CS/ECE 354
MIDTERM EXAMINATION #1
February 28, 1990
Open Book

Write your name and your student ID on each page. This test has two parts. The first part consists of 14 multiple choice questions and is worth a total of 28 points. The second part consists of 10 short answer questions and is worth a total of 27 points.

Multiple Choice Questions

Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the **single best** answer and circle the corresponding letter (A-E). Each multiple choice question counts two points, though some questions are harder than others. You may show your work and your reasoning on the test itself. If you think a question is ambiguous, explain way, but understand that the intent is that there be only a single correct answer.

1. The following numbers are represented in hexadecimal, octal, binary, and decimal, respectively. Which of the following numbers are all equivalent?

(A) `0x100, 0400, 0z0100000000, 256`
(B) `0x400, 0400, 0z0100000000, 256`
(C) `0x400, 0100, 0z0100000000, 256`
(D) `0x400, 0400, 0z0100000000, 400`
(E) `0x400, 0400, 0z010000000000, 256`

2. The following numbers are represented in hexadecimal, octal, binary, and decimal, respectively. Which answer specifies four unique integers?

(A) `0x050, 062, 0z000101000, 50`
(B) `0x050, 070, 0z001010000, 62`
(C) `0x032, 062, 0z001100010, 62`
(D) `0x062, 062, 0z010000010, 62`
(E) `0x032, 062, 0z001100010, 50`

3. Which one of the following representations is equivalent to `0z010101010101` ?

I. `0555`
II. `365`
III. `0x555`

(A) I only. (B) II only. (C) III only. (D) II and III only. (E) I, II, and III.

4. How many bits are needed to specify the number 256 in sign magnitude notation?

(A) 7. (B) 8. (C) 9. (D) 10. (E) 256.

5. What is the 8-bit two's complement representation for the sign magnitude number `0z10010001.`

(A) `0z11101111` (B) `0z00010001` (C) `0z11101110` (D) `0z11111101111` (E) `0z10010001`

6. Assume a computer supports 2's complement integers in two sizes, 8 and 16 bits. We want to add the 8-bit number `0xf9` to the 16-bit number `0x7ff1` and represent the result in 8 bits. What is the result of the addition?

(A) `0x7fea`

(B) `0z01111111`

(C) `0x8008`

(D) `0x7ff8`

(E) The result is not representable in the 8-bit format.

7. What does the following piece of assembly code do? Assume that the values input for both `y` and `z` are positive.

```
         get    y
         get    z
         sub    x, y, z
         blez   x, lab1
         put    y
         b      lab2
lab1:    put    z
lab2:    end
```

(A) It prints the value of `z.`

(B) It prints the difference between `y` and `z.`

(C) It prints the maximum of the two numbers `y` and `z.`

(D) It prints the value of `y.`

(E) It prints the minimum of the two numbers `y` and `z.`

8. What is the range of integers that can be represented in a 16-bit one's complement number?

(A) -65535 to 65535

(B) -65536 to 65535

(C) -32767 to 32768

(D) -16384 to 16384

(E) -32767 to 32767

9. Which of the following 12-bit 2's complement numbers represents -1?

I. `0xFFF`

II. `0z111111111111`

III. `0777`

(A) I only. (B) II only. (C) III only. (D) I and II only. (E) I, II, and III.

10. What is the largest number that can be represented by a 6-bit sign magnitude number?

(A) 5 (B) 31 (C) 32 (D) 63 (E) 64

11. Consider the code fragment below.

```
blez   tmp, out1
beq    tmp, 0, out2
b      loop
```

Which piece of code is equivalent to the fragment above?

(A)
```
bgtz   tmp, loop
b      out1
```

(B)
```
beq    tmp, 0, out1
b      loop
```

(C)
```
bgtz   tmp, out2
b      loop
```

(D)
```
b      out1
```

(E) None of the above.

