COMP329 Robotics and Autonomous Systems

Session: 2017-2018

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UNIVERSITY OF LIVERPOOL

What is a robot?

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Original Source: M. Wooldridge, S.Parsons, D.Grossi - updated by Terry Payne, Autumn 2016/17

What is a robot?

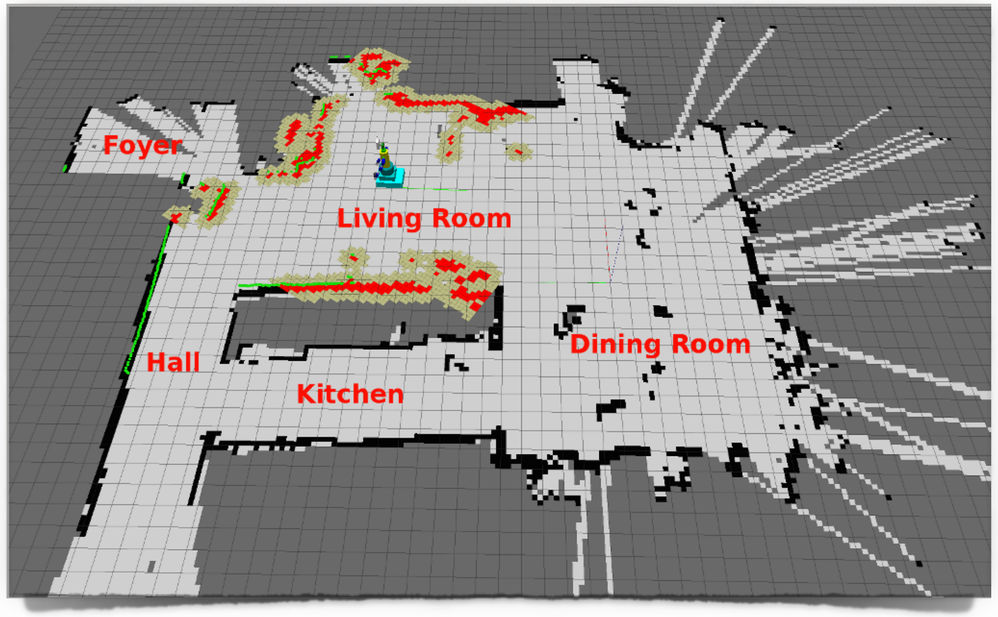

Boston Dynamics

Module Aims

- Complements the concepts taught in COMP310
  - Agents as rational decision makers
  - Deliberative vs Reactive Agents
  - Hybrid Systems
- Greater focus on how agent frameworks facilitate autonomy
  - Introduces agent development frameworks such as AgentSpeak

