CYCLE 0

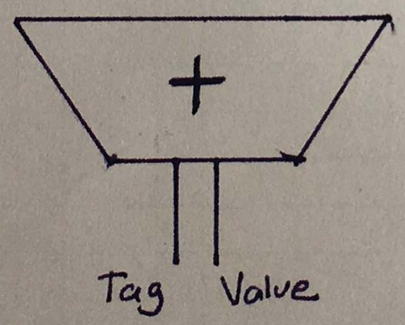
```
MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5
```

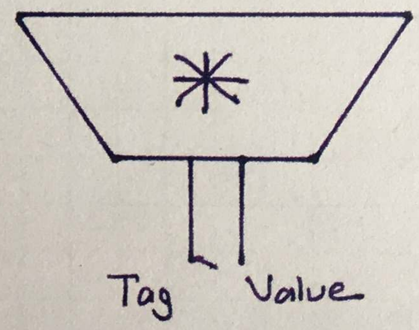
Register Alias Table

	V	Tag	Value
R1	1		1
R2	1		2
R3	1		3
R4	1		4
R5	1		5
R6	1		6
R7	1		7
R8	1		8
R9	1		9
R10	1		10
R11	1		11

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a						
b						
c						
d						

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x						
y						
z						
t						





CYCLE 1

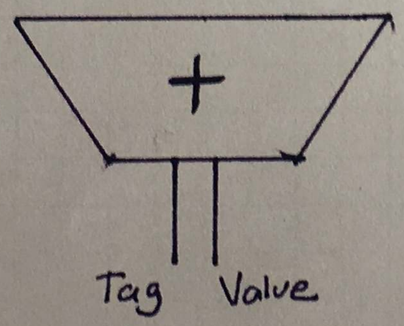
MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5

Execution Timeline
1
F

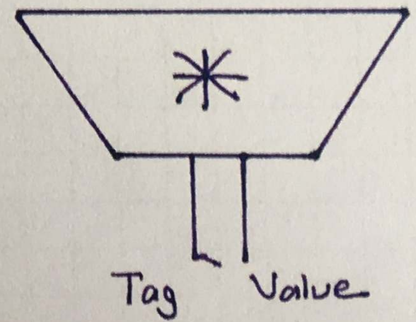
Register Alias Table

	V	Tag	Value
R1	1		1
R2	1		2
R3	1		3
R4	1		4
R5	1		5
R6	1		6
R7	1		7
R8	1		8
R9	1		9
R10	1		10
R11	1		11

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a						
b						
c						
d						



	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x						
y						
z						
t						



CYCLE 2

```
MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5
```

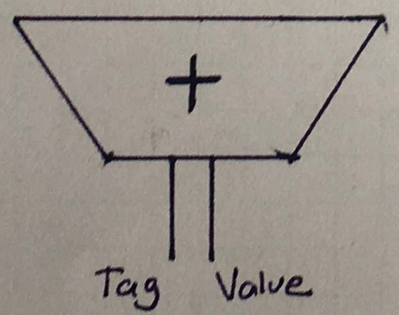
Cycle	1	2
	F	D
		F

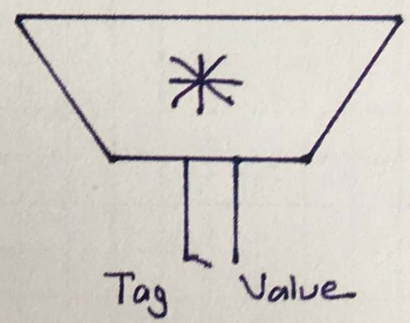
Register Alias Table

	V	Tag	Value
R1	1		1
R2	1		2
R3	0	x	
R4	1		4
R5	1		5
R6	1		6
R7	1		7
R8	1		8
R9	1		9
R10	1		10
R11	1		11

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a						
b						
c						
d						

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x	1	–	1	1	–	2
y						
z						
t						





CYCLE 3

```
MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5
```

Cycle 1 2 3

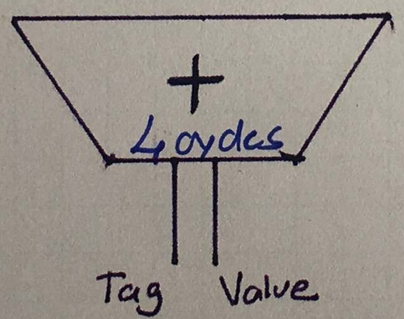
```
F D E1
  F D
    F
```

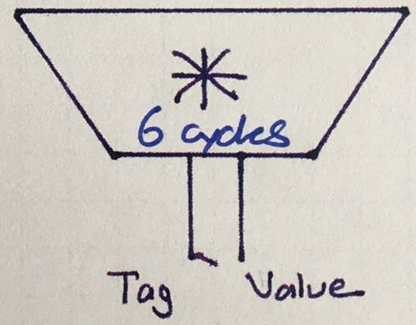
Register Alias Table

	V	Tag	Value
R1	1	-	1
R2	1	-	2
R3	0	x	-
R4	1	-	4
R5	0	a	-
R6	1	-	6
R7	1	-	7
R8	1	-	8
R9	1	-	9
R10	1	-	10
R11	1	-	11

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a	0	x	-	1	-	4
b						
c						
d						

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x	1	-	1	1	-	2
y						
z						
t						





Does the TAG HAVE TO be the ID of the Reservation Station Entry?

