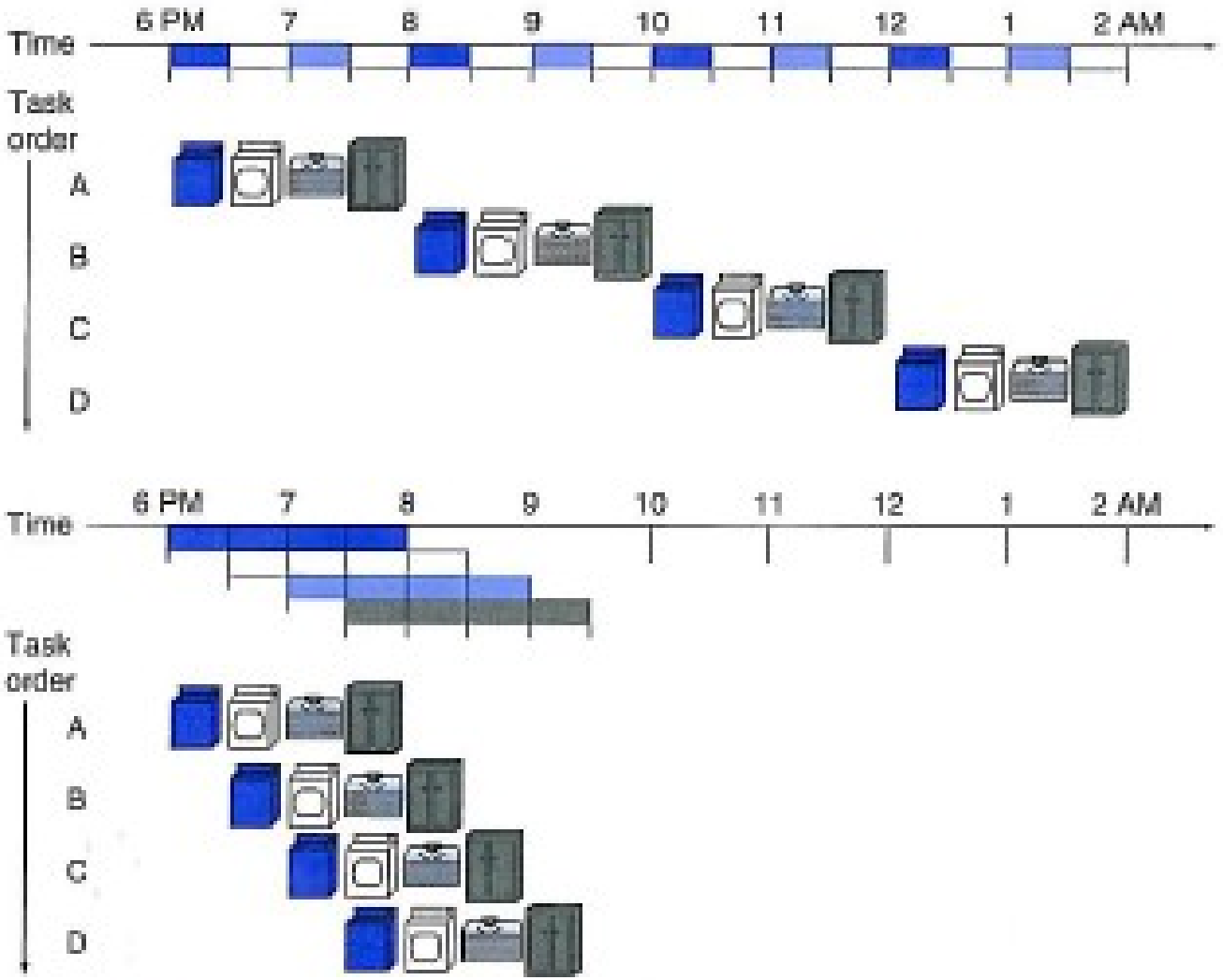
