Python Programming

L05: Strings, Loops

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Resources and Acknowledgements

- Intro to Programming with C++
  - Abhiram Ranade, Prof CSE, IIT Bombay
- A first course in programming
  - https://introcs.cs.princeton.edu/python/home/
  - https://introcs.cs.princeton.edu/java/home/
- Python for everybody
  - https://www.py4e.com
- Web Applications for everybody
  - https://www.wa4e.com
- https://education.pythoninstitute.org/course_datas
- https://www.w3schools.com/python/
  - Basic Python Tutorial

Overview

- Overview of Strings
- Overview of loops
  - For
  - while
- Exercises
- Summary

Strings

- Strings are lists with some additional functions and characteristics

```
name=‘python'
len(name)
name[2]
name[3:5]
name[::-1]
name[2::2]
name[2::-1]
names='abhiraj srujna aditya anuj vedant’
names.split('a')
x=names.split()
x[1].split('u')
```

Strings

- Strings are immutable

```
name='python'
name[0]='P' # gives error
```

- Concatenation

```
course = 'python' + 'programming'
```

- Multiply string by a number

```
name * 3 #gives 'pythonpythonpython'
```

- Iterating over a string

```
for letter in name:
  print(letter)
for index in range(len(name)):
  print(letter[index])
```

Strings Operations

- Comparing two string

```
name='python'
lang='python'
lang2='Python'
name == lang # True
name == lang2 # False
```

- Case conversion: returns new string

```
name.upper()
lang2.lower()
name.capitalize()
```

- Get list of all methods on string

```
dir(name)
```

Strings Operations

- Stripping spaces at beginning and end

```
name=' python  '
name.strip()
name.lstrip()
name.rstrip()
```

- Replacing a part of string

```
name.replace('py', 'Py')
name.replace('on', 'language')
```

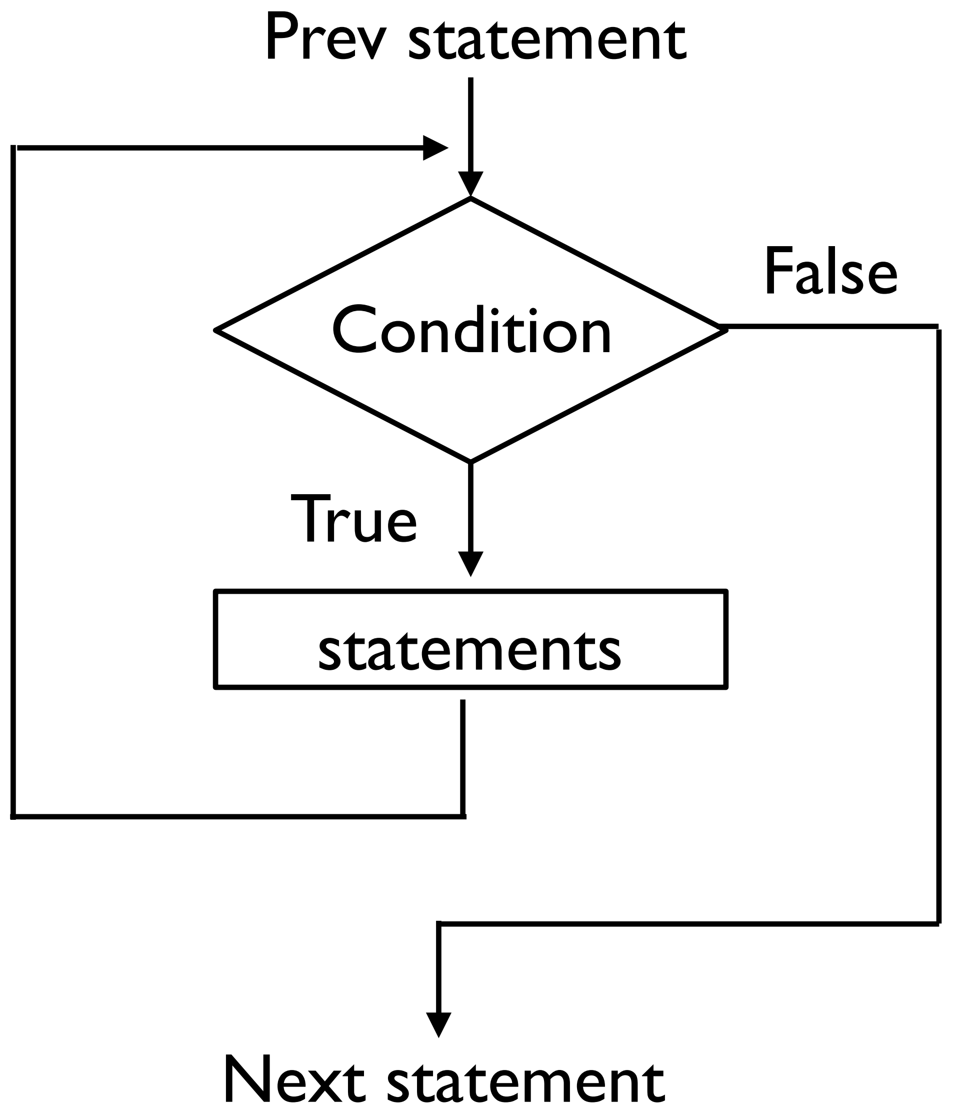
- Get prefix and suffix

```
name.startswith('py')
name.endswitdh(‘language')
```

