COMP110

CL30 – Recursive Structures & Processes

Announcements

Re: Quiz 03:

- *Regrade requests will be open* ***till 11:59pm (tonight)!***
  - Please submit a regrade request if you believe your quiz was not graded correctly according to the rubric

Re: Quiz 04:

- Practice quiz is on the site
  - Come to Tutoring to work through it with TAs today (5-7pm in SN011)!
- If you have a UAA and want to reschedule your quiz to another date, please let me know!

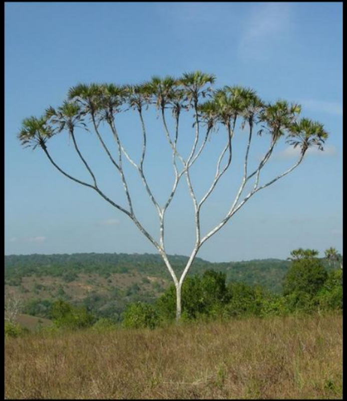
Assignments:

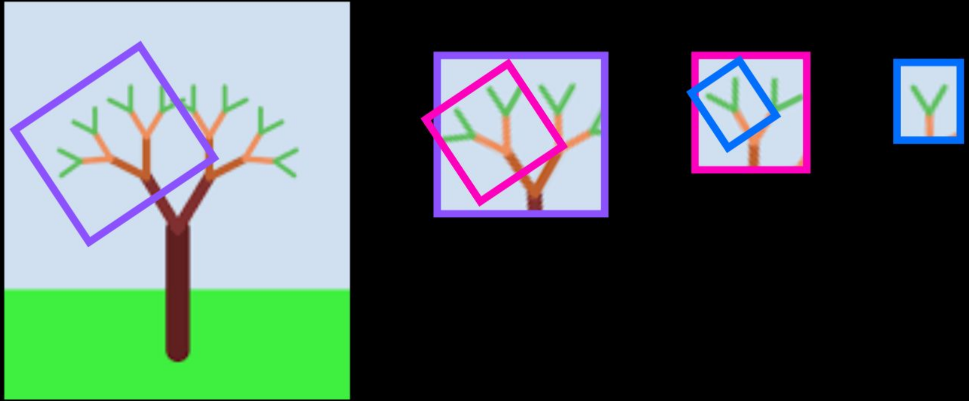
- LS13: Recursive Structures released today, due *tomorrow* (April 10)

Recursion: defining an operation/object in terms of itself

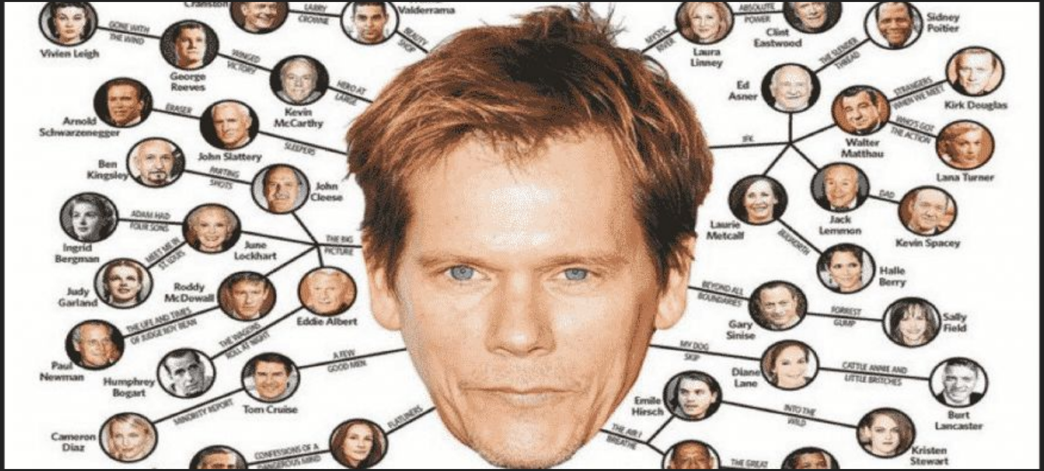
A real-world phenomenon! Examples:

- **You** have **parents**, who have **parents**, who have **parents**, who have **parents**, who…
  … were the **first humans**
- A **tree** has **branches**, which have **branches**, which have **branches**, which…
  … have **leaves**



