Debugging Python using the symbolic debugger in VSCode IDE

SWE course

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Why IDE?

(Integrated Development Environment)

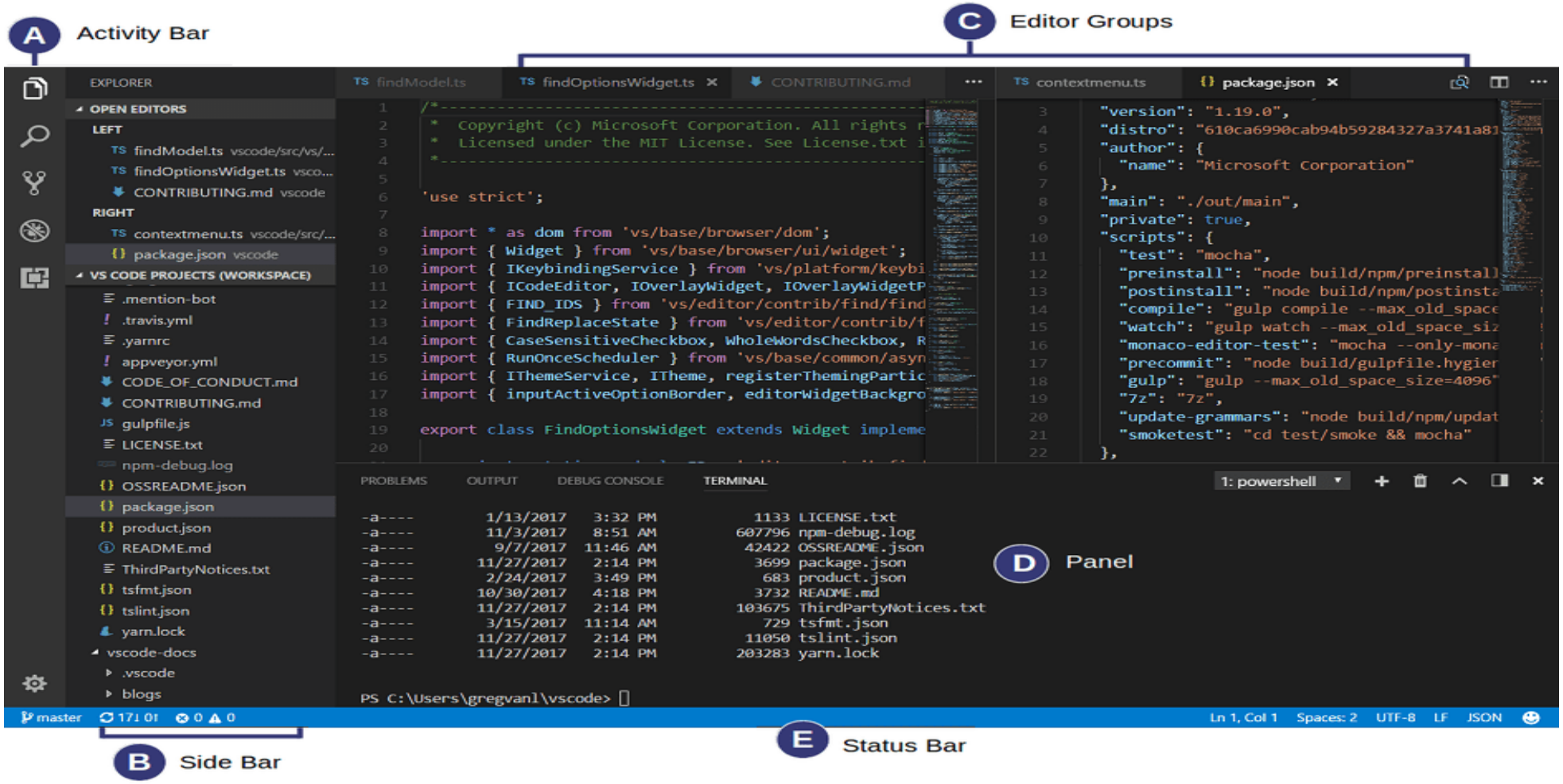
- **Consolidate different aspects of writing a computer program**
  - Color code editor, tendency to help you write better code
    - Docstring
    - Code completion
    - Parameter suggestion
    - Auto format code
  - Terminal/command line
    - Quickly test function in a python environment
  - Debugger
    - Symbolic debugger, inspect at runtime
  - Version control
    - Embedded git
  - Remote SSH
    - Write code in local machine, run code in server

Why VSCode?