Loops

- Loop statements
  - `while`, `for`
- General structure
  - while (condition)
    - body # statements
- Each execution of the body is called iteration.
- Execution ends when condition becomes false
- Body can be any number of statements
- For program to halt
  - Condition must become false at some point
  - Typically, condition involves some variables
    - Value of variables changes for halting condition

While Flowchart



A Bad While Loop

- Spot the issue in following program segment

```
n=int(input(“enter max even number”))
even=2
while (even != n):
 print(even)
 even = even + 2

print(“All even numbers up to “, n)
```

- What should be the changes in this program
  - Ensure that condition terminates (halts)

Loop: `for` statement

- `for` statement (3 parts)
  - Initialize an index variable to some value
  - Use a while loop to test terminating (exit) condition
  - Modify the index variable
- It is generally used when
  - **<u>count of iterations are known in advance</u>**
- Use while loop when
  - **<u>Count of iterations are unknown</u>**
  - Depending upon use case under consideration

Use Cases: `for/while` loop

- Write first `n` powers of 2

```
for i in range(n+1):
  print(2**i)
```

- Write largest power of 2 greater than `n`

```
power=1
while (2**power < n):
  power = power + 1
print("power of 2(>n)", 2**power)
```

Use Cases: `for/while` loop

- Write sum of first `n` even numbers

```
sum = 0
for i in range(n):
  sum = sum + 2*(i+1)
print(sum)
```

- Write a product of first n natural numbers

```
prod = 1
for i in range(1,n+1):
  prod = prod * i
print(prod)
```

Use Cases: `for/while` loop

- Compute `sqrt(num)` till `10` decimal places using newton's method
- Steps:
  - initalize variable `temp = num`
  - repeat below till `(temp - num/temp)` < 10^{-10}
    `temp=(num/temp + temp)/2.0`
- Code

```
val = num
while (abs(val - num/val)>10**-10):
  val=(val + num/val)/2.0
print(val)
```

Nesting: Loop and Conditions

- Compute prime factorization of `n`
  - e.g. for `n=24`, prime factorization is `2*2*2*3`
- Code

```
val = n
factor=2
while (val>factor):
  if (val % factor == 0):
    print(factor)
    val = val // factor
  else:
   factor = factor + 1
print(val)
```

Loop Termination in Block

- Keep computing square and cube of given integer
  – Until user decides to exit (enters 0)

```
while True:
  n=int(input("Enter a number: "))
  if (n == 0):
    break
  print("n^2=", n*n, ", n^3=", n*n*n)

print("Thanks for using the program")
```

Python Programming Considerations

- Should we use TAB in program for indentations?
  - It should be avoided. Many editors treat it differently.
- Can a statement be spread over multiple lines
  - Yes, but be careful
  - Understand how python treats indentation
    - Within parenthesis, splitting works just fine

```
n = (1 + 2  + 3
  + 4)
```

    - Otherwise, use backslash(\) as the last character

```
n = 1 + 2  + 3 \
  + 4
```

- How to create empty body of statement
  - use `pass` statement

Python Programming Considerations

- Can we use non-boolean expression in conditions?
  - It is not recommended.
  - numeric `0` and empty string is considered `False`.
- Can we change index variable in `for` loop?
  - Yes, but it is not recommended.
  - It may become too difficult to debug.
  - What is the output of following

```
for i in range(10):
  print(i)
  i = i + 2
```

- What is the value of index variable upon exit in `for` loop with `range(n)`?
  - `n`

Exercise

- What does following program do

```
n=10
f=0
g=1
for i in range(n):
  f=f+g
  g=f-g
  print(f)
```

- Answer: ?

