DEBUGGING

CS 3030: Python

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Review of homework 3 and 4 solutions

Damià Fuentes

Quiz 3

Final project - Team Forming Discussion

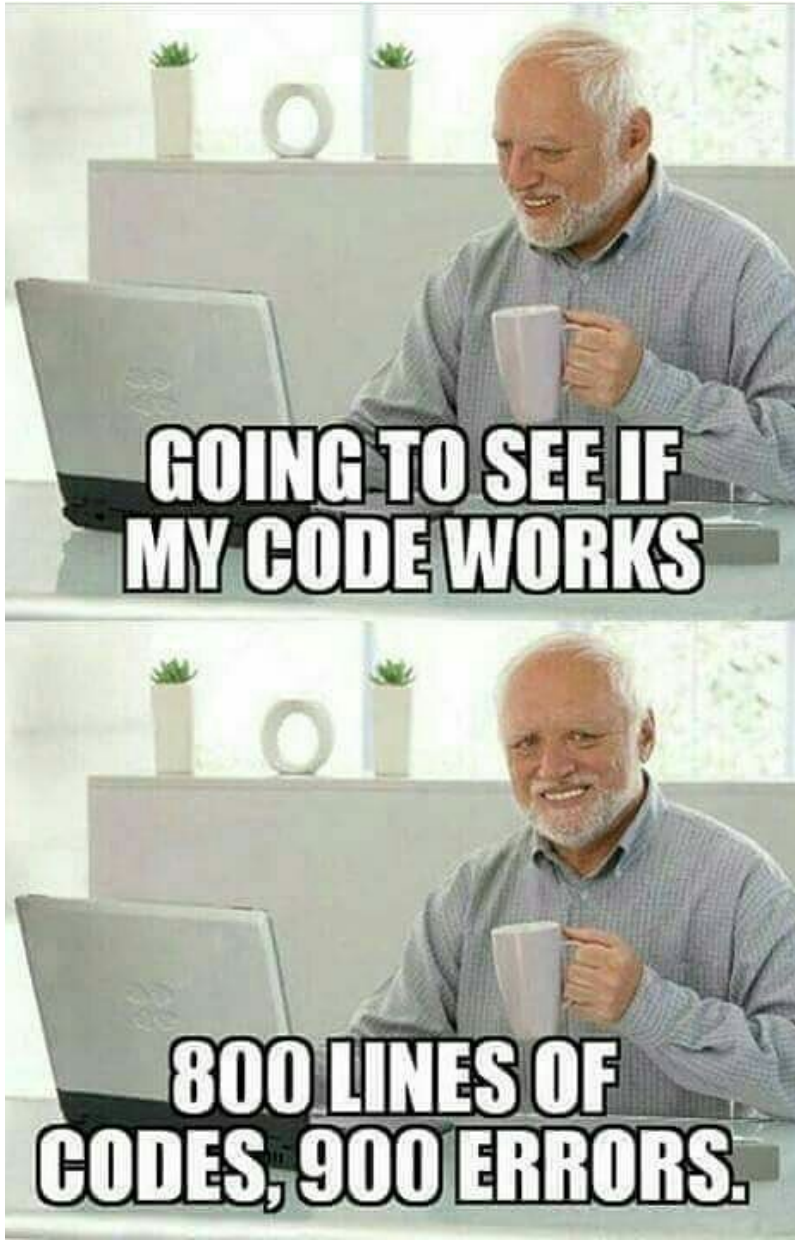
- https://canvas.uccs.edu/courses/29903/discussion_topics/90143

