Qishi Quiz 5

Instructions: Please post your solutions by **Tuesday, Nov. 24th**. You are encouraged to discuss the questions with other Qishi members. Please DO NOT share the problems with people outside Qishi.

1 Math/Stat.

1. (Sellside) What is martingale? What is the definition of Brownian motion?
2. (Sellside) In a nursery, there are 2 boys and unknown number of girls, the nurse bring in a newborn and then take out one, calculate (a) the probability of taking out a boy, given bring in a boy. (b) the probability of bring in a boy, given taken out a boy.
3. (sellside)

   Price a barrier call option using portfolio replication method, assume $S = 110$, $K = 100$, $Barrier = 100$, $r = 0$ and $d = 0$.
4. (Sellside) Calculate the price of the option with payoff $(S_t - K)^+$, given the stock price satisfies normal distribution $N(\mu, \sigma^2)$.
5. You can play one of the following three games by tossing dice, and you will win if you:
   1. Get more than once 1 in six tosses;
   2. Get more than twice 1 in twelve tosses;
   3. Get more than three times 1 in eighteen tosses.

   In which game you have the highest chance to win? Can you give the answer without calculating the probability of each game?
6. There are n variables, the correlation between each pair of them is r. What is the minimum value of r?
7. 6 people are going to hold a tournament, find the number of grouping methods, such that each people will compete with exactly three other people.
8. Toss a coin continuously, what is the probability that **HHT** happens before **HTH**?
9. Follow up, what is the probability of deriving **HHT** from **HH** status?

2 Programming

10. How to get the middle node of a linked list?

11. C++ questions
    (a) what is object oriented programming
    (b) constructor, destructor etc.
    (c) virtual function and realize method vs pure virtual function.
    (d) overloading vs overwriting
    (e) stl, vector, list etc.
    (f) template mechanism

12. Given a sorted matrix, which increases from left to right and up to bottom, design an efficient searching algorithm within the matrix.

13. What is machine epsilon? When will machine return 1 when calculating the cumulative distribution function of normal distribution?

14. Snake Problem: There are N points given by their coordinates on a plane. All coordinates (x_i, y_i) are integers in a range from -10000 up to 10000 inclusive . It is necessary to construct a broken line satisfying the following conditions:
    1. The broken line should be closed.
    2. End points of each segment (vertices) of the broken line can only be the given points, and all given points should be used.
    3. Each two consecutive segments of the broken line should form a corner of 90 degrees in each vertex point.
    4. The sides of the broken line should be parallel to coordinate axes.
    5. The broken line should have no self-crossing and self-contact.
    6. The broken line should have the minimal length.
    You have to either find the length L of the constructed broken line, or determine that it is impossible to construct such a broken line. INPUT: First line contains the number $N(4 \leq N \leq 10000)$ - amount of points. Each of the following N lines contains coordinates of points separated by space x_i and y_i $(1 \leq i \leq N)$. Points are given in random order. OUTPUT: First line should contain the length of the broken line L or 0 if there is no solution.