Home Work

- `H01`: Compose a program that takes `n`, and
  - Writes an `n`-by-`n` table such that there is a `*` in row `i` and column `j`
    - if the `gcd` of `i` and `j` is `1`, i.e.
      - `i` and `j` are relatively prime
    - A space in that position otherwise
- Example: n=8

```
 i→12345678
j 1
↓ 2  * * *
  3 * ** **
  4  * * *
  5 *** ***
  6    * *
  7  **** *
```

Home Work

- `H02`: Pythogoras theorem using `for` loop (and not `while` loop)
  - Taken an integer `n`, and list out all $c \leq n$, such that
    - $c^2=a^2+b^2$, where
    - All `a, b, c` are distinct positive integers
- Example: `n=25`

```
  5*5 = 3*3 + 4*4
 10*10= 6*6 + 8 *8
 13*13= 5*5 + 12*12
 15*15= 9*9 + 12*12
 17*17= 8*8 + 15*15
 20*20= 12*12 + 16*16
 25*25= 7*7 + 24*24
 25*25= 15*15 + 20*20
```

Home Work

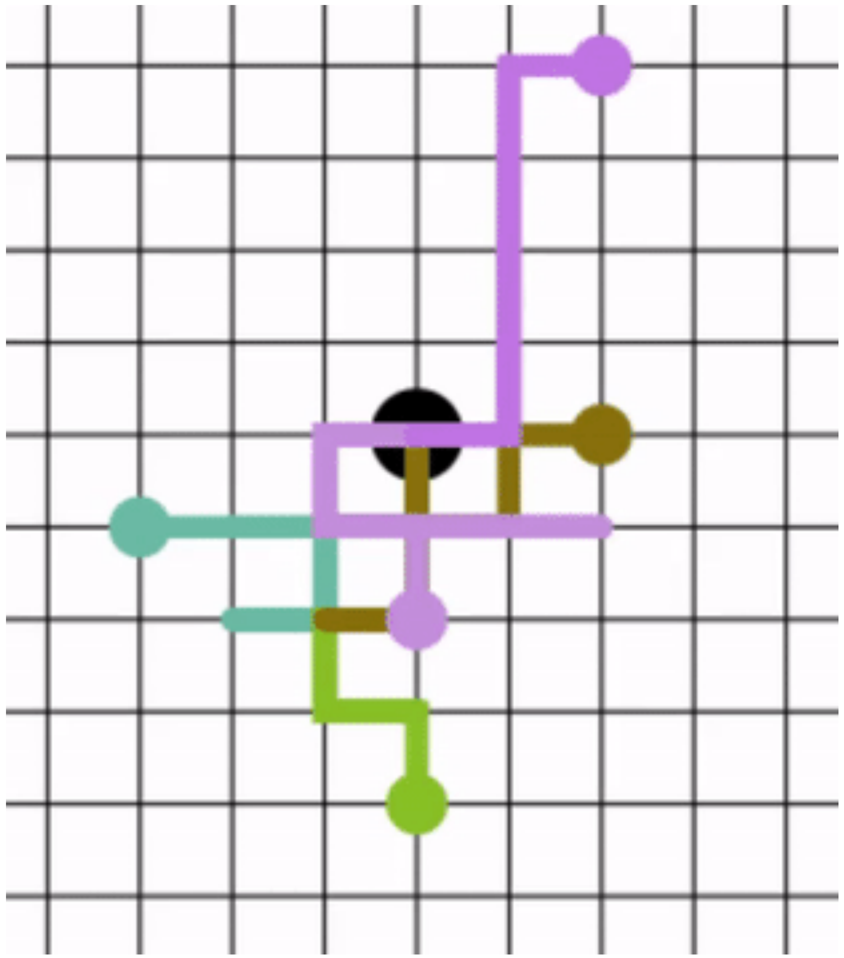
- `H03`: Ramajunjan's taxi number identification using `while` loop (and not `for` loop)
  - Taken an integer `n`, and list out all `m`≤`n`, such that
    - $m=a^3+b^3=c^3+d^3$, where
    - All `a, b, c, d` are distinct positive integers
- Example: `n=20000`

```
 1729 = 1**3+12**3 =  9**3+10**3
 4104 = 2**3+16**3 =  9**3+15**3
13832 = 2**3+24**3 =  18**3+20**3
```

Home Work

- `H04`: 2D random walk
  - ref: https://en.wikipedia.org/wiki/Random_walk
  - A two dimensional random walk simulates the behavior of a particle moving in a grid of points.
    - At each step, the random walker moves north, south, east, or west.
    - Each move is with probability `1/4`, independent of previous moves.
    - Compose a program that takes an argument `n` and estimates how long it will take a random walker to hit the boundary of a square of size `2n+1`-by-`2n+1` starting at the centre point.
  - Image of 2D Random walk

2D Random Walk



Home Work

- `H05`: Let us make a deal (Game Show)
  - A contestant is presented with three doors.
  - Behind one of them is a valuable prize.
  - After contestant chooses a door, host opens one of the other two doors (not the one containing the prize)
  - The contestant is then given the choice to switch to the other unopened door.
  - Should the contestant do so?
  - Write a program to answer this question
    - Run the logic `1000` times to answer
      - Should the contestant switch to other door?

Questions