课程总览

-- Data Structure --

Array

Stack / Queue

PriorityQueue (heap)

LinkedList (single / double)

Tree / Binary Tree

Binary Search Tree

HashTable

Disjoint Set

Trie

BloomFilter

LRU Cache

-- Algorithm --

General Coding

In-order/Pre-order/Post-order traversal

Greedy

Recursion/Backtrace

Breadth-first search

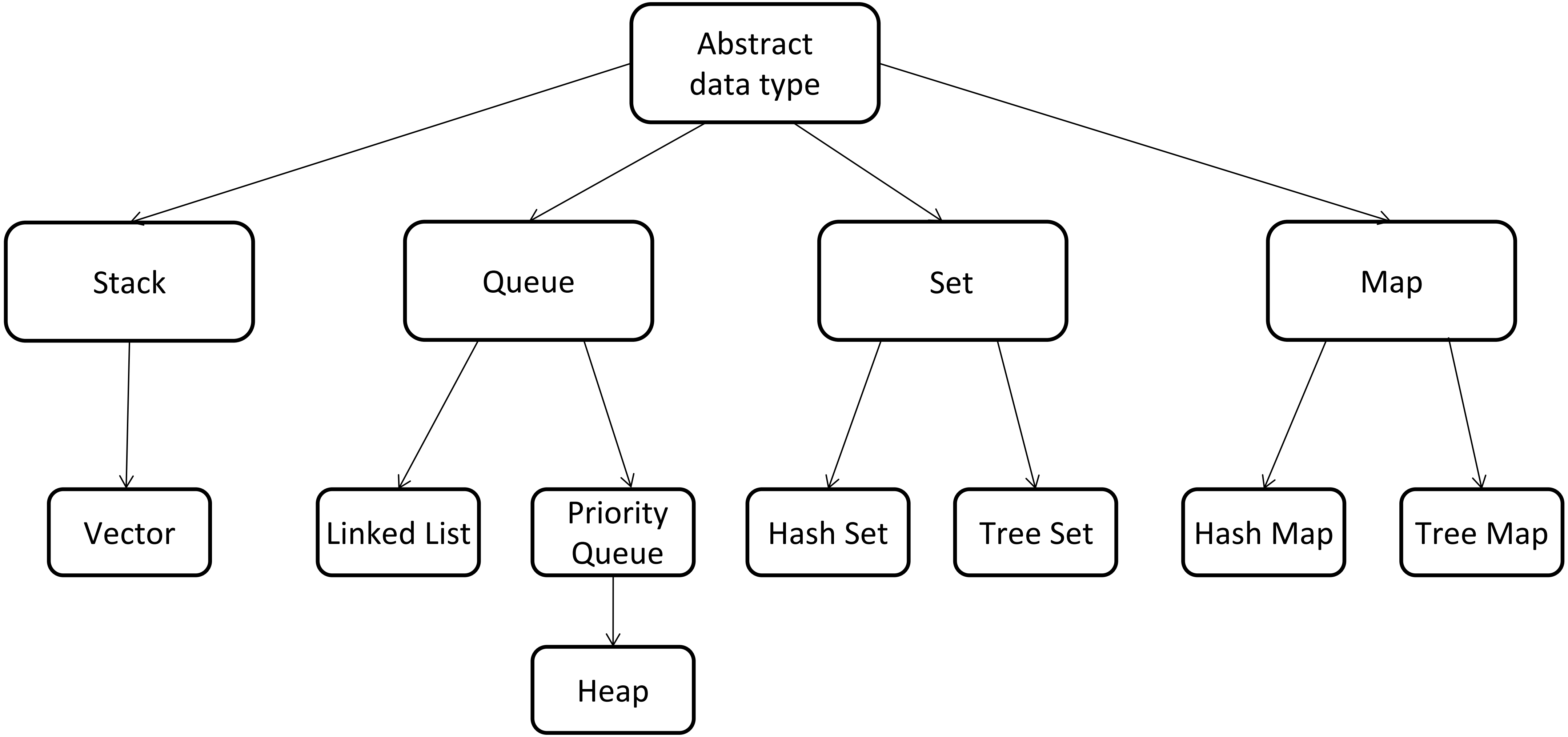
Depth-first search

Divide and Conquer

Dynamic Programming

Binary Search

Graph


Abstract data type
Stack
Queue
Set
Map
Vector
Linked List
Priority Queue
Hash Set
Tree Set
Hash Map
Tree Map
Heap

