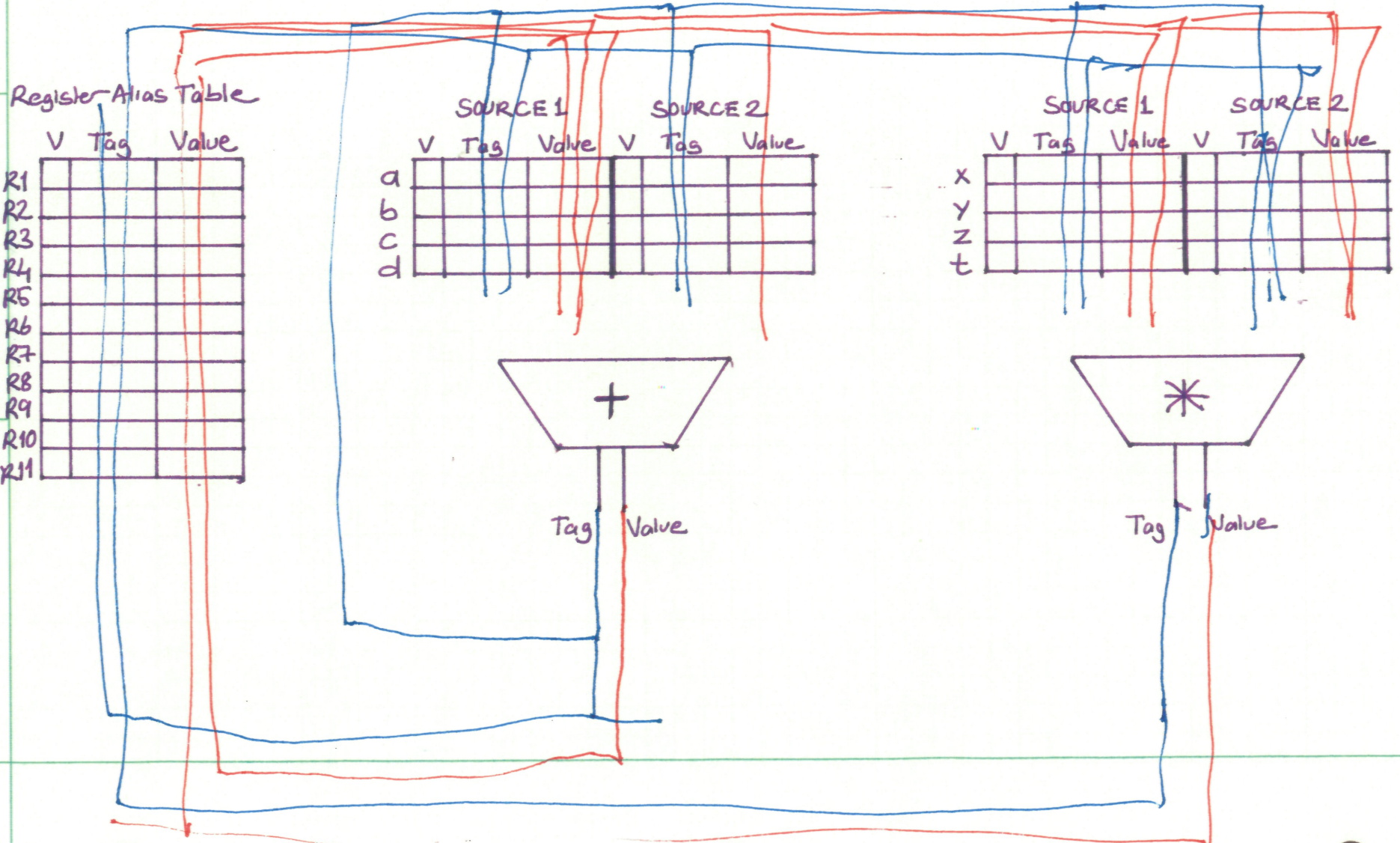


CYCLE —

```

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 0

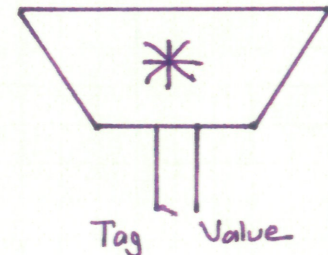
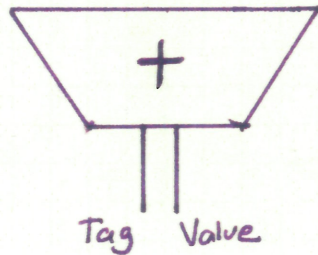
MUL R1, R2 → R3
 ADD R3, R4 → R5
 ADD R2, R6 → R7
 ADD R8, R9 → R10
 MUL R7, R10 → R11
 ADD R5, R11 → R5

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~~ 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

Execution Timeline

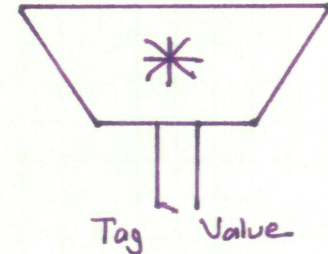
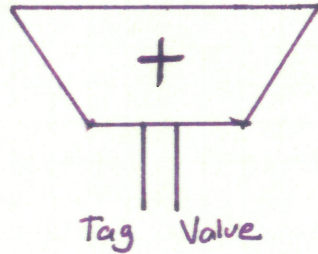
1 2
 F D
 F

Register Alias Table

	V	Tag	Value
R1	1	<u>1</u>	1
R2	1	<u>2</u>	2
R3	0	X	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	1	<u>1</u>	1	1	<u>2</u>	2
y						
z						
t						

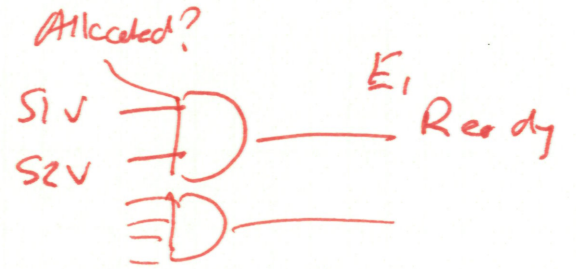


CYCLE 2³

Cycle 1 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

F D E,
 F D
 F



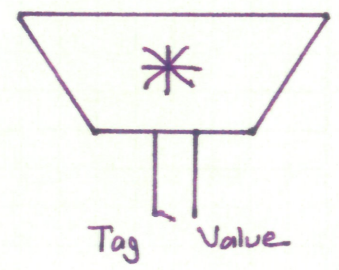
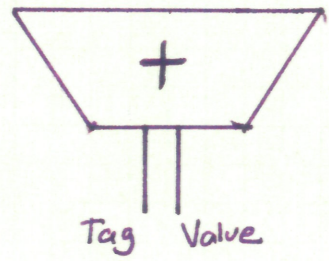
Register Alias Table

	V	Tag	Value
R1	1		1
R2	1		2
R3	0	PR5	
R4	1		4
R5	0	a	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	0	PR5	~	1	~	4
b						
c						
d						

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

Dest tag PR55



53 - PRF

CYCLE 3 ⁴

Cycle 1 2 3 4

```

