The 12 Steel Balls Logic Test

Computer Programming Logic Puzzle
You may be quite surprised to discover that you, perhaps the mathematically challenged, have natural programming talent. Since this is not an obvious skill, like musical or mathematical ability, you won't know if you'd make a good programmer unless you try doing this agreeable job.

You do not have to study computer science or engineering to work in this well-paid field. In fact, the vast majority of successful programming professionals I've met in my 43-year career graduated with a degree in English, music, history, or some other liberal-arts subject. (The genius programmer with whom I developed software for IBM didn't go to college at all.)

What you must have, though, is persistence, patience, and -- most important-- the ability to think logically. (**Proficiency in advanced math is not required.**) Here's a logic-puzzle that should show you how persistent (or not) you are.

It's a difficult test: Years ago, when I was teaching an IBM class in the RPG language, I gave it to my students as a little diversion. Only one person in the class (my future partner, then 18) got the test in the hour I allowed for it. But when I saw that the other students kept on trying various alternatives during that hour, it showed me that they had the kind of tenacious desire to find the answer that is the hallmark of a successful programmer.

The real test is not that you get the complete answer. I really do not expect you to solve the puzzle completely. The real test is that you actually try to get the answer by exercising your brain and logic skills, and that you ask for a hint when you really need one. After all, that's what successful corporate programmers must do.

Here's the Test:

Keep trying until you've either gotten the complete answer or gotten fed up. After about every 20 minutes of thinking, do something else, then come back to the test with a fresh mind. You may try the test as many times as you like, hopefully learning from previous attempts. E-mail me at paulhark@aol.com for another hint only when you really need it, or for confirmation that you got the complete answer.

Note: To get a **complete answer,** you must identify which ball of 12 steel balls is lighter or heavier than the other balls in the three weighings allowed on a pan scale, whether the scale pans are even or uneven on the first weighing.

Note - The lighter or heavier ball can be any of the 12 balls. Which ball it is, and whether it is lighter or heavier than the other 11 balls will depend on the sequence of balls that you select to weigh, and on your decisions of which way the scale pans move.

Materials needed:
- A paper and a pencil or pen (unless you can do it in your head)
- Twenty minutes of quiet time for each attempt at solving more of the puzzle (best in the morning)
- Bulldog persistence

- The willingness to try another approach when your attempt fails to find the lighter or heavier ball in the three weighings allowed.

*** Imagine there are 12 small balls**, 11 of which are of equal weight, and one ball that is ***either*** lighter or heavier than the other 11 balls. On the paper draw 12 small circles representing the 12 balls, and write the

number, from 1 through 12, of each ball in the center of each circle. Thus ball 1 is on the left, and ball 12 is on the right.

You can solve the puzzle more easily by indicating the weight of each ball relative to all the other balls:

U - Unknown weight (could be equal, lighter, or heavier than all the other balls). This is the status of each ball before the first weighing on the pan scale.

E - Equal weight (you know that this ball is not light or heavier)

L - The Light ball (all other balls are Equal)

H - The Heavy ball (all other balls are Equal)

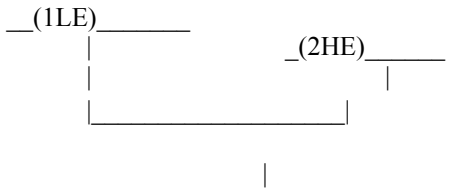
LE - The ball is Lighter or Equal

HE - The ball is Heavier or Equal

So, the 12 balls start the puzzle as:
(1U) (2U) (3U) (4U) (5U) (6U) (7U) (8U) (9U) (10U) (11U) (12U) (all balls are of Unknown weight)

*** Imagine that you have a two-pan balance (or see-saw) scale.** Draw the scale on the paper, something like the picture of the scale, or like this:

If you weighed only ball 1 and ball 2,the scale might look like this:



This will allow you to "weigh" the balls without an actual scale, observing whether the pans balance or whether they are uneven (one pan is higher than the other).

*** In three weighings, identify the ball that is different in weight,** and indicate whether it is ***lighter or heavier*** than the other 11 balls. Account for all possibilities, not just the easy one where the balls on the pans in the first weighing are of equal weight.

Rules:
* You can start the puzzle any number of times.
* You can take as much time as you want, even days or weeks.
* You may utilize any combination of balls in any of the three weighings, leaving some balls off, switching balls to the other pan, and using balls of known weight from previous weighings.
* There is at least one correct and complete answer, where every ball is of known weight, regardless of which way the pans happen to move. Unlike solitaire you can always solve the puzzle with the correct weighing strategy. (There are actually at least two correct answers)
* Each weighing has two possibilities: The balls on the pans may be of equal weight (the pans are in balance), or the balls on the pans are of unequal weight (one pan goes up and the other pan goes down). Your answer must consider **both** possibilities for each of the three weighings.

Hints:
Weigh 1: Divide and conquer. Weighing all 12 balls will teach you nothing (except that one pan will go up and the other pan will go down), and will waste the first weighing.
Weigh 2: Divide and conquer, and another strategy

Weigh 3: Divide and conquer
All weighings: You must put the **same number of balls on each of the two pans on each weighing** (for example; one ball on each pan, or five balls on each pan)
You will have a much easier time, and a much better chance of getting the complete solution, if you **list all the 12 balls, and their status, after each weighing,** and review this list for your next weighing. This will help you keep track of the status of each ball, and to not forget about a ball.

Use a ball, or balls, of known equal weight in later weighings to help reduce the unknowns more quickly.

You will learn something from each weighing about each ball, whether the ball is on a pan or not.

You can do some preliminary thinking of how the puzzle might be solved, before actually trying it by placing balls on the scale pans.

This is a very good example of how a computer programmer approaches a complex problem, and attempts to solve it with a possible solution, and keeps learning from each attempt, and trying until he or she finds the solution. Once you have solved the problem, it doesn't matter how long you tried, or how many attempts you took. It only matters that you successfully solved the problem and that you had the tenacity to keep trying, and to ask for more information when you really needed it to continue.

Help

If you make a serious try at solving the puzzle but are stumped, you may E-mail me for a major hint about the first weighing at paulhark@aol.com.

If you're still stumped, E-mail me for a major hint about the second weighing.

Have fun, and be persistent.

I gave this test in 1998 in my article "Programming: The Mystery Job" for the magazine NYcitylife. I got many emails with requests for hints, which I gave. The first person to correctly solve the puzzle and email the solution back to me was **Courtney.** She came up with a slightly different solution than my solution, so there may be even more than two correct solutions to the puzzle. Only a handful of my correspondents got the answer.

The Challenge

Can anyone write a computer program, in any language, on any computer that will find and print all the correct solutions to this puzzle, and allow the puzzle to be played interactively?

Hints:
* The program can simulate the logic used to manually solve the puzzle, as is the case for most computer programs.
* The number of combinations of balls required to be tested is much smaller than you might think, as odd numbers of balls on the pans cannot possibly solve the puzzle.
* Keep Trying