CSC 155 *Computer Science I* LAB 3

Student Name _____ Section _____

Instructor _____ Due Date _____

Project	1	2	3	4	5	6	TOTAL
Maximum Points	2 points	2 points	2 points	2 points	1 point	1 point	10 points
Your Score							

PROJECT ONE (Future Value of an Ordinary Annuity)

Objective To write, compile and execute a program that computes the future value of an ordinary annuity.

PROJECT DESCRIPTION

This project has you running a program that computes the future value of an ordinary annuity.

Information About This Project

An annuity is a sequence of equal, periodic payments.

The future value FV of an annuity, given by the formula below, is computed as the sum of all payments plus all earned interest.

$$FV = PMT\left[\frac{(1+i)^n - 1}{i}\right]$$

where:

PMT is the periodic payment (also called the rent)
i is the rate per period
n is the total number of payments or periods
FV is the future value or the future amount

Note: for this particular formula, payments are made at the end of each period.

Example (Future Value of an Annuity)

Determine the value of an annuity at the end of 10 years if $1,000 is deposited every six months into an account earning 8.5 %, compounded semi - annually. How much of the value is actually interest?

Solution

For this problem, known values and the unknown value(s) are:

$PMT = \$1{,}000$
$i = 0.085 / 2 = 0.0425$ (semi - annual compounding)
$n = 10 \times 2 = 20$ deposits (in 10 years)
$FV = ?$

To find the future value FV, use the formula:

$$FV = PMT\left[\frac{(1+i)^n - 1}{i}\right]$$

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PROJECT ONE

Upon substitution this becomes

$$FV = \$1{,}000 \left[\frac{(1 + 0.0425)^{20} - 1}{0.0425} \right]$$

which becomes

$$FV = \$30{,}562.50$$

Thus, the future value of an ordinary annuity is $30,562.50 when $1,000 is deposited every six months, for ten years, into an account earning 8.5 %, compounded semi-annually.

How much of the future value is actually earned interest? The answer can be computed using the expression below, which subtracts the total amount of all the periodic payments from the calculated future value.

$FV - PMT \times n$

For this particular example, this expression becomes:

$\$30{,}562.50 - 20 \times \$1{,}000.00 = \$10{,}562.50$ (interest earnings)

Steps To Complete This Project

STEP 1 **Open MS Visual C + + and Write the Program Code**

Open Visual C + + on you computer. Write the program code, which will allow the user to enter the necessary input items and then use these items to compute both the future value of the ordinary annuity as well as the amount of interest earnings. Include your name, course title and date in the header comment (remarks) section of your program code.

Save your file as: **lab3prj1.cpp**

Here are some hints as how you can code the Future Value application.

First, open your program code with the following pre-processing directives:

```
#include<iostream>    //cin, cout
#include<cmath>       //pow() function
#include<iomanip>     //output manipulation
using namespace std;
```

Next open the scope of a `main()` method with the following statement:

```
int main()
```

Declare all the variables associated with the program. Use descriptive names such as:

variable name	description	data type
`payment`	periodic payment	`double`
`rate`	annual rate	`double`
`period`	compounding frequency	`double`
`number`	number of payments	`integer`
`future`	future value	`double`
`interest`	interest earnings	`double`

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PROJECT ONE

Prompt the user for the three input items associated with this program, namely the periodic payment amount, the interest rate (as a percent), the compounding frequency and the number of payments.

Commence the processing portion of the program by writing the following statements:

```
rate = rate / 100.0;
rate = rate / period;
future = payment * (pow((1 + rate), number) – 1) / rate;
```

The above statements are used to convert the user's percent amount to a decimal, divide the rate by the compounding frequency to arrive at the rate per period and then to compute the future value.

To compute the interest earnings use the statement:

```
interest = future – payment * number;
```

Display the output variables using a currency format by writing the following statements.

```
//format output to show 2 decimal places
cout.setf(ios::fixed);
cout.setf(ios::showpoint);
cout.precision(2);
```

Lastly, output the future value and interest to the user.

STEP 2 **Compile and Run your Program**

Build, compile and run your program. Test the operation of your program using the example provided within the ***Information About This Project*** section of this lab project.

Once you have tested your program code, run your program using the information shown in the exercise below.

Exercise (**Future Value of an Annuity**)

Determine the value of an annuity at the end of 5 years if $1,000 is deposited every three months into an account earning 6.5 %, compounded quarterly. How much of the value is actually interest?

