CS 161A: Programming and Problem Solving I

Assignment A01 Sample Algorithmic Design Document

Make a copy before you begin (File -> Make a copy). Add the Assignment # above and complete the sections below BEFORE you begin to code. The sections will expand as you type. When you are finished, download this document as a PDF (File -> Download -> PDF) and submit to D2L.

This document contains an interactive checklist. To mark an item as complete, click on the box (the entire list will be highlighted), then right click (the clicked box will only be highlighted), and choose the checkmark.

Planning your program before you start coding is part of the development process. In this document you will:

- ❏ Paste a screenshot of your zyBooks Challenge and Participation %
- ❏ Paste a screenshot of your assigned zyLabs completion
- ❏ Write a detailed description of your program, at least two complete sentences
- ❏ If applicable, design a sample run with test input and output
- ❏ Identify the program inputs and their data types
- ❏ Identify the program outputs and their data types
- ❏ Identify any calculations or formulas needed
- ❏ Write the algorithmic steps as pseudocode or a flowchart
- ❏ Tools for flowchart - Draw.io - Diagrams.net

1. zyBooks

Add your zyBooks screenshots for the % and assigned zyLabs completions below. Required percentages: all **assigned** zyLabs, Challenge Activity with at least 70%, and Participation Activity with at least 80%.

Challenge and Participation % screenshot:
No zybooks this week

Assigned zyLabs completion screenshot:
No zylabs this week

2. Program Description

In the box below, describe the purpose of the program. You must include a detailed description with at least two complete sentences.

Program description:
This program will display a menu with cell phone plans to the user, when the user decides on a cellphone plan the program will read characters from the user until a valid character is entered. Once a valid character is entered the program will ask the user how many GigaBytes of data they used. It will then output their cost based on their previous input.

3. Sample Run

If you are designing your own program, you will start with a sample run. Imagine a user is running your program - what will they see? What inputs do you expect, and what will be the outputs from the given inputs? Choose test data you will use to test your program. Calculate and show the expected outputs. Use the sample run to test your program.

Sample run:

```
***** Welcome to Mint Mobile! *****

Let's calculate your monthly bill!

S: 2GB $35/mo*
M: 4GB $50/mo*
L: 8GB $70/mo*
U: Unlimited $75/mo

*Overage charges $15 per GB

Which plan are you on? (S/M/L/U): C
Invalid plan!

Which plan are you on? (S/M/L/U): b
Invalid plan!

Which plan are you on? (S/M/L/U): S
How many GB did you use last month? 2

Plan charges: $35.00
Total Cost: $35.00
```

```
Thank you for choosing Mint Mobile.
Goodbye!
```

```
***** Welcome to Mint Mobile! *****

Let's calculate your monthly bill!

S: 2GB $35/mo*
M: 4GB $50/mo*
L: 8GB $70/mo*
U: Unlimited $75/mo

*Overage charges $15 per GB

Which plan are you on? (S/M/L/U): M
How many GB did you use last month? 0

Plan charges: $50.00
Total Cost: $50.00

Thank you for choosing Mint Mobile.
Goodbye!
```

```
***** Welcome to Mint Mobile! *****

Let's calculate your monthly bill!

S: 2GB $35/mo*
M: 4GB $50/mo*
L: 8GB $70/mo*
U: Unlimited $75/mo

*Overage charges $15 per GB

Which plan are you on? (S/M/L/U): L
How many GB did you use last month? 10

Plan charges: $70.00
Overage charges: $30.00
Total Cost: $100.00

Upgrade to Unlimited and save $25.00 !!!

Thank you for choosing Mint Mobile.
Goodbye!
```

4. Algorithmic Design

Before you begin coding, **you must first plan out the logic** and think about what data you will use to test your program for correctness. All programmers plan before coding - this saves a lot

of time and frustration! Use the steps below to identify the inputs and outputs, calculations, and steps needed to solve the problem.

Algorithmic design:
a. Identify and list all of the user input and their data types.
○ Choice as character (to read the character from the user) ○ gitBit as double (to read the number from the user)
b. Identify and list all of the user output and their data types.
○ overCharge as double (to store the cost of overcharge fees) ○ planCost as double(to store the cost of users plan) ○ totalCost as double (to store the total cost of the phone bill) ○ upGrade as double (to store the of total and plan cost)
c. What calculations do you need to do to transform inputs into outputs? List all formulas needed, if applicable. If there are no calculations needed, state there are no calculations for this algorithm.
○ DECLARE gitBit with rounding up ceil ○ SET gitBit = gitBit - the limit (all plans) ○ Differences to find - upGrade (totalCost - planCost) ○ Conditional statements to calculate overage fees and potential savings
d. Design the logic of your program using pseudocode or flowcharts. Here is where you would use conditionals, loops or functions (if applicable) and list the steps in transforming inputs into outputs. Walk through your logic steps with the test data from the assignment document or the sample run above.
1. FUNCTION main() 2. **DISPLAY** welcome message and the plan information 3. **DELCARE** totalCost, planCost, overCharge, upGrade, gigBit as doubles 4. **DECLARE** choice as char 5. **DISPLAY** “Which plan are you on? (SMU) :” 6. **INPUT** into choice 7. WHILE user != (anything in the menu) a. DISPLAY “invaild plan! Pick again: “ b. INPUT into choice 8. **DISPLAY** “ How many GB did you use last month ?” 9. **INPUT** into gitBit

