# First year project Project 99: Who's Julia?

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#### 1 Introduction

- 1.1 Julia
- 1.2 Features of Julia
- 1.3 Syntax differences

## 2 Projecteuler 11

In the 20x20 grid below, four numbers along a diagonal line have been marked in red. The product of these numbers is  $26 \times 63 \times 78 \times 14 = 1788696$ . What is the greatest product of four adjacent numbers in the same direction (up, down,

```
4851 3238 1738 4414 2453 3781 1058 2209 2485 2302 1601 4652 4791 3553 706 2520 4236 3842 1210 4707 2305 497 4336 3310 42611 3945 2743 1781 4386 3920
```

left, right, or diagonally) in the 20x20 grid? 2476 1321 1870 471 1313 3326

The algorithm first reads through a file with the input and makes a matrix. To run through a matrix, a nested for loop is needed, a total of two for loops. The outer loop runs through each row, and the inner loop runs through the columns. To calculate all the product in all directions there's 3 sets of for loops. 3 sets is consisting of an outer and an inner loop. The first set calculates the horizontal and vertical directions, second diagonally from left to right(downwards) and third set going diagonally from right to left(downwards). The algorithm starts in the most upper left cell, and going through all cells in the matrix. Lets have the first cell as (1, 1), first number is row(i) and second number is column(j). The first set which calculated horizontal and vertical would do the following on the first iteration: spacing

```
Horizontal: (1,1) \cdot (1,2) \cdot (1,3) \cdot (1,4)
Vertical: (1,1) \cdot (2,1) \cdot (3,1) \cdot (4,1)
```

More generally it will look like the following: spacing

```
label Horizontal: (i, j + k) \cdot (i, j + k) \cdot (i, j + k) \cdot (i, j + k)
label Vertical: (j + k, i) \cdot (j + k, i) \cdot (j + k, i) \cdot (j + k, i)
```

In order to make the algorithm work on products with different amount of adjacent numbers(k), there's been added a for loop which loops (k) times,

to match the number of adjacent numbers. With four adjacent numbers it will look like this, with starting at cell (1,1): spacing

label Horizontal: 
$$(1, 1+0) \cdot (1, 1+1) \cdot (1, 1+2) \cdot (1, 1+2)$$

label Vertical: 
$$(1+0,1) \cdot (1+1,1) \cdot (1+2,1) \cdot (1+3,1)$$

After the first iteration the algorithm moves to next column, (i, j+1) until the last column is reached. Now going to next row, (i+1, j) and going through the columns once again until the last cell is reached. Last cell is the last cell which can still have  $\mathbf{k}$  adjacent numbers. When k=4 it stops 3 cells earlier than the last, since it can't go beyond the last column/row. The last horizontal product would be:  $(end, end-3) \cdot (end, end-2) \cdot (end, end-1) \cdot (end, end)$ . Diagonally from left to right looks like: spacing

label 
$$(i + k, j + k) \cdot (i + k, j + k) \cdot (i + k, j + k) \cdot (i + k, j + k)$$

Diagonally from right to left looks like: spacing

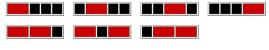
label 
$$(i + k, j - k) \cdot (i + k, j - k) \cdot (i + k, j - k) \cdot (i + k, j - k)$$

For testing the algorithm on inputs larger than a  $20 \cdot 20$  matrix, the numbers in each cell is 3-4 digits, the range of 100-9999. When making large matrices, e.g. a  $5000 \cdot 5000$  many numbers would be the same if they were just 2 digits. Some languages make optimizations if it can predict what the result will be, e.g. multiplying many of the same numbers, and trying to avoid this by increasing the range of the numbers in each cell.

## 3 Projecteuler 116

A row of five black square tiles is to have a number of its tiles replaced with coloured oblong tiles chosen from red (length two), green (length three), or blue (length four).

If red tiles are chosen there are exactly seven ways this can be done.



If green tiles are chosen there are three ways



And if blue tiles are chosen there are two ways.



Assuming that colours cannot be mixed there are 7 + 3 + 2 = 12 ways of replacing the black tiles in a row measuring five units in length.

How many different ways can the black tiles in a row measuring fifty units in length be replaced if colours cannot be mixed and at least one coloured tile must be used?

- 4 Quicksort
- 5 Statistics
- 6 Learning / Personal experience
- 7 Conclusion

8 Appendix (source code)