

GNG1106 Fall 2018 - Assignment 2

Available: Sept 19

Due: September 30, 23:59

Instructions

This assignment is to be done INDIVIDUALLY. Use the following instructions to complete and submit this assignment.

- You will need to submit your assignment electronically to Brightspace. Prepare the following
 - An assignment file in a PDF file (this allows you to use your favorite editor to create the PDF file). For question 1, insert the programming models for parts (a) and (b) filled in as per the question instructions. You may fill in the programming model using drawing features of your editor or by hand on paper which is then scanned and inserted into your document. For Question 2, insert in your assignment file the source code (take care in its appearance), and capture the output from running the program for all test cases. Also submit your **source code** files for question 2.
 - Place all your files (PDF file and C source code files) in a directory A2_xxxxxxx where xxxxxxxx is your student number.
 - Zip your PDF document and the C source files in a zip file with the name A2_xxxxxx.zip where xxxxxx is your student.
 - Submit the zip file before the assignment deadline via Brightspace. In Brightspace, navigate to the Assignment page and click on “Click to submit Assignment 2” to reach the assignment 2 submission folder. You can also select the Assignment tab to see the Assignment folder pages. The Brightspace video “Assignments” (found in the page https://documentation.brightspace.com/EN/le/assignments/learner/submit_assignments.htm) provides details to help you submit the zip file.
 - The questions are provided in both PDF and Word files. You may use the Word file to enter your answers in the document. An rtf file is also provided so that you may edit the file with a word processor other than Word. Be sure to submit a **PDF** file.
 - It is NOT permitted to use instructions such as branches and loops that have not yet been covered in the lectures.
- Do start the assignment soon and do **not** wait until the last minute. You will be more efficient with a number of smaller efforts over a few weeks before the deadline than one large effort just before the deadline.

Marking Scheme (total 30 marks)

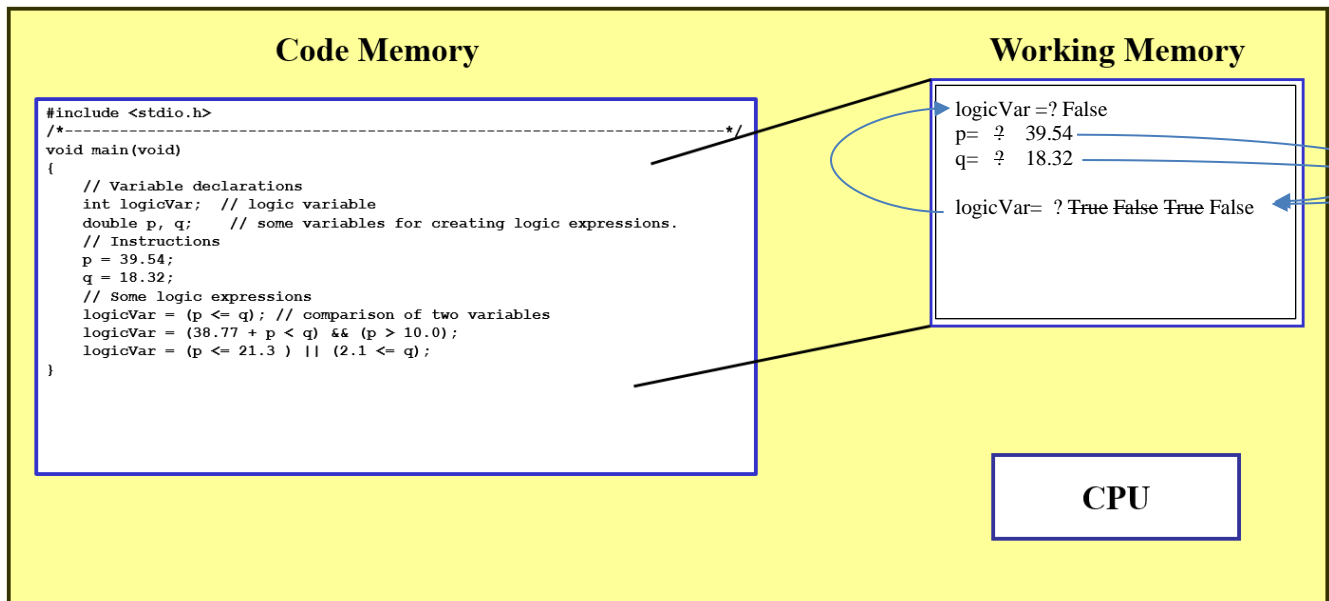
- Question 1: 15 marks
- Question 2: 15 marks

Question 1 (15 marks)

(a) (5 marks) The following programming model contains in its code memory the indicated C program composed of a single main function. You will be showing how the working memory is used during the execution of main. Show how the given C program affects the contents of the working memory:

- Show the values are assigned to the variables. Be sure to show all values that are assigned and replaced. Record successive assignments to variables/parameters as follows:

Variable name *7, 2, 6, 4, 10*

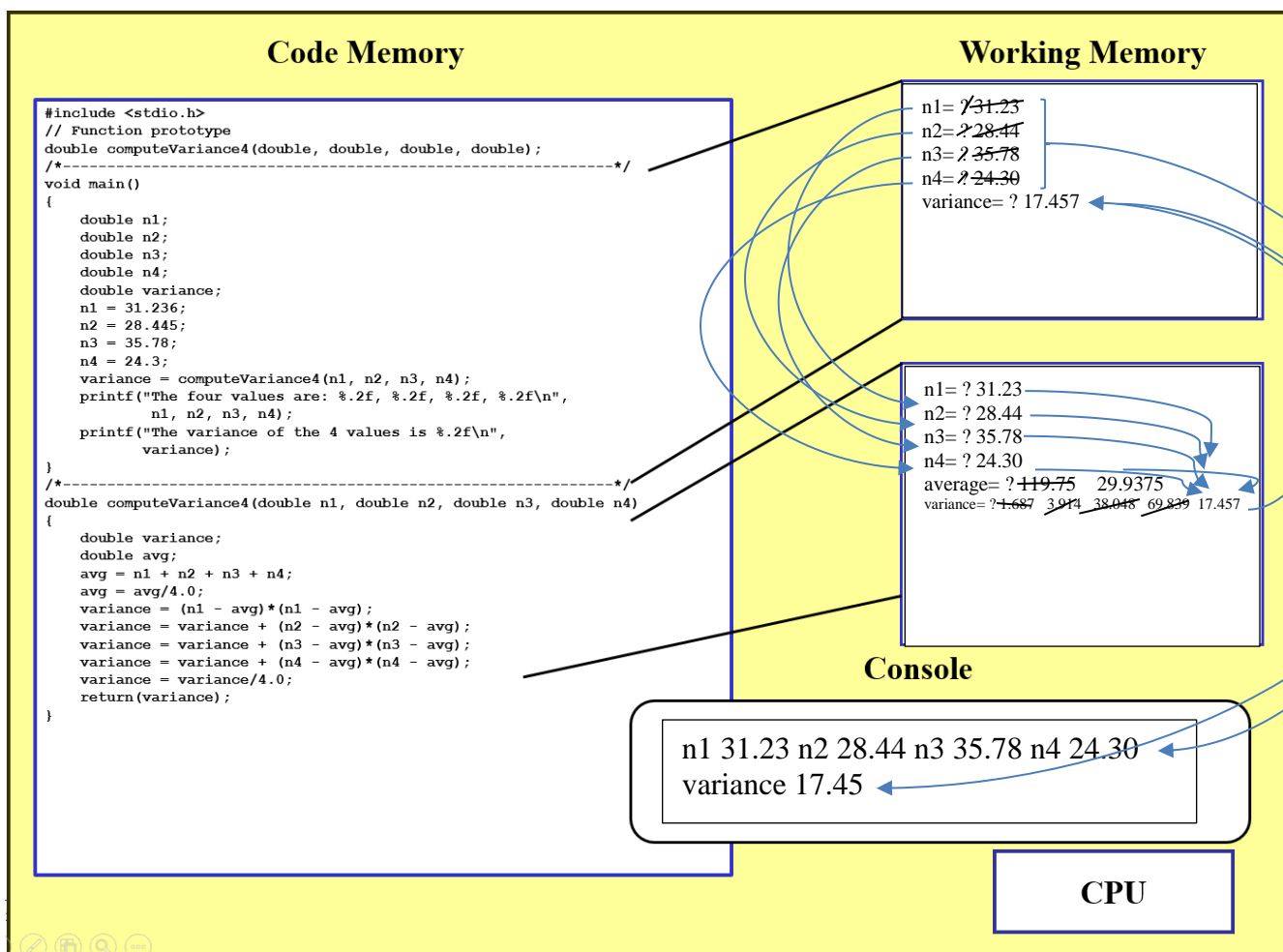


(b) (10 marks) The following programming model contains in its code memory the indicated C program composed of 2 functions. You must show how the working memory is used during the execution of the two functions. Each piece of working memory is associated to a function using a pair of lines. (Note: the first pair of lines associates the piece of working memory allocated to the function **main** and the second pair of lines associates the piece allocated to the function **computeVariance4**). Show how the given C program affects the contents of the working memory:

- Show the values are assigned to variables. Be sure to show all values that are assigned and replaced. Record successive assignments to variables/parameters as follows:

Variable name ~~7~~, ~~2~~, ~~6~~, ~~4~~, 10

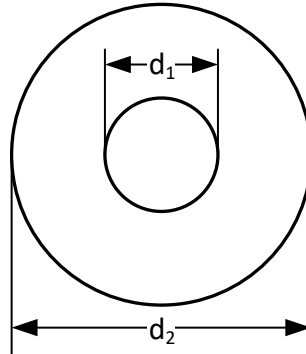
- Using arrows show how values are copied between the working memory allocated to the function **main** and the working memory allocated to the function **computeNetResistance**.
- In the console window show the output of the program.



