System-Level Programming

16 μC-System Architecture – Processor

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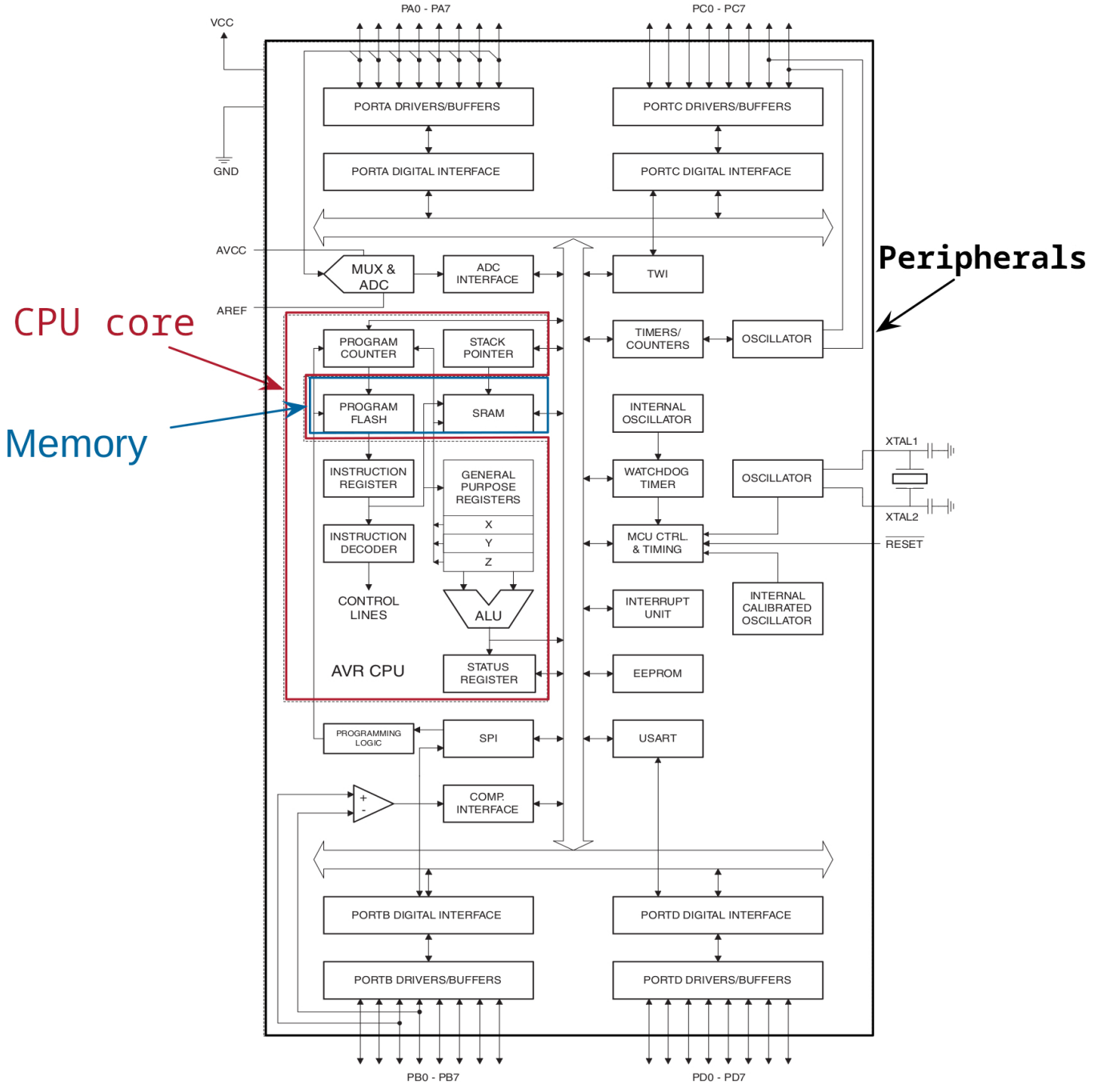
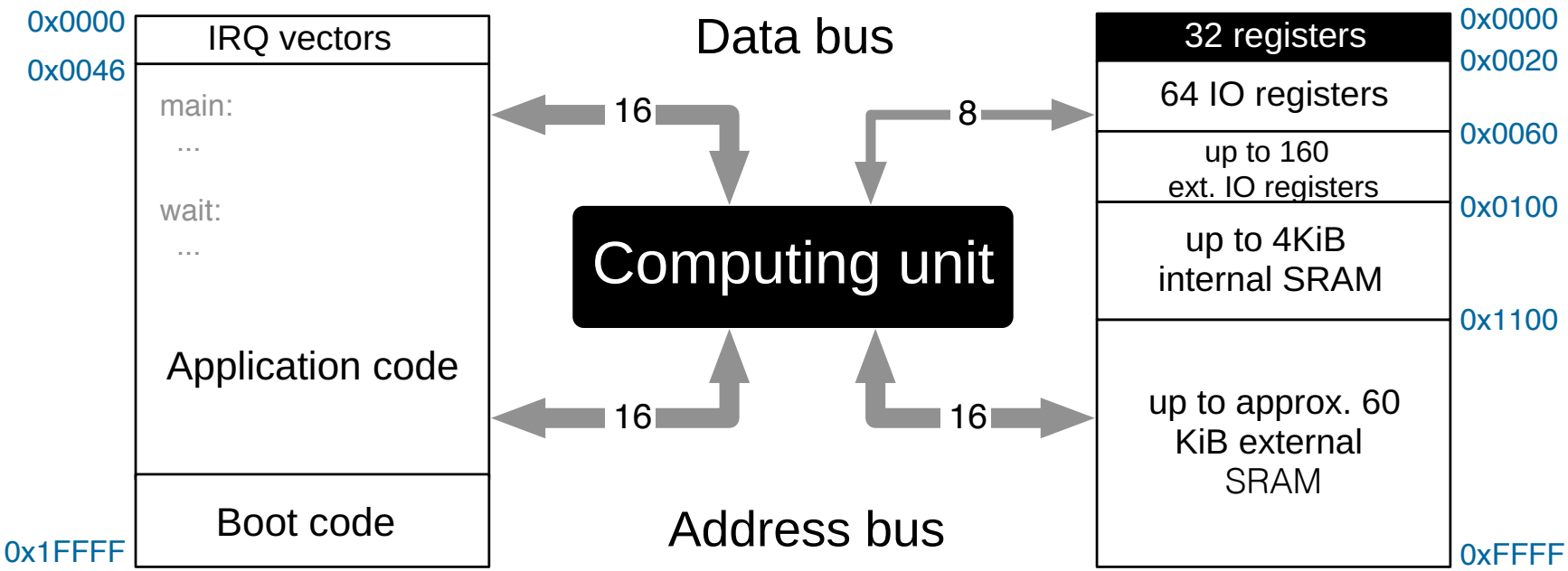
http://sys.cs.fau.de/lehre/ss24

