National University of Computer & Emerging Sciences

Lab Manual

CS461: Artificial Intelligence Lab

Course Instructor	Dr. Hafeez-Ur-Rahman
Lab Instructor	Muhammad Hamza
Semester	Spring 2022

Lab # 03

What is Artificial Intelligence?

The father of Artificial Intelligence, John McCarthy, defines it as

“The science and engineering of making intelligent machines, especially intelligent computer programs”

Artificial Intelligence (AI) Software is a computer program which mimics human behavior by learning various data patterns and insights.

AI is a fundamental risk to the existence of human civilization (Tech Tycoon Alan Musk).

Types of Artificial Intelligence?

AI Narrow Intelligence: weak AI, applying AI on specific tasks. Alexa for limited functions, autopilot feature in Tesla, google maps, Face recognition in iPhone etc.

AI General Intelligence: strong AI, involves machines that possess the ability to perform any intellectual task that a human being can (consciousness and mind).

AI Super Intelligence: Super AI, time when the capability of computers will surpass humans in future. Hypothetical like movies and science fiction books etc.

Popular Artificial Intelligence Software

- Cortana – Virtual Assistant
- IBM Watson – Question Answering system
- Chat bots
- Face unlock
- Google Assistant
- And more

Lab # 03

Recursion:

Recall Fibonacci series:

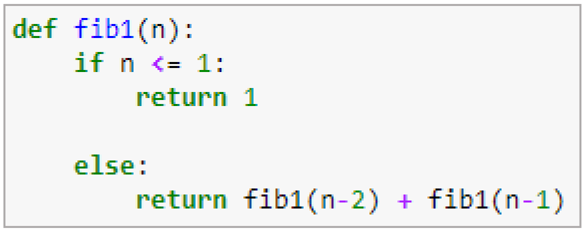
1,1,2,3,5,8,13, ... 1,1,2,3,5,8,13,...

fib (n) = fib(n−1) + fib(n−2)

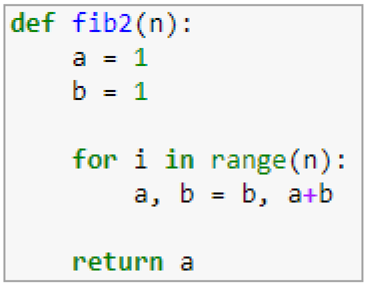
Recall Factorial!

Fact (n) = n*(n-1)*(n-2)*(n-3)* *1

We had two alternatives for computing fib (n)



```python
def fib1(n):
    if n <= 1:
        return 1

    else:
        return fib1(n-2) + fib1(n-1)
```



```python
def fib2(n):
    a = 1
    b = 1

    for i in range(n):
        a, b = b, a+b

    return a
```

Linked List:

The Push Operation

Push operation has two cases:

1. When there are no nodes
2. When there is already one or more nodes

The Pop Operation

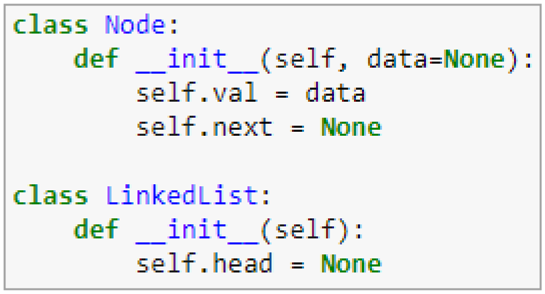
Pop also has two cases:

1. When there is only one node
2. When there are 2 or more nodes -- in this case, we keep two pointers: prev and temp. Move both until temp is the last. Then set next of prev to None

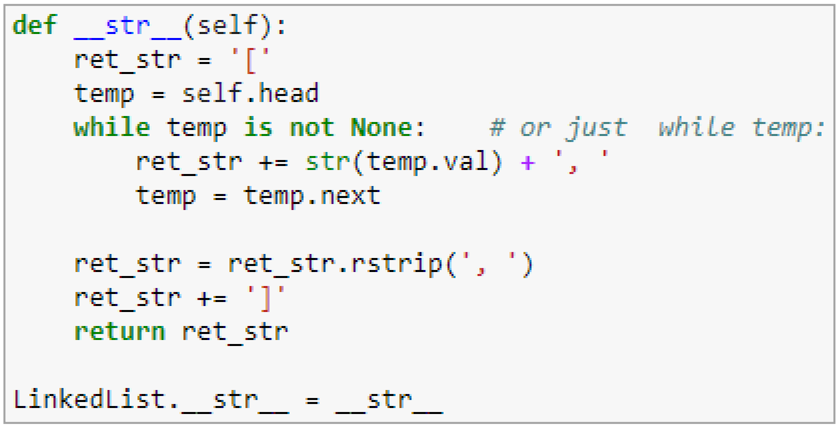
Conversion to String

Python has a special function __str__. This is called whenever a cast to string is made. (These are called dunder (double underscore) functions.)

