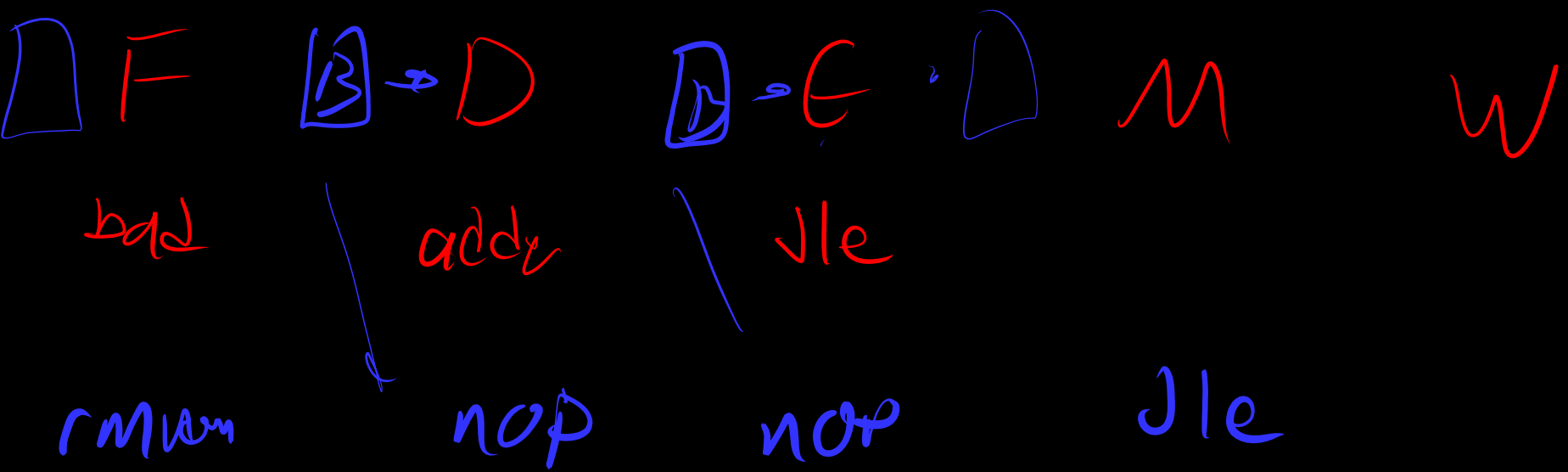




SURPRISE!





Precise interrupts

Jump Prediction ←

ret addr prediction

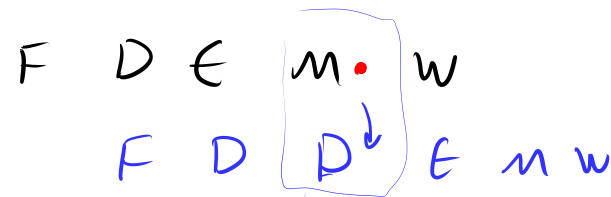
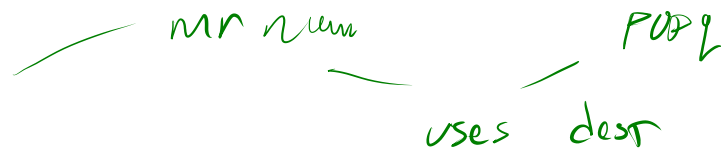
longer pipelines

- Some dep are hazard, others not

no PC register

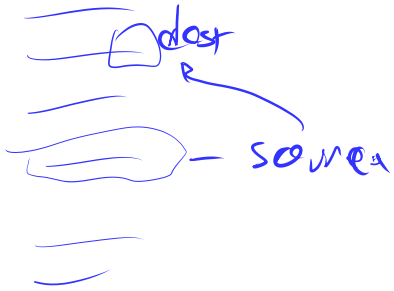
- bubbling a stage

- load/use stalls



data dependency

code:



```
addq _____, %rcx  
_____  
_____  
rnew %rcx, _____
```

```
int x = 3  
:  
_____ = x + _____
```

Hazard: dep that must stall (not forward)

