

Design and Analysis of Algorithms

T01b: Tutorial Algorithm Simple Exercises

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Resources

- <https://introcs.cs.princeton.edu/java/11hello/>

Understanding Programs: 01

- What does following code segment (Java) outputs

```
int n = 987654321;
int digits = 0;
while (n > 0) {
    n = n / 10; #integer division
    digits++;
}
System.out.println(digits);
```

- How many times loop code is run?

Understanding Programs: 02

- What does following java code segment outputs

```
int n = 987654321;
String s = "";
while (n > 0) {
    int digit = n % 10;
    s = s + digit;
    n = n / 10;
}
System.out.println(s);
```

- How many times loop code is run?

Understanding Programs: 03

- What does following code segment outputs

```
int num = 100;  
num = num++;  
System.out.println(num);  
num = ++num;  
System.out.println(num);  
num = num++ + num++;  
System.out.println(num);  
num = num++ + ++num;  
System.out.println(num);
```

- **Learning:**Avoid writing any code like above

Algo 4a: Prime Factors

- Given an integer n , find its prime factors

```
for factor = 2 to n, do
    while remainder(n, factor) eq 0, do
        print factor
        replace n by n/factor
    done //while
done //for
```

- How many times loop code is run?

Algo 4b: Prime Factors (improved)

- Given an integer n , find its prime factors

```
for factor = 2 to sqrt(n), do
    while remainder(n, factor) eq 0, do
        print factor
        replace n by n/factor
    done //while
done // for
if n > 1, then
    print n
fi
```

- How many times loop code is run?

Algo 5: Harmonic series

- Print first n terms of harmonic series and its sum

```
print "1/1"
```

```
sum = 1.0
```

```
for num = 2 to n, do
```

```
    print "1/", num
```

```
    sum = sum + 1/num
```

```
done // for
```

```
print sum
```

- How many times loop code is run?

Algo 6: Binary Conversion

- Given number n , outputs its value in binary without using any in-built functions.

```
binstr = ""
```

```
while number > 0:
```

```
    remainder = number % 2
```

```
    binstr = str(remainder) + binstr
```

```
    number = number // 2 #integer division
```

```
print(binstr)
```

- How many times loop code is run?

Algo 7: Fibonacci Series

- n terms of Fibonacci series starting from 1, 1

```
n = 10
```

```
prev = 1; curr = 1
```

```
print("1, 1")
```

```
while n > 2:
```

```
    sum = prev + curr
```

```
    prev = curr
```

```
    curr = sum
```

```
    n = n - 1
```

```
    print(", ", sum)
```

```
print("\n")
```

- How many times loop code is run?

Algo 8: Ramanujan 1729

- Given n , find all possible values of a, b, c and d such that $a^3+b^3=c^3+d^3 \leq n$, e.g.

$$1^3+12^3 = 10^3+9^3 = 1729$$

- How should you proceed.
 - Need 4 for loops
 - First : $a=1$ to $n^{1/3}$
 - Second: $b=a$ to $n^{1/3}$ and $a^3+b^3 \leq n$
 - Third: $c=a+1$ to $n^{1/3}$
 - Fourth: $d=c$ to $n^{1/3}$ and $c^3+d^3 < a^3+b^3$
 - Output line:
 - c^3+d^3 equals a^3+b^3

Algo 8: Ramanujan 1729

```
for a=1; a3 ≤ n; a++  
    for b=a; a3+b3 ≤ n; b++  
        for c=a+1; c3 ≤ n; c++  
            for d=c; c3+d3 ≤ a3+b3; d++  
                if c3+d3 == a3+b3 then  
                    print a3 + b3 = c3 + d3
```

- How many times loop code is run?

Summary

- Basic understanding of how programming logic is to be defined to write a program.