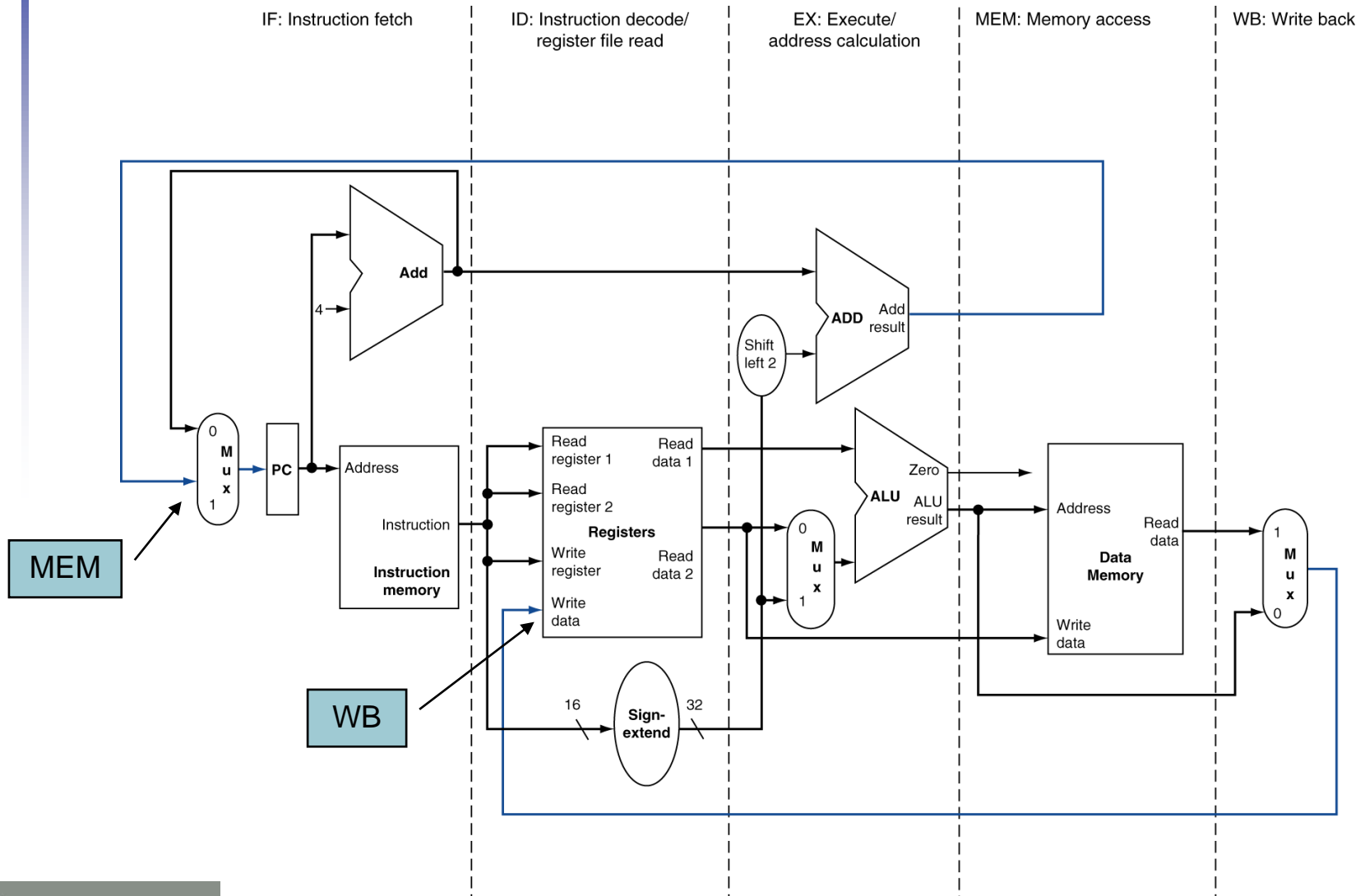


Arquitetura de um processador

4. Pipeline: caminho de dados e controle

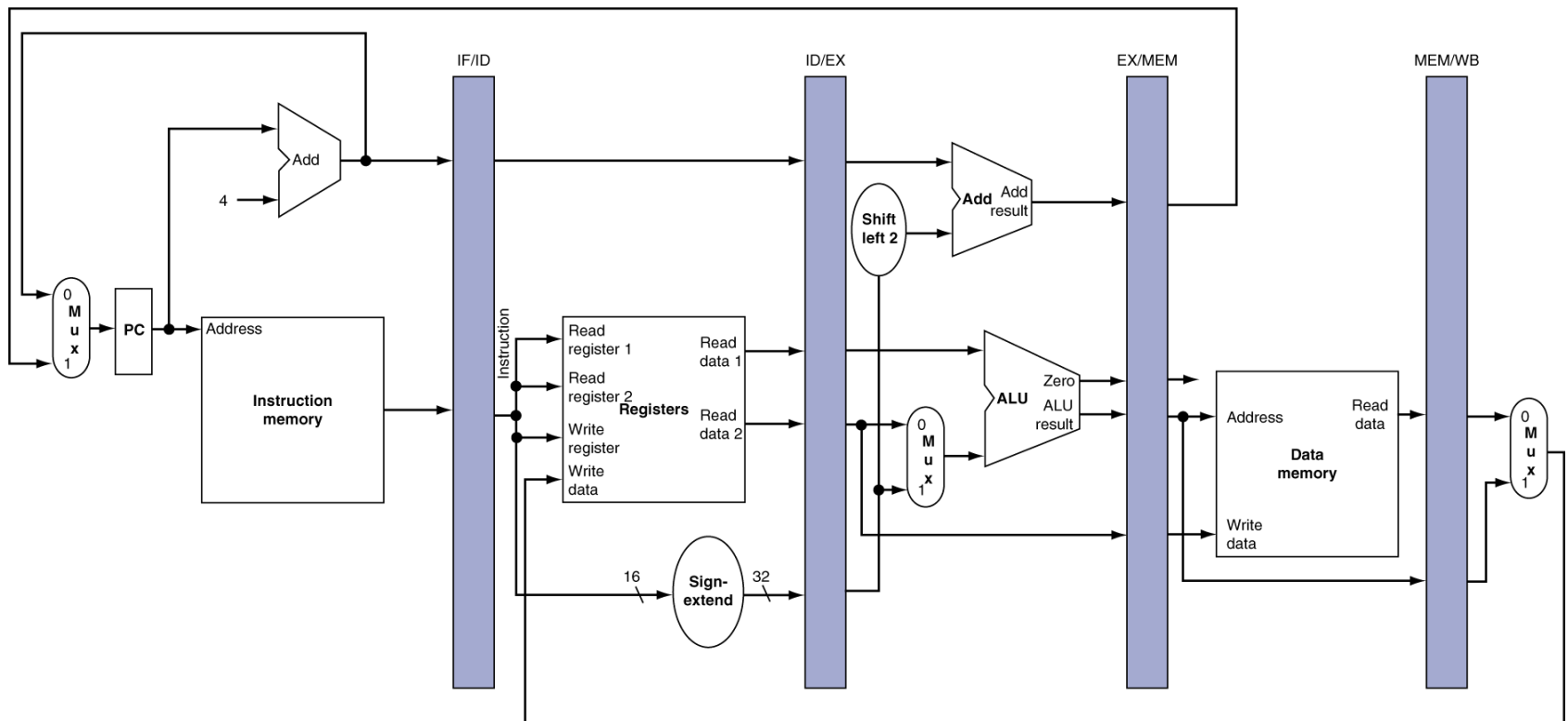
Prof. John L. Gardenghi
Adaptado dos slides do livro

