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].

![Debugging interface](https://bitbucket.org/plas/thonny)

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.

```python
for i in range(5):
    y = random.randint(0,10)
    print(5)
```

**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