Computer Programming 2 Lab

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Outline

- Binary Search
- Greedy Algorithm
- Homework 2

Binary Search

Binary Search

Find a integer in a sorted array

target = 9

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	2	3	4	***5***	6	7	8	9	10
1	2	3	4	5	6	***7***	8	9	10
1	2	3	4	5	6	7	***8***	9	10
1	2	3	4	5	6	7	8	***9***	10

Binary Search

For each step you can discard half of probability. $O(logn)$

Binary Search

Example - LeetCode 69. Sqrt(x)

Given a non-negative integer x, return the square root of x rounded down to the nearest integer. The returned integer should be non-negative as well.

```
int mySqrt(int x) {
    return (int)sqrt((double)x);
}
```

Binary Search

Example - LeetCode 69. Sqrt(x)

You must not use any built-in exponent function or operator.

Constraints:

- $0 \leq x \leq 2^{31} - 1$

Binary Search

Example - LeetCode 69. Sqrt(x)

- $\sqrt{2^{31}-1} \leq 1000000$
- Binary Search answer in 0 ~ 1000000

Binary Search

快速冪

- 計算 a^r

```
for(int i=0; i<r; i++){ // O(n)
    ans *= a;
}
```

Binary Search

快速冪

$O(\log n)$

- if r is even $a^r = a^{\frac{r}{2}} \cdot a^{\frac{r}{2}}$
- if r is odd $a^r = a^{\frac{r}{2}} \cdot a^{\frac{r}{2}} \cdot a$
- if $r = 1$ return a

Binary Search

矩陣快速冪 - 計算 A^r

$O(\log n)$

- if r is even $A^r = A^{\frac{r}{2}} \cdot A^{\frac{r}{2}}$
- if r is odd $A^r = A^{\frac{r}{2}} \cdot A^{\frac{r}{2}} \cdot A$
- if $r = 1$ return A

Greedy Algorithm

Greedy Algorithm

硬幣問題

一元硬幣、五元硬幣、十元硬幣、五十元硬幣、一百元硬幣、五百元硬幣分別有 $C_1, C_5, C_{10}, C_{50}, C_{100}, C_{500}$ 枚。我們想要以盡可能少的硬幣支付 A 元，問最少需要幾枚硬幣(保證至少有一種付款方式)

輸入

```
C1=3, C5=2, C10=1, C50=3, C100=0, C500=2, A=620
```

輸出

```
6 (500*1, 50*2, 10*1, 5*2)
```

Greedy Algorithm

硬幣問題

一元硬幣、五元硬幣、十元硬幣、五十元硬幣、一百元硬幣、五百元硬幣分別有 $C_1, C_5, C_{10}, C_{50}, C_{100}, C_{500}$ 枚。我們想要以盡可能少的硬幣支付 A 元，問最少需要幾枚硬幣(保證至少有一種付款方式)

- 可以用 500 就用 500
- 可以用 100 就用 100
- 可以用 50 就用 50
- 可以用 10 就用 10
- 可以用 5 就用 5
- 可以用 1 就用 1

Greedy Algorithm

硬幣問題

- 遵循統一規則，不斷選擇當時的最佳解
- 優先使用面額較大的硬幣

```
int V[6] = {1, 5, 10, 50, 100, 500};
int C[6] = {3, 2,  1,  3,   0,   2};
int ans = 0;
for(int i=5;i>=0;i--){
    int cnt = min(A/V[i], C[i]); // 用了多少硬幣 i
    A -= cnt*V[i];
    ans += cnt;
}

cout << ans << endl;
```

Greedy Algorithm

Example - LeetCode 409. Longest Palindrome

Given a string s which consists of lowercase or uppercase letters, return the length of the longest palindrome that can be built with those letters.

Letters are case sensitive, for example, "Aa" is not considered a palindrome here.

Greedy Algorithm

Example - LeetCode 409. Longest Palindrome

- 計算每個字母出現的次數，同一個字母每兩次就把答案加二。
- 是否有字母出現奇數次，有答案就加一。

Greedy Algorithm

我不是 Greedy - LeetCode 322. Coin Change

給定數個金幣價值 `coins` ，以及目標價值 `amount` ，問 `amount` 可由多少最少的金幣組成，如果無法組成輸出 -1

輸入

```
coins = [1, 3, 4]
amount = 6
```

輸出

```
2
```

Homework 2 - Is it good enough?

Homework 2

Description

Lian raises a pig and wants to sell it to the market. The pigs on the market need to have quality assurance, at least m kg. He has n bags of feed to feed the pigs, and the weight of each bag is a_i. If pig eats more than one bag per day, their absorption will start to decrease, the second bag -1, the third bag -2, and so on. How many days does it take Lian at least to get his pig up to standard?

Homework 2

Input

First line has two integers n, m.

Second line has n integers represents a_i.

Homework 2

Output

Print how many days does it take Lian at least to get his pig up to standard. If Lian cannot get his pig up to standard any way, print -1.

Homework 2

Sample1

Input sample	Output sample
5 5 1 1 1 1 1	5

Homework 2

Sample2

Input sample	Output sample
10 40 5 5 5 5 5 5 5 5 5 5	4

Homework 2

Sample3

Input sample	Output sample
10 56 1 2 3 4 5 6 7 8 9 10	-1

Homework 2

Constraints

For 30%:

- $1 \leq n \leq 10$

For 60%:

- $1 \leq n \leq 10^4$

For 100%:

- $1 \leq n \leq 2 \cdot 10^5$
- $1 \leq m \leq 2^{31} - 1$
- $1 \leq a_i \leq 10^4$