Lab # 03



```
class Node:
    def __init__(self, data=None):
        self.val = data
        self.next = None

class LinkedList:
    def __init__(self):
        self.head = None
```



```
def __str__(self):
    ret_str = '['
    temp = self.head
    while temp is not None:     # or just  while temp:
        ret_str += str(temp.val) + ', '
        temp = temp.next

    ret_str = ret_str.rstrip(', ')
    ret_str += ']'
    return ret_str

LinkedList.__str__ = __str__
```

Insertion

Again, two cases:

1. Insertion at index 0: new head, old head becomes next of this new head
2. Insertion at any other index: in this case, move prev and temp forward index times. Then, insert new node between prev and temp.

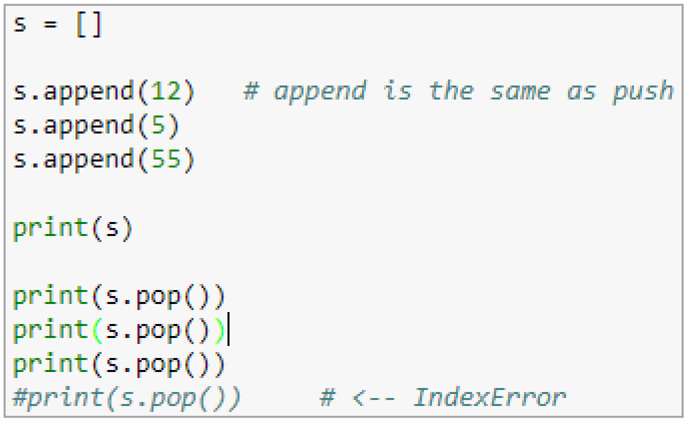
Remove Operation

This is also the same:

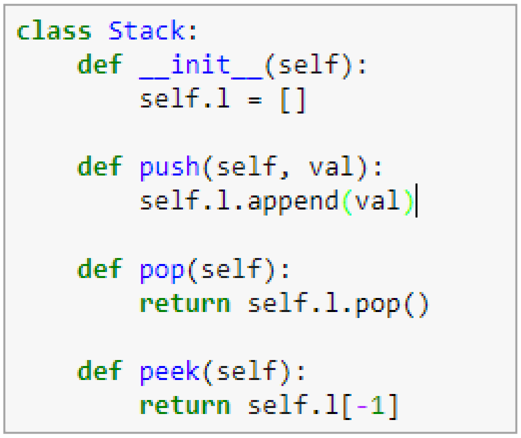
1. If first node is present and same as val, remove it.
2. Otherwise, move prev and temp until temp points to the value. Set next of prev to next of temp. (Temp is lost)

Stack

A stack is essentially free in Python. Here's what happens when we use Python's list.



```
s = []

s.append(12)   # append is the same as push
s.append(5)
s.append(55)

print(s)

print(s.pop())
print(s.pop())
print(s.pop())
#print(s.pop())     # <-- IndexError
```

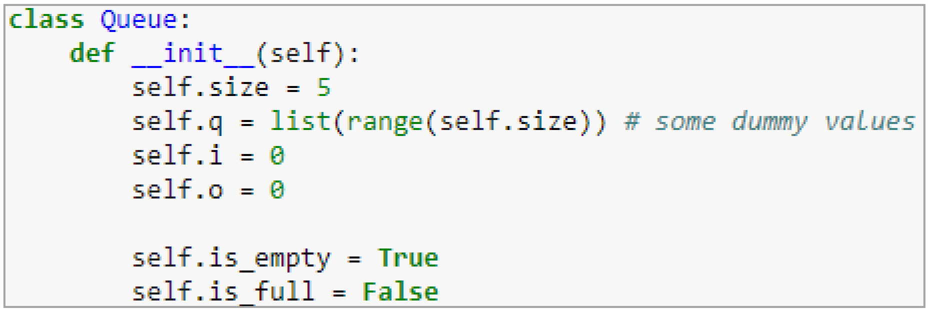


```
class Stack:
    def __init__(self):
        self.l = []

    def push(self, val):
        self.l.append(val)

    def pop(self):
        return self.l.pop()

    def peek(self):
        return self.l[-1]
```

Queue

Implement queue data structure in python with the following basic functions;

1. __init_(self)
2. __str_(self)
3. inc
4. Enqueue
5. Dequeue



```
class Queue:
    def __init__(self):
        self.size = 5
        self.q = list(range(self.size)) # some dummy values
        self.i = 0
        self.o = 0

        self.is_empty = True
        self.is_full = False
```

Lab Task

- Implement push(), pop(), insertAt() and remove() functions for Linked list class.
- Implement enqueue(), dequeue(), __str__ and inc() functions for Queue class.