CIT 590: Fall 2018
Homework 3

HW deadline as per Canvas.

This homework deals with the following topics:

- lists
- tuples

In this HW, we will be implementing the game *Tower Blaster*, which is a game that involves re-arranging a group of bricks in order to have an increasing sequence.

About the Game

While *Tower Blaster* is often played with 2 human players, we will keep this simple and just play the user versus the computer. The user's moves are decided by the user, by asking for input, and the computer's moves are decided by you, the programmer.

There is NO right answer for the section that asks you to program a strategy for the computer. All we want you to do is come up with a reasonable enough strategy that ensures a human user does not always beat the computer. So, unlike your previous assignments, this one has a creative component to it.

You must use Python lists and tuples for this assignment. Some of you might have seen this package called numpy. You are NOT allowed to use numpy at all.

For an online version of *Tower Blaster*, go here:
https://www.gamefools.com/onlinegames/free/towerblaster.html
Try to get a feel for the game. Our game will be similar, but read our specifications. Most importantly, we won't have levels.

A *Tower Blaster* game starts with a main pile of 60 bricks, each numbered from 1 to 60. Think of the numbers on the bricks as the width of the bricks. The objective is to be the first player to arrange 10 bricks in your own tower from lowest to highest (from the top down), because the tower will be unstable otherwise.

The bricks in the main pile are shuffled at the start and both the user and the computer are dealt 10 bricks from the main pile. As a player receives each brick, they must place it on top of their current tower in the order it is received. *Yes, initially your tower is likely to be unstable.*

After the first 10 bricks are dealt to the user and the computer, there will be 40 bricks remaining in the main pile. The top brick of the main pile is turned over to begin the

discarded brick pile.

On each player's turn, the player chooses to pick up the top brick from the discard pile or to pick up the top brick from the main pile. The top brick from the discard pile is known. In other words, the discard pile is 'face up' and everyone knows how wide the top brick is. The main pile is 'face down'. Choosing the top brick from the main pile can be risky, because the player does not know what the brick is.

Once a player chooses a brick, either from the discard pile or from the main pile, the player decides where in the tower to put the brick. The tower is always 10 bricks high, so placing a brick means that an existing brick in the tower is removed and replaced with the new brick.

If the player takes a brick from the main pile (the one that is 'face down'), the player can reject it and place it in the discard pile. This means that nothing in that player's tower changes during that turn. If the player takes a brick from the discard pile (the one that is 'face up'), the player MUST place it into the tower.

The first player to get their 10 bricks in order wins.

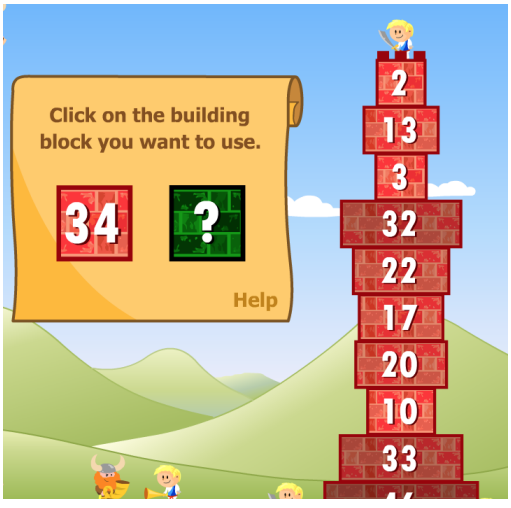
If, at any point, all of the cards have been removed from the main pile of bricks, then all of the cards in the discard pile are shuffled and moved to the main pile. Then the top card is turned over to start the new discard pile.

The Actual Program

Below you will find explanations of the functions that need to be written. We are expecting to see these functions with these names and these method signatures. Do not change the names of these functions, as we will be running automated tests against each individual function.

You will also have to write some functions by yourself, in addition to the ones listed below. Feel free to name those functions whatever you want, as long as they happen to reflect what the function does.

Note that we will make heavy use of lists in the assignment. Since a tower looks more like a vertically oriented structure, we need to have some convention. Our convention is that the tower in the picture to the right is going to be represented as [2, 13, 3, 32, 22, 17, 20, 10, 33, 46]



We know this is a somewhat awkward way to

represent the data, but we are deliberately asking you to do it this way in order for you to do more list exercises.

The main pile and discard pile are also going to be represented as lists. Note that in both the main pile and the discard pile, you should only have access to the top.

So, to add/remove bricks, consider the top of the brick pile or tower to be the beginning of the list. You will have to use the pop function, the append function, and the insert function, in some manner.

Here is an example:

tower [2, 13, 3, 32, 22, 17, 20, 10, 33, 46]

main pile [23,31,1,..] (invisible to players)

discard pile [34]

1. If the player choose to take a brick from the main pile (the brick 23) and reject it, notice that the top brick of the main pile will be placed on top of the discard pile.

tower [2, 13, 3, 32, 22, 17, 20, 10, 33, 46]

main pile [31,1,..] (invisible to players)

discard pile [23, 34]

2. If the player choose to take a brick from the main pile and insert it into his/her tower(replacing 3 in the original tower), notice that the 3 will be placed on top of the discard pile.

tower [2, 13, 23, 32, 22, 17, 20, 10, 33, 46]

main pile [31,1,..] (invisible to players)

discard pile [3, 34]

3.If the player choose to take a brick from the discard pile and insert it into his/her tower(replacing 46 in the original tower), notice that the 46 will be placed on top of the discard pile

tower [2, 13, 3, 32, 22, 17, 20, 10, 33, 34]

main pile [23,31,1,..] (invisible to players)

discard pile [46]

Required Functions

Be sure to add docstrings to all of your functions and comments to your code.

