

Project 1

This assignment is worth 40 points and is due before 11:59 on Friday, September 29, 2023.

Assignment Overview

This assignment will give you more experience on the use of:

1. integers (`int`)
2. floats (`float`)
3. strings (`str`)
4. conditionals
5. iteration

Your program will simulate a simple change maker for a vending machine. It will start with a stock of coins and dollars. It will then repeatedly request the price for an item to be purchased or to quit. If given a price, it will accept nickels, dimes, quarters, one-dollar and five-dollar bills—deposited one at a time—in payment. When the user has deposited enough to cover the cost of the item, the program will calculate the coins to be dispensed in change. Alternately, the user can cancel the purchase up until full payment has been deposited, in which case, your program will calculate the coins to be dispensed to refund any partial payment already deposited. With each purchase, the program will update the stock of coins and dollars. Before quitting, it will output the remaining stock of coins and dollars. The specifications are spelled out more thoroughly below. An example interaction with our program appears at the end of this description. All change and refunds must be in coins only and must use the minimum number of coins possible.

Background

The algorithm for calculating the numbers of coins of each denomination to dispense so as to minimize the total number of coins is an example of a greedy algorithm. Since each coin is at least twice the value of the previous coin, you can start by figuring out the greatest number of quarters you can dispense (without exceeding the amount), then the greatest number of dimes, and then the number of nickels. Knowledge of greedy algorithms is not required to complete this assignment. If you are curious, you can read http://en.wikipedia.org/wiki/Greedy_algorithm.

Project Description / Specification

Your program must meet the following specifications:

1. At program start, assume a stock of 25 nickels, 25 dimes, and 25 quarters. Print the contents of the stock.
2. Repeatedly prompt the user for a price in the form `xx.xx`, where `x` denotes a digit, or to enter 'q' to quit.
3. When a price is entered:
 - a. Check that the price entered is a (non-negative) multiple of .05 (i.e., it is payable in nickels). If not, then print an error message and start over requesting either a new price or to quit (indicated by entering a 'q').
 - b. Print a menu for indicating the coin/bill deposited or to cancel payment.
 - c. Prompt for a selection from this menu.
 - d. If the user enters an illegal selection, re-prompt for a correct one.
 - e. Following each deposit, print the remaining amount owed (indicate the number of dollars and the number of cents).

- f. When full payment has been deposited or a 'c' has been entered, determine the coins to be dispensed in change or as refund. This calculation will depend on the amount to be dispensed and also on the number of coins left in the stock. For example, the least number of coins needed to make up \$1.30 is 6 — 5 quarters and 1 nickel. But if there are only 3 quarters, 3 dimes, and 10 nickels left in the stock, then the least number is 11 — 3 quarters, 3 dimes, and 5 nickels.
 - g. Print the numbers of the coins to be dispensed and their denominations. (Omit a denomination if no coins of that denomination will be dispensed.)
 - h. In case exact payment is deposited, print a message such as "No change."
 - i. If the change cannot be made up with the coins remaining, dispense the coins available without exceeding the change amount and indicate the amount still due the user, which will have to be collected from a store manager. For example, if the stock contains one nickel, no dimes, and a quarter and if the change amount is 15 cents, dispense just the nickel and indicate the user should collect 10 cents from a store manager.
 - j. Print the contents of the stock following the transaction.
4. Just before quitting, print the total amount (the number of dollars and number of cents) left in the stock.

Notes and Hints:

1. Floating point numbers can be difficult to work with due to imprecision. To avoid imprecision in this program, you can multiply the price by 100, round, and convert to an integer (number of cents). For example, \$1.15 is the same as 115 cents. To see why you need to round, try evaluating `1.15*100` in the Python shell. Now evaluate `round(1.15*100)`.
2. The quotient (`//`) operation for integers will be useful for finding the numbers of each coin. For example, `195//25` is 7, the most number of quarters in 195 cents. But be careful—if the stock has fewer than 7 quarters left, you will only be able to dispense the number left in the stock. For example, if there are only 6 quarters left, then you can dispense only 6 quarters and must use dimes and nickels to make up any remaining change.
3. When we learn about format strings, we can more easily and elegantly print monetary amounts. For now, just use the Python `print(...)` command with appropriate string and/or integer arguments to print the number of dollars and the number of cents.
4. You do not need to check for any input errors other than those mentioned in this description.
5. The logic for this project is sufficiently complex that you will need to break it into small steps that you can implement incrementally. After implementing each step, test it thoroughly. For example, you could:
 - a. First implement the logic to initialize the stock, print it, and repeatedly prompt for a price until a 'q' is entered; just print the value that was input. Test your code.
 - b. Next, add code to check that the input is a legal price and, if it is not, to prompt for a new value. Again, just print the value that was input. Test code.
 - c. Next, add code to print the menu of selections. Test your code.
 - d. Next, add code to repeatedly prompt the user to deposit a coin until the full amount is collected or a 'c' is entered and to print the remaining amount owed after each deposit. Test your code.
 - e. Next, add code to update the stock. Test your code.
 - f. Next, add code to calculate the change or refund to be dispensed.
 - g. Next, add code to calculate the number of coins of each denomination to be dispensed and to update the stock.
 - h. Etc.

