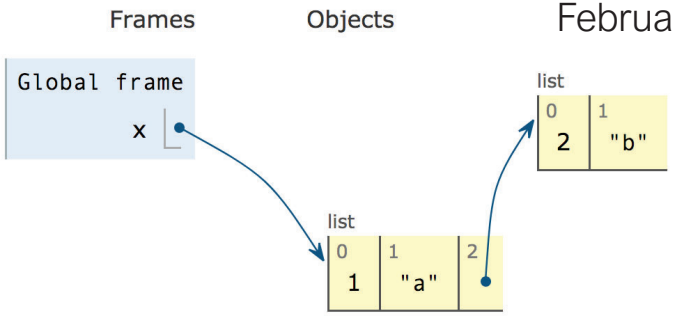
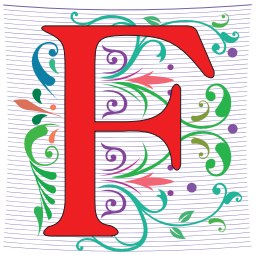
Compsci 101
Lists, Mutation, Objects
Part 1 of 4

Susan Rodger

February 9, 2021



F is for …



- **Function**
  - Key to all programming
- **Floating Point**
  - Decimal numbers aka Python float
- **File**
  - Sequence of stored bits

PFTD

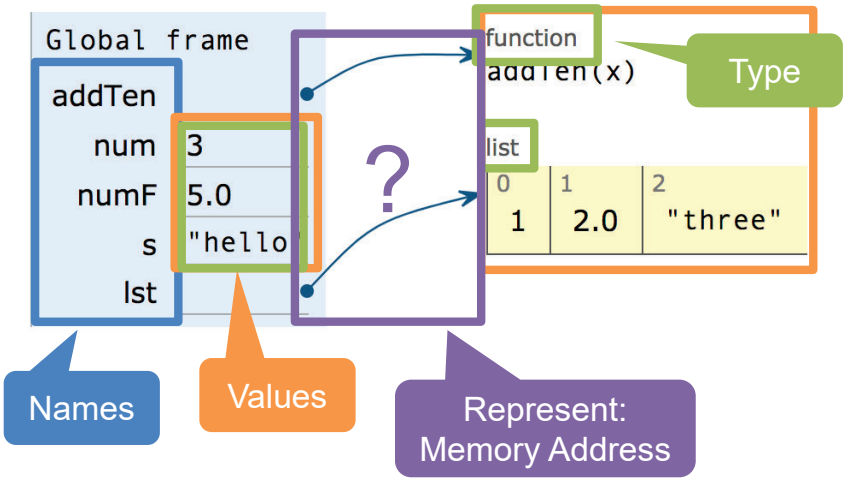
- Totem
- Debugging
- List concatenation and nesting
- Mutability
- Objects and what that means

Assignment 1: Totem Poles

Learning Goals: Totem Pole

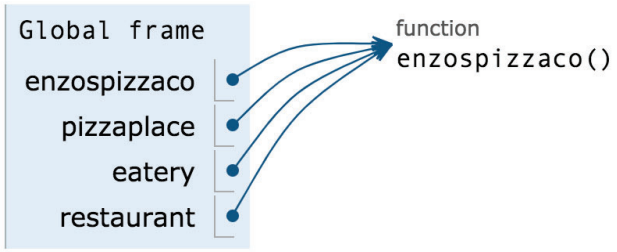
- Understand differences and similarities:
  - Function definitions vs function calls
  - Functions with return statements vs those without
  - Functions with parameters vs those without
  - Functions can be arguments
- Be creative and learn lesson(s) about software design and engineering
  - Create a small, working program, make incremental improvements.
  - Read the directions and understand specifications!

Name vs Value vs Type



What are the arrows?

