UKIEPC Names

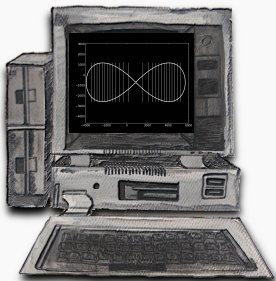Organisers: **Max Wilson**, **James Davenport**, **Rachid Hourizi**

Writers: **Robin Lee, Jim Grimmett**, **James Stanley**

Reviewers: **Ximo Lerma**, **Per Austrin**

Sysadmins: **Neil Francis**, **Matt Richards, Rob Perkins**

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Problem Solutions

B - Compiler

Author: **Robin**

Overview

A simple processor supplied with limited instructions, three registers, and a small stack.

No program can be longer than 40 instructions.

Write a program that will write the assembly language to output a number between 0 and 255

Compiler - Solution

Techniques

Dynamic programming
Shortest paths

Algorithm

3 registers and 256 bytes of stack is overkill. All we need is:

2 registers

1 item on the stack

Let state= {X,Y,Stack1} --- that's 257^3 = 16,974,593 choices

Breadth-first search over all possible CPU states

Worst case: 38 instructions

Another approach from Per

Factorise one register recursively via (PH S)*T, AD*(x-1), PL

Worst case: 40 instructions

E – Rhyming Slang

Author: **Jim**

Overview

Read a number of lists of word endings. If two endings are in the same list words with those endings rhyme.

Read a single common word and a number of possible phrases that could be rhyming slang for the common word.

Output YES if the word and phrase rhyme, NO otherwise.

Rhyming Slang - Solution

Techniques

Substrings
Hashmaps

Algorithm

Read in all of the endings and the common word.

We only care about rhyming sets where the common word matches at least one ending in the list.

Put the set of possible rhymes into a hash set.

For each possible rhyming phrase iterate over all possible suffix lengths for the end word.

Look them up in the hash set.

If any exist in there (possibly more than 1), write YES.

J- Grass Seed

Author: **Jim**

Overview

Given:

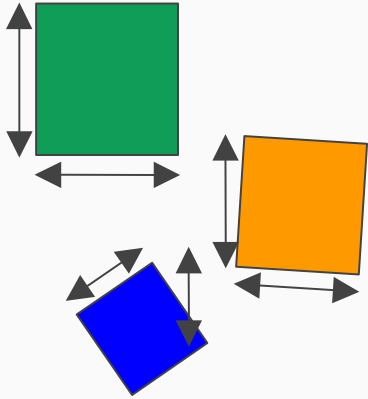The cost of seed for one square metre of lawn

Several lawn widths and lengths

Calculate the total cost of seed.

Grass Seed - Solution

Techniques

Floating point
Multiplication

Algorithm

For each lawn:

　　　Read in width and height

　　　Multiply to find the area

Sum the lawn areas.

Multiply the sum by the cost of the seed.

　　　Print back out with %.6f, %.7f, etc.

K- Secret Santa

Author: **James**

Overview

We have N people

Each person picks up a unique name from the set, on a piece of paper

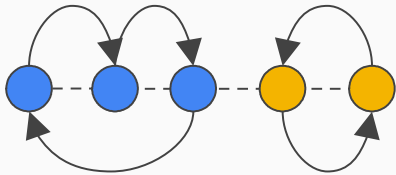What are the chances that someone (maybe several people) picked up their own name?

Secret Santa - Solution

Techniques

Dynamic programming
Permutations
Infinite series

Algorithm

Count the number of permutations with no fixed points

(these are also known as derangements)

With N people, whoever person 1 gives a gift to may:

Give a gift in return

In which case answer[N] += answer[N-2] * (N-1)

Give a gift to someone else

In which case answer[N] += answer[N-1] * (N-1)

Dynamic programming gives a fast solution for small N

But N <= 10^12

Luckily, the answer converges very quickly to 1-(1/e)

After 8 in fact---so brute force works too