1. 9 boys and 7 girls sit in a circle, what's the expectation of the number of boy-girl

neighbors?

<http://math.stackexchange.com/questions/513720/expectation-values-of-male-male-male-female-female-female-pairs>

总结一下类似问题？

2. What is the difference between uncorrelated and independent variables. Which state-

ment is stronger? Can you give an example?

<http://www.stat.cmu.edu/~cshalizi/uADA/13/reminders/uncorrelated-vs-independent.pdf>

3. You are allowed to toss a dice for up to three times. You can decide to stop after each

toss, and you will get the same value of dollars as the number shown on your last toss.

What is the value of this game?

倒推

4. If a rod with length L is cut randomly into N pieces, what is the distribution of the

longest piece?

<http://math.stackexchange.com/questions/14190/average-length-of-the-longest-segment?lq=1>

<http://math.stackexchange.com/questions/13959/if-a-1-meter-rope-is-cut-at-two-uniformly-randomly-chosen-points-what-is-the-av>

similar problem: <http://www.math.uah.edu/stat/buffon/Triangles.html>

5. Given three random variables X,Y and Z, (X; Y ) = (Y;Z) = r, (X;Z) = 0,

calculate the range of r.

correlation matrix, SPD, eignvalue matrix

6. A drunk man sits 1 step to the left door and 99 steps to the right door. He randomly

walks left and right. As soon as he reaches an open door, he will go back home. What

is the expected number of steps he takes to go home: a) if both the right and left doors

are open; b) if the left door is locked and the right door is open.

S=sum x\_i, martingale

类似于赌钱问题，总结一下类似问题？

7. What is ridge regression?

See Regression Summary last page

8. What is lasso regression?

See Regression Summary last page

9. Play a coin toss game, you win 2i dollars if the i-th toss is head. How much would be

pay for this game? (Spoiler: the expected payo is innity, but are you really willing

to pay 1 million dollars for this game?)

<https://en.wikipedia.org/wiki/St._Petersburg_paradox>

10. What is the use of 'default' ? When do you want to define your own default constructor?

The default constructor is the constructor called when objects of a class are declared, but are not initialized with any arguments.

If a class definition does not have constructors, the compiler will assume that the class have an implicitly defined default constructor. However, as soon as a class has constructor taking parameters explicitly declared, the compiler will no longer provide an implicit default constructor, and will no longer allow the declaration of new objects of that class without arguments.

In order to declare a new object that does not take any parameters, at the presence of some constructors with arguments, we need to explicitly define our own default constructor.

Reference: <http://www.cplusplus.com/doc/tutorial/classes2/>

11. Implement a thread safe singleton.

A singleton pattern is a design pattern that ensures a class has only one instance, and provides a global point of access to it.

The general method to make a program ‘thread safe’ is to lock shared resources whenever write permission is given. This way, if one thread is modifying the resource, other threads can modify it.

An example of the implementation is provided in “Cracking the Coding Interview”, 18.3

12. Say you have an array for which the i-th element is the price of a given stock on day i.

Design an algorithm to nd the maximum prot. You may complete at most k trans-

actions.

Note: You may not engage in multiple transactions at the same time (i.e. you must

sell the stock before you buy again).

// C++

// Dynamic programming

class Solution {

public:

int maxProfit(vector<int> input, int k) {

if(input.size() < 2) {

return 0;

}

int res = 0;

if (k >= input.size()){

for (int i = 1; i < input.size(); ++i) {

if (input[i] - input[i - 1] > 0) {

res += input[i] - input[i - 1];

}

}

} else {

vector<int> local(k + 1);

vector<int> global(k + 1);

for (int i = 0; i < input.size() - 1; ++i) {

int increase = input[i + 1] - input[i];

for (int j = k; j >= 1; --j) {

local[j] = max(global[j - 1] + max(increase, 0), local[j] + increase);

global[j] = max(global[j], local[j]);

}

}

res = global[k];

}

return res;

}

};

13. A vector of integers, every element appears twice except one. Find the integer which

only appears once.

// C++

// XOR.

class Solution {

public:

int findSingle(vector<int> input) {

// assume the vector is not null

int x = input[0];

for (int i = 1; i < input.size(); ++i) {

x = x^input[i];

}

return x;

}

void test1() {

int a[] = {5,3,2,4,3,4,2};

vector<int> v\_a(a, a + sizeof(a)/sizeof(int));

cout << findSingle(v\_a) << endl;

}

};

14. Is it okay for a non-virtual function of the base class to call a virtual function?

15. How to generate random numbers? How to evaluate the quality of a random number

generator?

True random number generators rely on a physical source of randomness: thermal noise, cosmic noise, nuclear decay etc.

Pseudo-random number generator takes one number(seed) and produce a sequence of bits. There are various ways to test the randomness: equidistribution, binary matrix rank, discrete fourier transform, compressibility, maximum distance to zero, average flight time, random excursions, etc.

References:

<http://pit-claudel.fr/clement/blog/how-random-is-pseudo-random-testing-pseudo-random-number-generators-and-measuring-randomness/>

<http://www.drdobbs.com/testing-random-number-generators/184403185>

16. How to simulate dices with a coin? How to maximize the efficiency?

// C++

// coin toss will produce random number (0,1)

// three coin tosses will produce random numbers 000 - 111 (bitwise representation)

// remove 000 and 111 if they appear, keep 001 - 110, or 1 - 6

class Solution {

private:

int coin() {

return rand()%2;

}

public:

int dice() {

int one;

int two;

int three;

while(1){

one = coin();

two = coin();

three = coin();

int sum = one + two + three;

if (sum != 0 && sum != 3){

return 4\*one + 2\*two + three;

}

}

}

};

17. Given two Robots, one of which is currently somewhere at negative axis and the other

one positive axis. The two Robots can only take the following commands:

Go left: go left by 1.

Go right: go right by 1.

If at-zero(): return true if the Robot is at 0.

Write a program with the above commands and \*ONLY\* while() or if-else to make the

two Robots meet. The meeting location is not important. Also, the two robots would

execute this program at the same time. E.g. if you make go left in you program, the

two robots will both go left.

// not sure about the requirement!!! if two robots always make identical move, they will never meet

// if they only need to follow the same program and they are able to know their relative positions,

// it can be done as follows:

// C++

class robot {

private:

int position;

public:

robot(int x){

position = x;

}

bool atZero() {

return (position == 0);

}

void goLeft() {

position -= 1;

}

void goRight() {

position += 1;

}

int getPosition() {

return position;

}

};

int test() {

robot robot1(3);

robot robot2(-7);

//cout << robot1.getPosition()<<endl;

//cout << robot2.getPosition()<<endl;

while(robot1.atZero() == false && robot2.atZero() == false){

robot1.goRight();

robot2.goRight();

}

if (robot1.atZero()) {

while (robot1.getPosition() < robot2.getPosition()){

robot1.goRight();

}

} else {

while(robot2.getPosition() < robot1.getPosition()){

robot2.goRight();

}

}

cout << robot1.getPosition() << endl;

return 0;

}