CompSci 101 - Assignment 01

Due: 4:30pm, Thursday 30\textsuperscript{th} March 2017.

Worth: This assignment is marked out of 15 and is worth 2.5\% of your final mark.

Topics covered:
- Using variables
- Arithmetic operators
- Printing output
- Manipulating string objects
- Generating random numbers
- Getting user input

\textbf{NOTE}: Each of your files must include a \textit{docstring} at the top of the file containing your name, username, ID number and a description of the program. When solving these questions you must \textit{only} use content covered in \textit{lectures 1 to 6}.

Submit the files containing your exercises using the Assignment Dropbox:

https://adb.auckland.ac.nz/Home/

\textbf{QUESTION 1 (3 MARKS)}

A right regular octagonal prism is a 3-dimensional shape consisting of 2 octagonal faces bound by 8 rectangles. An octagonal prism has 2 key dimensions:

1. The base edge – \(a\)
2. The height – \(h\)

An illustration of a right regular octagonal prism with these dimensions labelled is shown below:

\begin{center}
\includegraphics[width=0.5\textwidth]{octagonal_prism.png}
\end{center}

The formula to calculate the surface area of an octagonal prism is:

\[\text{Surface Area} = 8ah + 4\left(1 + \sqrt{2}\right)a^2\]

The formula to calculate the volume of an octagonal prism is:

\[\text{Volume} = 2\left(1 + \sqrt{2}\right)a^2h\]
Write a program that calculates the surface area and volume of a right regular octagonal prism. Name your program file 'YourUserNameA1Q1.py', e.g. dazh001A1Q1.py

Your program will need to:
- Display a banner.
- Ask the user to enter values for the base edge and height. You can assume that the user will always enter integer values.
- Calculate the surface area and volume of the prism using the values for the base edge and height entered by the user.
- Display these calculated values rounded to 3 decimal places.

Two example outputs using the completed program are shown below. Your program must give the output in the same format as the outputs in the two examples below.

```
Right Regular Octagonal Prism
Surface Area and Volume Calculator

Base Edge: 5
Height: 10
Surface Area: 641.421
Volume: 1207.107

Right Regular Octagonal Prism
Surface Area and Volume Calculator

Base Edge: 32
Height: 13
Surface Area: 13216.619
Volume: 64276.022
```

QUESTION 2 (4 MARKS)

Write a program which encrypts a five letter word. Name your program ‘YourUsernameA1Q2.py’, e.g. dazh001A1Q2.py

The program uses a normal alphabet and a scrambled alphabet. To encrypt a word, for each letter in this word you must:
- Find its position in the scrambled alphabet.
- Extract the letter at this position in the normal alphabet.
- Substitute the original letter with this new letter.

The two variables used for the alphabets and their initial values are shown below:

```python
alphabet = "abcdefghijklmnopqrstuvwxyz"
scrambled_alphabet = "updvcslymkxzfrejnaowhgbqit"
```

Please note that your program should still work if a different scrambled alphabet is used.

The user will enter the five letter word to be encrypted. You can assume that the user will always enter valid input.

Two example outputs using the completed program follow. Your program must give the output in the same format as the outputs in these two examples.
QUESTION 3 (4 MARKS)

Vehicles4Hire is a vehicle rental agency. They have four types of vehicles available for rental:

1. Shuttles that can seat 20 passengers.
2. Vans that can seat 9 passengers.
3. Cars that can seat 4 passengers.
4. Motorcycles that can seat 1 passenger.

The cost of hiring each type of vehicle is:

1. $85 per shuttle.
2. $45 per van.
3. $25 per car.
4. $15 per motorcycle.

Write a program that calculates the minimum number of vehicles required to transport a given number of passengers, and the cost of transporting that number of passengers. Name your program ‘YourUserNameA1Q3.py’, e.g. dazh001A1Q3.py

The number of passengers will be entered by the user. You can assume that the user will always enter an integer value. Note that due to traffic congestion in the city, a law has been passed banning any vehicle from the road unless it is full of passengers. In other words there can be no unused seats.

Your program must give the output in the same format as the outputs in the following three examples. The lines of “=” symbols contain 19 characters.
**QUESTION 4 (4 MARKS)**

Write a program which simulates four transactions on a bank account. Name your program ‘YourUserNameA1Q4.py’, e.g. dazh001A1Q4.py

Initially the bank account has a balance of $768. Each transaction is either a negative amount (a payment) or a positive amount (a deposit). The amount of each transaction (payment or deposit) is a random integer between 15 and 500 inclusive. Below are the statements that initialize the variables:

```python
initial_balance = 768
transaction_min = 15
transaction_max = 501
```

In the output, the amount of each transaction is displayed, followed by the balance in parentheses (after the transaction has been applied). The final two lines of output show the final balance and the overall sum of the four transactions.

*Hint*: In order to create a transaction which is either a payment or a deposit, you will find it useful to generate a random number which is either -1 or 1. The random transaction amount is then multiplied by this number.

Below are three two outputs using the completed program. Your program **must** give the output in the *same format* as the outputs in the two examples below.

<table>
<thead>
<tr>
<th>Number of people: 34</th>
<th>Number of people: 77</th>
<th>Number of people: 131</th>
</tr>
</thead>
<tbody>
<tr>
<td>You will need:</td>
<td>You will need:</td>
<td>You will need:</td>
</tr>
<tr>
<td>Shuttles: 1</td>
<td>Shuttles: 3</td>
<td>Shuttles: 6</td>
</tr>
<tr>
<td>Vans: 1</td>
<td>Vans: 1</td>
<td>Vans: 1</td>
</tr>
<tr>
<td>Cars: 1</td>
<td>Cars: 2</td>
<td>Cars: 0</td>
</tr>
<tr>
<td>Motorcycles: 1</td>
<td>Motorcycles: 0</td>
<td>Motorcycles: 2</td>
</tr>
<tr>
<td>Total cost: $170</td>
<td>Total cost: $350</td>
<td>Total cost: $585</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Initial bank balance: $768</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: -117 (651)</td>
</tr>
<tr>
<td>2: 43 (694)</td>
</tr>
<tr>
<td>3: -409 (285)</td>
</tr>
<tr>
<td>4: -331 (-46)</td>
</tr>
<tr>
<td>Final bank balance: $-46</td>
</tr>
<tr>
<td>Sum of transactions: $-814</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Initial bank balance: $768</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: -144 (624)</td>
</tr>
<tr>
<td>2: 162 (786)</td>
</tr>
<tr>
<td>3: 125 (911)</td>
</tr>
<tr>
<td>4: 237 (1148)</td>
</tr>
<tr>
<td>Final bank balance: $1148</td>
</tr>
<tr>
<td>Sum of transactions: $380</td>
</tr>
</tbody>
</table>