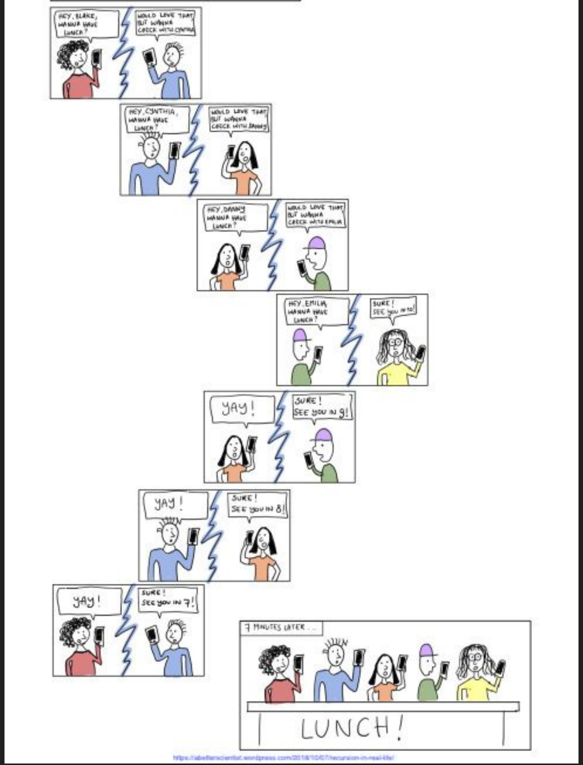


Different recursive structures for different purposes



Six degrees of Kevin Bacon

graph/network



HEY, BLAKE, WANNA HAVE LUNCH?
WOULD LOVE THAT BUT WANNA CHECK WITH CYNTHIA
HEY, CYNTHIA, WANNA HAVE LUNCH?
WOULD LOVE THAT BUT WANNA CHECK WITH DANNY
HEY, DANNY WANNA HAVE LUNCH?
WOULD LOVE THAT BUT WANNA CHECK WITH EMILIA
HEY, EMILIA, WANNA HAVE LUNCH?
SURE! SEE YOU IN 10!
YAY!
SURE! SEE YOU IN 9!
YAY!
SURE! SEE YOU IN 8!
YAY!
SURE! SEE YOU IN 7!
7 MINUTES LATER ...
LUNCH!

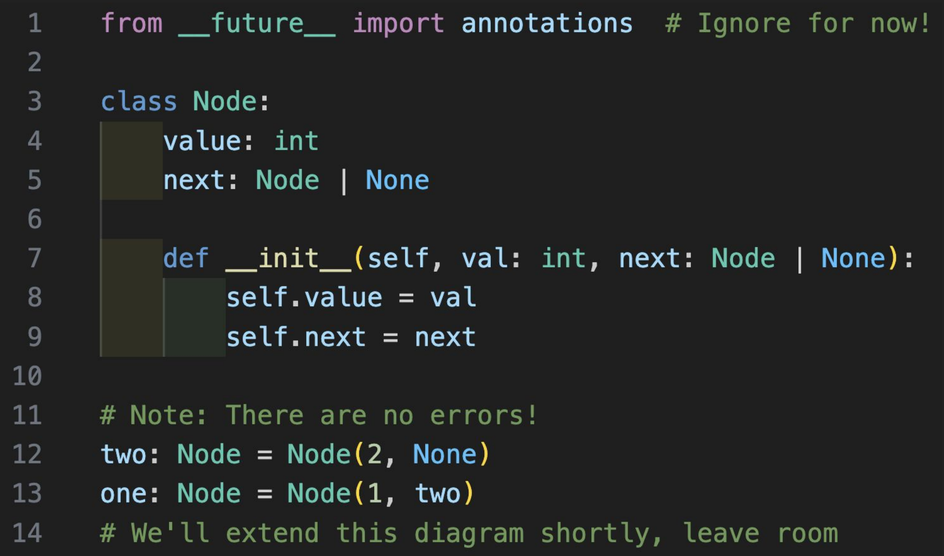
https://abetterscientist.wordpress.com/2018/10/07/recursion-in-real-life/

