AI in a Nutshell: Three Hands-on Activities for Teenagers

Bruno Dumas
Benoit Frnénay
Julie Henry
Anne Smal
University of Namur (Belgium)
PReCISE, NADI
[firstname.lastname]@unamur.be

Anne-Sophie Collard
Alyson Hernaelsteen
University of Namur (Belgium)
CRIDS, NADI
[firstname.lastname]@unamur.be

Abstract
UPDATED—April 15, 2018. Artificial intelligence is one of the digital skills that several experts propose to include in education. However, educational resources for AI teaching for students under 18 years of age are still scarce. In that context, this paper proposes three hands-on activities related to emotion synthesis, machine learning and robotics.

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Computer Science Education, Artificial Intelligence Education, Digital Education, Computational Thinking

ACM Classification Keywords
K.3.2 [Computers And Education]: Computer and Information Science Education.

Introduction
In French-speaking Belgium, computer science, including computational thinking, is almost missing from compulsory education, namely for 5 to 18 year-old students [7, 9]. The lack of teacher training [6] is often cited as a reason. Yet, in the near future, teachers may be required not only to integrate digital tools into their classrooms, but also to teach digital skills [8]. Indeed, Belgian education has been undergoing a major and complete reform "Pacte pour un Enseignement d'Excellence"[1] that stipulates that "from pri-

[1] www.pactedexcellence.be/index.php/lessentiel-du-pacte/

mary school, an introduction to digital logic can be achieved by programming simple machines" and also evokes a "minimum mastery of tool logic - *program or be programmed*". A forthcoming polytechnic education curriculum between 3 and 15 years is also envisioned, including a digital theme. Despite the desire to develop digital skills from an early age, the content of such education has yet to be defined [5].

This paper discusses a work-in-progress research between a research group mandated within the framework of the reform to identify pedagogical devices integrating digital tools and developing digital skills and a group of researchers in computer science didactic. A project was started in September 2017, partly funded by a plan for digital equipment in schools[2], to teach computational thinking to young people and introduce them to computer science. In a first phase, the project focuses on 12 to 15 year-old students from five partner secondary schools. It is part of a larger project to make everyone an actor in the digital transformation by raising awareness of computer science. The hypothesis is that "a better knowledge of a computer system and its inner working impacts the confidence, autonomy and perspective on the use of this system".

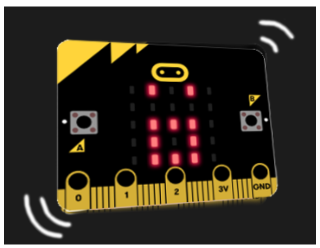

Figure 1: Fear expressed by micro:bit

A sequence of twelve activities lasting over one or two course periods has been designed with a variety of domains (security, communication, network, human-computer interaction, artificial intelligence, etc.), processes (analysis, coding, testing, etc.) and materials (unplugged activities, micro:bit[3], thymio[4], etc.). In particular, three of them are devoted to artificial intelligence (AI) [1]: more and more experts (Fredrik Heintz[5], Linda Liukas[6]) [2, 3]) and countries, such as US[7] or France with its "France is AI" project[8], defend teaching AI to young people. Yet, educational resources for AI teaching are still scarce [2, 4]. Following that analysis, this paper proposes three hands-on activities related to emotion synthesis, machine learning and robotics.

Hands-on Activities

The three activities on AI involve the different fields of emotion synthesis, machine learning and robotics. All three require a prior introduction to what an AI is, including examples that make sense for students: video games, voice recognition, facial recognition or robots, among others.

Emotion Synthesis

This activity aims to show a less mathematical and more "psychological" side of the discipline by asking students to develop an emotional agent via a micro:bit (see Figure 1). The Turing test is presented and a simplified version is proposed to the students so that they can evaluate the emotional agents developed during the activity.

