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Master's Thesis
DaaS – Debugging as a Service

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Teaching students technical details, especially how certain coding construct are handled “under the hood”, can be a challenging task. Debuggers can help to gain insight into how objects are structured and which data they currently store. Yet, typical debuggers lack visualization capabilities and only display the application’s state in tables. We develop a visualization system that aims to teach novices programming basics through the use of easy accessible visualizations based on data collected by a debugger. For example, students can write code in our visualization tool, which is then sent to the debugger, who then steps through the code line by line and returns a list of program states, i.e., a trace of the program execution. In addition to the mentioned trace generation (where the complete program is executed from start to end once the program has been compiled), it is also possible to use the debugger to step through the program line by line. Further, it is possible to send input to as well a to request output from the debugged application. We use a WebSocket interface for this communication.

Unfortunately, the current system forces the student to locally install the debugger to be able to use our visualization tool. The goal of this thesis is to develop a networked system that allows users to request a debugger “in the cloud” to render it unnecessary to install said debugger locally. This makes our visualization approach portable and more flexible.
Since students can send any code to this debugger, the system must ensure that every debugging session runs in a sandbox environment to prevent attacks using harmful code. To achieve this, upon the submission of new source code for debugging, the system should start a container (e.g., Docker) within which the debugging process is executed. It has to be ensured that the communication with the debugger’s web socket also works in the sandboxed environment.
During this thesis, the student should gradually improve the system, starting from a locally running prototype, moving to a dedicated server with multiple worker machines and scaling up to real cloud deployment of the final system.
The system should be fault-tolerant, thus the student has to consider certain corner cases such as disconnects by the user which should lead to a shutdown of the running container. Also, the student should at least provide a concept how the system can be built without a single point of failure in the design.

The final version of the written thesis must be submitted not later than 15.09.2021.