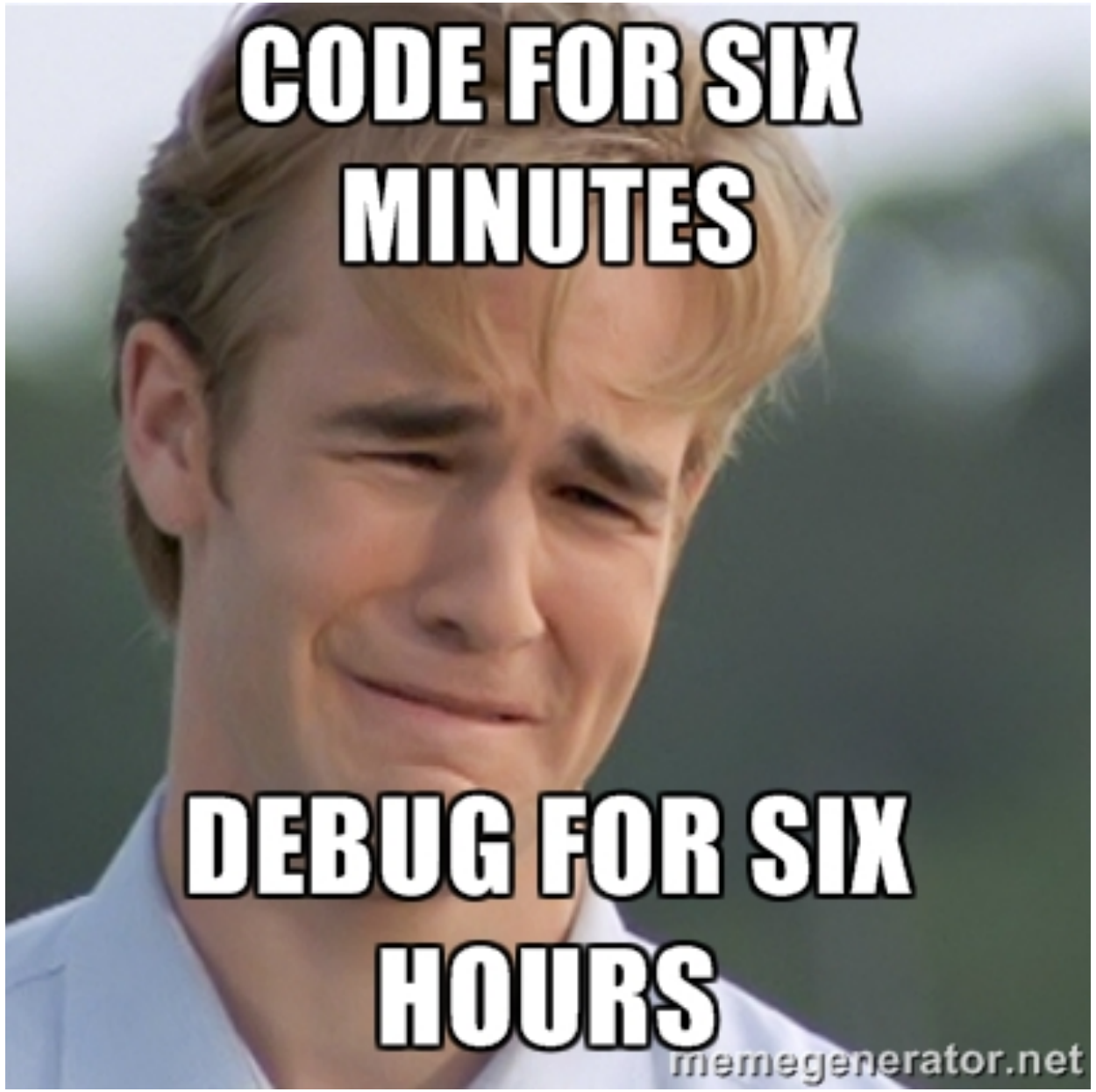
DEBUGGING

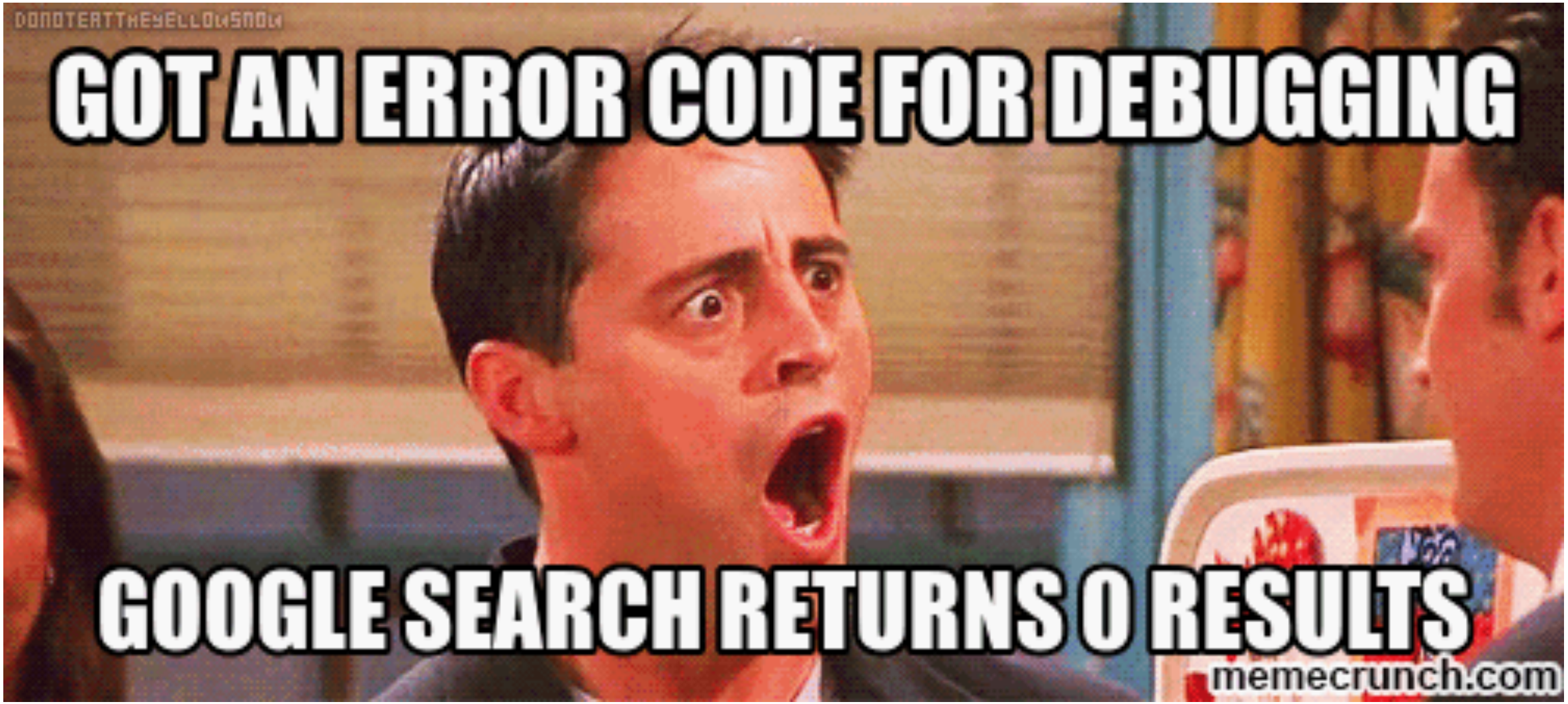
Debugging

- Now that you know enough to write more complicated programs, you may start finding not-so-simple bugs in them.
- This chapter covers some tools and techniques for finding the root cause of bugs in your program to help you fix bugs faster and with less effort.
- Definition (from google dictionary):
  - *The process of identifying and removing errors from computer hardware or software.*

“Writing code accounts for 90 percent of programming. Debugging code accounts for the other 90 percent.”


GOING TO SEE IF
MY CODE WORKS
800 LINES OF
CODES, 900 ERRORS.


CODE FOR SIX MINUTES
DEBUG FOR SIX HOURS
memegenerator.net


GOT AN ERROR CODE FOR DEBUGGING
GOOGLE SEARCH RETURNS 0 RESULTS
memecrunch.com


FOOD GROUPS

Debugging

- Your computer will do only what you tell it to do; it won’t read your mind and do what you intended it to do.
- Even professional programmers create bugs all the time, so don’t feel discouraged if your program has a problem.