时间复杂度

空间复杂度

Big O notation

-- What is Big O? --

O(1): Constant Complexity: Constant 常数复杂度

O(log n): Logarithmic Complexity: 对数复杂度

O(n): Linear Complexity: 线性时间复杂度

O(n^2): N square Complexity 平方

O(n^3): N square Complexity 立方

O(2^n): Exponential Growth 指数

O(n!): Factorial 阶乘

O(1)

```java
int n = 1000;
System.out.println("Hey - your input is: " + n);
```

O(?)

```java
int n = 1000;
System.out.println("Hey - your input is: " + n);
System.out.println("Hmm.. I'm doing more stuff with: " + n);
System.out.println("And more: " + n);
```

O(N)

```
for (int = 1; i<=n; i++) {
    System.out.println(“Hey - I'm busy looking at: " + i);
}
```

O(N^2)

```
for (int i = 1; i <= n; i++) {
    for (int j = 1; j <=n; j++) {
        System.out.println("Hey - I'm busy looking at: " + i + " and " + j);
    }
}
```

O(log(n))

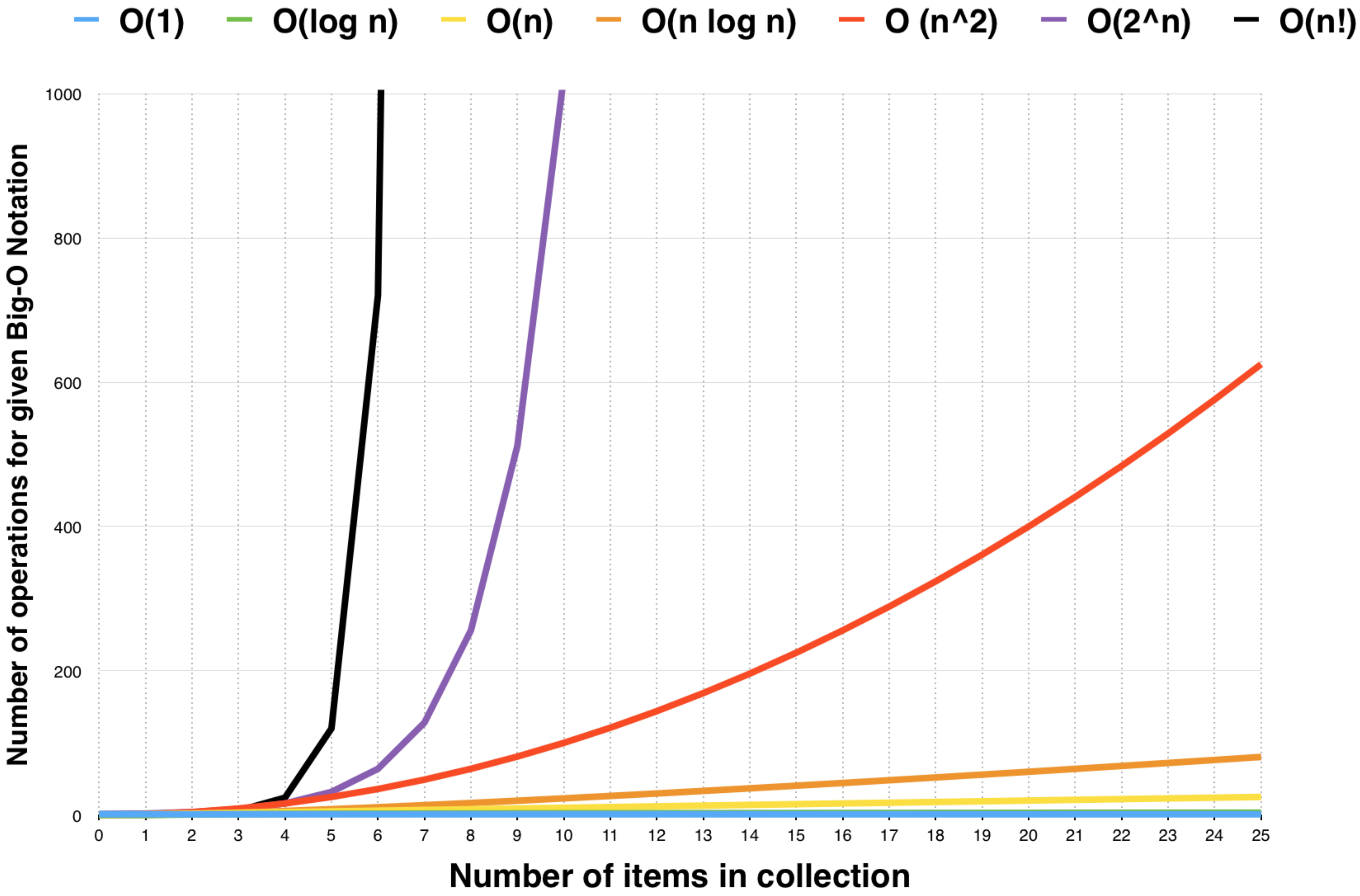
```
for (int i = 1; i < n; i = i * 2) {
    System.out.println("Hey - I'm busy looking at: " + i);
}
```

