

Module 02

Types, Operators, Debugging

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Agenda

- Tutoring Resources
- Review Module 2 / Go over Quiz 2
- Practice Problems

Module #2

- Commenting Your Code
- Data Types
- Data Type Conversion
- Math Operators + Mixed Type Expressions
- Error + Error Types
- Formatting Strings + Numbers
- Drawing Graphics in Python (Turtle)

Data Types

Data Types

String Literals (character-based data):

```
greeting = "Hello, World!"
```

Numeric Literals:

```
num = 5
```

```
pi = 3.1415
```

Logical Values:

```
isThursday = True
```

Data Type Conversions

Source:

```
# Calculating total age

age1 = input("How old is person 1?: ")
age2 = input("How old is person 2?: ")

print("Your total age is:", age1 + age2)
```

Execution:

```
How old is person 1?: 10
How old is person 2?: 15
Your total age is: 
```

Source:

```
# Calculating total age

age1 = input("How old is person 1?: ")
age2 = input("How old is person 2?: ")

print("Your total age is:", age1 + age2)
```

Execution:

```
How old is person 1?: 10
How old is person 2?: 15
Your total age is: 1015
```


Old Source:

```
# Calculating total age
```

```
age1 = input("How old is person 1?: ")
```

```
age2 = input("How old is person 2?: ")
```

```
print("Your total age is:", age1 + age2)
```

New Source:

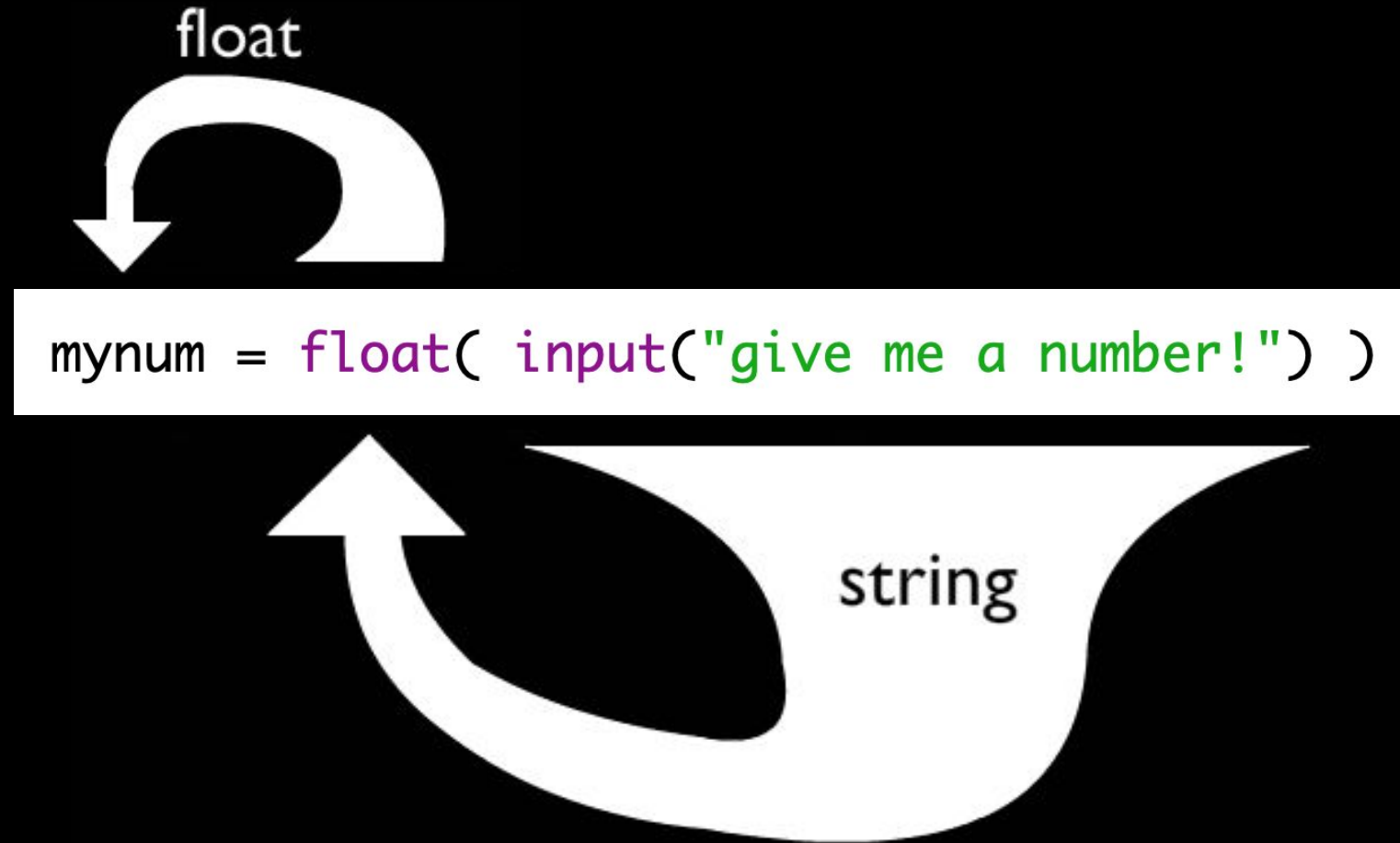
```
# Calculating total age
```

```
age1 = float(input("How old is person 1?: "))
```

```
age2 = input("How old is person 2?: ")
```

```
print("Your total age is:", age1 + float(age2))
```

Nesting data type conversions



Conversion functions

- **To String**
`str()`
- **To Float**
`float()`
- **To Integer**
`int()`

Math Operators + Mixed Type Expressions

What's the difference between / and //?