It is not required that you develop the project exactly in this way. But if you don't find a way to incrementally build and test your projects, they generally will be more difficult and take you

longer to do. We also recommend an incremental strategy, not just because it is easier, but also because it allows me to give partial credit. If you hand in a program that I can run and that meets some, but not all, of the requirements, we can grade what you managed to get working.

Sample Interaction (user inputs shown in red):

```
>>> ===== RESTART =====
```

```
>>>
```

```
Welcome to the vending machine change maker program
```

```
Change maker initialized.
```

```
Stock contains:
```

```
    25 nickels
```

```
    25 dimes
```

```
    25 quarters
```

```
    0 ones
```

```
    0 fives
```

```
Enter the purchase price (xx.xx) or `q' to quit: 1.96
```

```
Illegal price: Must be a non-negative multiple of 5 cents.
```

```
Enter the purchase price (xx.xx) or `q' to quit: 1.95
```

```
Menu for deposits:
```

```
    'n' - deposit a nickel
```

```
    'd' - deposit a dime
```

```
    'q' - deposit a quarter
```

```
    'o' - deposit a one dollar bill
```

```
    'f' - deposit a five dollar bill
```

```
    'c' - cancel the purchase
```

```
Payment due: 1 dollars and 95 cents
```

```
Indicate your deposit: 1
```

```
Illegal selection: 1
```

```
Payment due: 1 dollars and 95 cents
```

```
Indicate your deposit: o
```

```
Payment due: 95 cents
```

```
Indicate your deposit: o
```

```
Please take the change below.
```

```
    1 nickels
```

```
Stock contains:
```

```
    24 nickels
```

```
    25 dimes
```

```
    25 quarters
```

```
    2 ones
```

```
    0 fives
```

```
Enter the purchase price (xx.xx) or `q' to quit: 3.25
```

```
Menu for deposits:
```

'n' - deposit a nickel
'd' - deposit a dime
'q' - deposit a quarter
'o' - deposit a one dollar bill
'f' - deposit a five dollar bill
'c' - cancel the purchase

Payment due: 3 dollars and 25 cents
Indicate your deposit: o
Payment due: 2 dollars and 25 cents
Indicate your deposit: d
Payment due: 2 dollars and 15 cents
Indicate your deposit: d
Payment due: 2 dollars and 5 cents
Indicate your deposit: o
Payment due: 1 dollars and 5 cents
Indicate your deposit: d
Payment due: 95 cents
Indicate your deposit: c

Please take the change below.
9 quarters
1 nickels

Stock contains:
23 nickels
28 dimes
16 quarters
4 ones
0 fives

Enter the purchase price (xx.xx) or `q' to quit: .05

Menu for deposits:
'n' - deposit a nickel
'd' - deposit a dime
'q' - deposit a quarter
'o' - deposit a one dollar bill
'f' - deposit a five dollar bill
'c' - cancel the purchase

Payment due: 5 cents
Indicate your deposit: f

Please take the change below.
16 quarters
9 dimes
1 nickels

Stock contains:
22 nickels

19 dimes
0 quarters
4 ones
1 fives

Enter the purchase price (xx.xx) or `q' to quit: 25

Menu for deposits:

'n' - deposit a nickel
'd' - deposit a dime
'q' - deposit a quarter
'o' - deposit a one dollar bill
'f' - deposit a five dollar bill
'c' - cancel the purchase

Payment due: 25 dollars and 0 cents

Indicate your deposit: f

Payment due: 20 dollars and 0 cents

Indicate your deposit: f

Payment due: 15 dollars and 0 cents

Indicate your deposit: f

Payment due: 10 dollars and 0 cents

Indicate your deposit: f

Payment due: 5 dollars and 0 cents

Indicate your deposit: c

Please take the change below.

19 dimes

22 nickels

Machine is out of change.

See store manager for remaining refund.

Amount due is: 17 dollars and 0 cents

Stock contains:

0 nickels

0 dimes

0 quarters

4 ones

5 fives

Enter the purchase price (xx.xx) or `q' to quit: .35

Menu for deposits:

'n' - deposit a nickel
'd' - deposit a dime
'q' - deposit a quarter
'o' - deposit a one dollar bill
'f' - deposit a five dollar bill
'c' - cancel the purchase

Payment due: 35 cents

Indicate your deposit: q
Payment due: 10 cents
Indicate your deposit: d

Please take the change below.
No change due.

Stock contains:
0 nickels
1 dimes
1 quarters
4 ones
5 fives

Enter the purchase price (xx.xx) or `q' to quit: .35

Menu for deposits:
'n' - deposit a nickel
'd' - deposit a dime
'q' - deposit a quarter
'o' - deposit a one dollar bill
'f' - deposit a five dollar bill
'c' - cancel the purchase

Payment due: 35 cents
Indicate your deposit: q
Payment due: 10 cents
Indicate your deposit: q

Please take the change below.
1 dimes
Machine is out of change.
See store manager for remaining refund.
Amount due is: 5 cents

Stock contains:
0 nickels
0 dimes
3 quarters
4 ones
5 fives

Enter the purchase price (xx.xx) or `q' to quit: q

Total: 29 dollars and 75 cents
>>>