COSC 2436: Time Complexity

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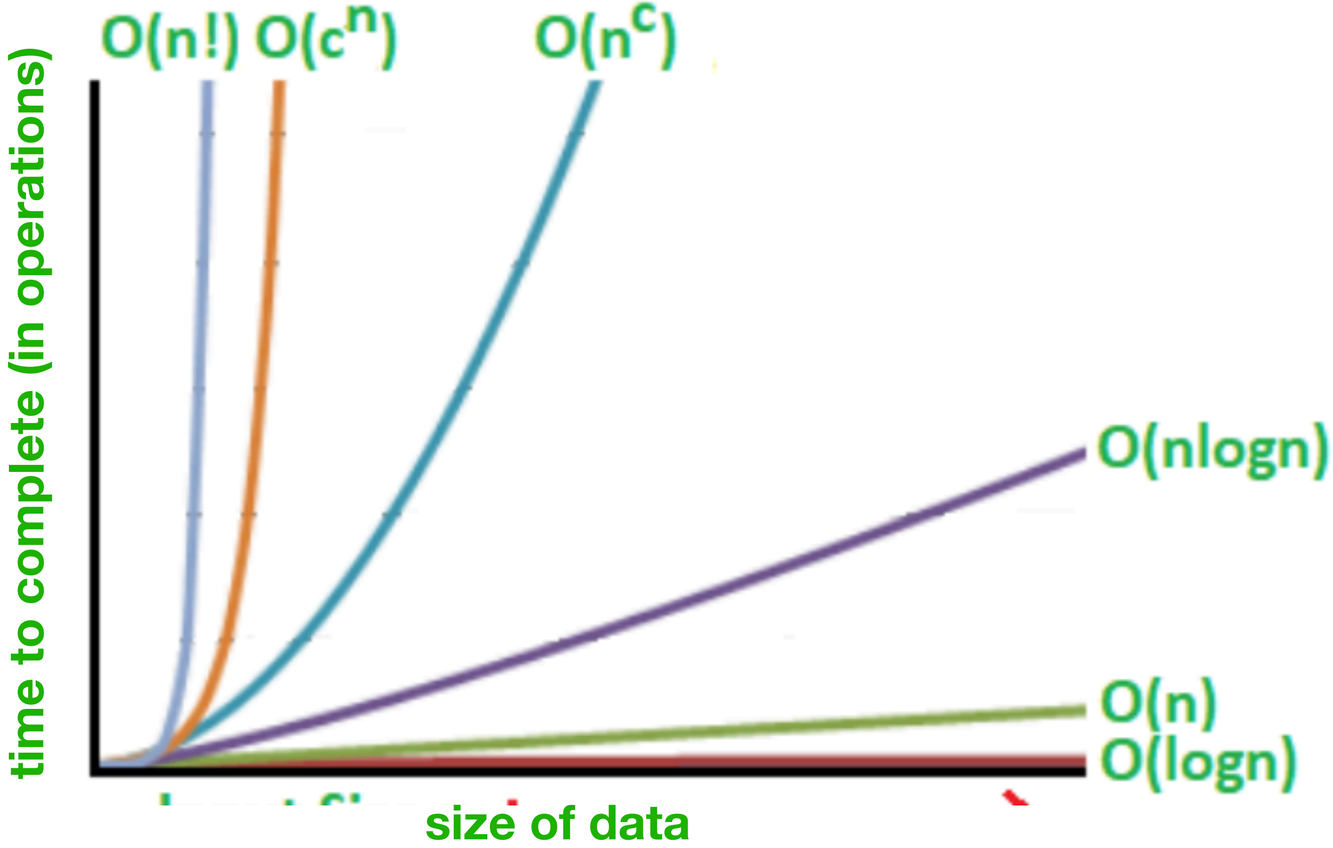
What is time complexity?

