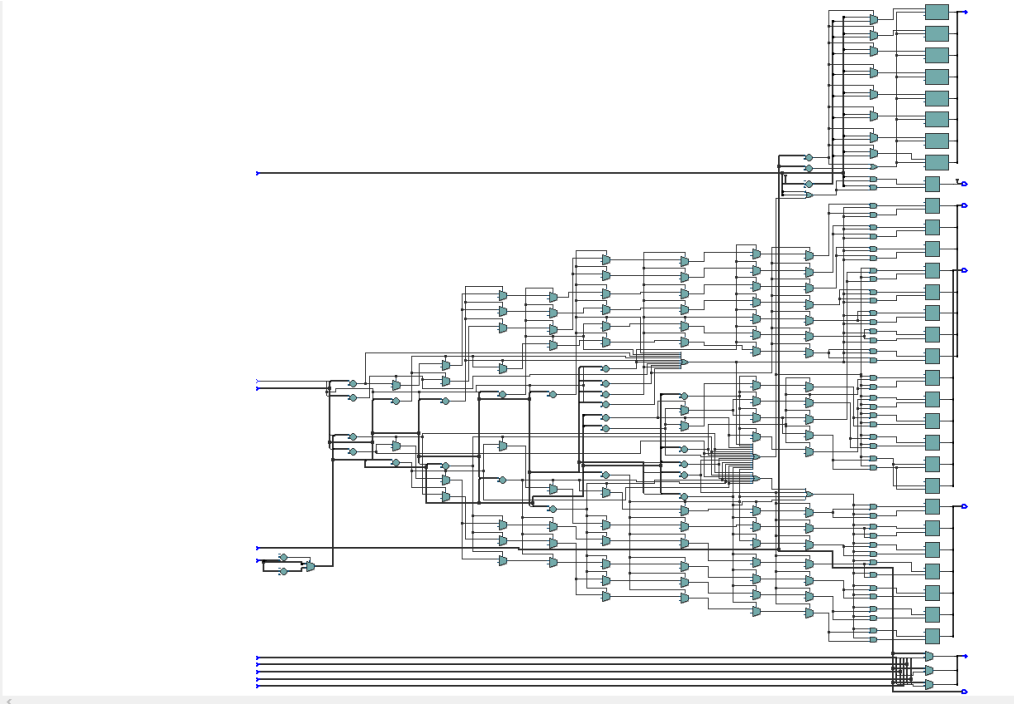
Sasha Floru

Project Overview:

ALM Count: 296

RTL Diagram



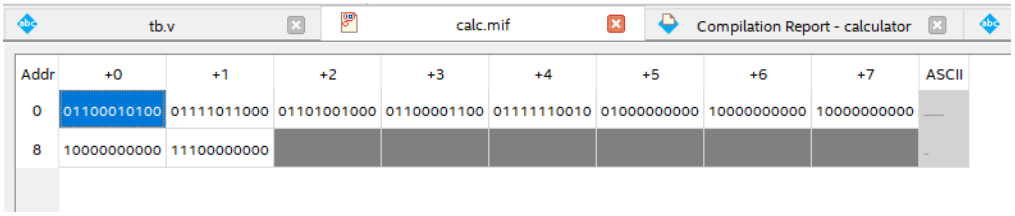
Encoding:

op_code → 3 bits
operand (number) → 8 bits
Format: op_code, operand

Example:
01100001000 → push 8
01111110110 → push 10
01000000000 → multiply

op_code	operation
001	push
100	add
101	sub
010	mult
111	halt

Input Example (See Additional Example)



Addr	+0	+1	+2	+3	+4	+5	+6	+7	ASCII
0	01100010100	01111011000	01101001000	01100001100	01111110010	01000000000	10000000000	10000000000	.....
8	10000000000	11100000000							..

Example A

push 8	01100001000
push 5	01100000101
push 3	01100000011
mult	01000000000
sub	10100000000
halt	11100000000

