



Maynooth University Computational Thinking Transition Year Module

Introduction for teachers

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<https://pact.cs.nuim.ie>

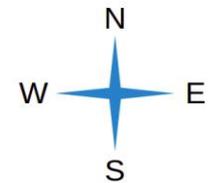
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Computational thinking is a problem solving approach that everyone can learn and benefit from knowing. It promotes logical thinking, reading, communication skills, teamwork, and self-reflection. This module is unique in that Bebras tasks (renowned for their engaging style, see picture) are used as the basis for the materials. Each lesson consists of an introduction to a computational thinking topic followed by problem solving teamwork exercises.

The Bebras Challenge attracts 2.5 million pupils annually from 56 countries and is the most gender-neutral computer science activity worldwide. This module has been prepared by the Science Foundation Ireland-funded PACT team at Maynooth University, that creates international Bebras tasks on behalf of Ireland, assisting the national Bebras organiser, the Irish Computer Society.

In Santa's warehouse, three robots always work as a team. When the team gets a direction symbol (N, S, E, W), all robots move one grid square in that direction at the same time. After following a list of direction symbols, each robot picks up whatever present is in its grid square. There are only three different shapes of present in the warehouse: small, large, flat.

For example, if we give the list W, S to the team, then robot A will pick up a small present, robot B will pick up a small present, and robot C will pick up a large present.



QUESTION

What list can be sent so that each robot in the team picks up a different shape present?

- A. E, S, S, E, E
- B. E, W, W, S
- C. E, S, N, S, W
- D. E, S, S, W, W

Overview of the whole module

"My vision is that computational thinking will be a fundamental skill used by everyone by the middle of the 21st century, just like reading, writing, and arithmetic." Jeannette Wing (2006)

Computational thinking describes *thought processes* involved in understanding a problem and designing a set of instructions to solve that problem that a human or computer can follow.

Overview of the whole module

In the world of software development, computer programmers use computational thinking to plan a solution before they start coding.

However, computational thinking is broader than programming.

There are a few computational thinking concepts that everyone can easily learn, and benefit from knowing.

Overview of the whole module – 8 lessons

We have chosen eight fundamental concepts in computational thinking spread over seven lessons (the eighth lesson is a Moodle quiz).

Each lesson introduces a topic (such as abstraction or decomposition) and the topic is characterised into several different aspects.

We use Bebras[®] tasks to illustrate the different aspects (see final slides for more about Bebras and our involvement).



Over 30 Bebras tasks have been carefully chosen, and in some cases modified, to help to explain the essence of, and distinction between various computational thinking aspects.

Overview of the whole module – 8 lessons

1. Decomposition – breaking down a problem to make it easier to solve
2. Pattern recognition – spotting repetitions in a problem to make it easier to solve
3. Representation – converting information into a new form using different symbols
4. Abstraction – choosing only the most important information and ignoring the rest
5. Algorithms – creating a set of instructions as a solution to a problem
6. Evaluation – recognising the good points and bad points about a solution
7. Logic – figuring out if statements are true or false from the information available
Generalisation – using the solution for one problem to solve another
Recap on all topics – recognising computational thinking concepts in Bebras tasks
8. Quiz – multiple-choice quiz using Moodle

Impact of computational thinking

Computational thinking has had a huge impact on many disciplines, most noticeably biology (sequencing the human genome, predicting stem cell behaviour, and so on).

One computational method alone, *machine learning/artificial intelligence*, has influenced

- almost all academic disciplines (biology, medicine, physics, chemistry, mathematics, engineering, computer science, and others),
- society (economics, law, healthcare, archaeology, journalism),
- sport (to optimise/personalise training), and
- business (product/movie recommenders, financial markets, recruitment, gas/oil exploration, manufacturing, security, drug discovery, self-driving cars).

Authors and contributors to the module

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Bebras[®] (www.bebras.org), founded by Prof. Valentina Dagienė, Vilnius University, Lithuania, is an international initiative to promote computational thinking among primary and secondary students. It designs one of the most popular gender-balanced computer science-related activities for primary and secondary school students worldwide: the annual Bebras Computational Thinking Challenge (2.5 million participants from 56 countries last year alone, see www.bebras.org/statistics.html).

The Irish Computer Society (ICS) is the National Bebras Organiser for Ireland. The ICS organises the Bebras Ireland challenge as part of its Tech Week (bebras.techweek.ie) activities. Since 2016, Maynooth University PACT members have been the Ireland representatives to the annual International Bebras Task Workshop where tasks for the subsequent international Bebras Challenges are developed. Bebras Ireland tasks created by the PACT team have been translated into tens of different languages by overseas national Bebras organisations and tackled by hundreds of thousands of primary and secondary students worldwide.



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The PACT team at Maynooth University Department of Computer Science develops resources and supports to allow teachers to teach topics in computer science at both primary and secondary school.

We specialise in computational thinking resources and supports (see <https://pact.cs.nuim.ie>). Computational thinking is a set of problem solving skills that computer scientists use when they do their everyday work. It intersects with all STEM subjects because computational solutions have proven useful in all scientific fields.

To sign up for information about our teacher workshops, school visits, and teacher resources, email pact@mu.ie .

Over recent years we have been funded by Maynooth University Department of Computer Science, the Google CS4HS programme, and Science Foundation Ireland.