Introduction to Computation for the Humanities and Social Sciences

CS 3

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Lecture 23

Methods Man*

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ANNOUNCEMENTS

- Projects **must** be submitted by Dec 3 at 11:59pm
- completed in-class assignment should be shown to a TA in order to get full HW credit (i.e., HW10)
- To have your project graded, sign up for a session w/ your Mentor TA (Dec 3 - Dec 10)
- Sign up for a presentation slot (Dec 4, 6, 11)

GOALS FOR TODAY

- Learn difference b/w functions and methods
- Understand why the choices in data structures and algorithms are super important

Lecture 23

- Functions vs Methods
- Data Structures
- Algorithms

Functions vs Methods

Functions

- We've exhaustively talked about functions, which are defined by their:
  - names
  - inputs
  - specific computations
  - outputs

Functions vs Methods

Functions

```
1   def plus(a, b):
2       a = 2 * a
3       b = 3 + b
4       c = a + b
5       return c
6
7   def main():
8       a = 3
9       b = 5
10      c = plus(a, b)
11      c += 1
12      print(a)
13      print(b)
14      print(c)
15
16  if __name__ == "__main__":
17      main()
```

Functions vs Methods

Methods

```
text = “Code didn't work, no idea why…”
pattern = ‘a’
re.findall(pattern, text)
```

- Remember when we’d see things like **findall()** and I’d commonly call it a function then say *“well, technically it’s not a function, but close enough”*?
- Technically, **findall()** belongs to a specific object (a concrete instance of a Python file), i.e., **re.** so although it is a function, it is more aptly and specifically a **method**.

Functions vs Methods

Objects

- Object-oriented programming is the most common paradigm of programming, and Python supports such.
- Covering this topic would require at least 1-2 lectures, but basically, any single .py file we've written can be nicely grouped into a single **class**

```
1  class BasicMathExamples:
2      def plus(a, b):
3          return a + b
4
5      def multiply(a, b):
6          return a * b
7
8      def mystery_function(a, b):
9          return -1*a * 3*b
```

Functions vs Methods

Objects

- Anytime someone (including yourself) wishes to use this code, they can create a particular instance of your class, similar to when we import a package:

```
test = BasicMathExamples()
```

- And we could access the functions (technically **methods**) via:

```
test.plus(31,97)
```

- **plus()** corresponds to that particular **test** object.

Functions vs Methods

Moral of the Story

- if you're calling a function defined within your specific .py file, it's referred to as a **function**
- if you're calling a function specific to a particular object, e.g.

```
re.findall(pattern, text)

line = line.strip().split("\n)
```

they are technically **methods**

Lecture 23

- Functions vs Methods
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Data Structures

- Remember: data structures are the constructs which house our data, e.g.,
  - single-valued (a single String, Int, Bool, Float)
  - lists
  - sets
  - dictionaries
  - tuples — we didn’t really cover these

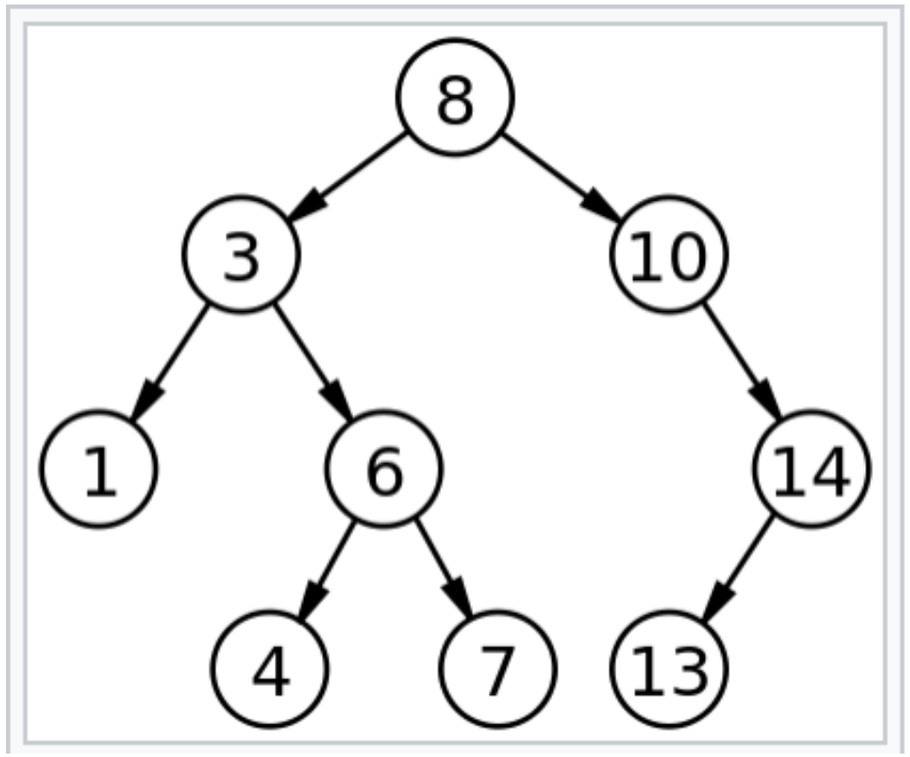
Data Structures

- They’re immensely important because they allow us to store and retrieve our data in which ways are most intuitive to us, and hopefully efficient for the computation we’re working on.

- Some make more sense than others, for a given scenario,
  e.g., **list** vs **dictionary** for storing all student names.

- Some are faster than others, depending on what we’re trying to do,
  e.g., **list** vs **set**

Advanced Data Structures



- **Binary Trees** allow us to quickly sort items and keep them sorted whenever we add new items.

Lecture 23

- Functions vs Methods
- Data Structures
- Algorithms

Algorithms

- When we decide an approach to compute something, that is our algorithm.
- As mentioned, there are essentially an infinite number of ways to compute a given task
- Some are more efficient approaches than others.

Algorithms

- Example: write a program which determines if any two items in a list sum to a particular value

```
special_num = 40
ages = [22, 18, 24, 34, 19, 21]
for i in ages:
    for j in ages:
        if i + j == special_num:
            print("Yes, two do!")
```

- This requires going through the entire list… for every single item in the list!
- So, if our list is of length **N**, that's **N^2** operations/checks.
- That's not too efficient. Imagine if **N** = 1,000 items, that's **1 million** operations.

Algorithms

- Instead, if we stored our numbers in a **set()**, we could instantly check if a number exists within it.

```
special_num = 40
ages = set({22, 18, 24, 34, 19, 21})
for i in ages:
    if special_num - i in ages:
        print("Yes, two do!")
```

- This requires just going through the list once
- So, if our list is of length **N**, that's **N** operations/checks.
- That's very efficient. Imagine if **N** = 1,000 items, that's **only 1,000 operations, which is 1,000 times faster than the previous solution.**

Algorithms

Main Takeaway

- The way you design your computations can be insanely important for speed-purposes.
- Some solutions (algorithms) can be so painfully slow, your program will never finish
- In fact, some types of problems are so complex, there are no known solutions which can ever finish, e.g.,

Travelling Salesman Problem:

"Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city and returns to the origin city?"

LAB TIME