Python For Engineers III

Where we left off…

- Last workshop, we covered more advanced features of Python.
  - Extra data types.
  - Object-Oriented Programming.
  - Libraries.
- In this workshop, we're going to learn:
  - How to read syntax & runtime errors.
  - How to reference the Python Standard Library.
  - Using everything we've learned to solve real-life problems.
  - How to use the PIP program to add more libraries.
  - Basically, we're going to learn what real Software Engineers do often on the job.

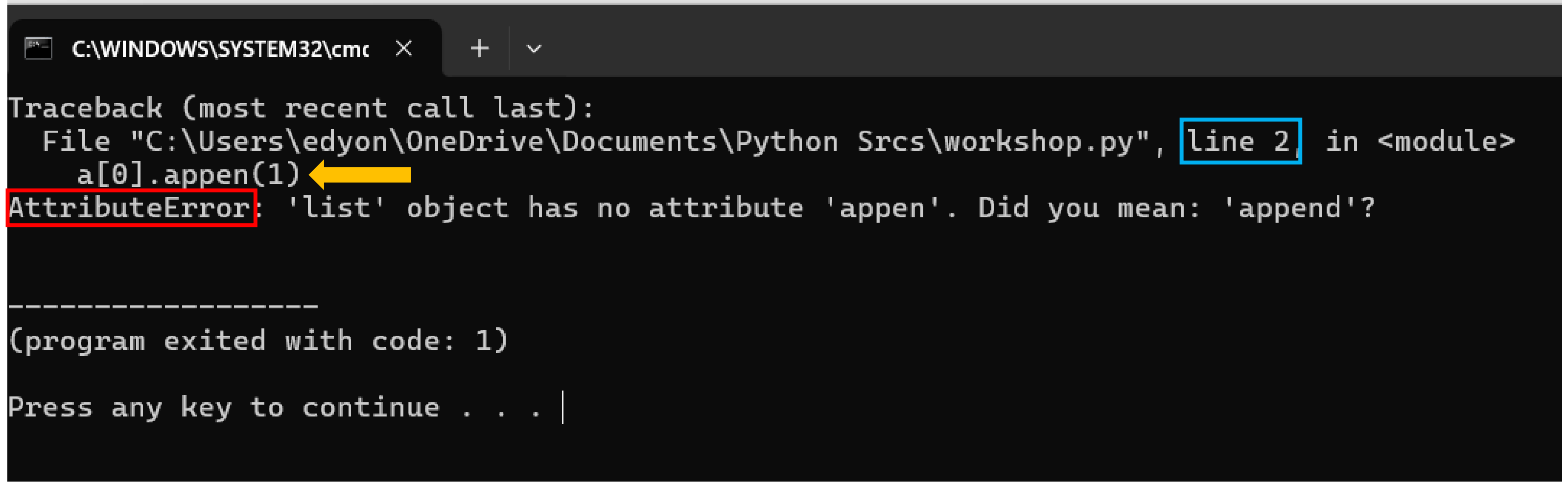
Exploration of the Python Standard Library

- Python’s motto when it comes to libraries is: “batteries included”.
- Just don’t ask what the voltage is.
- Python 3 Standard Library Reference Link

How to Read & Comprehend Errors I

- Step 1: Read type of error.
  - **NameError**, **AttributeError**, **ValueError**, etc
- Step 2: Check for the line number.
- Step 3: Investigate and try to resolve the error based on the error type.
- Step 4: practice making errors.
- **DON'T forget, these errors can be used in try-excepts!**

```python
a = [[]] * 5
a[0].appen(1)
print(a)
```