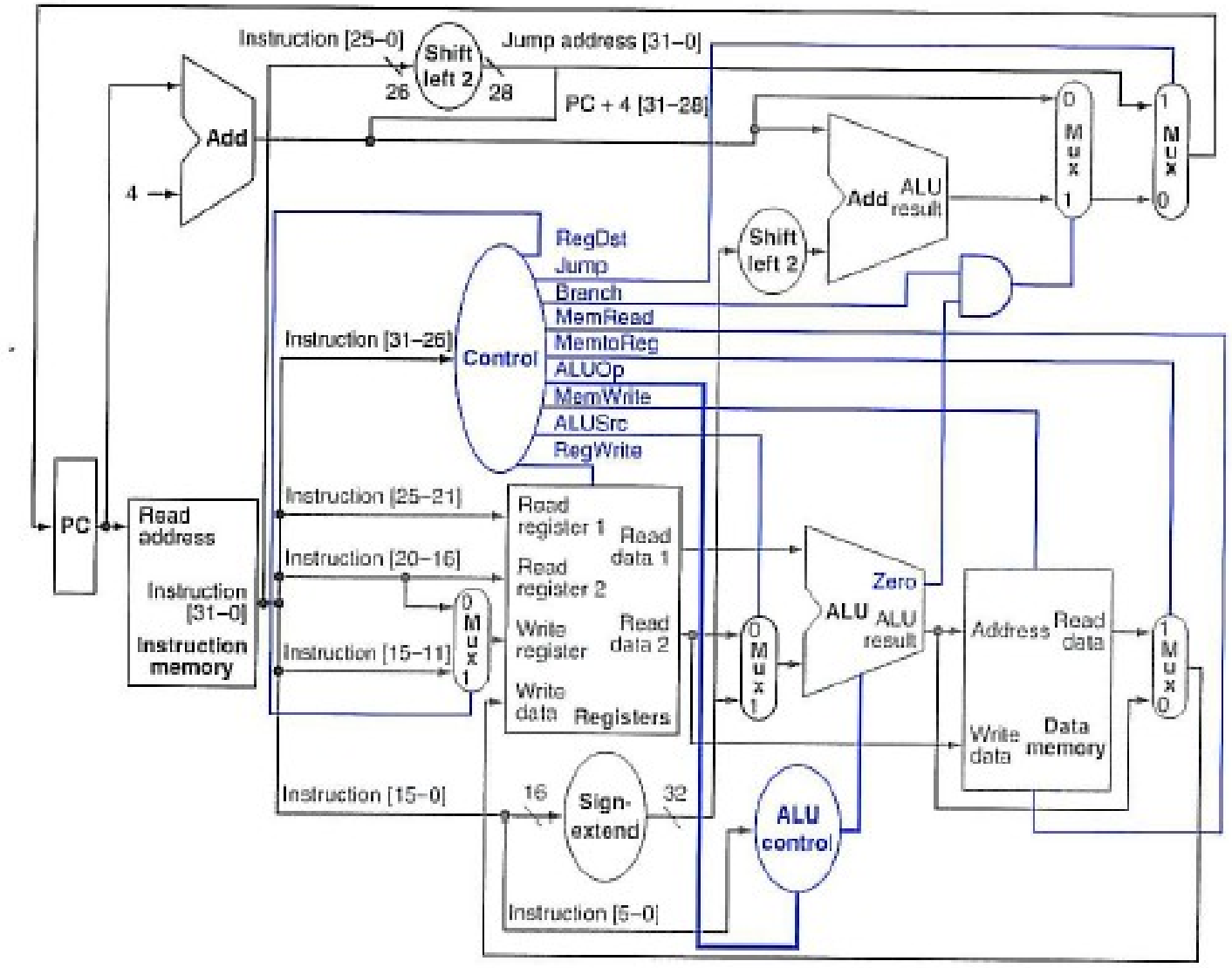
PIPELINE CONCEPTOS GENERALES 1/4