What's the output?

2 + 3 → 5

5 / 2 → 2.5

5 // 2 → 2

2 + 3.0 → 5.0

6 / 2 → 3.0

6 // 2 → 3

2.0 + 3.0 → 5.0

Programming Challenge: Subway Ride Calculator

- Write a program that asks the user for the value of their current Metrocard
- Compute how many rides they have left on their card. Only provide whole number results (i.e. you cannot have 3.5 rides left on a card)
- The fare for one ride is \$2.75

Programming Challenge: Subway Ride Calculator

```
# Programming Challenge: Subway Ride Calculator

# ask user for value of current MetroCard
mc_value = float(input("Value of Metrocard: "))

# compute rides left in whole numbers
rides_left = mc_value // 2.75
print("Rides left:", int(rides_left))
```


Convert the expression

$$2^4 \rightarrow 2^{**4}$$

$$\sqrt{4} \rightarrow 4^{** (1 / 2)}$$

What does the `%` operator do?

What does the **%** operator do?

Remainder (Modulo) Operator

12 % 7 → 5

34 % 3 → 1

10 % 5 → 0

Programming Challenge: Time Calculations

- Ask the user to input a number of seconds as a whole number. Then express the time value inputted as a combination of minutes and seconds.

```
Enter seconds: 110
```

```
> That's 1 minute and 50 seconds
```

Programming Challenge: Time Calculations

```
# Programming Challenge: Time Calculations

# ask user to input number of seconds as whole number
seconds = int(input("Enter seconds: "))

# output combination of minutes and seconds
minutes = seconds // 60
secs_remain = seconds % 60

print(minutes)
print(secs_remain)
print("That's", minutes, "minutes and", secs_remain, "seconds")
```

Programming Challenge: Calculate Half Birthday Month

- Write a program that takes a user's birth month and returns their half birthday month

```
Enter your birth month (i.e. 10): 10  
Your half birthday month is 4
```

Programming Challenge: Calculate Half Birthday

```
1 # Calculate Half Birthday
2 month = input("Enter your birth month (i.e. 10): ")
3
4 # How do I calculate a half birthday month?
5
6 # Let's find a pattern
7 # Feb -> Aug: add 6 (2 + 6 = 8)
8 # Dec -> Jun: subtract 6 (12 - 6 = 6)
9 # Oct -> Apr: how do I get 4? (10 ?? = 4)
10
11 # Need to come up with a formula
12 # (month + 6) % 12
13
14 half = (int(month) + 6) % 12
15 print("Your half birthday month is", half)
```

Error + Error Types

“Debugging”

1947, Harvard Mark II Computer, Grace Hopper's log book:


9/9

0800 Andam started
1000 " stopped - andam ✓

1300 (032) MP-MC ~~1.982647000~~
(033) PRO 2 2.130476415 ~~2.130476415~~ 4.615925059(-2)
conch 2.130676415

Relays 6-2 in 033 failed special speed test
in relay 10,000 test.

1100 Relays changed
Started Cosine Tape (Sine check)
1525 Started Multi-Adder Test.

1545  Relay #70 Panel F
(moth) in relay.

First actual case of bug being found.

1630 Andam started.
1700 closed down.

Relay 3145
Relay 3370

Types of Errors

- **Syntax Errors:**
Does not follow the rules of the language
- **Runtime Errors:**
Code is fine, but program crashes when it runs
- **Logic Errors:**
Hardest to find; program is correct syntactically, but the output is unanticipated or outright wrong

What kind of error is this?

```
print ("Hello, world!')
```

- **Syntax**
- **Runtime**
- **Logical**

What kind of error is this?

```
print ("Hello, world!')
```

- **Syntax**
- Runtime
- Logical

```
SyntaxError: EOL while scanning string literal
```

What kind of error is this?

Source:

```
num = input ('give me a number: ')\nnum_float = float(num)\nnew_num = 10 + num_float\nprint (new_num)
```

- Syntax
- Runtime
- Logical

Execution:

```
give me a number: apple
```

```
Traceback (most recent call last):
```

```
  File "/Volumes/GoogleDrive/My Drive/teaching/intro-to\n-computer-programming/fall-22/class-website/code/day-02\n-scratch.py", line 3, in <module>
```

```
    num_float = float(num)
```

```
ValueError: could not convert string to float: 'apple'
```

What kind of error is this?