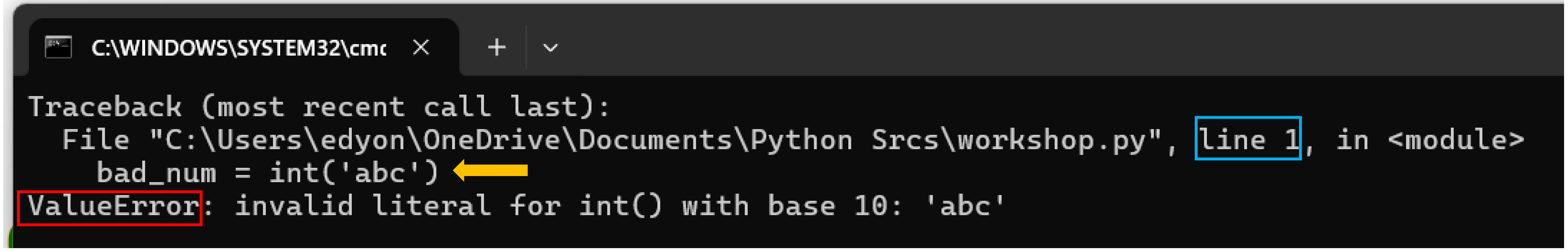
```
Traceback (most recent call last):
  File "C:\Users\edyon\OneDrive\Documents\Python Srcs\workshop.py", line 2, in <module>
    a[0].appen(1)
AttributeError: 'list' object has no attribute 'appen'. Did you mean: 'append'?


------------------
(program exited with code: 1)

Press any key to continue . . .
```

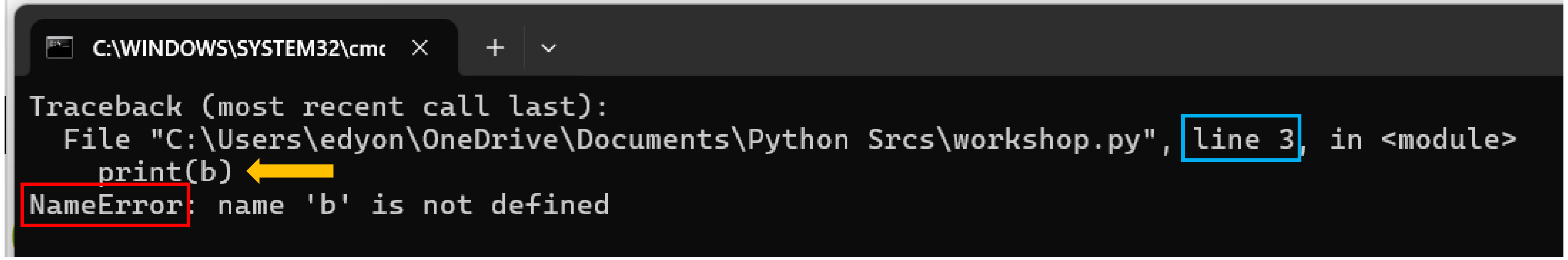
How to Read & Comprehend Errors II

```
bad_num = int('abc')
```



```
Traceback (most recent call last):
  File "C:\Users\edyon\OneDrive\Documents\Python Srcs\workshop.py", line 1, in <module>
    bad_num = int('abc')
ValueError: invalid literal for int() with base 10: 'abc'
```