Caminho de dados com pipeline



Registradores pipeline

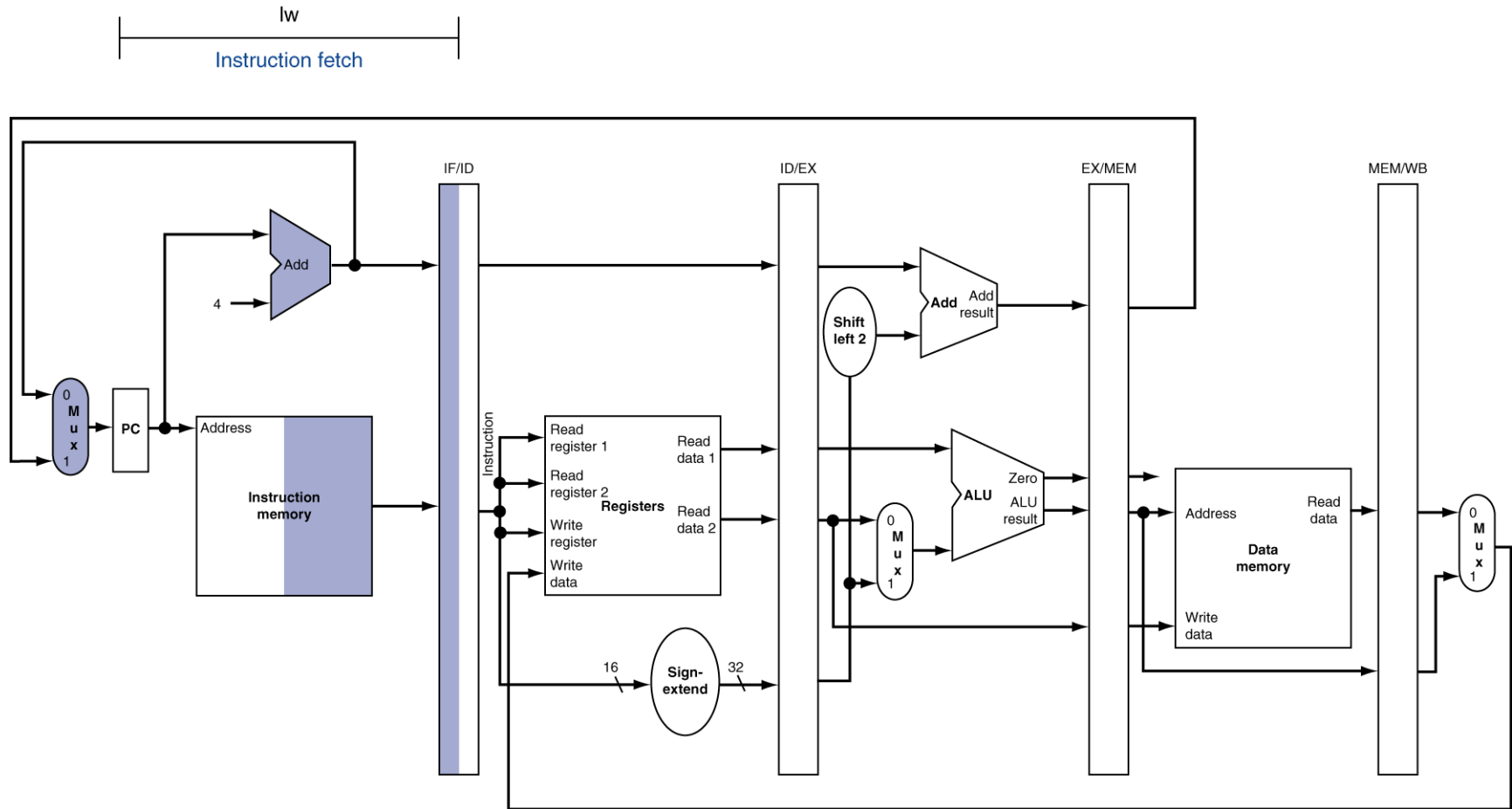
- Há registradores entre os estados
 - Armazenam a informação do ciclo anterior



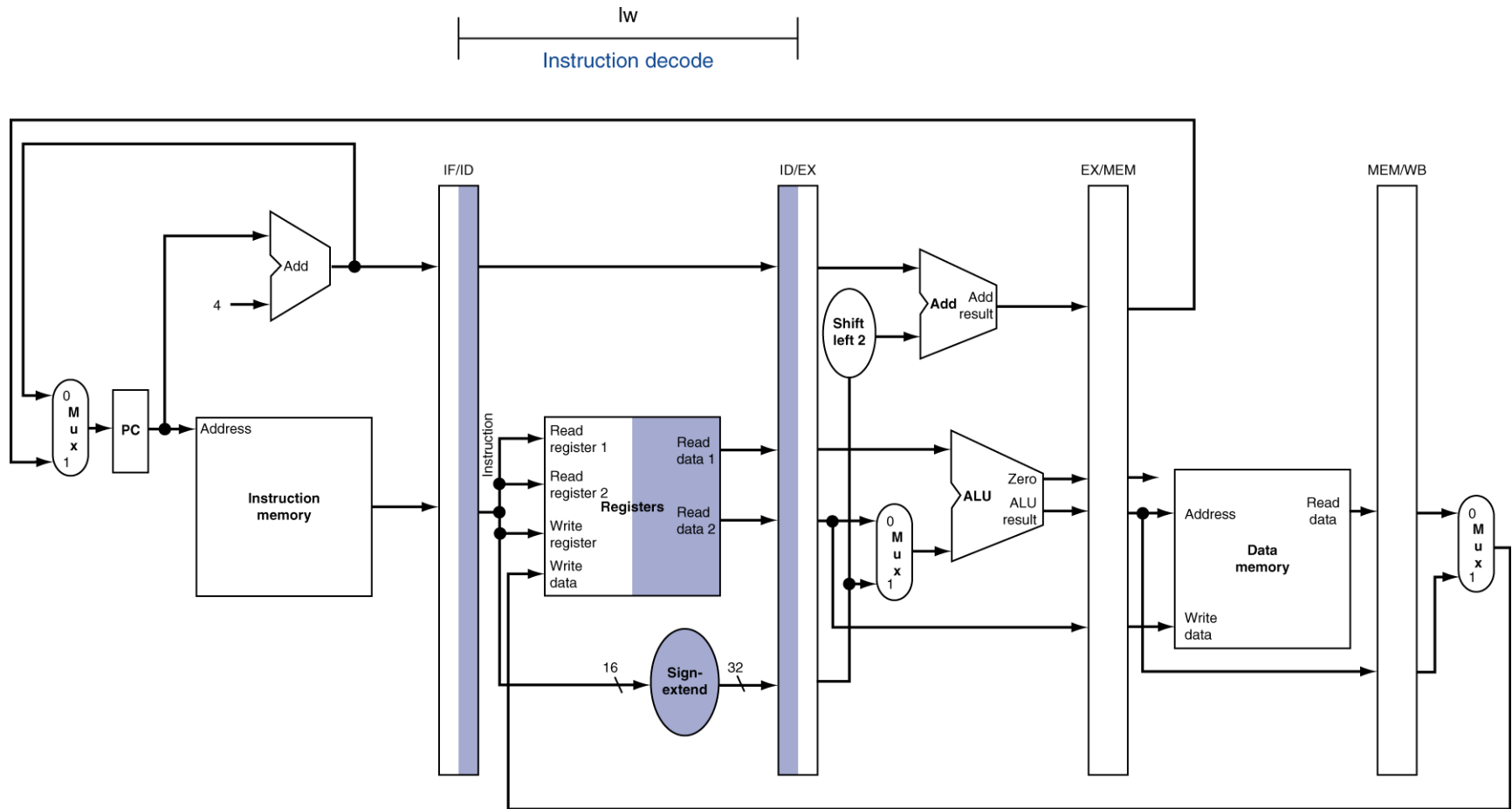
Representação gráfica do pipeline

- Fluxo de uma instrução por ciclo de clock através do caminho de dados pipeline
 - Diagrama de pipeline “Single-clock-cycle”
 - Mostra o uso do pipeline num único ciclo de clock
 - Destaca os recursos utilizados
 - Diagrama “multi-clock-cycle”
 - Gráfico da operação através do tempo (com as fases do pipeline)
- Próximos slides: diagramas “single-clock-cycle” para load & store