10. **FUNCTION** for gitBit to round up
11. **FUNCTION** to uppercase char choice
12. **SELECT** uppercase choice
    a. **CASE** 'S':
        i. SET planCost = 35
        ii. SET gitBit to gitBit - 2
    b. CASE 'M':
        i. SET planCost = 50
        ii. SET gitBit to gitBit - 8
    c. CASE 'L':
        i. SET planCost = 70
        ii. SET gitBit to gitBit - 2
    d. CASE 'U':
        i. SET planCost = 75
        ii. SET total Cost = 75
        iii. SET gitBit to 0

13. END SELECT
14. **IF** gitBit is less than 0 THEN
    a. SET overCharge to gitBit * 15
    b. SET totalCost to overCharge + planCost
15. **ELSE**
    a. **SET** totalCost to equal planCost
16. **DISPLAY** Plan charge: $ planCost
17. **IF** overCharge greater than 0
    a. **DISPLAY** overcharges: overCharge
18. **DISPLAY** Total Cost: $ totalCost
19. **IF** totalCost is greater than 75
    a. **SET** upGrade to totalCost - 75
    b. **DISPLAY** upgrade message with upgrade variable
20. **DISPLAY** Thank you message
21. **RETURN** 0
22. **END FUNCTION** main()

5. Pseudocode Syntax

Think about each step in your algorithm as an action and use the verbs below:

To do this:	Use this verb:	Example:
Create a variable	DECLARE	`DECLARE integer num_dogs`
Print to the console	DISPLAY	`DISPLAY "Hello!"`

window		
Read input from the user into a variable	INPUT	`INPUT num_dogs`
Update the contents of a variable	SET	`SET num_dogs = num_dogs + 1`
Conditionals		

Use a single alternative conditional	IF *condition* THEN
	  statement
	  statement
	END IF
		`IF num_dogs > 10 THEN`
		`  DISPLAY "That is a lot of dogs!"`
		`END IF`

Use a dual alternative conditional	IF *condition* THEN
	  statement
	  statement
	ELSE
	  statement
	  statement
	END IF
		`IF num_dogs > 10 THEN`
		`  DISPLAY "You have more than 10 dogs!"`
		`ELSE`
		`  DISPLAY "You have ten or fewer dogs!"`
		`END IF`

Use a switch/case statement	SELECT *variable or expression*
	  CASE *value_1:*
	  statement
	  statement
	  CASE *value_2:*
	  statement
	  statement
	  CASE *value_2:*
	  statement
	  statement
	  DEFAULT:
	  statement
	  statement
	END SELECT
		`SELECT num_dogs`
		`  CASE 0: DISPLAY "No dogs!"`
		`  CASE 1: DISPLAY "One dog.."`
		`  CASE 2: DISPLAY "Two dogs.."`
		`  CASE 3: DISPLAY "Three dogs.."`
		`  DEFAULT: DISPLAY "Lots of dogs!"`
		`END SELECT`

Loops		

Loop while a condition is true - the loop body will execute 0 or more times.	WHILE *condition*
	  statement
	  statement
	END WHILE
		`SET num_dogs = 1`
		`WHILE num_dogs < 10`
		`  DISPLAY num_dogs, " dogs!"`
		`  SET num_dogs = num_dogs + 1`
		`END WHILE`

Loop while a condition is true - the loop body will execute 1 or more times.	DO
	  statement
	  statement
	WHILE *condition*
		`SET num_dogs = 1`
		`DO`
		`  DISPLAY num_dogs, " dogs!"`
		`  SET num_dogs = num_dogs + 1`
		`WHILE num_dogs < 10`

Loop a specific number of times.	FOR *counter* = *start* TO *end* *statement*	`FOR count = 1 TO 10` `  DISPLAY num_dogs, " dogs!"`

	statement END FOR	`END FOR`
Functions		

Create a function	FUNCTION *return_type name (parameters)*
	statement
	statement
	END FUNCTION
		`FUNCTION Integer add(Integer num1, Integer num2)`
		`  DECLARE Integer sum`
		`  SET sum = num1 + num2`
		`  RETURN sum`
		`END FUNCTION`

Call a function	CALL *function_name*	`CALL add(2, 3)`
Return data from a function	RETURN *value*	`RETURN 2 + 3`