Testbench output :

```
# Top level modules:
# tb
# End time: 11:39:42 on Mar 03,2024, Elapsed time: 0:00:00
# Errors: 0, Warnings: 0
vsim -gui -l msim_transcript work.tb -Lf altera_mf_ver
# vsim -gui -l msim_transcript work.tb -Lf altera_mf_ver
# Start time: 11:39:54 on Mar 03,2024
# Loading work.tb
# Loading work.calculator
# Loading work.myrom
# Loading altera_mf_ver.altsyncram
# Loading altera_mf_ver.altsyncram_body
# Loading altera_mf_ver.ALTERA_DEVICE_FAMILIES
# Loading altera_mf_ver.ALTERA_MF_MEMORY_INITIALIZATION
run -all
# time =          0 | clk = 0 | pc =   0 | op_code = 000 | operand = 00000000 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          1 | clk = 1 | pc =   1 | op_code = 000 | operand = 00000000 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          2 | clk = 0 | pc =   1 | op_code = 000 | operand = 00000000 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
```

```
# time =         3 | clk = 1 | pc =   2 | op_code = 011 | operand = 00001000 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =         4 | clk = 0 | pc =   2 | op_code = 011 | operand = 00001000 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =         5 | clk = 1 | pc =   3 | op_code = 011 | operand = 00000101 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0000000 |overflow = 0 |topofstack =    8
# time =         6 | clk = 0 | pc =   3 | op_code = 011 | operand = 00000101 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0000000 |overflow = 0 |topofstack =    8
# time =         7 | clk = 1 | pc =   4 | op_code = 011 | operand = 00000011 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0010010 |overflow = 0 |topofstack =    5
# time =         8 | clk = 0 | pc =   4 | op_code = 011 | operand = 00000011 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0010010 |overflow = 0 |topofstack =    5
# time =         9 | clk = 1 | pc =   5 | op_code = 010 | operand = 00000000 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0110000 |overflow = 0 |topofstack =    3
# time =        10 | clk = 0 | pc =   5 | op_code = 010 | operand = 00000000 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0110000 |overflow = 0 |topofstack =    3
# time =        11 | clk = 1 | pc =   6 | op_code = 101 | operand = 00000000 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0010010 |overflow = 0 |topofstack =   15
# time =        12 | clk = 0 | pc =   6 | op_code = 101 | operand = 00000000 | HEX3 = 1111111|
HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0010010 |overflow = 0 |topofstack =   15
# time =        13 | clk = 1 | pc =   7 | op_code = 111 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        14 | clk = 0 | pc =   7 | op_code = 111 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        15 | clk = 1 | pc =   8 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        16 | clk = 0 | pc =   8 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        17 | clk = 1 | pc =   9 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        18 | clk = 0 | pc =   9 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        19 | clk = 1 | pc =  10 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        20 | clk = 0 | pc =  10 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        21 | clk = 1 | pc =  11 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        22 | clk = 0 | pc =  11 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        23 | clk = 1 | pc =  12 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =        24 | clk = 0 | pc =  12 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
```

```
# time =         25 | clk = 1 | pc =  13 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         26 | clk = 0 | pc =  13 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         27 | clk = 1 | pc =  14 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         28 | clk = 0 | pc =  14 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         29 | clk = 1 | pc =  15 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         30 | clk = 0 | pc =  15 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         31 | clk = 1 | pc =  16 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         32 | clk = 0 | pc =  16 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         33 | clk = 1 | pc =  17 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         34 | clk = 0 | pc =  17 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         35 | clk = 1 | pc =  18 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         36 | clk = 0 | pc =  18 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         37 | clk = 1 | pc =  19 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|
HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111000 |overflow = 0 |topofstack =   -7
# time =         38 | clk = 0 | pc =  19 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|

# ** Note: $finish    : C:/Users/afloru1/OneDrive - Brown University/engn1640/hw3/tb.v(60)
#    Time: 500 ns  Iteration: 0  Instance: /tb
```

Example B

- Expected result: 14

push 5	01100000101
push 1	01100000001
push 2	01100000010

add	10000000000
push 4	01100000100
mult	01000000000
push 3	01100000011
sub	10100000000
halt	11100000000

Testbench output:

```
# Top level modules:
# tb
# End time: 11:34:24 on Mar 03,2024, Elapsed time: 0:00:00
# Errors: 0, Warnings: 0
vsim -gui -l msim_transcript work.tb -Lf altera_mf_ver
# vsim -gui -l msim_transcript work.tb -Lf altera_mf_ver
# Start time: 11:34:35 on Mar 03,2024
# Loading work.tb
# Loading work.calculator
# Loading work.myrom
# Loading altera_mf_ver.altsyncram
# Loading altera_mf_ver.altsyncram_body
# Loading altera_mf_ver.ALTERA_DEVICE_FAMILIES
# Loading altera_mf_ver.ALTERA_MF_MEMORY_INITIALIZATION
run -all
# time =          0 | clk = 0 | pc =   0 | op_code = 000 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          1 | clk = 1 | pc =   1 | op_code = 000 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          2 | clk = 0 | pc =   1 | op_code = 000 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          3 | clk = 1 | pc =   2 | op_code = 011 | operand = 00000101 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          4 | clk = 0 | pc =   2 | op_code = 011 | operand = 00000101 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          5 | clk = 1 | pc =   3 | op_code = 011 | operand = 00000001 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 1000000| HEX0 = 0010010 |overflow = 0 |topofstack =    5
# time =          6 | clk = 0 | pc =   3 | op_code = 011 | operand = 00000001 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 1000000| HEX0 = 0010010 |overflow = 0 |topofstack =    5
```

