ECE 331 – Fall 2024
Homework 2
Assigned Monday, September 16th
Due Monday, September 23rd

1. Hex representations of three Arm instructions are given below: (10)

      (a) 0x8b14020b

      (b) 0xf8460198

      (c) 0xd1155869

      For each of these instructions, answer/do the following:

      • Write the 32-bit binary representation of this instruction.

      • What instruction is this (name and mnemonic)?

      • What type (R, I, D) is this instruction?

      • Specify the contents of each field.

      Express opcode in hexadecimal and all other fields in decimal.

      • Write this instruction in Arm assembly language.

      • In words, what does this instruction do? Be concise and precise.

2.   (a) Explain the need for subroutines.   (5)

      (b) Explain the steps involved in a procedure call.   (5)

3. Consider the following code: (10)

      if(i == j){f=g+h; f=f+1;}
      else f=f+1;

      Write a sequence of ARM assembly instructions that will execute this line of code...

      (a) ... assuming that the values of f, g and h are stored in x19, x20 and x21, respectively. The values i and j are stored in x9 and x10, respectively.

      (b) ... assuming instead that the values of f, g and h are stored at memory locations 68100, 68108, 68116, respectively, and the values i and j are stored

in x9 and x10, respectively. Assume also that the decimal value 68092 resides in register x19.

4. Logical Operations:

(a) For what practical applications in a program can logical operations be Used? (5)

(b) Write ARM code (a few instructions) demonstrating the applications you listed in part (a). (5)

5. Consider the following C code: (10)

```
unsigned long long main()
{
  unsigned long long x = 1;
  switch (x)
  {
    case 1: i=1;
    case 2: i=5;
  }
  return 0;
}
```

Based on this code, answer the following:

(a) Convert the above C code to ARM assembly. Assume that unsigned long long corresponds to a 64-bit unsigned integer datatype.

(b) The condition you are testing is met at Case 1. You do not want the Case 2 to be tested. Add appropriate instructions in Arm for this implementation.

(c) If int x is any integer other than 1 or 2, you want 'i' to be 0. First, add C code that implements this, then add the appropriate instructions in ARM for this implementation.

6. a) Convert the following C code to Arm: (10)

```
unsigned long long sum( unsigned long long arr[], unsigned long long size ) {
  if ( size == 0 )
```

return 0 ;
  else
    return sum(arr, size - 1) + arr[size - 1] ;
}

Assume arr is in x19 and size is in x20 and follow all standard ARM conventions for procedures. Also, assume that the unsigned long long data type corresponds to a 64-bit unsigned integer.

b) What else would be saved on the stack?