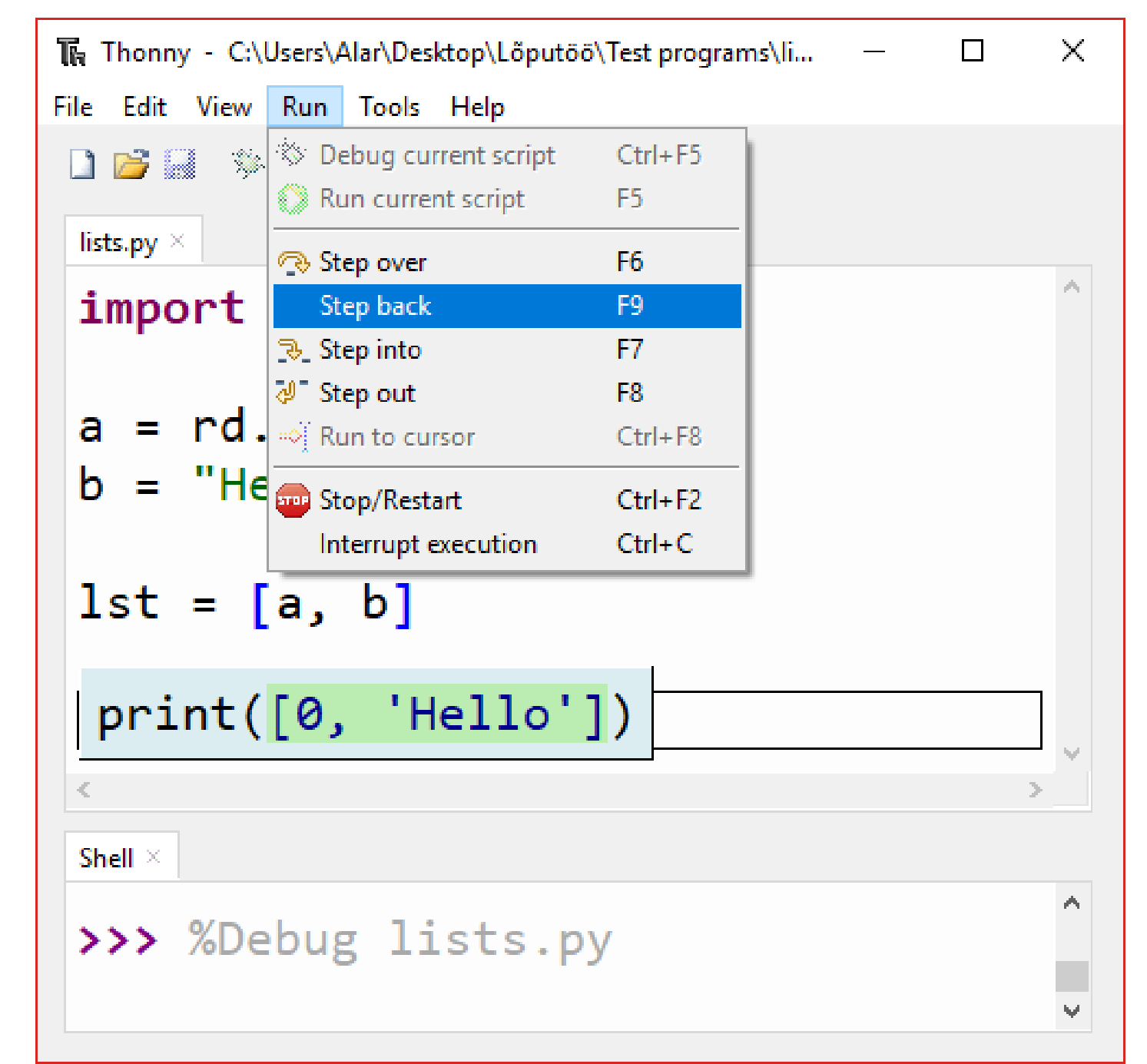


Omniscient Debugger for Thonny IDE

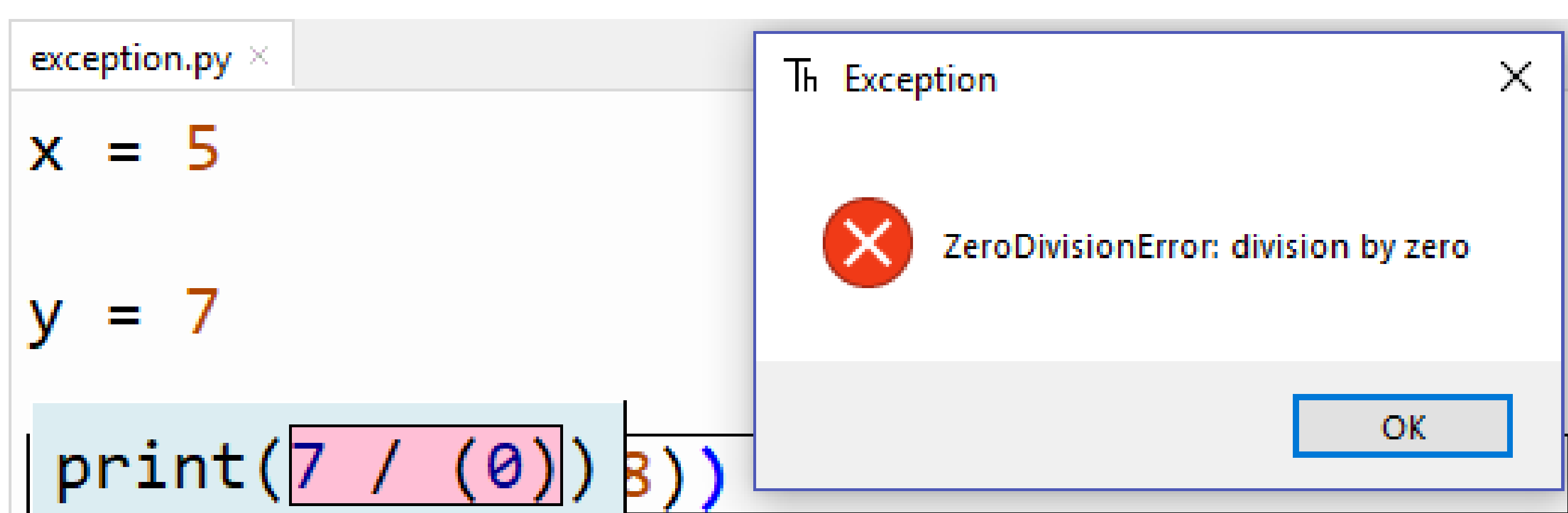


Problem

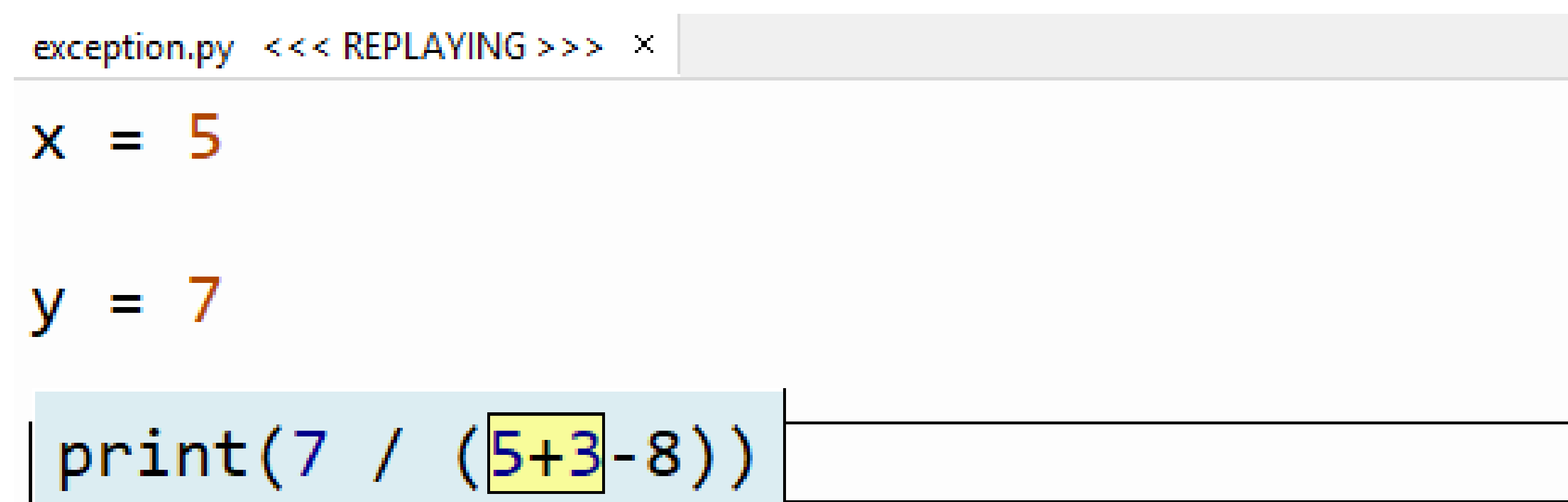
Consider a beginner programmer trying to find a bug in a written program. A debugging session may look like this:

1. Start debugging;
2. Step through lines of code;
3. Possibly find clues about the issue;
4. Repeat steps 1-3 until enough is discovered about the issue.

Once the bug is found, the programmer could have **restarted debugging sessions multiple times**. This can become frustrating very quickly, especially for novice developers.