Source:

```
num = input ('give me a number: ')\nnum_float = float(num)\nnew_num = 10 + num_float\nprint (new_num)
```

- Syntax
- Runtime
- Logical

Execution:

```
give me a number: apple
```

```
Traceback (most recent call last):
```

```
  File "/Volumes/GoogleDrive/My Drive/teaching/intro-to\n-computer-programming/fall-22/class-website/code/day-02\n-scratch.py", line 3, in <module>
```

```
    num_float = float(num)
```

```
ValueError: could not convert string to float: 'apple'
```


What kind of error is this?

Source:

```
num_1 = float (input ('give me a num: '))  
num_2 = float (input ('give me another num: '))  
print ('the sum is: ', num_1 - num_2)  
  
num_1 = float (input ('give me a num: '))  
num_2 = float (input ('give me another num: '))  
print ('the sum is: ', num_1 - num_2)
```

- Syntax
- Runtime
- Logical

Execution:

```
give me a num: 5  
give me another num: 2  
the sum is: 3.0
```

What kind of error is this?

Source:

```
num_1 = float (input ('give me a num: '))  
num_2 = float (input ('give me another num: '))  
print ('the sum is: ', num_1 - num_2)  
  
num_1 = float (input ('give me a num: '))  
num_2 = float (input ('give me another num: '))  
print ('the sum is: ', num_1 - num_2)
```

- Syntax
- Runtime
- **Logical**

Execution:

```
give me a num: 5  
give me another num: 2  
the sum is: 3.0
```


Formatting Strings + Numbers

Line Continuation

- Sometimes the code you write can get very long
- You can use the `\` symbol to indicate to Python that you would like to continue your code onto another line

```
1 print("Once upon a time, there was a king; who used to wear a single \  
2     horned crown. He had a lavish palace, three beautiful wives, \  
3     and seven children; all well qualified in their respective fields. \  
4     The king was reaching the retirement age, so he asked his elder son \  
5     to lead his empire so that he could undergo seclusion.")
```

Escape Characters

- An “escape character” allows you to perform special actions inside the confines of a delimiter
- In Python, the escape character is `\`
- It causes Python to treat the next character as “special”

```
print('Hi, I\'m Harry Potter, a wizard.')
```

Escape Characters

- There are a number of special characters you can use in conjunction with the escape character to perform special string operations
- `\n` forces a line break
- `\t` creates a tab

```
print ("line 1\n\tline 2\nline 3\n")
```

```
# line 1  
#   line 2  
# line 3
```

The `format` function

```
format(value, format_spec="")
```

The `format` function

Input	Format Spec	Output	Description
3.1415926	".2f"		
3141.5926	",.2f"		
0.52	"%"		
0.52	".0%"		
11			
11			
11	"^10d"		
11	"0>10d"		

The `format` function

```
x = format('Conversation table for lbs to kgs', '<45s')
```

- * Make sure that your padding length (45) is actually longer than the length of your string.
- You can calculate the length of strings by using `len("string")`.

The `format` function

```
print(format('Harry', '<15s'))
```

Harry

└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

```
print(format(Harriet, '<15s'))
```

Harriet

└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘└┘
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

“Harry” and “Harriet” are now both 15 character spaces long, justified to the left.

The `format` function

```
print(format('Apple', '<15s'), end="")  
print(0.75)  
print(format('Banana', '<15s'), end="")  
print(0.25)
```

Apple	0.75
Banana	0.25

Setting “Apple” and “Banana”
both to 15 characters long to
create a two column layout

┌┐┌┐┌┐┌┐┌┐┌┐┌┐┌┐
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Programming Challenge: Formatting a Table

- Reproduce the following table using format (40 spaces wide)

Class Grades	

Harry Potter	81.5
Hermione Granger	99.9
Ron Weasley	61.9

Programming Challenge: Formatting a Table (Extension)

Class Grades	
Harry Potter	81.5
Hermione Granger	99.9
Ron Weasley	61.9

- What if I wanted to make the table half as wide? Is there an easy way to refactor your code so that I can just change one number (40 to 20) instead of changing every instance of 40?
- In general, how can we incorporate variables/formulas?

Programming Challenge: Formatting a Table (Extension)

```
1 width = 40
2 divider = "-" * width
3
4 print(divider)
5 print(format("Class Grades", "^" + str(width) + "s")) # ^40s
6 print(divider)
7
8 # watch out for integer division!
9 # dividing by 2 so that they are equal columns
10 name1 = format("Harry Potter", "<" + str(width//2) + "s") # <20s
11 grade1 = 81.5
12
13 name2 = format("Hermione Granger", "<" + str(width//2) + "s")
14 grade2 = 99.9
15
16 name3 = format("Ron Weasley", "<" + str(width//2) + "s")
17 grade3 = 61.9
18
19 print(name1, end="")
20 print(grade1)
21 print(name2, end="")
22 print(grade2)
23 print(name3, end="")
24 print(grade3)
```

Homework

- Assignment #1 (due next class)
- Self-Paced Learning Module #3 (due in one week)
- Quiz #3 (due in one week)