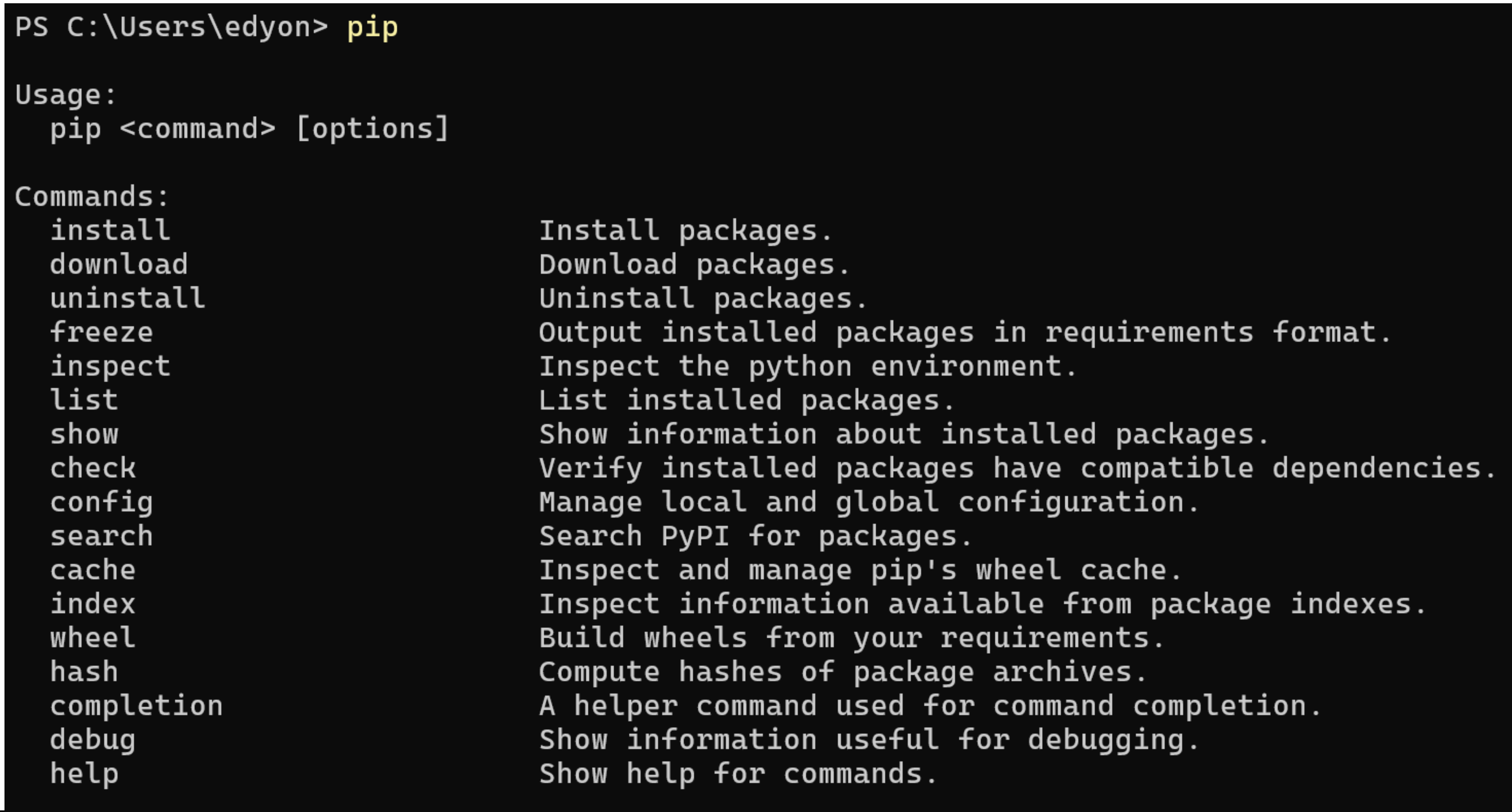
```
a = [[]] * 5
a[0].append(1)
print(b)
```



```
Traceback (most recent call last):
  File "C:\Users\edyon\OneDrive\Documents\Python Srcs\workshop.py", line 3, in <module>
    print(b)
NameError: name 'b' is not defined
```

