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Is WALL-E Human? : Introducing STEM and ethical decision-making to younger audiences

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1. Motivation

Robogals, a global organisation that empowers, inspires, and engages young people, particularly girls, in STEM by running free workshops, aims to decrease the STEM gender gap, where only 21% of the UK workforce are women [4]. This is particularly necessary in Computer Science, where women are negatively affected by biased algorithms [2], smart devices [1], and in software engineering [3]. Given that technology is not value neutral, ethical decision-making should be taught simultaneously in diversifying STEM.

2. Diversity and Ethics in Education

Increased awareness of the STEM gender gap has prompted investment in equality from non-profits such as Code First: Girls, Robogals, and Stemettes. Recent dilemmas in research ethics, data protection, and robotic legal personhood has led to universities including STEM ethics courses. While diversity and ethics are both goals within STEM, the topics are dealt with separately. As controversies within these disciplines impact women in society, an inclusive and ethical STEM education should happen simultaneously.

3. Robogals St Andrews Annual Report

Robogals St Andrews
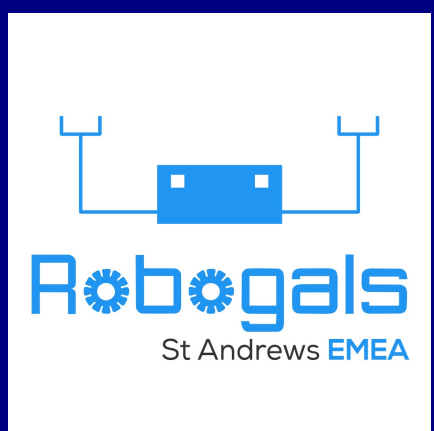
Robogals St Andrews Annual Report 2018

Established in January, over the course of 4 weeks, Robogals St Andrews …

Reached 250+ kids across Fife

Taught 11 sessions at 6 schools

Attended the SINE Conference Robogals EMEA

Represents 1 of 2 Scottish Chapters out of 35+ globally

Communicated with **Scottish Schools Education Research Centre** to inspire STEM educators

Increased 82% girls' interest in future STEM participation

Received support for & will present Robogals' teaching experience at the **Association for Computing Machinery womENcourage 2018 Conference**

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4. Robogals St Andrews Workshops

Robogals St Andrews encourages diversity and ethics in STEM. Volunteers teach students how to build robots and understand programming languages through ethical lenses. For example, by asking 'Is WALL-E human?', children broaden their understanding of robots' capabilities, developing the ability to build ethical systems. Robogals St Andrews teaches classes of all genders, with special attention for girls. Within 4 weeks, Robogals St Andrews taught 11 STEM workshops to 252 primary school children, of which 58% identified as female. 82% girls showed interest in future STEM participation. 99% enjoyed the workshops. Class teachers were surprised by girls' interest, suggesting the importance of increased exposure and encouragement for STEM participation.

