UNIVERSITY OF TECHNOLOGY, JAMAICA

School of Computing & Information Technology

CMP1025: Programming II

Week 1 - Tutorial/Lab Sheet – Functions

Students should be able to :

i. Understand the concept of parameter passing
ii. Understand the different parts of a function
iii. Implement function definitions for various problems
iv. Use local, automatic and static variables in C programs

1. What did you learn from the lecture?
    a. A program module in C is called a _____.
    b. A function is invoked with a _____.
    c. A variable that is known only within the function in which it is defined is called a _____.
    d. The _____ statement in a called function is used to pass the value of an expression back to the calling function.
    e. Keyword _____ is used in a function header to indicate that a function does not return a value or to indicate that a function contains no parameters.
    f. The _____ of an identifier is the portion of the program in which the identifier can be used.
    g. A function must have a _____, _____ and a _____.
    h. A value that is returned from a function to the called function may be _____, _____ or _____
    i. The storage class specifiers are _____, _____, _____ and _____.

2. Write an appropriate function call for each of the following functions:

    a.
```
int mystery (int x)
{
  int y;
  y = 5 * x – 3;
  return y;
}
```

    b.
```
void display(int a, int b)
{
  int c;
  c = sqrt(a * a + b * b);
  printf("c = %d\n",c);
}
```

3. Write the function prototype and header for the following functions

    a. A function called sample that generates and returns an integer quantity.
    b. A function called root accepts two integer arguments and returns a floating-point result.

c. A function called convert accepts a character and returns another character.
d. A function called process accepts an integer and two floating point quantities (in that order) and displays a result.

Are there any similarities between the function header and prototype? Any differences?

4. Write appropriate function prototypes for *function1* in each of the code segments shown below

a.
```
void main()
{
        int a, b;
         char c;
         …
        c = function1(a, b);
        …
}
```

b.
```
void main()
{
        int z;
        balance = Withdrawal();
}
```

c.
```
void main()
{
        double a, b, c;
        …
        function1(a, b);
        …
}
```

d.
```
void main()
{
        double a, b, c;
        …
        function1( );
        …
}
```

5. Identify the errors in the following:

(a)
```
double divide (int, int);

double divide (int divisor, int dividend)
{
        double val;
        val = dividend/divisor;
}
```

(b) double divide (int, int);

```
double divide (float dividend, float divisor)
{
        double val;
        val = dividend/divisor;
        return val;
}
```

(c) double divide (int, int);

```
void divide (int dividend, int divisor)
{
        double z;
        ….
        return z;
}
```

(d) double divide (int, int);

```
double divide (double dividend, divisor)
{

        val = dividend/divisor;
        return ans;
}
```

6. Using the function **mystery** in question 2 what would be displayed from the following?

a)
```
int val = 2, ans;
ans = mystery(val);
ans = mystery (ans);
 printf("ans = %d\n",ans);
```

b)
```
int ans = 3;
ans = mystery(ans * 2);
printf("%d", mystery(ans));
```

c)
```
ans = mystery(mystery(ans) * mystery(ans));
printf("ans = %d\n",ans);
```

7. (a) Write a program that adds two numbers that were accepted as input and displays the result of the addition.

   (b) Write a modular program, that adds two numbers and displays the result. A function called Add(), is responsible for accepting input, adding the numbers and displaying the result. What will main do? What are the return and parameter types for the Add() function.

(c) Write a modular program, that adds two numbers and displays the result. A function called Add(), is responsible for adding the numbers and displaying the result. What will main do? What are the return and parameter types for the Add() function.

(d) Write a modular program, that adds two numbers and displays the result. A function called Add(), is responsible for accepting input and adding the numbers, the result will be displayed in main. What are the return and parameter types for the Add () function.

8. Consider the following C program:

```
#include <stdio.h>
void useGlobalVal(void);
void useStaticVal (void);

int x = 1;
void main(void)
{
        int x = 8;
        {// start new inner scope
                int x = 12;
                printf("local x in inner scope of main is %d", x);
        }// end inner scope
        printf("local x in outer scope of main is %d", x);
        useStaticVal();
        useGlobalVal();
        useStaticVal();
        printf("local x in outer scope of main is %d", x);
 }//end main

void useStaticVal (void)
{
         static int x = 45;
         printf("\nlocal static x on entering useStaticVal is %d", x);
         x++;
         printf("\nlocal static x on exiting useStaticVal is %d", x);
}

void useGlobalVal (void)
{
        printf("\nglobal static x on entering useGlobalVal is %d", x);
        x *= 5;
        printf("\nglobal static x on exiting useGlobalVal is %d", x);
}
```

Identify your

i) Function prototypes, function calls and function definition

ii) Conduct a trace on the program and identify your local, global and static variables and showing what will be displayed through each step keeping note of your variable scope.

