Placement Exam for Computer Science: Connect Four*

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You will be given a two-dimensional grid of numbers, with m rows and n columns, in the following format:

```
 674   20  305 -921  912  779   25  525  331  181  660 -123 -620  -88  269
 650  640  613  575  617 -883 -202  159 -201  874  184 -893 -863 -655  550
  30  888  649  959 -339  668  471  519  538  -45  905 -427  350  607 -275
-140  362 -397  230 -638 -658 -499  -74  710  840 -856 -553  726   14  547
 753  288 -318 -432 -302  584   94   47  752 -901 -384  -14 -209 -435  443
-662 -943   59 -601 -650  934 -509  757 -323 -679   57 -780 -924 -853  207
 823 -582   21  168  729    1  839 -873  334  151  252  919  733 -481 -565
-385  562 -661  298 -646 -834  592 -753  277   97 -179   64  993 -168  421
-540 -803  917 -781  989 -789 -158  243  775 -394 -130  -19  655  318  420
  44  -18  112 -533 -886  699 -884 -607 -904  -17  971 -224 -956  134  110
```

Let's call four numbers that appear "in a row" a *quadsequence*. A quadsequence can be horizontal (e.g., starting in the upper-left corner, `674 20 305 -921`), vertical (`674 650 30 -140`), down-diagonal (`674 640 649 230`), or up-diagonal (the upper-left-most example is `-140 888 613 -921`).

The problem. Write a program that finds the largest value produced by multiplying together the four numbers in any quadsequence in a given grid. For example, the product of the first example quadsequence above—the horizontal sequence of the first four numbers in the first row—is $674 \cdot 20 \cdot 305 \cdot -921 = -3{,}786{,}599{,}400$. The product of the up-diagonal example is $-140 \cdot 888 \cdot 613 \cdot -921 = 70{,}187{,}715{,}360$. The latter is bigger. You seek the largest such product among all quadsequences in the grid.

You are to write a program in Python (either Python 2.7 or Python 3.x) or Java to solve the above problem. (Sorry, we don't support other languages; your solution must be written in Python or Java. If you have knowledge of another language, please get in touch.) The input data for your program—that is, the grid of numbers—will be given to you via a URL (a web address), specified as a command-line argument to your program. (There are some helpful hints about handling command-line parameters and URLs later in this document; don't worry if you haven't used them before!) Write a function that reads in the grid from the web page located at a given URL, whose format will be as in the example above, and then computes the maximum product among all quadsequences in the grid. You may assume that each line contains the same number of entries (e.g., 15 entries per row in the example grid above), that all entries are properly formatted integers (possibly negative), and that all entries are separated by one or more spaces. The grid in the file may not have the same dimensions as this example, and the number of rows might differ from the number of columns, but you may assume that it will have at least 4 rows or at least 4 columns (or both).

Hint: if you write your solution in Java, use `Long` variables instead of `Integer` variables; some of the numbers you compute may be large.

A test case. The above grid is at `http://cs.carleton.edu/faculty/dln/placement/grid.txt`. The product of the largest quadsequence in this grid is 568,764,139,559. You should ensure that your program correctly computes the largest quadsequence of this grid. We will run your submitted solution on this file, and on several other test cases.

*Thanks to one of the problems from Project Euler, `https://projecteuler.net`, for the inspiration for this question. Regardless of which class ends up being your initial placement in computer science at Carleton, you might find Project Euler to be an amusing and interesting set of programming/algorithmic challenges.

How your submission will be tested. We will run your program with the test URL as a command-line parameter. As output, your program should print one and only one line of output, which should be precisely the specified product (that is, the product of the largest quadsequence). In other words, here is a complete successful execution of this program on the sample grid:

```
$ python2 solution2.py http://cs.carleton.edu/faculty/dln/placement/grid.txt
568764139559
```

```
$ python3 solution3.py http://cs.carleton.edu/faculty/dln/placement/grid.txt
568764139559
```

```
$ javac Solution.java
$ java Solution http://cs.carleton.edu/faculty/dln/placement/grid.txt
568764139559
```

Help! I don't know how to open a webpage or use command-line parameters. Here are some skeleton pieces of code to help you get started. The following programs simply open a URL and print out the lines of that file, one by one. (You don't have to start from these skeletons, but they might be helpful.)

Python 2 skeleton code

```
import sys
import urllib

command_line_parameter = sys.argv[1]
f = urllib.urlopen(command_line_parameter)
for line in f:
    print line
f.close()
```

Python 3 skeleton code

```
import sys
import urllib.request

command_line_parameter = sys.argv[1]
f = urllib.request.urlopen(command_line_parameter)
for line in f:
    print(line)
f.close()
```

Java skeleton code

```
import java.net.*;
import java.util.*;

public class Sample {
   public static void main(String[] args) throws Exception {
      String commandLineParameter = args[0];
      URL url = new URL(commandLineParameter);
      Scanner scanner = new Scanner(url.openStream());
      while (scanner.hasNextLine()) {
         System.out.println(scanner.nextLine());
      }
      scanner.close();
   }
}
```