Two Strands

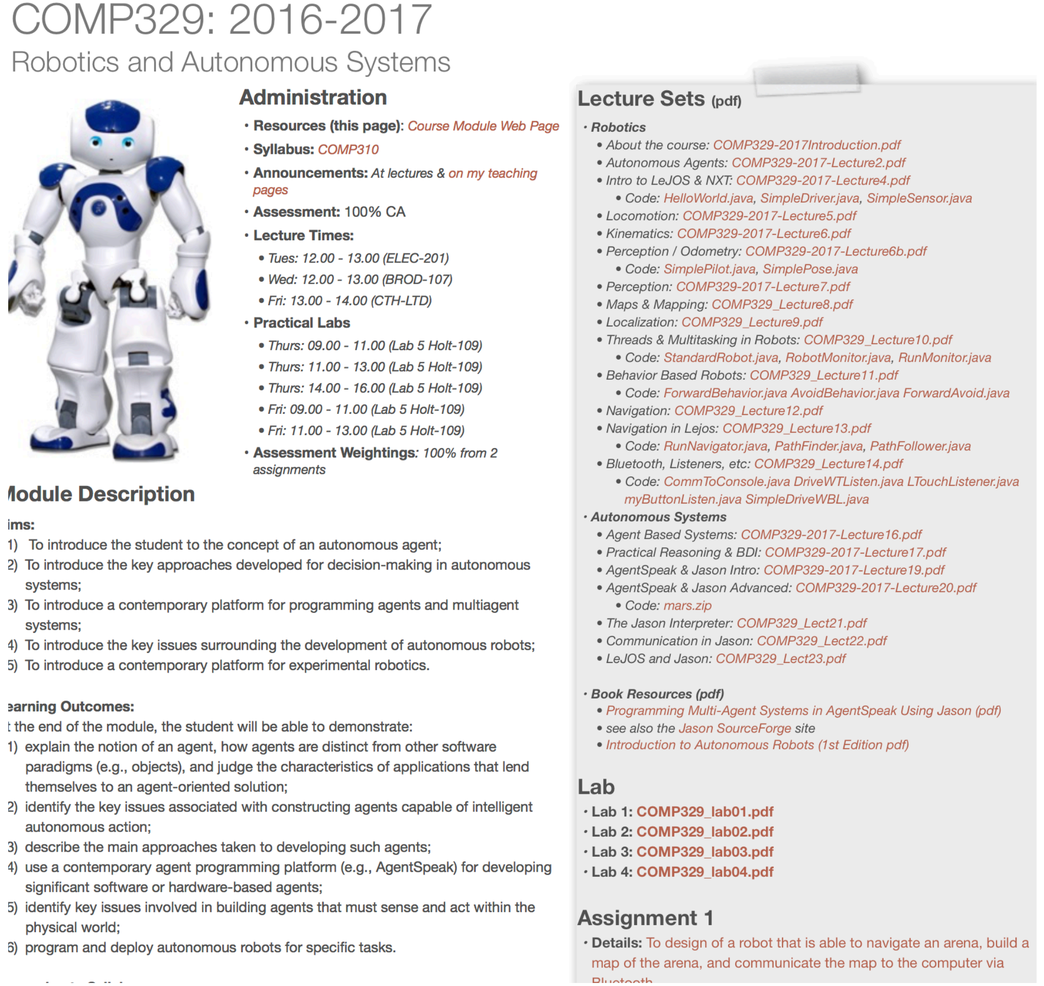
- Principles of Robotics
  - Sensors & Actuators
  - Locomotion & Kinematics
  - Path Planning & Obstacle Avoidance
  - Localisation & SLAM
    - Simultaneous Location and Mapping



- Principles of Autonomous Agents
  - Agent control loop and modelling runs
  - Subsumption Model & BDI Architectures

General Admin

- Lecturer: Dr Terry Payne
  - Ashton Building
  - Email: T.R.Payne@liverpool.ac.uk
    - Surgery: Mon/Tues/Thur (email for appointment)
- Course Notes
  - Available from the web site as pdfs
    - Lectures will be screen cast and available from the web sites
- Web Site and Resources
  - General information
    - http://www.csc.liv.ac.uk/people/trp/COMP329.html



COMP329: 2016-2017

Robotics and Autonomous Systems

Administration

- **Resources (this page):** *Course Module Web Page*
- **Syllabus:** *COMP310*
- **Announcements:** *At lectures & on my teaching pages*
- **Assessment:** 100% CA
- **Lecture Times:**
  - *Tues: 12.00 - 13.00 (ELEC-201)*
  - *Wed: 12.00 - 13.00 (BROD-107)*
  - *Fri: 13.00 - 14.00 (CTH-LTD)*
- **Practical Labs**
  - *Thurs: 09.00 - 11.00 (Lab 5 Holt-109)*
  - *Thurs: 11.00 - 13.00 (Lab 5 Holt-109)*
  - *Thurs: 14.00 - 16.00 (Lab 5 Holt-109)*
  - *Fri: 09.00 - 11.00 (Lab 5 Holt-109)*
  - *Fri: 11.00 - 13.00 (Lab 5 Holt-109)*
- **Assessment Weightings***: 100% from 2 assignments*

lodule Description

ims:

1) To introduce the student to the concept of an autonomous agent;
2) To introduce the key approaches developed for decision-making in autonomous systems;
3) To introduce a contemporary platform for programming agents and multiagent systems;
4) To introduce the key issues surrounding the development of autonomous robots;
5) To introduce a contemporary platform for experimental robotics.

