San Francisco Bay University

CE305 - Computer Organization
2023 Fall Homework #4

Kritika Regmi
ID:19702

1. Write the program to print the string "*Hello*" in MARIE assembly language.

ANSWER:

CODE:

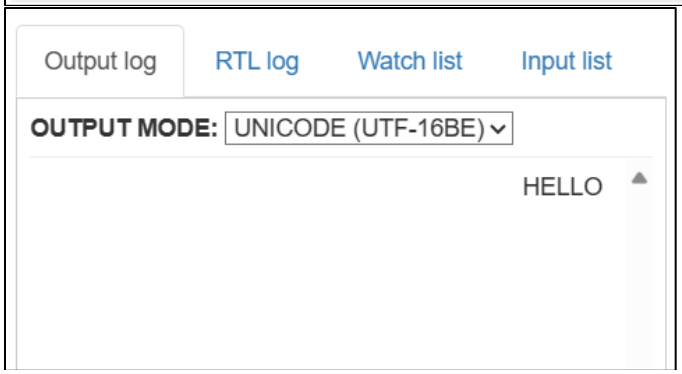
```
ORG 100  // Start the program at address 100
  LOAD H // Load 'H' into the AC
  OUTPUT  / Output 'H'
  LOAD E // Load 'E' into the AC
  OUTPUT  / Output 'E'
  LOAD L // Load 'L' into the AC
  OUTPUT  / Output 'L'
  OUTPUT  / Output 'L'
  LOAD O // Load 'O' into the AC
  OUTPUT  / Output 'O'
  HALT    / Halt the program

H, DEC 72  // ASCII code for 'H'
E, DEC 69  // ASCII code for 'E'
L, DEC 76  // ASCII code for 'L'
O, DEC 79  // ASCII code for 'O'
```

Assembly code: Autosaved file

```
1  ORG 100  // Start the program at address 100
2    LOAD H // Load 'H' into the AC
3    OUTPUT  / Output 'H'
4    LOAD E // Load 'E' into the AC
5    OUTPUT  / Output 'E'
6    LOAD L // Load 'L' into the AC
7    OUTPUT  / Output 'L'
8    OUTPUT  / Output 'L'
9    LOAD O // Load 'O' into the AC
10   OUTPUT  / Output 'O'
11   HALT    / Halt the program
12
13 H, DEC 72  // ASCII code for 'H'
14 E, DEC 69  // ASCII code for 'E'
15 L, DEC 76  // ASCII code for 'L'
16 O, DEC 79  // ASCII code for 'O'
17
```

Machine halted normally.



2. Write the MARIE assembly program to implement "*break*" statement in for-loop shown as follows in Python program.

```
for i in range(5):
    if i == 3:
        break
    print(i)
0
1
2
```

ANSWER:

CODE:

```
Load x
store x
Loop, Load x
 Subt f
 Skipcond 000
 Jump ENDLOOP
 Load x
 Subt t
 Skipcond 400
 Jump Loop1
 Jump ENDLOOP
Loop1, Load x
Output
Add one
store x
Jump Loop
ENDLOOP, Halt
x, DEC 0
t, DEC 3
one, DEC 1
f, DEC 5
END 100
```

Assembly code:

```
1  Load x
2  store x
3  Loop, Load x
4   Subt f
5   Skipcond 000
6   Jump ENDLOOP
7   Load x
8   Subt t
9   Skipcond 400
10  Jump Loop1
11  Jump ENDLOOP
12 Loop1, Load x
13 Output
14 Add one
15 store x
16 Jump Loop
17 ENDLOOP, Halt
18 x, DEC 0
19 t, DEC 3
20 one, DEC 1
21 f, DEC 5
22 END 100
```

Machine halted normally.

OUTPUT MODE: DEC

```
0
1
2
```

3. As the question above, it is very similar but needs to implement "*continue*" statement in MARIE assembly language within the for-loop as follows in Python program.

```
for i in range(5):
    if i == 3:
        continue
    print(i)
0
1
2
4
```

ANSWER:

CODE:

```
ORG 100
Load x
Store x
Loop, Load x
 Subt f
 Skipcond 000
 Jump ENDLOOP
 Load x
 Subt t
 Skipcond 400
 Jump Loop1
 Jump Continue
 Output
Loop1, Load x
 Output
 Add o
 Store x
 Jump Loop
ENDLOOP, Halt
Continue, Load x
 Add o
 Store x
 Jump Loop
x, Dec 0
t, Dec 3
o, Dec 1
f, DEC 5
END 100
```

Assembly code:

```
1  ORG 100
2  Load x
3  Store x
4  Loop, Load x
5   Subt f
6   Skipcond 000
7   Jump ENDLOOP
8   Load x
9   Subt t
10  Skipcond 400
11  Jump Loop1
12  Jump Continue
13  Output
14 Loop1, Load x
15  Output
16  Add o
17  Store x
18  Jump Loop
19 ENDLOOP, Halt
20 Continue, Load x
21  Add o
22  Store x
23  Jump Loop
24 x, Dec 0
25 t, Dec 3
26 o, Dec 1
27 f, DEC 5
28 END 100
```

Machine halted normally.

OUTPUT MODE: DEC

0
1
2
4

4. Since there is not a multiplication instruction in ISA of MARIE, two integers multiplication operation, for instance, 4×3, must be done by the addition operation, like $4 \times 3 = 4 + 4 + 4$. Write the MARIE assembly program to find the product of two integers $m \times n$.

ANSWER:

CODE:

```
ORG 100
INPUT
Store m
Input
Store n
loop, Load m
 add multiply
 store multiply
 load n
 subt one
 store n
 skipcond 400
 jump loop
 load multiply
 output
halt
m,dec 0
n,dec 0
one, Dec 1
multiply, dec 0
End 100
```

Assembly code:

```
1  ORG 100
2  INPUT
3  Store m
4  Input
5  Store n
6  loop, Load m
7   add multiply
8   store multiply
9   load n
10  subt one
11  store n
12  skipcond 400
13  jump loop
14  load multiply
15  output
16 halt
17 m,dec 0
18 n,dec 0
19 one, Dec 1
20 multiply, dec 0
21 End 100
```

Machine halted normally.

OUTPUT when input is given 4 and 5 :