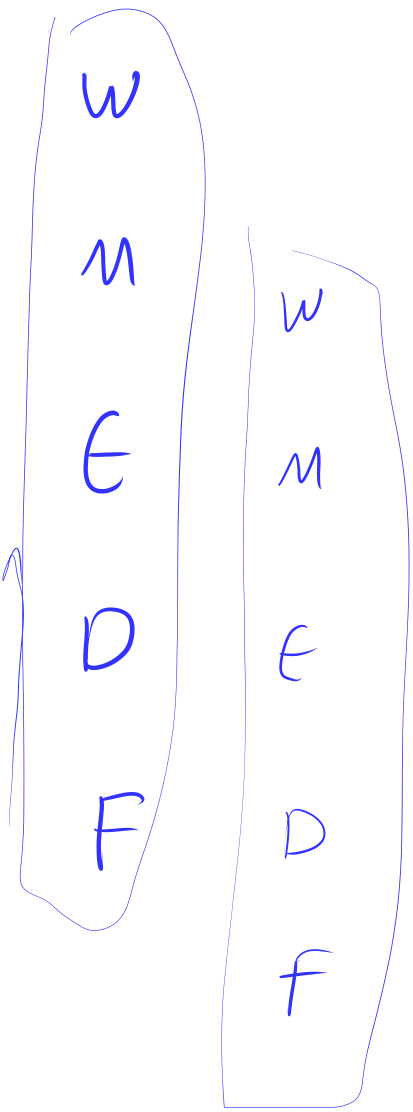
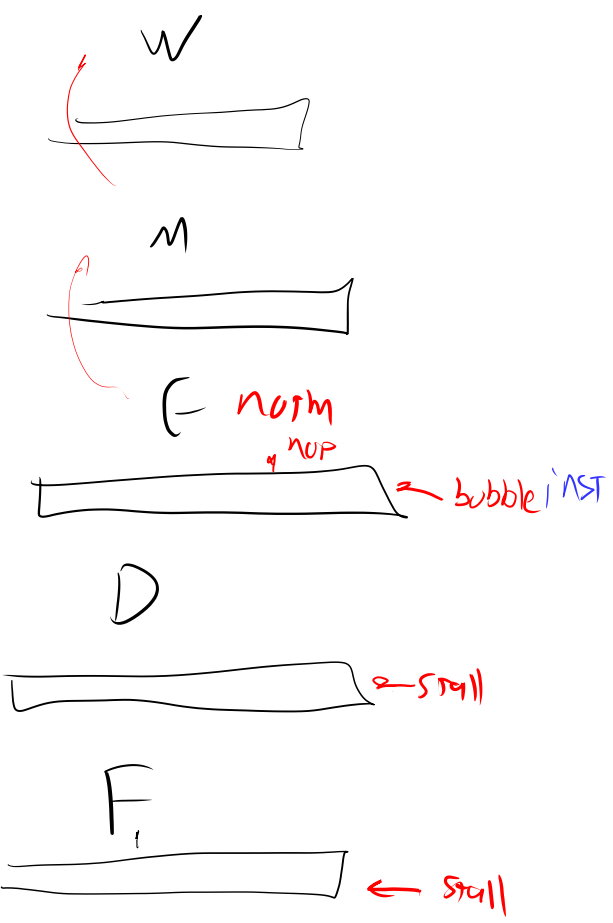
Control dependency

OP_q

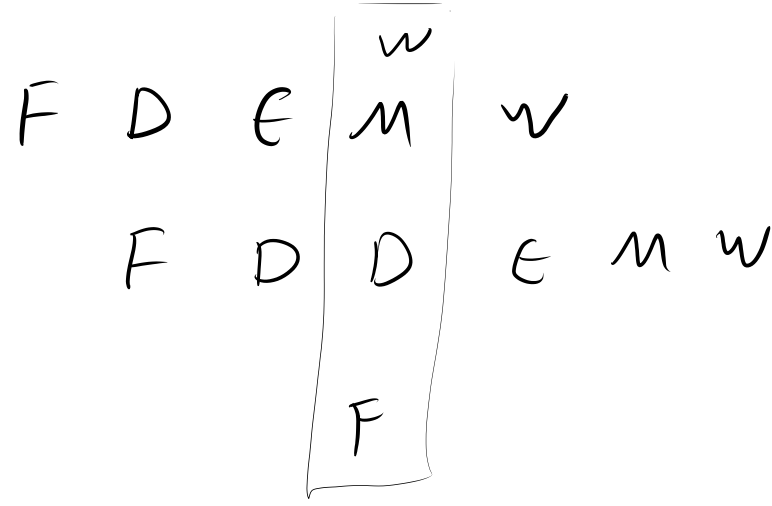
⋮

J|e

ret_q

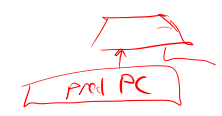
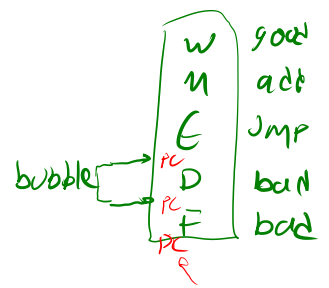


E M W



1. how do I pick before I know?

2. If wrong, how do I fix it?



addq	%rax, %rdx	F	D	E	M	W
jle	Target	F	D	E	M	W
xorq						F

target:

Mr Mang

→

F	D	X
	F	X

miss: .2 cycles

10% are cond br

85% accur

$$.85 \cdot 10 + .15 \cdot 12 =$$

Precise interrupts

