

Please complete these 3 tasks in 2 weeks.

### 1. Reorganize Linear Regression in Python mode.

You have seen what we are doing in class to do linear regression. That is not bad in C++. But it's not a good idea in Python because we were not using Python's features at all.

So, your first task is: rewrite linear regression code in Python. You are not allowed to use "Too Many For Loops", especially when doing calculations.

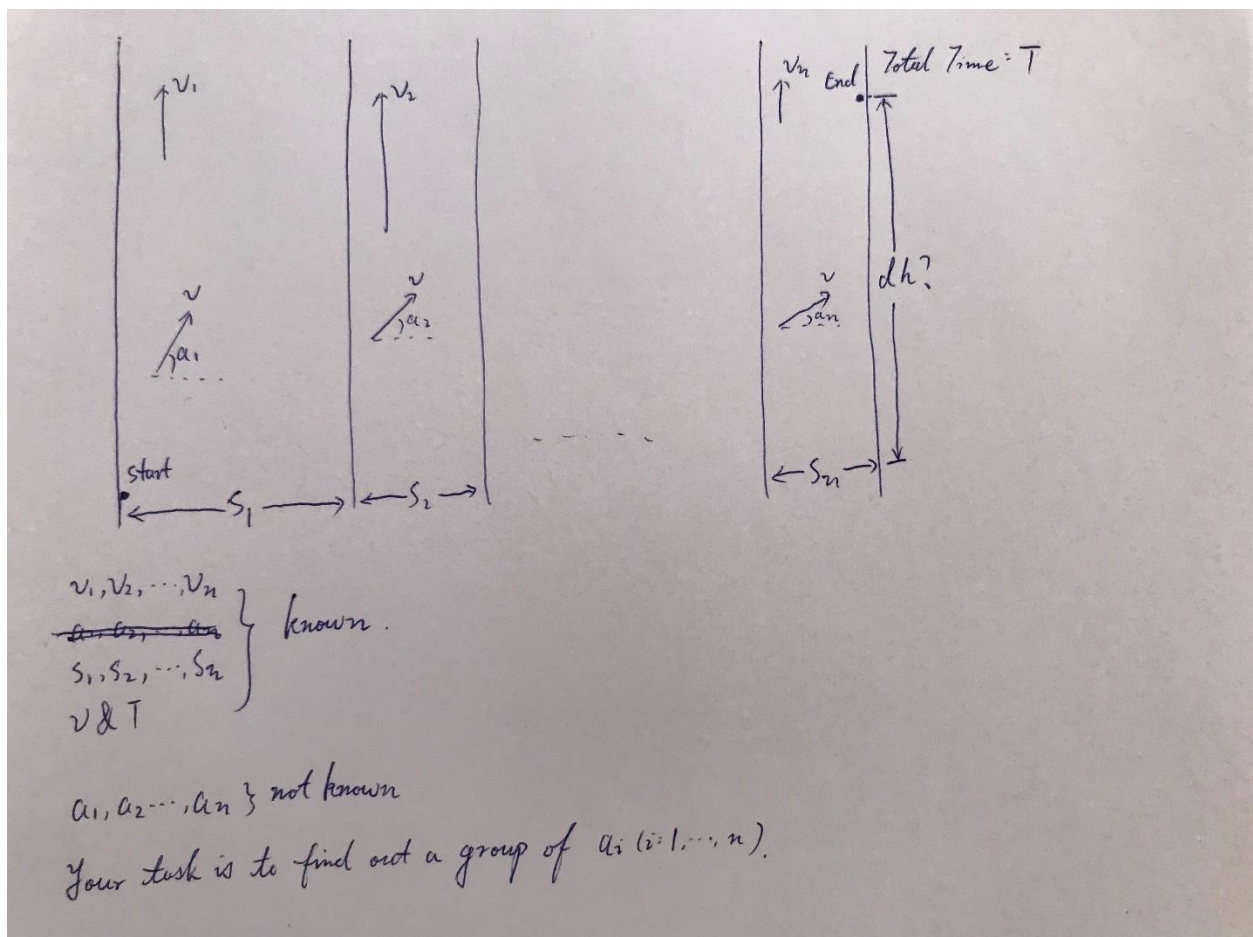
Write the code in "Python's way". Go ahead and good luck.

### 2. Logistic regression:

Logistic regression is widely used. We derived the cost function and it's gradient in class. Please complete the logistic regression code in "Python's way" as well.

Tips: It's almost like the linear regression code. The only difference is you need to complete a sigmoid function and use the result of that as your "new X" and also you need to generate your own training data.

### 3. Mathematics:



A person is swimming across several rivers.

Speeds of those rivers are different:  $v_1, v_2, \dots, v_n$ . To simplify this problem, we only consider the speed in vertical direction.

The person's speed is  $v$ . It's a constant, no way to change that. And the angle of the person's velocity to horizontal line is  $a_1, a_2, \dots, a_n$ .

The total time for swimming is  $T$ . And, the person must pass those rivers.

**Your task is:**

Find out an equation to determine by choosing what angles ( $a_1, a_2, \dots, a_n$ ) the person can get maximum distance in vertical direction (That is to say, please maximize  $dh$  by determining  $a_1, a_2, \dots, a_n$ ) under the total time  $T$ . **【You are not required to give out concrete angle numbers, a "cost function" that can be derived from is enough】**

Tips: For this question, a mathematical tool you may need is called "**Lagrangian Multiplier**". Which means, when you provide a formula, say  $E$ , which still need to satisfy some more conditions, say  $a > 1$ , for the convenience of calculating, we can write those 2 parts (formula  $E$  and condition  $a > 1$ ) together as one new formula. Here the new formula will be:  $E - \lambda(a - 1)$ .

Good luck to your math trip.

**【Note】 This is a real interview question.**