

Lecture 5: iteration with `while` and `for`

while loop

```
def factors(n):  
    i = n  
    while (i > 0):  
        if (n % i == 0):  
            print(i)  
            i = i - 1
```

```
$ python3 factors.py 99
```

```
99  
33  
11  
9  
3  
1
```

```
$ python3 factors.py 75
```

```
75  
25  
15  
5  
3  
1
```

```
$ python3 factors.py 645367
```

```
645367  
1
```

for loop

```
def print_matrix(n):  
    for i in range(n):  
        print(str(i) + ":\t", end="")  
        for j in range(n):  
            print(j, end="\t")  
        print()
```

```
$ python3 matrix.py 3  
0: 0 1 2  
1: 0 1 2  
2: 0 1 2
```

```
$ python3 matrix.py 4  
0: 0 1 2 3  
1: 0 1 2 3  
2: 0 1 2 3  
3: 0 1 2 3
```

```
$ python3 matrix.py 5  
0: 0 1 2 3 4  
1: 0 1 2 3 4  
2: 0 1 2 3 4  
3: 0 1 2 3 4  
4: 0 1 2 3 4
```

Testing for primality

```
$ python3 prime.py 99  
False
```

```
$ python3 prime.py 43  
True
```

```
$ python3 prime.py 785467  
False
```

```
$ python3 prime.py 785463  
False
```

```
$ python3 prime.py 785461  
True
```

Making squares

```
$ python3 square.py 4
```

```
****  
*..*  
*..*  
****
```

```
$ python3 square.py 5
```

```
*****  
*...*  
*...*  
*...*  
*****
```

```
$ python3 square.py 10
```

```
*****  
*.....*  
*.....*  
*.....*  
*.....*  
*.....*  
*.....*  
*.....*  
*.....*  
*****
```

Greatest common divisor

- Write a *function* called $\text{gcd}(a, b)$ that computes the *greatest common divisor* of a and b . How many iterations does your function make in terms of a and b ?
- In 300 BCE, Euclid developed an algorithm for computing the greatest common divisor. “The Euclidean algorithm is based on the principle that the greatest common divisor of two numbers does not change if the larger number is replaced by its difference with the smaller number.”¹ Notice that repeating this subtraction step until the the larger number is now the smaller now is identical to finding the remainder of $b \bmod a$. Implement an algorithm based on this observation. How many iterations does this algorithm make in terms of a and b now?

¹http://en.wikipedia.org/wiki/Euclidean_algorithm