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Programming and Data Structures with Python

Primes

isprime(n)

- check if n has a factor in $2, 3, \ldots, n-1$

primesupto(n)

- for p in $2, 3, \ldots, n$, collect all primes in a list

Instead

Find the first n primes

2, 3, 4 - - - - - -

Upper bound of iteration?

range(2, ?)

Until we have generated n primes

Test next integer

While

if (condition):

executes once if condition is True

Uniform indentation

tabs vs space

execute and check condition again

Non termination !

Conditional iteration

While (we have generated less than n primes):

    check next integer

```
def nprimes(n):
    primelist = []
    i = 2
    while (len(primelist) < n):
        if isprime(i):
            primelist.append(i)
        i = i + 1
    return(primelist)
```

for x in l:
———.

l = [, , , .. ,]
↑ 0 ↑ 1 ↑ 2 ↑ n-1

i = 0
While (i < len(l)):
    x = l[i]
    ≡
    i = i+1

l[i]

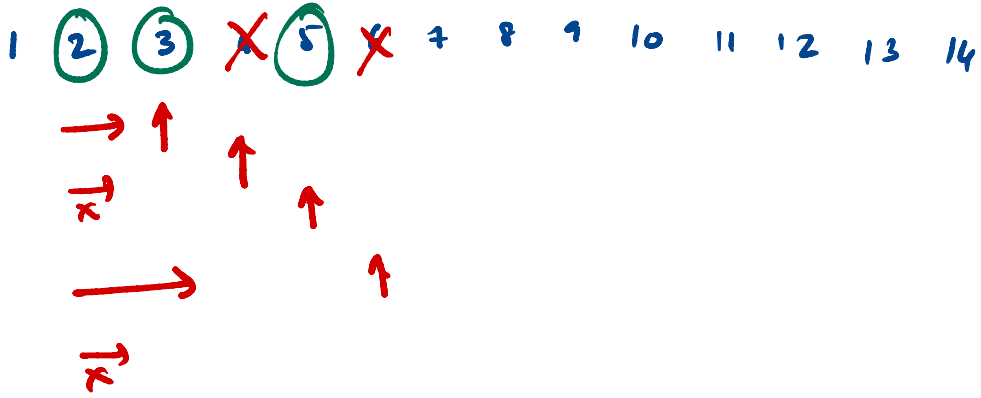
↘ if l is [],
len(l) is 0
so 0 < len(l) false

Making isprime more efficient

1. $2 \ldots \sqrt{n}$
2. Only primes smaller than n

?

Sieve of Eratosthenes


1
2
3
4
5
6
7
8
9
10
11
12
13
14

(1) $2 \ldots \sqrt{n}$ — Testing $\sqrt{n}$ = $\frac{n}{\sqrt{n}}$

(2) Only primes smaller than n — Testing $\frac{n}{\log n}$

Which is better? $\log n \ll \sqrt{n}$

Prime Number Theorem. primes upto $n \approx \frac{n}{\log n}$

(3) primes $< \sqrt{n}$

Datatypes

Names (variables) have no type

Only values have type

x = True ← type(x) is bool

⋮

x = 7 ← type(x) is int

Boolean

Comparisons

```
if n % i == 0
```

!=

↓

bool

```
if l == []
   l != []
```

Other comparisons

< >

<= >=

!= (other PLs <> =/= ...)

Python convention

Any "empty" value is interpreted as False

0 is False

[] is False

"" is False

Everything else is true

```
if n%i == 0:
```

```
if not (n%i):
```

```
if l != []:
```

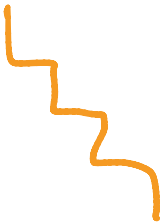
```
if l:
```

if (cond):

else:

$$\text{sign}(x) = \begin{cases} -1 & \text{if } x < 0 \\ 0 & \text{if } x = 0 \\ 1 & \text{if } x > 0 \end{cases}$$

```
if x < 0:
    return(-1)
else:
    if x == 0:
        return(0)
    else:
        return(1)
```



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