

Problem Solving Workshop #9

Tech Interviews and Competitive Programming Meetup

July 2, 2016

<https://www.meetup.com/tech-interviews-and-competitive-programming/>

Instructor: Eugene Yarovoi (can be [contacted](#) through the group Meetup page above under Organizers)

**More practice questions:** leetcode.com, glassdoor.com, geeksforgeeks.org

**Books:** Elements of Programming Interviews, Cracking the Coding Interview

**Have questions you want answered?** Contact the instructor, or ask on [Quora](#). You can post questions and [follow the instructor](#) and other people who write about algorithms.

Try to find optimized solutions, and provide a time and space complexity analysis with every solution for the algorithms questions.

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## THE "SPREADSHEET PROBLEM"

Suppose you have a spreadsheet application. When a user clicks the mouse, you want to know which cell they're clicking on so that you can switch the focus to it. You get (x, y) mouse click coordinates as input, and you want to return the cell number clicked on.

Since solving for the row number when given the y-coordinate and solving for the column number when given the x-coordinate are analogous problems, you can just worry about computing the column number, given an x-coordinate.

Initially, you'll get an array *columnSizes* denoting the column sizes. For example, an input of [8, 2, 10, 10] means that there are 4 columns (numbered 0 through 3), with the 0th column having width 8 pixels, the 1st column having width 2, etc.

Then, you will receive as input a sequence of user operations. A user operation either has the form *Click(x)* or *Resize(index,newWidth)*. In the first case, the operation specifies an integer x, and you must print the column # of the column at pixel coordinate x. In the second case, you don't print anything, but you must update column # *index* to now have *newWidth*. This change may affect the result of subsequent *Click* operations.

The 0th column starts at the 0th pixel. With the earlier example array, if a *Click* occurs before any updates, if x is between 0 and 7 you should print 0, for x=8-9 print 1, for x=10-19 print 2, and for x=20-29 print 3.

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(i) Give any correct solution to this problem. It can be inefficient. **Difficulty level: basic**

(ii) You want the *Click* operation to be very fast because it's a common operation. However, you don't care if *Resize* is very slow, since resizing columns is much less common. You can also take some time to pre-process the *columnSizes* array when you load the file. Give an algorithm that achieves *Click* in less than linear time with respect to *columnSizes.length*. **Difficulty: mid-tier company interview**

Rot 13 hint only if you're stuck for 20 mins or more: Ohvyq na neenl gung ubyqf gur fgnegvat k-cbfvgvba bs rnpu pbyhza, gura ovanel frnepu guvf neenl.

(iii) Accomplish both *Click* and *Resize* efficiently. Target complexity is  $O(\log n)$  for both operations, but it's OK to not quite reach that mark and give less optimized solutions as long as both operations run in less than linear time. **Difficulty: elite company interview**

Rot 13 hint if you're really stuck (getting this is expected to take a while, so only use if you've made no progress for 30 mins): Fcyvg guvf ceboyrz vagb gjb unyirf, yrsg naq evtug, naq fgber n qngn fgehpgher sbe rnpu, gura qb guvf erphefviryl. Va rnpu qngn fgehpgher, fgber gur gbgny ahzore bs cvkryf vg pbiref.

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## "STOCK QUERIES" (ADVANCED)

You have a large array that denotes stock prices, one value for each second. This array is static (no updates). You want to pre-process the array and then answer queries of the form "between time X and time Y, what percentage of the time was the stock above price P?"

Of course you could pre-process with the answer to every possible query, but this requires a huge amount of space. Instead, solve this problem using similar techniques to (iii) from the last problem.

Rot 13 hint: Va rnpu oybpx, be abqr bs gur gerr, qrcraqvat ba ubj lbh fbyirq gur cerivbhf ceboyrz, fgber n fbegrq neenl bs gur cevprf pbirerq ol gung abqr/oybpx. Gura hfr ovanel frnepu.

Advanced follow-up: how would you make this work with updates to the underlying array?