PIPELINE CONCEPTOS GENERALES 2/4

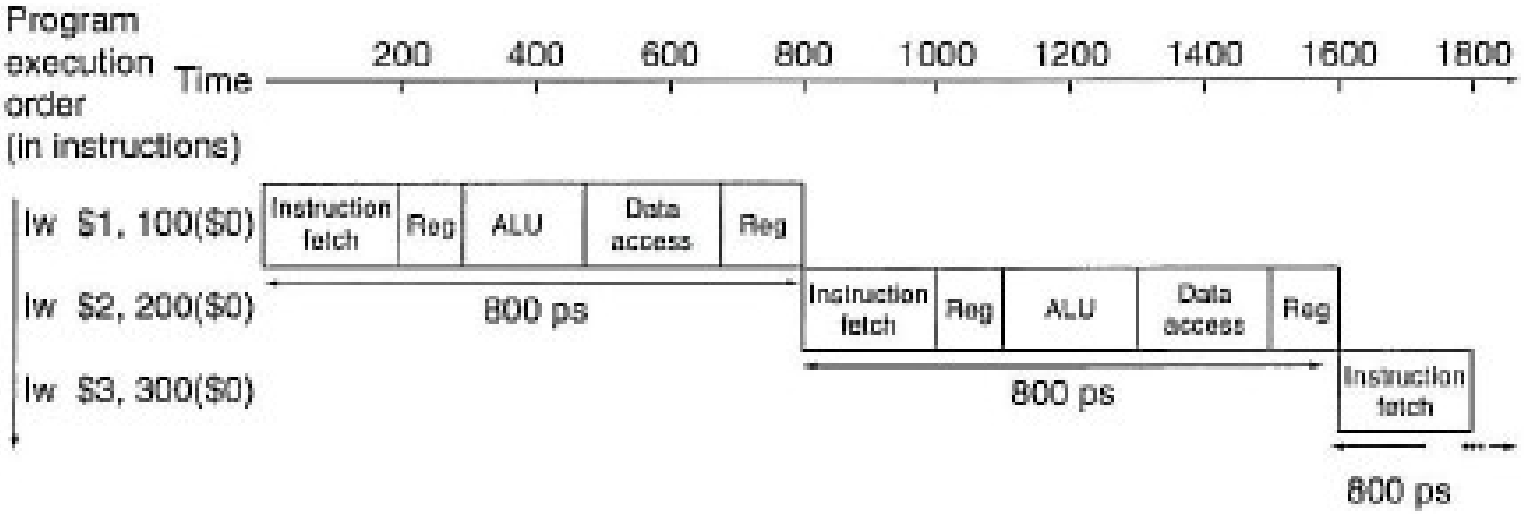


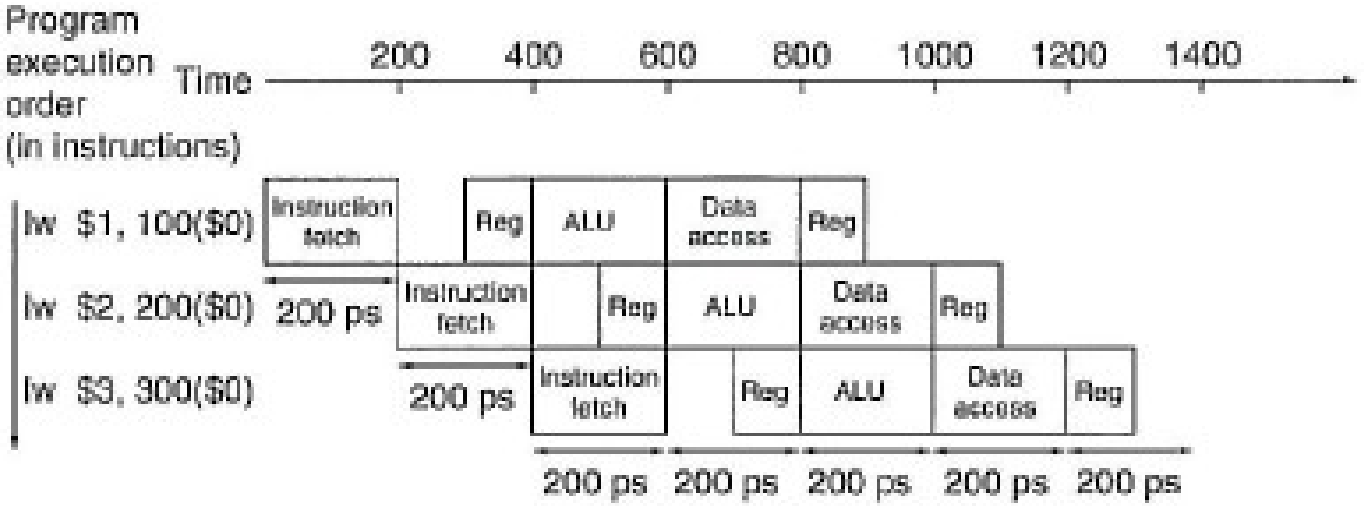
PIPELINE CONCEPTOS GENERALES 3/4

Instruction class	Instruction fetch	Register read	ALU operation	Data access	Register write	Total time
Load word (lw)	200 ps	100 ps	200 ps	200 ps	100 ps	800 ps