Using PIP: Python Index Packager

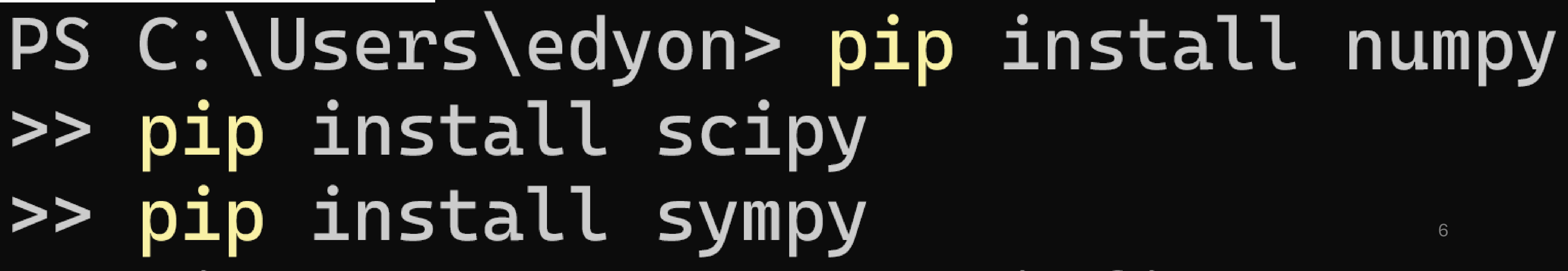
- Go to a terminal whether Windows, MAC, or Linux.
- Type ‘pip’.
- If this doesn’t work, try: ‘**`python -m pip <command>`**’



```
PS C:\Users\edyon> pip

Usage:
  pip <command> [options]

Commands:
  install                     Install packages.
  download                    Download packages.
  uninstall                   Uninstall packages.
  freeze                      Output installed packages in requirements format.
  inspect                     Inspect the python environment.
  list                        List installed packages.
  show                        Show information about installed packages.
  check                       Verify installed packages have compatible dependencies.
  config                      Manage local and global configuration.
  search                      Search PyPI for packages.
  cache                       Inspect and manage pip's wheel cache.
  index                       Inspect information available from package indexes.
  wheel                       Build wheels from your requirements.
  hash                        Compute hashes of package archives.
  completion                  A helper command used for command completion.
  debug                       Show information useful for debugging.
  help                        Show help for commands.
```

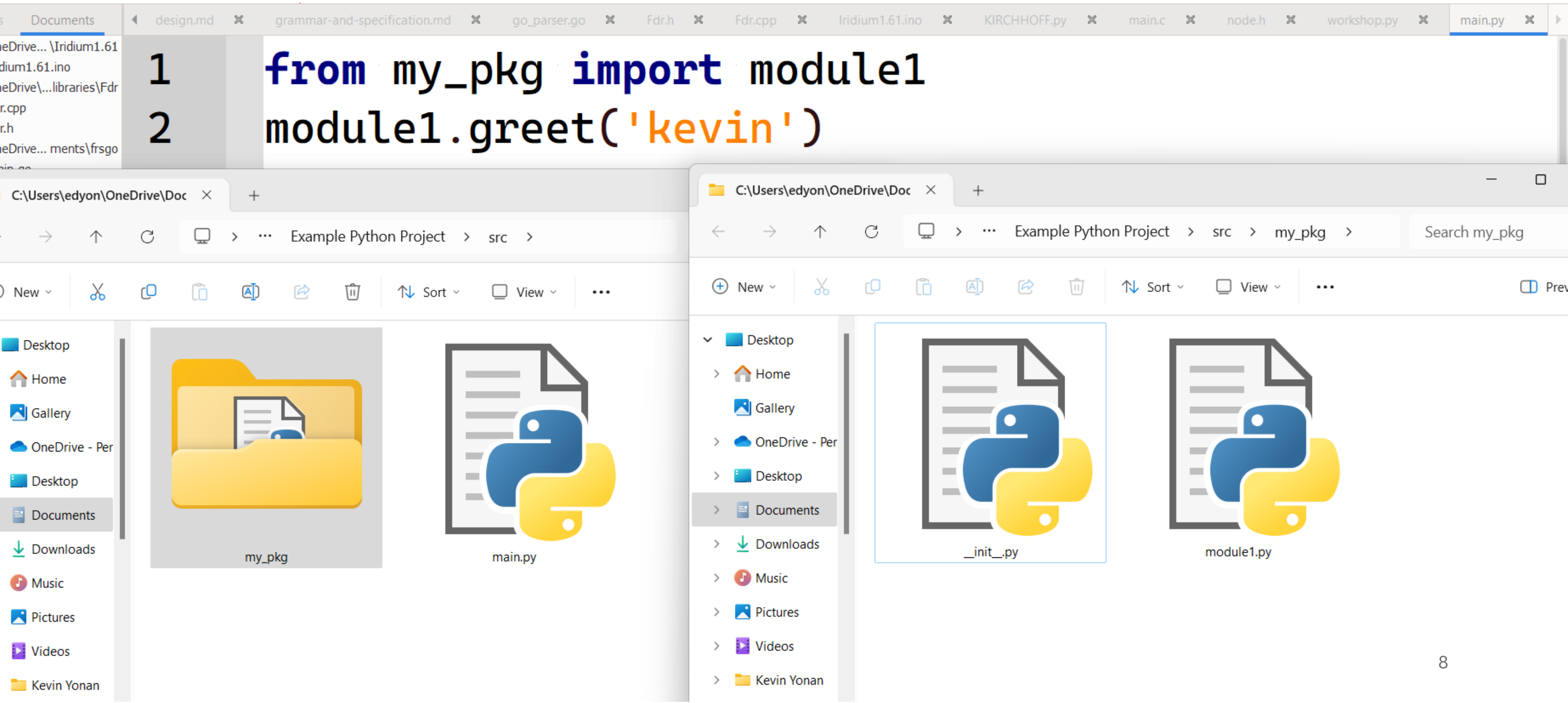


```
PS C:\Users\edyon> pip install numpy
>> pip install scipy
>> pip install sympy
```