Note: You do NOT need to show how the CPU interacts with memory.

Question 2 (15 marks)

You must develop a program that calculates the weight of a number of flat washers with the following dimensions.



The given dimension of the washer is given by its thickness (x), the external diameter (d_2) and the hole diameter (d_1). Thus the area of the washer is given by $a = \pi(d_2 / 2)^2 - \pi(d_1 / 2)^2$.

The volume, v , of the washer is given by $v = xa$.

The weight, w , of the washer is given by $w = vd$

where d is the density of washer's material. From these equations, the weight w_n of n washers is given by

$$w_n = nw = nvd = nxd = nxd \left(\pi(d_2 / 2)^2 - \pi(d_1 / 2)^2 \right) \\ = \frac{nx d \pi (d_2^2 - d_1^2)}{4}$$

Develop a program that requests from the user the following data

- The number n of washers,
- The density of the washer's material, in kg/cm^3 ,
- The thickness x of the washer, in centimeters (cm),
- The external diameter, d_2 , of the washer in cm,
- The diameter of the hole, d_1 , of the washer in cm.
- For the main function
 - Obtains the data from the user and save them in appropriate variables.
 - Calls the function `totalWeight` to compute weight of the n flat washers.
 - Display results to the user in a message (see the following example) that includes data input by the user and the weight of the washers. Format the output values to display at most the number of digits in the fractional part of the real values shown the message example.

The washer characteristics are

Density: 0.00260 kg/cm^3

Thickness: 0.030 cm

External diameter: 0.500 cm

Diameter of the hole: 0.230 cm

The weight of 1 washers is 1.21e-005 kg.

- For the function `totalWeight`
 - Define parameters to receive the data input by the user.
 - Define local variable for storing the total weight, w_n .
 - Note that the math header file, *math.h*, provides the symbolic constant `M_PI` for the value of π .
 - Instead of using a single instruction to compute the force value, use a number of instructions to “accumulate” values into the variable w_n as follows. Note that these are not true mathematical equations but show how w_n as a computer variable can accumulate intermediate values during the computation.

$$w_n = d_2^2 - d_1^2 \quad \text{Assigns to } w_n \text{ the value of } x^2 + a^2$$

$$w_n = nxd\pi w_n \quad \text{Assigns to } w_n \text{ the value of } nxd\pi(d_2^2 - d_1^2)$$

$$w_n = w_n/4 \quad \text{Assigns to } w_n \text{ the value of } \frac{nxd\pi(d_2^2 - d_1^2)}{4}$$

The following table gives the density of different metals and plastics that can be used in the production of flat washers:

Métal	Density in kg/cm ³
Aluminium	0.0026
Brass	0.0085
Bronze (8-14% tin)	0.0074 to 0.0089
Iron	0.00787
Stainless steel	0.00748 to 0.00795
Plastic	Density in kg/cm ³
Polyethylene (low density)	0.00091 to 0.00094
Polyethylene (high density)	0.00094 à 0.00096

(Source: <https://www.globalplasticsheeting.com/our-blog-resource-library/bid/72325/Density-of-Polyethylene>).

The following table presents test cases to be used for testing your program. Note that intermediate values for w_n are provided to allow you to trace your program to debug any problems.

Description	# (n)	Density d (kg/cm ³)	Thick. x (cm)	Ext. Dia. d_2 (cm)	Dia. hole d_1 (cm)	$d_2^2 - d_1^2$	$nxd\pi(d_2^2 - d_1^2)$	Weight w_n (kg)
Aluminum (M2)	1	0.0026	0.03	0.5	0.23	0.1971	4.83E-05	1.21E-05
Aluminum (M160)	1	0.0026	1.8	24.9	16.5	347.76	5.112995	1.28E+00
Acier (M12)	125	0.0076	0.25	2.35	1.3	3.8325	2.859537	7.15E-01
Acier (M24)	525	0.0076	0.39	4.4	2.5	13.11	64.08997	1.60E+01
Plastique (M20)	1530	0.00094	0.29	3.7	2.1	9.28	12.15948	3.04E+00
Bronze (M3)	750	0.0089	0.056	0.69	0.033	0.4750	0.557818	1.39E-01

The answer to this question should provide:

- 1) The source code to your program (also insert the source code into the assignment file).
- 2) The output showing the results of all the test cases; insert the output into the assignment file.

