NWERC 2019 practice solutions

A: Account Numbers

Problem Author: Jeroen Bransen

Problem

Validate an IBAN, which involves replacing letters by digits and doing modular arithmetic.

Solution

```
x = raw_input()
x = x[4:]+x[:4]
for i in range(26):
    x = x.replace(chr(65+i), str(10+i))

print 'correct' if int(x) % 97 == 1 else 'incorrect'
```

Pitfalls

- Numbers can get quite large

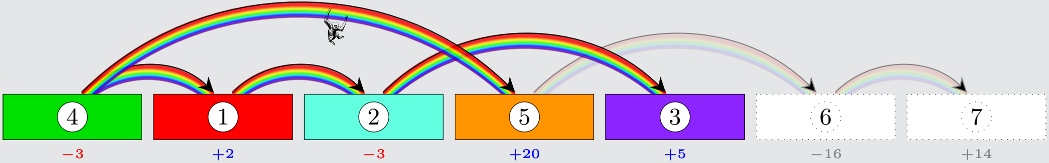
Statistics: 163 submissions, 119 accepted

B: Brinksmanship

Problem Author: Jeroen Bransen

Problem

Topics in a negotiation have dependencies on other topics. Some topics move us closer to Brexit, some further away. We want to get as close to Brexit as possible.



Which subset of topics should we choose to negotiate?

B: Brinksmanship

Problem Author: Jeroen Bransen

Solution

- Let's focus less on the rainbows and more on the practicalities. The dependencies form a graph.
- We can model a *minimum-cut* problem using this graph.
    - We'd like to *cut* some of the downstream nodes from the upstream ones.
    - But we can't cut an upstream node a without cutting a downstream one b.
    - Express this relationship as a having an infinite-weight edge to b.
- We also need to encode the objective function: as high a sum of values on the "keep" side of the cut as possible.
    - If a vertex has *positive* value, create an edge *from* a virtual source node with weight equal to the value $|v|$. Cutting the edge represents *discarding* this node.
    - If a vertex has *negative* value, create an edge *to* a virtual sink node with weight equal to the value $|v|$. Cutting the edge represents *keeping* this node.
- Now solve with your favourite maximum flow algorithm.
- This is known as the closure problem.

Statistics: 93 submissions, 8 accepted

C: Circus Tent

Problem Author: Per Austrin

Problem

We want to run a fence around the border of a circular circus tent to keep modernisation out. The area of the tent in metres^2 is already known. Tell us its perimeter.

C: Circus Tent

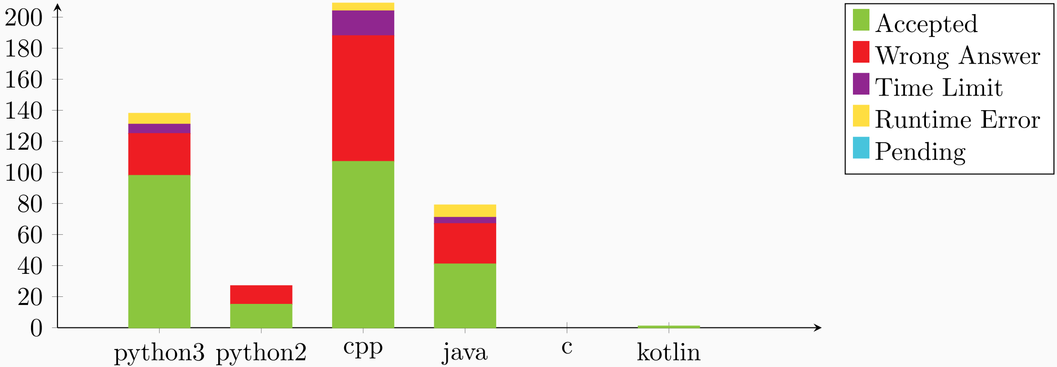
Problem Author: Per Austrin

Solution

- The area a of a circle with radius r is given by πr^2.
- The perimeter p of such a circle is $2\pi r$.
- Because $a = \pi r^2$, we know $r = \sqrt{\frac{a}{\pi}}$.
- Hence $p = 2\pi\sqrt{\frac{a}{\pi}} = \sqrt{4\pi a}$.
- Remember to print with high-precision:
  - C++: `cout.precision(12)` or `printf("%.9f\n", p)`
  - Python: `"{:.9f}".format(p)`
  - Java: `System.out.printfln("%.9f\n", p)`
- Time complexity: $O(1)$

Statistics: 144 submissions, 123 accepted

Language stats


python3
python2
cpp
java
c
kotlin
Accepted
Wrong Answer
Time Limit
Runtime Error
Pending