12. Assume that the simple machine language (described in Chapter 2) has only one branch instruction `bltz x, label` which branches to label if `x` is less than zero. Suppose we want to branch to some code that handles errors if `i < 1` or `i > 10.` What line of code should be used for the missing instruction?

```
        .data
i:      .word
tmp:    .word
        .text
        sub     tmp, i, 1
        bltz    tmp, error
        ????    ???????????
        bltz    tmp, error
```

(A) `add tmp, 10, i`

(B) `add tmp, 9, i`

(C) `sub tmp, 10, i`

(D) `sub tmp, 9, i`

(E) `sub tmp, i, 9`

13. What is the most negative integer that can be represented in 8 bits as a 2's complement number?

(A) -7 (B) -127 (C) -128 (D) -255

14. Which of the following statements is true about transferring data from Big Endian machine BIG to Little endian machines LITTLE?

(A) Within a 32-bit word, data from byte 0 of BIG is transferred to byte 0 of LITTLE, byte 1 to byte 1, byte 2 to byte 2, byte 3 to byte 3.

(B) Within a 32-bit word, data from byte 0 of BIG is transferred to byte 3 of LITTLE, byte 1 to byte 2, byte 2 to byte 1, byte 3 to byte 0.

(C) Within a 32-bit word, either the method described in (A) or the method described in (B) will be used depending on the type of data stored in the word .

(D) Data cannot be exchanged between little- and big- endian machines.

(E) The rules for data transfer from BIG to LITTLE are not the same as the rules for data transfer from LITTLE to BIG.

Short Answer Questions

The following questions were chosen so that they can be answered in a few words. A longer answer, even though more complete, is not better, and will receive a lower grade. The maximum score for each question is indicated.

15. (5 points) The five words on the left represent machine code for MIPS instructions. Match **each** word of machine code to its corresponding MIPS instruction on the right.

(A)	`0x8eaaaaaa`	(1)	`add $7, $2, $5`
(B)	`0x00444022`	(2)	`lw  $10, -21846($21)`
(C)	`0x00453820`	(3)	`sub $8, $2, $4`
(D)	`0x3c030100`	(4)	`sw  $5, 2570($20)`
(E)	`0xae850a0a`	(5)	`lui $3, 256`

16. (2 points) Ternary is the base 3 number system (binary is base 2, and decimal is base 10).

(A) What digits would be allowed in ternary?

(B) Give the ternary representation for the decimal number 46.

17. (2 points)

(A) What is the 8-bit 2’s complement representation of the integer -128?

(B) What is the additive inverse (negative) of this number?

18. (3 points) Add the following 8-bit 2’s complement numbers. If the result is stored in 8 bits, which (if any), of the additions cause overflow?

```
(A)      10111000      (B)      00001111      (C)      01001100
 +       11100101       +       11110000       +       01110011
```

19. (3 points) Give an algorithm to detect overflow during the addition of two 16-bit 2’s complement integers.

20. (3 points) Show the representation of -27 as an 8-bit binary number in

(A) Sign/Magnitude representation.

(B) 1’s complement representation.

(C) 2’s complement representation.

21. (2 points) Assume a computer does not have an unconditional branch instruction but otherwise has the instructions of the MIPS R-2000. How can you simulate the unconditional branch using a single conditional branch instruction?

22. **(2 points)** Multiply the 4-bit 2's complement numbers 0z0110 and 0z1100. Show the result in 8 bits.

23. **(2 points)** Assume that memory has the following information.

Address	Contents
`0x40`	`10`
`0x44`	`20`
`0x48`	`30`
`0x4c`	`lw   $3, ($2)`
`0x50`	`lw   $4, 4($2)`
`0x54`	`lw   $5, 8($2)`
`0x58`	`add  $6, $3, $4`
`0x5c`	`add  $6, $6, $5`
`0x60`	`sw   $6, -12($2)`

Further assume that initially `$2` contains the value `0x40,` and the PC contains the value `0x4c.` At the end of six instruction cycles show the contents of:

(A) All the registers used by the program.

(B) The address and content of memory locations whose contents have been modified by the program.

24. **(3 points)** What is the result of adding the 8-bit 2's complement number `0z11000100` to the 16-bit 2's complement number `0z0000100000101111` ? Show your work.