1-

```
#include <stdio.h>
#include <math.h>
#define pi 3.141593
double totalWeight(double, double, double, double, double);
void main(void)
{
    double n, d, x, d2, d1, w;
    printf("Please enter the number n of washers:");
    scanf("%lf", &n);
    printf("Please enter the density of the washer material:");
    scanf("%lf", &d);
    printf("Please enter the thickness of the washer:");
    scanf("%lf", &x);
    printf("Please enter the external diameter:");
    scanf("%lf", &d2);
    printf("Please enter the diameter of the hole:");
    scanf("%lf", &d1);
    w= totalWeight(n, d, x, d2, d1);
    printf("\nThe washer characteristics are \nDensity: %lf kg/cm^3 \nThickness: %lf cm
\nExternal diameter: %lf cm \nDiameter of the hole: %lf cm \nThe weight of %lf washers is %.2e
kg",d, x, d2, d1, n, w);

}
double totalWeight(double n, double d, double x, double d2, double d1)
{
    double w;
    w=pow(d2,2)-pow(d1,2);
    w = n * x * d * pi * w;
    w=w/4;
    return w;
}
```

```
Please enter the number n of washers:1
Please enter the density of the washer material:0.026
Please enter the thickness of the washer:0.03
Please enter the external diameter:0.5
Please enter the diameter of the hole:0.23
```

```
The washer characteristics are
Density: 0.026000 kg/cm^3
Thickness: 0.030000 cm
External diameter: 0.500000 cm
Diameter of the hole: 0.230000 cm
The weight of 1.000000 washers is 1.21e-004 kg
Process returned 197 (0xC5)   execution time : 12.637 s
Press any key to continue.
```

2-

```
Please enter the number n of washers:1
Please enter the density of the washer material:0.0026
Please enter the thickness of the washer:1.8
Please enter the external diameter:24.9
Please enter the diameter of the hole:16.5
```

```
The washer characteristics are
Density: 0.002600 kg/cm^3
Thickness: 1.800000 cm
External diameter: 24.900000 cm
Diameter of the hole: 16.500000 cm
The weight of 1.000000 washers is 1.28e+000 kg
Process returned 199 (0xC7)   execution time : 23.901 s
Press any key to continue.
```

```
Please enter the number n of washers:125
Please enter the density of the washer material:0.0076
Please enter the thickness of the washer:0.25
Please enter the external diameter:2.35
Please enter the diameter of the hole:1.3
```

```
The washer characteristics are
Density: 0.007600 kg/cm^3
Thickness: 0.250000 cm
External diameter: 2.350000 cm
Diameter of the hole: 1.300000 cm
The weight of 125.000000 washers is 7.15e-001 kg
Process returned 199 (0xC7)   execution time : 18.954 s
Press any key to continue.
```

```
Please enter the number n of washers:525
Please enter the density of the washer material:0.0076
Please enter the thickness of the washer:0.39
Please enter the external diameter:4.4
Please enter the diameter of the hole:2.5
```

```
The washer characteristics are
Density: 0.007600 kg/cm^3
Thickness: 0.390000 cm
External diameter: 4.400000 cm
Diameter of the hole: 2.500000 cm
The weight of 525.000000 washers is 1.60e+001 kg
Process returned 199 (0xC7)   execution time : 22.955 s
Press any key to continue.
```

```
Please enter the number n of washers:1530
Please enter the density of the washer material:0.00094
Please enter the thickness of the washer:0.29
Please enter the external diameter:3.7
Please enter the diameter of the hole:2.1
```

```
The washer characteristics are
Density: 0.000940 kg/cm^3
Thickness: 0.290000 cm
External diameter: 3.700000 cm
Diameter of the hole: 2.100000 cm
The weight of 1530.000000 washers is 3.04e+000 kg
Process returned 200 (0xC8)   execution time : 18.228 s
Press any key to continue.
```

```
Please enter the number n of washers:750
Please enter the density of the washer material:0.0089
Please enter the thickness of the washer:0.056
Please enter the external diameter:0.69
Please enter the diameter of the hole:0.033
```

```
The washer characteristics are
Density: 0.008900 kg/cm^3
Thickness: 0.056000 cm
External diameter: 0.690000 cm
Diameter of the hole: 0.033000 cm
The weight of 750.000000 washers is 1.39e-001 kg
Process returned 199 (0xC7)   execution time : 26.282 s
Press any key to continue.
```