COMP0204: Introduction to Programming for Robotics and AI

Module Outline

Course lead: Dr Sophia Bano

MEng Robotics and AI
UCL Computer Science

What is a Computer?

- Computers are electronic devices that can follow instructions to **accept input**, **process that input**, and **produce information**.

- Alternatively, a computer is a device capable of performing calculations and making logical decisions at speeds millions, and even billions, of times faster than **human beings** can.

What is Software?

- A computer is an electronic device, operating under the control of **instructions (software)** stored in its own memory unit, that can accept data (input), manipulate data (process), and produce information (output) from the processing.

What does a Computer do?

Computers can perform four general operations, which comprise the information processing cycle.

Input
- Keyboard, Mouse, Scanner, Network/Internet

Process
- Software

Output
- Monitor, Printer

Storage
- RAM, Hard drive, Pen drive

Computers in Robotics

Microcontroller units (MCU)

Input

- Sensors (ultrasound, infrared, light, temperature, camera, etc)
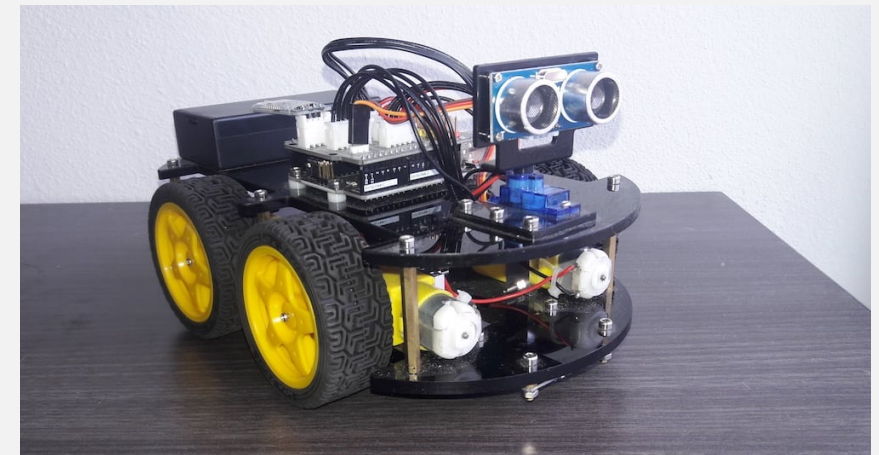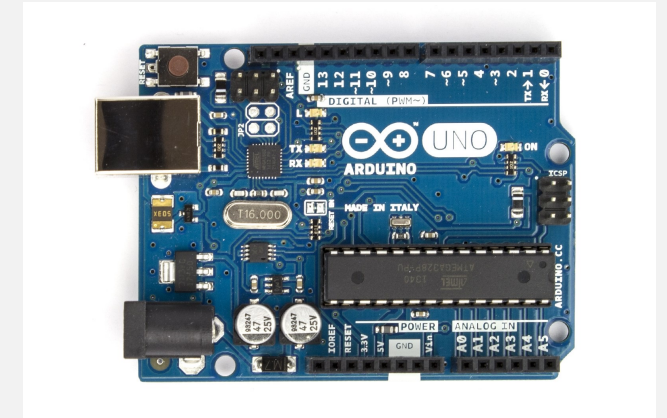
Output

- Actuators (motors, LEDs, display, buzzer)

Process

- Software

Storage

- Program memory (flash), RAM, SD cards etc

How does a Computer Know what to do?

- It must be given a detailed list of instructions, called a **computer program or software**, that tells it exactly what to do.

- Before processing a specific job, the computer program corresponding to that job must be stored in memory (RAM).

- Once the program is stored in memory the computer can start the operation by executing the program instructions one after the other.
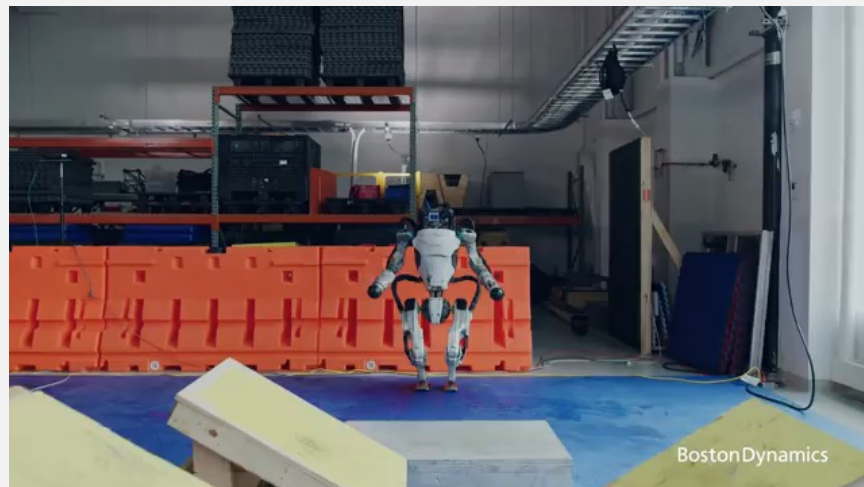
Why learn programming?

