Fall, 2023
Week 6
2023.10.16

組別：_____　　簽名：_____

[group11]

1. 綜合題

    (a)Jump addressing can jump to anywhere in memory. Is this statement true or false?

    (b)In the MIPS instruction set, given that the current value of the PC (Program Counter) is 0xCA40001C, and the instruction is 0x08228BCC, what is the target address?

    (c) What is the immediate value of the branch instruction below?

    Loop:

slt	$10, $9, 8
beq	$10, $0, End
addi	$9, $9, -1
j	Loop

    End:

    Ans:

    (a)False.

    The range of a jump is limited and is determined by the 4 highest order bits of the Program Counter. The target address for a jump instruction is constructed by taking these 4 bits from the PC, with the last two bits always set to 00.

    (b)0xC08A2E30

    Pc address : 0xCA40001C

    1100,1010……

    instr : 0x08228BCC

    0000,10(opcode)00,0010,0010,1000,1011,1100,1100

    (4 highest order bits of the pc)+(26 bit address)+(word aligned, always 00)

    1100 || 0000,1000,1010,0010,1111,0011,00 || 00

    0xC08A2F30

    (c)2

    Number of instructions to add to (or subtract from) the PC, starting at the instruction following the branch

    => immediate = 2

2. Translate the following C code to MIPS assembly code. Assume that v and k, they will be found in registers t0 and t1. The only other variable is temp, which we associate with register a0.

temp = v[k];

v[k] = v[k+1];

v[k+1] = temp;

Ans:

swap:

slli a1, t1, 2 // reg a1 = k * 4

add a1, t0, a1 // reg a1 = v + (k * 4)

lw a0, 0(a1) // reg a0 (temp) = v[k]

lw a2, 4(a1) // reg a2 = v[k + 1]

sw a2, 0(a1) // v[k] = reg a2

sw a0, 4(a1) // v[k+1] = reg a0 (temp)

jr ra // return to calling routine

3.

(a) What are the 5 addressing modes and 3 types of instructions in MIPS?

(b) What instruction type does each addressing mode belong to?Besides, please give an instruction example for each addressing mode

Ans:

The 5 addressing modes are: Immediate addressing、register addressing、base addressing、PC-relative addressing、pseudodirect addressing

The 3 types of instruction: R-type、I-type、J-type

Immediate addressing：I-type, ex: addi、ori

Register addressing：R-type, ex: add、sub

Base addressing: I-type, ex: lw、sw

PC-relative addressing：I-type, ex: beq、bne

Pseudodirect addressing ：J-type ex：j

4. Convert the C code below into MIPS.
   int leaf(int a, int b) {
       int f;
       f = a - b;
       return f;
   }

   int non_leaf(int g, int h, int i, int j) {
       int f;
       f = leaf(g + h, i + j);
       return f;
   }

   Ans:
   leaf:
       sub $t0, $a0, $a1
       add $v0, $t0, $zero
       jr $ra

   non_leaf:
       addi $sp, $sp, -4
       sw $ra, 0($sp)
       add $a0, $a0, $a1
       add $a1, $a2, $a3
       jal leaf
       lw $ra, 0($sp)
       addi $sp, $sp, 4
       jr $ra

5. Please briefly describe after j type instruction deducting 6 bits, how can we specify a 32-bit memory address to jump to?

   Ans:
   First, add "00" at the end of the address (在後面加入"00"). After that, take the 4 highest order bits from the PC, and prepend them to the address. With the operations, we have a full 4+26+2=32 bit address to utilize.

6. In the execution of a procedure, the program must follow some steps. What is the correct order these 6 steps happen in？

A：Acquire the storage resources needed for the procedure.

B：Perform the desired task.

C：Put the result value in a place where the calling program can access it.

D：Put parameters in a place where the procedure can access them.

E：Transfer control to the procedure.

F：Return control to the point of origin, since a procedure can be called from several points　　in a program.

Ans:

D -> E -> A -> B -> C -> F

7. Choose the correct statements.

　　(A) In branch addressing, opcode specifies beq or bne; rs and rt specify registers to compare and immediate specifies the entire address of the label to jump.

　　(B) In non-leaf procedures, it is necessary to store $ra.

　　(C) Instruction in callee and which in caller use different register file.

　　(D) Assume base address of A in $s0 and $s0=1000.

　　lb $s1 0($s0)

　　lbu $s2 2($s0)

Memory location	1000	1001	1002	1003
value	15	C7	66	F0

After the following instructions are executed,

$s1=0x11111115 and $s2=0x000000F0.

Ans:(B)

The wrong answer:

(A)immediate is 16 bits and address is 32 bits, so immediate can't specify the entire address.

(C)There is only one register file.

(D) $s1=0x77777715

8. Choose the correct answer(s) for the following statements:

(A) Caller is in charge of placing parameter in registers, transferring control to procedure, which acquires storage for procedure

(B) There are 32 registers can be defined freely by the programmer

(C) We have one register file in caller and callee, so when using it, what we only need to do is storing the former data in a stack in memory

(D) We can implement a recursive function in non-leaf procedure

Ans:

D

(A) Caller doesn't acquire the storage for procedure

(B) Some registers are defined in hardware and programmer cannot redefine them such as $zero

(C) also need to reload it back to the restore

(D) is correct, see example in p.89 on the lecture slide