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

```

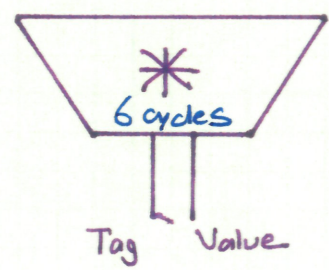
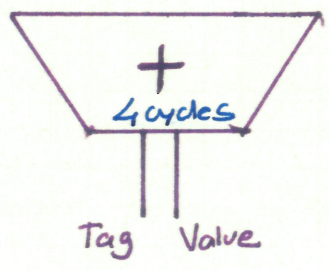
F D E, E2
F D -
F D
F
  
```

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						



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

CYCLE ~~4~~⁵

Cycle 1 2 3 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

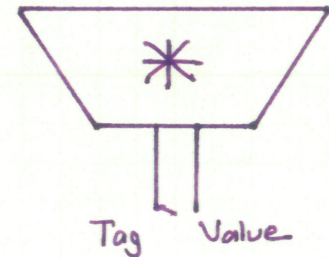
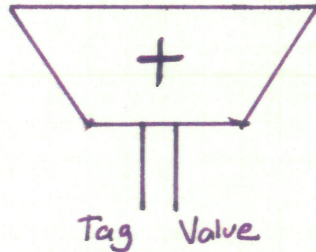
F D E E₂ E₃
 F D - -
 F D E₁ -
 F D
 F

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	0	b	
R8	1		8
R9	1		9
R10	0	c	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	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 b can execute now (it is READY)
- Both of its sources are READY
- It wakes up & it is selected to be executed
- Out of order dispatch into the functional unit

CYCLE 5⁶

Cycle 1 2 3 4 5

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

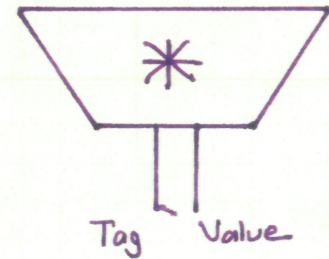
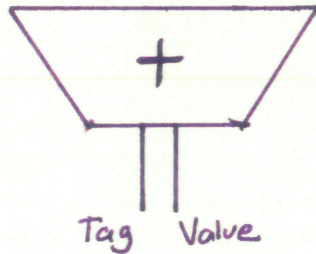
F D E₁ E₂ E₃ E₄
 F D - - -
 F D E₁ E₂
 F D E₁
 F D
 F

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	0	b	
R8	1	-	8
R9	1	-	9
R10	0	c	
R11	0	y	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	-	8
d						