STEP 3 **Print your Program Code and your Run Time Output**

When completed, print your program source code as well as the program output showing the result of the above exercise. Attach the hardcopies to your lab cover sheet for credit.

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PROJECT TWO (Digits Separator)

Objective To write, compile and execute a program that adds and multiplies the individual digits of a given four - digit number.

PROJECT DESCRIPTION

Write a program that accepts a user - input, four - digit number, separates the number into its individual digits and then finds both the sum and the product of the individual digits. For example, if the user types the number 4321, the program will print both $4 + 3 + 2 + 1$ or 10 and $4 \times 3 \times 2 \times 1$ or 24.

A partially completed program (starter code), based on the above program, is provided for you to determine the missing code.

Information About This Project

This programming exercise illustrates the idea of taking a given four - digit number and separating the digits of the number by classifying the individual digits as being in the thousands, hundreds, tens or ones decimal position. The basic idea behind the given starter code is to first divide a given number four - digit by its largest place value, namely 1000. The integer value of the quotient separates the left - hand digit. The remaining decimal amount of the quotient is then divided by the next largest place value, namely 100. The integer value of the new quotient separates the second digit. Continuing in this manner the other two digits can be separated.

Steps To Complete This Project

STEP 1 **Open MS Visual C + + and Write the Program Code**

Open Visual C + + on you computer. Complete the code given in **Figure 1**, which follows, by determining the missing ten entries. Then type your completed program onto Visual C + +.

STEP 2 **Compile and Run your Program**

Build, compile and run your program. Test the operation of your program using the four - digit number 1234 for your sample input value. Your correct output is 10 for the sum and 24 for the product.

STEP 3 **Print your Program Code and your Run Time Output**

When you have determined that your program is running successfully, print your program source code as well as a snapshot of the program output(s). Attach the hardcopies to your lab cover sheet for credit.

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PROJECT TWO

Figure 1 Partially Completed Source code for The Digits Separator Program

```
#include <iostream>
using namespace std;

int main()
{
  //Digits Separator Program
  //Sammy Student, Programmer

  double number, first, second, __________ , fourth;
  double sum, product, __________ ;

  cout << "Please enter a four digit integer" << endl;
  cin >> number;

  temp = number;
  temp = temp / 1000;
  first = int( __________ );
  cout << "first = " << first << endl;

  temp = (1000 * (temp - first));
  temp = temp / __________ ;
  second = int(temp);
  cout << "second = " << second << endl;

  temp = (100 * ( __________ - second));
  temp = temp / 10;
  third = int(temp);
  cout << "third = " << third << endl;

  temp = ( __________ * (temp - __________ ));
  fourth = temp;
  cout << "fourth = " << fourth << endl;

  __________ = first + second + third + fourth;
  product = first * __________ * third * fourth;

  cout << "The sum of the digits is " << __________ << endl;
  cout << "The product of the digits is " << product << endl;

return 0;
}
```

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PROJECT THREE (Credit Card Program)

Objective To write, compile and execute a program that displays a total sum, under certain conditions.

PROJECT DESCRIPTION

Complete the following program code, shown within **Figure 1**, by entering the missing code on the underlined spaces. This program reads the amount of a purchase, discounts a purchase, if applicable, displays a subtotal, adds tax to the subtotal and displays the total amount due. Cash purchases of $100.00 or more are discounted by 5%. Credit card purchases of $20.00 or more are discounted by 10%. All purchases are subject to a fixed tax of 6%, which is added after the discount is considered.

Information About This Project

This programming exercise illustrates the use of `if` statements for decision-making.

Steps To Complete This Project

STEP 1 **Open MS Visual C++ and Write the Program Code**

Open Visual C++ on you computer. Complete the code given in **Figure 1**, which follows, by determining the missing ten entries. Then type your completed program onto Visual C++.

STEP 2 **Compile and Run your Program**

Build, compile and run your program. Test the operation of your program using the sample input values provided below. Take a screen snapshot of your output for each of these scenarios.

purchase amount	purchase type
$ 50.00	cash
$ 75.00	credit card
$200.00	cash
$300.00	credit card

STEP 3 **Print your Program Code and your Run Time Output**

When you have determined that your program is running successfully, print your program source code as well as a snapshot of each of the program output(s). Attach the hardcopies to your lab cover sheet for credit.

