如何讓電腦聽話
-- 何為程式設計

程式 program

學園都市一日遊：

栅川中學
長點上機學園
霧之丘女子學院
Seventh Mist
繚亂家政學校
常盤台中學

程式 program

1. 表演會俄國舞
2. 湖上漁歌
3. 公車浮沉錄
4. 吉他彈唱
5. 威尼華爾滋
6. Song without Words
7. 諸神的會議 -- 時代諷刺劇
8. 鋼琴獨奏
9. 義大利鈴鼓舞

程式 program

蛋塔皮的作法 :

將奶油打軟

把糖粉和蛋加入打至白色

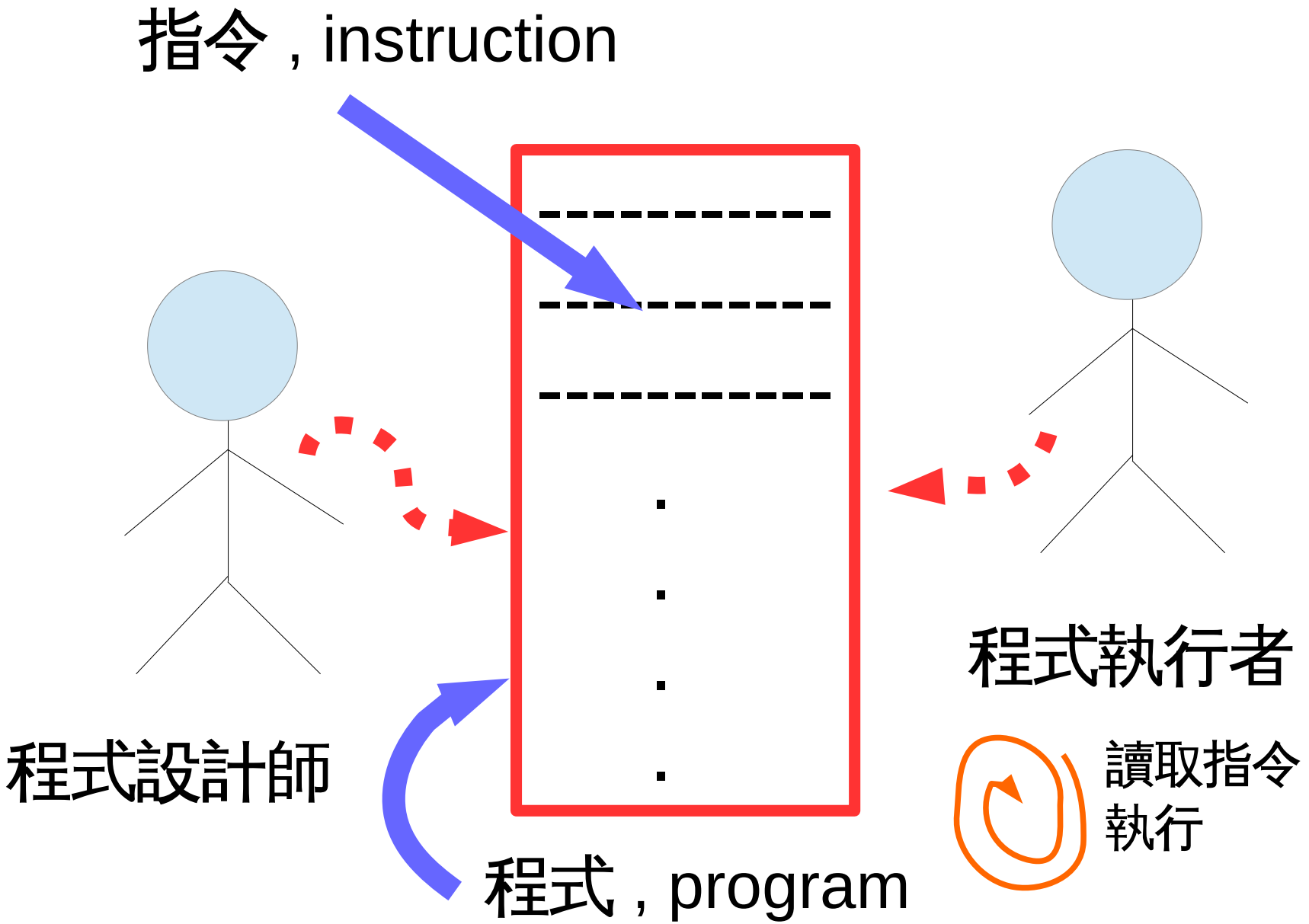
加低筋麵粉和泡打粉後揉軟

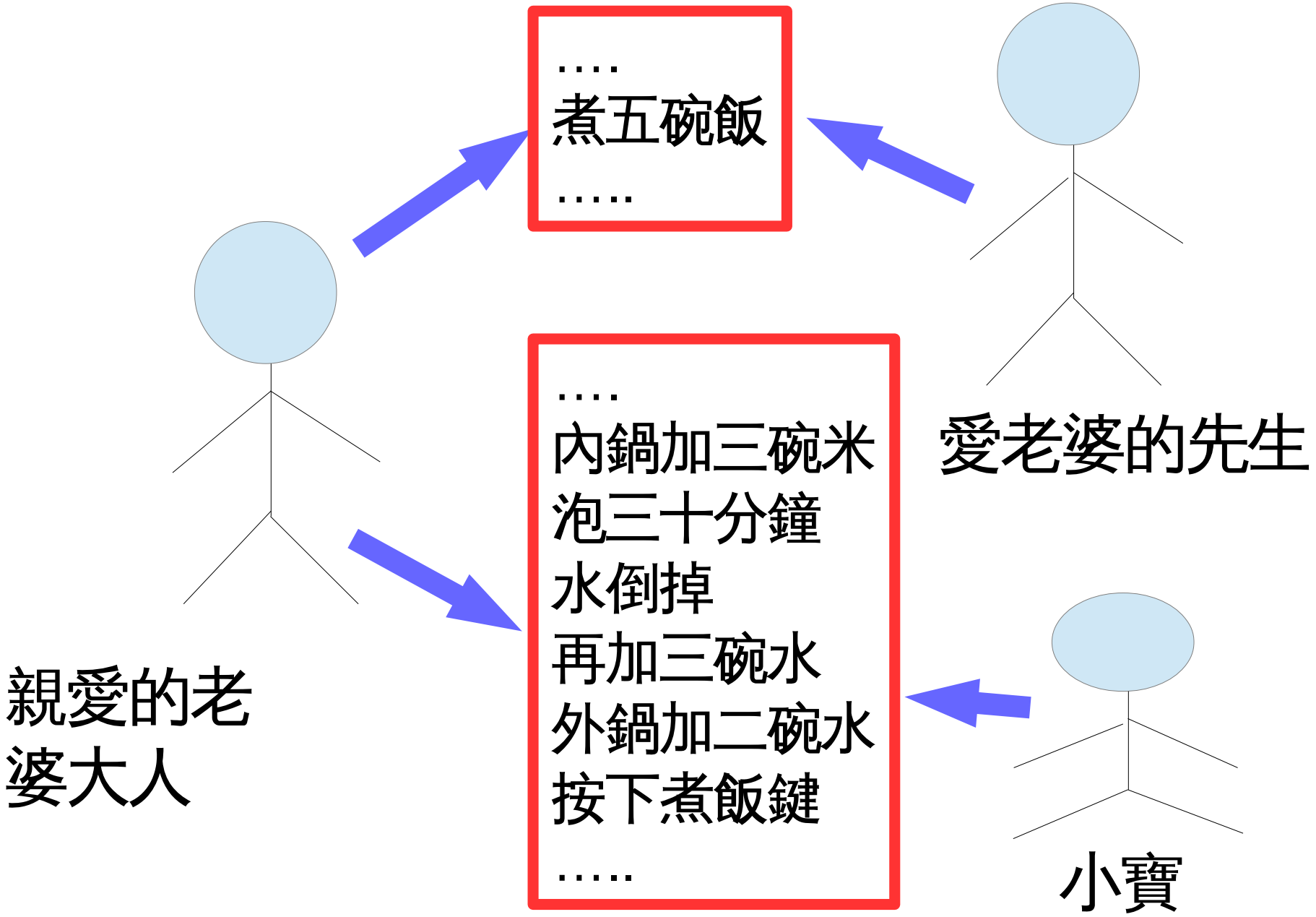
將皮放置冰箱冰 5 到 10 分鐘

取出，至模型中壓緊

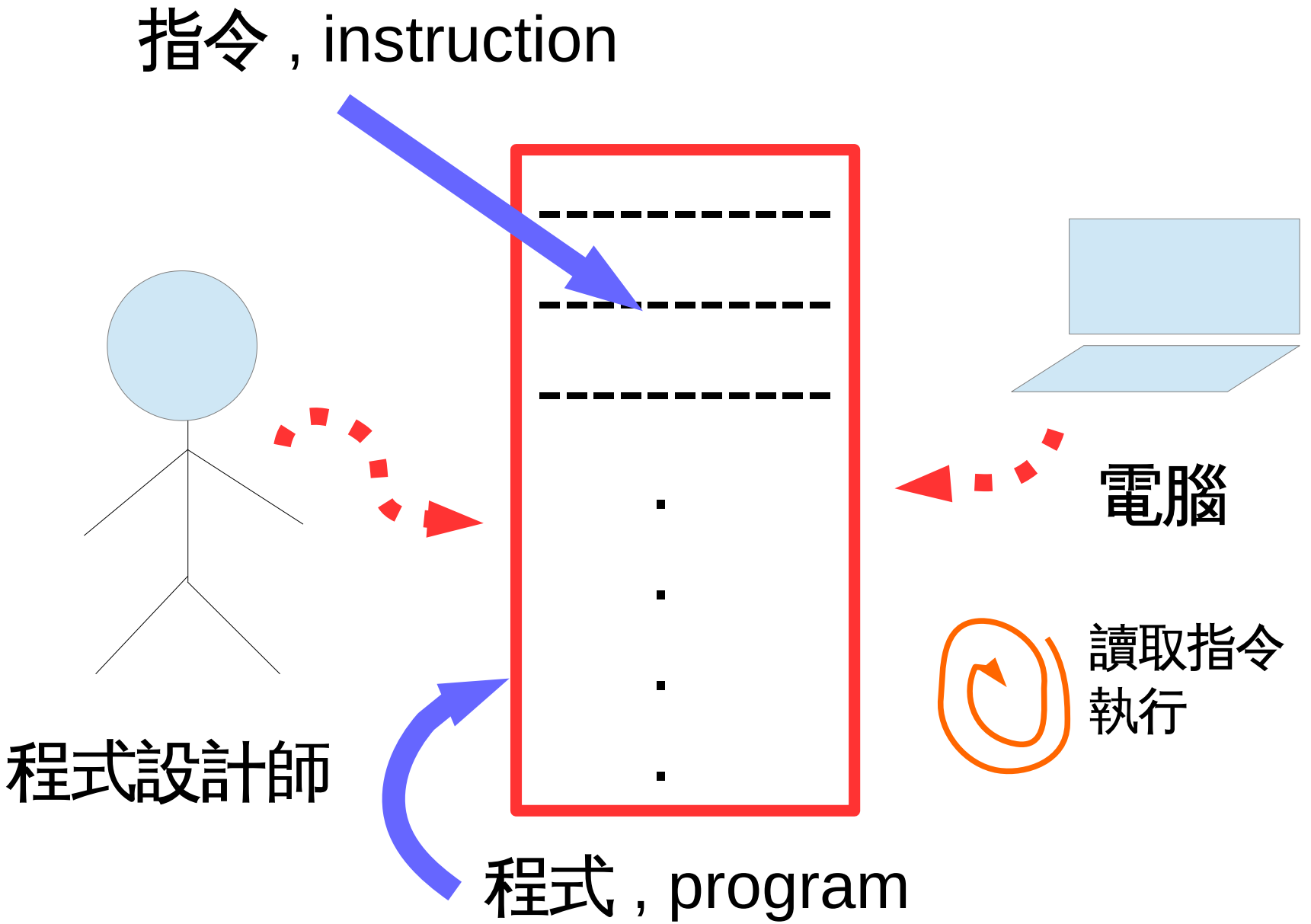
程式 program

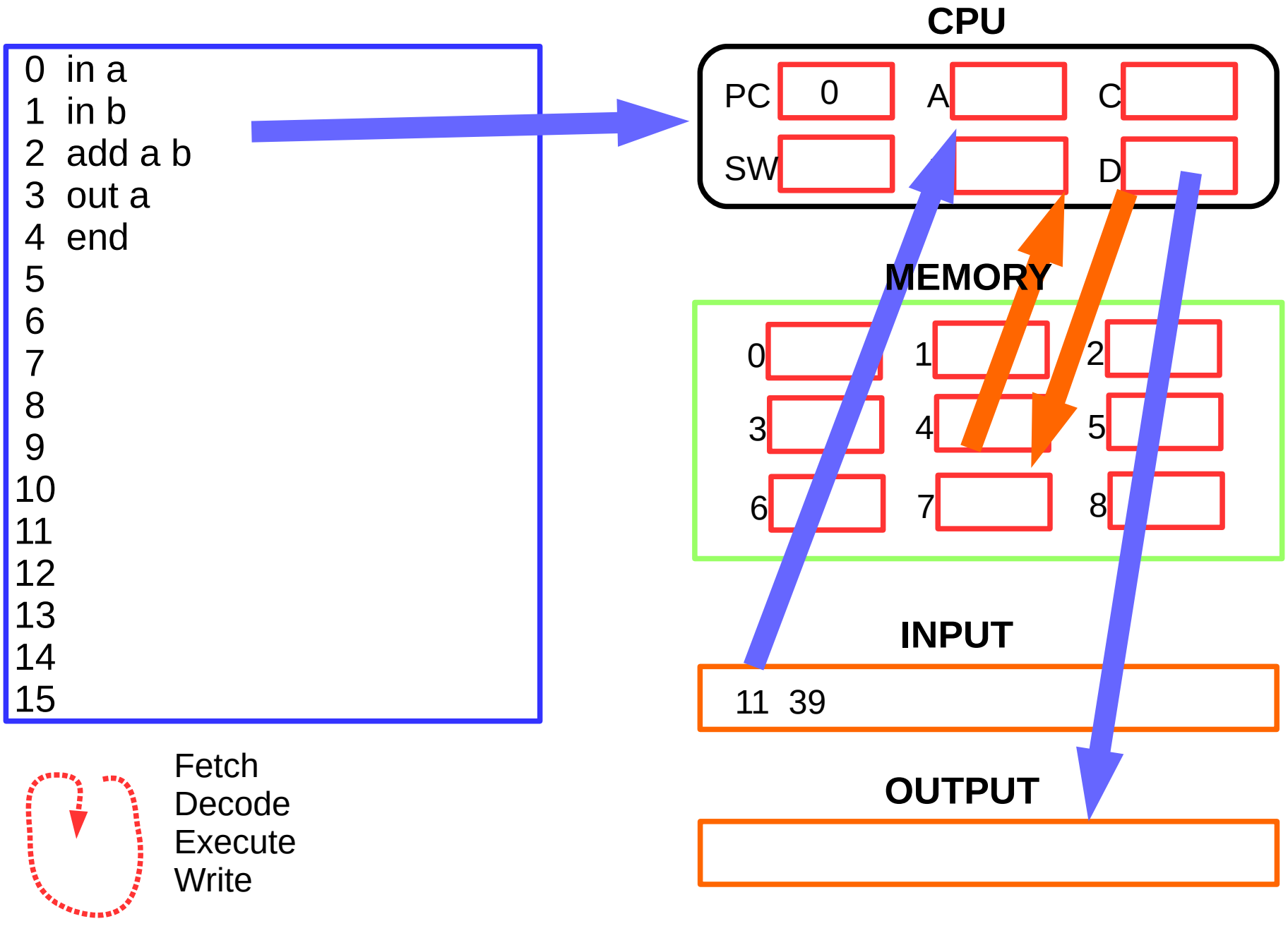
- Merriam Webster:
  a brief usually printed outline of the order to be followed
- American Heritage Dictionary:
  an ordered list of events to take place or procedures to be followed; a schedule
- 一序列的指令

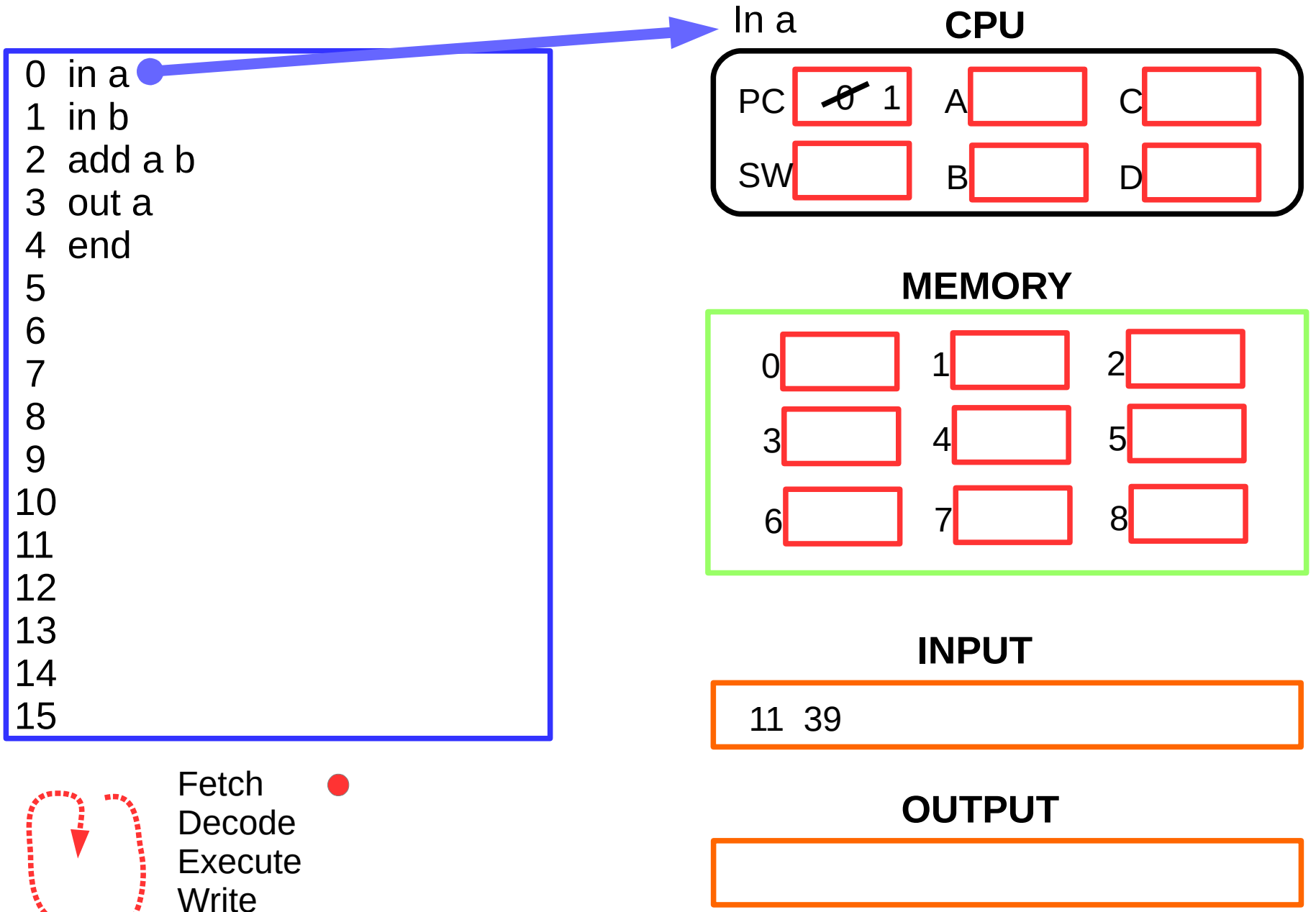

指令，instruction
程式設計師
程式執行者
讀取指令
執行
程式，program


....
煮五碗飯
.....
愛老婆的先生
....
內鍋加三碗米
泡三十分鐘
水倒掉
再加三碗水
外鍋加二碗水
按下煮飯鍵
.....
親愛的老婆大人
小寶

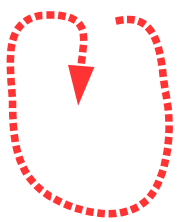
程式之長短，繁簡，難易，
取決於程式設計者與程式
執行者之間的差異


指令，instruction
電腦
讀取指令
執行
程式設計師
程式，program


0 in a
1 in b
2 add a b
3 out a
4 end
5
6
7
8
9
10
11
12
13
14
15
CPU
PC
0
A
C
SW
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
11 39
OUTPUT
Fetch
Decode
Execute
Write


0 in a
1 in b
2 add a b
3 out a
4 end
5
6
7
8
9
10
11
12
13
14
15
In a
CPU
PC
0
1
A
C
SW
B
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
11 39
OUTPUT
Fetch
Decode
Execute
Write

```
0  in a
1  in b
2  add a b
3  out a
4  end
5
6
7
8
9
10
11
12
13
14
15
```



