Programming Club

Trial by fire

Hello everyone! Please carefully read the following and try your best.

- These problems are hard; do not be discouraged. Many questions were created with the express intention of being difficult. If you don't know an answer **write down your thought process or any incomplete code**. Any information will help us in deliberating and will be taken into consideration.
- Furthermore it is an expectation that over the three days that you have to complete this test you will have **access to the internet** and that you will be making use of the resources available to you (don't talk to friends or teachers or tutors, however).
- These questions exist not to scare beginners but to allow people to show off their abilities. It also guarantees that those who deserve to get in will. **You may also choose to not complete the test if you so wish, but it is *not* recommended.**
- Turn it in **by the end of Thursday** either by email to young-jin.park20@stu.siskorea.org or turn it in person to Mr. Montague in the old school building by 3:00. **We cannot consider any late submissions** since Friday is the last day to decide.

Numbers (Show your work, please)

n1. Convert 101_2 to decimal 10
n2. Convert 351_8 to decimal 233
n3. Convert 351_8 to hexadecimal 0xE9

Operators[1]

o1. Evaluate `5*2+12.` = 22
o2. Evaluate `10<<2.` = 20
o3. Evaluate `10|24.` = 26
o4. Evaluate `10&24.` =8
o5. Evaluate `5^3<<1*2.` = 24
o6. Evaluate `53|356&2<<6*2.` = 217088

Data structures

Take the following sequence `4 6 3 7 p 2 1 p p p`
A number is an insertion of that number into the data structure. A `p` is a 'pop' where a number is taken off the data structure and printed depending on what data structure is used.

d1. Stack 4 6
d2. Queue 7 2 1

[1] https://en.cppreference.com/w/cpp/language/operator_precedence

p1. **Star printing**

Print a staircase of stars depending on the input n as shown in the examples.

Input 1:

```
3
```

Output 1:

```
*
**
***
```

Input 2:

```
5
```

Output 2:

```
*
**
***
****
*****
```

p2. **Star printing**

Print a diamond of stars depending on the input n as shown in the examples. (only odd)

Input 1:

```
3
```

Output 1:

```
 *
***
 *
```

Input 2:

```
5
```

Output 2:

```
  *
 ***
*****
 ***
  *
```

p3. **Digit-all age**

Make a program that adds up all the digits of a number

Input 1:

```
123456789
```

Output 1:

```
45
```

p4. **Greedy secretary**

Make a program that can schedule the most amount of appointments you can within `k` time. There are `n` possible appointments and each appointment has a designated start and end time, st_i and ed_i.

The first line of input gives us `n`, the number of appointments and `k`, the maximum time. For `n` lines after that, there is an appointment on each line with st_i and ed_i.

Input 1:

```
5 100
1 29
3 11
14 28
34 55
78 80
```

Output 1:

```
4
```

p5. **Maximum Sum**

Given a sequence of numbers of size `n`, find the largest possible sum of consecutive integers.

Input 1:

```
11
-4 -3 5 8 -100 -20 10 5 -1 2 4
```

Output 1:

```
20
```

p6. **The electric thief**

The electric thief broke into Walmart. His doctor told him he can only carry `k` kg on his back before his spine suddenly snaps in half. Yet he wants to steal the most amount possible. Assume there are an infinite amount of each item. Write a program for the electric thief that can tell him what his maximum profit is.

The first line of input gives us `n`, the number of items and `k`, the maximum weight your spine can manage For `n` lines after that, there is an item on each line with the weight `w` and value `v`.

Input 1:

```
3 100
100 5
20 10
30 1
```

Output 1:

```
50
```

p7. **The electric thief (again)**

The electric thief is at it again! Thanks to you, he had avoided having his spine snapped in half in Walmart. This time, he has levelled up and made his way into the Louvre museum. There is only one of each item. His doctor told him he can only carry `k` kg on his back before his spine suddenly snaps in half. Yet he wants to steal the most amount possible. Write a program for the electric thief that can tell him what his maximum profit is.

The first line of input gives us `n`, the number of items and `k`, the maximum weight your spine can manage For `n` lines after that, there is an item on each line with the weight `w` and value `v`.

Input 1:

```
3 100
100 5
20 10
30 1
```

Output 1:

```
11
```

p8. **Challenge Question**

Suppose you have a sequence $a_1, a_2, \ldots, a_n$. Find the minimum number of consecutive elements to remove such that all remaining elements in the sequence are distinct.

The first line of input gives us `n`,

Input 1:

```
3
1 2 3
```

Output 1:

```
0
```

Input 2:

```
4
1 1 2 2
```

Output 2:

```
2
```

Input 3:

```
5
1 4 1 4 9
```

Output 3:

```
2
```

Input 4:

```
9
1 1 3 4 5 9 1 2 2
```

Output 4:

```
7
```

p9. **Challenge challenge problem**

Prove or disprove P=NP. If you solve this problem, not only will you be guaranteed to become the president of programming club, you will also get a million dollars and international recognition as one of the greatest contemporary mathematicians.