

### Homework 4 Answer Sheet

Please state the name, SID and email of each member of your group.

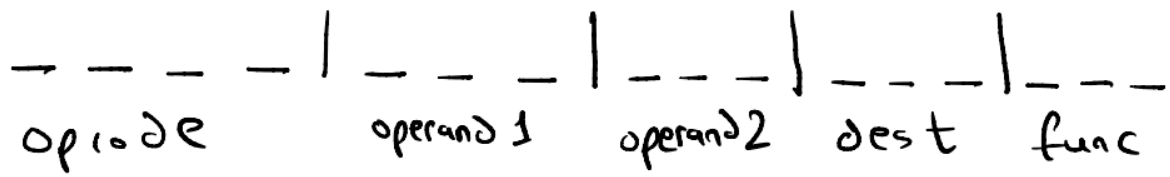
member	name	SID	email
#1 (contact person)	Beket YERMEKOV	56679630	byermekov2-c@my.cityu.edu.hk
#2	Alibi ZHENIS	57065469	azhenis4-c@my.cityu.edu.hk
#3	Intiser RAHMAN	56880558	irahman2-c@my.cityu.edu.hk

A. Do all members make significant contributions to this homework? If not, please specify the details.

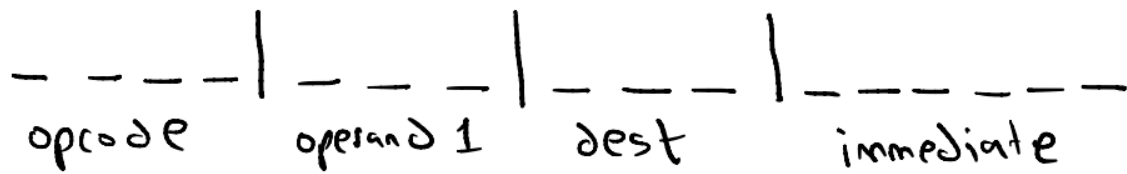
Yes, everyone has made equal amount of contribution in assembling the CPU.

B. Please explain how many types of instructions are supported in your processor, and explain the format of each type of instructions (e.g., which bits are used as the operation or function code, which bits are used to index the 1<sup>st</sup>, 2<sup>nd</sup> or 3<sup>rd</sup> operand, and which bits are used to store the immediate number). You can draw figures to better explain your answer.