Fetch
Decode
Execute
Write

In a

CPU

PC 1 A C

SW B D

MEMORY

0 1 2

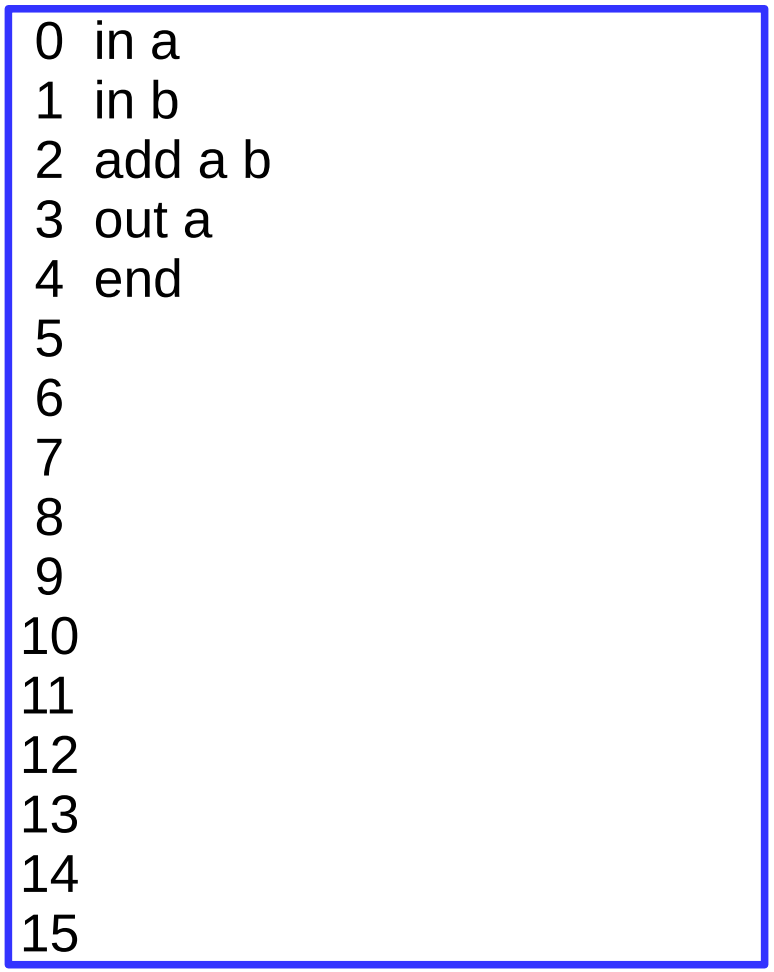
3 4 5

6 7 8

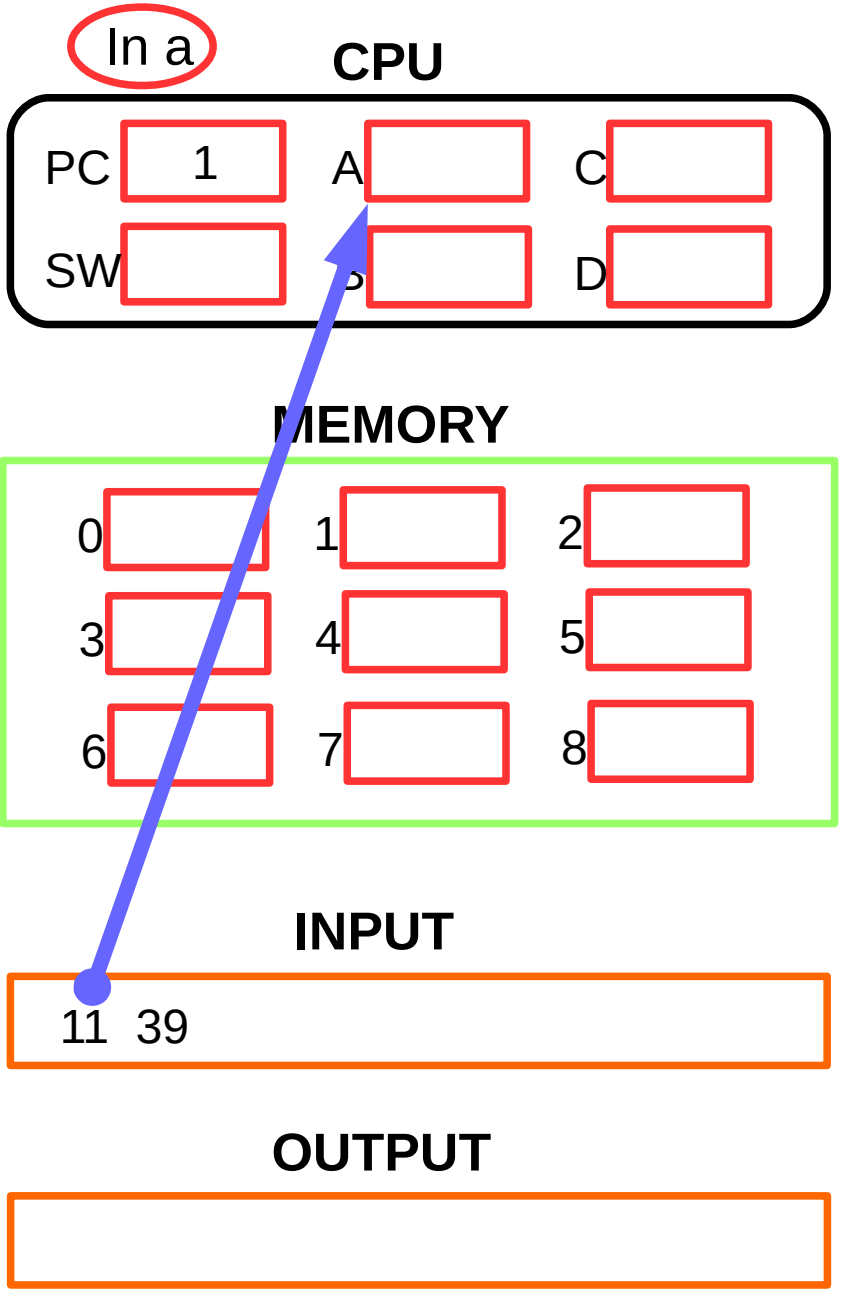
INPUT

11 39

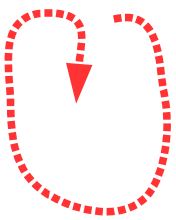
OUTPUT


0 in a
1 in b
2 add a b
3 out a
4 end
5
6
7
8
9
10
11
12
13
14
15


Fetch
Decode
Execute
Write


In a
CPU
PC
1
A
C
SW
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
11
39
OUTPUT

```
0  in a
1  in b
2  add a b
3  out a
4  end
5
6
7
8
9
10
11
12
13
14
15
```



