

Introduction to Computer Organization (ICO, CCIT 4026)

HKU SPACE Community College

AY2526 S2

(Assignment #1)

Instructions:

1. Fill in the information

		(Insert a photo of your student ID card below)
Student Name:		(No mark would be given if no student ID card is present here)
Student no.:		
Class Number:		

2. **TYPE** all your answers on the space provided or screen capture of your final assembly source code (with colors) and the input/output messages and paste onto this WORD file, then convert to PDF format for submission.
3. Make sure the source codes are readable and neatly formatted. Unclear, incorrectly-sized or codes of poor readability would **NOT** be graded.
4. Add adequate amount of program remarks to improve readability.
5. All problems are expected to be answered by using the **results/instructions** mentioned in the course materials. If you have to bring in results/instructions out of this scope, prior consent from the lecturer should be sought and a proper citation has to be provided otherwise the answers would be considered as **INCORRECT**.
6. Where applicable, it is okay to run (and single-step) your codes on MARS simulator to confirm its functionality before submission.
7. No late submission will be accepted.
8. Please read the Student Handbook for issues related to academic honesty. The College places very high importance on honesty in academic work submitted by students, and adopts a policy of zero tolerance on cheating and plagiarism. Any related offense may be passed to the Guidance Committee. Possible disciplinary action, including termination of study, may follow.
9. By making a submission, you also confirm to have read and understood the above-listed instructions and HKU SPACE Community College's academic honesty policy, and agree to comply with them. Failure to comply with the above instructions may lead to disqualification of your assignment results and possible disciplinary actions.

Answer ALL FOUR questions:

Q1. [30 marks]

Given the following data segment definition in a MIPS assembly program, clearly draw the memory map and content of this data segment with the corresponding physical address, label name and memory content for each variable.

```

Str1:      .data
           .space 3
           .ascii "abc"
           .align 2
Str2:      .asciiz "DEFG"
Hf:        .half 18
W:         .word -1, 3
B:         .byte 4
Str3:      .asciiz "\n"
    
```

Assume the starting address of the data segment is **0x2000** and ALL memory contents are initialized to **ZERO** after reset. **Assume Little Endian byte ordering.**

[25 marks]

For example:

```

           .data
           .space 1
Test:     .byte 12
    
```

Address in Byte (Hexadecimal)	Label Name	Memory Content (Hexadecimal)
0x1000		X
0x1001	Test:	0x0C

Place a "X" for reserved space

Fill your answers below:

Byte Address (Hexadecimal)	Label Name	Memory Content (Hexadecimal)
0x2000		
0x2001		
0x2002		
0x2003		
0x2004		
0x2005		
0x2006		
0x2007		
0x2008		
0x2009		
0x200A		
0x200B		
0x200C		
0x200D		
0x200E		
0x200F		
0x2010		
0x2011		
0x2012		
0x2013		
0x2014		
0x2015		
0x2016		
0x2017		
0x2018		
0x2019		
0x201A		
0x201B		

Q2. [20 marks]

Given the following MIPS program:

```
.data
sid: .word d2 d1 d0
     .word d4
s:   .word d3

.text
.globl __start
__start:

la $t0, sid
lw $t1, 8($t0)
la $t2, s
lw $t3, -4($t2)
li $t4, 0x20
add $t4, $t4, $t1
sub $t5, $t4, $t3

li $v0, 10          # terminating the program
syscall
```

The values of d4, d3, d2, d1 and d0 are determined based on your student no., for example, if your student no. is 12345678,

d4	d3	d2	d1	d0
4	5	6	7	8

The starting address of the data segment is assumed to be set according to the following table,

1 st Student Number	Starting address of data segment
1	0x0000 0010
2	0x0000 0020
3	0x0000 0030
4	0x0000 0040
5	0x0000 0050
6	0x0000 0060
7	0x0000 0070

8	0x0000 0080
9	0x0000 0090
0	0x0000 00A0

For example, if your student no. was 12345678, your 1st student number would be **8** so the starting address of the data segment is **0x0000 0080**.