CYCLE 4

```
MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5
```

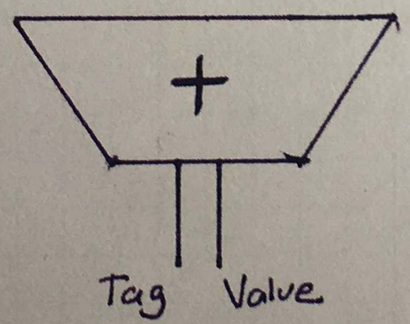
Cycle	1	2	3	4
	F	D	E_1	E_2
		F	D	–
			F	D
				F

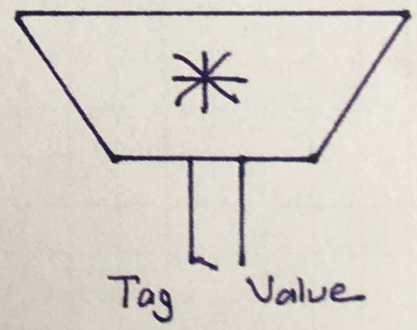
Register Alias Table

	V	Tag	Value
R1	1		1
R2	1		2
R3	0	x	
R4	1		4
R5	0	a	
R6	1		6
R7	0	b	
R8	1		8
R9	1		9
R10	1		10
R11	1		11

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a	0	x	–	1	–	4
b	1	–	2	1	–	6
c						
d						

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x	1	–	1	1	–	2
y						
z						
t						





→ ADD at RS b is ready to execute now (it is READY)
→ Because both of its sources are READY (valid)
It wakes up & it is selected to be executed on the ADDER
This is an example of OUT-OF-ORDER DISPATCH

CYCLE 5

MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5

Cycle 1 2 3 4 5

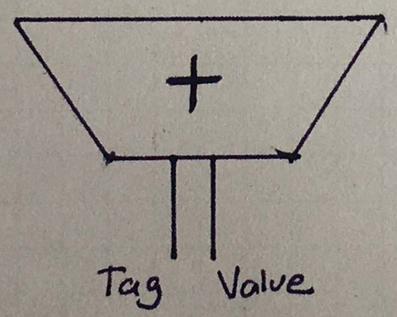
F	D	E_1	E_2	E_3
	F	D	–	–
		F	D	E_1
			F	D
				F

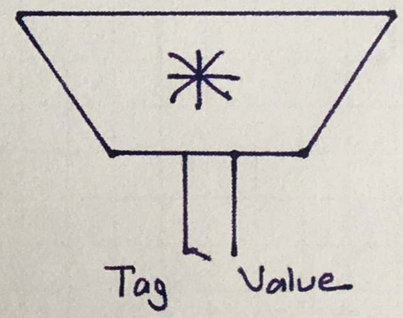
Register Alias Table

	V	Tag	Value
R1	1		1
R2	1		2
R3	0	x	
R4	1		4
R5	0	a	
R6	1		6
R7	0	b	
R8	1		8
R9	1		9
R10	0	c	
R11	1		11

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a	0	x	–	1	–	4
b	1	–	2	1	–	6
c	1	–	8	1	–	9
d						

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x	1	–	1	1	–	2
y						
z						
t						





ADD at RS c is READY to Execute

CYCLE 6

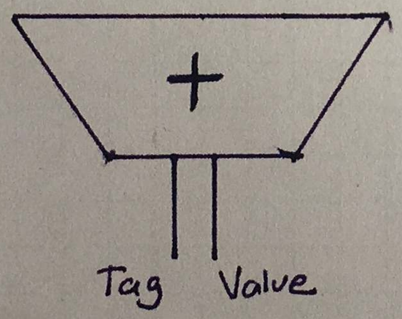
```
MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5
```

Cycle	1	2	3	4	5	6
	F	D	E_1	E_2	E_3	E_4
		F	D	-	-	-
			F	D	E_1	E_2
				F	D	E_1
					F	D
					I	F

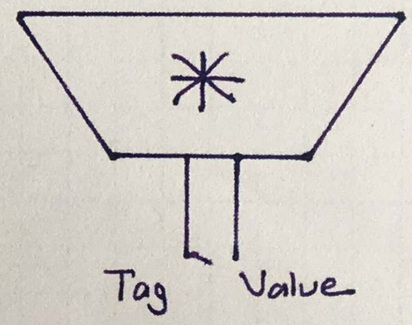
Register Alias Table

	V	Tag	Value
R1	1		1
R2	1		2
R3	0	x	
R4	1		4
R5	0	a	
R6	1		6
R7	0	b	
R8	1		8
R9	1		9
R10	0	c	
R11	0	y	

