# Intro to programming 8

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- And more and more complicated bugs. . .
- 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
- Everyone create bugs and everyone has to correct them
- Fortunately, python comes will tools to help you get over them

# Today

- Debugging level 0
- Assertion
- Logging
- pdb module

# Disclaimer

- This document is highly based on **Automate the Boring Stuff with Python** chapter 11...
- https://automatetheboringstuff.com/2e/chapter11/

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  - print the type of your variable: **print(type(your_variable))**

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  - print it: **print(your_variable)**
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- **print()** can be useful for simple check but please don't debug your all your script with print()
- It's the level 0 of debugging

# Try and except statements 1/5

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- Example: What's wrong in the following script:

```
def isDivided(divisor):
    return 42 / divisor

print(isDivided(2))
print(isDivided(12))
print(isDivided(0))
print(isDivided(3))
```

# Try and except statements 2/5

- If you have an error in your script, the execution is stropped.
- Example: What's wrong in the following script:

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def isDivided(divisor):
    return 42 / divisor

print(isDivided(2))
```

```
## 21.0
```

```
print(isDivided(12))
```

```
## 3.5
```

```
print(isDivided(0))
```

```
## Error in py_call_impl(callable, dots$args, dots$keywords): ZeroDivisionError:
      division by zero
```

# Try and except statements 3/5

- But you can still have your way around this error:
  - **try :**
  - **except ... :**

```
def isDivided(divisor):
    try:
      return 42 / divisor
    except ZeroDivisionError:
      print("What have I done again...")

print(isDivided(2))
```

```
## 21.0
```

```
print(isDivided(12))
```

```
## 3.5
```

```
print(isDivided(0))
```

```
## What have I done again...
## None
```

```
print(isDivided(3))
```

# Try and except statements 4/5

- You can as well include the call of your function in the try

```
def isDivided(divisor):
  return 42 / divisor

try:
  print(isDivided(2))
  print(isDivided(12))
  print(isDivided(0))
  print(isDivided(3))

except ZeroDivisionError:
  print("What have I done again...")
```

```
## 21.0
## 3.5
## What have I done again...
```

# Try and except statements 4/5

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def isDivided(divisor):
  return 42 / divisor

try:
  print(isDivided(2))
  print(isDivided(12))
  print(isDivided(0))
  print(isDivided(3))

except ZeroDivisionError:
  print("What have I done again...")
```

```
## 21.0
## 3.5
## What have I done again...
```

- Note that **print(isDivided(3))** is not executed. Once the execution jumps in the except statement, it does not goes back to the try clause. Instead, it just continues moving down the program as normal

# Try and except statements 5/5

- **try except** is useful:
  - For making some checks on your program flow
  - To get a (hopefully) clearer (or more adapted) error message than what python can provide
- **try except** is not useful:
  - To dodge error without solving them
  - To get a running program without crash

# Raising Exceptions 1/2

- Python raises exceptions every time it attempts to execute an invalid code
- Exceptions are raised this way:
  - **raise** keyword
  - **Exception()** function
  - A useful sentence that will help you understand the problem in the Exception function

```
raise Exception('Ah Shit, Here We Go Again: another day another bug')
```

```
## Error in py_call_impl(callable, dots$args, dots$keywords): Exception: Ah Shit, Here We
     Go Again: another day another bug
```

- The **try** and **except** statement allows us to handle those exceptions if we anticipate them
- Without the **try** and **except** statement the program stops at the first exception raised

# Raising Exceptions 2/2

- When / how to raise exception ?
- Exception can be passed as argument or returned at the end of a function

```
def doBullshit():
  raise Exception('I did bullshit')

try:
  doBullshit()
except Exception as err:
  print("Ooops, ", str(err) )
```

```
## Ooops,  I did bullshit
```

# Getting the Traceback as a String 1/2

- Getting the information of your error.
- When your program crashes you always have an error with some information like:
  - The line of the error / the differents lines if your program uses several files
  - The error message
  - The function / the sequence of functions involved (i,e, the call stack)
- All of that is called the **traceback**
- Example:

```
def callErrorTest():
  errorTest()

def errorTest():
  raise Exception('FATAL ERROR')

callErrorTest()
```

```
## Error in py_call_impl(callable, dots$args, dots$keywords): Exception: FATAL ERROR
```

- Those informations are here to help you locate and understand you error.