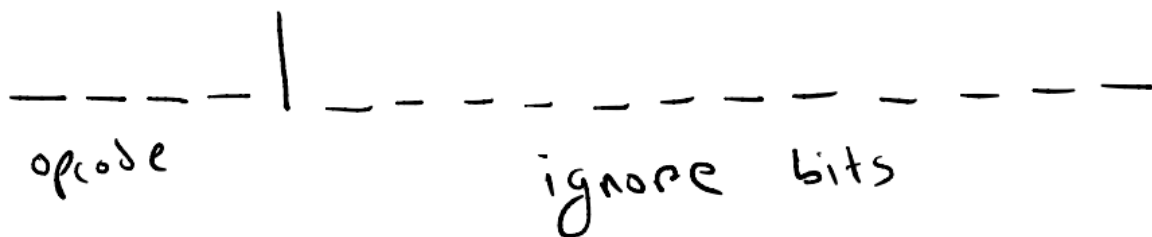
r-type



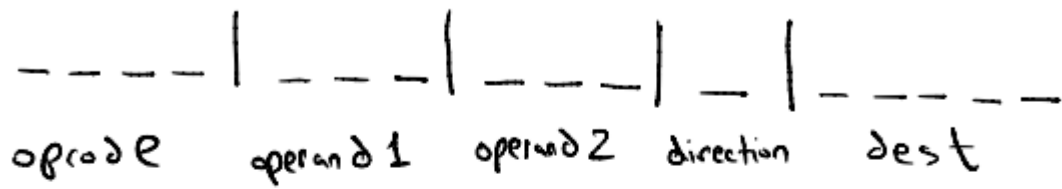
i-type



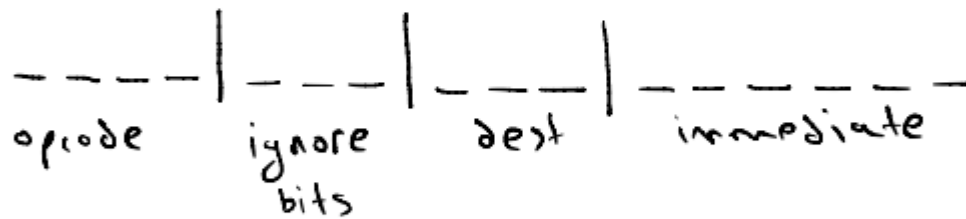
Halt/Return



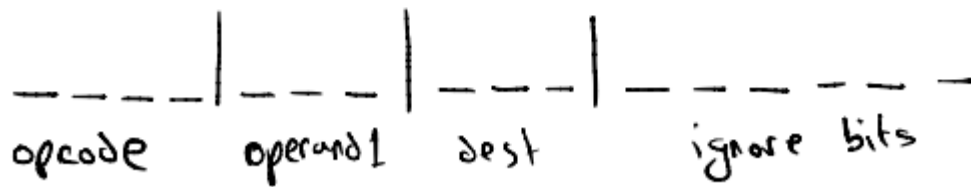
Branch



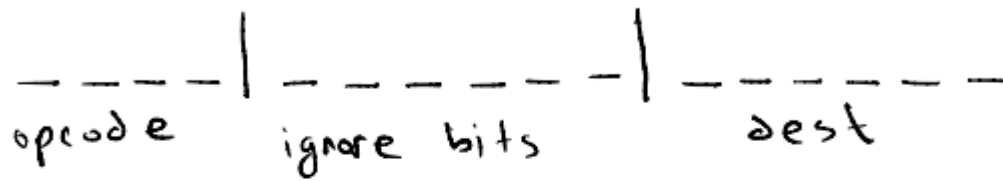
Li



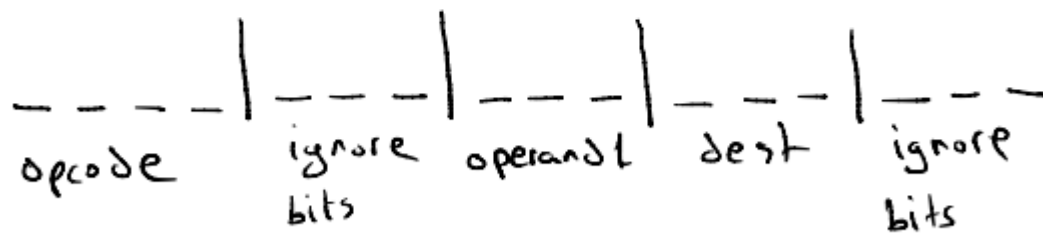
Load / Store



call/Jump



Move



- C. Please explain the format of each instruction (including the format of this instruction and its operation codes, and other information if needed).

(x-ignore, o1 – operand1, o2-operand2, dir – direction of jump, d-dest, i-immediate)

li	0101 xxx ddd iiiii
add	0000 o1o1o1 o2o2o2 ddd 000
and	

	0000 o1o1o1 o2o2o2 ddd 011
or	0000 o1o1o1 o2o2o2 ddd 100
load	1001 o1o1o1 ddd xxxxxx
store	1011 o1o1o1 ddd xxxxxx
move	0111 xxx o1o1o1 ddd xxx
addi	0011 o1o1o1 ddd iiiiii
andi	0001 o1o1o1 ddd iiiiii
ori	

	0010 o1o1o1 ddd iiiii
ble	0100 o1o1o1 o2o2o2 dir ddddd
bne	
jump	1100 xxxxxx ddddd
call	0110 xxxxxx ddddd
rtn	1000 xxxxxxxxxxxx
halt	1111 xxxxxxxxxxxx

D. Fill the following tables with the machine codes of each instruction of the testing programs:

**Test program 1:**

instruction	machine code (binary)	machine code (hex)
li \$r1, 1	0101000000000001	5001
li \$r2, 2	0101000001000010	5042
li \$r3, 10	0101000010001010	508a
add \$r2, \$r1, \$r2	0000000001001000	0048
ble \$r2, \$r3, -1	0100001010100001	42a1
halt	1111000000000000	F000

**Test program 2:**

instruction	machine code (binary)	machine code (hex)
li \$r1, 6	0101000000000110	5006
li \$r2, 5	0101000001000101	5045
andi \$r3, \$r1, 3	0001000010000011	1083
ori \$r4, \$r3, 8	0010010011001000	24c8
halt	1111000000000000	F000

**Test program 3:**

instruction	machine code (binary)	machine code (hex)
li \$r1, 6	0101000000000110	5006
li \$r2, 5	0101000001000101	5045
and \$r3, \$r1, \$r2	0000000001010011	0053
li \$r8, 0	0101000111000000	51c0
store \$r3, \$r8	1011111010000000	Be80
or \$r4, \$r1, \$r2	0000000001011100	005c
li \$r8, 1	0101000111000001	51c1
store \$r4, \$r8	1011111011000000	Bec0
li \$r8, 1	0101000111000001	51c1
load \$r7, \$r8	1001111110000000	9f80
halt	1111000000000000	F000

**Test program 4:**

instruction	machine code (binary)	machine code (hex)
li \$r1, 6	0101000000000110	5006
li \$r2, 4	0101000001000100	5044
call 7	0110000000000111	6007
move \$r4, \$r3	0111000010011000	7098
li \$r1, 7	0101000000000111	5007
li \$r2, 8	0101000001001000	5048
call 3	0110000000000011	6003
move \$r5, \$r3	0111000010100000	70a0
jump 3	1100000000000011	C003
add \$r3, \$r1, \$r2	0000000001010000	0050
rtn	1000000000000000	8000
halt	1111000000000000	F000