arning Outcomes:

the end of the module, the student will be able to demonstrate:

1) explain the notion of an agent, how agents are distinct from other software paradigms (e.g., objects), and judge the characteristics of applications that lend themselves to an agent-oriented solution;
2) identify the key issues associated with constructing agents capable of intelligent autonomous action;
3) describe the main approaches taken to developing such agents;
4) use a contemporary agent programming platform (e.g., AgentSpeak) for developing significant software or hardware-based agents;
5) identify key issues involved in building agents that must sense and act within the physical world;
6) program and deploy autonomous robots for specific tasks.

Lecture Sets (pdf)

- ***Robotics***
  - *About the course: COMP329-2017Introduction.pdf*
  - *Autonomous Agents: COMP329-2017-Lecture2.pdf*
  - *Intro to LeJOS & NXT: COMP329-2017-Lecture4.pdf*
    - *Code: HelloWorld.java, SimpleDriver.java, SimpleSensor.java*
  - *Locomotion: COMP329-2017-Lecture5.pdf*
  - *Kinematics: COMP329-2017-Lecture6.pdf*
  - *Perception / Odometry: COMP329-2017-Lecture6b.pdf*
    - *Code: SimplePilot.java, SimplePose.java*
  - *Perception: COMP329-2017-Lecture7.pdf*
  - *Maps & Mapping: COMP329_Lecture8.pdf*
  - *Localization: COMP329_Lecture9.pdf*
  - *Threads & Multitasking in Robots: COMP329_Lecture10.pdf*
    - *Code: StandardRobot.java, RobotMonitor.java, RunMonitor.java*
  - *Behavior Based Robots: COMP329_Lecture11.pdf*
    - *Code: ForwardBehavior.java AvoidBehavior.java ForwardAvoid.java*
  - *Navigation: COMP329_Lecture12.pdf*
  - *Navigation in Lejos: COMP329_Lecture13.pdf*
    - *Code: RunNavigator.java, PathFinder.java, PathFollower.java*
  - *Bluetooth, Listeners, etc: COMP329_Lecture14.pdf*
    - *Code: CommToConsole.java DriveWTListen.java LTouchListener.java myButtonListen.java SimpleDriveWBL.java*
- ***Autonomous Systems***
  - *Agent Based Systems: COMP329-2017-Lecture16.pdf*
  - *Practical Reasoning & BDI: COMP329-2017-Lecture17.pdf*
  - *AgentSpeak & Jason Intro: COMP329-2017-Lecture19.pdf*
  - *AgentSpeak & Jason Advanced: COMP329-2017-Lecture20.pdf*
    - *Code: mars.zip*
  - *The Jason Interpreter: COMP329_Lect21.pdf*
  - *Communication in Jason: COMP329_Lect22.pdf*
  - *LeJOS and Jason: COMP329_Lect23.pdf*
- ***Book Resources (pdf)***
  - *Programming Multi-Agent Systems in AgentSpeak Using Jason (pdf)*
  - *see also the Jason SourceForge site*
  - *Introduction to Autonomous Robots (1st Edition pdf)*

