# Embedded Programing (Lab 6)

*zyBooks Chapter 4 & Visual Studio*

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***Embedded Systems Programming***
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## INTRODUCTION

- In this lab, we used a combination of practices. We finish reading chapter 4 of "Embedded Systems Programming" in zyBooks. Following the reading, we wrote two separate programs in Visual Studio. The first one was for a user to guess a random number generated by the program. The program also indicated if the number guessed was close or not to the random number. The second one was to compute the costs of a money loan. The time, rate and loan were inputted by the user. The time it took to pay back the loan and the total costs were outputted to the user.

## OBJECTIVES

- Further enhance our understanding in C.
- Develop more efficient ways to create code in C.
- Further more understand control structures (while loop & for loop) in C.

## MATERIAL USED

- (1x) computer for zyBooks and Visual Studio.

## PROCEDURE

- *Step 1:* Read the instructions outlined in the **lab paper**.
- *Step 2:* Follow the instructions given from the **lab paper** (Follow the order of given instructions *i.e. "Read zyBooks first then do the C code"*).

## RESULTS AND DISCUSSION

***(Continued on next page)***

## *C code for Question 1*

```c
/*
This program is desgined for a user to guess a number. A number between 1 and 50 is randomly selected by the computer and the user is asked to guess that number.
The program stops when the user guesses the correct number.

Embedded Systems Programming
Lab 6, Question 1
Subash Handa

Program made by: Leonardo Fusser (1946995)
*/

#include <stdio.h>
#include <stdlib.h>
#include <time.h>

void main() {

    //varible definitions
    int randNum; //random number
    int guessNum; //user number (guess)
    int numTries = 1; //loop (count) variable

    srand((int)time(0)); //create seed
    randNum = (rand() % 50) + 1; //generated random number between 1 and 50

    //user input
    printf("-----------------------------------------------------\n"); //page break
    printf("Enter a guess between 1 & 50: "); //user input number between 1 and 50
    scanf_s("%d", &guessNum);

    //guess check (if guessed number isn't equal to random number)
    while (guessNum != randNum) { //logical NOT check

        //input check (if outside range)
        while (guessNum <= 0 || guessNum >= 51) {
            printf("Please try again!\n");
            printf("The number entered is not between 1 and 50.\n");
            printf("Guessed number: %d\n", guessNum); //print guessed number
            printf("-----------------------------------------------------\n"); //page break
            printf("Enter a guess between 1 & 50: "); //take user input again, else infinite loop
            scanf_s("%d", &guessNum);
        }


            //if guessed number is greater than random number
            if (guessNum > randNum) {
                printf("Please try again!\n");
                printf("Your guess is too high! Try guessing a lower number.\n");
                printf("Guessed number: %d\n", guessNum); //print guessed number
                printf("-----------------------------------------------------\n"); //page break
                printf("Enter a guess between 1 & 50: "); //take user input again, else infinite loop
                scanf_s("%d", &guessNum);

                //count +1 for successful try
                numTries += 1;
            }
            //if guessed number is less than random number
            else if (guessNum < randNum) {
                printf("Please try again!\n");
                printf("Your guess is too low! Try guessing a higher number.\n");
                printf("Guessed number: %d\n", guessNum); //print guessed number
                printf("-----------------------------------------------------\n"); //page break
                printf("Enter a guess between 1 and 50: "); //take user input again, else infinite loop
                scanf_s("%d", &guessNum);

                //count +1 for successful try
                numTries += 1;
            }
            //if all else fails
            else {
                printf("An internal error has occured! Please try to run the program again.");
            }
    }
    //if guessed number is = to random number
    printf("-----------------------------------------------------\n"); //page break
    printf("You guessed the correct number! The mysterious number was %d.\n", randNum); //print to user the  number
    printf("You guessed %d times to get the correct answer.\n", numTries); //print to user the number of successful guessed attempts
}
```

*C code output for Question 1*

```
-----------------------------------------------------
Enter a guess between 1 & 50: 34
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 34
-----------------------------------------------------
Enter a guess between 1 & 50: 200
Please try again!
The number entered is not between 1 and 50.
Guessed number: 200
-----------------------------------------------------
Enter a guess between 1 & 50: 400
Please try again!
The number entered is not between 1 and 50.
Guessed number: 400
-----------------------------------------------------
Enter a guess between 1 & 50: 20
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 20
-----------------------------------------------------
Enter a guess between 1 & 50: 10
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 10
-----------------------------------------------------
Enter a guess between 1 & 50: 1
Please try again!
Your guess is too low! Try guessing a higher number.
Guessed number: 1
-----------------------------------------------------
Enter a guess between 1 and 50: 5
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 5
-----------------------------------------------------
Enter a guess between 1 & 50: 8
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 8
-----------------------------------------------------
Enter a guess between 1 & 50: 9
Please try again!
Your guess is too high! Try guessing a lower number.
```

```
--------------------------------------------------
Enter a guess between 1 & 50: 1
Please try again!
Your guess is too low! Try guessing a higher number.
Guessed number: 1
--------------------------------------------------
Enter a guess between 1 and 50: 5
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 5
--------------------------------------------------
Enter a guess between 1 & 50: 8
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 8
--------------------------------------------------
Enter a guess between 1 & 50: 9
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 9
--------------------------------------------------
Enter a guess between 1 & 50: 6
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 6
--------------------------------------------------
Enter a guess between 1 & 50: 5
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 5
--------------------------------------------------
Enter a guess between 1 & 50: 4
Please try again!
Your guess is too high! Try guessing a lower number.
Guessed number: 4
--------------------------------------------------
Enter a guess between 1 & 50: 3
--------------------------------------------------
You guessed the correct number! The mysterious number was 3.
You guessed 11 times to get the correct answer.

C:\Users\Leonardo Fusser\Google Drive\Leonardo CEGEP\Vanier (Year 1, 2, 3)\Vanier (Year 1)\Vanier Wint
mming\Lab 6 (Question 1)\x64\Debug\Lab 6 (Question 1).exe (process 16832) exited with code 0.
Press any key to close this window . . .
```