Creating Larger Python programs

- Until now, we’ve made single-file Python programs.
- Single-file Python programs are alright but unrealistic in the long run.
- Sometimes programs are more complex in scale.
    - Requires breaking up into systems of independent actions.
    - This is where ***software engineering*** comes in.
    - Knowing how and what best practices to do when designing larger-scale software systems.
    - Systems Engineering practice also helps here!
- Tip: Isolate higher-level actions into systems.
- Break down each system into lower-level actions.
- lower-level actions accomplish specific objectives.
- Organize each system as *packages*.
- Packages are basically folders of python scripts that you import.

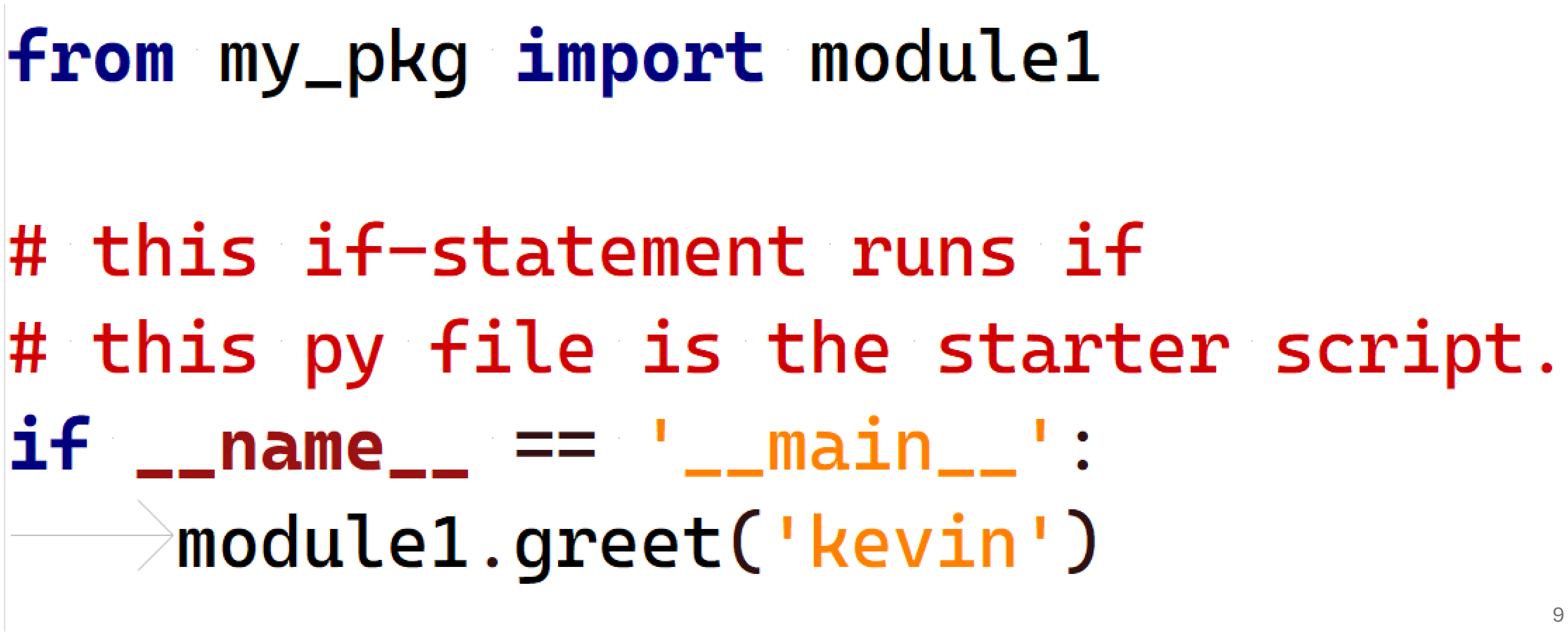
Setting up structured Python programs



```python
from my_pkg import module1
module1.greet('kevin')
```