- **Many options: VSCode, Spyder, PyCharm**
- **Why VSCode**
  - Lightning fast, open source code editor
  - Rich extensions support: code completion, docstring, Docker, jupyter, GitLens …
  - Support multiple programming languages – over 100 programming languages, editing/debugging the same across languages.
  - Nice looking ☺

VSCode interace

Typical VSCode interface (largely customizable)



https://code.visualstudio.com/docs/getstarted/userinterface

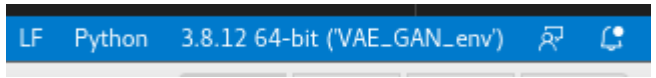
How to load VSCode in BioHPC

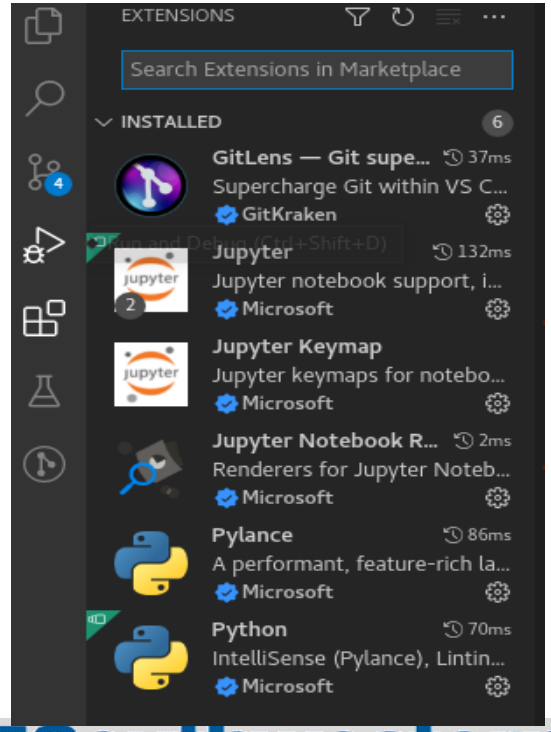
VSCode was installed as a module in BioHPC

module load cuda101
module load cudnn/7.6.5.32
export CUDA_VISIBLE_DEVICES=1
source activate /archive/course/SWE22/shared/week2/CondaEnvs/VAE_GAN_env
module load vscode
code .

- **First thing to do is install Python extension.**
- **Useful extensions: Jupyter, GitLens, PyLance, Remote - SSH**
- **Choose the course anaconda environment as interpreter from status bar**

Bottom right of VSCode should look like below





Debugging in VSCode

Stack trace

- Series of error messages printed out when the code fail to run, often starts with “Traceback”

```
Traceback (most recent call last):
  File "test.py", line 4, in <module>
    y = np.matmul(x,W)
ValueError: matmul: Input operand 1 has a mismatch in its core dimension 0, with gufunc
signature (n?,k),(k,m?)->(n?,m?) (size 3 is different from 4)
```

- Error message often has information about which file/line cause the problem, what is the problem
- Only helpful when the bug causes error, does not work with “silent bugs”.