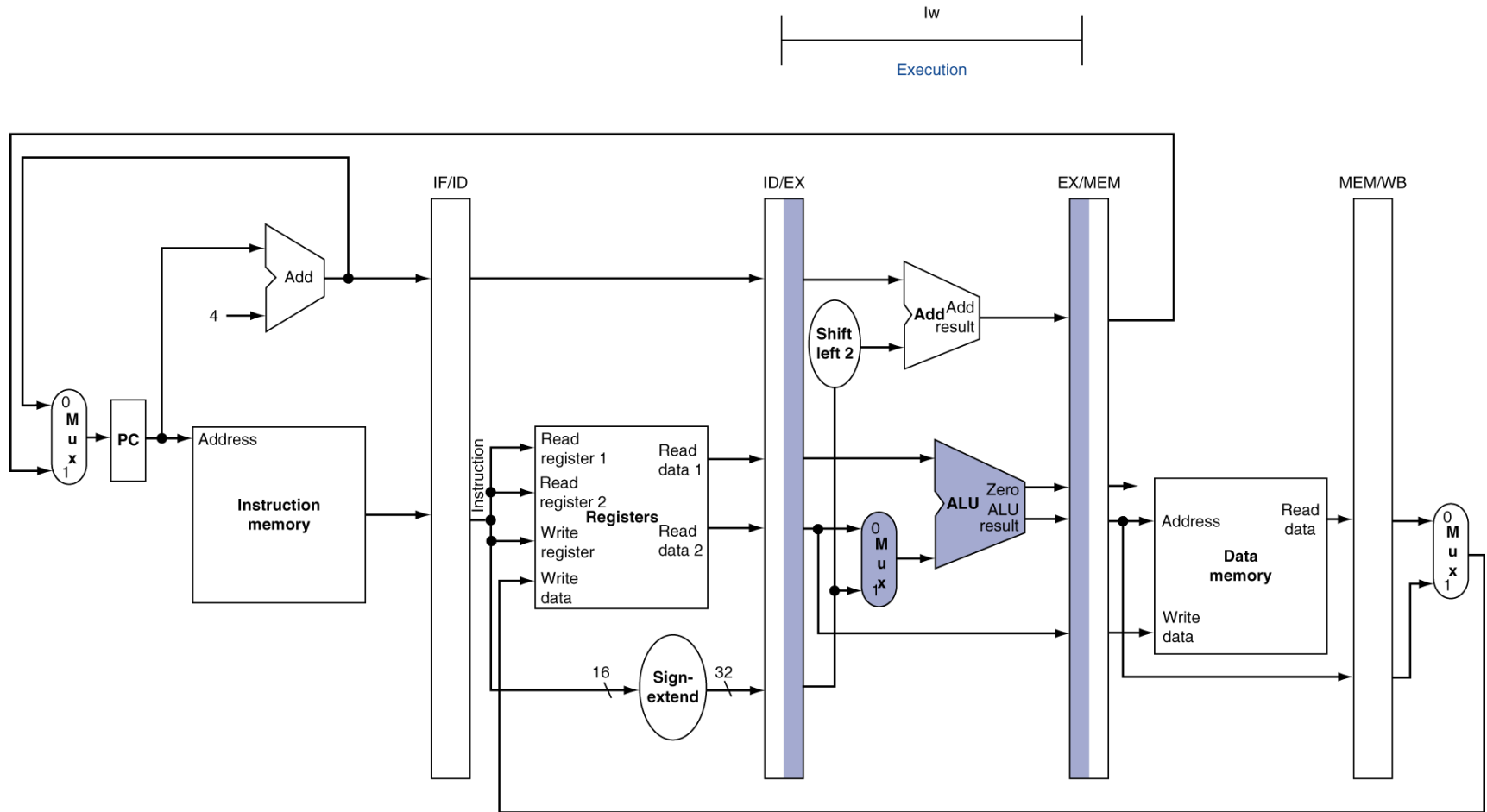
IF para Load, Store, ...



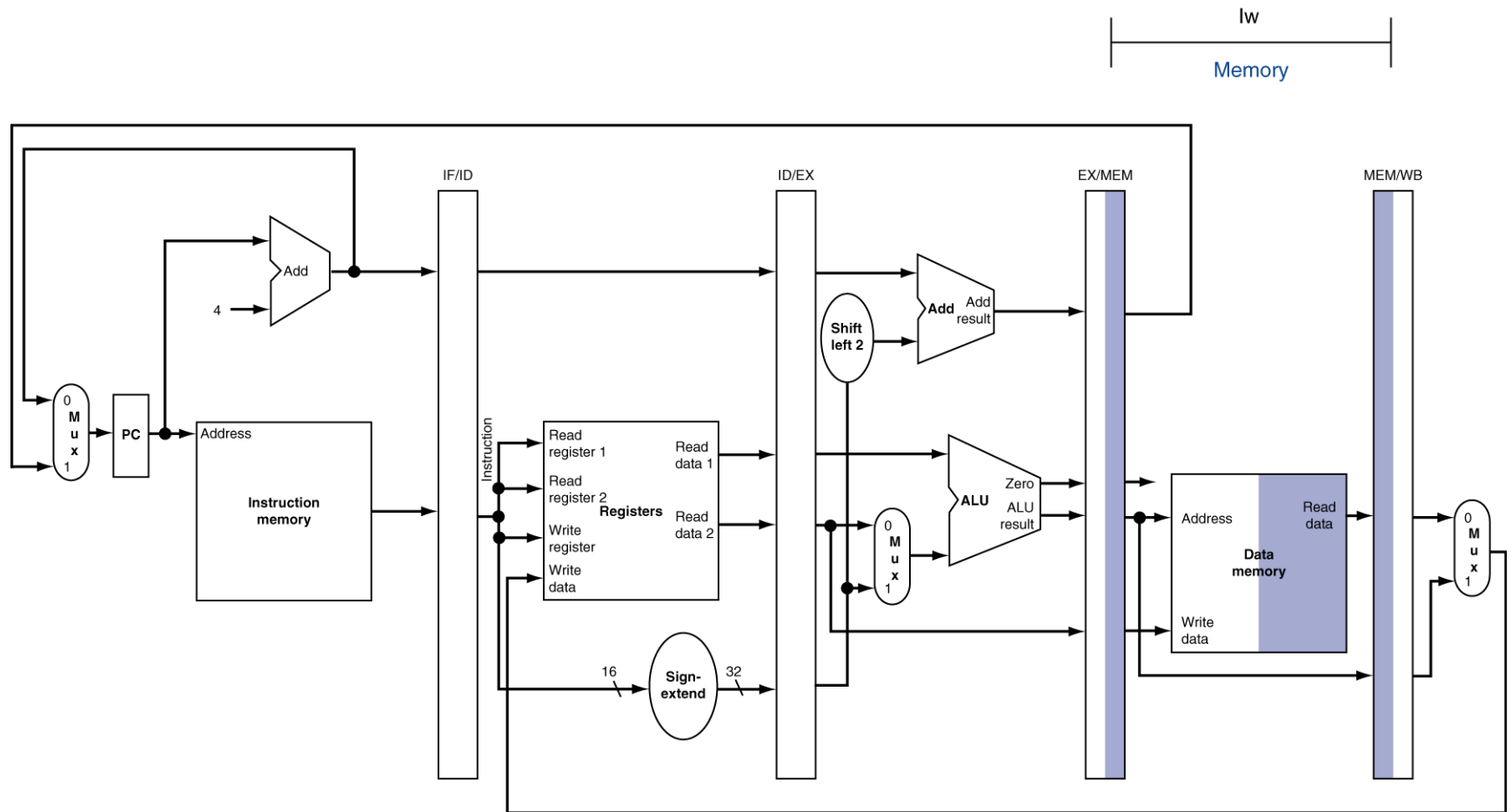
ID para Load, Store, ...



