Architetture dei sistemi di elaborazione
Esame del 27.6.2019 - parte I

A1

Nome, Cognome, Matricola.....

Question #2

Considering the MIPS64 architecture presented in the following:

- Integer ALU: 1 clock cycle
- Data memory: 1 clock cycle
- FP arithmetic unit: pipelined, 2 stages
- FP multiplier unit: pipelined, 6 stages
- FP divider unit: unpipelined, 10 stages
- branch delay slot: 1 clock cycle, and the branch delay slot is not enabled
- forwarding is enabled
- it is possible to complete instruction EXE stage in an out-of-order fashion.

Considering the following code fragment, show the timing of the loop-based program and compute how many cycles does this program take to execute, filling the table.

```
; ********************* MIPS64 ***********************
;  for (i = 0; i < 10; i++) {
;       v5[i] = v1[i]*v2[i] - v3[i]/v4[i];
;  }
```

		comments	Clock cycles
	.data		
V1:	.double “10 values”		
V2:	.double “10 values”		
V3:	.double “10 values”		
…			
V5:	.double “10 zeros”		
	.text		
main:	daddui r1,r0,0	r1← pointer	5
	daddui r2,r0,10	r2 <= 10	1
loop:	l.d f1,v1(r1)	f1 <= v1[i]	1
	l.d f2,v2(r1)	f2 <= v2[i]	1
	mul.d f5,f1,f2	f5 <= v1[i]*v2[i]	7
	l.d f3,v3(r1)	f3 <= v3[i]	0
	l.d f4,v4(r1)	f4 <= v4[i]	0
	div.d f6, f3, f4	f6 <= v3[i]/v4[i]	8
	sub.d f5,f5,f6	f5 <= f5-f6	2
	s.d f5,v5(r1)	v5[i] <= f5	1
	daddui r1,r1,8	r1 <= r1 + 8	1
	daddi r2,r2,-1	r2 <= r2 - 1	1
	bnez r2,loop		2
	halt		1
		total	256

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daddui r1,r0,0	F	D	E	M	W																										
daddui r2,r0,10		F	D	E	M	W																									
l.d f1,v1(r1)			F	D	E	M	W																								
l.d f2,v2(r1)				F	D	E	M	W																							
mul.d f5,f1,f2					F	D		E	E	E	E	E	E	M	W																
l.d f3,v3(r1)						F		D	E	M	W																				
l.d f4,v4(r1)								F	D	E	M	W																			
div.d f6, f3, f4									F	D		E	E	E	E	E	E	E	E	E	M	W								
sub.d f5,f5,f6										F		D									E	E	M	W						
s.d f5,v5(r1)												F									D	E		M	W					
daddui r1,r1,8																					F	D		E	M	W				
daddi r2,r2,-1																						F		D	E	M	W			
bnez r2,loop																								F		D	E	M	W		
halt																															