Symbolic debugger

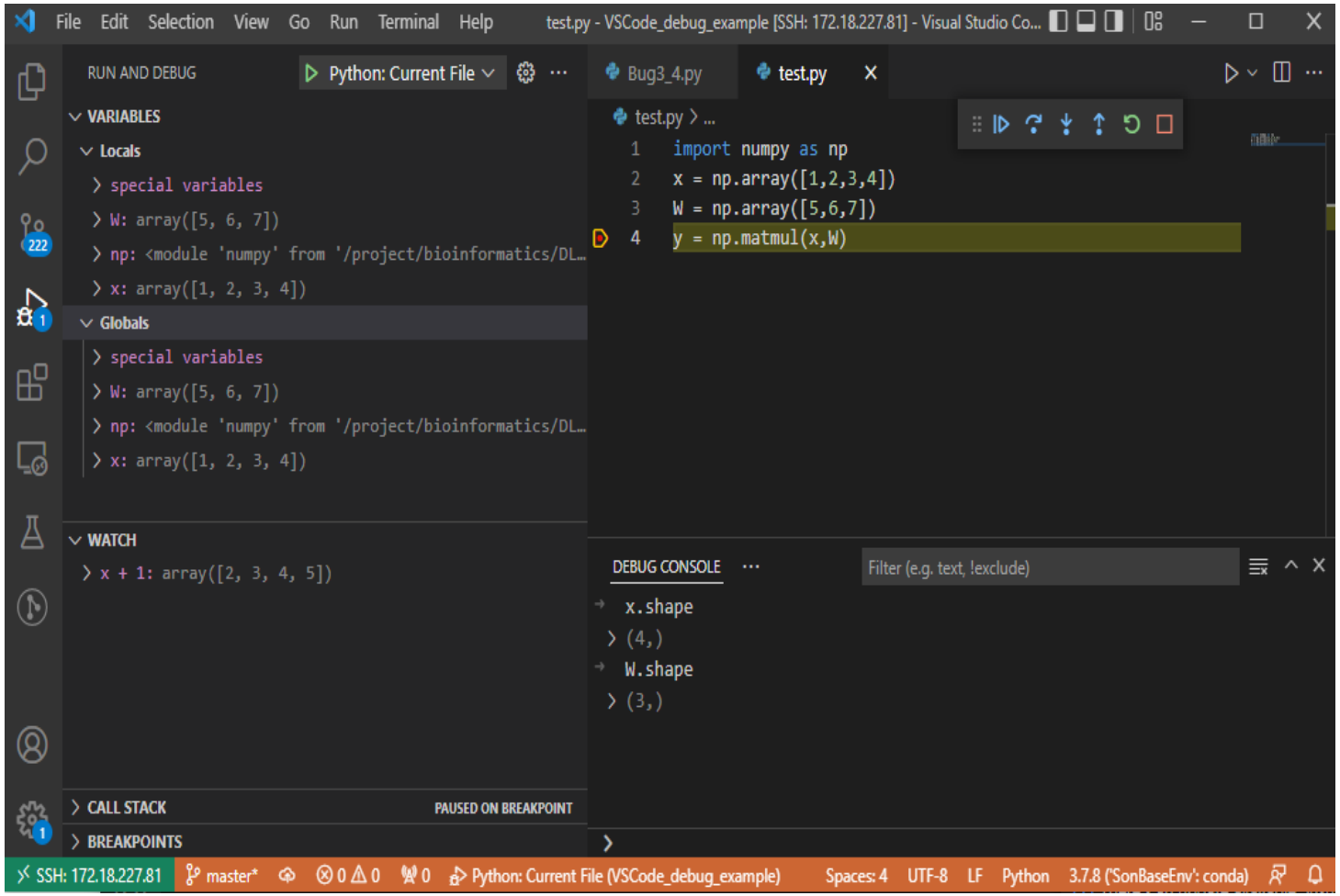
- Let users to inspect directly a running program.
- Stop at breakpoints why keeping all objects/variables of current scope.

