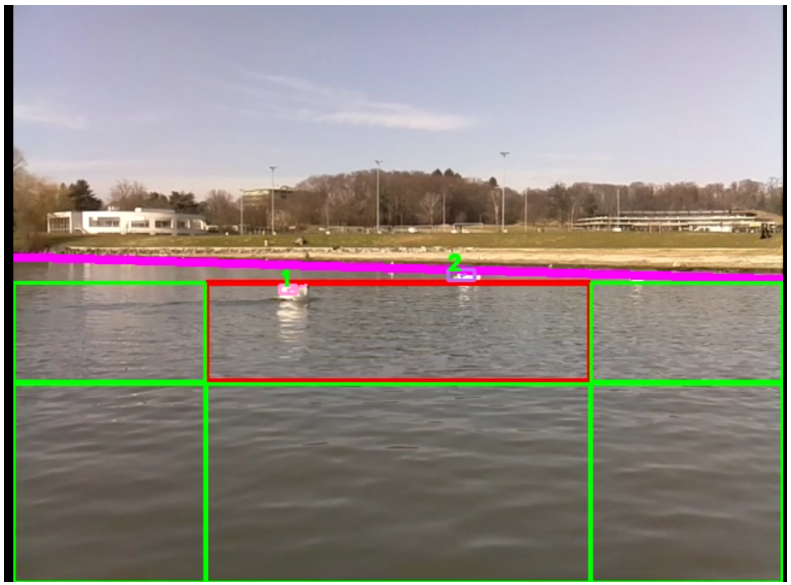



# Water Monitoring: perception for autonomous behaviors



Use computer vision to detect relevant features and situations

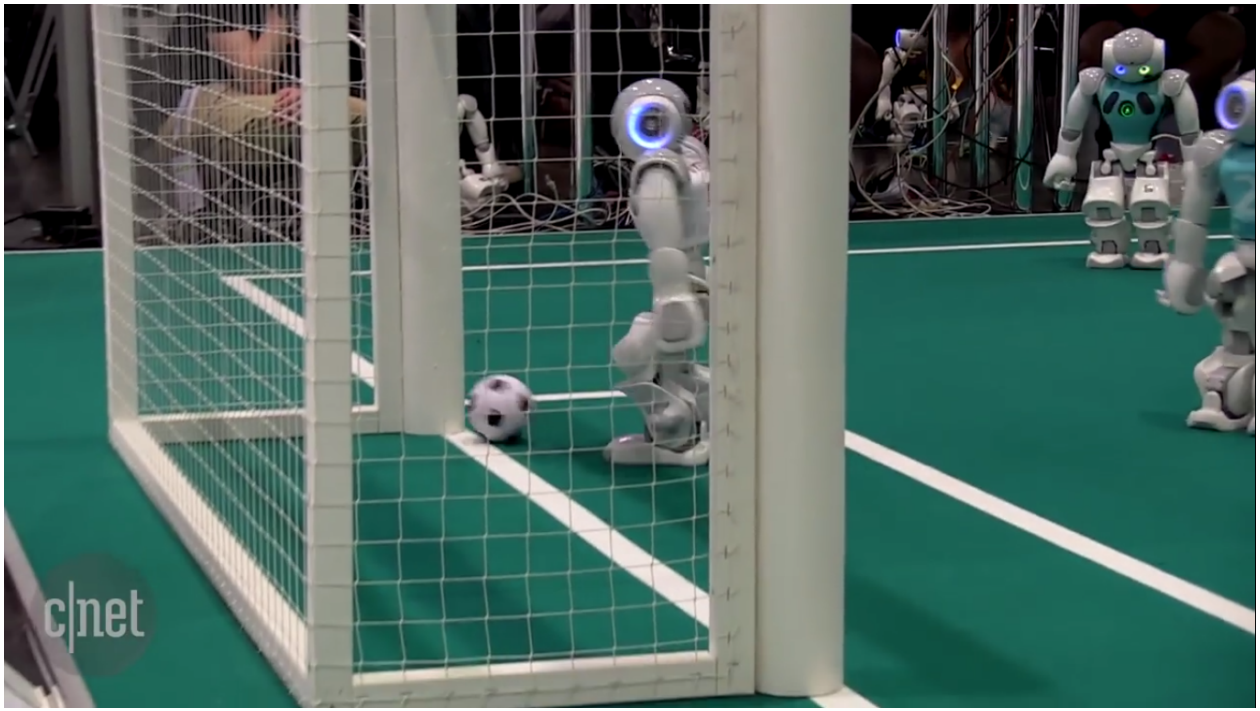




# Entertainement, Games and education: robocup



Robots that play football autonomously



# The long and winding road to AI...



...is full of epic failures!

# Course Plan I

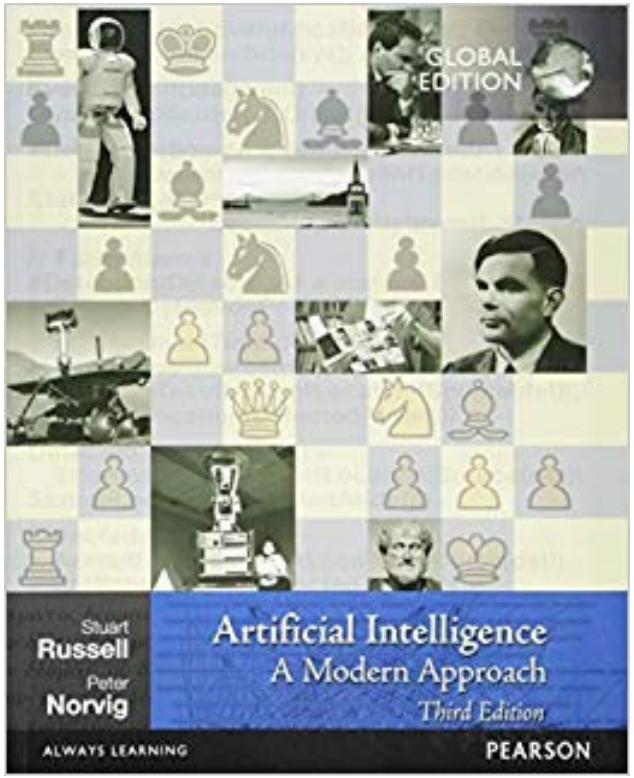
- Problem Solving: *Search* (about 6 lessons)
  - Uninformed search (Breadth first, Depth First, Iterative Deepening, etc.)
  - Informed Search (A*, Heuristics, Local Search and Optimization)
- Constraint Processing (CSP, COP) (about 6 lessons)
  - Contraint Satisfaction Problems, Constraint Network and Graphical models
  - Basic techniques for CSP (Consistency enforcing, Local Search)
  - Tree-Decomposition (Dynamic Programming)
  - Constraint Optimisation Problems

# Course Plan II

- Probabilistic Reasoning (about 8 lessons)
  - background on Probability
  - Markov Decision Processes
  - Reinforcement Learning
  - Deep Reinforcement Learning
- Programming laboratory (about 6 lessons)
  - Implement state-space search techniques
  - Implement solution techniques for Markov Decision Processes
  - Implement solution techniques for Reinforcement Learning and Deep Reinforcement Learning