Fetch
Decode
Execute
Write

In a

CPU

PC	1	A	11	C	
SW		B		D	

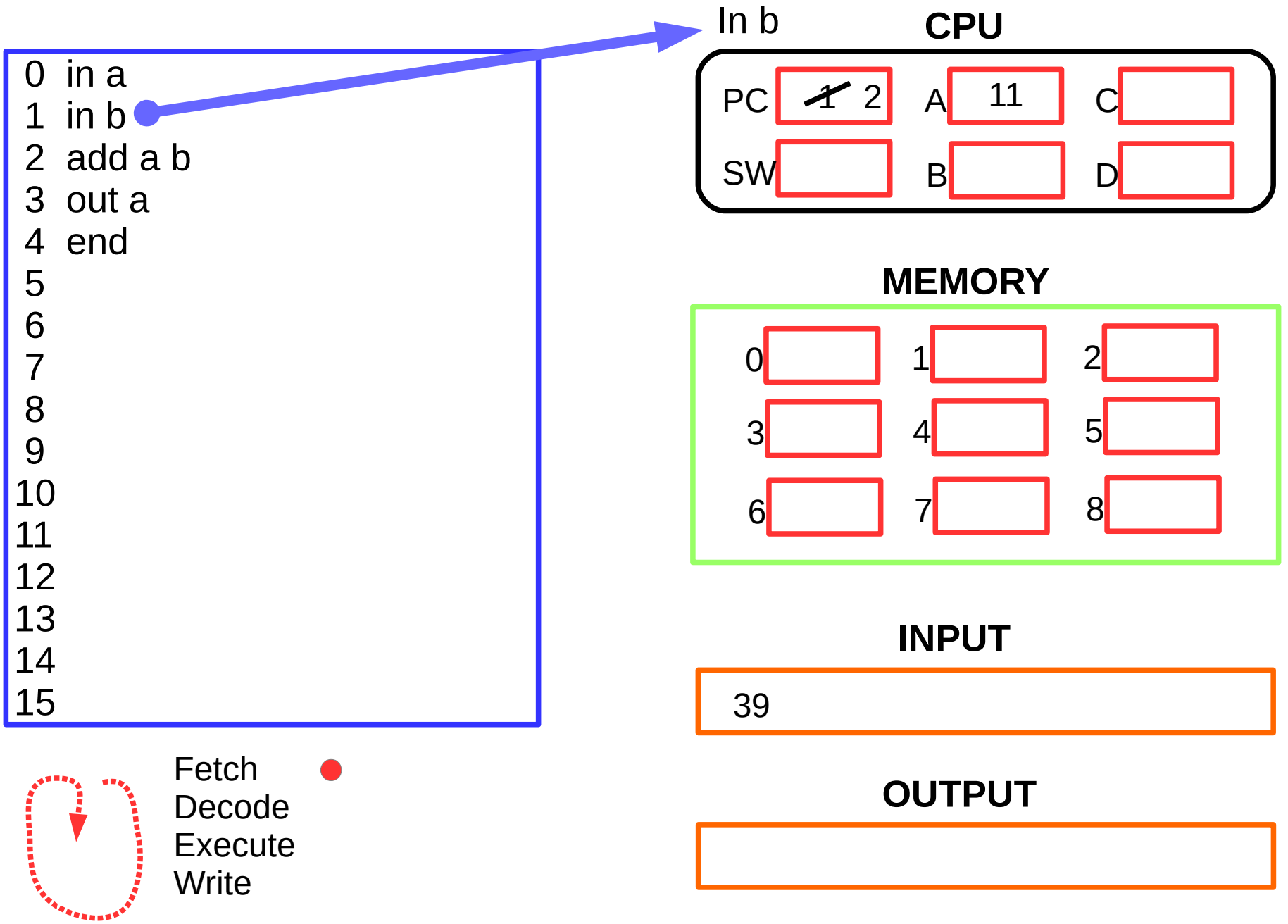
MEMORY

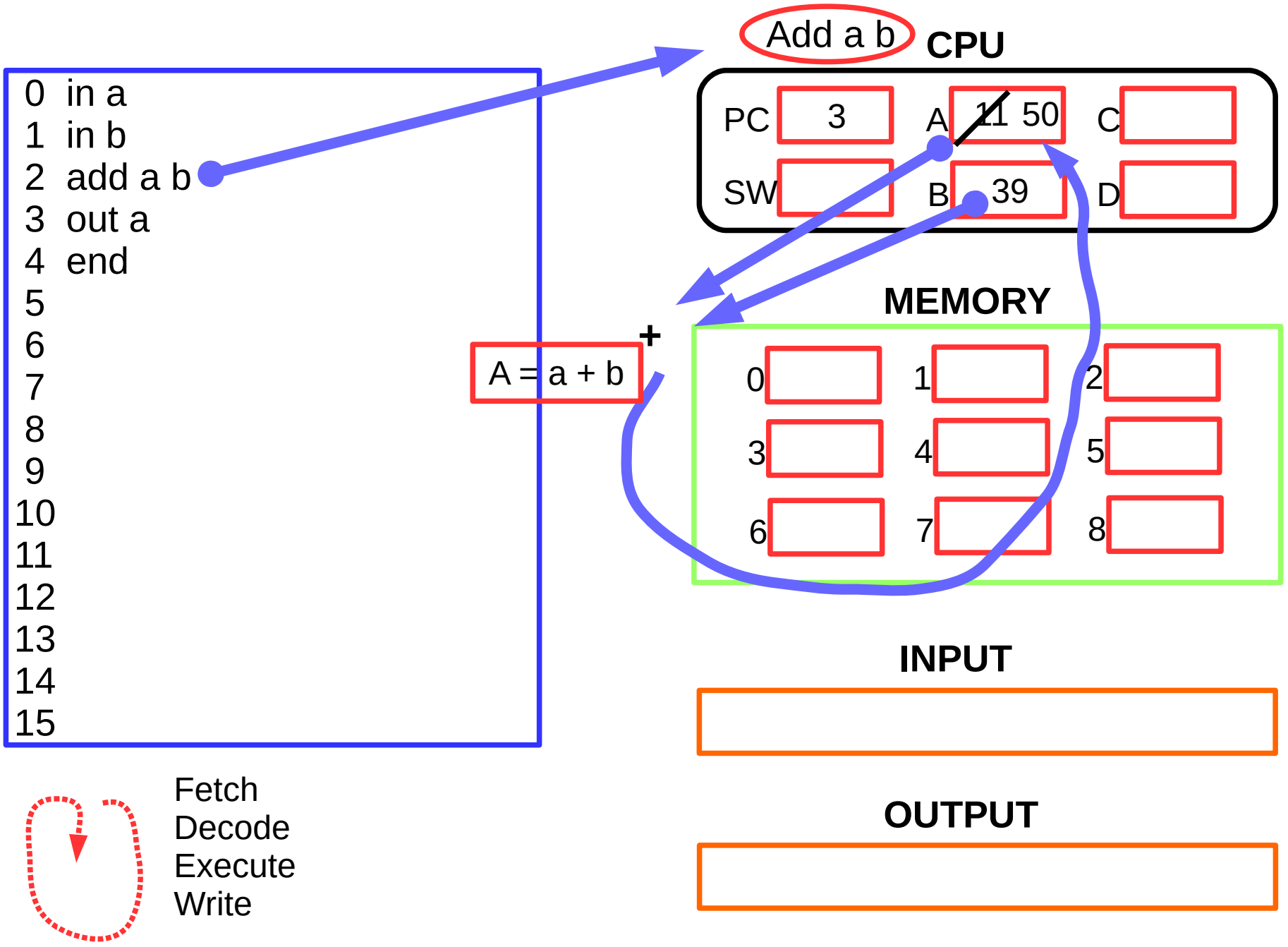
0	1	2
3	4	5
6	7	8

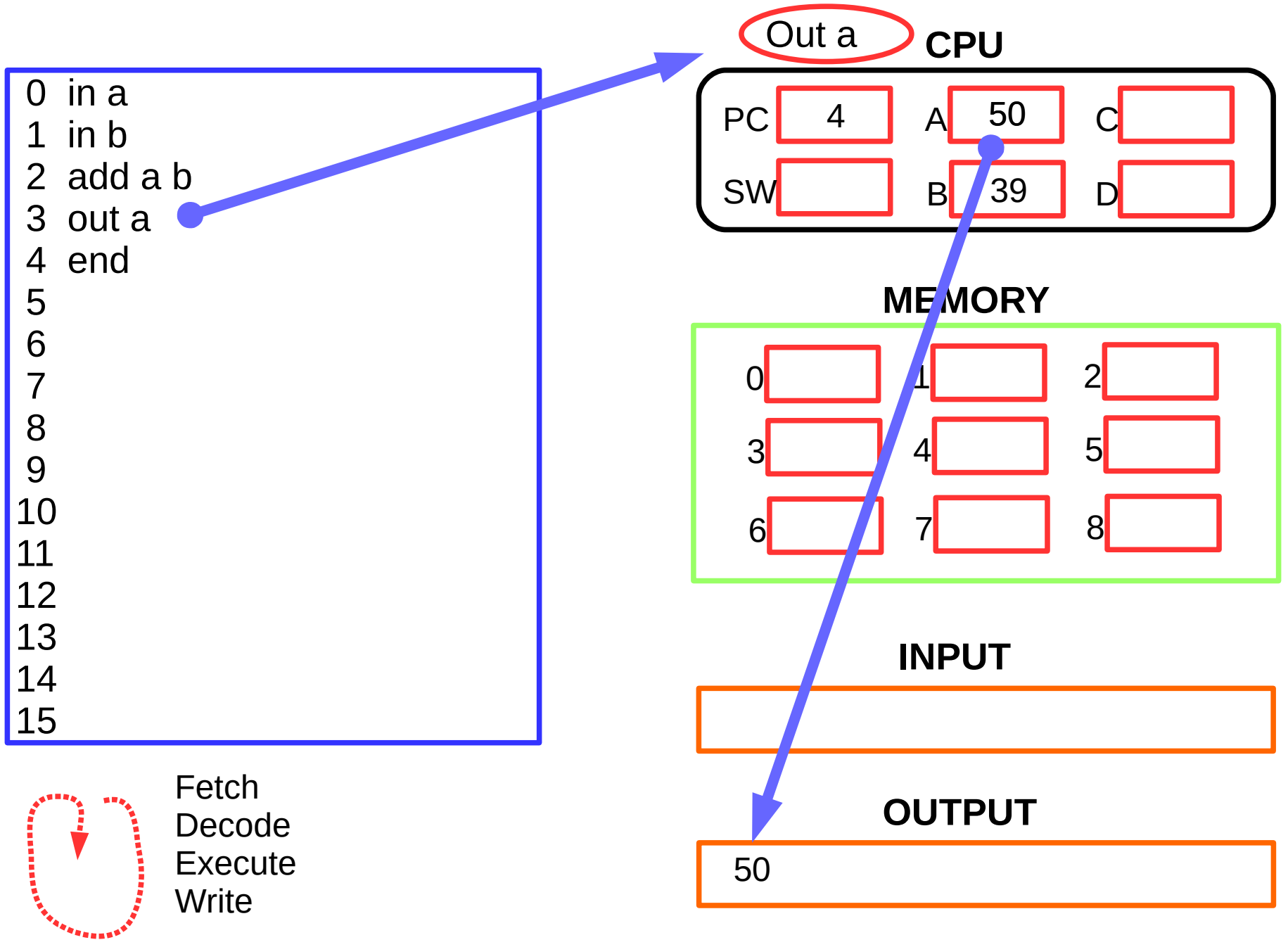
INPUT

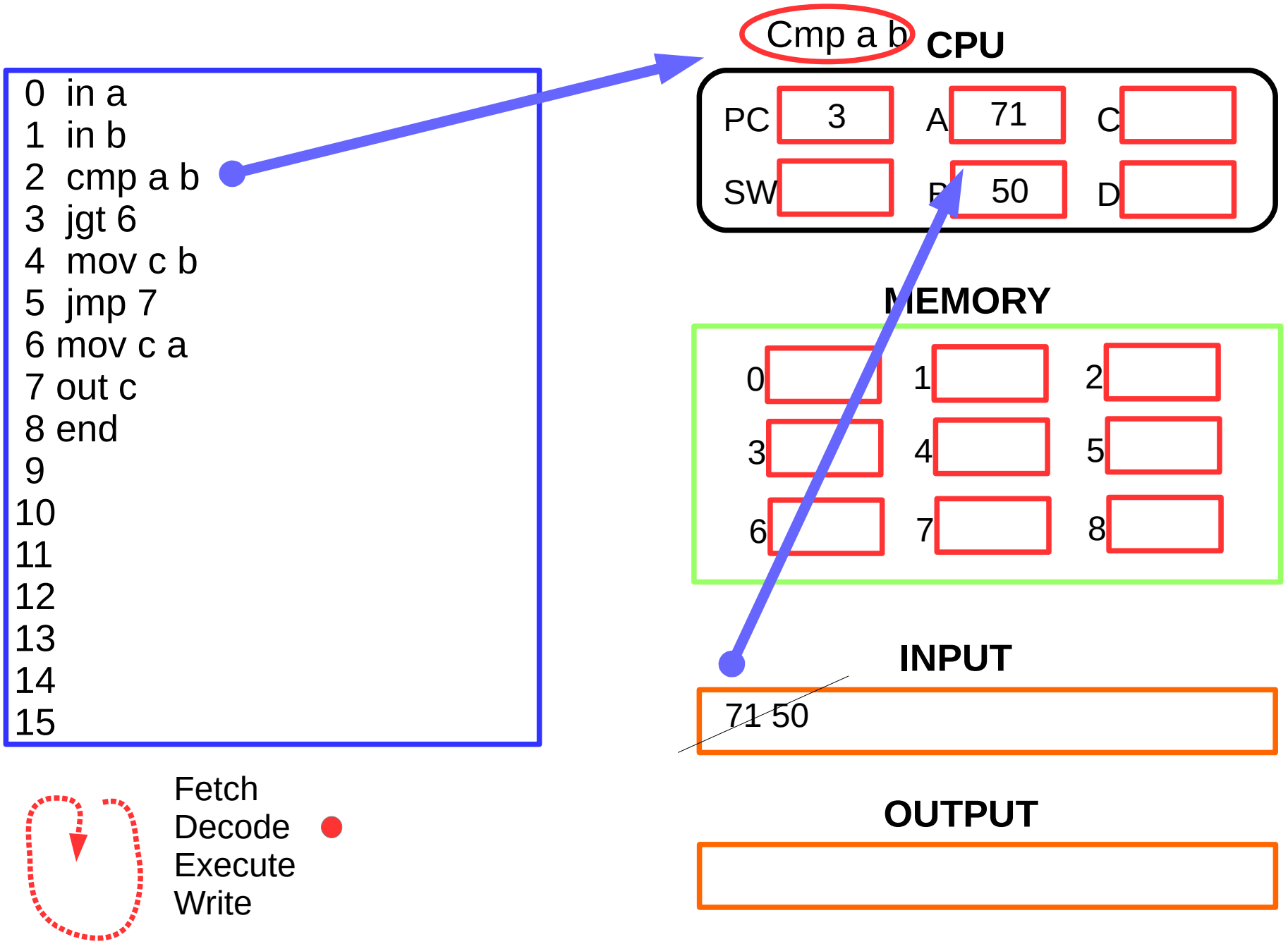
39