Coordinating plans before 3-way calls were possible

linked list

Anatomy of a Node

Memory diagram



```python
from __future__ import annotations  # Ignore for now!

class Node:
    value: int
    next: Node | None

    def __init__(self, val: int, next: Node | None):
        self.value = val
        self.next = next

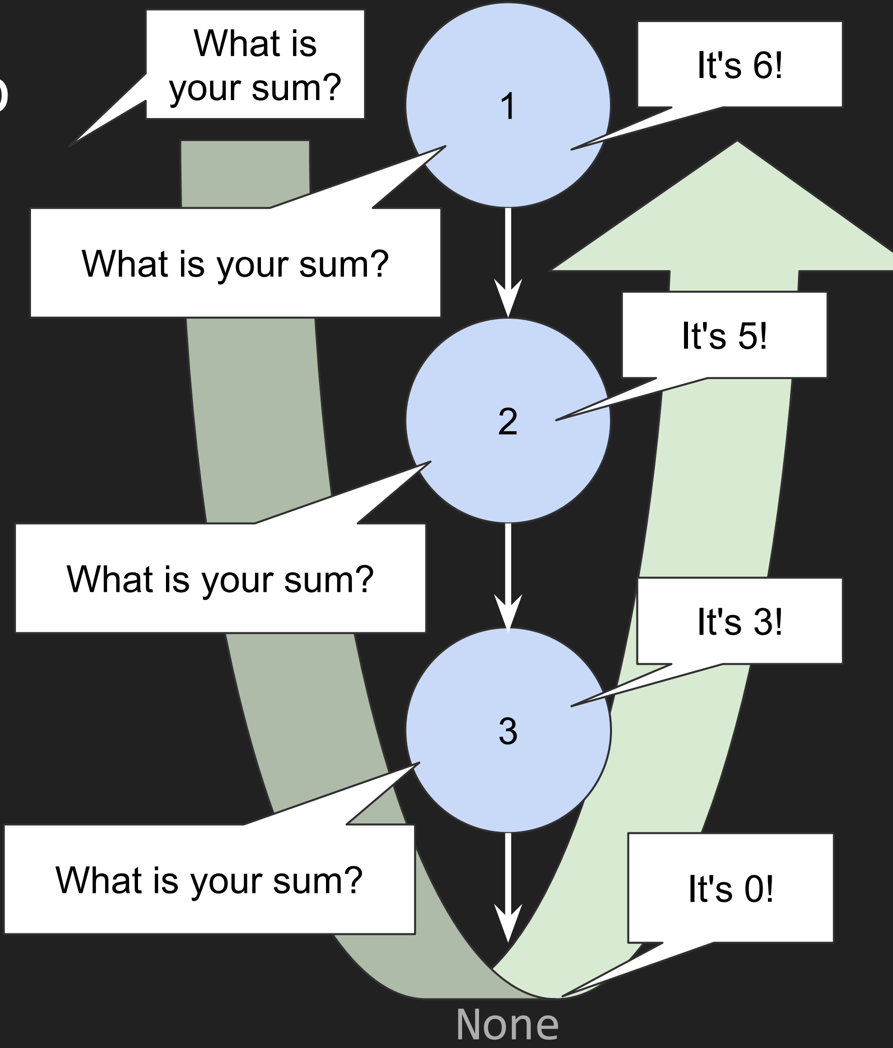
# Note: There are no errors!
two: Node = Node(2, None)
one: Node = Node(1, two)
# We'll extend this diagram shortly, leave room
```

