Ulster University
School of Computing, Engineering and Intelligent Systems

Promoting STEM via Robotics Based Programming

FoE 2018 – Florence, Italy

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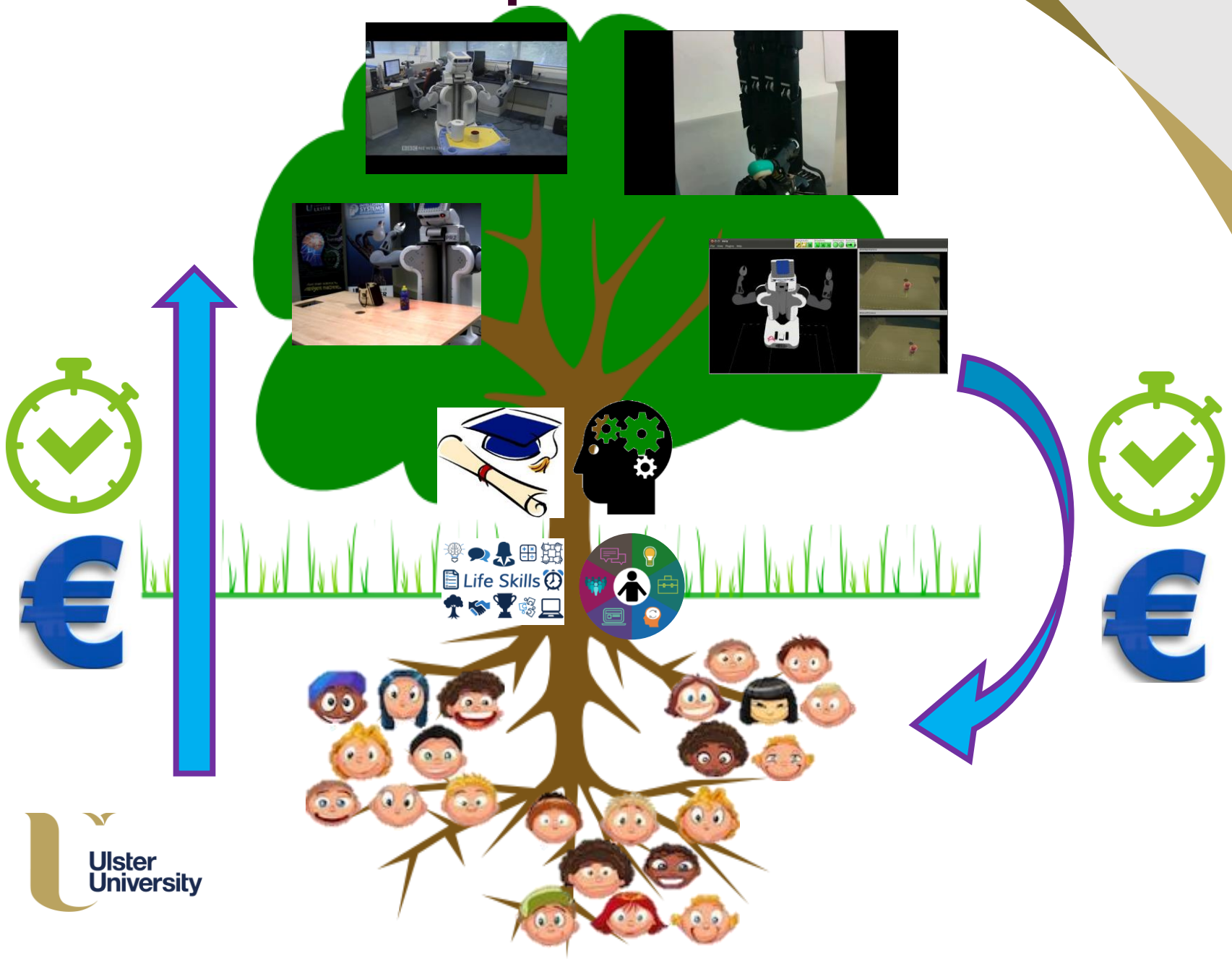
Motivation – You Reap What You Sow!!