Starter Python Scripts

- This code is in `**main.py**`
- **__name__** refers to the current python script file.



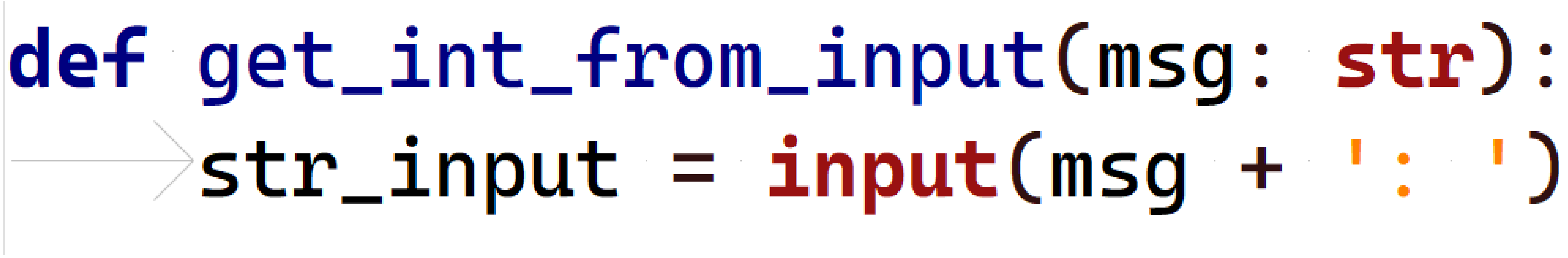
```python
from my_pkg import module1

# this if-statement runs if
# this py file is the starter script.
if __name__ == '__main__':
    module1.greet('kevin')
```

Word Problem Example & Practice I

- Make a function that prompts the user for an integer.
- If the given input can’t be converted, ask the user to try again.