A Recursive sum Algorithm Demo

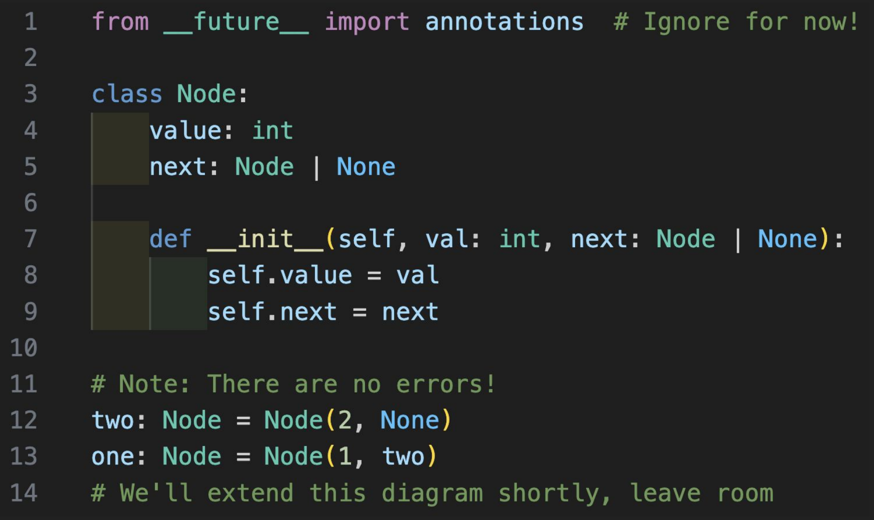
1. When you are asked,
   "what is your sum?"

2. Ask the ***next*** Node,
   "what is your sum?"
   Wait patiently for an answer!

3. Once the answer is returned back to you, add ***your value to it***, then turn to the person who asked you and give them this answer.



Let’s write a recursive function called **`sum`**!



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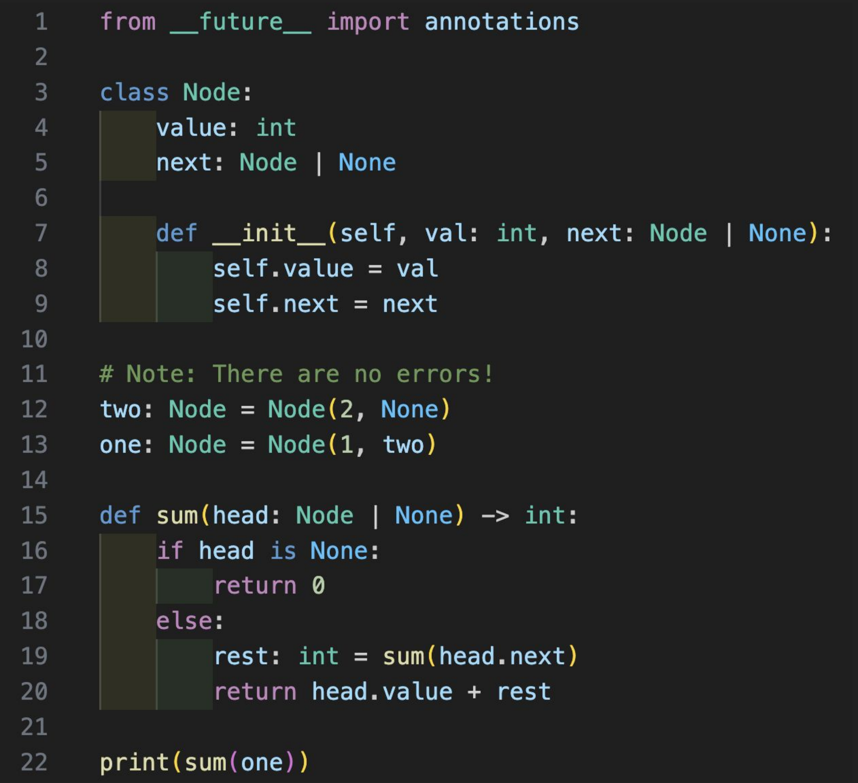
Write a function called **`sum`** that adds up the **`value`**s of all **`Node`**s in the linked list.

Diagramming the **`sum`** function call



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    def __init__(self, val: int, next: Node | None):
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# Note: There are no errors!
two: Node = Node(2, None)
one: Node = Node(1, two)

def sum(head: Node | None) -> int:
    if head is None:
        return 0
    else:
        rest: int = sum(head.next)
        return head.value + rest

print(sum(one))
```

For reference: checklist for developing a recursive function:

Base case:

- ❑ Does the function have a clear base case?
    - ❑ Ensure the base case returns a result directly (without calling the function again).
- ❑ Will the base case *always* be reached?

Recursive case:

- ❑ Ensure the function moves closer to the base case with each recursive call.
- ❑ Combine returned results from recursive calls where necessary.
- ❑ Test the function with edge cases (e.g., empty inputs, smallest and largest valid inputs, etc.). Does the function account for these cases?