Random Numbers

9. The _____ function is used to produce random numbers.

10. The _____ function is used to set the random number seed to randomize a program.

11. Define the range of the random numbers generated by the following integral expressions:
    a) rand() % 20
    b) rand() % 20 + 1
    c) rand() % 100
    d) rand() % 2 + 2
    e) rand() % 30 – 10

12. Write a C statement that will generate and store a random number in the following ranges:
    a) $-15 \leq x \leq -5$
    b) $19 < x \leq 40$
    c) $1 \leq x \leq 36$
    d) $0 \leq x \leq -20$

13. Generate a real random number for the following:
    a) 0.0 and 1.0
    b) 100.0 and 300.0 (exclusive)

I DARE YOU!!

...*to* perform the following exercises. Separate each program into different modules.

Question 14

You are required to implement a simple ATM system with the following menu:

Welcome to BANK-AT-HOME's ATM System

Please select from the menu below:
A. Cash Withdrawals
L. Lodgments
B. Balance Check
P. Bill Payment
C. Credit Purchase
E. Exit

Enter option:

The following functions/procedures should be included:

1. *menu* – this displays the options onto the screen, accepts a character from the user and returns to the main function the option selected.

2. *Cash Withdrawals* – this uses the current balance as a parameter to the function, prompts the user for the amount to be deposited and returns the updated balance to the main function.

3. *Bill Payment* - this uses the current balance as a parameter to the function, prompts the user for the amount to be paid and the institution it is to be paid and the account number of the bill and returns the updated balance to the main function.

4. *balance_check* – this uses the current balance as a parameter to the function and displays it onto the screen

5. ECash Lodgements – This uses the current balance as a parameter to the function. The amount is added to the balance and the updated balance is returned to the main function

6. *Credit Purchase* – This uses the current balance as a parameter to the function. Persons can purchase credit for their Digicel, Claro or Lime phones with valid purchases of 200, 300, 500 and 1000 only. The amount along with the required 25% tax should be deducted from their balance and returns the updated balance to the main function

After selecting and performing a transaction, the user should be prompted as to whether he/she would like to perform another transaction. If yes, the menu should be re-displayed onto the screen otherwise the program should display a message:

Thank you for using BANK-AT-HOME, then exit.

Validation for the program is as follows: No matter the transactions users should always have a minimum balance of $100 in their account.

E-Cash Lodgment

- Amount cannot be less than 1000
- Cannot lodge amounts not divisible by 100

Bill_Payment

- Amount cannot be less than or equal to 0
- Amount cannot be greater than or equal to the current balance

Withdrawals

i) A user cannot withdraw more than what they have in the account.
ii) Withdrawal amounts must be divisible by 100.

There is a transaction fee of $80 applicable to all transactions except balance check which is free.

Updated balances are printed on the screen after each transaction has occurred.

Assume the following:

- the starting balance for the program
- only one account is being used

Question 15

Build a functional scientific calculator using a menu option demonstrating the different kinds of functions (user-defined/built-in) showing parameter passing and incorporating recursive functions.

a) Write a menu function that does not accept a parameter and returns a parameter (of your type) that represents an option from a list of calculator functions. E.g.

```
***M E N U ***
+……..Addition
-……...Subtraction
*……..Multiply
/……...Divide
x……..Exit

Enter choice:
```

b) Write a function add that accepts a parameter and allows the user to add as many numbers as they wish until the user enters a 0 to end the addition. The function will then display the final total.

c) Implement your main program that will utilize the menu function above that will allow the execution of any of the calculator functions until the user decides to exit.

d) Define the remaining functions one at a time, Execute your program and evaluate.

e) Add some additional built-in functions to your menu such as: finding x to the power of a number, square root, factorial, and the trigonometric functions.

(If implemented wisely your program should make use of all the control structures: Repetition, Selection (Case/if) and Sequence)).

Be creative!!!! Remember your hand-held calculator where the values calculated can always be used in another calculation or you can just return the value to 0.

Question 16

Computers are playing an increasing role in education and are referred to a Computer-assisted Instruction. One problem that develops is student fatigue. Write a program that will help an elementary school student learn multiplication and/or addition.

a) Develop a function **CorrectResponses** that will generate and display random responses to a correct answer such as:

Very Good!
Excellent!
Nice Work!
Keep up the good work!

b) Develop a function **IncorrectResponses** that will generate and display random responses to a correct answer such as:

No. Please try again!
Wrong. Try once more!
Don't give up!
No. Keep trying

c) Write a function Level_1 that will use rand() to generate two random single digit numbers and will display a question such as:

6 x 7 =

The student types the answer and the program checks the answer. If it is correct/incorrect then it displays a random response accordingly and asks another question. The student is asked 10 such questions and the program should calculate the percentage of correct responses. If the percentage is lower that 75% then the student will have to do the module again or exit otherwise they have the option of moving to level 2.

d) Develop Level_2 function as defined in (c) above but where the numbers that are generated consist of 1 single digit and 1 double digit. Students can then move to Level_3 upon passing Level_2 where 2 double digits are generated.