# Text books: Main Reference

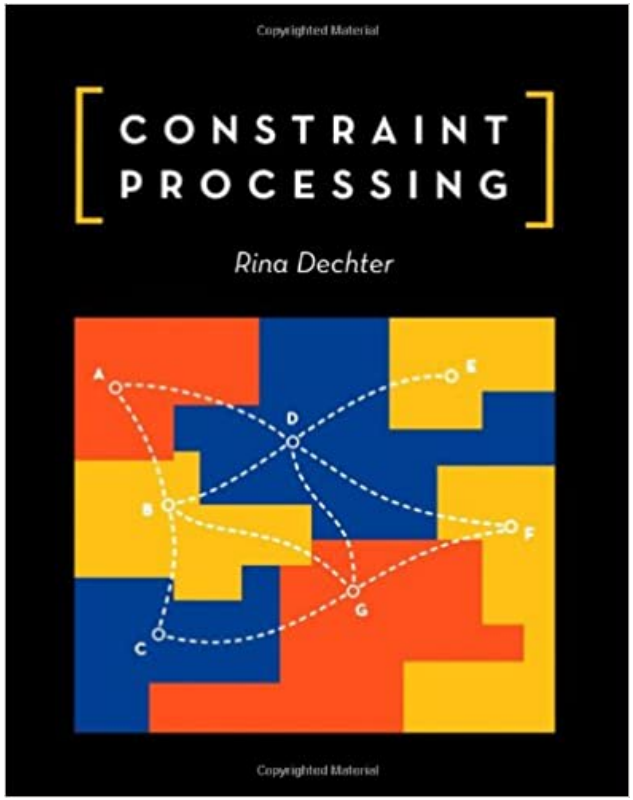





*Artificial Intelligence: a modern approach (3rd Editon); Stuart Russel and Peter Norvig (English edition)*

# Text books: Constraint Processing

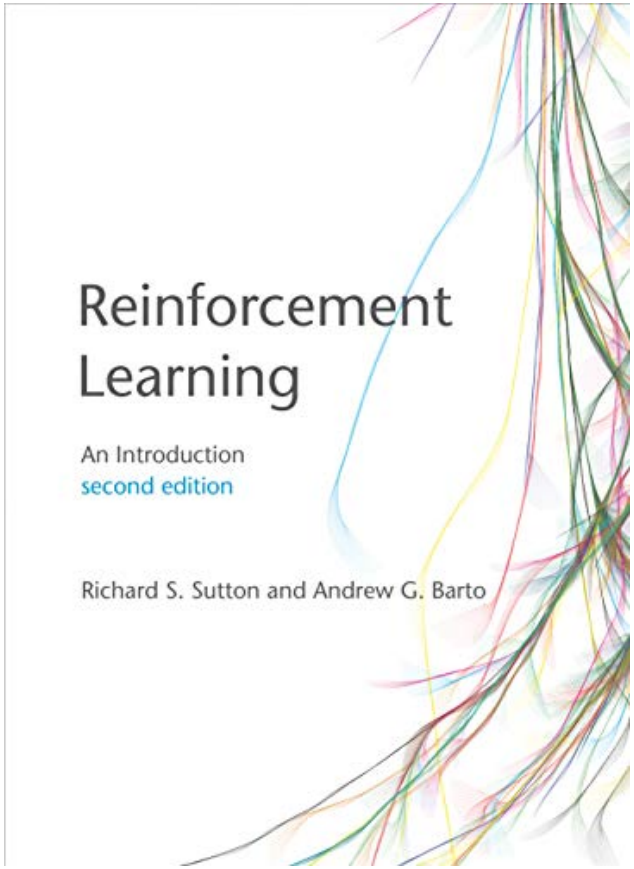





*Constraint Processing; Rina Dechter*

# Text books: Reinforcement Learning






*Reinforcement Learning: an introduction (2nd Edition); Richard S. Satto and Andrew G. Barto*

# Resources: other material



- Scientific Papers, Slides, etc.
- Will be available on moodle and on course web site

Web Page link

# Exam modalities



- Oral test
  1. oral test on topics studied during the course (including the programming lab);
     - exercises and questions to evaluate the level of comprehension of the topics covered during the course.
  2. oral test on a specific project assigned by the teacher (and on the programming lab).
     - presentation of the project (see next slides) plus questions.
- Programming lab: questions to assess the level of understanding of the delivered software (see next slides).

# 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;
  - Projects usually involve a programming part (in the language most appropriate for the project);
  - Students will present the project during the oral test and deliver the developed code;
  - Possible Project Ideas
  - Ask for more info if interested.

# Programming Lab



- Goal: hands on exercise for key topics (state space search, MDPs, RL, DRL);
- Based on a public available platform to develop AI projects (OpenAI);
- Instructor will describe the exercises, student will implement the software;
- Tutor will help students to develop the code;
- Questions during oral test to assess level of comprehension of the delivered code.