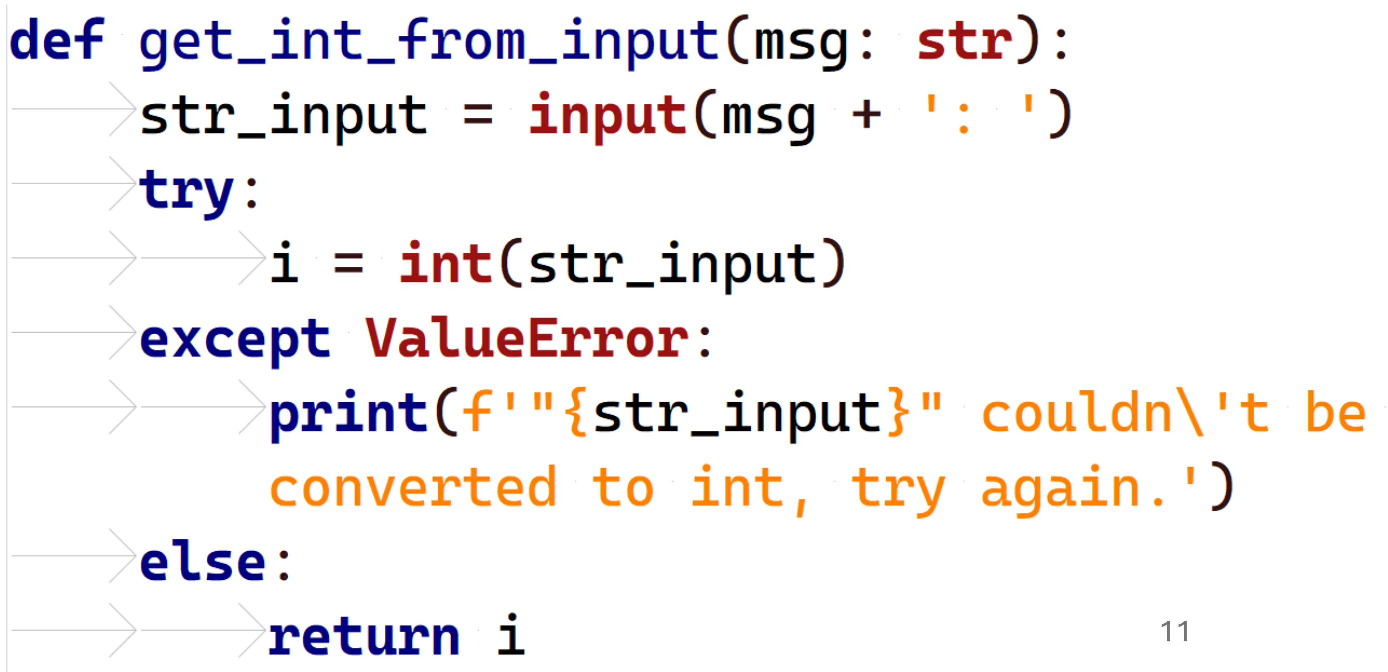
- First part isn’t too bad:



```python
def get_int_from_input(msg: str):
    str_input = input(msg + ': ')
```

Word Problem Example & Practice II

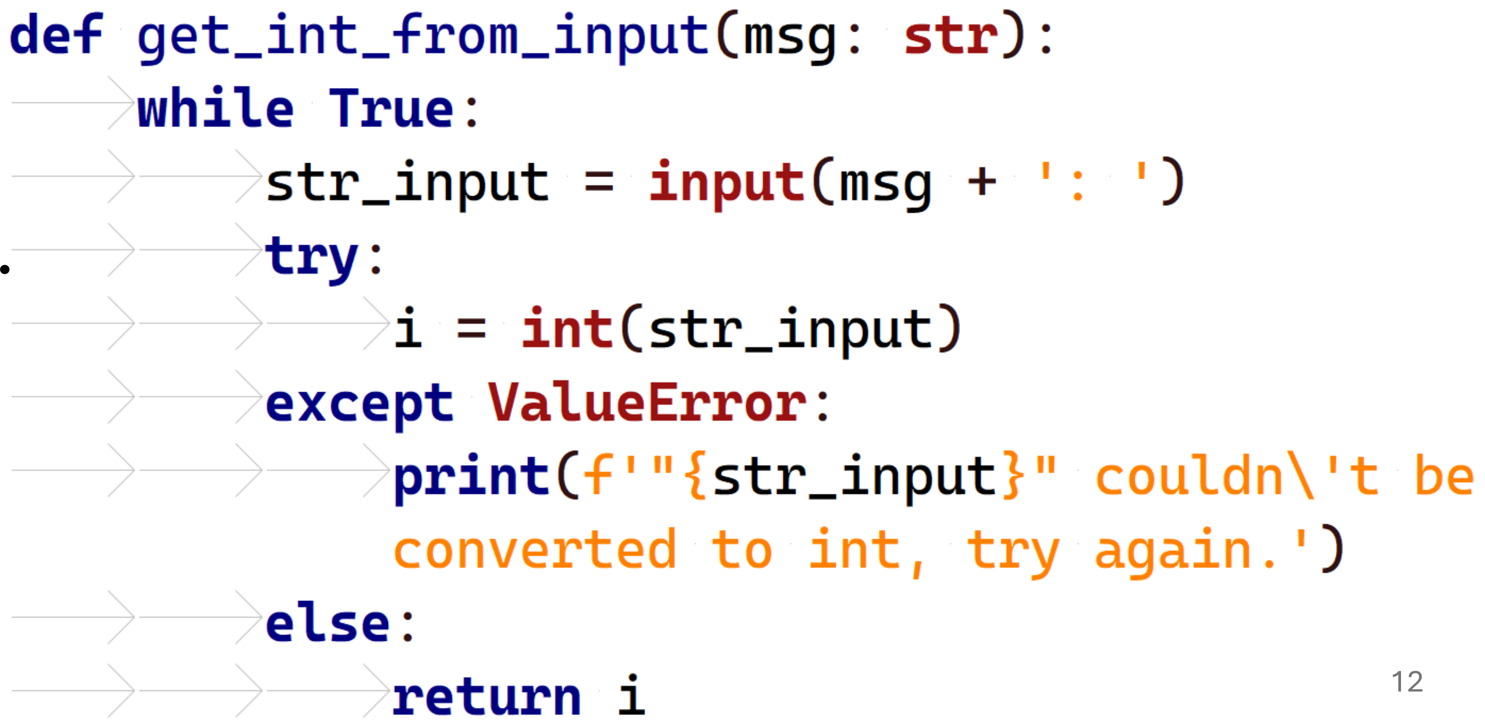
- But what happens if the user fat-fingers the input and gives a letter by accident?
  - We get a **ValueError** runtime exception!
- Well don’t we just use an exception to handle this? ***Yes***
- One problem though: Still doesn’t ask our user to try again!
- **Function *prints* for the user to try again but doesn’t restart!**



```python
def get_int_from_input(msg: str):
    str_input = input(msg + ': ')
    try:
        i = int(str_input)
    except ValueError:
        print(f'"{str_input}" couldn\'t be
        converted to int, try again.')
    else:
        return i
```

