Programming Design In-class Practices

Selection and Repetition

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Problem 1: age for legal marriage

- Before 2011, in Taiwan the age for legal marriage depends on one's gender:
  - Men: 18.
  - Women: 16.
- Please let a user enter her/his gender and age and then determine whether she/he is legal for marriage.
  - To make the problem easier, let's assume that the gender may only be male or female.
  - (It is good that the age now does not depend on gender!)

Problem 1: age for legal marriage

- Input:
  - A binary value $g \in \{0,1\}$ and a positive integer a. g and a are separated by a white space.
  - g is 1 if the user is a man; g is 0 if the user is a woman. a is her/his age.
  - $a \leq 200$.
- Output:
  - "Yes" if the user is legal for marriage or "No" otherwise.
- Sample input/output:

Input:	Input:	Input:
`1 18`	`1 17`	`0 17`
Output:	Output:	Output:
`Yes`	**`No`**	**`Yes`**

Problem 1: age for legal marriage

- Would you complete the program without using any logical operator?
- Would you complete the program without using any nested selection?

Problem 2: Converging to 1?

- Consider the following process:
  - You are given a positive integer.
  - If it is odd, multiply it by 3 and then add it by 1.
  - If it is even, divide it by 2.
  - Repeat until it becomes 1.
- Will it becomes 1 eventually?
- Write a program to test this!
  - Print out all the values we obtain during the process.

Problem 2: Converging to 1?

- Input:
  - A positive integer a.
  - $a \leq 1000000$.
- Output:
  - All values we obtain during the process.
  - Two consecutive values should be separated by a white space.
- Sample input/output:

Input:
`1`
 	
Output:
`4 2 1`
	Input:
	`3`
	
	Output:
	`10 5 16 8 4 2 1`
		Input:
		`23`
		
		Output:
		`70 35 106 53 160 80 40 20 10 5 16 8 4 2 1`

Problem 3: Monopoly pricing

- We sell a product to a small town.
- The demand of this product is $q = a - bp$:
  - a is the base demand.
  - b measures the price sensitivity of the product.
  - p is the unit price to be determined.
- Let c be the unit production cost.
- Given a, b, and c, how to solve

$$\max_{p} (a - bp)(p - c)$$

to find an optimal (profit-maximizing) integer price p^*?

  - If multiple prices all result in the maximized profit, we consider the lowest price as the optimal one.

Problem 3: Monopoly pricing

- Input:
  - Three positive integers a, b, and c in a row.
  - Two consecutive values are separated by one white space.
  - All three values are no greater than 10000; $a > bc$.
- Output:
  - The optimal integer price, a white space, and then the maximized profit.
- Sample input/output:

Input:	Input:	Input:
`10 1 2`	`1000 15 50`	`10000 1000 5`
Output:	Output:	Output:
`6 16`	`58 1040`	`7 6000`

Problem 4: Safe locations

- On a two-dimensional plane, there are $6 \times 6 = 36$ grid points within the square whose vertices are $(0, 0)$, $(5, 0)$, $(0, 5)$, and $(5, 5)$.
- We are given the locations of 3 snippers (x_1, y_1), (x_2, y_2), and (x_3, y_3).
  - $x_i \in \{0, 1, \dots, 5\}$, $y_i \in \{0, 1, \dots, 5\}$.
- A location (x, y) is considered dangerous if its relationship with any one of the three snippers satisfies one of the following:
  - On the same horizontal line: $y = y_i$ for any $i \in \{1, 2, 3\}$.
  - On the same vertical line: $x = x_i$ for any $i \in \{1, 2, 3\}$.
  - On the same diagonal line: $|x - x_i| = |y - y_i|$ for any $i \in \{1, 2, 3\}$.
- A location is safe if it is not dangerous. Find all safe locations.

- Hint: Use the function **`abs()`** in **`<cmath>`**.

Problem 4: safe locations

- Input:
  - Six integers x_1, y_1, x_2, y_2, x_3, and y_3 in a row.
  - Two consecutive values are separated by one white space.
  - All three values are within 0 and 5.
- Output:
  - All the safe locations (x, y).
  - To print out a location, print out x, then a white space, then y.
  - If there are multiple safe locations, print out each one in a new line.
  - If two locations are both safe, print out the one with the smaller x first; if their x values are the same, print out the one with the smaller y.

Problem 4: safe locations

- Sample input/output:

Input:
```
0 0 0 1 0 2
```

Output:
```
1 4
1 5
2 5
4 3
5 3
5 4
```

Input:
```
0 0 1 2 3 5
```

Output:
```
4 1
4 3
5 1
5 4
```

Input:
```
1 1 3 4 5 2
```

Output:
```
0 3
0 5
4 0
```