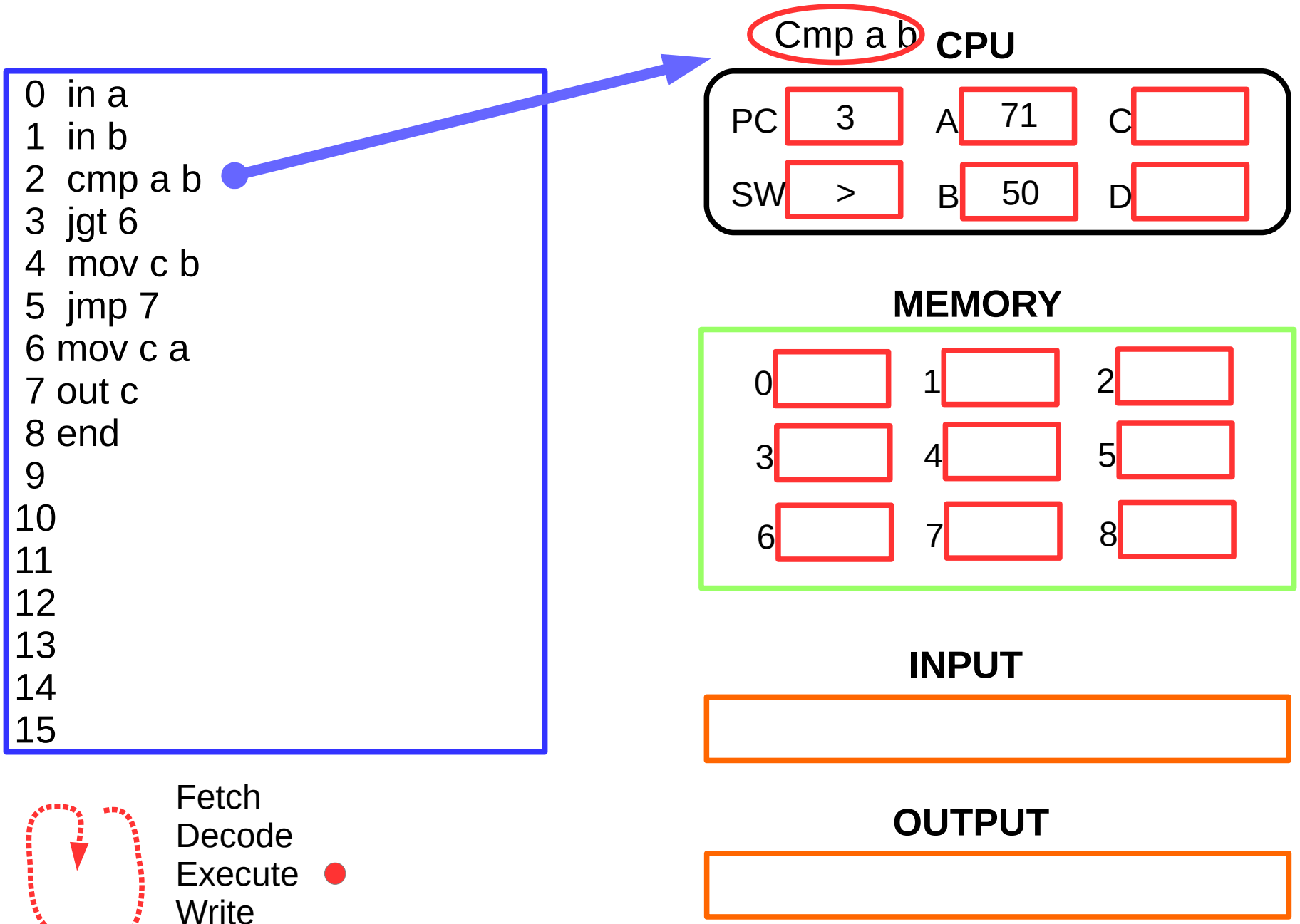
OUTPUT

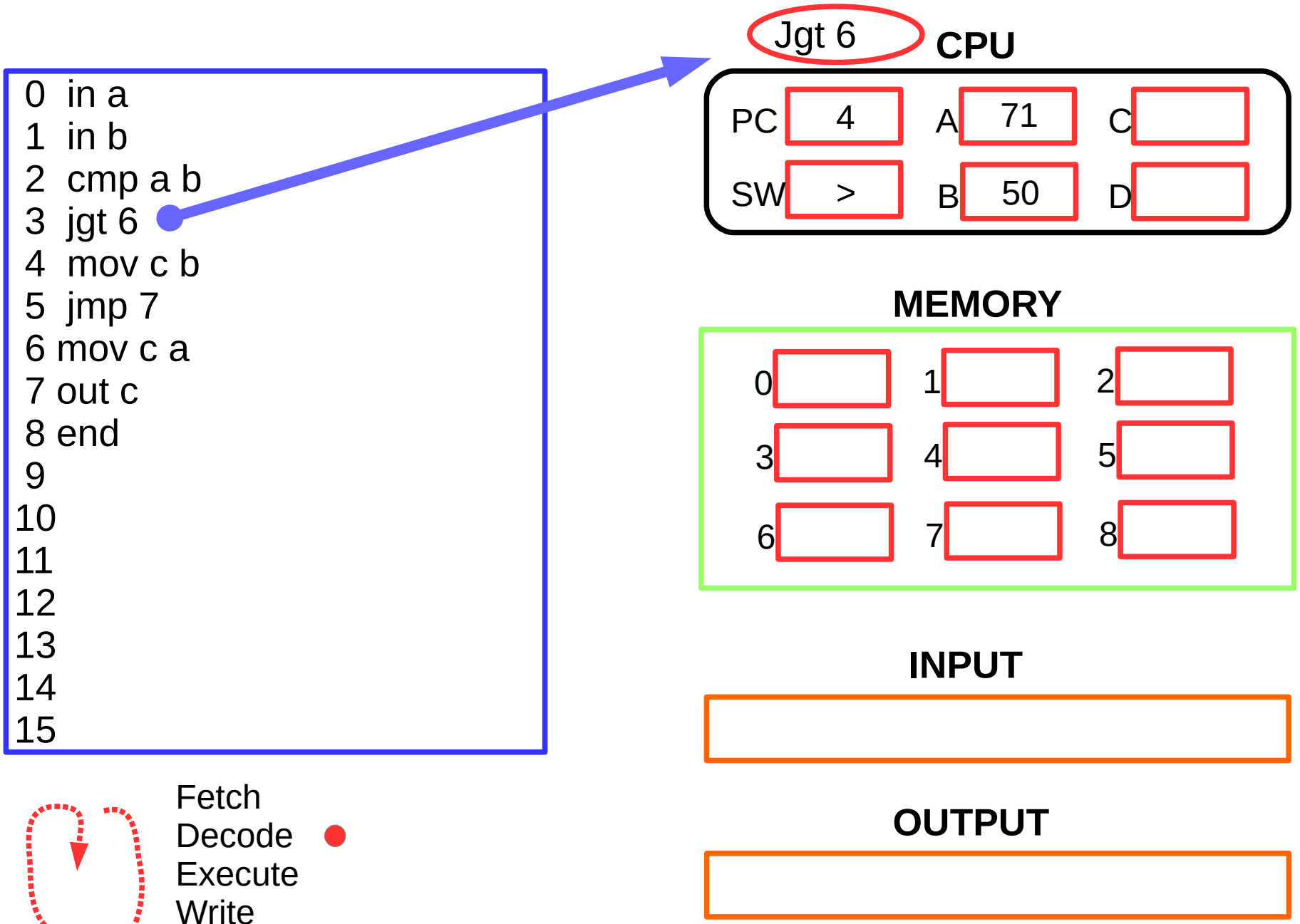

0 in a
1 in b
2 add a b
3 out a
4 end
5
6
7
8
9
10
11
12
13
14
15
In b
CPU
PC 1 2
A 11
C
SW
B
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
39
OUTPUT
Fetch
Decode
Execute
Write

