The Stack: Unplugged Activities for Teaching Computer Science

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ABSTRACT

The Stack is a free open repository of learning activities for adults that illustrate computing principles without a computer. We explain the rationale behind its development, describe its content with an example, and discuss its applications in university teaching practice.

CCS CONCEPTS

• **Social and professional topics → Computing education**.

KEYWORDS

active learning, unplugged activities, university-level education

ACM Reference Format:
Valdemar Švábenský and Martin Ukrop. 2021. The Stack: Unplugged Activities for Teaching Computer Science. In *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education (SIGCSE '21), March 13–20, 2021, Virtual Event, USA.* ACM, New York, NY, USA, 1 page. https://doi.org/10.1145/3408877.3439569

1 INTRODUCTION

CS Unplugged [1] is a popular collection of activities that explain computing concepts without a computer. It uses active learning methods to motivate students and illustrate abstract principles, especially to young learners: CS Unplugged activities were shown to positively impact middle school students' learning [3]. Initiatives such as `code.org` also feature unplugged activities for children [2]. However, to the best of our knowledge, there was no published attempt to create such activities for adult learners.

Although some of our colleagues designed unplugged activities for their university classes, they were not available for others. To encourage the sharing of teaching content, we created the Stack: an open-source collection of computer science activities aimed primarily at university students. In contrast to previous work, the Stack activities explore advanced concepts as the adult learner already knows the basics and can learn faster.

2 ACTIVITIES IN THE STACK

The Stack [4] features 27 open-source activities from various domains, including theoretical computer science, algorithms and data structures, and cybersecurity. Each activity page follows a uniform structure containing (1) the summary (including learning outcomes), (2) attributes (duration, number of students, equipment, …), (3) preparation guide (including printable handouts), (4) step-by-step execution, (5) tips and tricks, and (6) links to related teaching materials.

"Encryption modes" is an exemplary activity for teaching block ciphers. Students form small groups and match printed diagrams of five encryption modes with the corresponding decryption processes. This is followed by assigning cards with operation properties and suitable real-world use cases. The activity enables the students to visualize the encryption modes and their relationships, compare their inner workings and (dis)advantages, and discuss their usage.

For an activity to be included in the Stack, it must have been previously used in teaching practice. The Stack was employed on multiple occasions since its inception in June 2018:

(1) by dozens of teaching assistants (TAs) of courses on programming, automata, and network security at our university;
(2) as a part of the Teaching Lab (the TA training initiative) [5];
(3) during outreach events with high-school students.

Moreover, the activities crossed the boundaries of our institution since we already have a contributor from abroad.

Anecdotal evidence from students suggests they found the activities engaging and helpful for grasping abstract concepts. An interesting research topic for future work is to evaluate the learning impact of unplugged activities on undergraduates.

3 CONTRIBUTIONS OF THE POSTER

The poster aims to spark a conversation about using unplugged activities in university classes. We want to find out whether SIGCSE participants have experience with using such activities with adults and how they perceive them. Moreover, our goal is to encourage collecting and sharing unplugged activities. The Stack repository provides a template that eases the creation of new activities, and we invite teachers to share their activities with others.

ACKNOWLEDGMENTS

We are grateful for the continuous faculty support and the efforts of Ondráš Přibyla and other people shaping the Teaching Lab.

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SIGCSE '21, March 13–20, 2021, Virtual Event, USA