Raising Exceptions

- Python raises an exception whenever it tries to execute invalid code
- But you can also raise your own exceptions in your code.
- Raising an exception is a way of saying:
  - *“Stop running the code in this function and move the program execution to the except statement.”*

Raising Exceptions

```
raise Exception('This is the error message.’)
# Traceback (most recent call last):
# File "<pyshell#191>", line 1, in <module>
# raise Exception('This is the error message.’)
# Exception: This is the error message.
```

Raising Exceptions

```
def boxPrint(symbol, width, height):
    if len(symbol) != 1:
        raise Exception('Symbol must be a single character string.')
    if width <= 2:
        raise Exception('Width must be greater than 2.')
    if height <= 2:
        raise Exception('Height must be greater than 2.')
    print(symbol * width)

    for i in range(height - 2):
        print(symbol + (' ' * (width - 2)) + symbol)

    print(symbol * width)
```

Raising Esceptions

```
for sym, w, h in (('*', 4, 4),
                  ('O', 20, 5),
                  ('x', 1, 3),
                  ('ZZ', 3, 3)):
    try:
        boxPrint(sym, w, h)
    except Exception as err:
        print('An exception happened: ' + str(err))
```

Getting the Traceback as a String

- When Python encounters an error, it produces a treasure trove of error information called the **traceback**.
- The traceback includes:
  - *the error message,*
  - *the line number of the line that caused the error,*
  - *and the sequence of the function calls that led to the error. This sequence of calls is called the **call stack**.*

Getting the Traceback as a String

```
def spam():
    bacon()

def bacon():
    raise Exception('This is the error message.’)

spam()
```

Getting the Traceback as a String

```
def spam():
    bacon()

def bacon():
    raise Exception('This is the error message.’)

spam()
```

```
Traceback (most recent call last):
  File "/Users/damiafuentes/Documents/UCCS/CS_3030_Python/Lectures/test.py", line 7, in <module>
    spam()
  File "/Users/damiafuentes/Documents/UCCS/CS_3030_Python/Lectures/test.py", line 2, in spam
    bacon()
  File "/Users/damiafuentes/Documents/UCCS/CS_3030_Python/Lectures/test.py", line 5, in bacon
    raise Exception('This is the error message.')
Exception: This is the error message.
```

Getting the Traceback as a String

- Instead of crashing your program right when an exception occurs, you can write the traceback information to a log file and keep your program running. You can look at the log file later, when you're ready to debug your program.

```
import traceback
try:
    raise Exception('This is the error message.')
except:
    errorFile = open('errorInfo.txt', 'w')
    errorFile.write(traceback.format_exc())
    errorFile.close()
    print('The traceback info was written to errorInfo.txt.')
```

Assertions

- An assertion is a sanity check to make sure your code isn't doing something obviously wrong.
- These sanity checks are performed by **assert statements**.
- If the sanity check fails, then an AssertionError exception is raised.

Assertions

```
def kelvinToFahrenheit(temp):
    assert (temp >= 0),"Colder than absolute zero!”
    return ((temp-273)*1.8)+32


print(kelvinToFahrenheit(273))              # 32.0
print(int(kelvinToFahrenheit(505.78)))      # 451
print(kelvinToFahrenheit(-5))
# AssertionError: Colder than absolute zero!
```

Assertions

- In plain English:
  - *“I assert that this condition holds true, and if not, there is a bug somewhere in the program.”*
- Unlike exceptions, your code should not handle assert statements with try and except; if an assert fails, your program should crash.
- By failing fast early in the program’s execution, you can save yourself a lot of future debugging effort.
- This will reduce the amount of code you will have to check before finding the code that’s causing the bug.
- **Assertions are for programmer errors, not user errors.** For errors that can be recovered from (such as a file not being found or the user entering invalid data), raise an exception instead of detecting it with an assert statement.

Assertions

```
def kelvinToFahrenheit(temp):
    assert (temp >= 0),"Colder than absolute zero!”
    return ((temp-273)*1.8)+32

# Some code that obtains the kelvin temperature not
# involving user input
fahrenheit = kelvinToFahrenheit(kelvin)
# Work with the fahrenheit temperature
```

Logging

- If you've ever put a print() statement in your code to output some variable's value while your program is running, you've used a form of logging to debug your code.
- Logging is a great way to understand what's happening in your program and in what order its happening.
- We are going to use the logging module

Logging

Where is the error?

```
import logging

logging.basicConfig(level=logging.DEBUG, format=' %(asctime)s - %(levelname)s
- %(message)s’)
logging.debug('Start of program’)

def factorial(n):
    logging.debug('Start of factorial(%s%%)' % (n))
    total = 1
    for i in range(n + 1):
        total *= i
        logging.debug('i is ' + str(i) + ', total is ' + str(total))
    logging.debug('End of factorial({})'.format(n))
    return totallogging.debug(factorial(5))

logging.debug('End of program')
```

