Name: .... Student ID: ....

Laboratory 2

Data types, variables, and arithmetic expressions

0. A test program

1. Double click on the icon "Visual Studio 2017" on the desktop (or the Start Menu).
2. To create a new project, click File -> New -> Project.
3. In the New Project window, choose "Visual C++ -> Windows Desktop". Then choose "Windows Desktop Wizard" as the project type.
4. Choose Console Application (.exe) as the application type, and check the Empty Project check box. Then click the OK button.
5. Type **TestProgram** in the Name text box, then click the OK button.
6. In the Solution Explorer, right-click at the project **TestProgram**. Then choose Add -> New Item.
7. In the Add New Item – TestProgram window, choose C++ File (.cpp).
8. Type **Main.c** in the name text box, then click the Add button.
9. Type the following code into **Main.c**:

```c
#define  _CRT_SECURE_NO_WARNINGS   // for visual studio only
#include <stdio.h>

int main()
{
  const float PI = 3.141593;
  int a,b,c,r,s,t;
  float i,j,k,l,m,n;
  double p;
  char x;


  // type your code here!


  return 0;
}
```

10. Edit the program and use it to solve Problem 1.

1. Expression evaluation

1.1 Given a = 65, p = 66 and x = 67. The variable **a** is of type int, **p** is of type double, and **x** is of type char. Execute the following **printf()** statements and observe the output.

Statements	Output
printf("a = %d\n", a);	
printf("a = %c\n", a);	
printf("a = %f\n", a);	
printf("p = %d\n", p);	
printf("p = %c\n", p);	
printf("p = %f\n", p);	
printf("x = %d\n", x);	
printf("x = %c\n", x);	
printf("x = %f\n", x);	

Conclusion:

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1.2 Determine the data type of the following expressions. Then write proper **printf()** statements to evaluate them. The variable **a** is of type int, **k** is of type float, and **p** is of type double.

Expressions	Data type	Values
(2 / 5) * 5;		
(2.0 / 5) * 5;		
a = (2 / 5.0) * 5;		
k = (2.0 / 5.0) * 5;		
p = (2 / 5) * 5.0;		

Conclusion:

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1.3 Given a = 10, b = 6, i = 10.5, j = 12.0, k = 8.5, write proper **printf()** statements to determine the value of the sub-expression on the right-hand side of '=' and the value stored in the variable of the left-hand side of '='. The variables **r**, **s**, and **t** are of type int and **l**, **m** and **n** are of type float.

Expressions	Computed values (right-hand side of =)	Stored values (left-hand side of =)
r = a – b * 5 – i / 2 + j;		
s = a * i + b – j / 2;		
t = a / 2 + i + j;		
l = a * 5 + b / 2 + i – j + k;		
m = i + a / 2 + b – j * 5;		
n = 2 * PI * a;		

Conclusion:

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1.4 Given a = 4, b = 5, i = 3.5 and j = 2.0, determine the corresponding algebraic equation, and write proper **printf()** statements determine the value of the sub-expression on the right-hand side of '=' and the value stored in the variable of the left-hand side of '='.

Expressions	Algebraic expression	Computed values (right-hand side of =)	Stored values (left-hand side of =)
c = (i + j) / (a + b)			
c = j + i / (a + b)			
k = (j + i) / a + b			
p = j + i / a + b			

Conclusion:

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| Instructor's signature |

2. **Average of three numbers**

Problem: Write a C program to calculate the average of three integers 1, 4, and 2, then output the numbers and the average.

Output: x = 1   y = 4   z = 2   average = 2.333333

Instructor's signature

3. **Slope of a straight line**

Problem: Write a C program to calculate the slope of a line, given the data for coordinates of the end points of the line
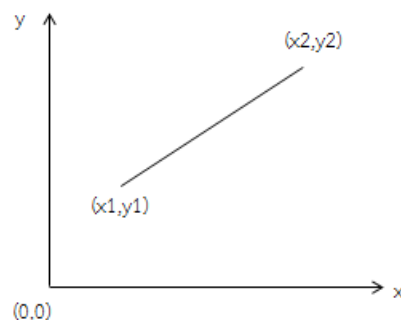
Method: The slope of a line is given by the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$

Data: Input four real numbers representing: x_1, y_1, x_2 and y_2

Input/Output:
```
Input the Coordinate Points of the Line:
3.00   4.00     16.00  18.00
Coordinates of Point1: x1 = 3.00     y1 = 4.00
Coordinates of Point2: x2 = 16.00    y2 = 18.00
Slope of the Line:  1.08
```

Instructor's signature

4. Volume of a sphere

Problem: Write a C program to compute the volume of a sphere of radius r.

Data: Radius **r**.

Method: Given the radius r, the volume of the sphere is computed from the formula Volume = $4/3\pi r^3$

Input and output:

```
Input a real value for the radius:

4.0

The radius of the sphere is: 4.00 cm

The volume of the sphere is: 268.08 cubic cm.
```

Instructor's signature

5. Set of simultaneous equations

Problem: Write a C program to solve a set of simultaneous equations:

$$ax + by = c$$
$$dx + ey = f$$

where *a, b, c, d, e,* and *f* are the input values

Data: Six real numbers

Method: The formulas for the solution are:

$$x = \frac{ce - bf}{ae - bd} \;\; ; \;\; y = \frac{af - cd}{ae - bd}$$

Input and output:
```
Input the values for the constants:
2.5  1.6  3.2  5.4  6.2  4.6

Given: a = 2.50  b = 1.60   c = 3.20    d = 5.40   e = 6.20   f = 4.60
x = 1.82  y = -0.84
```

Instructor's signature