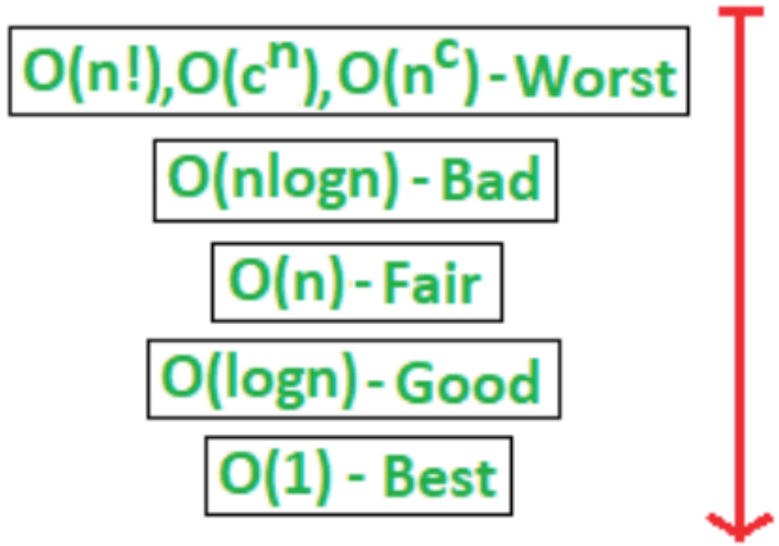
- **Measures how many times a statement will execute.**

Time compexity is NOT the amount of time a program takes to run.

How do we measure time complexity?

We measure time coplexity using Big O Notation





https://www.geeksforgeeks.org/analysis-algorithms-big-o-analysis/

What is the time complexity of the code below?

```
for(int i = 0; i < n; i++){
 cout << i << endl;
}
```

What is the time complexity of the code below?

```
for(int i = 0; i < n; i++){
 cout << i << endl;
}
```

O(n)

What is the time complexity of the code below?

```
for(int i = 0; i < n; i++){
  for(int j = 0; j < n; j++){
    cout << i + j << endl;
  }
}
```

What is the time complexity of the code below?

```
for(int i = 0; i < n; i++){
   for(int j = 0; j < n; j++){
      cout << i + j << endl;
   }
}
```

$O(n^2)$

What is the time complexity of the code below?

```
for(int i = 0; i < n; i *= 2){
  for(int j = 0; j < n; j++){
    cout << i + j << endl;
  }
}
```

What is the time complexity of the code below?

```
for(int i = 0; i < n; i++){
  for(int j = 0; j < n; j *= 2){
    cout << i + j << endl;
  }
}
```

O(nlogn)

What is the time complexity of the code below?

```
for(int i = 0; i < n; i++){
  for(int j = 0; j < 1000; j++){
    cout << i + j << endl;
  }
}
```

What is the time complexity of the code below?

```
for(int i = 0; i < n; i++){
   for(int j = 0; j < 1000; j++){
      cout << i + j << endl;
   }
}
```

O(n)

What is the time complexity of the code below?

```
for(int i = 0; i < n; i++){
   cout << i << endl;
}
for(int j = 0; j < n; j++){
   cout << j << endl;
}
```

What is the time complexity of the code below?

```
for(int i = 0; i < n; i++){
   cout << i << endl;
}
for(int j = 0; j < n; j++){
   cout << j << endl;
}
```

O(n)

What is the time complexity of the code below?

```
for(int i = n; i >= 0; i/=2){
  for(int j = n; j >= 0; j/=2){
    cout << j - i << endl;
}
```

What is the time complexity of the code below?

```
for(int i = n; i >= 0; i/=2){
   for(int j = n; j >= 0; j/=2){
      cout << j - i << endl;
}
```

$O(\log n^2)$

What is the time complexity of the code below?

```
void func(int n){
   if(n <= 1)
      return n;
   return func(n-1) + func(n-1);
}
```

What is the time complexity of the code below?

```
void func(int n){
   if(n <= 1)
      return n;
   return func(n-1) + func(n-1);
}
```

$O(2^n)$

What is the time complexity of the code below?

```
void func(int n){
  if(n <= 1)
    return n;
  return func(n-1) + func(n-1) + func(n-1);
}
```

What is the time complexity of the code below?

```
void func(int n){
   if(n <= 1)
      return n;
   return func(n-1) + func(n-1) + func(n-1);
}
```

$O(3^n)$

What is the time complexity of these linked list class functions?

```
struct node{
  int value;
  node *next;
};

class LinkedList{
  private:
    node *head;
  public:
    LinkedList();
    node *getHead();
    void insertAtHead(int);
    void removeTail();
    void removeValue(int);
    void print();
};
```

What is the time complexity of these linked list class functions?

```
struct node{
  int value;
  node *next;
};

class LinkedList{
  private:
    node *head;
  public:
    LinkedList();  // O(1)
    node *getHead();  // O(1)
    void insertAtHead(int);  // O(1)
    void removeTail();  // O(n)
    void removeValue(int);  // O(n)
    void print();  // O(n)
};
```