HELLO WORLD: MACHINE WAY
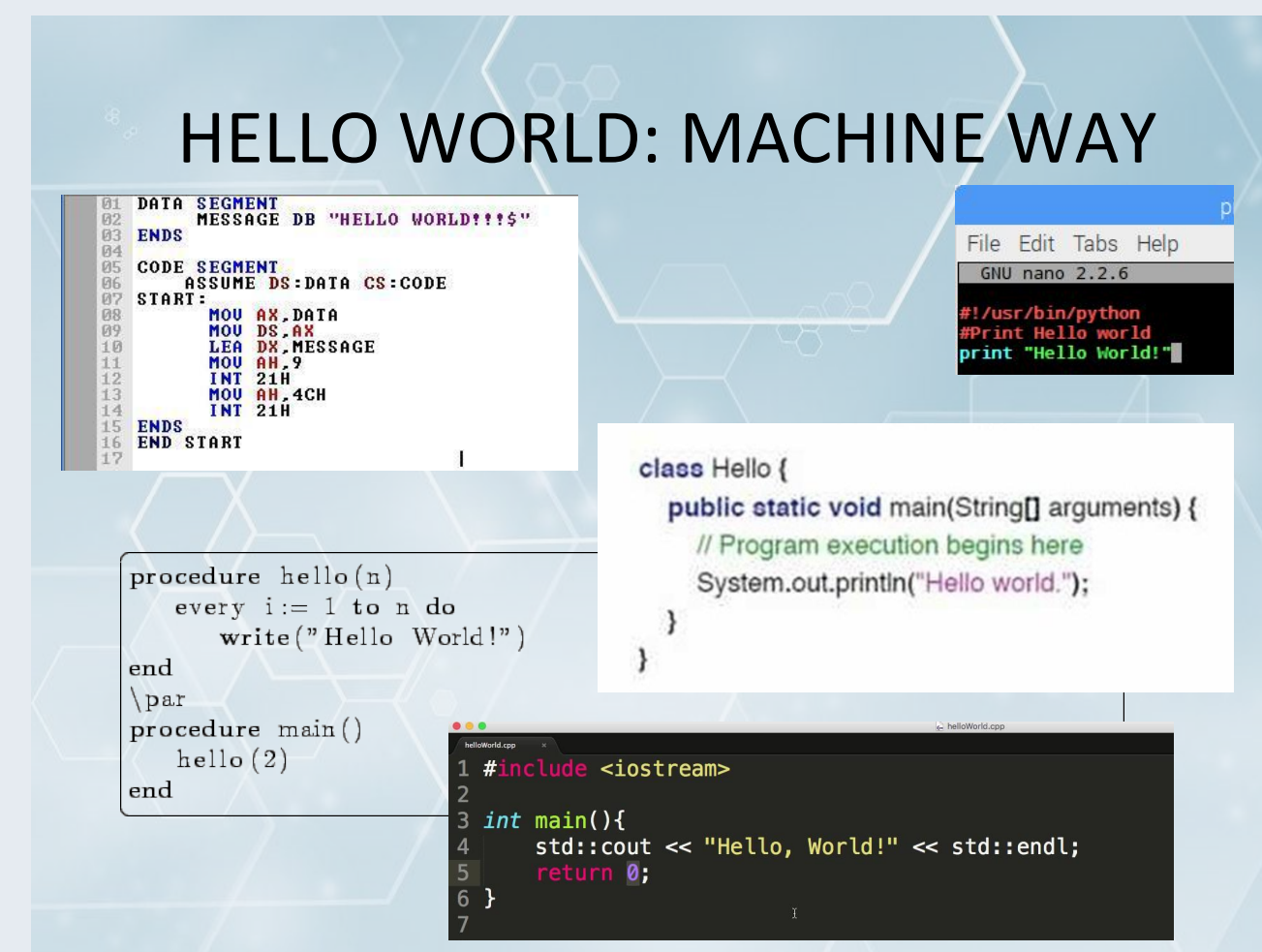
- Some programming languages are simpler for humans
- Some are harder

AND THIS IS HOW WE WRITE HELLO WORLD IN HASKELL

- We will use a simple one for this workshop

TASKS FOR YOUR ROBOT

1. Go forward for 5 seconds
2. Go forward infinitely
3. Go forward infinitely until sensor is activated and then stop
4. Go forward infinitely until sensor is activated and then reverse until sensor is activated and then reverse…
5. Go forward infinitely until sensor is activated and then reverse

5. Suggestions for Teaching Younger Audiences

Primary school education in important for encouraging girls in STEM. Greater appreciation of ethics is essential to prepare future generations for the challenges to be faced in our data-driven society. Suggestions include:

1. **Ask open-ended questions:** 'What if…', 'Should…', and 'Is it right if…'.
2. **Support independent thinking,** explaining concepts in detail with clarifications as necessary by encouraging question asking.
3. **Recognise effort,** using inclusive language to dismantle gendered norms.
4. **Promote agency,** using phrases that go beyond technological capabilities such as 'It can *if you want it to.*' and 'If *you program it to.*'
5. **Relate ethical dilemmas to everyday problems,** normalising decision-making, such as mapping robotic decisions to making a cup of tea.

Acknowledgements

References

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[2] Schiebinger, L., Klinge, I., Sánchez de Madariaga, I., Paik, H. Y., Schraudner, M., and Stefanick, M. Gendered innovations in science, health & medicine, engineering and environment, 2015. https://genderedinnovations.stanford.edu.

[3] Terrell, J., Kofink, A., Middleton, J., Rainear, C., Murphy-Hill, E., Parnin, C., and Stallings, J. Gender differences and bias in open source: Pull request acceptance of women versus men. *PeerJ Preprints 4* (July 2016), e1733v2.

[4] WISE. Women in the STEM workforce 2016, 2016. https://www.wisecampaign.org.uk/statistics/women-in-the-stem-workforce-2016/.