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**CSC121 Python Programming**

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LAB 01 **DESIGNING ALGORITMS FOR COMPUTER PROGRAMS**

# Objectives

In this lab assignment, students will learn:

- How to design algorithms for computer programs

- How to design steps for getting user input

- How to design steps for processing

- How to design steps for displaying output

- How to execute steps by hand and keep track of value changes in variables

# Goals

In this lab assignment, students will demonstrate the abilities to:

- Design algorithms for computer programs

- Design steps for getting user input

- Design steps for processing

- Design steps for displaying output

- Execute steps by hand and keep track of value changes in variables

# Instruction and Problems

There are five problems in this lab. For each problem, please do the following:

1. Design an algorithm for a computer program to solve the problem. All algorithms in this lab should include input steps, processing steps (e.g. steps performing calculations) and output steps.
2. Execute your algorithm by hand and use a table to show value changes of the variables with the test cases provided.

The following is an example.

Problem to solve:

*The power of an air conditioner is measured in British Thermal Units (BTU). The higher the BTU, the more heat the air conditioner can bring away. When people buy an air conditioner, they need to know how many BTU they need to keep the room cool. Design a program to estimate how many BTU we need when we install a window air conditioner in a room. This number is determined by the volume of the room. The rule of thumb is that we need 3.5 BTU per cubic foot. The program should ask the user to enter the length, width and height of the room. It should calculate and display the number of BTU needed for the air conditioner.*

*Execute your algorithm by hand with this test case: room length = 15, room width = 11 and room height =10. Create a table to show how the value of each variable changes during program execution.*

Algorithm:

Step 1: Input the length of the room

Step 2: Input the width of the room

Step 3: Input the height of the room

Step 4: Calculate volume = length \* width \* height

Step 5: Calculate BTU needed = volume \* 3.5

Step 6: Display BTU needed

Variable Table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step | Room length | Room width | Room height | Room volume | BTU needed |
| Input room length | 15 |  |  |  |  |
| Input room width | 15 | 11 |  |  |  |
| Input room height | 15 | 11 | 10 |  |  |
| Calculate volume = length \* width \* height | 15 | 11 | 10 | 1650 |  |
| Calculate BTU needed = volume \* 3.5 | 15 | 11 | 10 | 1650 | 5775 |
| Display BTU needed | 15 | 11 | 10 | 1650 | 5775 |

You need to submit an algorithm and a variable table for each problem. Please type and save your answers for all five problems in a single Microsoft Word document. Submit the file to Blackboard for credit.

## Problem 1

A hotdog stand sells hotdogs, potato chips and sodas. Hotdogs are $2.50 each. Potato chips are $1.50 per bag. Sodas are $1.25 per cans. Design a program to do the following. Ask the user to enter number of hotdogs, chips and sodas ordered by the customer. The program will calculate and display the total amount due.

Execute your algorithm by hand and create a table to show how the values of the variables change during program execution. Please use the following test case: hotdogs = 4, chips = 2, sodas = 3

## Problem 2

Each student in a course needs to submit 3 lab assignments and take 2 tests. Design a program to do the following. Ask the user to enter 3 lab scores and 2 test scores. Calculate and display the lab average and the test average. Also calculate and display the course grade, which equals 55% of the lab average plus 45% of the test average.

Execute your algorithm by hand and create a table to show how the values of the variables change during program execution. Please use the following test case: Lab 1 score = 95, lab 2 score = 82, lab 3 score = 90, test 1 score = 88, test 2 score = 97.

## Problem 3

Design a program to calculate sales tax, tip and the total amount of a meal purchased at a restaurant. The program asks the user to enter the charge for the food. It will calculate and display the sales tax and tip. Sales tax is 7% of the food charge. Tip is 18% of the food charge. Also calculate and display the total amount due from the customer.

Execute your algorithm by hand and create a table to show how the values of the variables change during program execution. Please use the following test case: food charge = 42.50

## Problem 4

Admission to an aquarium is $14 per person. There is also an IMAX theatre in the building, which charges $8 per ticket for a 3D shark show. Customers have three choices: admission to the aquarium only without watching 3D show, watch 3D show only with no admission to the aquarium, or do both with a 25% discount. Design a program for group orders. Ask the group to enter number of people who want admission only but no 3D show, number of people who want 3D show only but no admission to the aquarium, and number of people who want both. Calculate and display the total amount due from the group.

Execute your algorithm by hand and create a table to show how the values of the variables change during program execution. Please use the following test case: number of people who want admission only but no 3D show = 5, number of people who want 3D show only but no admission = 7, number of people who want both = 8

## Problem 5

The jackpot of a lottery is paid in 20 annual installments. There is also a cash option, which pays the winner 65% of the jackpot instantly. In either case 30% of the winnings will be withheld for tax. Suppose the jackpot is $100. If installments are chosen, the winner will receive $5 each year before tax, and $3.5 each year after tax (because 30% of $5 is withheld for tax). If cash option is chosen, the winner will receive $65 instantly before tax, and $45.5 instantly after tax (because 30% of $60 is withheld for tax). Design a program to do the following. Ask the user to enter the jackpot amount. Calculate and display how much money the winner will receive annually before tax and after tax if annual installments is chosen. Also calculate and display how much money the winner will receive instantly before and after tax if cash option is chosen.

Execute your algorithm by hand and create a table to show how the values of the variables change during program execution. Please use the following test case: jackpot amount = 1234000

# Grading rubric for Problem 1 - 5

Designing input steps [3 points]

Designing processing steps [7 points]

Designing output steps [3 points]

Showing correct values in variable table [7 points]