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Investing In Our Future

"Learning to write programs stretches your mind, and helps you think better, creates a way of thinking about things that I think is helpful in all domains." - Bill Gates

- Programming or coding is the process of developing sets of instructions (computer programmes) that enable computers to carry out tasks.
- Over the past 7 years there has been a 31% increase in the number of students (1450) taking the United Kingdom's GCE A-Level Information, Communication and Technologies (ICT) which does not include programming [1].
- New A-Level Software Systems Development course, which includes programming, attracted only 37 candidates in the same year [2].

[1] C. Perry, "Coding in Schools," 2015. [Online]. Available: http://www.niassembly.gov.uk/globalassets/documents/raise/publications/2015/education/3715.pdf.

[2] M. O'Kane, "Coding in the Northern Ireland Curriculum," 2016. [Online]. Available: http://www.iteach-uk.com/coding-in-the-northern-ireland-curriculum.

Investing In Our Future

- Northern Ireland is the leading foreign direct investment region in Europe for software development and IT technical support centres [3].
- There are more than 900 companies in the ICT sector and many of these are international organisations.
- Rise of Big Data analysis
- Inspire young people to stay in school
  - Inform them of benefits of staying in education (£100,000 more over their lifetime) [4]
  - Enable young people to participate in courses and training in school that enables them to make informed decisions
- It is against this backdrop that we need to promote secondary level programming education

[3] InvestNI, “InvestNI Sectors.” [Online]. Available: https://www.investni.com/international/europe/fdi.html.

[4] D. Council, “Derby Council Leaving School Education Report,” 2018. [Online]. Available: https://www.derby.gov.uk/education-and-learning/post-16/leaving-school/.

Widening Access Robotics Programming (WARP)

- The WARP program introduced programming into secondary schools in a fun and novel way, upgrading WABIPS program.
- Learning university and industry standard programming languages (e.g., Java) and using them to program a Lego Mindstorms EV3.
- Visual demonstration inspires students to learn programming and help students understand programming in a practical manner.
- Students gain confidence and be inspired to select IT related A-Levels and continue to tertiary education.

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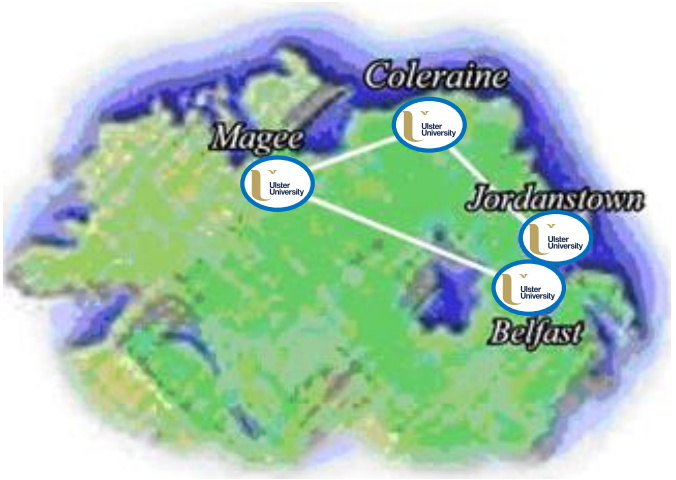
WARP for All

Three key issues were identified in the Ulster University's Widening Access Audit: non-completion, gender imbalance and religious imbalance.

- Widening access has been a policy priority within the UK since 1997.
- Schools for WARP were selected in line with underrepresented groups within STEM subjects in HE ensuring the representation of students from:
  - state schools;
  - lower socio-economic groups;
  - low participation neighbourhoods;
  - Female schools



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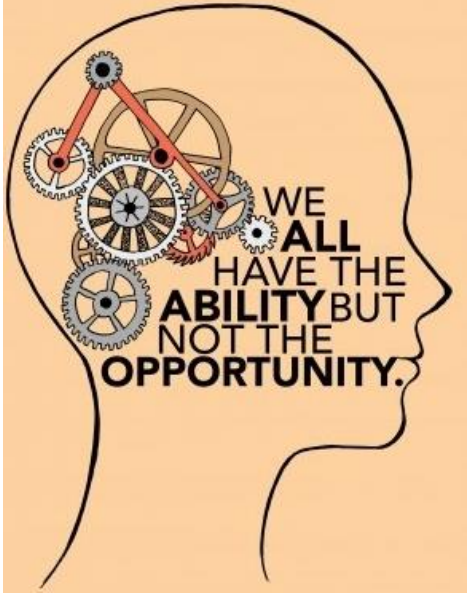
WARP for All