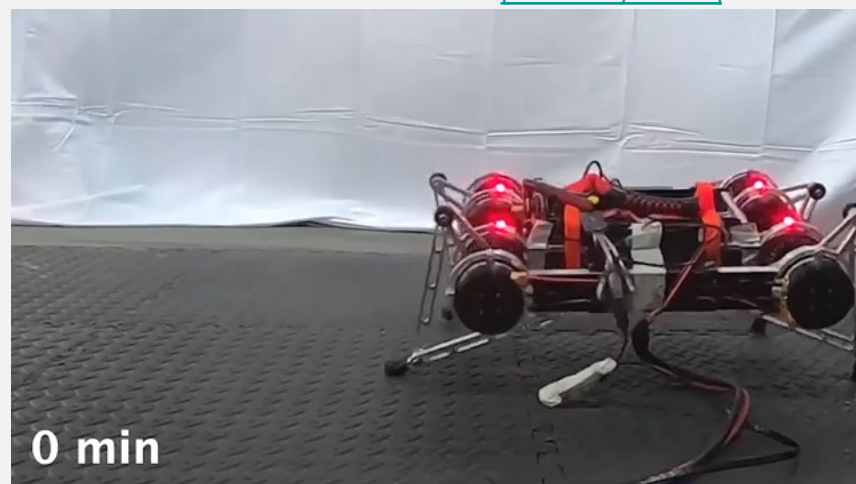Programming is the foundation for a successful robot deployment

- Turns your ideas into actions of the robot
- Way to effectively communicate with computers
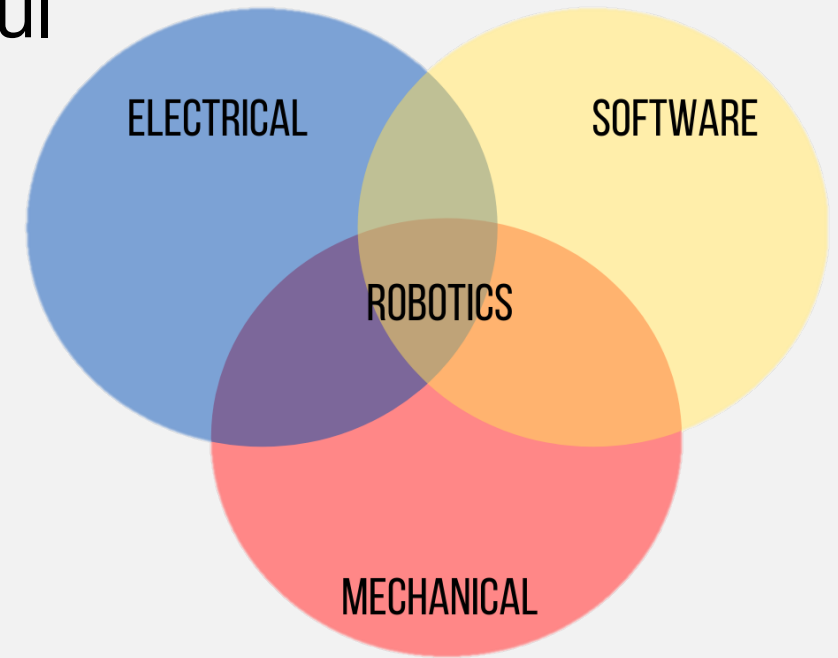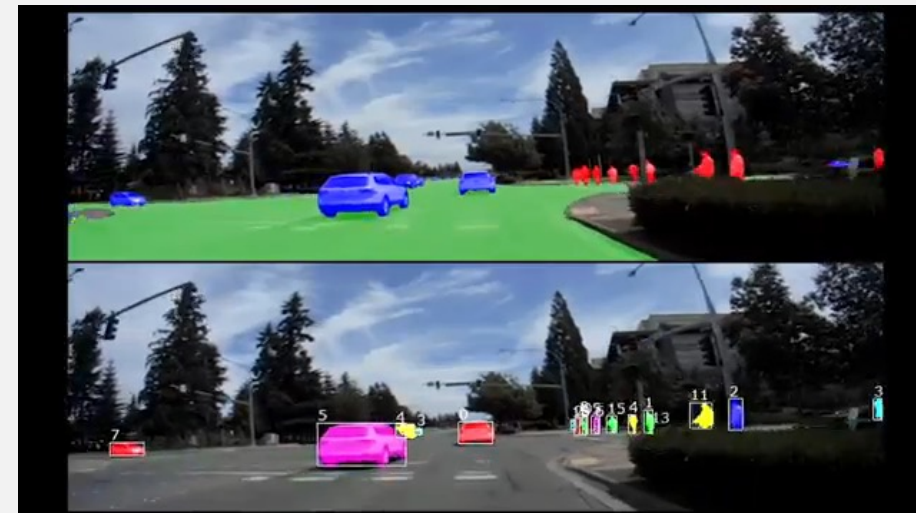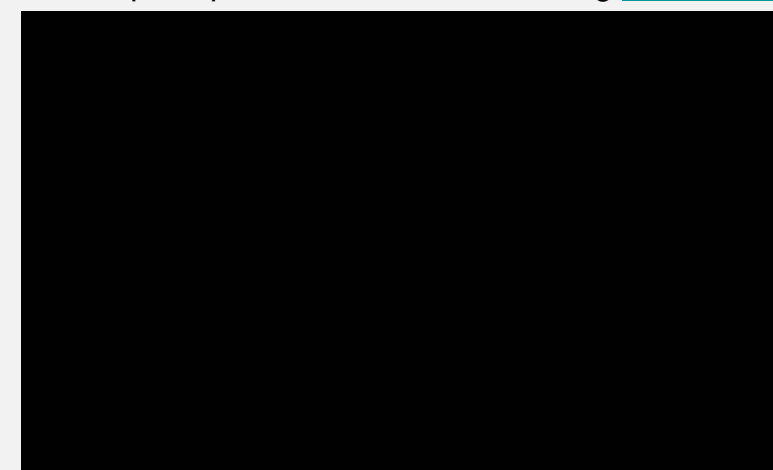
Robotics in Action