Store word (sw)	200 ps	100 ps	200 ps	200 ps		700 ps
R-format (add, sub, AND, OR, slt)	200 ps	100 ps	200 ps		100 ps	600 ps
Branch (beq)	200 ps	100 ps	200 ps			500 ps

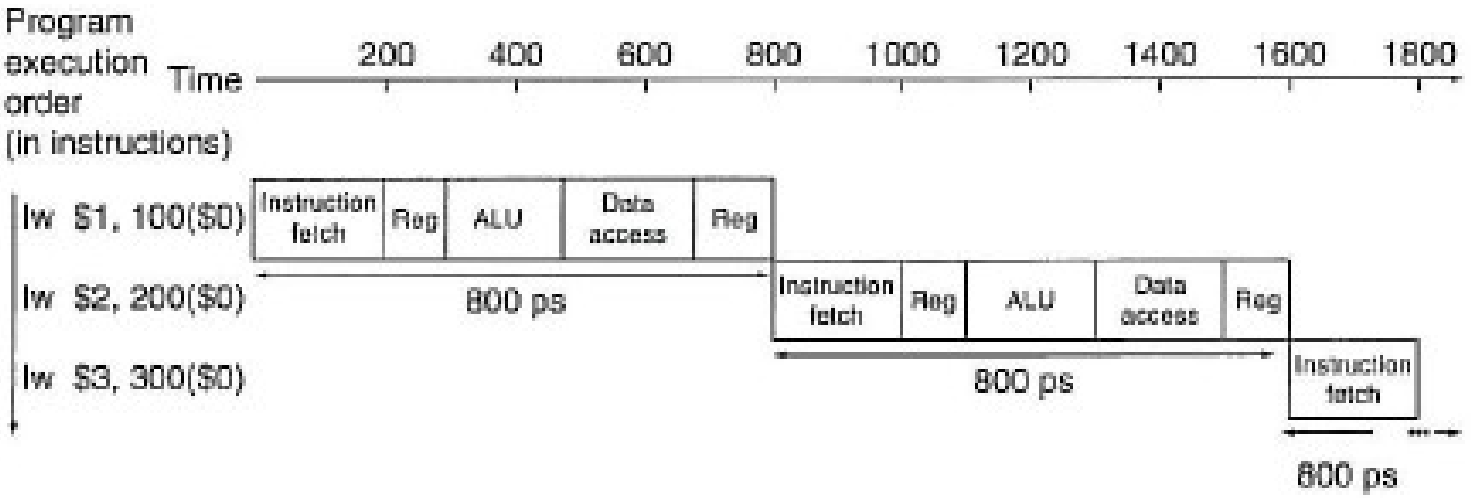
$$\text{Time between instructions}_{\text{pipelined}} = \frac{\text{Time between instructions}_{\text{nonpipelined}}}{\text{Number of pipe stages}}$$