time = 7 | clk = 1 | pc = 4 | op_code = 011 | operand = 00000010 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111001 |overflow = 0 |topofstack = 1
time = 8 | clk = 0 | pc = 4 | op_code = 011 | operand = 00000010 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 1111001 |overflow = 0 |topofstack = 1
time = 9 | clk = 1 | pc = 5 | op_code = 100 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0100100 |overflow = 0 |topofstack = 2
time = 10 | clk = 0 | pc = 5 | op_code = 100 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0100100 |overflow = 0 |topofstack = 2
time = 11 | clk = 1 | pc = 6 | op_code = 011 | operand = 00000100 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0110000 |overflow = 0 |topofstack = 3
time = 12 | clk = 0 | pc = 6 | op_code = 011 | operand = 00000100 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0110000 |overflow = 0 |topofstack = 3
time = 13 | clk = 1 | pc = 7 | op_code = 010 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0011001 |overflow = 0 |topofstack = 4
time = 14 | clk = 0 | pc = 7 | op_code = 010 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0011001 |overflow = 0 |topofstack = 4
time = 15 | clk = 1 | pc = 8 | op_code = 100 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0100100 |overflow = 0 |topofstack = 12
time = 16 | clk = 0 | pc = 8 | op_code = 100 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0100100 |overflow = 0 |topofstack = 12
time = 17 | clk = 1 | pc = 9 | op_code = 011 | operand = 00000011 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 1111000 |overflow = 0 |topofstack = 17
time = 18 | clk = 0 | pc = 9 | op_code = 011 | operand = 00000011 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 1111000 |overflow = 0 |topofstack = 17
time = 19 | clk = 1 | pc = 10 | op_code = 101 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0110000 |overflow = 0 |topofstack = 3
time = 20 | clk = 0 | pc = 10 | op_code = 101 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1000000| HEX0 = 0110000 |overflow = 0 |topofstack = 3
time = 21 | clk = 1 | pc = 11 | op_code = 111 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 22 | clk = 0 | pc = 11 | op_code = 111 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 23 | clk = 1 | pc = 12 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 24 | clk = 0 | pc = 12 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 25 | clk = 1 | pc = 13 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 26 | clk = 0 | pc = 13 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 27 | clk = 1 | pc = 14 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 28 | clk = 0 | pc = 14 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14

time = 29 | clk = 1 | pc = 15 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 30 | clk = 0 | pc = 15 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 31 | clk = 1 | pc = 16 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 32 | clk = 0 | pc = 16 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 33 | clk = 1 | pc = 17 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 34 | clk = 0 | pc = 17 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 35 | clk = 1 | pc = 18 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 36 | clk = 0 | pc = 18 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 = 1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack = 14
time = 37 | clk = 1 | pc = 19 | op_code = 000 | operand = 00000000 | HEX3 = 1111111| HEX2 =
** Note: $finish : C:/Users/afloru1/OneDrive - Brown University/engn1640/hw3/tb.v(60)
Time: 500 ns Iteration: 0 Instance: /tb

Additional Example:

- Expected Result: -116, overflow should be detected during subtraction

push 20	01100010100
push -40	01111011000
push 72	01101001000
push 12	01100001100
push -14	01111110010
multiply	01000000000
add	10000000000
add	10000000000
add	10000000000
halt	11100000000

