

Assignment 2

Cover Page

Structure and Application of Microcomputers

Student Information (Print)

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Instructions: This assessment is designed to emphasize and reinforce some of the important concepts related to reading, lecture, and lab materials covered in week 2. To maximize your benefit from this exercise you are encouraged to do the following:

- (1) Read through the assignment questions *before* listening to the lectures.
- (2) Answer as many questions as possible in tandem with viewing and listening to the lectures. You can easily pause a lecture to answer a question, or re-listen to any material that you do not fully understand.
- (3) Simply writing down a solution to a particular problem is not enough to obtain full points. You must show how you arrived at the solution by showing the step-by step procedure that you performed. This procedure can be hand-written or typed – the choice is yours. However, make sure to answer each question in the provided spaces.
- (4) Review your answers a few days after completing the assignment. Taking a few minutes to do this can dramatically improve your understanding of key concepts and increase your retention.

Submission: Submission of this assessment is a two-step process that involves (1) uploading your written work as a single PDF to the Dropbox on CourseLink, and (2) entering only the final answers to the assignment questions under the Quiz Section on CourseLink. **Only assignments that complete both steps will be marked. The overall submission procedure is outline below.**

- (1) Once you have filled in the cover page with your personal information and answered all of the assignment questions, scan your assignment pages (including this cover sheet and in the correct order) and convert them into a

single PDF submission. If you do not have a scanner, you may use a cellphone to take pictures of each page, then use a program like Adobe Acrobat Scan to create a single PDF. (Remember to use appropriate lighting, as dim or blurry pictures that cannot be read will not be marked.) Do not upload individual pages. Upload your single PDF submission to the **Dropbox labeled Assignment 2** on CourseLink.

- (2) While in CourseLink, now click on the **Quizzes tab** on the navigation bar. On the Quiz List page, you will see a quiz called **Assignment 2**. Click Start Quiz. Then, answer each question using the final answers that you have already determined. As you complete each question, the answer will be automatically saved. You can see which questions have saved answers in the Questions section of the quiz's left panel. You can also click the question number in the quiz's left panel to go back to the question. Click **Go to Submit Quiz** after you answer all quiz questions.

Assignment 2 is due **11:59pm, September 25, 2020**. As stated in the course outline, assignments can be at most 2-days late without penalty. This corresponds to 11:59pm, September 27, 2020. No additional extension will be granted for any reason.

Best of success!

1. What is the name of the register that must be initialized before the processor can execute a program? [1 point]

program counter (PC)

2. How does the computer differentiate between instructions and data? Explain. [2 points]

Anything between START and END
is interpreted as an instruction.
Instructions themselves vary in size,
whereas data registers have fixed capacities

3. Machine-language code for the Motorola 68000 will execute directly on a computer based on the x86 ISA? Circle one of the options below.[1 point]

- a. True
 b. False

4. Based on the terminology used in the 68000's ISA, classify the decimal value 256 as *byte*, *word*, or *longword*. You may assume that it is possible to use more than one classification. Circle one or more of the options below. [1 point]

- a. Byte
- b. Word
- c. Longword

5. According to the 68000's ISA, do the following three numeric values all signify the same number: %1001010, 74, \$4A? Circle one of the options below. [1 point]

- a. True
- b. False

6. The contents of data register D3 after the instruction MOVE.W 1000,D3 is (circle one of the options below) [1 point]

- a. The number 1000
- b. The contents of memory location 1000
- c. The 16-bit value from word location 1000
- d. None of the above

7. Which instruction initializes word in data register D1 to the (decimal) value 18? Circle one of the options below. [1 point]

- a. MOVE.W 18,D1
- b. MOVE.L #18,D1
- c. MOVE #\$12,D1
- d. None of the above

Use the following information for questions 8-10:

What, if anything, is wrong with following instructions?

8. ADD D2,#5 [1 point]

Answer: Cannot move data into constant
Dest. cannot be const.