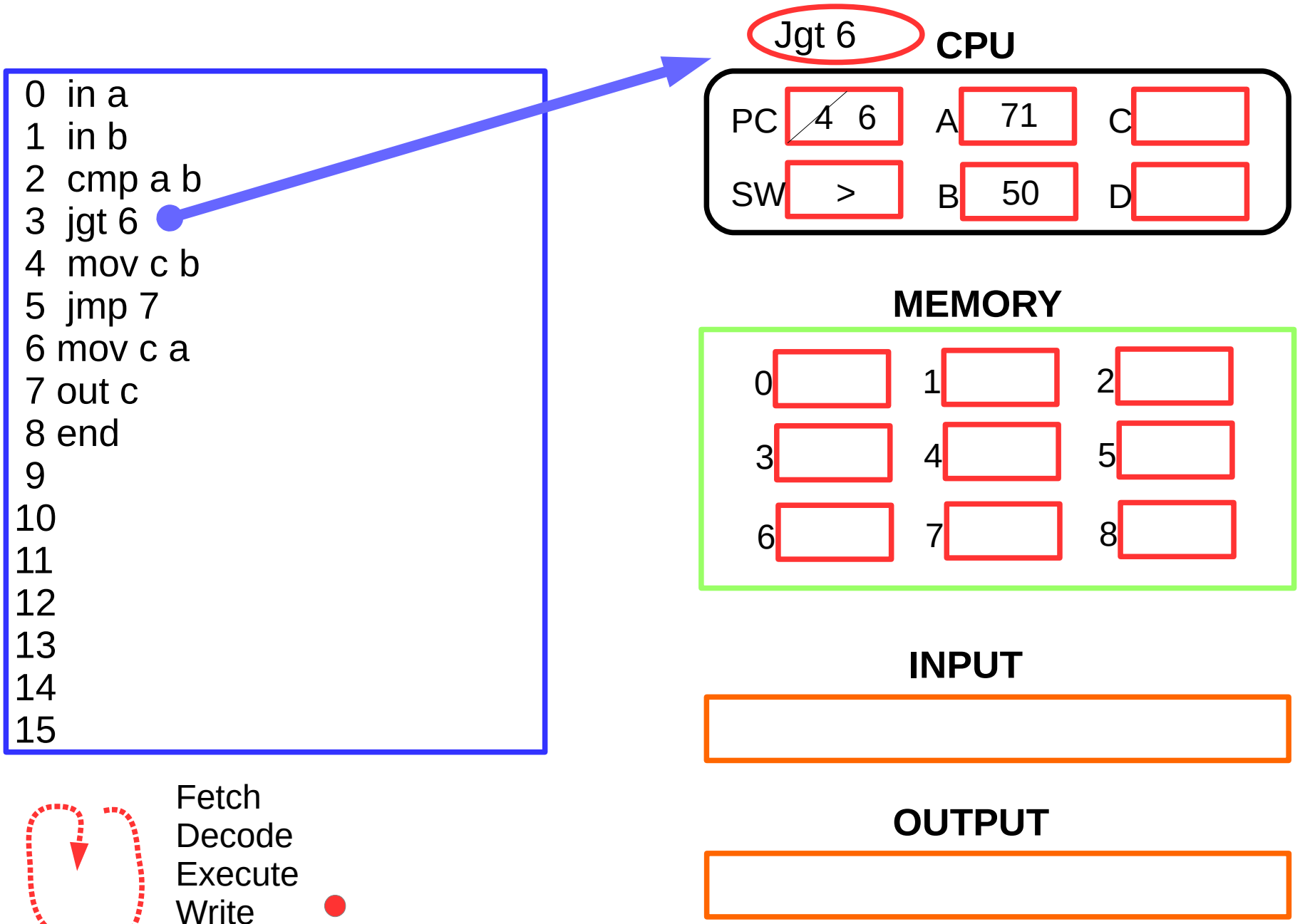

0 in a
1 in b
2 add a b
3 out a
4 end
5
6
7
8
9
10
11
12
13
14
15
Add a b
CPU
PC
3
A
11 50
C
SW
B
39
D
MEMORY
A = a + b
+
0
1
2
3
4
5
6
7
8
INPUT
OUTPUT
Fetch
Decode
Execute
Write

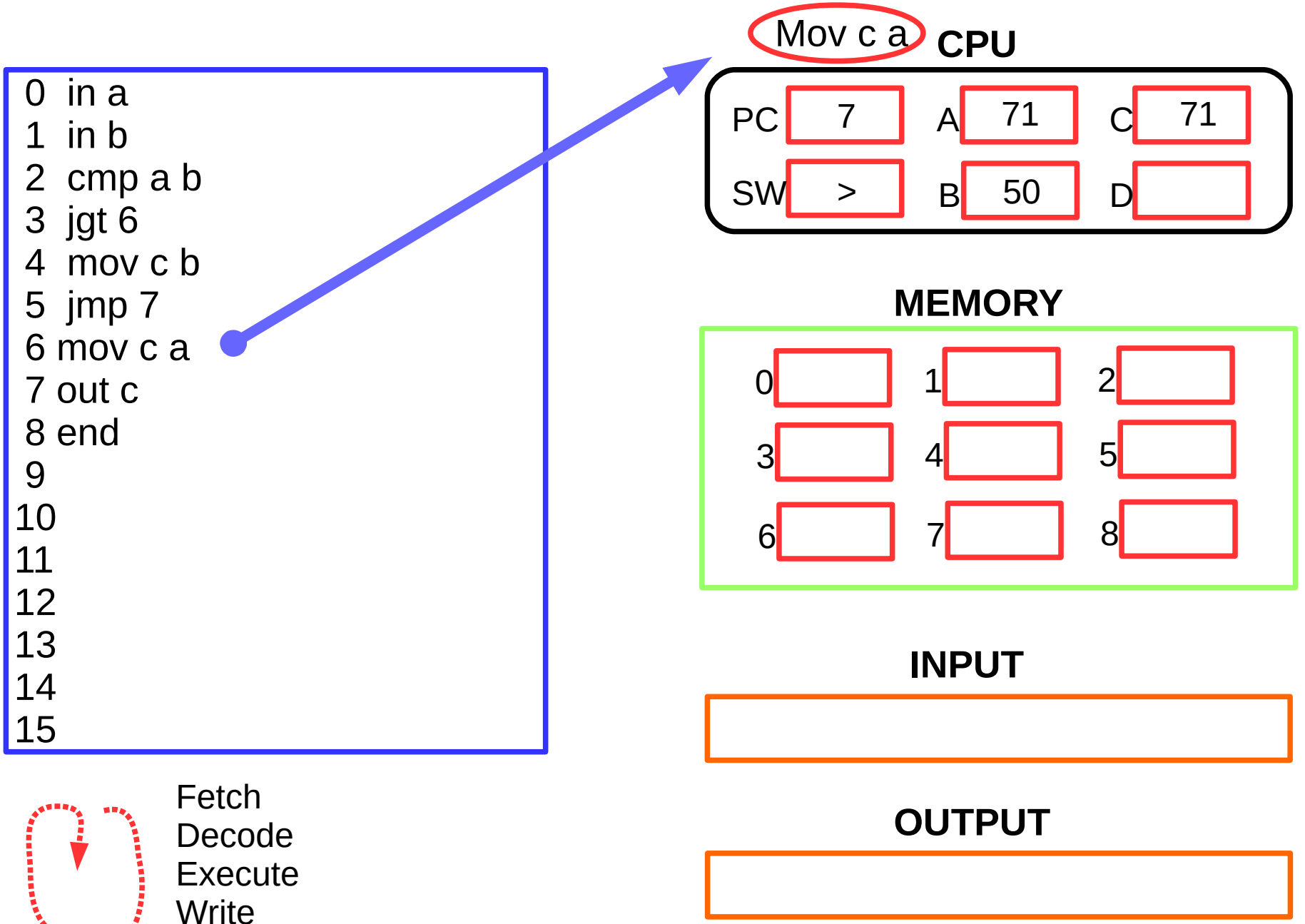

0 in a
1 in b
2 add a b
3 out a
4 end
5
6
7
8
9
10
11
12
13
14
15
Out a
CPU
PC
4
A
50
C
SW
B
39
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
OUTPUT
50
Fetch
Decode
Execute
Write

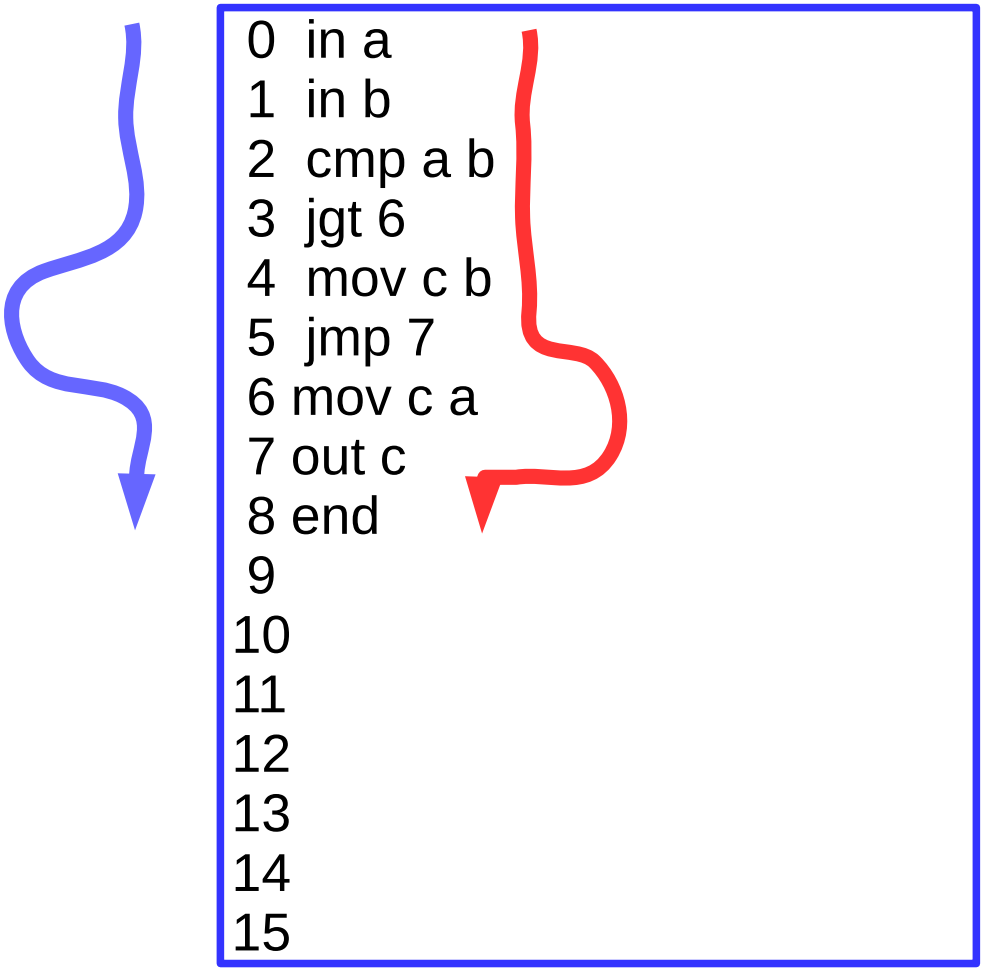

0 in a
1 in b
2 cmp a b
3 jgt 6
4 mov c b
5 jmp 7
6 mov c a
7 out c
8 end
9
10
11
12
13
14
15
Cmp a b
CPU
PC
3
A
71
C
SW
B
50
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
71 50
OUTPUT
Fetch
Decode
Execute
Write