Lab

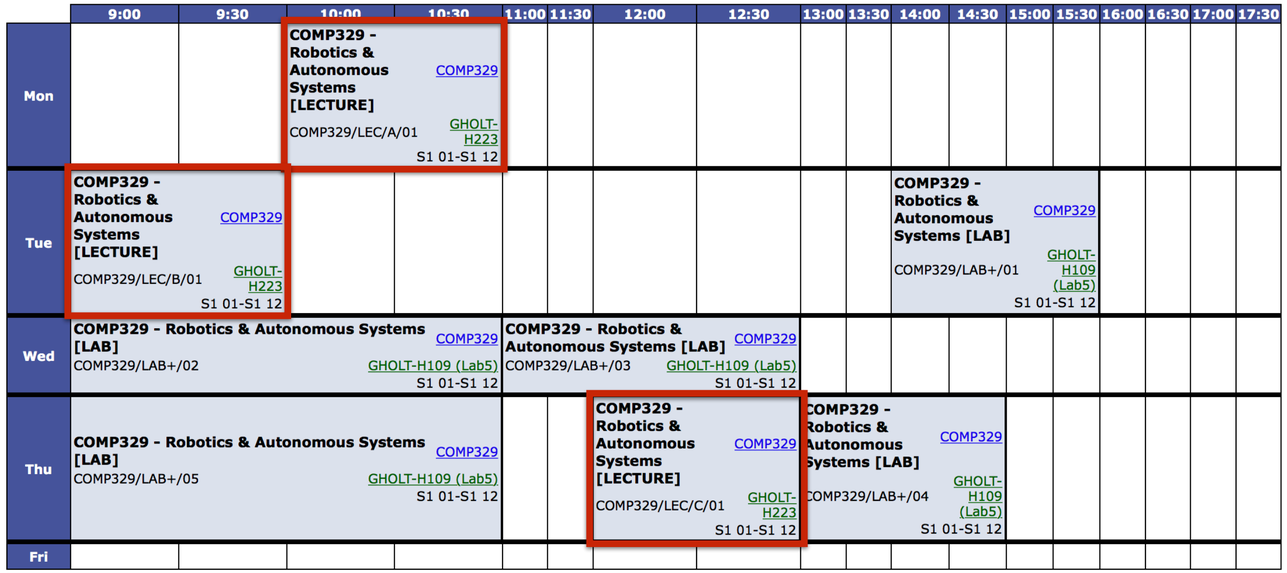
- **Lab 1: COMP329_lab01.pdf**
- **Lab 2: COMP329_lab02.pdf**
- **Lab 3: COMP329_lab03.pdf**
- **Lab 4: COMP329_lab04.pdf**

Assignment 1

- **Details:** To design of a robot that is able to navigate an arena, build a map of the arena, and communicate the map to the computer via

Module Delivery

- Lectures / Labs
  - Lectures in Holt 223
  - Supervised Lab Sessions in Robot Lab
    - Four Robot Bays for testing
    - Eight PCs (+ spare)
  - Lab Capacity for Assessed Work
    - 8 groups max at any time, with groups taking turns using the bays
  - RoboSym - Robot Simulator
    - Java libraries to support prototyping solutions without the need for EV3
- Assessment
  - Groups of 3 students
  - 2 Assignments worth 50% each
    - Joint Demonstration
    - Individual Report



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Assessment Details

- Two assignments (combined weight 100%) to be carried out in teams
  - The first assignment will be published end of Week 2
    - Provisional deadline: 3rd Nov (week 6)
  - The second assignment will be published end of Week 7
    - Provisional deadline: 10th Dec (week 11)
  - Each assignment is worth 50%

- Each assignment includes a demo component (organised on the Wednesday after submission deadline)
  - Teams are decided by the lecturer and are non-negotiable
  - The individual mark for each assignment will depend on:
    - Team Report / Individual Report / Demo Performance and Q&A / Peer Review

Module Structure

- PART 1: Robotics
  - Principles of robotics
    - Modelling paradigms
    - Perception & Odomotory
    - Locomotion & Kinematics
    - Path planning and obstacle avoidance
    - Mapping and localisation
  - the EV3 platform, and the LeJOS programming language.
- PART II: Autonomous systems
  - Principles of agent theory
    - Beliefs Desires Intention
    - Subsumption Architecture
    - Robots viewed as agents (autonomous systems), and
  - the Jason programming language, agent coordination.

Module Aims

- Module Aims
  - To introduce the student to the concept of an autonomous agent
  - To introduce the key approaches developed for decision-making in autonomous systems;
  - To introduce a contemporary platform for programming agents and multiagent systems;
  - To introduce the key issues surrounding the development of autonomous robots;
  - To introduce a contemporary platform for experimental robotics.