- Name: Enzo's Pizza Co.
- Address (arrow): 2608 Erwin Rd # 140, Durham, NC 27705
- Value: Physical Store



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Part 2 of 4

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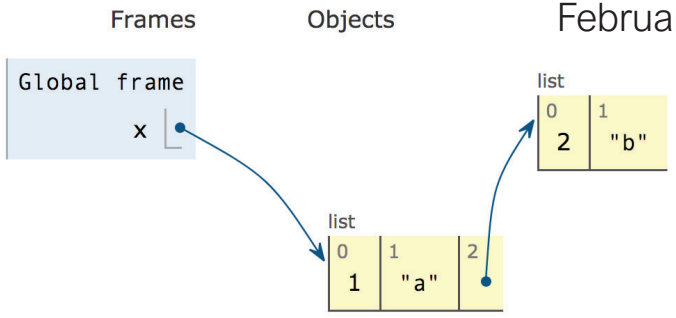
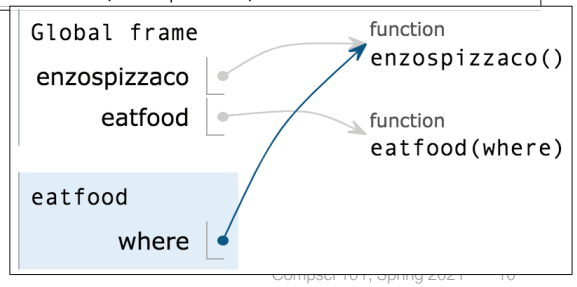


Pizza.py

```
6   def enzospizzaco():
7       print("Pizza!")
8       return "2608 Erwin Rd # 140, Durham, NC 27705"
9
10  def eatfood(where):
11      print("Let's go eat!")
12      address = where()
13      print("The address is", address)
14
15  if __name__ == '__main__':
16      eatfood(enzospizzaco)
```


Functions can be arguments

```
1  def enzospizzaco():
2      print("Pizza!")
3      return "2608 Erwin Rd # 140, Durham, NC 27705"
4
5  def eatfood(where):
6      print("Let's go eat!")
7      address = where()
8      print("The address is", address)
9
10 if __name__ == '__main__':
11     eatfood(enzospizzaco)
```



Pizza2.py - Pass multiple functions to eatfood

```
7   def naanstop():
8       print("Indian cuisine!")
9       return "2812 Erwin Road, Durham, NC 27705"
10
11  def enzospizzaco():
12      print("Pizza!")
13      return "2608 Erwin Rd # 140, Durham, NC 27705"
14
15  def eatfood(where):
16      print("Let's go eat!")
17      address = where()
18      print("The address is", address)
19
20  if __name__ == '__main__':
21      eatfood(enzospizzaco)
22      eatfood(naanstop)
```


Output of Pizza2.py

```
Run:  pizza2
C:\Users\Susan\AppData\Local\Programs\Python\Python38
Let's go eat!
Pizza!
The address is 2608 Erwin Rd # 140, Durham, NC 27705
Let's go eat!
Indian cuisine!
The address is 2812 Erwin Road, Durham, NC 27705

Process finished with exit code 0
```

Functions Need Docstrings

- Docstring – a triple quote string right after the "`def …(…):`" describing the function
  - Recommend: 80 characters wide
  - PyCharm has a command for this!
    - Highlight string
    - Edit -> Fill Paragraph

```
def f():
    """
    I am a docstring, which stands for document string, that describes what this function is doing
    """
```

```
        def f():
            """
            I am a docstring, which stands for document string, that describes what
            this function is doing.
            """
```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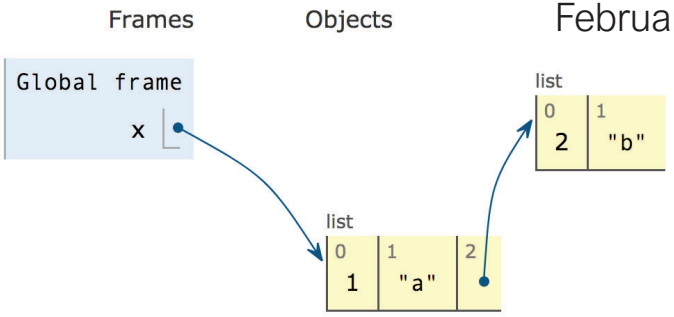