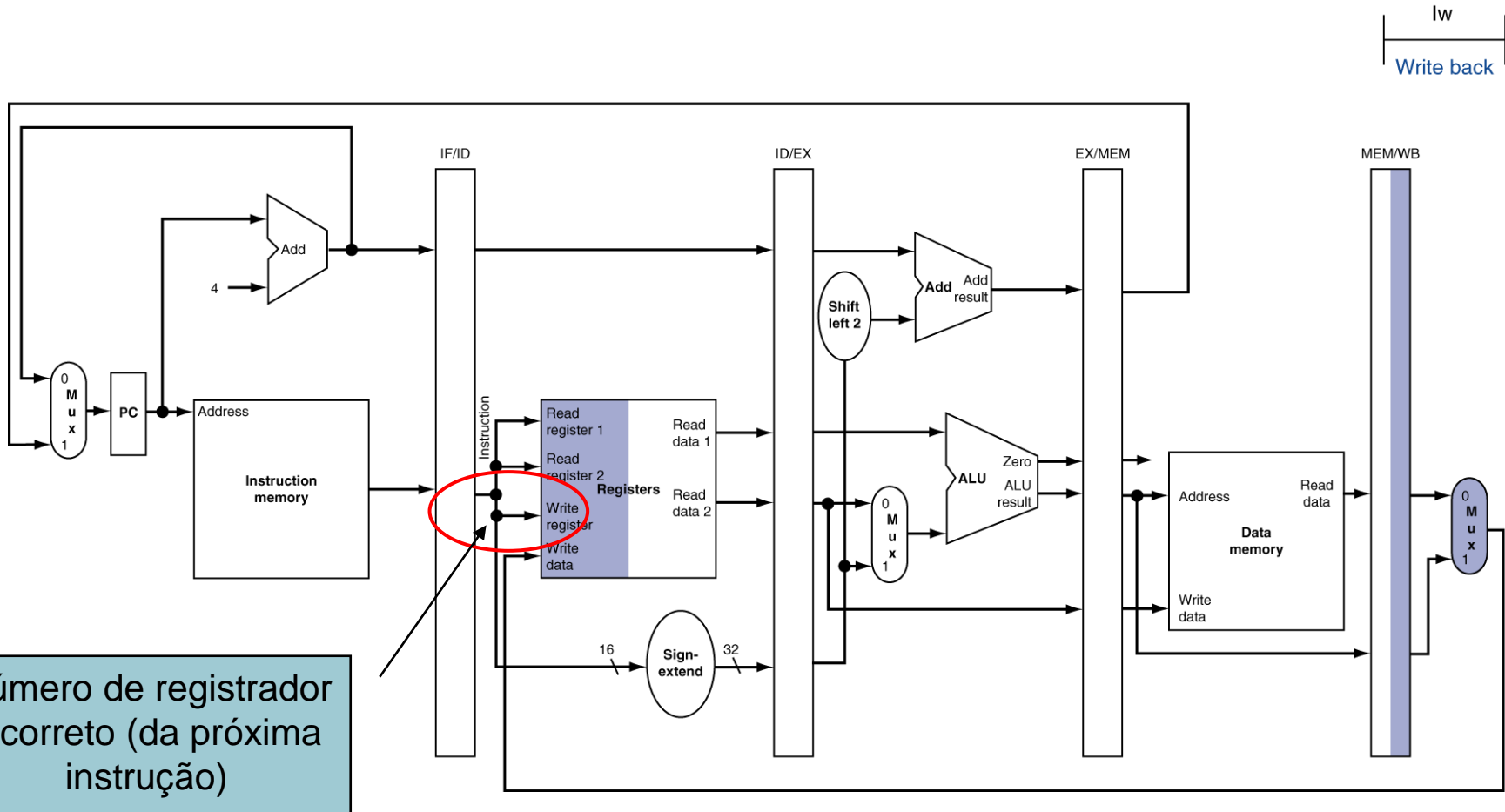
EX para Load



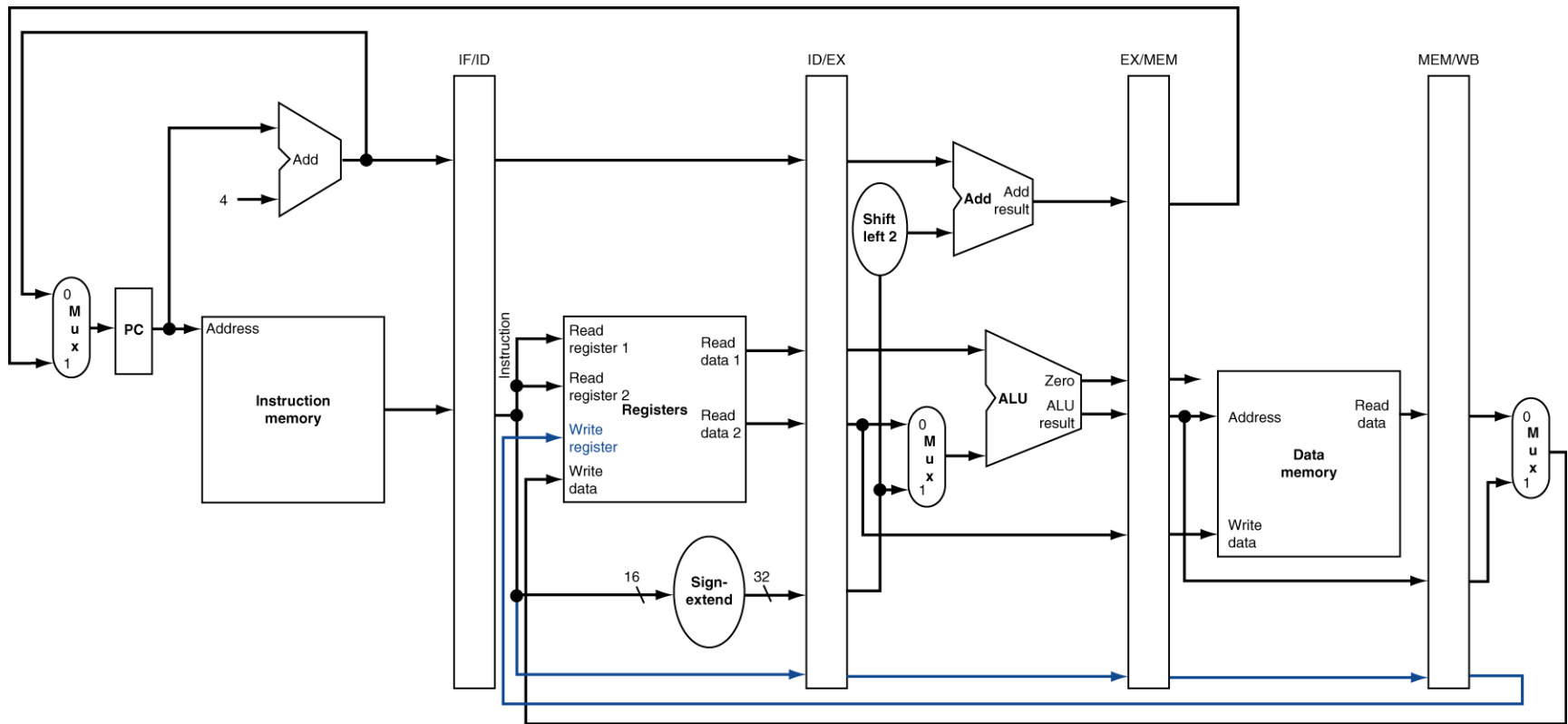
MEM para Load



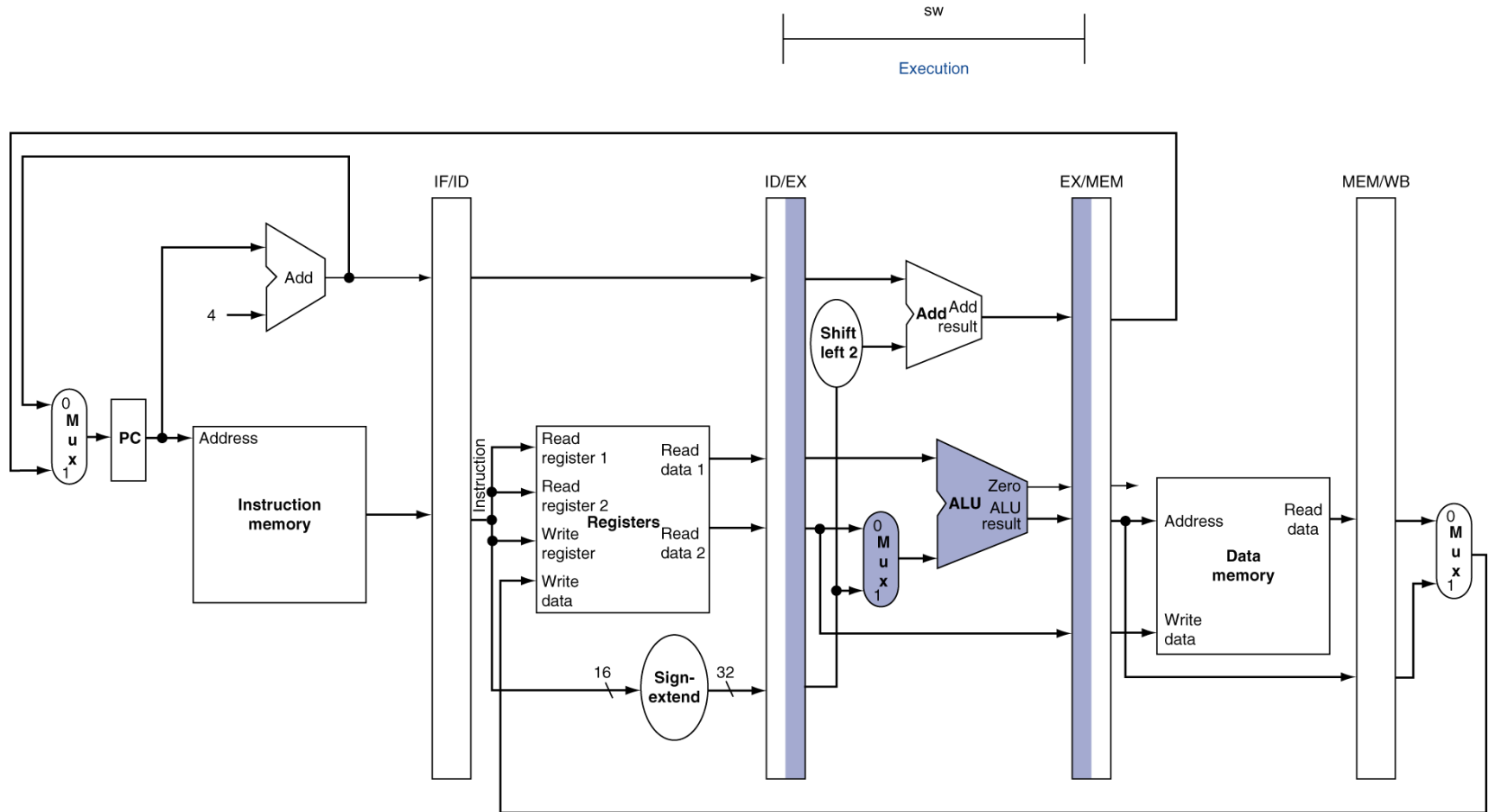