O(k^n)

```
for (int i = 1; i <= Math.pow(2, n); i++){
    System.out.println("Hey - I'm busy looking at: " + i);
}
```

O(n!)

```
for (int i = 1; i <= factorial(n); i++){
    System.out.println("Hey - I'm busy looking at: " + i);
}
```


O(1)
O(log n)
O(n)
O(n log n)
O (n^2)
O(2^n)
O(n!)
1000
800
600
400
200
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Number of operations for given Big-O Notation
Number of items in collection

To calculate: 1 + 2 + 3 + … + n

- 1 + 2 + 3 + … + n (总共累加n次)

```
y = 0
for i = 1 to n:
    y = i + y
```

- 求和公式：n(n+1)/2

```
y = n * (n + 1) / 2
```

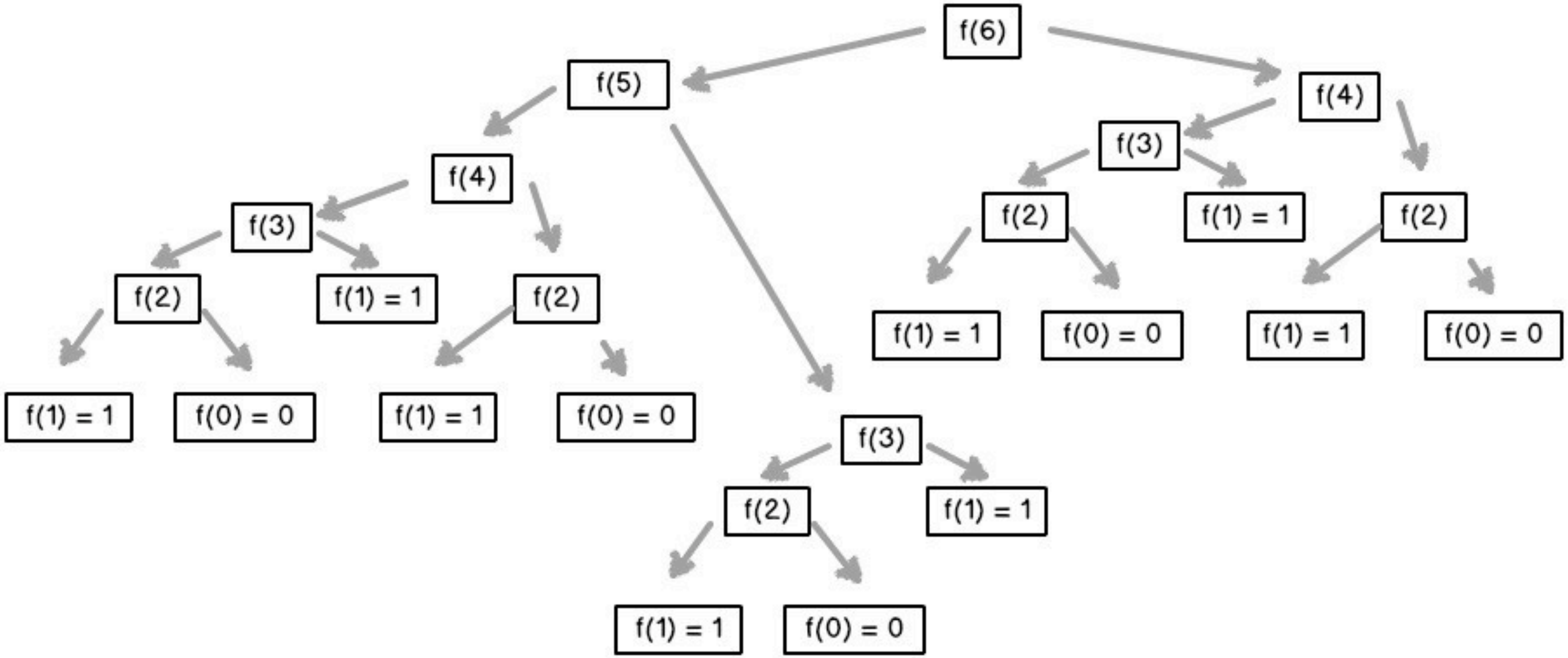
What if recursion ?