# Getting the Traceback as a String 2/2

- Instead of just prompting it on your terminal, you can have access to your traceback using: **traceback.format_exc()**
- That way you can obtain your traceback information as a string
- You'll need the tracback module to access the function.
- It can be useful if you want to keep track of an error and write the info in a file. That way you keep it for later when you'll be mentally prepared to debug your code.

```
import traceback

try:
  raise Exception('FATAL ERROR')

except:
  errorFile = open('errorInfo.txt', 'w')
  errorFile.write(traceback.format_exc())
  errorFile.close()
  print('Don\'t have time now to debug but all info are in errorInfo.txt')
```

```
## 97
## Don't have time now to debug but all info are in errorInfo.txt
```

# Assertions 1/3

- Assertion is a very a sanity check to be sure that the data has the expected format
- If the sanity check fails then an **AssertionError** exception is raised
- Assertions are raised this way:
  - **assert** keyword
  - A condition
  - A comma
  - A string to display when the check fails
- Example 1:

```
olympicGamesYears =[2021, 2012, 2008, 2024, 2016, 2000, 2004]

assert olympicGamesYears[0] < olympicGamesYears[-1] , "Years doesn't seem sorted"
```

```
## Error in py_call_impl(callable, dots$args, dots$keywords): AssertionError: Years doesn'
     t seem sorted
```

# Assertions 2/3

- Assertion is a very a sanity check to be sure that the data has the expected format
- If the sanity check fails then an **AssertionError** exception is raised
- Assertions are raised this way:
  - **assert** keyword
  - A condition
  - A comma
  - A string to display when the check fails
- Example 2:

```
olympicGamesYears =[2004, 2012, 2008, 2024, 2016, 2000, 2021]

olympicGamesYears.sort()

assert olympicGamesYears[0] < olympicGamesYears[-1] , "Years doesn't seem sorted"
```

# Assertions 3/3

- Assertion are very useful:
  - At a key point to check that your data have the right format
  - If well design it gives you the location and the exact reason why if failed.
  - To save time in debugging
- But you need first to have a very concrete idea of what to expect and where in your program to set up some assertions

# Logging 1/7

- Logging is to write down info or variable content from your script to keep track of the execution of your program
- **print()** is some form of logging.
- Why logging better than print :
  - You can have access to better information like timings for example
  - It can be systematic and organized
- Of course Python has a logging module and the name is **logging**: https://docs.python.org/3/library/logging.html

# Logging 2/7

- Example:

```
def factorial(n):
    total = 1
    for i in range(n + 1):
        total *= i
    return total

print(factorial(5))
```

# Logging 2/7

- Example:

```
def factorial(n):
    total = 1
    for i in range(n + 1):
        total *= i
    return total

print(factorial(5))
```

```
## 0
```

- What will be the output ?

# Logging 3/7

- Example with logging:

```
import logging

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

```
## 2022-11-29 15:41:06,740 -  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(%s)'  % (n))
    return total

logging.debug('Call of the function')
```

```
## 2022-11-29 15:41:06,747 -  DEBUG -  Call of the function
```

```
print(factorial(5))
```

```
## 0
```

# Logging 4/7

- Example with logging:

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

```
## 2022-11-29 15:41:06,917 -  DEBUG -  Start of program
```

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

logging.debug('Call of the function')
```

```
## 2022-11-29 15:41:06,929 -  DEBUG -  Call of the function
```

```
print(factorial(5))
```

```
## 120
##
```

# Logging 5/7

- The function **logging.basicConfig(level=logging.DEBUG, format='%(asctime)s - %(levelname)s - %(message)s')** can be set to look at several levels:
  - **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 6/7