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a	0	x	-	1	-	4
b	1	-	2	1	-	6
c	1	-	8	1	-	9
d						



	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x	1	-	1	1	-	2
y	0	b	-	0	c	-
z						
t						



CYCLE 7

MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5

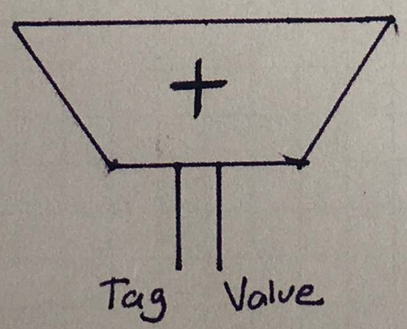
Cycle	1	2	3	4	5	6	7
	F	D	E_1	E_2	E_3	E_4	E_5
		F	D	-	-	-	-
			F	D	E_1	E_2	E_3
				F	D	E_1	E_2
					F	D	-
						F	D

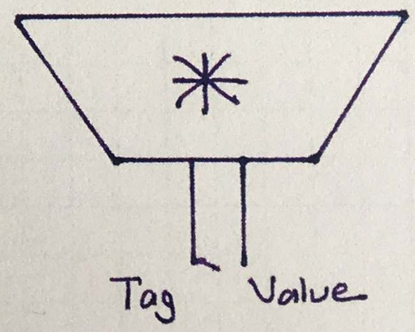
Register Alias Table

	V	Tag	Value
R1	1		1
R2	1		2
R3	0	x	
R4	1		4
R5	0	d	
R6	1		6
R7	0	b	
R8	1		8
R9	1		9
R10	0	c	
R11	0	y	

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a	0	x	-	1	-	4
b	1	-	2	1	-	6
c	1	-	8	1	-	9
d	0	9	-	0	x	-

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x	1	-	1	1	-	2
y	0	b	-	0	c	-
z						
t						





CYCLE 8

```
MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5
```

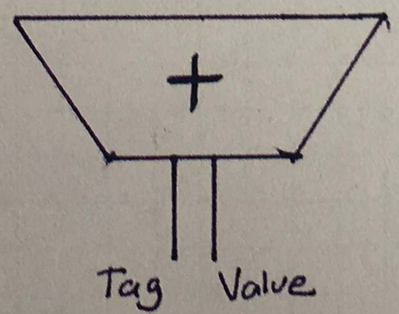
Cyde	1	2	3	4	5	6	7	8
	F	D	E_1	E_2	E_3	E_4	E_5	E_6
		F	D	-	-	-	-	-
			F	D	E_1	E_2	E_3	E_4
				F	D	E_1	E_2	E_3
					F	D	-	-
						F	D	-

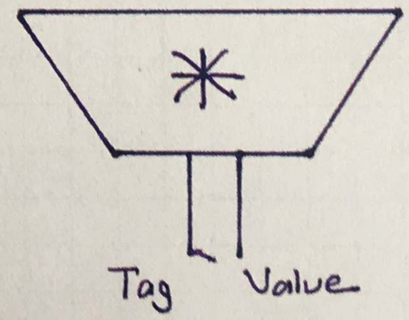
Register Alias Table

	V	Tag	Value
R1	1		1
R2	1		2
R3	1	x	2
R4	1		4
R5	0	d	
R6	1		6
R7	0	b	8
R8	1		8
R9	1		9
R10	0	c	
R11	0	y	

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a	1	x	2	1	-	4
b	1	-	2	1	-	6
c	1	-	8	1	-	9
d	0	a	-	0	y	-

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x	1	-	1	1	-	2
y	1	b	8	0	c	-
z						
t						





→ MUL at RS x broadcasts its tag and value
→ ADD at RS b also broadcasts its tag and value
→ All RS and RAT entries waiting for the corresponding tag capture ~~the broadcast~~ value and ~~set their V bits~~
→ ADD at RS a becomes READY to execute

CYCLE 20

```
MUL R1, R2 → R3
ADD R3, R4 → R5
ADD R2, R6 → R7
ADD R8, R9 → R10
MUL R7, R10 → R11
ADD R5, R11 → R5
```

Cycle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	F	D	E_1	E_2	E_3	E_4	E_5	E_6	W											
		F	D	–	–	–	–	–	E_1	E_2	E_3	E_4	W							
			F	D	E_1	E_2	E_3	E_4	W											
				F	D	E_1	E_2	E_3	E_4	W										
					F	D	–	–	–	E_1	E_2	E_3	E_4	E_5	E_6	W				
						F	D	–	–	–	–	–	–	–	–	E_1	E_2	E_3	E_4	W

Register Alias Table

	V	Tag	Value
R1			
R2			
R3			
R4			
R5			
R6			
R7			
R8			
R9			
R10			
R11			

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
a						
b						
c						
d						

	SOURCE 1			SOURCE 2		
	V	Tag	Value	V	Tag	Value
x						
y						
z						
t