# Computer Organization & Assembly Languages

**Midterm Exam – 2006/11/30**

**Dept. of Engineering Science, National Cheng Kung University**

**1. [16 points] General Knowledge**

**(A) Short Answer: Assume using the MIPS architecture.**

(1) How many bits are used to represent an "int" in C? 32

(2) How many bits are used to represent a "float" in C? 32

(3) One of the most important examples of an abstraction is the interface between hardware and the lowest-level software. What is this abstraction called? instruction set architecture

(4) List the five class components of a computer as defined by the textbook authors. input, output, datapath, control, memory.

**(B) True/False: Ambiguous responses will be marked wrong.**

(5) True/False The stack in MIPS grows from higher address to lower address. T

(6) True/False Conditional branches in MIPS employ PC-relative addressing. T

(7) True/False A left shift instruction can replace an integer multiply by a power of 2 if no overflow occurs. T

(8) True/False A right shift instruction can replace an integer division by a power of 2 if no underflow occurs. F

**2. [6 points]** Suppose die area is 0.4 $cm^2$ and there are 8 defects per $cm^2$. Calculate the yield. Then calculate the yield if defects per area can be cut in half. Note that the answers should be in the form of xx.xx%.

$$Yield = \frac{1}{\left(1+DefectsPerArea \bullet \frac{DieArea}{2}\right)^2}$$

$Y = \frac{1}{(1+8\times\frac{0.4}{2})^2} = 14.79\%$

$Y' = \frac{1}{(1+4\times0.2)^2} = 30.86\%$

**3. [12 points] Fill in the following blanks.**

R-format:

| op | rs | rt | rd | shamt | funct |
|---|---|---|---|---|---|
| 6 bits | 5 bits | 5 bits | 5 bits | 5 bits | 6 bits |

I-format:

| op | rs | rt | Addr/immediate |
|---|---|---|---|
| 6 bits | 5 bits | 5 bits | 16 bits |

J-format:

| op | address |
|---|---|
| 6 bits | 26 bits |

**4. [4 points]** Explain the meaning of the *stored-program* concept.

内储程式观念，指将指令，程序元，当用数字的形式表存，如此可让系统更加一致性，也是现今系统储存的方式

**5. [16 points]** Compile the following C program into MIPS instructions. Assume that the usage of registers is specified as (f : $s0).

```
int function_x (int* a, int h){
    int f;
    if (h >= 0)     f = a[10] + h;
    else            f = a[10] - h;
    return f;
}
```

a0 a1

jr → jump-register, jump到register所在的位址，常用於一程序執行完要返回程式時

addi $sp, $sp, -4
sw $s0, 0($sp)
lw $t0, 40($a0) [若$a1 < Zero, 則$t1=1]
slt $t1, $a1, $zero
bne $zero, $t1, else
add $s0, $t0, $a1
j exit
else: sub $s0, $t0, $a1

**6. [6 points]** Make a comparison among the following three MIPS instructions: j, jr and jal.

j: jump
jal: jump and link
jal → jump and link, jump到指定的程序，並將PC+4的位址放置在$ra，如此當使用jr $ra時即可跳回，並優先於程式的下一行指令繼續執行，J格式

無條件jump，為J格式

**7. [16 points]** Given a 32-bit bit pattern: 00110010010100010010101010110010

(1) What is the corresponding hexdecimal representation if it is an integer? 32 52 2A 52

(2) What is the corresponding string if it is an ASCII string? 2Q*R

(3) What is the corresponding instruction if it is a MIPS instruction? 001|00|0 | 0|0|000|
50 81

(4) Assume that $t0=$t1=$t2=$t3=$23_{ten}$ and $s0=$s1=$s2=$s3=$51_{ten}$. If the instruction decoded in (3) is then executed, which register is updated? What is the new value (in decimal) for this register? (13) 31~29 28~26 I-type

(14) $s1, 18

001 100

001|00 | 100|0 | 1000|
6 5 5

**8. [6 points]**

Add $3.63_{ten} \times 10^4$ to $6.87_{ten} \times 10^3$, assuming that you have only three significant digits, first with guard and round digits and then without them.

00|0|0|00|0|00|0
16

**9. [8 points]**

Show the IEEE 754 binary representation for the floating-point number $20.5_{ten}$ and $-5/6_{ten}$ in single precision, respectively.

**10. [4 points]**

When using the IEEE 754 format, what is the meaning of *overflow* and *underflow*, respectively?

**11. [6 points]**

Raise a counterexample to prove that floating-point addition may not be associative; that is, x+(y+z) != (x+y)+z. Explain why it happens for computer arithmetic.