A. Rectangle in a Rectangle

Author: Sean Falconer, October 1, 2004

Given two rectangles, A and B, where A is specified by top left-hand coordinates of $(Ax1, Ay1)$ and bottom right-hand coordinates of $(Ax2, Ay2)$ and B is specified by top left-hand coordinates of $(Bx1, By1)$ and bottom right-hand coordinates of $(Bx2, By2)$, write an "if" statement in the programming language of your choice to determine if rectangle B lies within or on rectangle A.

B. Swapping Numbers

Author: Sean Falconer, October 1, 2004

Given two integers, a and b, how can I swap their values without using a temporary variable or calling a built in function?

For instance, consider the following piece of code:

```
int a = 7;
int b = 10;
```

I want to swap the values of a and b, so that $a = 10$ and $b = 7$ without using any additional variables.

Normally, this is done as follows:

```
int temp = a;
a = b;
b = temp;
```

You must figure out a way to perform the same operation without using a third integer variable.

C. Team Selection

Author: Joe Horton October 1, 2004

Nine people show up for a programming competition. However there are only four computers, so the orgranisers decide that the people will be divided up into 4 teams. Each team must have at least one person on it, but otherwise each team can have any number of people on it. In how many ways can the teams be selected?

D. What's Wrong?

Author: Sean Falconer, October 1, 2004

For some reason my program keeps crashing, but I don't know what is wrong with it. I managed to trace the problem to the following inputs to the following method. Please tell me what is wrong.

The inputs are:
$p1.x = 10$, $p1.y = 12$
$p2.x = 46$, $p2.y = 12$
$q1.x = 82$, $q1.y = 4$
$q2.x = 6$, $q2.y = 4$.

```
Point intersectPoint(Point p1, Point p2, Point q1, Point q2) {
        Point p;
        p.y = -((p1.x-q1.x)*(p1.y-p2.y)*(q1.y-q2.y)+q1.y*(p1.y-p2.y)*(q1.x-q2.x)-p1.y*(q1.y-q2.y)
                *(p1.x-p2.x))/((p1.x-p2.x)*(q1.y-q2.y)-(q1.x-q2.x)*(p1.y-p2.y));
        p.x = -((p1.y-q1.y)*(p1.x-p2.x)*(q1.x-q2.x)+q1.x*(p1.x-p2.x)*(q1.y-q2.y)-p1.x*(q1.x-q2.x)
                *(p1.y-p2.y))/((p1.y-p2.y)*(q1.x-q2.x)-(q1.y-q2.y)*(p1.x-p2.x));

        return p;
}
```

The method above has four Point objects as parameters. A Point object contains an x coordinate and a y coordinate value. Point $p1$ and $p2$ represent the points of a line segment, and Point $q1$ and $q2$ represent the points of a second line segment. The method determines the intersection point of the two lines, and returns that as a Point object. Somehow, the above inputs are crashing my method, but I don't know why. I know the method is correct, can you please tell me why those particular inputs cause a problem?

E. Picnic Baskets

Author: Sean Falconer October 1, 2004
Source: William Poundstone

You have three picnic baskets filled with fruit. One has apples, one has oranges, and the third has a mixture of apples and oranges. You cannot see the fruit inside the baskets. Each basket is clearly labelled. Each label is wrong. You are permitted to close your eyes and pick one fruit from one basket, then examine it. How can you determine which is in each basket?

F. Open Water

Author: Ken Kent, Sean Falconer, and Nathan Scott :-) October 1, 2004

There is a string of buoys in the water. Each buoy is attached to a maximum of two other buoys and there is only one string of buoys, i.e. there can't be two disconnected segments of buoys. Fred and Dave are in the water, and it's foggy, so visibility is limited, also, they're hearing is not so great, so they can't yell to eachother. However, they each have synchronized watches. They want to figure out if there is a loop (i.e. cycle) in the string of buoys. All buoys are identical, meaning they cannot tell if they've seen a given buoy before.

All Fred and Dave are allowed to do is swim forward or backwards along the string of buoys. Explain how, using some sequence of movements (possibly involving their watches), Fred and Dave can find out if the string of buoys has a loop?

G. Cable Car

Author: Joe Horton, October 1, 2004

Four people, a man (M), a woman (W), a person in a wheelchair (C) and a quadriplegic (Q) are travelling in a forest, trying to escape a forest fire. They are coming soon to a cable car that crosses a ravine to safety. The cable car can only hold two people at a time and requires a passenger to cross the ravine (i.e. the car cannot not return from one side of the ravine by magic, someone must be in it). It is also difficult to get into, so that the woman can cross in one minute, the man can cross in two minutes, but the wheelchair person can only cross in 5 minutes and the quadriplegic can only cross in 10 minutes. If two people take the cable car, they can cross in the time of the slower person.

In what order should they use the cable car? Remember minutes count!

H. The Eternal Triangle

Author: Joe Horton, October 1, 2004

Six people get on an elevator. Some pairs of these people know each other, the other pairs do not. Prove that there are 3 people all of whom know each other, or that there are three people who do not know either of the other two.

I. The Maze

Author: David Bremner October 1, 2004

You are trapped in a maze of twisty passages, all alike. There is exactly one exit. You are not there. You have been equipped with a bag holding an infinite number of HB pencils with erasers, but no way to sharpen the pencils. Describe a scheme to escape the maze.

J. Choosing Coins

Author: Kent Kent October 1, 2004

You are attending a coin collecting fair with your mother and she wants to buy a coin for your father's birthday. With both of you being unfamiliar with coins she asks that you chose at random the coin to purchase. Luckily you arrive as coins are being displayed one at a time across the stage. Without counting the number of coins that are displayed (and not knowing how many coins you will see before your mother wants to know your choice) how can you randomly chose a coin giving equal weight to each coin?

K. Shuffle it to the Man

Author: David Bremner October 1, 2004

You have taken a summer job working for a courier company, but you hate your boss. The warehouse contains 20 boxes with shipping labels on them, and a 20 sided die borrowed from your older brothers Dungeons and Dragons set.

Describe an organized way of shuffling the shipping labels so that:

1) Nobody gets the correct package (to make the boss mad)
2) There is no pattern to the way labels are matched to boxes.

L. Clean Up After the Jerk

Author: David Bremner October 1, 2004

You have taken a summer job working for a courier company. The previous person to work in your position for some unknown reason scrambled all the shipping labels in the warehouse. Your job is to reorder the shipping labels so that they correspond to the boxes. The boxes are labelled from 1 to 20, but the shipping labels only have bar codes. You have been given a handheld computer that can tell you for any two labels A and B, does the box of A have a lower number than the box of B.

M. Clean Up After the Jerk v2.0

Author: David Bremner October 1, 2004

You have taken a summer job working for a courier company. The previous person to work in your position for some unknown reason scrambled all the shipping labels in the warehouse. The boxes are labelled from 1 to 20, but the shipping labels only have bar codes. You have been given a handheld computer that can tell you for any two labels A and B, does the box of A have a lower number than the box of B. How can you reorder the shipping labels so that they correspond to the boxes in at most 100 uses of the handheld computer?

N. Man Overboard!

Author: Joe Horton October 1, 2004

You are in a boat that is exactly one kilometer from a shore. The shore is perfectly straight, with no headlines or bays. You fall overboard, and do not know in what direction the shore is. What is the shortest path that you should swim to guarantee that you will reach shore? The night is very foggy, and you cannot detect the shore until actually reach it. Give the length of the path.