Humanoid robots in action [Boston Dynamics]

Learning to walk [Haarnoja et al. RSS 2019]

Visual perception for autonomous driving [NVIDIA DRIVE labs]

Da Vinci robot demo from Edward Hospital

Module's Aims

- Provide you with **enabling knowledge in fundamental concepts in programming** as applied to embedded microcontrollers.

- Support you in developing **problem solving, analysis and debugging** skills for implementing effective solutions to problems.

- Provide you **tools to carry out relevant critical analysis** of the effectiveness and efficiency of programs.

- Develop your **holistic understanding of the practical application** of theory and foundational knowledge of AI-based robotic systems

Learning Outcomes

On successful completion of the module, you will be able to:

1. Demonstrate the **ability to build programs** on the basis of a systematic decomposition of a problem.

2. Select and explain the **rationale behind the choices** made for appropriate techniques for use in implementing solutions.

3. Demonstrate increasingly developing **inventive and creative problem-solving skills** through a real-world project.

4. Demonstrate **critical understanding** of the role **mathematical** and **programming** knowledge plays in AI-based robotic systems.

Module Delivery

- Interactive lectures (2 hours/week)
- Lab/tutorial sessions (2 hours/week)

- Independent study – at least 3 hours/week

Meet the team

Dr Sophia Bano
(Module Lead)

Dr Igor Gaponov
(Module Deputy)

Dr Narsimlu Kemsaram
(Teaching Assistant)

Maria Stamatopoulou
(Teaching Assistant)

Alexander Saikia
(Teaching Assistant)

ROBOTICS
Innovation + Application

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Instructor and Textbooks

Instructor: Sophia Bano
Office: Room 206, One Pool Street
Email: sophiabano@ucl.ac.uk
Office hours: Mon. 16:00 - 17:00 Mondays (via Teams)

Textbooks:

• "The C programming language" by Brian W. Kernighan and Dennis M. Ritchie (1988)

• "C programming: absolute beginner's guide" by Greg M. Perry and Dean Miller (2014)

• The reading list is available here

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Module Communications

- **Announcements**
- **Ask a question forum**

Module Communications

Important information will be posted by staff in the **Announcements forum** and you will automatically receive an email notification for these. You cannot reply to these emails.

Please post any general queries relating to module content and administration **in the Q&A forum** instead of emailing staff directly. Others may respond more quickly and the response may benefit other students too.

If your query is **personal** or concerns **accessibility** (e.g. to **request an alternative format for any resource)** please contact staff directly.

If you do email staff, they will aim to respond within **3 working days** of receipt. Please do not expect them to reply outside normal working hours (Monday–Friday, 09:00–18:00 excluding public holidays and UCL closure periods), and make sure to include your student ID number, and the module/assessment the query relates to.

Please be courteous in your communications with staff and fellow students.

💬 **Announcements**

Forum for important news and announcements. Only staff can post here.

💬 **Ask a question**

Students can use this forum to ask (or answer) a question about the module as a whole, e.g. guidance you don't understand, the resources available, etc. Staff will check the forum weekly and respond to any unanswered questions or provide clarity where needed.

Assessment Methods

- Six programming assessments (12+12+12+12+12+20 = 80%)
- **Project – term 3**(report and practical – 20%)
- **First assessment:** 16th Oct (10am during the lab session)

Assessments

- cover topics covered during lectures and labs
- take place during lab sessions **(be on time**) – see schedule on Course Moodle

Topics

- Introduction to C programming
- Variables, Data Types and Operators
- Control structures
- Functions and modular programming
- Pointers and Memory Management
- Data structures
- File handling in C
- Multithreading and concurrency