Word Problem Example & Practice III

- So how do we make sure the function restarts if an exception happens? There's two options to do this:
  - We could recursively call the function until the user gives valid input.
  - Put the whole code inside an infinite loop.
- Doing things recursively sometimes is simpler and/or more efficient. Here it's neither.
- Go with infinite loop.
- Why? Because simplicity.



```python
def get_int_from_input(msg: str):
    while True:
        str_input = input(msg + ': ')
        try:
            i = int(str_input)
        except ValueError:
            print(f'"{str_input}" couldn\'t be converted to int, try again.')
        else:
            return i
```

Word Problem Tips

- Make sure you’re understanding the problem.
- IMPORTANT to Determine whether a function itself should handle an error or if it should “bubble up” (have the function return an error and let higher-level systems deal with it).
- Determine the inputs and outputs.
  - Recall that Python’s functions and methods can return more than one thing.
  - *If* you need to return anything that is.
- Break down the problem, start simple.
- Remember to think of and handle edge cases.
- If there are duplicate sections of code, it might be worth putting that code into a function and replacing the duplicate section with a function call.

Abstract Word Problem

- Make a program that asks the user for 3 coefficients of the values in the quadratic formula: $Ax^2 + Bx + C$
- Best to make this as a function so we can return two x values.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Practice Project: Hangman

- Requirements:
  - The game will prompt the player for a letter as a guess from input.
  - The player is allowed 6 total wrong guesses.
  - For each letter in the mystery word matching the player’s letter, the player gains $100.
  - If the letter is a vowel, charge the player $50.
  - The player is not allowed to go into debt.
  - The player cannot use the same letter they previously guessed.
  - If the player got 6 wrong guesses in total or other situations that make the game stuck, the player then loses and prompted to either play again or quit.
- Hints:
  - Try to break this up into one or more systems.
  - Use dictionaries and/or classes if needed.

End of
Python For Engineers III

- Thank you for attending.
- Next Time: **Python for Engineers IV**.
  - Implement Numerical Methods from Calculus in Python.
  - Learn about Numpy, SciPy, and SymPy.