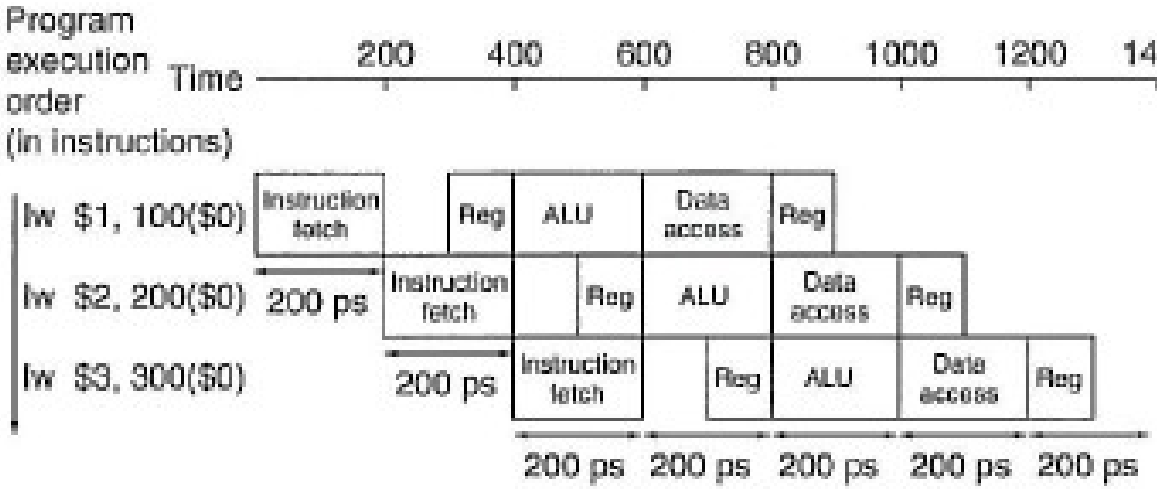
PIPELINE CONCEPTOS GENERALES 4/4





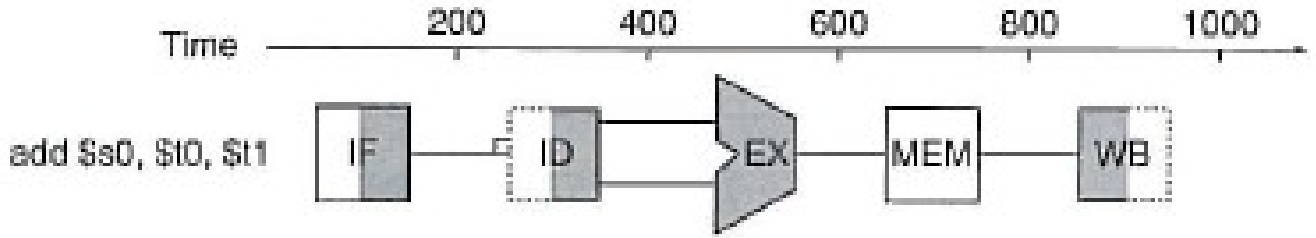
PIPELINE HAZARDS1/7
STRUCTURAL HAZARDS