To make debugging smoother, the debugging tool should allow **stepping back in time**. This enables the programmer to **browse all states of the flawed program execution** without leaving the debugging session. This was added to **Thonny**, a Python 3 IDE that features debugging tools for beginners [1].



Development

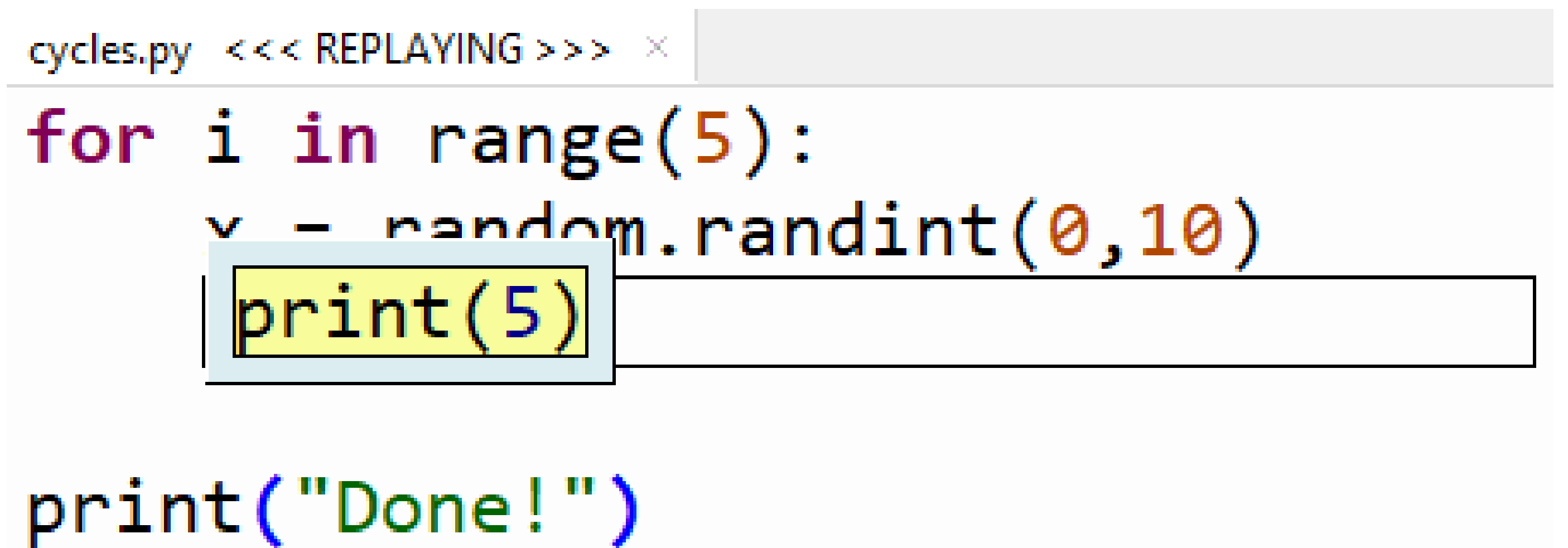
There are two main approaches for implementing stepping back in time: reverse execution or omniscience (saving all program states and replaying these). Omniscient debugging was chosen, as it does not necessitate large changes to the existing debugging architecture [2].

Development of omniscient debugging started by first implementing a basic proof of concept. This was taken as a foundation on which different options to integrate the solution were tested and the final solution was implemented.

Solution

The following changes were introduced to Thonny's debugger:

- All states of the program are saved.
- Step back command added.
- Stepping both into and over in past states.
- View previous states after encountering unhandled exception.



The following operations can be done **without restarting** the debugging process:

- Check states prior to the current program state.
- After accidentally stepping over, step back and step into the most interesting piece of code.
- Continue debugging previous program states after encountering an unhandled exception.

There are also some expected drawbacks – memory usage and time complexity is noticeably higher, mainly affecting larger programs. Omniscient debugging will be made optional to keep the debugger feasible for larger programs.

Try it Yourself!

The beta version featuring omniscient debugging among other new features is available at Thonny's repository – refer to the downloads page and download-install Thonny version 2.2.0b2. To try omniscient debugging:

- start debugging a program;
- issue some “Step into” or “Step over” commands;
- issue the “Step back” command by pressing the F9 key or choosing “Step back” from the run dropdown menu.

Bibliography

1. Annamaa A. Thonny, a Python IDE for Learning Programming. *Proceedings of the ITICSE '15 Innovation and Technology in Computer Science Education Conference*. Vilnius, 2015, 343.
2. Engblom J. A Review of Reverse Debugging. *Proceedings of the System, Software, SoC and Silicon Debug Conference (S4D)*. Vienna, 2012, 1-6.

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Code repository: <https://bitbucket.org/plas/thonny>



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