- Assessed through the two coursework assignments

Module Objectives

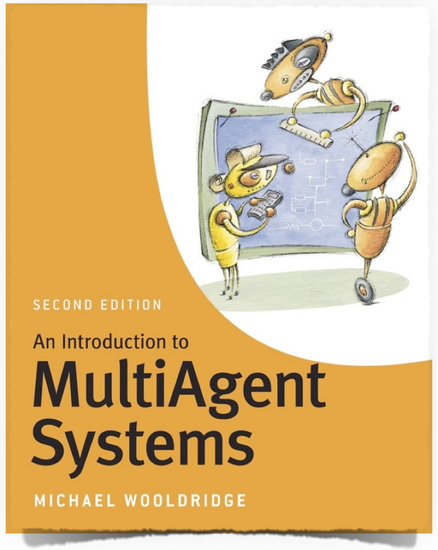
- At the end of the module, the student will be able to demonstrate:
  - Explain the notion of an agent, how agents are distinct from other software paradigms (e.g., objects), and judge the characteristics of applications that lend themselves to an agent-oriented solution
  - Identify the key issues associated with constructing agents capable of intelligent autonomous action
  - Describe the main approaches taken to developing such agents
  - Use a contemporary agent programming platform (e.g., AgentSpeak) for developing significant software or hardware-based agents
  - Identify key issues involved in building agents that must sense and act within the physical world
  - Program and deploy autonomous robots for specific tasks

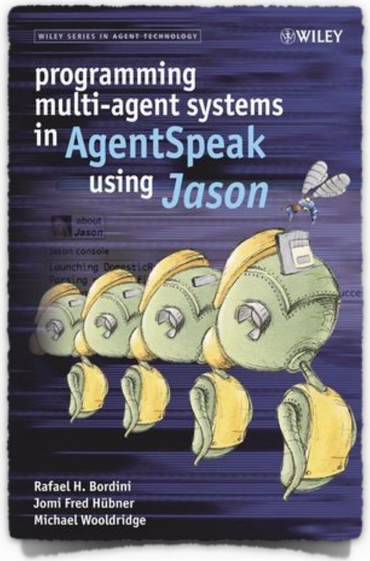
Soft Skills

- You will be able to practice how to work in groups:
  - discussing solutions together
  - distributing tasks and managing time
  - giving and keeping deadlines
  - respecting each others ideas
- You will be able to practice how to manage a computer science project spanning over several weeks
  - planning ahead
  - keeping track of design challenges and choices made
- Don’t underestimate the challenge of either of these aspects.

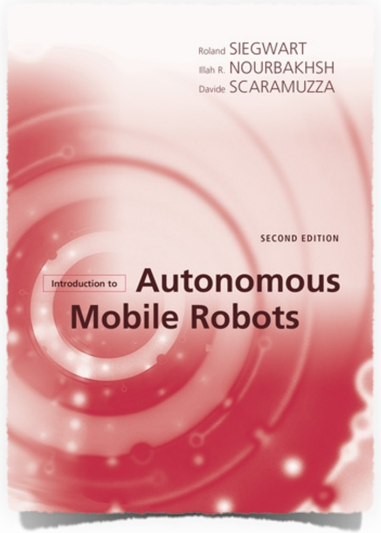
Course Texts

- Much of this module is based on Michael Wooldridge's book:
  - An Introduction to MultiAgentSystems
  - Wiley 2009
    - http://www.cs.ox.ac.uk/people/michael.wooldridge/pubs/imas/IMAS2e.html





- Other books worth checking…
  - Introduction to Autonomous Mobile Robots by Roland Siegwart, Illah R. Nourbakhsh and Davide Scaramuzza
  - Autonomous Robots: From Biological Inspiration to Implementation and Control by George A Bekey
  - Programming Multi-agent Systems in AgentSpeak Using Jason by Rafael H. Bordini, Jomi Fred Hubner and Michael Wooldridge



Finally

- The obvious...
  - Switch off all mobile phones during lectures
  - Do not sign the register on behalf of others
  - Attend lectures and attempt the exercises set - this will help you do the continuous assessments
  - Ask questions if there is anything that you do not understand

- And respect your fellow students...
  - There are people here who want to learn!
  - If you want to talk or mess around, then fine...
  - ...BUT do it somewhere else!