WB para Load



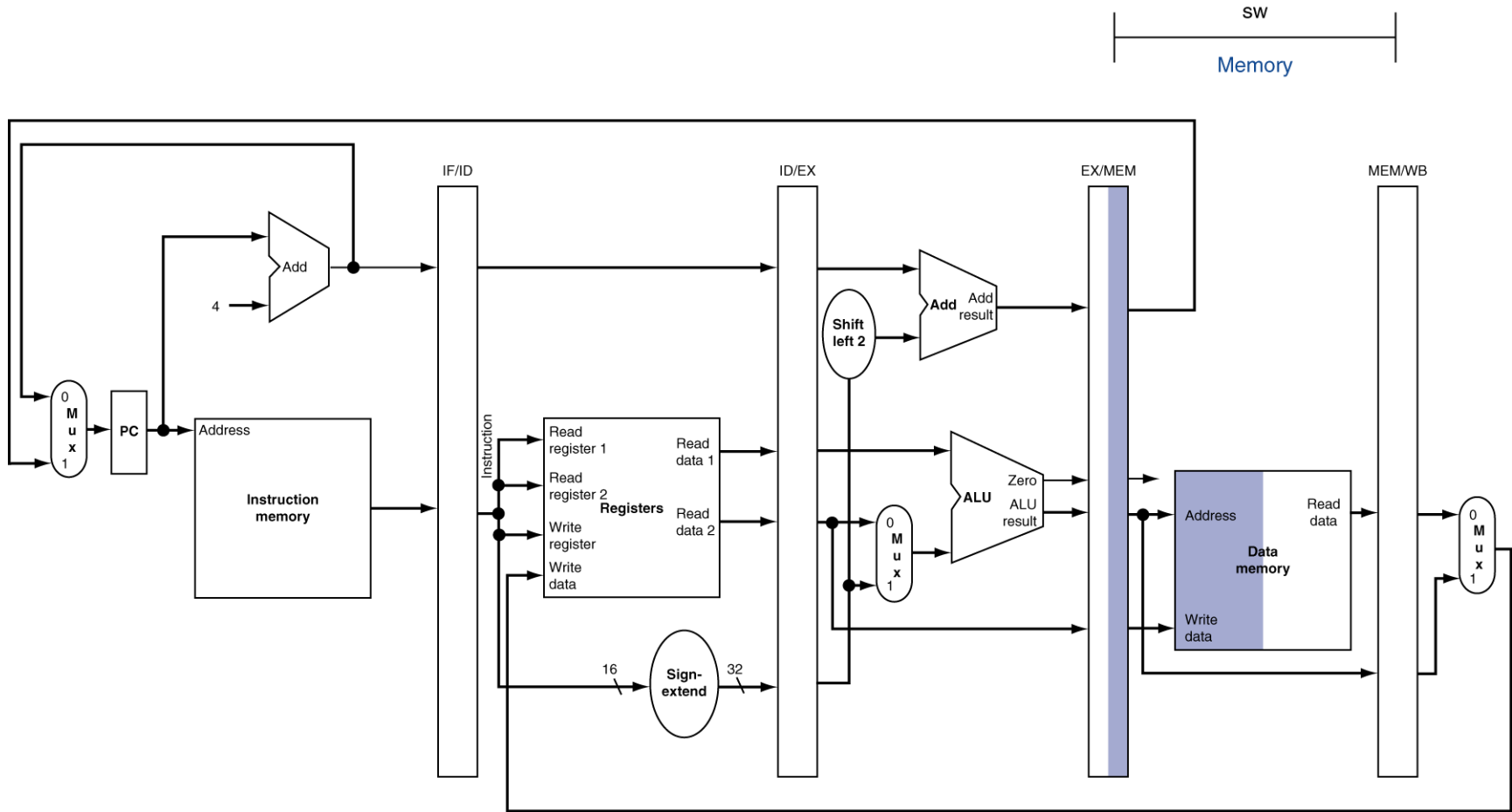
Caminho correto para Load



EX para Store



MEM para Store



WB para Store

