

Computer Architecture

Fall, 2019

Week 3

2019.9.23

組員簽名： _____

[group7] (對抗賽)

- (a) 為什麼需要存取資料時需要對齊(Alignment)記憶體?
(b) 如果記憶體不對齊，那存取資料時可能會發生什麼情況?舉例說明。

A :

(a) 進行存取會最有效率。

word 是存取記憶體最自然的單位。word 的大小是電腦架構所定義，一般現代的系統通常 word 不是 4bytes(32bit)就是 8bytes(64bit)。早期的電腦記憶體只能以 word 為單位進行存取，因此所有的記憶體存取都要落在以 word 為倍數的邊界上。但現代的電腦架構通常能夠存取小至單獨的 byte，大至多個 word。

(b)

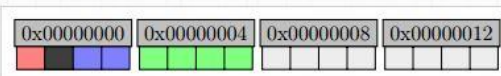
想像一個簡單的情況，假設電腦的系統是以word(4bytes)來存取，假設我們要在記憶體內擺放一個char，一個short，一個int

沒對齊的情況：



如果要存取int，那麼需要先存取第一個word，再存取第二個word，然後各自做bit shift再組合起來，才有辦法得到int。原本只要存取記憶體一次的，結果現在要兩次，還有額外計算bitshifting的開銷。這是很嚴重的問題，在某些架構上可以造成兩倍以上的效能差異。

對齊的情況：



我們在第一個char之後加一個padding byte，int符合4-bytes對齊，此時存取就簡單多了，只要一次memory access即可。

[group5] (對抗賽)

- There is no instruction move (move the data from one register to another register), but we still can move the data from one register to another, how?

A2: by using add (ex: add \$t1 \$s1 \$zero)

[group11] (對抗賽)

3. What is the difference between register and memory? Consider from 3 distinct perspective, including access frequency, size, access speed.

Ans:

1. Register holds the data that the CPU is currently processing, whereas the memory holds the data which will be required for processing
2. The register ranges from 32-bits register to 64-bits register, whereas the memory capacity ranges from some GB to some TB
3. The processor accesses register faster than the memory

[group9] (對抗賽)

4. Which statement below is true for MIPS?
- (A) Assembly use RAM as a place for temporary storage.
 - (B) The data stored in a 32 bits wide register can also be called as a word.
 - (C) ADD \$0, 1, 1 is a valid assembly code.
 - (D) Normally each register is 32bits, while Floating Point register is 64bits.

ANS.

- (A) Assembly use **register file** as a place for temporary storage.
- (B) true
- (C) ADD need **three register operands**
- (D) Floating Point register is **32bits**.

[group10] (對抗賽)

5. 下列關於 MIPS 敘述哪些符合 design principle : **Simplicity favors regularity?**
- (A)所有 instructions 皆為 32 bits
 - (B) Basic MIPS arithmetic/logic instructions 中為 1 operator, 3 operands
 - (C) 在每種 instruction 格式中，暫存器欄位(register fields)固定在相同地方
 - (D) 在每種 instruction 格式中，指令欄位(opcode fields)固定在相同地方

ANS : ABCD

[group2] (對抗賽)

6.

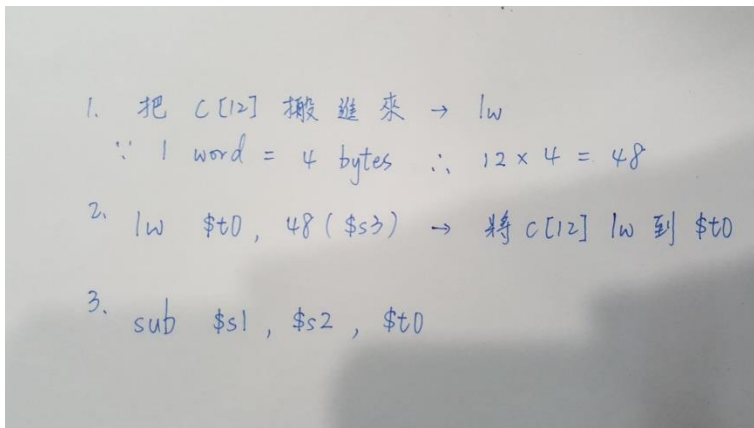
\$s1:a, \$s2:b, \$s3:base address of C

$a = b - C[12]$

Q1:Please write down the assembly code.

Q2:Please explain your assembly code.

答案：



[group12] (對抗賽)

7. The following is the part of MIPS code, after executing it, what is the result of \$t3?
(Suppose a integer array A, $A[i]=2*i$, the base address of A is in \$s3)

```
1 addi $t0, $0, 5
2 add $t0, $t0, $t0
3 add $t0, $t0, $t0 # or it could be sll $t0, $t0, 2
4 add $t1, $s3, $t0
5 lw $t2, 0($t1)
6 add $t2, $t2, $t2
7 add $t2, $t2, $t2
8 add $t1, $s3, $t2
9 lw $t3, 0($t1)
```

A: 20

[group4]

8. For the following MIPS assembly instructions above, what is a corresponding C statement?

add f, g, h

add f, i, f

ANS: $f = i + (g + h)$