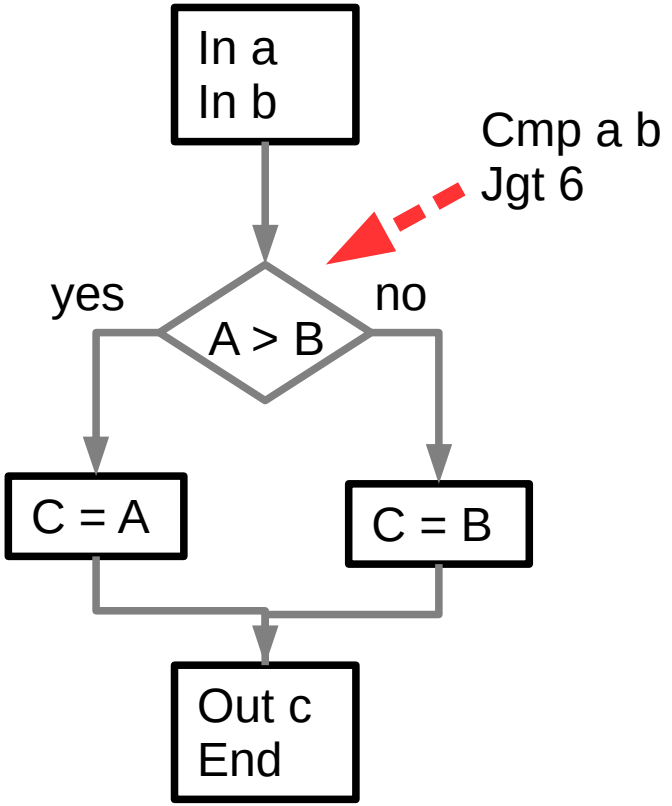

0 in a
1 in b
2 cmp a b
3 jgt 6
4 mov c b
5 jmp 7
6 mov c a
7 out c
8 end
9
10
11
12
13
14
15
Cmp a b
CPU
PC
3
A
71
C
SW
>
B
50
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
OUTPUT
Fetch
Decode
Execute
Write


0 in a
1 in b
2 cmp a b
3 jgt 6
4 mov c b
5 jmp 7
6 mov c a
7 out c
8 end
9
10
11
12
13
14
15
Jgt 6
CPU
PC
4
A
71
C
SW
>
B
50
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
OUTPUT
Fetch
Decode
Execute
Write

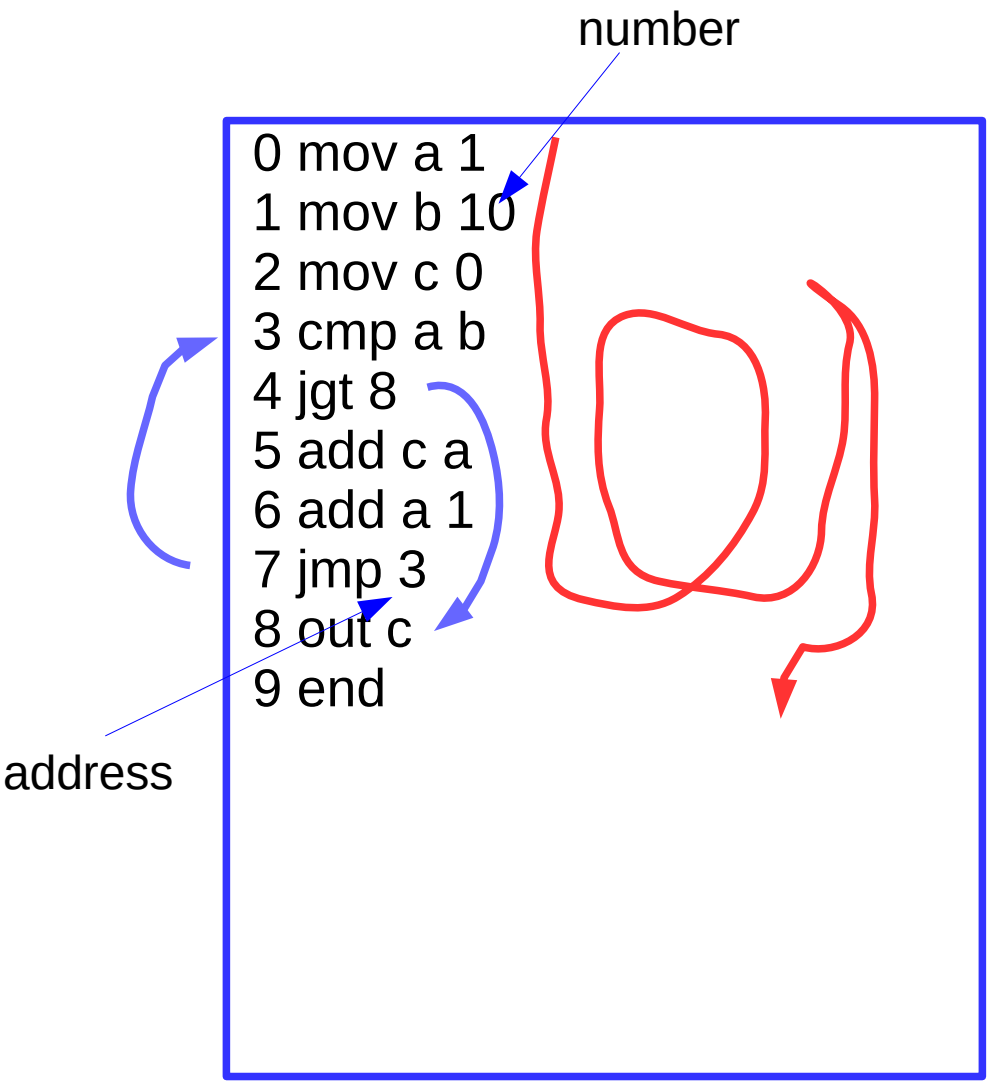

0 in a
1 in b
2 cmp a b
3 jgt 6
4 mov c b
5 jmp 7
6 mov c a
7 out c
8 end
9
10
11
12
13
14
15
Jgt 6
CPU
PC 4 6
A 71
C
SW >
B 50
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
OUTPUT
Fetch
Decode
Execute
Write

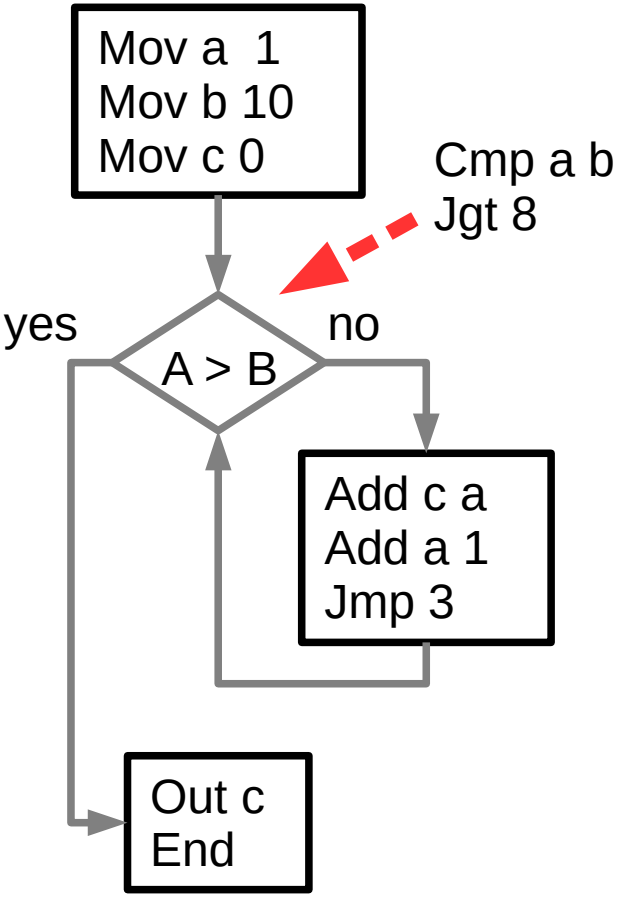

0 in a
1 in b
2 cmp a b
3 jgt 6
4 mov c b
5 jmp 7
6 mov c a
7 out c
8 end
9
10
11
12
13
14
15
Mov c a
CPU
PC
7
A
71
C
71
SW
>
B
50
D
MEMORY
0
1
2
3
4
5
6
7
8
INPUT
OUTPUT
Fetch
Decode
Execute
Write