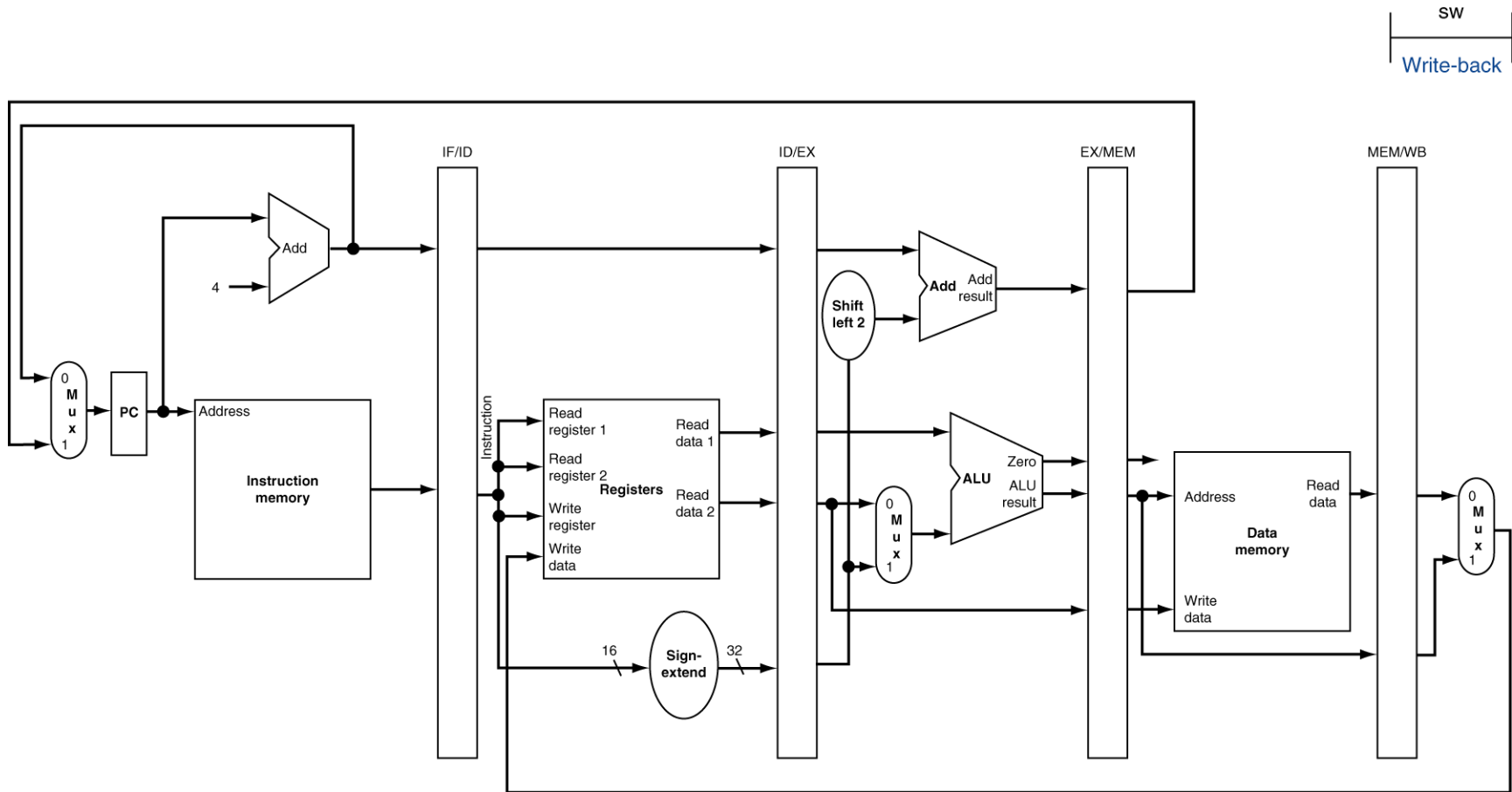


Diagrama pipeline Multi-Cycle

- Formato que mostra o uso de recursos

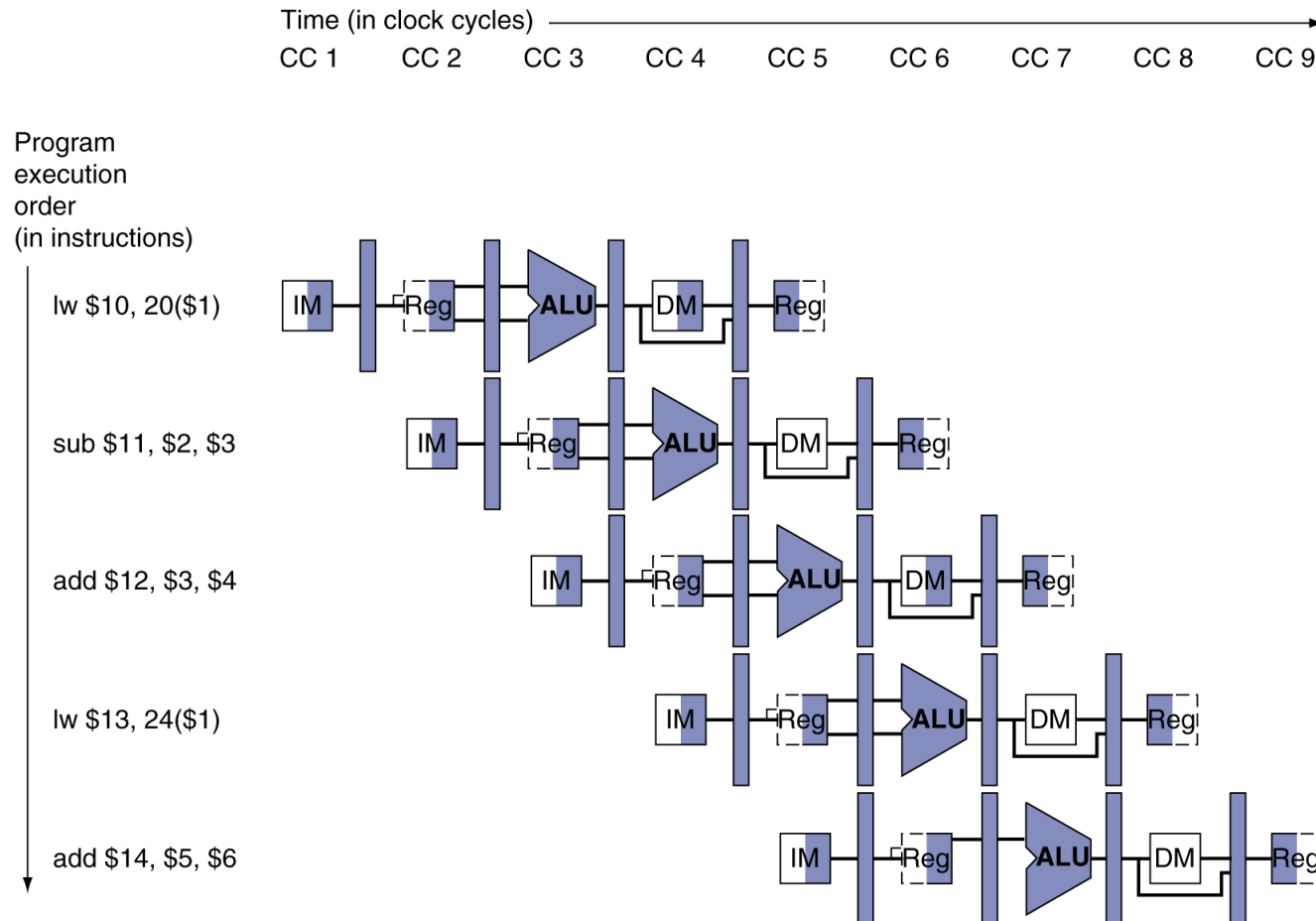