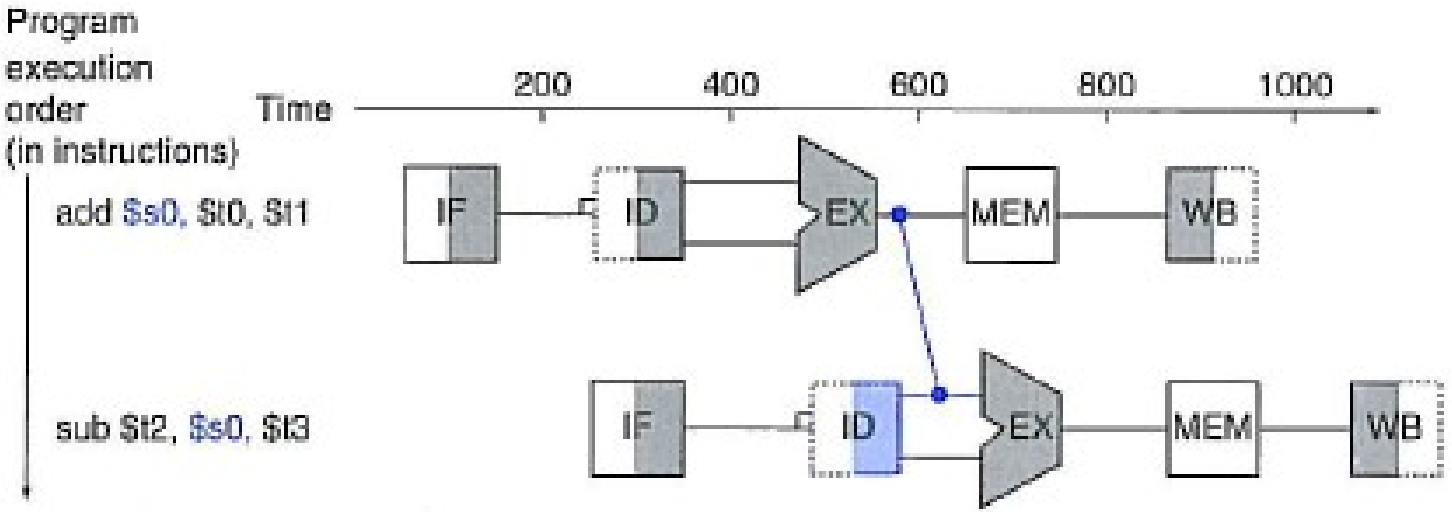




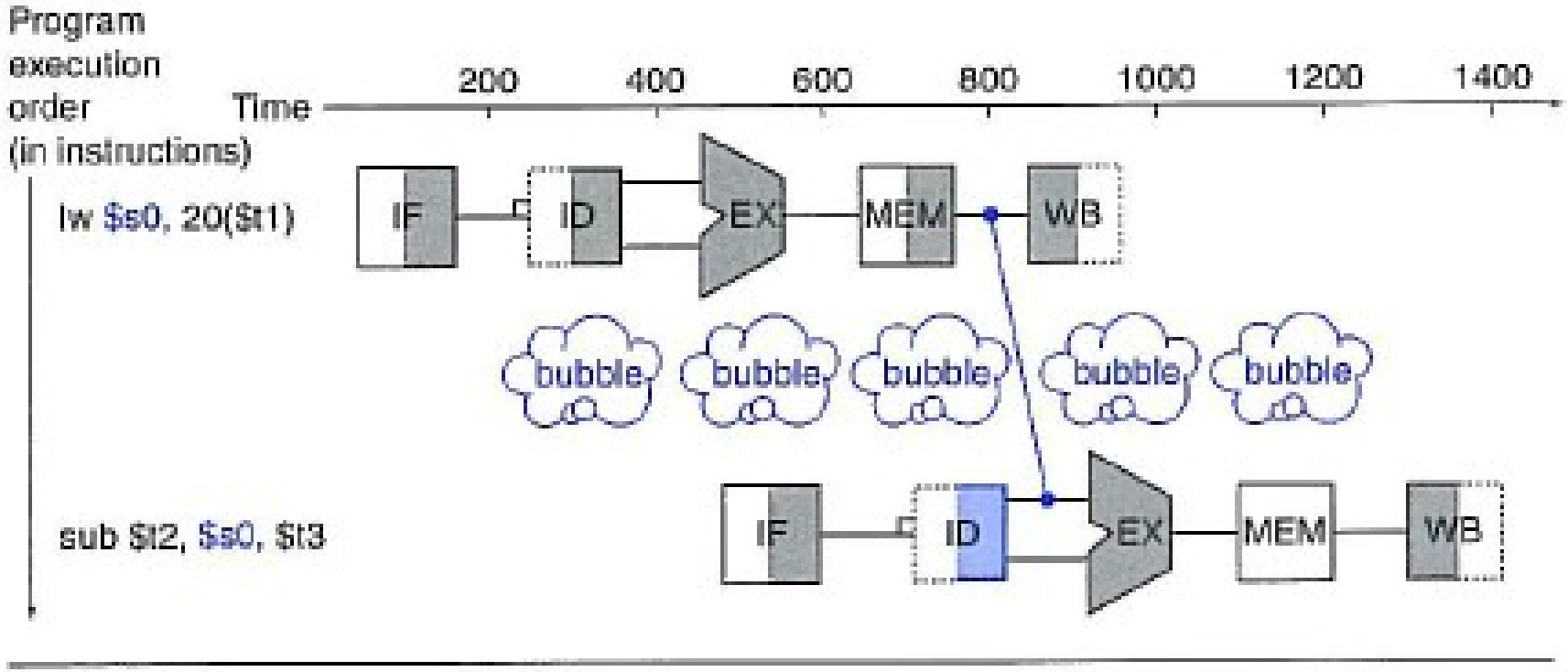
PIPELINE HAZARDS 2/7
DATA HAZARDS

```
add    $s0, $t0, $t1
sub    $t2, $s0, $t3
```