List Concatenation

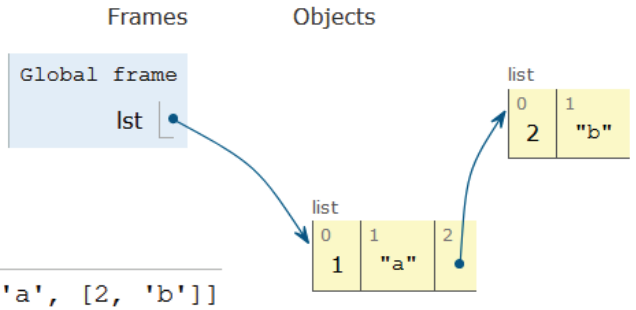
- String concatenation:
  - "hi" + " there" == "hi there"
- List concatenation:
  - [1, 2] + [3, 4] == [1, 2, 3, 4]

Nested Lists

- Lists are heterogenous, therefore!
  - `lst = [1, 'a', [2, 'b']]` is valid
  - `len(lst) == 3`
    - `[2, 'b']` is one element in list lst
- How to index?
  - [...] all the way down
  - lst[2][1] returns 'b'

```
lst[2][1]
[2, 'b'][1] == 'b'
```

Nested Lists with Python Tutor




```
1  lst= [1, 'a', [2, 'b']]
2  print(len(lst))
3  print(type(lst[2]))
4  print(lst[2])
5  print(lst[2][1])
```


Mutating Lists

- **`lt = ['Hello', 'world']`**
  - Change to: `['Hello', 'Ashley']`
- Concatenation: **`lt = [lt[0]] + ['Ashley']`**
- Index: **`lt[1] = 'Ashley'`**

- How change **`'b'`** in **`lt = [1, 'a', [2, 'b']]`**?
  - `lt[2][1] = 'c'`

Mutating Lists code

```
1  lst1 = ['Hello', 'world']
2  print(lst1)
3  lst2 = [lst1[0]] + ['Ashley']
4  print(lst2)
5  print(lst1)
6  lst1[1] = 'Ashley'
7  print(lst1)
8
9  lst3 = [1, 'a', [2, 'b']]
10 print(lst3)
11 lst3[2][1] = 'c'
12 print(lst3)
```


Sir Tim Berners-Lee

- Turing award 2016
  - World Wide Web
- HTTP vs. TCP/IP
  - Just protocols?

I want you to realize that, if you can imagine a computer doing something, you can program a computer to do that.

Unbounded opportunity... limited only by your imagination. And a couple of laws of physics.

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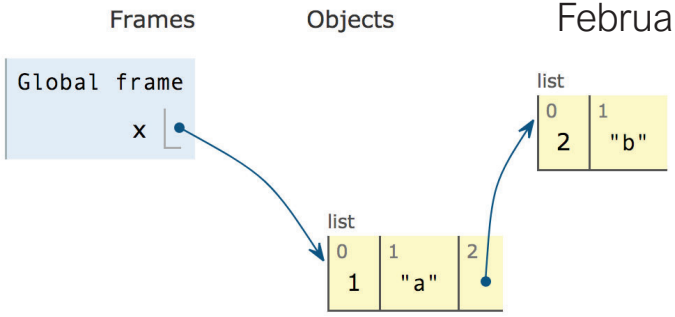

Immutable built-in Types

- In python string, int, float, boolean - Immutable
  - Once created cannot change
  - These are still objects in Python3!!
- PythonTutor gets this wrong
  - Everything should be in Objects area
- Objects don't change
  - Value associated with variable changes

```
val = 0
bee = val
val = val + 20
```


Immutable built-in Types

- In python string, int, float, boolean - Immutable
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```
val = "apple"
bee = val
val = val + "sauce"
```


Aside: The Object Concept

- Sometimes it helps to know how things "work"
  - Sometimes it's wonderful to be oblivious
  - Abstraction!
- Object – a "thing" in memory/object space

Arrow / Computer memory address

- Python variables are references
  - Label that refers to object
  - Label is small, object is big

bat or ant?

Python 3.6

```
1  a = ["pig", "cow", "dog", "bat"]
2  b = a
3  print(a)
4  a[-1] = "ant"
5  print(a)
6  print(b)
```

print(b) -> has ‘bat’ or ‘ant’?