Diagrama pipeline Multi-Cycle

■ Formato tradicional

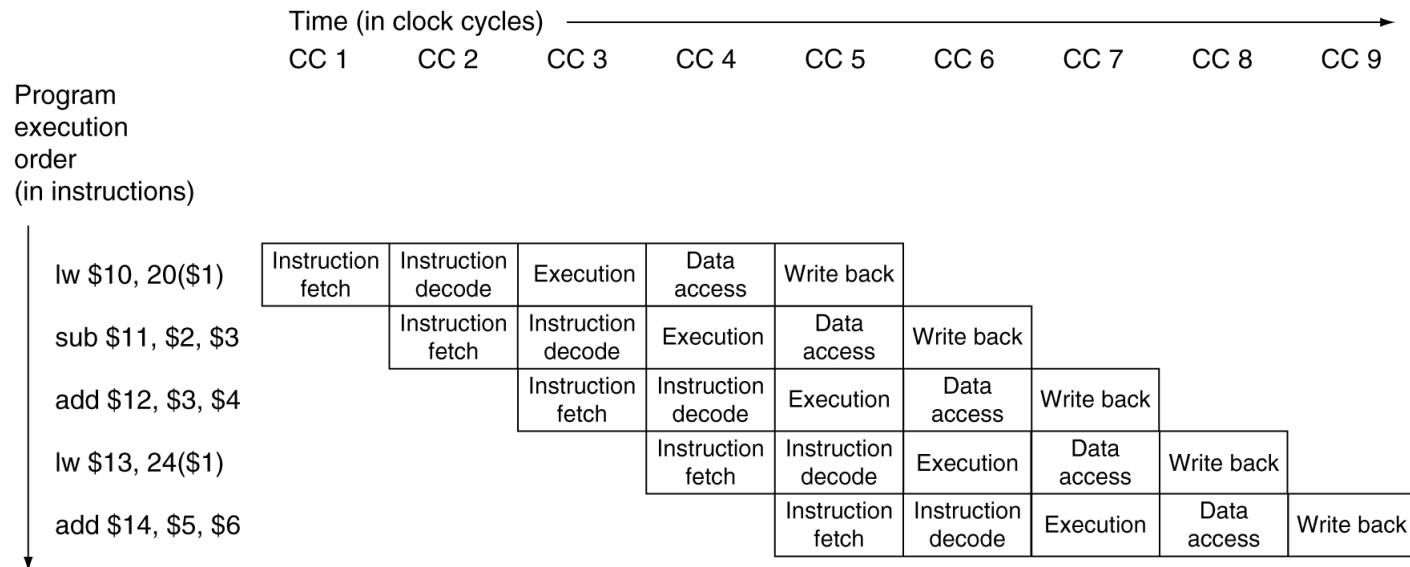
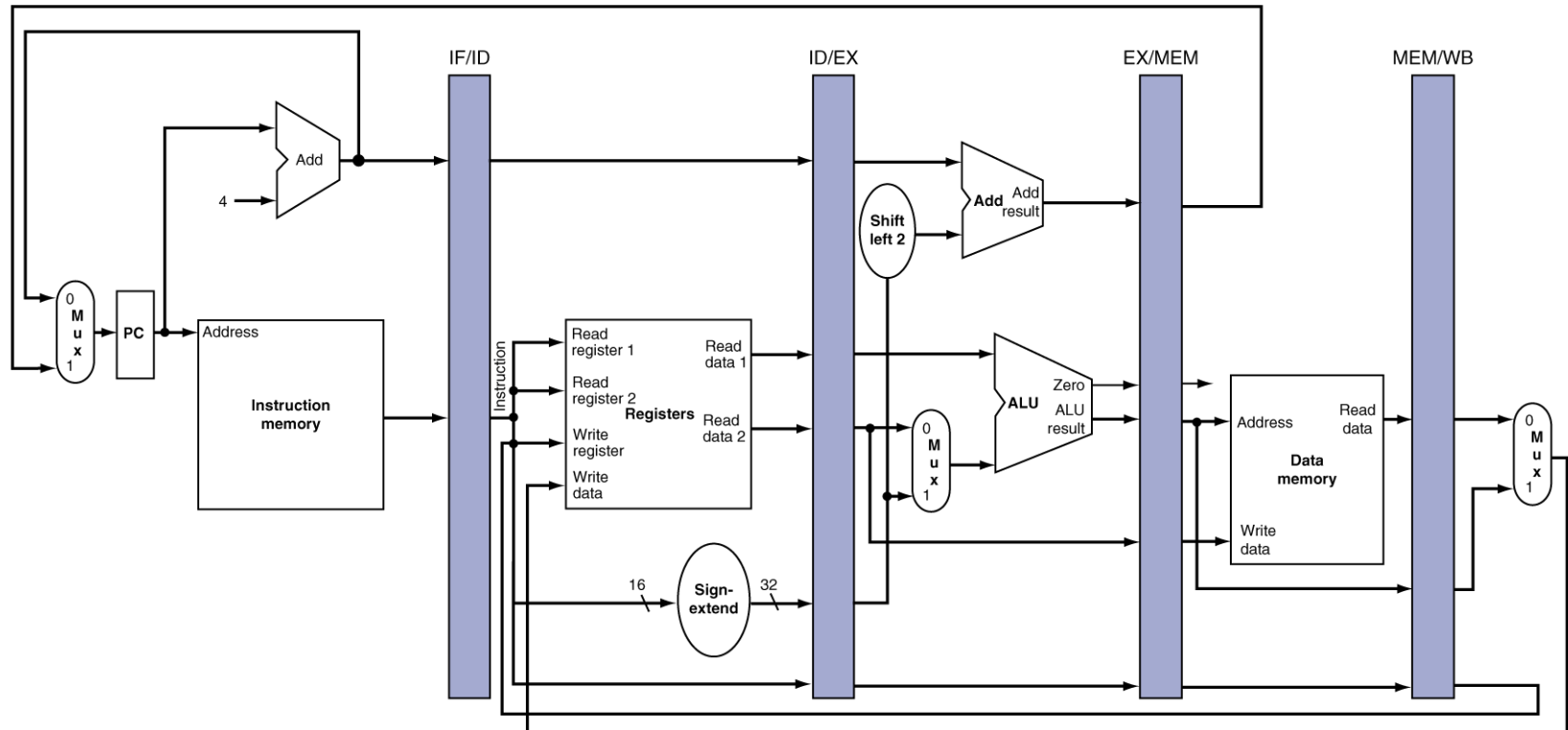