Logging

Where is the error?

```
import logging

log                                                    elname)s
    %
log

def

    2019-02-18 19:02:17,336 - DEBUG - Start of program
    2019-02-18 19:02:17,337 - DEBUG - Start of factorial(5%)
    2019-02-18 19:02:17,337 - DEBUG - i is 0, total is 0
    2019-02-18 19:02:17,337 - DEBUG - i is 1, total is 0
    2019-02-18 19:02:17,337 - DEBUG - i is 2, total is 0
    2019-02-18 19:02:17,337 - DEBUG - i is 3, total is 0
    2019-02-18 19:02:17,337 - DEBUG - i is 4, total is 0
    2019-02-18 19:02:17,337 - DEBUG - i is 5, total is 0
    2019-02-18 19:02:17,337 - DEBUG - End of factorial(5)
    2019-02-18 19:02:17,337 - DEBUG - 0
    2019-02-18 19:02:17,337 - DEBUG - End of program

logging.debug('End of program')
```

LogRecord attributes

```
logging.basicConfig(level=logging.DEBUG, format=' %(asctime)s
- %(levelname)s - %(message)s')
```

```
2019-02-18 19:02:17,336 - DEBUG - Start of program
2019-02-18 19:02:17,337 - DEBUG - Start of factorial(5%)
2019-02-18 19:02:17,337 - DEBUG - i is 0, total is 0
2019-02-18 19:02:17,337 - DEBUG - i is 1, total is 0
2019-02-18 19:02:17,337 - DEBUG - i is 2, total is 0
2019-02-18 19:02:17,337 - DEBUG - i is 3, total is 0
2019-02-18 19:02:17,337 - DEBUG - i is 4, total is 0
2019-02-18 19:02:17,337 - DEBUG - i is 5, total is 0
2019-02-18 19:02:17,337 - DEBUG - End of factorial(5)
2019-02-18 19:02:17,337 - DEBUG - 0
2019-02-18 19:02:17,337 - DEBUG - End of program
```

LogRecord attributes

- %(asctime)s
  - *Human-readable time*
- %(filename)s
- %(pathname)s
- %(funcName)s
- %(levelname)s
  - *Text logging level for the message ('DEBUG', 'INFO', 'WARNING', 'ERROR', 'CRITICAL').*
- %(lineno)d
  - *Source line number where the logging call was issued (if available)*
- %(message)s
  - *The logged message*

Find all of them: https://docs.python.org/3/library/logging.html#logrecord-attributes

Logging levels

Level	Logging Function	Description
DEBUG	`logging.debug()`	The lowest level. Used for small details. Usually you care about these messages only when diagnosing problems.
INFO	`logging.info()`	Used to record information on general events in your program or confirm that things are working at their point in the program.
WARNING	`logging.warning()`	Used to indicate a potential problem that doesn't prevent the program from working but might do so in the future.
ERROR	`logging.error()`	Used to record an error that caused the program to fail to do something.
CRITICAL	`logging.critical()`	The highest level. Used to indicate a fatal error that has caused or is about to cause the program to stop running entirely.

Logging levels

- After developing your program some more, you may be interested only in errors. In that case, you can set basicConfig()'s level argument to logging.ERROR. This will show only ERROR and CRITICAL messages and skip the DEBUG, INFO, and WARNING messages.

```
logging.basicConfig(level=logging.ERROR, format='%(asctime)s
- %(levelname)s - %(filename)s - %(lineno)d - %(message)s')
```

Disabling Logging

- After you've debugged your program, you probably don't want all these log messages cluttering the screen.
- The logging.disable() function disables these so that you don't have to go into your program and remove all the logging calls by hand.
- You simply pass logging.disable() a logging level, and it will suppress all log messages at that level or lower.
- So if you want to disable logging entirely, just add
  - *logging.disable(logging.CRITICAL)*