"Education is the most powerful weapon which you can use to change the world." - Nelson Mandela

- Three separate 3-day interactive workshops (outside of classroom time)
- Three different schools covering different demographics:
  - Female secondary school with invited students from other local female secondary schools
  - Protestant school with students from other local Protestant and multi-cultural schools
  - Secondary school in a lower socio-economic area of NI with invited students from other schools in the area



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Aims of WARP

"I would encourage you: be informed – knowledge is power!" – Matt Bevin

- Teach fundamental programming concepts in a fun and interactive way, providing students with sufficient knowledge to help them to make informed decisions on their career
- Improve the employability of young people in Northern Ireland and the UK - Under-supply of Engineering and Technology, Maths and Computer Science graduates to 2026 in NI [5].
- Address the issue of non-completion or failure of first year students on STEM related degree programmes, in turn, lowering the rate of non-completion.
- Reduce gender and religious imbalance in applications to STEM courses

Gender breakdown of entrants to SCEIS				
	2016/17 (#students)	2016/17 (%)	2017/18 (#students)	2017/18 (%)
Female FT	49	23.4 %	32	18.5 %
Female PT	1	25.0 %	0	0.0 %
Male FT	160	76.6 %	141	81.5 %
Male PT	3	75.0 %	5	100.0 %

[5] Ulster University, "Northern Ireland 2017 Skills Barometer - 'Skills in Demand,'" 2018. [Online]. Available: https://www.ulster.ac.uk/__data/assets/pdf_file/0020/181406/NI-Skills-Barometer-2017-Summary-Report.pdf.

WARP Structure

"Personally, I am always ready to learn although I do not always like being taught." – Winston Churchill

- Introduction to Java – outlining major benefits and uses
- Brief presentation about the fundamentals that would be learnt that day
- Students work through interactive examples of each core concept and write functioning programs
  - PhD Students providing hands-on support
- At the end of each subject, they write another piece of their robot code

```
//Remember to use comments
public class Me
{
        public static void main(String [] args)
        {
            System.out.print("I am called _________"); //first name
            System.out.println(" _________________."); //surname
            System.out.print("I am a pupil at _________.\nI have just started
                programming in Java!");
        }
}
```

Robot Code

Add a line to your robot code that will display another line of information on the robot screen that will inform the user about who wrote the program. You should have a String variable in your code called something like "developer" and you can assign your own first name to this variable.

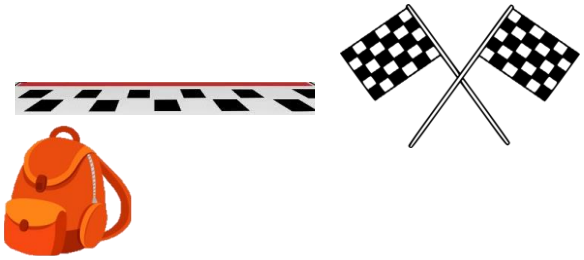
Your program should now display the information like this:

Drive Forward and Stop!!!
Programmed by Wall-E
Press any key to start

Robot Competition

"I have been up against tough competition all my life. I wouldn't know how to get along without it." - Walt Disney

- On the last day they implement the code onto their robot
- Basic navigation task set up
- Each group of students competed to complete the course in the quickest possible time
  - Peer Assisted Learning



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Evaluation Method

"Feedback is among the most powerful influences on achievement."– John Hattie

- A novel mix of a happy sheet and minute paper was used at the end of each session
- Inspired students to complete it as it was fast and easy to do
- Informed us what we can focus more energy on at the next session

My key learning today is:

_____

_____

_____

An area I would like more input on is:

_____

_____

_____

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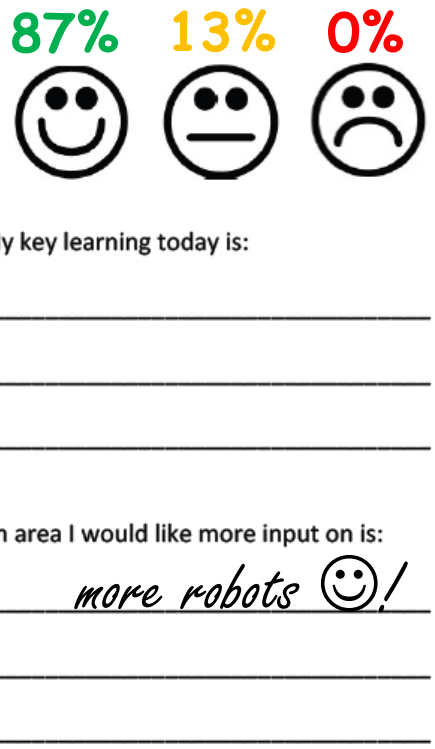
Feedback

"We all need people who will give us feedback. That's how we improve." – Bill Gates

- Zero students felt they were unhappy with the course
- 13% had neutral feelings about it
- 87% of students were positive about their learning throughout the course.



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Verbal Feedback

"if it was my job every day to program robots, I wouldn't even feel like it is work because I enjoy it so much" – Happy student!

- The majority of students said they had no doubt that they would be applying for a STEM based degree and in particular Computer Science
- A lot of students also stated that although they may not have previously considered Ulster University for a Computer Science degree, they would now apply to attend a degree at Ulster University

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Future Work

- Host a similar workshop this year
- Measure the success of students in our courses who participated in WARP
- Analyse if WARP helped them choose the correct course
- Investigate the potential of running similar style courses in engineering

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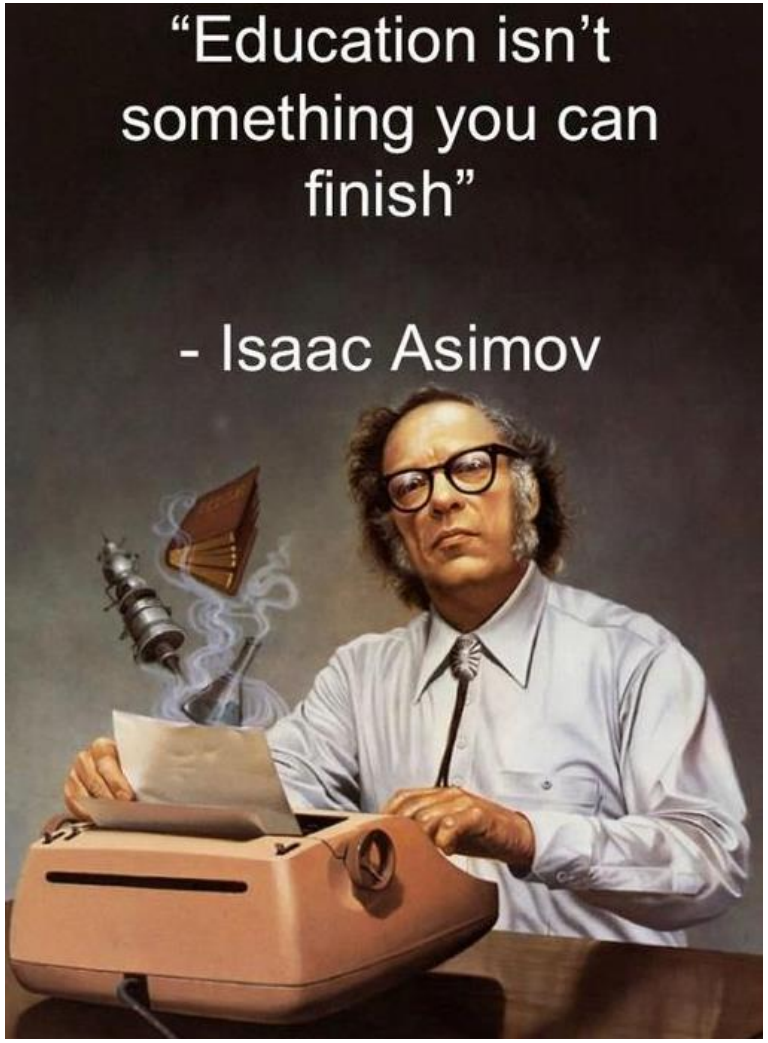
STEM

Questions?

- Thank you for listening and remember……



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