- Logging can be very useful to inspect systematically your program execution

```
import logging
logging.disable(logging.CRITICAL)
logging.basicConfig(level=logging.DEBUG, format='%(asctime)s - %(levelname)s - %(
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- Logging can be very useful to inspect systematically your program execution
- It needs some time to adapt to it but it's very practical and customizable at need

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- Logging can be very useful to inspect systematically your program execution
- It needs some time to adapt to it but it's very practical and customizable at need
- Why is it better than print ?
  - print function can be non debugging feature so make the difference between debugging print and necessary print becomes hell
  - can be switch off easily with **logging.disable(logging.CRITICAL)**

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logging.debug('Call of the function')
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```

# Logging 7/7

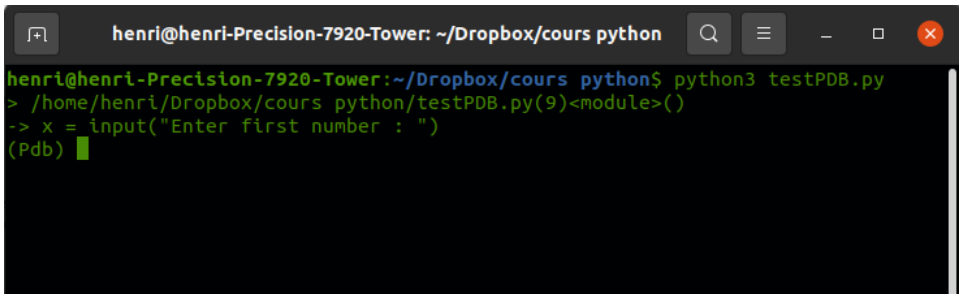
- Logging is very useful for debugging without interrupting the execution
- For example when your program doesn't crash but doesn't exactly what you want
- Debugging even post mortem (after execution)
- It is especially efficient when you can not have access to the terminal (i,e when you program experiment with visual stimuli)

# Python debugger: PDB 1/4

- The ultimate debugging tool is the **pdb** module: https://docs.python.org/3/library/pdb.html
- You just need to **import pdb** and call **pdb.set_trace()**

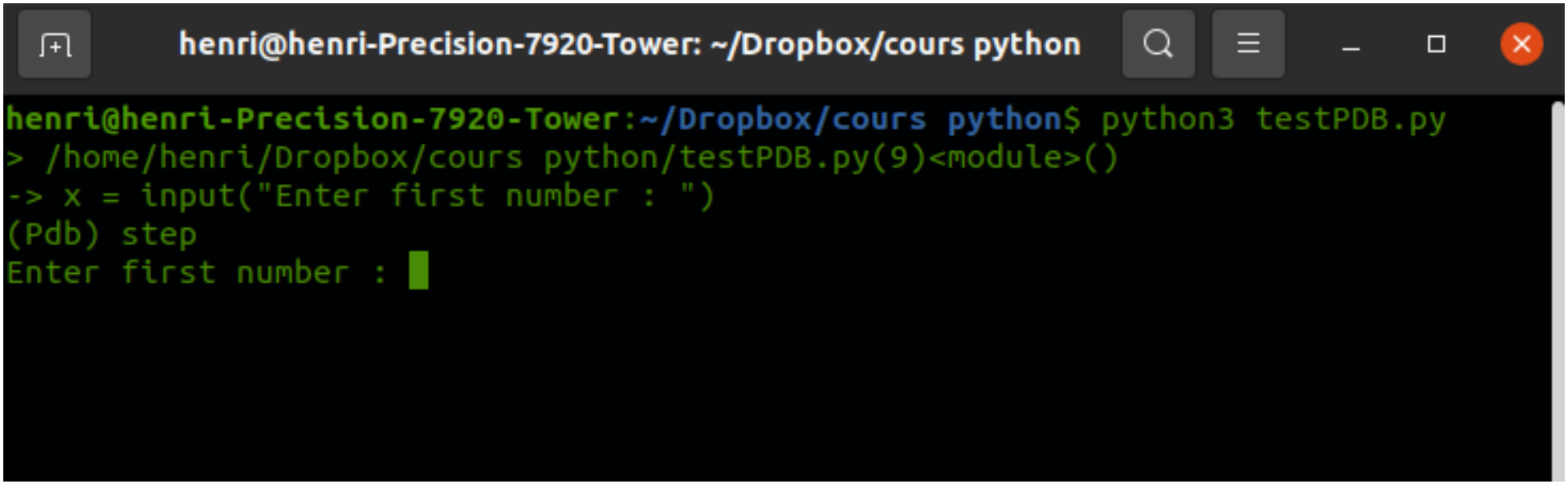
```
import pdb

def addition(a, b):
    answer = a * b
    return answer

pdb.set_trace()
x = input("Enter first number : ")
y = input("Enter second number : ")
sum = addition(x, y)
print(sum)
```

- When executing your program with the module **pdb** you have a screen like that



# Python debugger: PDB 2/4

- It is a command line tool that go sequentially at every step of the program
- There are a certain number of command to know:
  - **help** To display all commands
  - **where** Display the stack trace and line number of the current line
  - **next** Execute the current line and move to the next line ignoring function calls
  - **step** Step into functions called at the current line
  - **whatis** Check the type of variable

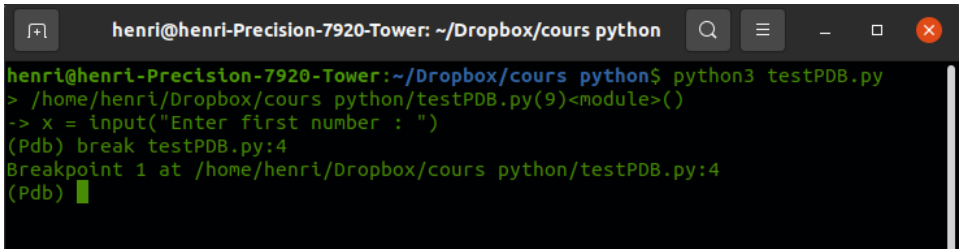


# Python debugger: PDB 3/4

- You can use as well:
  - **args** To get all arguments of a function
  - **p** To get the value at a time t of a variable
- You can navigate in pdb prompt using:
  - **c** continue execution
  - **q** quit the debugger/execution
  - **n** step to next line within the same function
  - **s** step to next line in this function or a called function
  - **u** (up)
  - **d** (down)

# Python debugger: PDB 4/4

- You can also set a breakpoint at a specific point in the script
- To do that you need to write on the terminal: **break filename: lineno, condition**




- You can then use **c** to run the program until your breakpoint