shuffle(bricks):

- Shuffle the given bricks (represented as a list). (You'll do this to start the game.)
- This function does not return anything.
- You are allowed to import the random module and just use random.shuffle.

check_bricks(main_pile, discard):

- Check if there are any cards left in the given main pile of bricks.
- If not, shuffle the discard pile (using the *shuffle* function) and move those bricks to the main pile.
- Then turn over the top card to be the start of the new discard pile.

check_tower_blaster(tower):

- Given a tower (the user's or the computer's list), determine if stability has been achieved.
- Remember, stability means that the bricks are in ascending order.
- This function returns a boolean value.

get_top_brick(brick_pile):

- Remove the top brick from any pile of bricks. This can be the main_pile, discard, or your tower or the computer's tower. In short, the first element of any list.
- So, it is used at the start of game play for dealing bricks. This same function will also be used during each player's turn to take the top brick from either the discarded brick pile or from the main pile.
- Note: Brick piles are vertically oriented structures, with the top having index 0.
- This function must return an integer.

deal_initial_bricks(main_pile):

- Start the game by dealing two sets of 10 bricks each.
- This function returns two lists - one representing the user's hand and the other representing the computer's hand.
- The method of returning 2 things from a function is to make a tuple out of the return values. For an example of this, refer to the lecture slides/code where we return both the maximum and minimum in a list.
- Make sure that you follow the normal conventions of dealing. So you have to deal one brick to the computer, one to the user, one to the computer, one to the user, and so on.

- The computer is always the first person that gets dealt to and always plays first.
- Remember that the rules dictate that you have to place your bricks one on top of the other. In the earlier picture, this would mean that someone was dealt 46, 33, 10, ..., in that order.

add_brick_to_discard(brick, discard):

- Add the brick (represented as an integer) to the top of the discard pile (which is a list)
- This function does not return anything.

find_and_replace(new_brick, brick_to_be_replaced, tower, discard):

- Find the brick to be replaced (represented by an integer) in the tower and replace it with new brick.
- Check and make sure that the brick to be replaced is truly a brick in the tower.
- The brick to be replaced then gets put on top of the discard pile.
- Return True if the brick is replaced, otherwise return False.

computer_play(tower, main_pile, discard):

- This function is where you can write the computer's strategy down. It is also the function where we are giving you very little guidance in terms of actual code.
- You are supposed to be somewhat creative here, but I do want your code to be deterministic. That is, given a particular tower and a particular brick (either from the discarded brick pile or as the top brick of the main pile), you either always take the brick or always reject it.
- Here are some potential decisions the computer has to make
    - Given the computer's current tower, do you want to take the top brick on the discarded brick pile or do you want to take the top brick from the deck and see if that brick is useful to you.
    - How do you evaluate the usefulness of a brick and which position it should go into.
    - There might be some simple rules you can give the computer. For instance, it is disastrous (provably so) to put something like a 5 at the very bottom of the tower. You want big numbers over there.
- You are allowed to do pretty much anything in this function except make a random decision or make a decision that is obviously incorrect. For instance, making your bottom brick a 5 is a recipe for disaster.
- Also, the computer CANNOT CHEAT. What does that mean? The computer cannot peek at the top brick of the main pile and then make a decision of going to the discard. Its decision-making should be something that a human should be able to make as well.
- This function returns the new tower for the computer.
- Hint: One approach is to try to think of how you, as a user, would consider selecting a new brick (from main pile or discard pile) and replacing one in your own tower.

main():

- The function that puts it all together.
- You play until either the user or the computer gets *Tower Blaster*, which means their tower stability has been achieved.
- Unlike the previous HW, we want you to assemble the functions in the main function by yourself. Think about how the game should proceed and where each function should go.
- All user input should take place in the main function.

Evaluation

The primary goal of this assignment is to get you to feel familiar with lists and tuples and to have some level of fun while creating a game.

While we want you to spend time on coming up with some kind of strategy for the computer, that is NOT the primary part of the assignment. Any simple, but reasonable strategy will have you doing some fun things with lists. If the user always does absolutely nothing at all, that is, if they reject the top discarded brick and they reject the top brick from the main pile and move it onto the discard, then we want the computer to win. Your computer player should be smart enough to beat the 'stupid, lazy' user.

Also, remember the human player has no idea what you are doing internally in your functions and does not want to be shown a large amount of print statements. At any given point in the game, they should know only 3 things: their entire tower (printed in list form), the top brick of the discard pile, and, if they choose to pick from the main pile, they get to know the top brick of the main pile.

You will be evaluated on 4 things:

1. Does your game work? Again, please do not worry about the TAs trying to crash your program. Just ensure that reasonable inputs will allow a user to play the game.
2. Strategy - Is your computer's strategy something that makes sense? Please comment your code for that part of the homework very thoroughly, and explain your strategy for the computer.
3. Usability - This is going to be a subjective evaluation. You are making a game. A user who knows the rules of *Tower Blaster* should be able to play it without too much trouble. In particular, they should not have to read a single line of your code in order to operate the game.
4. Style - The usual stuff here. Style includes things like variable names, function names, comments, and general readability of your code. Does every function have a docstring defined? Are all non trivial lines of code commented? Style will always be part of your evaluation.

Data Structures

In this HW *you are only allowed to use lists and tuples*. Do not use dictionaries, classes or any built-in python libraries (other than the *random* library for shuffling). Remember that the deck, the discard pile, and the two towers (user and computer) are just lists.

Submission

Submit a single file called *tower_blaster.py*.

Remember to put the following lines of code at the end of your file, as the entry point of your program.

```
if __name__ == '__main__':
    main()
```