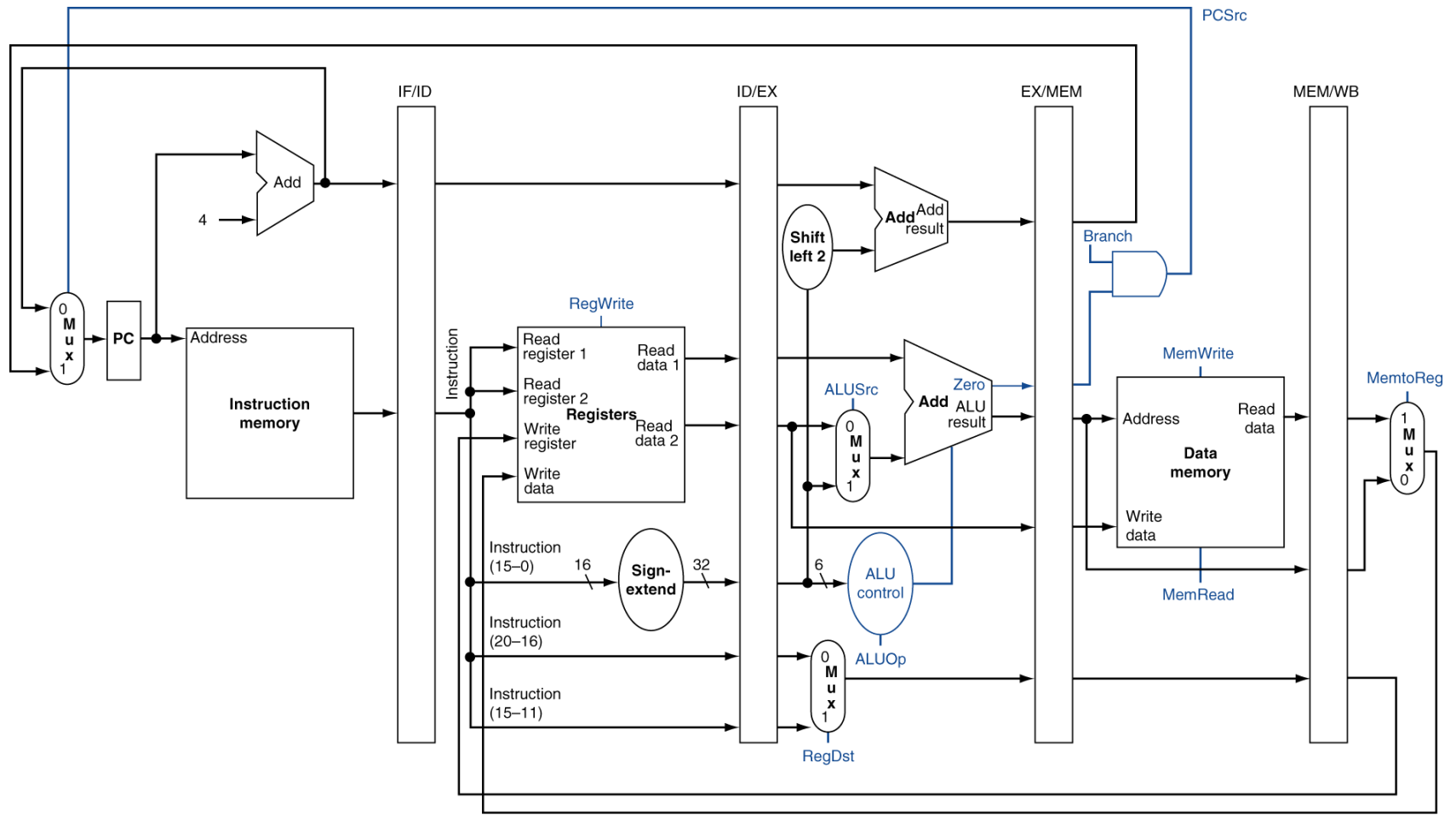
Diagrama pipeline Single-Cycle

■ Estado de um pipeline num dado ciclo

add \$14, \$5, \$6	lw \$13, 24 (\$1)	add \$12, \$3, \$4	sub \$11, \$2, \$3	lw \$10, 20(\$1)
Instruction fetch	Instruction decode	Execution	Memory	Write-back

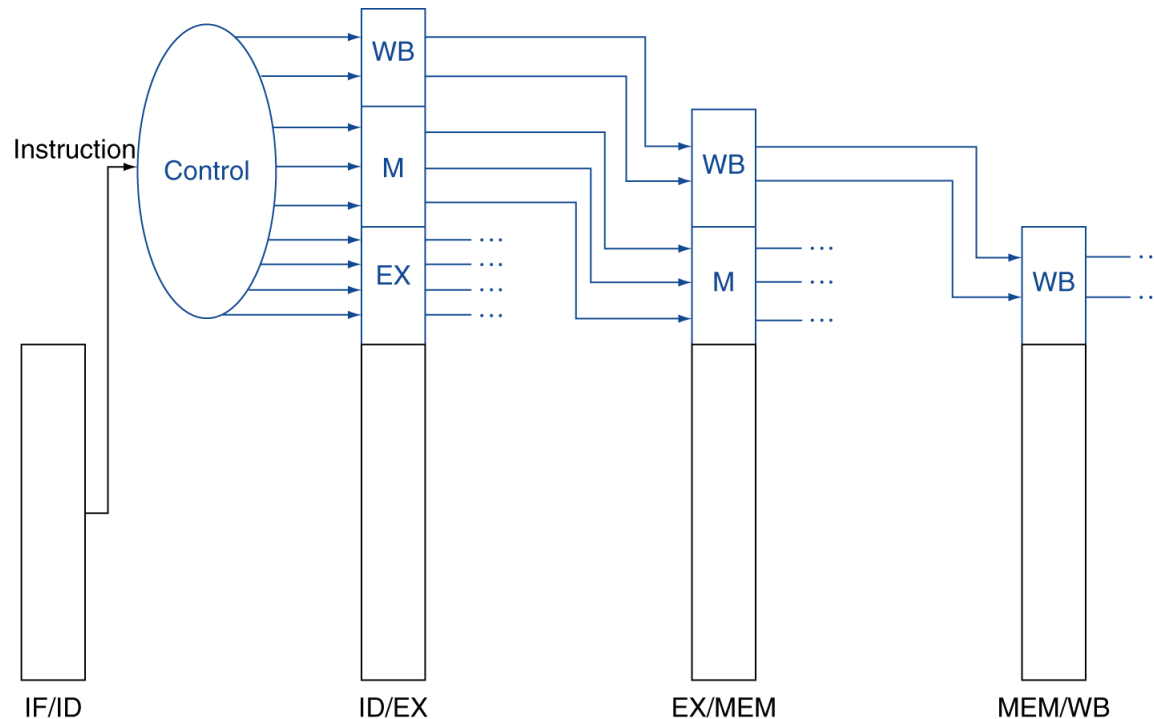


Controle no Pipeline (simplif.)



Controle no pipeline

- Os sinais são definidos a partir da instrução
 - Como na implementação monociclo



Controle no Pipeline

