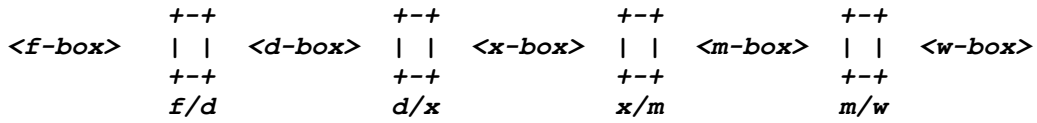
Pipeline Practice Exercises

Consider our instruction-execution pipeline ***with forwarding***: Each of the following 6 questions is independent.



a- When the d-box decodes the instruction 'l.d f6,-24(r2)', it sends the following 3 information to the x-box: _____add signal_____, _____immediate -24_____, _____register r2 value_____.

b- When the d-box decodes the instruction 'mul.d f6, f2, f4', it sends the following 3 information to the x-box: ___oppcode multiply_____, _____value of f2_____, _____value of f4_____. The w-box will receive the following 2 information: _____result of multiplication_____, _____id of f6_____ for the same instruction.

c- When the m-box processes the instruction 'l.d f6, -4(r4)', it receives the following information: ___the address 4-r4_____, _____load signal_____ from the __x-_____ box and it sends the following information: _____data from memo address r4-4_____, _____id of f6_____ to the _____w-box_____ box.

d- When the pipeline is processing the instruction 's.d f8, 4(r2), the **m-box** receives 2 different types of values. Indicate type & value for each : __memory address 4+r2__, ____data/value at f8_____.

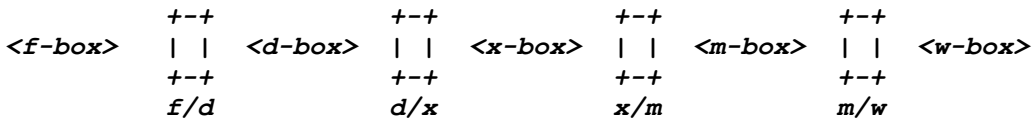
e- In the pipeline, the _____f-box_____ increments the PC for each and every instruction while the ____d-box_____ modifies the PC only if a branch will be executed.

f- Consider the following 2 independent sets of instructions:

	1	**2**	**3**	**4**	**5**	**6**	
add r1, r1, 8	f	d	x	n	w		
l.d f8, 4(r1)		f	d	x	m	w	

	1	**2**	**3**	**4**	**5**	**6**	**7**
l.d f8, 4(r1)	f	d	x	m	w		
add f6, f8, f4		f	d	s	x	n	w

There is data dependency within each set of instructions; Explain briefly (1-2 sentences) each dependency and how it affects the data flow in the pipeline.



Assume that the following are the only control signals: <x-box> no-op, add, mult, shift; <m-box> no-op, load, and store; <w-box> no-op, write-back. Consider the following program

```
                 1 2 3 4 5 6 7 8 9 0
l.d   f6,-8(r2)  f d x m w
l.d   f8,-16(r3)   f d x m w
mul.d f10,f6,f8      f d   x m w
sll   f10,f10,16       f   d x m w
s.d   f10,24(r4)           f d x m
```

a) Write down the 4 control signals received by the x-box during cycles 4-7. Ans add noop multiply shift

b) Write down the 4 control signals received by the m-box during cycles 4-7. Ans load load noop noop

c) Write down the 4 control signals received by the w-box during cycles 4-7. Ans noop writeback writeback noop

d) Which box initiates the control signals for other boxes working on the same instruction? d-box