

15-110: Principles of Computing

HOMEWORK 05

Due: 6th September, 2022 at 10:00pm

- You need to complete the Python file for this assignment and submit it to Gradescope.
- There are 100 points.
- You must solve the tasks **individually**, always abiding by the course and CMU's academic integrity policy.

1. (20 points) **Change coins**

You have an unlimited amount of coins with the values 25, 10, 5, and 1. You need to give n in change to someone, but you want to use the smallest number of coins possible.

Implement the function `changeCoins(n)` that returns the minimum number of coins you will use to give n in change. For example, `changeCoins(142)` should return 9 (5 coins of 25, 1 coin of 10, 1 coin of 5, and 2 coins of 1).

Challenge: solve this problem without using loops.

2. (20 points) **Reverse**

Implement the function `reverse(n)` that returns the reverse of the number `n`. For example, `reverse(12345)` should return 54321.

Leading zeros can be ignored, so `reverse(100)` should return 1.

Hint: It may be helpful to count the number of digits of `n` before reversing the number.

3. (20 points) **Last hit**

Dorđe and Igli are playing a computer game where they both need to defeat a monster who is keeping a treasure. According to the rules of the game, both players get points for defeating the monster, but only the player who delivers the final blow gets to keep the treasure.

At the beginning, both Dorđe and Igli attack, dealing d_D and d_I damage points to the monster. After each attack, both Dorđe and Igli need to wait exactly t_D and t_I seconds, respectively, to attack again. Whenever Dorđe and Igli attack together (such as in the beginning), Dorđe has priority and attacks first. The monster is defeated when its life points become zero or less.

Implement the function `lastHit(dD, tD, dI, tI, m)` that takes as input:

- `dD`: Dorđe's damage
- `tD`: Dorđe's recovery time
- `dI`: Igli's damage
- `tI`: Igli's recovery time
- `m`: monster's total life

and returns "Dorde" if Dorde is the one giving the last blow, or "Igli" if Igli is giving the last blow.

For example, `lastHit(5, 3, 5, 3, 10)` should return "Igli", since:

- Second 0: Dorde attacks causing 5 points of damage. Now the monster has 5 life points.
- Second 0: Igli attacks causing 5 points of damage. The monster has 0 life points and Igli dealt the last blow.

Another example, `lastHit(5, 3, 5, 3, 11)` should return "Dorde".

Yet another example: `lastHit(5, 3, 10, 7, 213)` should return "Dorde".

4. (20 points) **Collatz Conjecture**

Let us consider the numeric sequence defined as follows:

$$x_{n+1} = \begin{cases} \frac{1}{2}x_n & \text{if } x_n \text{ is even} \\ 3x_n + 1 & \text{if } x_n \text{ is odd} \end{cases}$$

The number x_0 where it begins is arbitrary. For example, if $x_0 = 10$, then the sequence consists of the numbers:

$$x_0 = 10, x_1 = 5, x_2 = 16, x_3 = 8, x_4 = 4, x_5 = 2, x_6 = 1.$$

The Collatz conjecture states that this sequence, irrespectively of the starting value, will always reach the value 1 (and stay there).

Implement the function `collatzConjecture(a)` which takes as input a positive integer value `a` to start the sequence, and returns the total number of integer values that have been generated by the sequence until reaching the value 1 (including both 1 and the starting point).

For example:

- `collatzConjecture(10)` should return 7
- `collatzConjecture(5)` should return 6
- `collatzConjecture(100)` should return 26

5. (20 points) **Next prime**

Implement the function `nextPrime(n)` that returns the first prime bigger than `n` (not including `n`). For example, `nextPrime(3)` should return 5, and `nextPrime(90)` should return 97.

Hint: Loops can be inside loops.