A short video about debugging Python code in VSCode

https://www.youtube.com/watch?v=w8QHoVam1-I

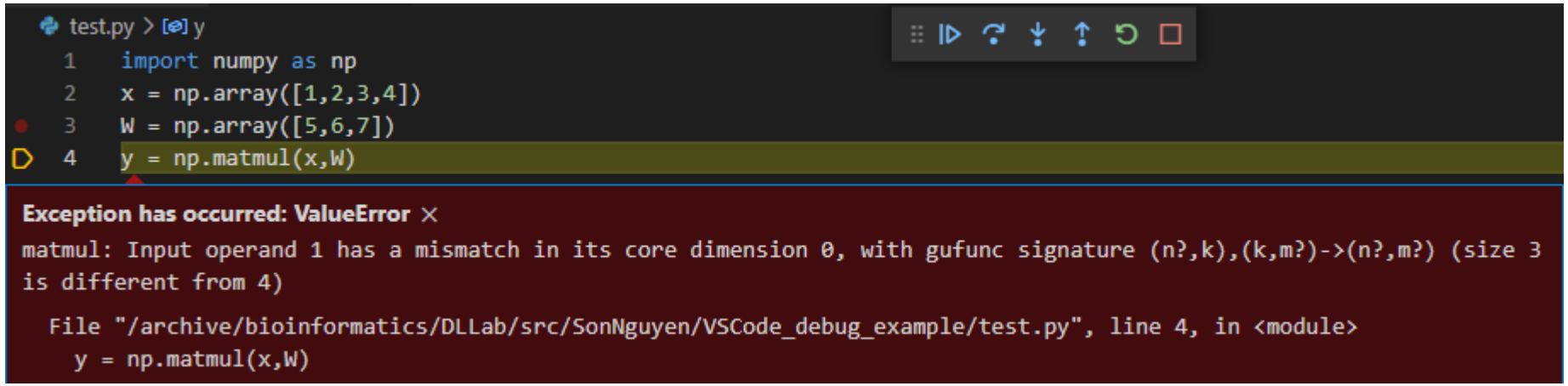
VSCode debugger

- Start debugger: Run → Start Debugging
- Debugger will stop at Exceptions or Breakpoints
  - If there is no Exception/Breakpoint, the code will run normally
- Useful panels: 
  - Step panels
    - Continue, step over, step into, step out, restart, stop
  - VARIABLES: Locals and Globals variables
  - WATCH: add object/function you want to monitor
  - DEBUG CONSOLE: where you can interact with all variables in VARIABLES



VSCode debugger

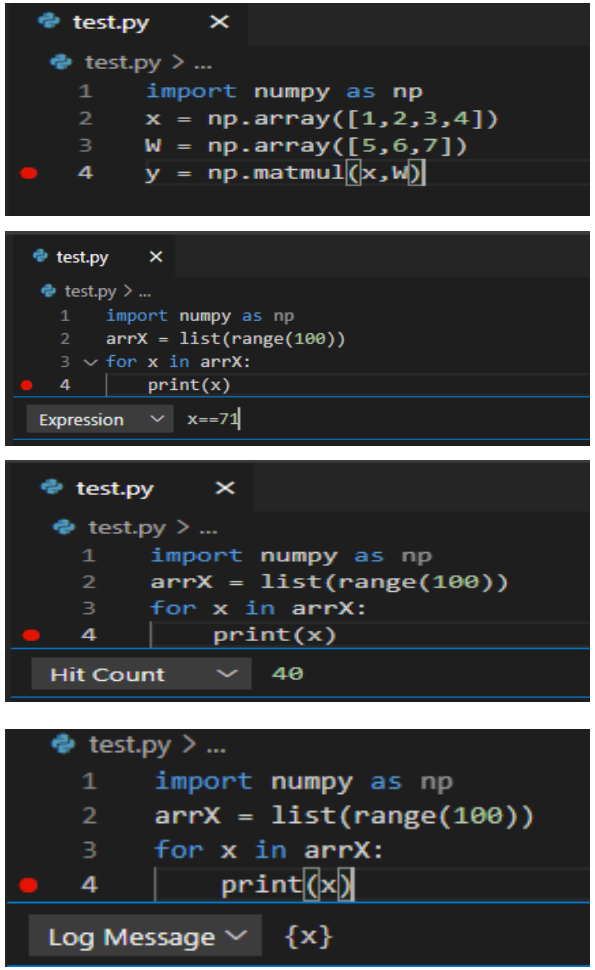
- 1. Auto catch Exception
  - VSCode can auto catch (stop at) most of the exceptions before it happens



  - When there is no exception (or there are exceptions that VSCode misses), we have to place breakpoints to tell VSCode to stop.

VSCode debugger

- 2. Breakpoints
  - Breakpoints are used to tell the debugger where to stop. There are *modified breakpoints* that are also useful.
  - Conditional break points - Expression: only stop when a condition happens. Useful when the bug happens only on a few cases in a big loop.
  - Hit Count: stop when the given line of code was about to be executed n^{th} times (*n*=40 in the example).
  - Log message: does not stop, but log a message to debug console instead, similar to print() function debugging style, but you do not have to change the code to see the message.



Excercise

- **Now is time for bug hunting and fixing.**
- **There are 4 files with 5 bugs**
  - The first 3 (bug0.py, Bug1.py, Bug2.py), each file has a single bug. They are all independent
  - Bug3_4.py has 2 bugs in it, please fix the first then the second bug.
  - All bugs have *hints*, hope they helps
  - Solutions will be posted Friday night.

Questions?