Introducing Parallel Computing Concepts through a POGIL Activity: A Pilot Study

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ABSTRACT

POGIL activities have been used for various computer science courses. However, there is no published POGIL activity for introducing parallel and distributed computing concepts. Recent ABET curriculum recommendations include the introduction of parallel and distributed computing concepts in undergraduate Computer Science/Engineering programs. In this work, we plan a cross-university study of evaluating the impact of using POGIL to introduce parallel computing topics in Data Structures and Algorithms or similar courses in an undergraduate computer science curriculum. We designed a POGIL tool that includes an unplugged activity that helps demonstrate some fundamental concepts of parallel computing. This unplugged activity is then followed by a set of reflective questions regarding potential advantages and challenges of using parallel computing. We plan to use PRE/POST surveys to collect data from undergraduate CS students from five universities located in different parts of the US with diverse student population. At the end of this work in progress, we will use the data to investigate how this POGIL activity helps students gain an understanding of parallel computing.

CCS CONCEPTS

• **Social and professional topics** → **Computing education**; • **Theory of computation** → **Parallel algorithms**; • **Applied computing** → **Collaborative learning**.

KEYWORDS

POGIL activities; parallel computing; classroom activity

1 BACKGROUND

Introducing parallel and distributed computing concepts to undergraduate students is essential for any robust computing curriculum. In this regard, we mention three notable efforts: the NSF-supported *Center for Parallel and Distributed Computing Curriculum Development and Educational Resources (CDER)*, the *Computer Science Curricula 2013* [2] that dedicates an entire body of knowledge on

Parallel and Distributed Computing and notes: "that some familiarity with this topic has become essential for all undergraduates in CS", and the most recent *ABET curriculum recommendations* [1] for undergraduate Computer Science/Engineering programs that include: "exposure to [...] parallel and distributed computing".

There are many ways one can introduce parallel computing to undergraduate students. One such way is to use Process Oriented Guided Inquiry Learning (POGIL) activities. Such activities have already been used for various computer science areas [3] and they seem to be of great interest to Computer Science Education scholars, including the IEEE-Computer Society and ACM-SIGCSE communities. Despite being a twenty five year-old instructional strategy, there is no published POGIL activity yet for introducing parallel and distributed computing concepts to undergraduate students.

2 OVERVIEW

Our goal is to design a POGIL tool to demonstrate some fundamental concepts of parallel computing. This will include an unplugged activity using sorting algorithms, and follow-up questions to reflect on the potential benefits and challenges of parallel computing. The students will be provided with pre-written code in Java, C/C++, or C# to get hands-on experience. This tool will be tested in a cross-university setting, by introducing parallel computing topics in Data Structures and Algorithms or similar courses.

3 EVALUATION

We will evaluate the effectiveness of the proposed POGIL tool using PRE/POST surveys. This data will give us an insight into if and how POGIL activities can be effective in introducing parallel computing concepts in a Data Structures or similar course.

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