



wait — stall

find rest of — forward

guess — Speculation

Speculation

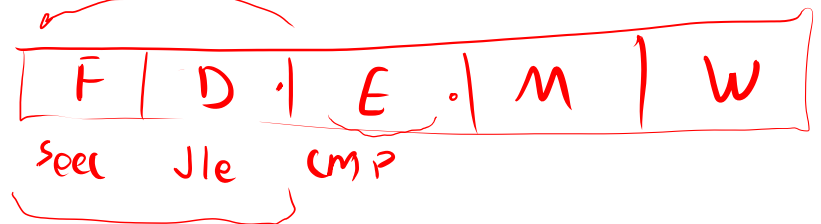
- req: must not do anything we can't undo
- no going to write to Reg file or Memory

• Branches, Conditional

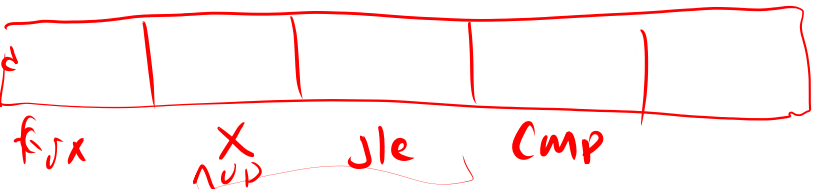
- do we jump — branch prediction
- where to

jle ^{imm} label;

- guess we jump -



+1 cycle / mispred



- Taken
- not taken

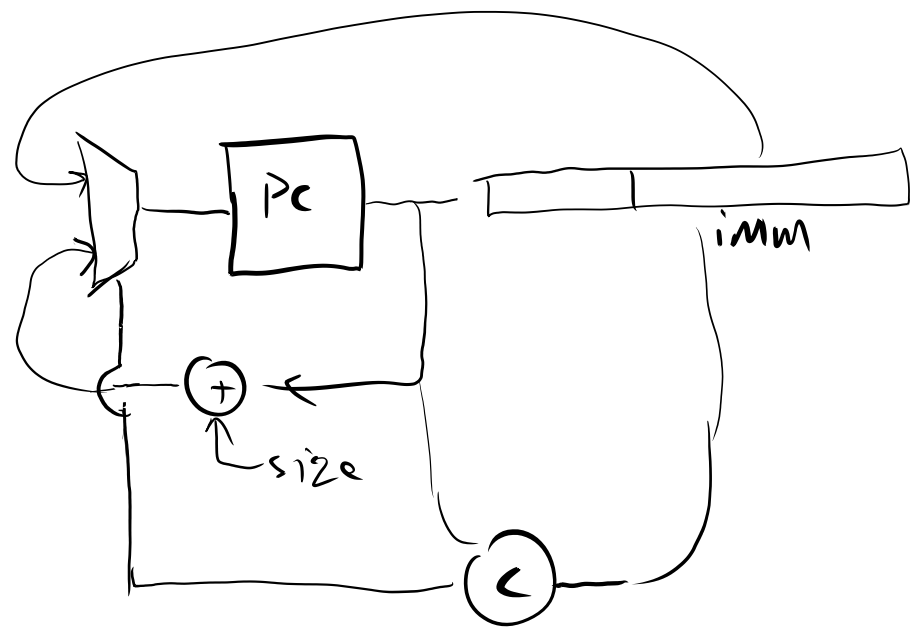
Profile

label:

loop

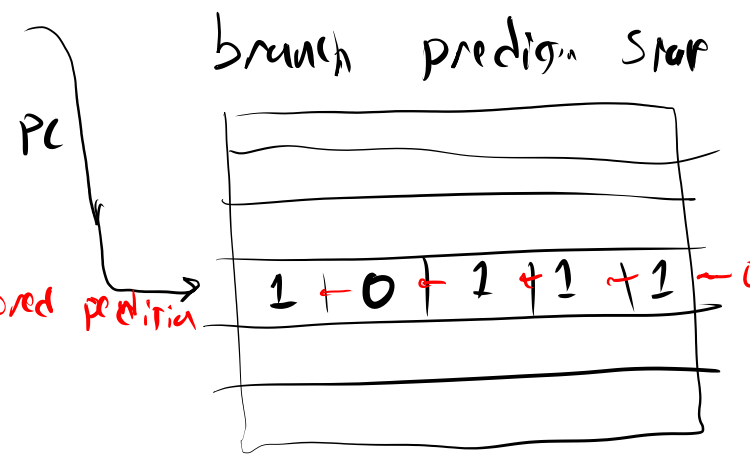
→ Jle label if

- forward jump: not taken
- backward jump: taken



label:

90% accuracy
 3-cycle mispred penalty
 $.9 \times 1 + .1 \times 4$
 aver 1.3



Side Channel

Set
BP13

loop
if (pw[i] == pw_exp[i])
...

fix: erase
on context switch

extracted

- use same entry
- TIME it
↳ tell how raw

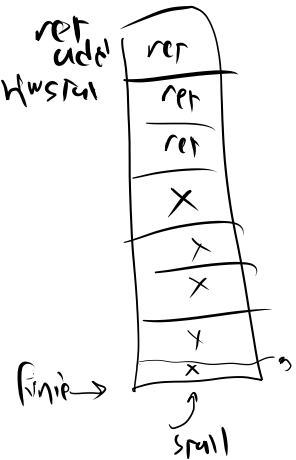
callq foo ✓

lret foo good prediction

→ jmp *%rax forwardin

↙ rret

fake stack

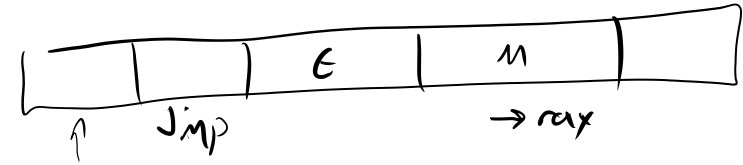


Object [] x

```

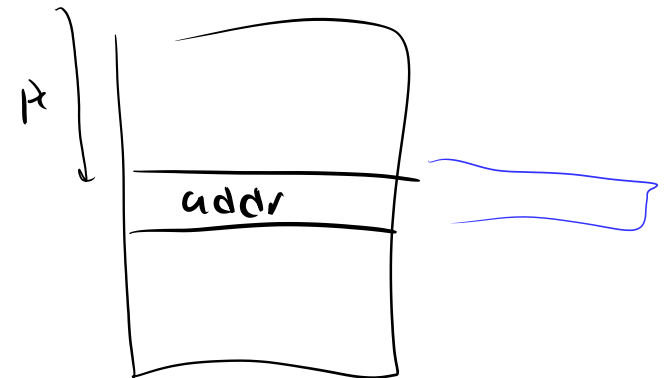
for (Object y : x) {
  println (y.toString)
  jmp *y.vtable[2]
}

```



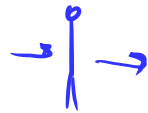
Jump Target predictor

indirect jump - buffer of addr



Pipeline: assembly line

Multicore: each do it

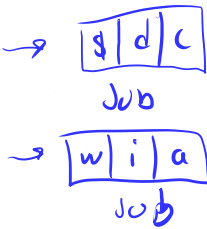


Management

Priority

Employee backlog →

Communication →



fetch



add



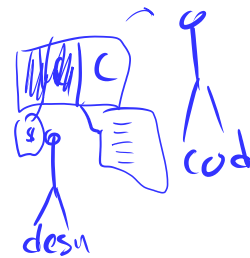
under instr



wrt



wrt m



functional units