PIPELINE HAZARDS 3/7
DATA HAZARDS



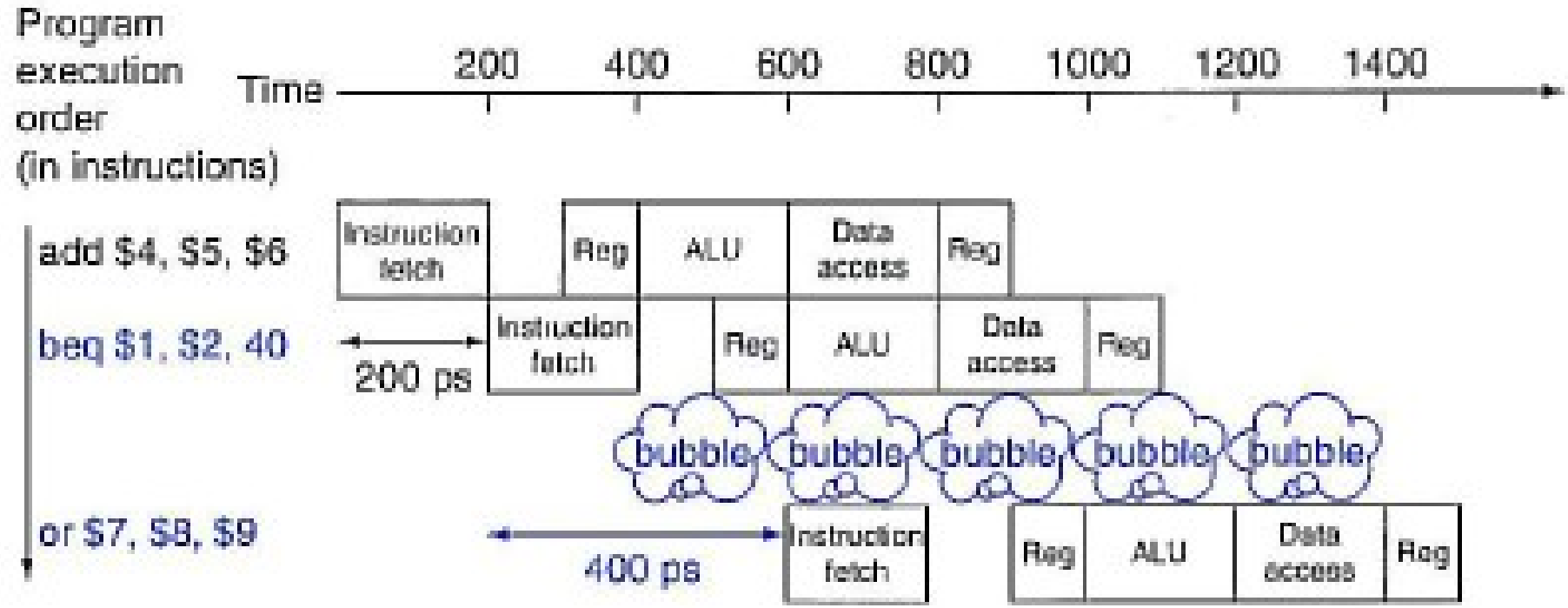
PIPELINE HAZARDS 4/7
DATA HAZARDS

```
a = b + e;
c = b + f;
```

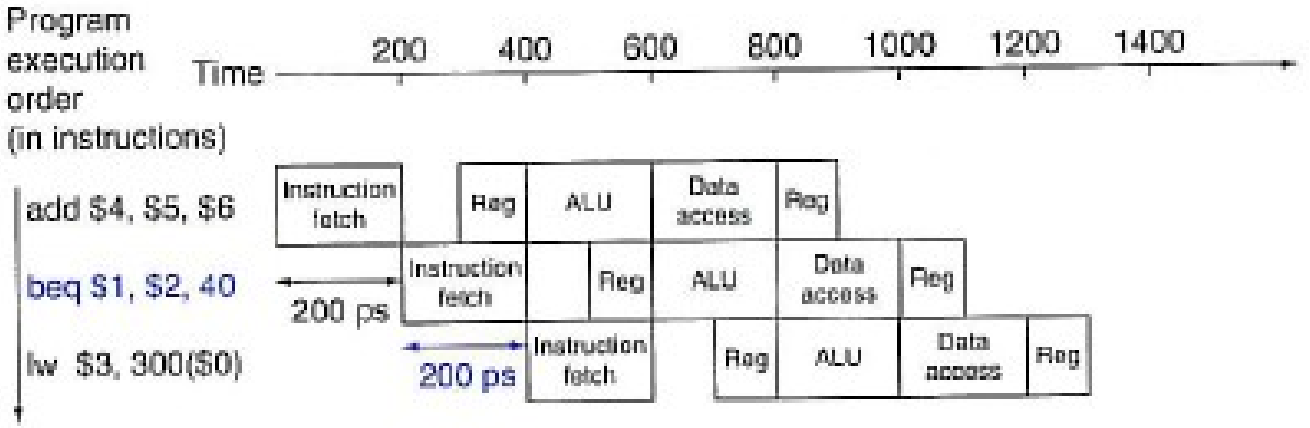
```
lw   $t1, 0($t0)
lw   $t2, 4($t0)
add  $t3, $t1,$t2
sw   $t3, 12($t0)
lw   $t4, 8($t0)
add  $t5, $t1,$t4
sw   $t5, 16($t0)
```