Logging to a File

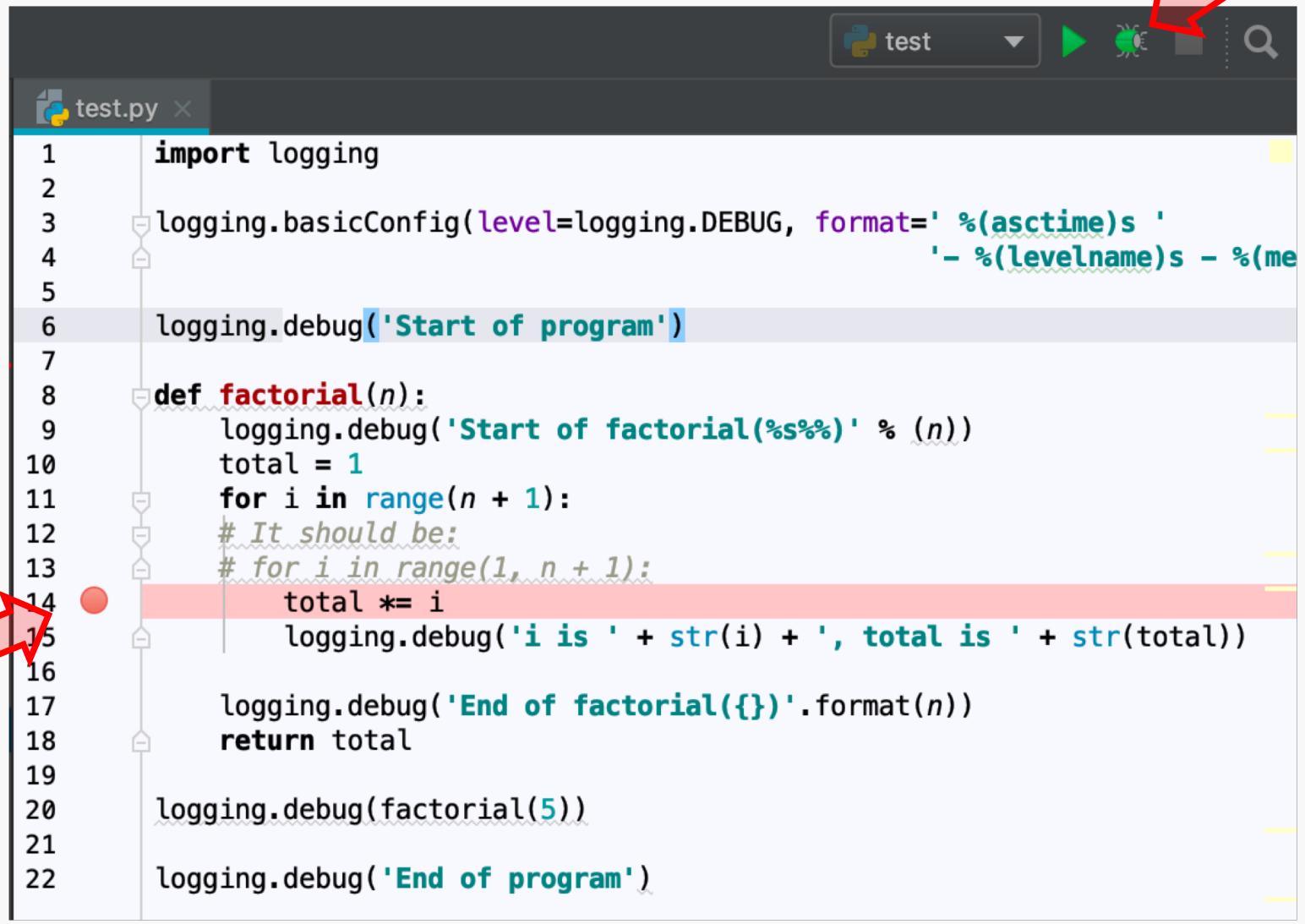
- While logging messages are helpful, they can clutter your screen and make it hard to read the program's output. Writing the logging messages to a file will keep your screen clear and store the messages so you can read them after running the program.

```
import logging

logging.basicConfig(filename='myProgramLog.txt',
                    level=logging.DEBUG,
                    format='%(asctime)s - %(levelname)s - %(message)s')
```

PyCharm debugger

Run with debugger mode



Breakpoint