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



ADD at R5 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 7

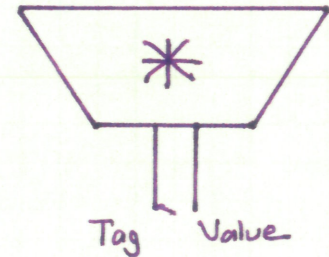
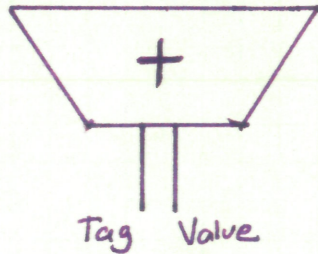
F D E₁ E₂ E₃ E₄ E₅
 F D - - - -
 F D E₁ E₂ E₃
 F D E₁ E₂
 F D -
 F D

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	0	a	-	0	y	-

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



CYCLE ~~7~~ 8

Cycle 1 2 3 4 5 6 7 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

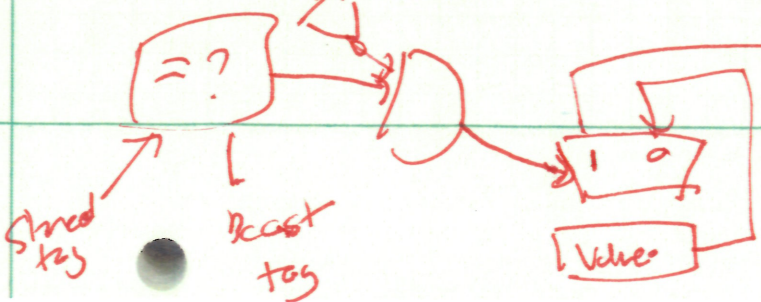
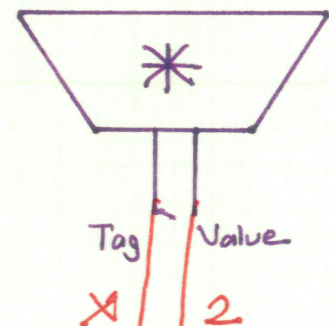
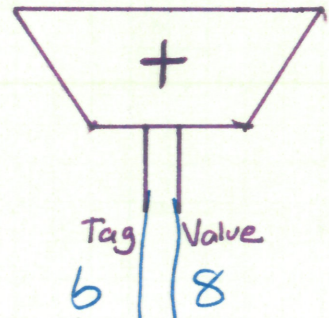
F D E₁ E₂ E₃ E₄ E₅ E₆ |
 F D - - - - - |
 F D E₁ E₂ E₃ E₄ |
 F D E₁ E₂ E₃ |
 F D - - - |
 F D - - - |

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	1	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	0	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						



CYCLE ~~8~~ 9

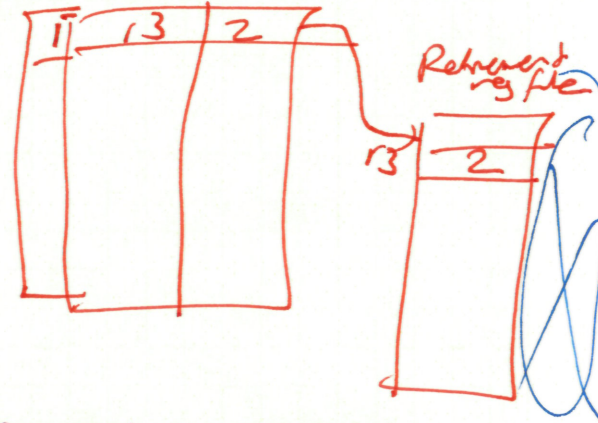
MUL R1, R2 → R3
 ADD R3, R4 → R5
 ADD R2, R6 → R7
 ADD R8, R9 → R10
 MUL R7, R10 → R11
 ADD R5, R11 → R5

Cycle 1 2 3 4 5 6 7 8 9

F D E₁ E₂ E₃ E₄ E₅ E₆ ~~WR~~ W
 F D - - - - -
 F D E₁ E₂ E₃ E₄
 F D E₁ E₂ E₃
 F D - -
 F D -

Clustering

dest reg produced
 dest reg ID value



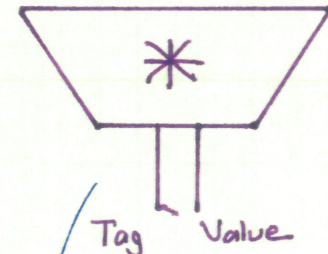
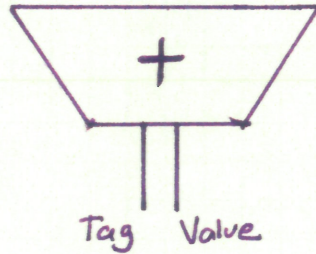
Future

Register Alias Table

	V	Tag	Value
R1			
R2			
R3	1	x → -	2
R4			
R5			
R6	1	b → -	8
R7			
R8			
R9			
R10			
R11			

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



PRF

- MUL at RS x broadcasts its tag & value
- All RS and RAT entries waiting for the tag capture the value and set their V bits
- ADD at RS a becomes READY to execute now!