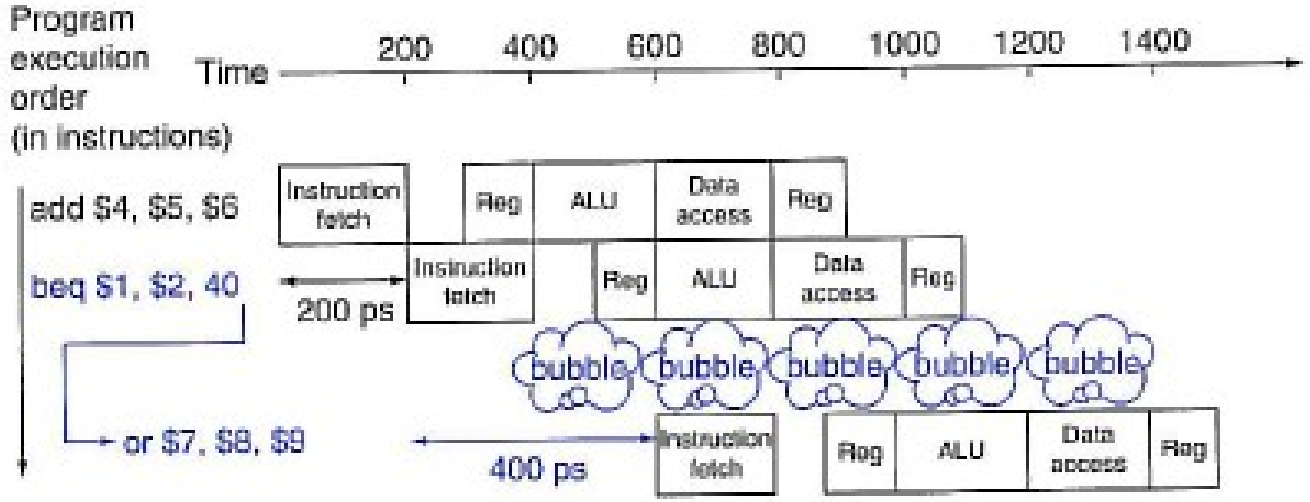
```
lw   $t1, 0($t0)
lw   $t2, 4($t0)
lw   $t4, 8($t0)
add  $t3, $t1,$t2
sw   $t3, 12($t0)
add  $t5, $t1,$t4
sw   $t5, 16($t0)
```

PIPELINE HAZARDS 5/7
CONTROL HAZARDS



PIPELINE HAZARDS 6/7
CONTROL HAZARDS





PIPELINE HAZARDS 7/7
CONTROL HAZARDS

Ejercicio: Para cada una de las secuencias que siguen determinar:
a)Cual debe sufrir un stall
b)Cual puede evitar stall usando forwarding
c)Cual se puede ejecutar sin stall ni forwarding

Sequence 1	Sequence 2	Sequence 3
lw $t0,0($t0)	add $t1,$t0,$t0	addi $t1,$t0,#1
add $t1,$t0,$t0	addi $t2,$t0,#5	addi $t2,$t0,#2
	addi $t4,$t1,#5	addi $t3,$t0,#2
		addi $t3,$t0,#4
		addi $t5,$t0,#5