- Fibonacci array: 1, 1, 2, 3, 5, 8, 13, 21, 34, …

  F(n) = F(n-1) + F(n-2)

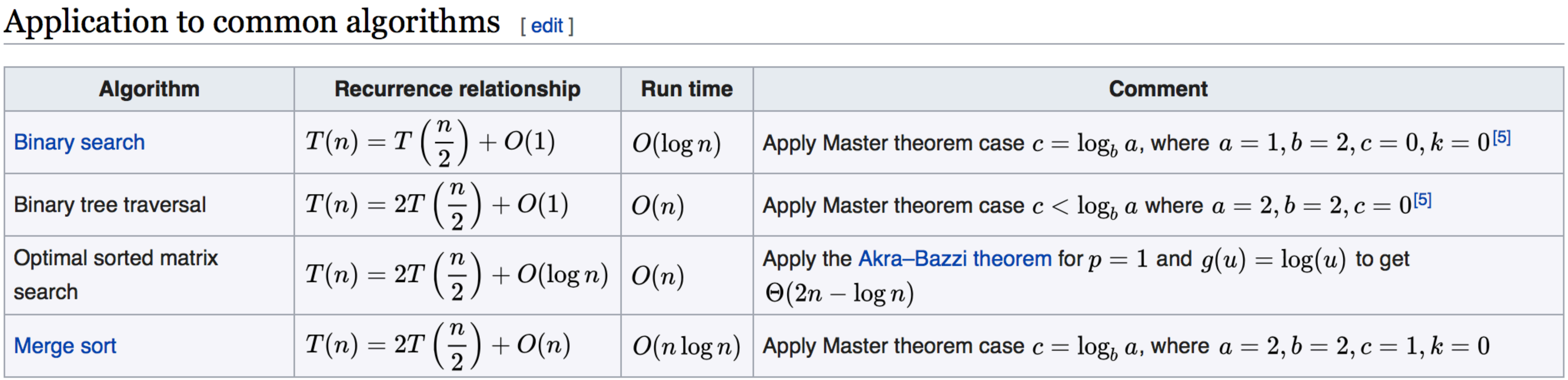
```
def fib(n):
  if n == 0 or n == 1:
      return n
  return fib(n - 1) + fib(n - 2)
```

Fib(6)


f(6)
f(5)
f(4)
f(4)
f(3)
f(3)
f(2)
f(1) = 1
f(2)
f(2)
f(1) = 1
f(2)
f(1) = 1
f(0) = 0
f(1) = 1
f(0) = 0
f(1) = 1
f(0) = 0
f(1) = 1
f(0) = 0
f(3)
f(2)
f(1) = 1
f(1) = 1
f(0) = 0

Master Theorem

https://en.wikipedia.org/wiki/Master_theorem_(analysis_of_algorithms)
https://zh.wikipedia.org/wiki/%E4%B8%BB%E5%AE%9A%E7%90%86



Application to common algorithms [edit]

Algorithm	Recurrence relationship	Run time	Comment
Binary search	$T(n) = T\left(\frac{n}{2}\right) + O(1)$	$O(\log n)$	Apply Master theorem case $c = \log_b a$, where $a = 1, b = 2, c = 0, k = 0$[5]
Binary tree traversal	$T(n) = 2T\left(\frac{n}{2}\right) + O(1)$	$O(n)$	Apply Master theorem case $c < \log_b a$ where $a = 2, b = 2, c = 0$[5]
Optimal sorted matrix search	$T(n) = 2T\left(\frac{n}{2}\right) + O(\log n)$	$O(n)$	Apply the Akra–Bazzi theorem for $p = 1$ and $g(u) = \log(u)$ to get $\Theta(2n - \log n)$
Merge sort	$T(n) = 2T\left(\frac{n}{2}\right) + O(n)$	$O(n \log n)$	Apply Master theorem case $c = \log_b a$, where $a = 2, b = 2, c = 1, k = 0$