9. MOVE.W #%10001110,D8 [1 point]

Answer: This operation is valid and would result in a success. However, MOVE.B should be used instead

10. MOVE.B #293,D0 [1 point]

Answer: 293 is greater than 8 bits.

The instruction should be MOVE.W
11. According to the 68000's ISA, to successfully load a 32-bit value it should be fetched from which of the following memory (hexadecimal) memory locations? Circle one of the options below. [1 point]

- a. 0xA00CE2
- b. 0xFFFFFE
- c. 0x009DDB
- d. None of the above

12. What size (in bits) are the *addresses* sent from the 68000 processor to main memory when performing a load (read) or store (write) operation? Circle one of the options below. [1 point]

- a. 8
- b. 16
- c. 32
- d. None of the above

13. The ISA of a certain computer system specifies that each memory cell contains 12 bits. If the data-bus is 18-bits, how many *bytes* of memory can the processor address? Show your calculation below. [1 point]

Answer: 2^{12}

14. On a certain computer system, the numeric value \$12345678 is loaded into memory at location \$1002. If the computer system employs *little-endian* byte ordering, what is the memory address of the byte \$78? Show your answer below. [1 point]

Answer: \$1002

15. On a certain computer system, the numeric value \$12345678 is loaded into memory at location \$1002. If the computer system employs *big-endian* byte ordering, what is the memory address of the word \$1234? Show your answer below. [1 point]

Answer: \$1004 → \$1005 → \$12

16. What does the attempted execution of the instruction MOVE.L #\\$1010,\\$1011 yield? Explain in a sentence or two below. [1 point]

Answer: This yields failure.

Cannot move longword to odd address

17. Are all of the CCR flags always updated after the execution of an instruction?
Explain in a sentence or two below. [1 point]

Answer: The CCR is updated after most instructions execute to reflect the characteristics of the result.

18. What is the difference between the Carry (C) and Overflow (V) flags in the 68000's Condition-Code Register (CCR) from a programmer's perspective? Explain below in a sentence or two below. [1 point]

Answer:

The carry flag represents a carry that we would normally discard, but an overflow flag represents a change in sign (signed overflow) owing information for questions 19-21:

Consider the following code fragment:

MOVE.L #120,D1
ADD.B #136,D1

19. In the space below, perform the binary addition by hand showing the final value contained in data register D1. [1 point]

01111000
10001000
EV 00000000

20. Using the previous result, show how each of the flags (C, Z, V and N) in the CCR are updated in the space below. [0.25 points each]

XX 00000000

C:1 Z:1 V:1 N:0

21. What specific things does each of the flags tell you about this particular result. Be specific, and write your answers in the space below. [0.25 points each]

Z: This result is zero

V: Prior to the operation, this result was the opposite sign.

C: If there were space for more bits, this number would be different.

22. Does the instruction ADD.W D0,D1 use extension words? Explain your answer in one or two sentences in the space below. [2 points]

No because neither the source, nor destination is an immediate address

23. What is the size (in words) of the shortest and longest possible 68000 instructions? Answer in the space below. [1 point]

Answer: shortest: 1 word

longest: 5 words (1 word, 4 ext.)

Use the following information for questions 24-25:

The following 68000 machine-language instructions (represented in hexadecimal) are all variations of the MOVE instruction. Manually disassemble each instruction; that is, convert each machine-language instruction into assembly language. (Note: The instruction format for the MOVE instruction can be found on pages 316-317 of your textbook and textbook excerpts through Ares.) Show your work (e.g., individual fields and their corresponding assembler syntax) in the spaces below.

24. 2E06 [2 points]

00 01 111 000 000 110
MOVE.L D7 D6

MOVE.L D6, D7

25. 2E3C00123456, [2 points]

00 10 111 000 111 100
MOVE.L D7 #Data

↓
Decimal: 1193046

MOVE.L #1193046, D7