Testbench output

```
# Top level modules:
# tb
# End time: 11:19:41 on Mar 03,2024, Elapsed time: 0:00:00
# Errors: 0, Warnings: 0
vsim -gui -l msim_transcript work.tb -Lf altera_mf_ver
# vsim -gui -l msim_transcript work.tb -Lf altera_mf_ver
# Start time: 11:19:53 on Mar 03,2024
# Loading work.tb
# Loading work.calculator
# Loading work.myrom
# Loading altera_mf_ver.altsyncram
# Loading altera_mf_ver.altsyncram_body
# Loading altera_mf_ver.ALTERA_DEVICE_FAMILIES
# Loading altera_mf_ver.ALTERA_MF_MEMORY_INITIALIZATION
run -all
# time =          0 | clk = 0 | pc =   0 | op_code = 000 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          1 | clk = 1 | pc =   1 | op_code = 000 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          2 | clk = 0 | pc =   1 | op_code = 000 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          3 | clk = 1 | pc =   2 | op_code = 011 | operand = 00010100 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          4 | clk = 0 | pc =   2 | op_code = 011 | operand = 00010100 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =    0
# time =          5 | clk = 1 | pc =   3 | op_code = 011 | operand = 11011000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0100100| HEX0 = 1000000 |overflow = 0 |topofstack =   20
# time =          6 | clk = 0 | pc =   3 | op_code = 011 | operand = 11011000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0100100| HEX0 = 1000000 |overflow = 0 |topofstack =   20
# time =          7 | clk = 1 | pc =   4 | op_code = 011 | operand = 01001000 | HEX3 = 0111111|  HEX2 =
1000000 | HEX1 = 0011001| HEX0 = 1000000 |overflow = 0 |topofstack =  -40
# time =          8 | clk = 0 | pc =   4 | op_code = 011 | operand = 01001000 | HEX3 = 0111111|  HEX2 =
1000000 | HEX1 = 0011001| HEX0 = 1000000 |overflow = 0 |topofstack =  -40
# time =          9 | clk = 1 | pc =   5 | op_code = 011 | operand = 00001100 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 1111000| HEX0 = 0100100 |overflow = 0 |topofstack =   72
# time =         10 | clk = 0 | pc =   5 | op_code = 011 | operand = 00001100 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 1111000| HEX0 = 0100100 |overflow = 0 |topofstack =   72
# time =         11 | clk = 1 | pc =   6 | op_code = 011 | operand = 11110010 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 1111001| HEX0 = 0100100 |overflow = 0 |topofstack =   12
# time =         12 | clk = 0 | pc =   6 | op_code = 011 | operand = 11110010 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 1111001| HEX0 = 0100100 |overflow = 0 |topofstack =   12
# time =         13 | clk = 1 | pc =   7 | op_code = 010 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack =  -14
```

```
# time =         14 | clk = 0 | pc =   7 | op_code = 010 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1000000 | HEX1 = 1111001| HEX0 = 0011001 |overflow = 0 |topofstack =  -14
# time =         15 | clk = 1 | pc =   8 | op_code = 100 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =   88
# time =         16 | clk = 0 | pc =   8 | op_code = 100 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1000000 | HEX1 = 0000000| HEX0 = 0000000 |overflow = 0 |topofstack =   88
# time =         17 | clk = 1 | pc =   9 | op_code = 100 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1000000 | HEX1 = 0011000| HEX0 = 0000010 |overflow = 1 |topofstack =  -96
# time =         18 | clk = 0 | pc =   9 | op_code = 100 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1000000 | HEX1 = 0011000| HEX0 = 0000010 |overflow = 1 |topofstack =  -96
# time =         19 | clk = 1 | pc =  10 | op_code = 100 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1111001 | HEX1 = 0100100| HEX0 = 1000000 |overflow = 1 |topofstack =  120
# time =         20 | clk = 0 | pc =  10 | op_code = 100 | operand = 00000000 | HEX3 = 1111111|  HEX2 =
1111001 | HEX1 = 0100100| HEX0 = 1000000 |overflow = 1 |topofstack =  120
# time =         21 | clk = 1 | pc =  11 | op_code = 111 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1111001 | HEX1 = 1111001| HEX0 = 0000010 |overflow = 1 |topofstack = -116
# time =         22 | clk = 0 | pc =  11 | op_code = 111 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1111001 | HEX1 = 1111001| HEX0 = 0000010 |overflow = 1 |topofstack = -116
# time =         23 | clk = 1 | pc =  12 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1111001 | HEX1 = 1111001| HEX0 = 0000010 |overflow = 1 |topofstack = -116
# time =         24 | clk = 0 | pc =  12 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1111001 | HEX1 = 1111001| HEX0 = 0000010 |overflow = 1 |topofstack = -116
# time =         25 | clk = 1 | pc =  13 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1111001 | HEX1 = 1111001| HEX0 = 0000010 |overflow = 1 |topofstack = -116
# time =         26 | clk = 0 | pc =  13 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1111001 | HEX1 = 1111001| HEX0 = 0000010 |overflow = 1 |topofstack = -116
# time =         27 | clk = 1 | pc =  14 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1111001 | HEX1 = 1111001| HEX0 = 0000010 |overflow = 1 |topofstack = -116
# time =         28 | clk = 0 | pc =  14 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1111001 | HEX1 = 1111001| HEX0 = 0000010 |overflow = 1 |topofstack = -116
# time =         29 | clk = 1 | pc =  15 | op_code = 000 | operand = 00000000 | HEX3 = 0111111|  HEX2 =
1111001 | HEX1 = 1111001| HEX0 = 0000010 |overflow = 1 |topofstack = -116

# ** Note: $finish    : C:/Users/afloru1/OneDrive - Brown University/engn1640/hw3/tb.v(60)
#    Time: 500 ns  Iteration: 0  Instance: /tb
```