Kettering University

Microcomputers I

Class Exercise Packet II

Spring 2022

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Notes

- Answer the questions provided in this handout during normal class times when the instructor asks you to do so, and then upload it to Bb (to get extra credit) using one of the following methods when you are notified:
  - You may directly answer the questions in the electronic copy of the handout posted on Bb, and then convert it to .pdf format to submit the packet.
  - You may answer the questions in the paper copy, and then scan and convert it to .pdf format to submit the packet.
  - (Preferred) You may answer the questions in the paper copy, then transfer your answers to the electronic copy, and convert it to .pdf format to submit the packet.
- In multiple-choice questions, highlight the correct choice(s).
- Exercises are **open** book/notes unless specified otherwise.
- If you know the answers, please **teach** other students; otherwise, **learn** from other students, but do NOT copy from them!
- If you **run out of time** on a question, answer that question later but **before** you walk into the classroom next time.
- **Do NOT hesitate to stop by my office if you need help!**
- This handout (and not anything else!) in .pdf may be collected for grading purposes electronically **anytime**. So, keep it updated!

23. Write a program to perform the following task:

$1010 ← ($1000) + ($1002) – ($1005)

```
ldaa $1000
adda $1002
suba $1005
staa $1010
```

24. Assemble the branch instruction:

```
loop:  aba
       ldx    $2000
       decb
       decb
       bne    loop
done:  staa   $2100
```

Offset for bne = -7

Machine code for bne loop: $26 F7

25. Determine (in your head as much as you can) whether or not the 10 conditional branch instructions would be taken (successful) if they were placed right after the compare instruction. For each branch instruction type either a Yes or No in the space provided in the table. What happens to the condition flags?

Code	Difference	N	Z	V	C	beq	bne	bhi	blo	bhs	bls	bgt	blt	bge	ble
ldd #$840D cpd #$7A10	09FD	0	0	1	0	0	1	1	0	1	0	0	1	0	1

1	0	0	1	1
	8	4	0	D
	8	5	E	F
	0	9	**F**	**D**

Table 1

	Yes or No
Borrow	No
Overflow	Yes

Table 2

26. As you know, when subtraction X – Y is performed or X and Y are compared, all the four NZVC flags are affected meaningfully. You obtained the following two tables in HW Assignment 1, which show the necessary and sufficient conditions for the 5 relationships between X and Y, namely =, <, ≤, >, and ≥.

Unsigned Comparison	
Z = 1	X = Y
B = 1	X < Y
B + Z = 1	X ≤ Y
B + Z = 0	X > Y
B = 0	X ≥ Y

Signed Comparison	
Z = 1	X = Y
N XOR V = 1	X < Y
N XOR V + Z = 1	X ≤ Y
N XOR V + Z = 0	X > Y
N XOR V = 0	X ≥ Y

Right after a "Compare X, Y" instruction (*not in the HCS12 format!*), let us assume that flag N = 1, and then a bgt instruction executes and happens to be successful. What can you tell about the V flag value right after the compare instruction?

The V-flag is 0.

27. Go over the following Data Segment:

```
; Data Segment
            org     $3000

pntr:       dc.w    arey

size:       dc.b    5       ; array size

sum:        ds.b    1       ; reserved for sum

flag:       ds.b    1       ; reserved for error flag

            org     $3100

arey:       dc.b    12, 45, 96, 20, 52, 86, 120, 4, 37
```

Then fill in the blanks:

; Code Segment:

```
        clra            ; A = 0
        tfr     A, Y    ; Transfer "sign extended A" to Y, Y = 0
        ldab    size    ; B = 5
        aby             ; (Y ← Y + B)  Y = 5

        ldx     #arey   ; X = 3100
        ldy     #pntr   ; Y = 3000

        ldx     arey    ; X = C2D
        ldy     pntr    ; Y = 3100

        clr     flag    ; which memory location is reset to 0?  3004
        ldaa    4, Y    ; A = 34
```

Note: Pay close attention to the *indentation* used in this code. Indentation along with *explanatory* and *short* comments make your code much more readable. You are expected to follow these rules in our Microcomputers I class.

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28. Use Boolean instructions to toggle the even bits of location $3000: (Note: The index of the LSb is 0, so even.)

```
ldaa $3000
eora #%01010101
staa $3000
```

29. Use bit manipulate instructions to reset the upper 4 bits of location $3500

```
bclr $3500, #$F0
```

30. Use bit manipulate instructions to set odd bits of the byte at address $3A00

```
bset $3A00, #%10101010
```

31. What is the largest value in location $30C0 that makes the following branch *successful*:

brclr $30C0, $24, loop

DB
Reason:
24 = 00100100
Largest successful branch = 11011011 = DB

32. What is the smallest value in location $30C0 that makes the following branch *unsuccessful*:

brclr $30C0, $24, loop

04
Reason:
24 = 00100100
Smallest unsuccessful branch = 00000100 = 4

33. Determine the contents of register X after the following instruction: (SP = $3010)

leax 8, -SP

3008

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