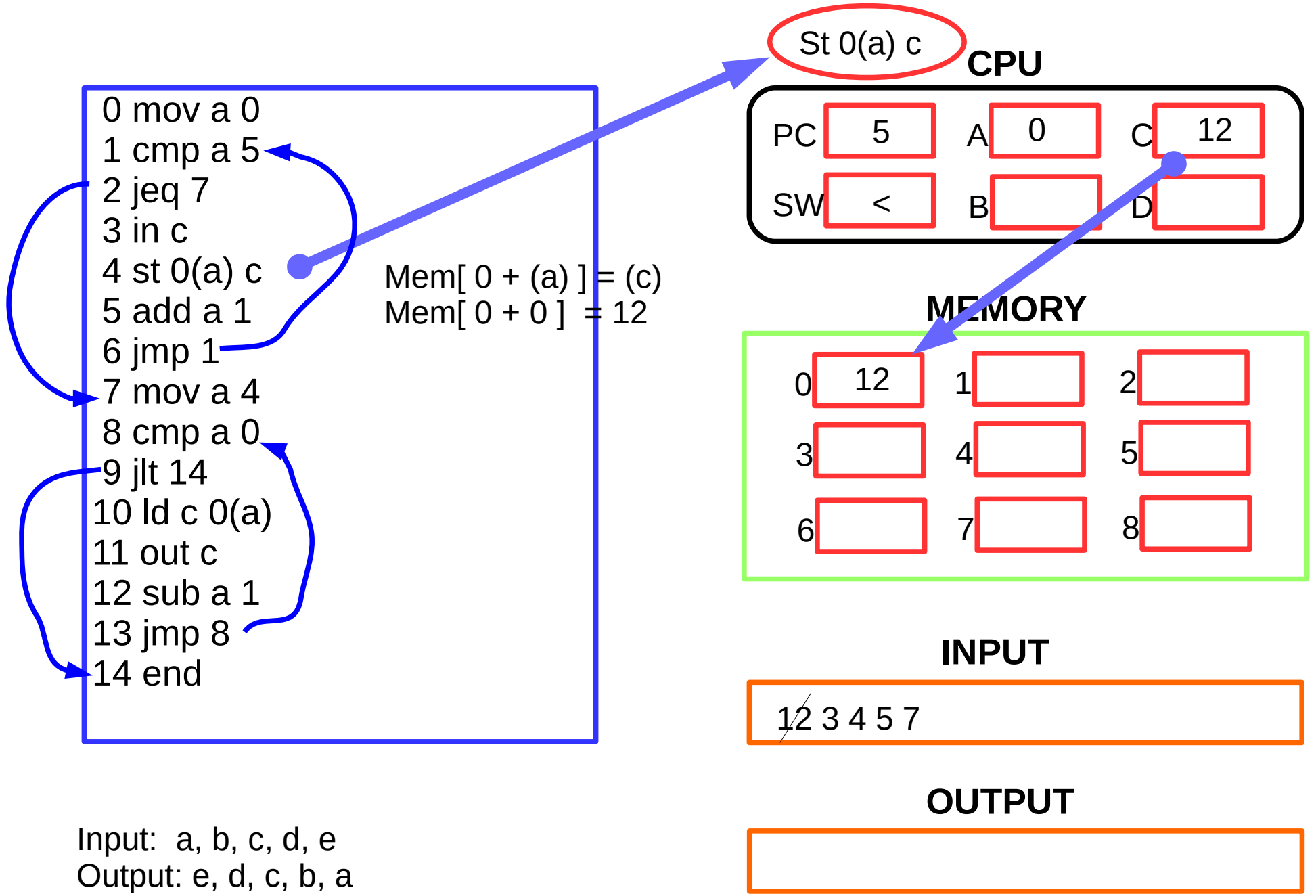


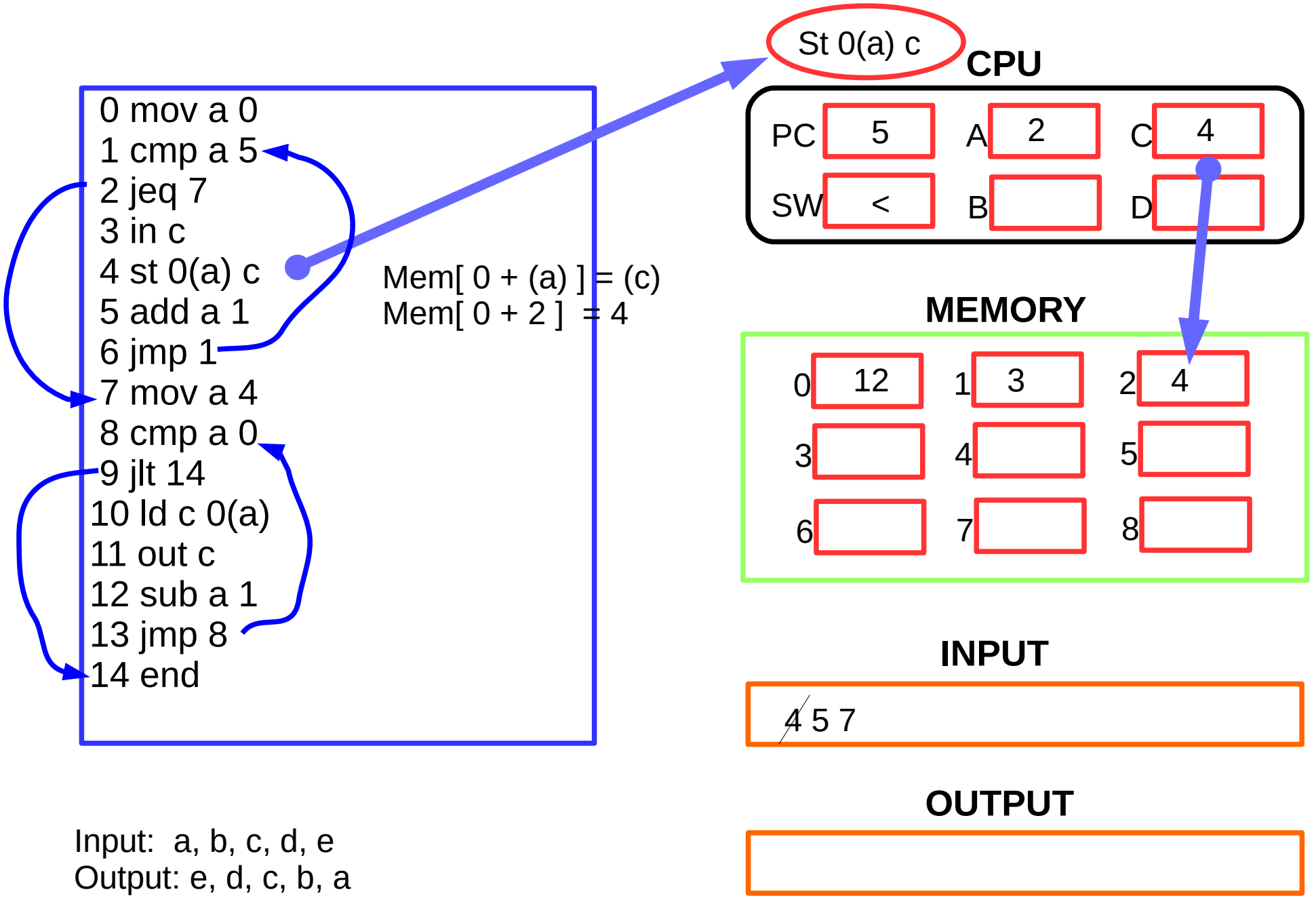
Input: x, y
Output: maximum of x and y

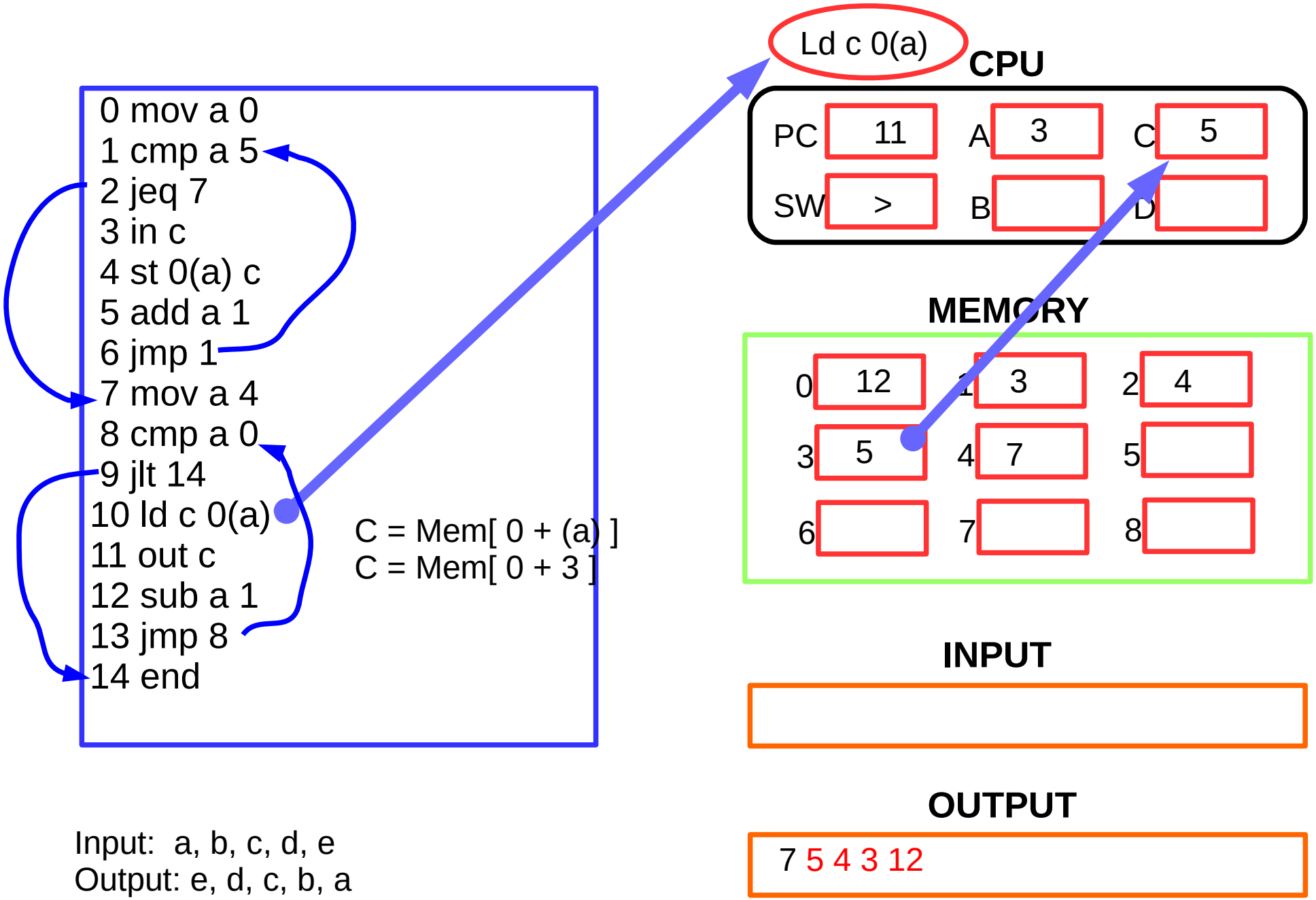




Input: none
Output: sum of 1,2,3,.....10


St 0(a) c
CPU
PC 5
A 0
C 12
SW <
B
D
0 mov a 0
1 cmp a 5
2 jeq 7
3 in c
4 st 0(a) c
5 add a 1
6 jmp 1
7 mov a 4
8 cmp a 0
9 jlt 14
10 ld c 0(a)
11 out c
12 sub a 1
13 jmp 8
14 end
Mem[0 + (a)] = (c)
Mem[0 + 0] = 12
MEMORY
0 12
1
2
3
4
5
6
7
8
INPUT
12 3 4 5 7
OUTPUT
Input: a, b, c, d, e
Output: e, d, c, b, a


St 0(a) c
CPU
PC 5
A 2
C 4
SW <
B
D
0 mov a 0
1 cmp a 5
2 jeq 7
3 in c
4 st 0(a) c
5 add a 1
6 jmp 1
7 mov a 4
8 cmp a 0
9 jlt 14
10 ld c 0(a)
11 out c
12 sub a 1
13 jmp 8
14 end
Mem[0 + (a)] = (c)
Mem[0 + 2] = 4
MEMORY
0 12
1 3
2 4
3
4
5
6
7
8
INPUT
4 5 7
OUTPUT
Input: a, b, c, d, e
Output: e, d, c, b, a


0 mov a 0
1 cmp a 5
2 jeq 7
3 in c
4 st 0(a) c
5 add a 1
6 jmp 1
7 mov a 4
8 cmp a 0
9 jlt 14
10 ld c 0(a)
11 out c
12 sub a 1
13 jmp 8
14 end
C = Mem[0 + (a)]
C = Mem[0 + 3]
Ld c 0(a)
CPU
PC 11
A 3
C 5
SW >
B
D
MEMORY
0 12
1 3
2 4
3 5
4 7
5
6
7
8
INPUT
OUTPUT
7 5 4 3 12
Input: a, b, c, d, e
Output: e, d, c, b, a

Input: X, Y
Output: X 平方 + Y 平方

Input: X, Y, Z
Output: X Y Z 中最小者

Input: n, X1, X2, …. Xn
Output: 此 n 個數的和