CS 161A: Programming and Problem Solving I

Assignment 2 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.

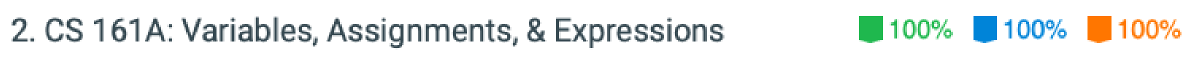
This document contains an interactive checklist. To mark an item as complete, click on the box (the entire list will be highlighted), then right click (the clicked box will only be highlighted), and choose the checkmark.

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

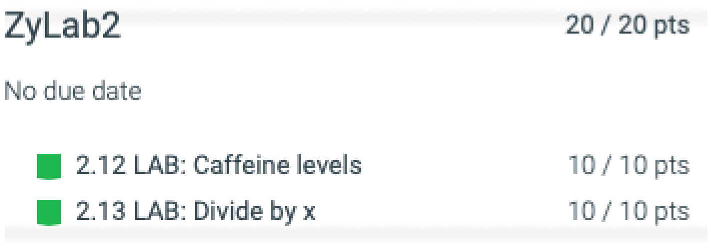
- ❏ Paste a screenshot of your zyBooks Challenge and Participation %
- ❏ Paste a screenshot of your assigned zyLabs completion
- ❏ Write a detailed description of your program, at least two complete sentences
- ❏ If applicable, design a sample run with test input and output
- ❏ Identify the program inputs 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:
 2. CS 161A: Variables, Assignments, & Expressions 🟩 100% 🟦 100% 🟧 100%

Assigned zyLabs completion screenshot:


ZyLab2 20 / 20 pts

No due date

🟩 2.12 LAB: Caffeine levels 10 / 10 pts

🟩 2.13 LAB: Divide by x 10 / 10 pts

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:
The purpose of this program is to calculate the number of gumballs in a jar. Using the volume of the jar, the jar's capacity, and the radius of a gumball, we should be able to estimate the total number of gumballs.

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:

The user would input the radius of a gumball (in cm) and volume of the jar (in mL). The output would give the number of gumballs in the jar. For example, if the radius of a gumball was 1 cm and the volume of the jar was 10 mL, the calculation would be:

1. Volume of gumball = 4.0 / 3 π (1 cm)^3 = 4.19 cm^3
2. Volume of jar (to hold gumballs) = 100 mL (volume of jar) * .64 (capacity) = 64 mL (able to fill)
3. Number of gumballs = 64 mL (volume of jar) / 4.19 cm^3 (volume of gumball) = 15 gumball (rounded down)

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.

Radius of gumball, Capacity of jar

b. Identify and list all of the user output and their data types.

Number of gumballs

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.

Volume of a gumball = $4.0 / 3 \pi r^3$

Total number of gumballs = .64 (% of jar volume) / volume of a gumball

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. DECLARE integer radius_gumball
2. DECLARE integer volume_gumball
3. DECLARE integer volume_jar
4. DECLARE integer LOAD_FACTOR = .64
5. DECLARE integer total_gumballs
6. DISPLAY “What is the radius of one gumball?”
7. INPUT radius_gumball
8. DISPLAY “What is the volume of the jar?”
9. INPUT volume_jar
10. SET volume_gumball = $4.0 / 3 \pi (radius\_gumball)^3$
```

```
11. SET volume_jar *= LOAD_FACTOR
12. SET total_gumballs = volume_jar / volume_gumball
13. DISPLAY “There are approximately “ total_gumballs “ in the jar.”
```

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 window	DISPLAY	`DISPLAY “Hello!”`
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
		`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`

	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
	   statement
	END FOR
		`FOR count = 1 TO 10`
		`   DISPLAY num_dogs, “ dogs!”`
		`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`