University of Florida — EEL 3701 — Dr. Eric M. Schwartz

Department of Electrical & Computer Engineering

HOMEWORK 12

Revision **0**

*Note: Late HW is **not** accepted! Put your **"last name, first name," the course number (3701), and the HW number** in the **top right hand corner** of the first page of **all** HW assignments. Also for **all** homework, use file name **HWx.pdf**. Do **NOT** put your social security number or your UF ID number on your HW.*

1. List all the addressing modes for the G-CPU and provide short examples of code for each addressing mode.

2. a) Hand-assemble the following code. Briefly explain (but in detail) the function of this code.

```
        ORG     $0       ; assembler directive (origin) to tell where code will be placed in memory
        LDX     #$1100   ; pointer to data
        LDAA    #$10     ; counter value
        STAA    $1200    ; counter will be saved in memory to free up a CPU register
LOOP:   LDAA    0,X      ; get 1st data value
        LDAB    $10,X    ; get 2nd data value
        SUM_AB           ; data1 + data2
        SHFB_R           ; divide sum by 2
        STAB    $20,X    ; store average. value
        INX              ; increment pointer
        LDAB    #$FF     ; -1 in 2's complement format
        LDAA    $1200    ; count = count – 1
        SUM_BA
        BEQ     DONE     ; branch to done if count is zero
        STAA    $1200    ; else, save counter value
        BNE     LOOP     ; and repeat loop
DONE:   BEQ     DONE     ; loop forever
```

   b) How many times (decimal) will the loop execute?
   c) Why do we have to save the counter value in memory during each pass of the loop?
   d) Re-write the programs using labels and other assembler directives where appropriate.

3. Assume that both the A and B accumulators are pre-loaded with distinct values before the below program is executed. Given the following bytes stored in memory (with all address and data values given in hexadecimal), disassemble the below machine codes and write the corresponding program. What function does this program perform?

Addr	Data
100	06
101	00
102	14
103	1A
104	16

Addr	Data
105	06
106	01
107	14
108	04
109	00

Addr	Data
10A	14
10B	1B
10C	16
10D	00
10E	04

Addr	Data
10F	01
110	14
111	18

4. Write a program to determine the number of (decimal) 37's found in memory from addresses $1000 through $107F.

5. Create a new instruction called "Branch always" using the syntax "BRA addr". Modify the G-CPU Controller ASM and next state table for this new instruction. (Show only the modifications to these files.)