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PROJECT THREE

Figure 1 Partially Completed Source code Credit Card Program

```
#include <iostream>
#include <iomanip>
using namespace std;

//Credit Card Program
//Sammy Student, Programmer
void main()
{
   char __________ ;
   double __________ ;
   double tax = 0.06;
   double discountOne = __________ , __________ = 0.10;

   cout << "Is this a credit card purchase? (Y/N)\t";
   cin >> card;
   cout << "Please enter the total purchase: \t";
   cin >> purchase;

   if(purchase >= __________ && (card == 'N' || card == 'n'))
      purchase *= (1.00 - __________ );
   if(purchase >= __________ && (card == 'Y' || card == 'y'))
      purchase *= (1.00 - discountTwo);

   cout << setiosflags(ios::fixed | ios::showpoint);
   cout << setprecision(2);

   cout << "\nThe subtotal is: \t$" << purchase << endl;

   tax = tax * __________ ;

   cout << "The tax is:        \t$" << tax << endl;
   purchase += __________ ;

   cout << "The total due is:  \t$" << __________ << endl;
   cout << "\nThank you for your purchase\n\n";
}
```

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PROJECT FOUR (Customer Invoice)

Objective To write and run a program that displays a total sum, under certain conditions.

PROJECT DESCRIPTION

Empire Enterprises charges its customers $2.75 for each unit of its novelty item A5086. A discount of 10.0% applies to all customer orders that exceed 100 units. An additional discount of 15.0% applies to all customer orders that exceed 1,000 units. A tax rate of 6.0% applies to the subtotal (amount after the discount) of each customer purchase.

Complete the following program code, shown within **Figure 2**, that requests the number of novelty items A5086 sold to a particular customer. This program prompts the user to enter the customer's full name and the total number of the novelty item purchased. The program calculates any required amounts and displays to the user each of the following: the customer's full name, today's date (using an `mm/dd/yy` format), the item ordered, the number of items purchased, the subtotal, the tax and the grand total. (Note: all dollar amounts are to be displayed in a currency type format, with a dollar sign and two decimal places)

A sample program run is given below.

Information About This Project

This programming exercise illustrates the idea of using separate `if` statement blocks for decision - making.

Steps To Complete This Project

STEP 1 **Open MS Visual C + + and Write the Program Code**

Open Visual C + + on you computer. Complete the code given in **Figure 2**, which follows, by determining the missing twelve entries. Then type your completed program onto Visual C + +.

STEP 2 **Compile and Run your Program**

Build, compile and run your program. Test the operation of your program using the sample input values provided below. Take a screen snapshot of your output for this sample run. Submit the hardcopy for credit.

Figure 1 Sample Program Run for the Discount Program

```
Customer Name:          Sammy Student
------------------      -------------------
Order Date:             10/10/02
Item Ordered:           A5086
Number Ordered:         2100
Subtotal:               $4417.88
Tax:                    $265.07
Total:                  $4682.95
Thank you for your order
```

The program code that you are required to complete appears on the following page.

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PROJECT FOUR

STEP 3 **Print your Program Code and your Run Time Output**

When completed, print your program source code as well as the program output(s). Attach the hardcopies to your lab cover sheet for credit.

Figure 2 Partially Completed Source code for the Discount Program

```
#include <iostream>
#include <__________>
using namespace std;

//Empire Enterprises

void main()
{

  char date[10], name[40];
  double number, total;
  const double DISCOUNT1 = 0.10, DISCOUNT2 = 0.15, __________ = 0.06;
  cout << "Enter the customer name:       ";
  cin.getline(name, 40);
  cout << "\nEnter today's date(mm/dd/yy):  ";
  cin.getline( __________ , 10);
  cout << "\nNumber of units purchased?:    ";
  cin >> __________ ;

  total = 2.75 * __________ ;

  if(number > 100)

    total *= (1 - __________);

  if(number > __________)

    total *= (1 - __________);

  cout << "\nCustomer Name:\t\t" << name << endl;
  cout << "-----------------\t" << "-------------------\n";
  cout << "\nOrder Date:     \t" << __________ << endl;
  cout << "\nItem Ordered: \t\t" << "__________" << endl;
  cout << "\nNumber Ordered: \t" << number << endl;

  cout << setiosflags(ios::fixed | ios::showpoint);
  cout << setprecision(2);
  cout << "\nSubtotal:         \t$" << total << endl;
  cout << "\nTax:             \t$" << _________ * _________ << endl;
  cout << "\nTotal:            \t$" << total + RATE * total << endl;
  cout << "\n\n";
  cout << "Thank you for your order" << endl;

}
```

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PROJECT FIVE (Currency Converter)

Objective To write a program to convert currency exchange rates.