Based on your student no., what will be the values stored in \$t1, \$t2, \$t3, \$t4 and \$t5 (in decimal) after the program is executed?

Fill in your answers below:

Your student no.:	
-------------------	--

d4	d3	d2	d1	d0

1 st Student Number	Starting address of data segment

	Values (in decimal) after the program is executed.
\$t1=	
\$t2=	
\$t3=	
\$t4=	
\$t5=	

Q3. [25 marks]

Assemble the machine codes of the following 2 MIPS instructions (all the way to HEX values) according to your student no.

2 nd Student Number	Instruction 1	Instruction 2
1	add \$s5, \$t0, \$v0	lw \$t1, -2(\$s0)
2	add \$s5, \$t1, \$v1	lw \$t1, -4(\$s1)
3	add \$s5, \$t2, \$v0	lw \$t1, -6(\$s0)
4	add \$s5, \$t3, \$v1	lw \$t1, -8(\$s1)
5	add \$s5, \$t4, \$v0	lw \$t1, -10(\$s0)
6	add \$s5, \$t5, \$v1	lw \$t1, -12(\$s1)
7	add \$s5, \$t6, \$v0	lw \$t1, -14(\$s0)
8	add \$s5, \$t7, \$v1	lw \$t1, -16(\$s1)
9	add \$s5, \$t8, \$v0	lw \$t1, -18(\$s0)
0	add \$s5, \$t9, \$v1	lw \$t1, -20(\$s1)

For example, if your student no. was 123456**1**8, your 2nd student number would be **1** so the two instructions are:

2 nd Student Number	Instruction 1	Instruction 2
1	add \$s5, \$t0, \$v0	lw \$t1, -2(\$s0)

a) TYPE the machine codes in HEX and clearly show the values for each bit field of the Instruction 1 below:

Instruction 1:

b) TYPE the machine codes in Hex and clearly show the values for each bit field of Instruction 2 below:

Instruction 2:

Q4. [25 marks]

Given two arrays $A = \{a_0, a_1\}$ and $B = \{b_0, b_1\}$, each array contain 2 **WORD** elements defined as follows,

Array_A: .word a_0, a_1

Array_B: .word b_0, b_1

The values of the elements in Array_A and Array_B are determined by your student no., for example, if your student no. is **12345678**,

a_0	a_1	b_0	b_1
5	6	7	8

Therefore the two arrays would be defined as,

Array_A: .word 5 6

Array_B: .word 7 8

The dot product C of A and B is calculated by,

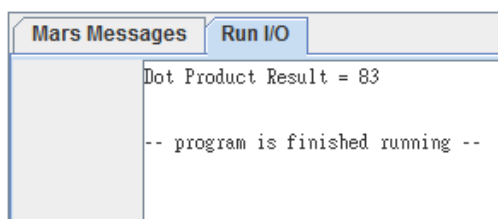
$$C = \langle A \cdot B \rangle = \sum_{i=0}^1 a_i b_i.$$

Hence $C = 5 \times 7 + 6 \times 8 = 83$.

Write a MIPS program to calculate and print the dot product C **based on your student no.**

Assume the starting address for the two arrays should be stored in **\$t0 and \$t1**, screen capture your source code and the output results shown on the "RUN I/O" windows on the space provided below.

For example, if your student no. is **12345678**, the following output message should be shown,



Fill in your answers below:

Your student no.:	
-------------------	--

a_0	a_1	b_0	b_1	Expected value of $C = \langle A \cdot B \rangle = \sum_{i=0}^1 a_i b_i$

Attached your screen capture of your final assembly program source code from MARS editor with line no.) below:

Attached your screen capture of output message shown in the “RUN I/O” window

END OF ASSIGNMENT 1