The activity takes place in several stages. Students use human behaviour to define the behaviour of the emotional agent. After identifying emotions to be reproduced by the emotional agent, students build a knowledge base for artificial intelligence by defining "rules" leading to these emotions under the following formalism:

$$context \land event \implies emotion$$

[2] www.ecolenumerique.be/
[3] http://microbit.org/
[4] https://www.thymio.org/en:Thymio

[5] *From AI to Computational Thinking* - https://www.youtube.com/watch?v=GremeqAPIiE, consulted on 04-13-18
[6] YOW!2017 Conference - http://yowconference.com.au, consulted on 04-13-18
[7] https://www.nitrd.gov/pubs/national_ai_rd_strategic_plan.pdf
[8] https://www.economie.gouv.fr/files/files/PDF/2017/Rapport_synthese_France_IA_.pdf

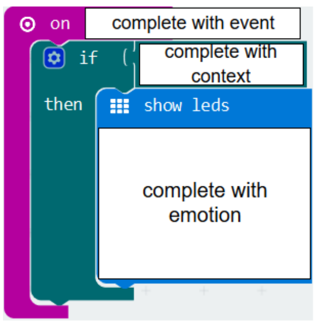

Figure 2: Framework to code a rule

For example, when it's dark (*context*) AND someone pushes me (*event*), I'm scared (*emotion*).

The students then find metaphors so that selected contexts and events can be implemented on a device (in our case, the micro:bit). A possible metaphor for the above rule is: when the light intensity level is less than 20 AND the micro:bit is shaken, the smiley ":o" appears (see Figure 1).

To program (in blocks) their emotional agent, students follow a framework for each rule (see Figure 2).

Finally, the students test the different emotional agents created by their classmates during the activity and validate them (or not) thanks to the simplified Turing test.

Machine Learning

This activity aims to raise awareness of how a computer can learn on the basis of a set of images. The students use a camera and a teachable machine[9] (see Figure 3). This machine can be trained to recognize objects and sounds.

Students teach their machine to recognize shapes (circles, triangles and squares) of different colors by using their camera, live in the browser. No coding is required.

The activity shows the importance of the quantity and variety of data to be presented to the machine so that it learns in a rigorous way. Students are invited to test the recognition rate of their classmates' machines.

Robotics

When we talk about AI, many people think directly about robots. However, not all robots are AIs and not all AIs are robots. For a robot to be an AI, one possibility is to imitate human behavior. This is how this activity begins.

[9] a tool developed by Google: https://teachablemachine.withgoogle.com

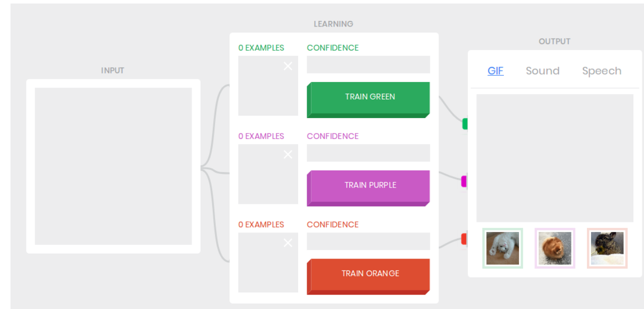

Figure 3: A machine that wants to learn - Screenshot from https://teachablemachine.withgoogle.com

Students discover the Thymio robot and its various predefined behaviors. A discussion took place on the humanization of robots and the difficulty of defining what an AI is. For some students, the Thymio is not an AI because it simply does what a (predefined) program asks it to do. It is then important to explain to them that all AIs have been programmed by someone and that if they do what they do, it is because someone has asked them to do it.

The second part of the activity consists in having the students develop an AI whose role is to be able to circumvent any obstacle that only contains right angles (see Figure 4). The students use the different Thymio sensors and actuators to achieve their goals.

Future Research

The activities described here were validated in real context and iterated based on the observations made during these tests. If, at the technical level, they have been the subject of solid reflection, they may suffer, from the teacher's point of view, from the absence of a context that makes sense

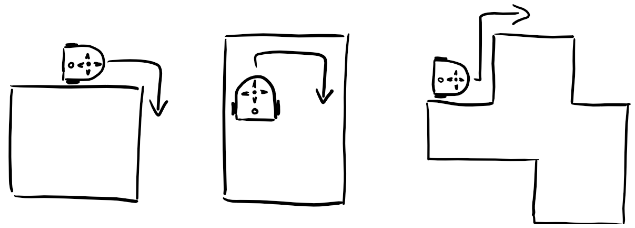

Figure 4: The thymio is programmed to circumvent objects

for children. So, they will be analyzed in two dimensions. In addition to the didactic project conducted by the designers of the pedagogical device, the activities will be analyzed on the basis of a study initiated by the two groups [5]. This study highlights the complementarity between digital technology education and digital media education.

In addition to observations already made during activities, interviews will be set up with teachers participating in the project. The objective will be to bring the two fields (technology and media) closer together and thus make it possible to develop digital technology education that would be both technical and critical, with a view to educating citizens.

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