PROJECT DESCRIPTION

Write a program that will have the user enter both a U.S. dollar amount and a choice of foreign currency to be converted to and then display the foreign currency equivalent of the given dollar amount. Your program is to written such that the user can select from at least two separate foreign currencies to convert.

For example, the user can input how many dollars he / she wants converted and then choose from either of the following foreign currencies: Mexico Pecos, Cyprus Pounds, Japanese Yen, Russian Rubles or Euro Dollar.

Your program should include current conversion rates, which can be obtained from specific Web sites, such as that given below.

Information About This Project

You may retrieve current currency information by going to the following web site:

http://www.xe.net/ucc

This connects you to the Universal Currency Converter ®.

This particular converter, allows you to perform interactive foreign exchange rate calculations on the Internet, using real-time, up-to-the-minute currency rates.

To start the conversion process, simply type the amount of source currency in the input box (you may include commas and a decimal point). Then, select the source and destination currencies using the scrolling selection boxes. (Note: there are more currencies available than the initial five displayed.) When you are finished, click the Perform Currency Conversion button. The results of your conversion will then be displayed.

Steps To Complete This Project

STEP 1 **Open MS Visual C++ and Type the Program Code**

Open Visual C++ on you computer. Write the program code necessary to accept the input items and display the required output items of the above project. Save your file as: **lab3proj5.cpp**

Include your name, date and course information in the heading portion of your code.

STEP 2 **Compile and Run your Program**

Build, compile and run your program. Test your program by using your own dollar amounts.

STEP 3 **Print Your Program Code**

Finally, print your program code and attach it to this lab packet for credit. Include for submission, run time images of your program showing the results of various conversion scenarios (include at least two separate different dollar amounts each converted to two different currencies). You therefore should have a total of four separate screen snapshots. For example, you can show the result of your program when $120 U.S. dollars are converted to Euro dollars and when $120 U.S. dollars are converted to Cyprus Pounds. Then show the result of your program when $50 U.S. dollars are converted to Euro dollars and when $50 U.S. dollars are converted to Cyprus Pounds.

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PROJECT SIX (Cramer's Rule)

Objective To write a program that uses Cramer's Rule to solve a 2×2 system of equations.

PROJECT DESCRIPTION

Write, compile and execute a computer program which will solve any 2×2 system of linear equations of the following form.

$$A x + B y = C$$
$$D x + E y = F$$

Your program should allow for the fact that division by zero is undefined. That is, if the denominator of the Cramer's Rule solution, $A \times E - B \times D$, is equal to zero, then your program should print a statement indicating that the solution to the given system is inconsistent, i.e. the system either does not have a solution or it has an infinite number of solutions.

Information About This Project

A 2×2 system of linear equations has the form:

$$A x + B y = C$$
$$D x + E y = F$$

Where A , B , C , D , E and F are constant values and x and y are the variables.

According to Cramer's Rule, the solution to the above 2×2 system of linear equations is dependant solely upon the constant values A , B , C , D , E and F ; namely:

$$x = \frac{C \times E - B \times F}{A \times E - B \times D} \quad \text{and} \quad y = \frac{A \times F - C \times D}{A \times E - B \times D}$$

Steps To Complete This Project

STEP 1 **Open MS Visual C + + and Write the Program Code**

Open Visual C + + on you computer. Write the program code which will allow the user to enter the necessary input items A , B , C , D , E and F and then use these items to compute both the values of x and y.

Include your name, course title and date in the header comment (remarks) section of your program code.

Save your file as: **lab3prj6.cpp**

STEP 2 **Compile and Run your Program**

Build, compile and run your program.

Once you have tested your program code, run your program using the information shown in the exercises below. Print the individual outputs for each of the following exercises and attach them to your lab cover sheet for credit.

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PROJECT SIX

Exercises (**Cramer's Rule**)

(a) $2x - 5y = 8$
$3x + 8y = -50$

solution: $x =$ _____ $y =$ _____

(b) $-4x + y = 30.5$
$2x + 5y = 31.5$

solution: $x =$ _____ $y =$ _____

(c) $-0.05x - 0.20y = -0.405$
$0.10x + 0.14y = 0.355$

solution: $x =$ _____ $y =$ _____

(d) $3x + 10y + 10 = -25$
$5x + 2y - 20 = -49$

solution: $x =$ _____ $y =$ _____

STEP 3 **Print your Program Code and your Run Time Output**

When completed, print your program source code as well as the program outputs showing the results of each of the above exercises. Attach the hardcopies to your lab cover sheet for credit.