## *C code for Question 2*

```c
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
//This program is a simple loan calculation. The user enters the value of the loan, the duration and the interest given to the user.//
//The program then calculates the monthly payment and other costs associated with the user's loan.                                //
//                                                                                                                                //
//Embedded Systems Programming (Lab 6, Question 2)                                                                                //
//Subash Handa                                                                                                                    //
//                                                                                                                                //
//Program made by: Leonardo Fusser (1946995)                                                                                      //
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

#include <stdio.h>
#include <math.h>

void main() {
    //variable definition
    double usrLoanAmount;
    double usrInterest;
    double usrInterestRate;
    double usrDuration;
    double usrMonths;
    double MonthlyPayment;
    double MonthlyTerm;
    double Term;
    double CalculatedInterest;
    double CalculatedPrincipal;
    double CalculatedBalance;

    printf("-----------------------------------------------\n"); //page break
    printf("Enter the amount of the loan (in $): ");
    scanf_s("%lf", &usrLoanAmount); //usr's loan
    printf("Enter the interest rate (in %%): ");
    scanf_s("%lf", &usrInterest); //usr's interest
    printf("Enter the duration of the loan (in years): ");
    scanf_s("%lf", &usrDuration); //usr's duration of the loan
    printf("-----------------------------------------------\n"); //page break
    printf("Entered loan amount is: %.2lf $.\n", usrLoanAmount);
    printf("Entered interest rate is: %.1lf %%.\n", usrInterest);
    printf("Entered loan duration is: %.1lf years.\n", usrDuration);
    printf("-----------------------------------------------\n"); //page break

    usrMonths = usrDuration * 12; //convert usr's months to years
    usrInterest = usrInterest / 100; //convert usr's interest (%) to decimal
    usrInterestRate = usrInterest / 12; //convert yearly interest and convert to monthly interest

    printf("You need to make a total of: %.1lf payments.\n", usrMonths);
    MonthlyTerm = pow((1 + usrInterestRate / 12), (usrDuration * 12)); //usr monthly payment calculation
    MonthlyPayment = (usrLoanAmount * usrInterestRate / 12 * MonthlyTerm)/ (MonthlyTerm - 1); //usr monthly payment calculation
    printf("Each monthly payment is: %.2lf $.\n", MonthlyPayment);

    printf("-----------------------------------------------\n"); //page break
    printf("\tMonth\tInterest\tPrincipal\tBalance\n"); //print months, interest, principal and balance headers
    printf("\t-----------------------------------------------\n"); //page break

    //iterate depending on loan duration and calculate interest, principal and balance for each month
    for (int i = 1; i < usrMonths + 1; ++i) {
        Term = pow((1 + usrInterestRate / 12), (usrDuration * 12));
        CalculatedBalance = (usrLoanAmount - (i * MonthlyPayment)); //calculated balance
        CalculatedInterest = (CalculatedBalance * usrInterestRate); //calculated interest
        CalculatedPrincipal = (MonthlyPayment * CalculatedInterest); //calculated principal

        if (CalculatedBalance < 0) {
            CalculatedBalance = 0.00; //ensure that balance at last month is = 0.00
        }
        printf("\t%d\t%.2lf$\t\t%.2lf\t\t%.2lf\n", i, CalculatedInterest, CalculatedPrincipal, CalculatedBalance); //print months, interest, principal and balance
    }
}
```

*C code output for Question 2*

```
Enter the amount of the loan (in $): 200
Enter the interest rate (in %): 7.5
Enter the duration of the loan (in years): 2
-------------------------------------------
Entered loan amount is: 200.00 $.
Entered interest rate is: 7.5 %.
Entered loan duration is: 2.0 years.
-------------------------------------------
You need to make a total of: 24.0 payments.
Each monthly payment is: 8.39 $.
-------------------------------------------
        Month   Interest        Principal       Balance
        -------------------------------------------------
        1       1.20$           10.04           191.61
        2       1.15$           9.61            183.22
        3       1.09$           9.17            174.84
        4       1.04$           8.73            166.45
        5       0.99$           8.29            158.06
        6       0.94$           7.85            149.67
        7       0.88$           7.41            141.29
        8       0.83$           6.97            132.90
        9       0.78$           6.53            124.51
        10      0.73$           6.09            116.12
        11      0.67$           5.65            107.74
        12      0.62$           5.21            99.35
        13      0.57$           4.77            90.96
        14      0.52$           4.33            82.57
        15      0.46$           3.89            74.18
        16      0.41$           3.45            65.80
        17      0.36$           3.01            57.41
        18      0.31$           2.57            49.02
        19      0.25$           2.13            40.63
        20      0.20$           1.69            32.25
        21      0.15$           1.25            23.86
        22      0.10$           0.81            15.47
        23      0.04$           0.37            7.08
        24      -0.01$          -0.07           0.00
```