Example ATmega32: Block Circuit Diagram



Example ATmega Family: CPU Architecture

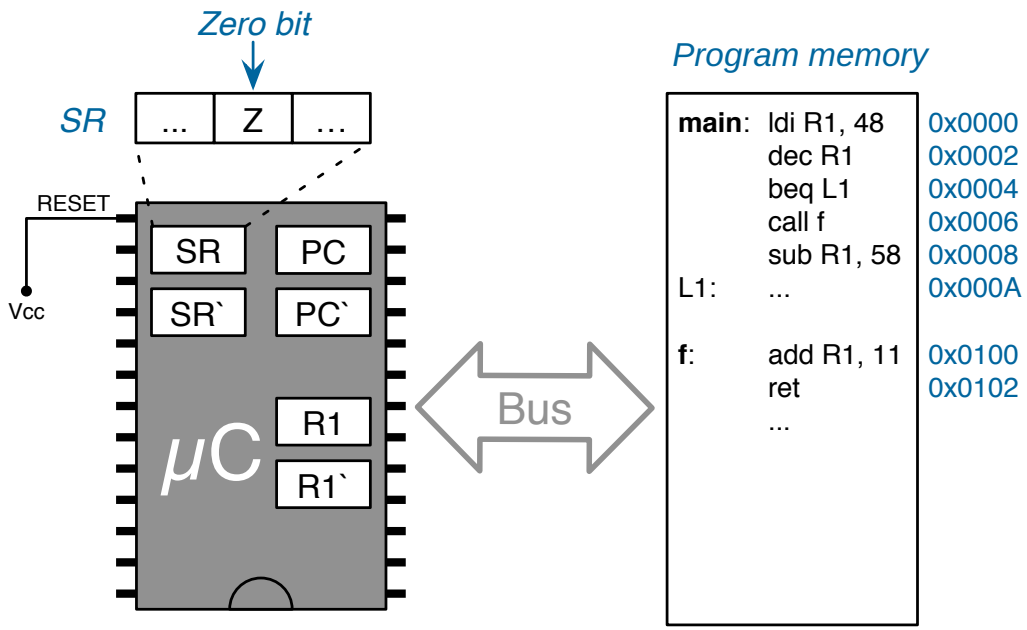


Program address space (Flash)
1–128 KiB, 2-Byte elements

Data address space (SRAM)
0–64 KiB, 1-Byte elements

- Harvard architecture (memory for code and data is separated)
- Peripheral registers are integrated into the memory
  ⇝ can be accessed like global variables

How does a Processor work?



- This example assumes a simplified pseudo processor
  - only one multi-purpose register (R1)
  - program counter (PC) and status register (SR) (+ “shadow copies”)
  - no data memory, no stack $\rightsquigarrow$ program only works on registers

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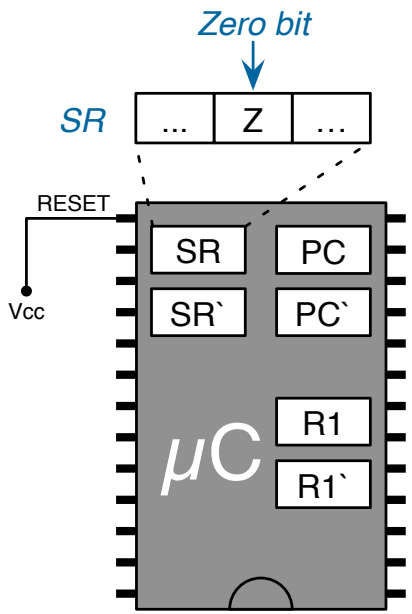
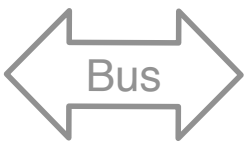
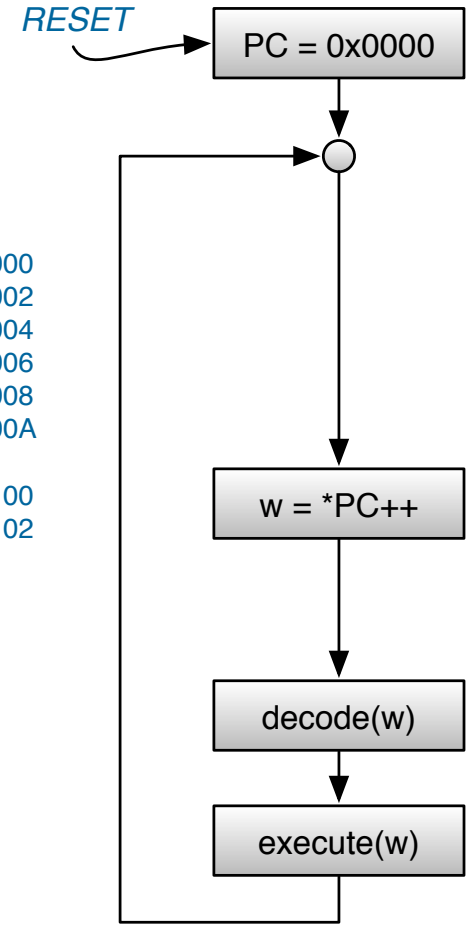




Program memory

main:	ldi R1, 48	0x0000
	dec R1	0x0002
	beq L1	0x0004
	call f	0x0006
	sub R1, 58	0x0008
L1:	...	0x000A
f:	add R1, 11	0x0100
	ret	0x0102
	...	



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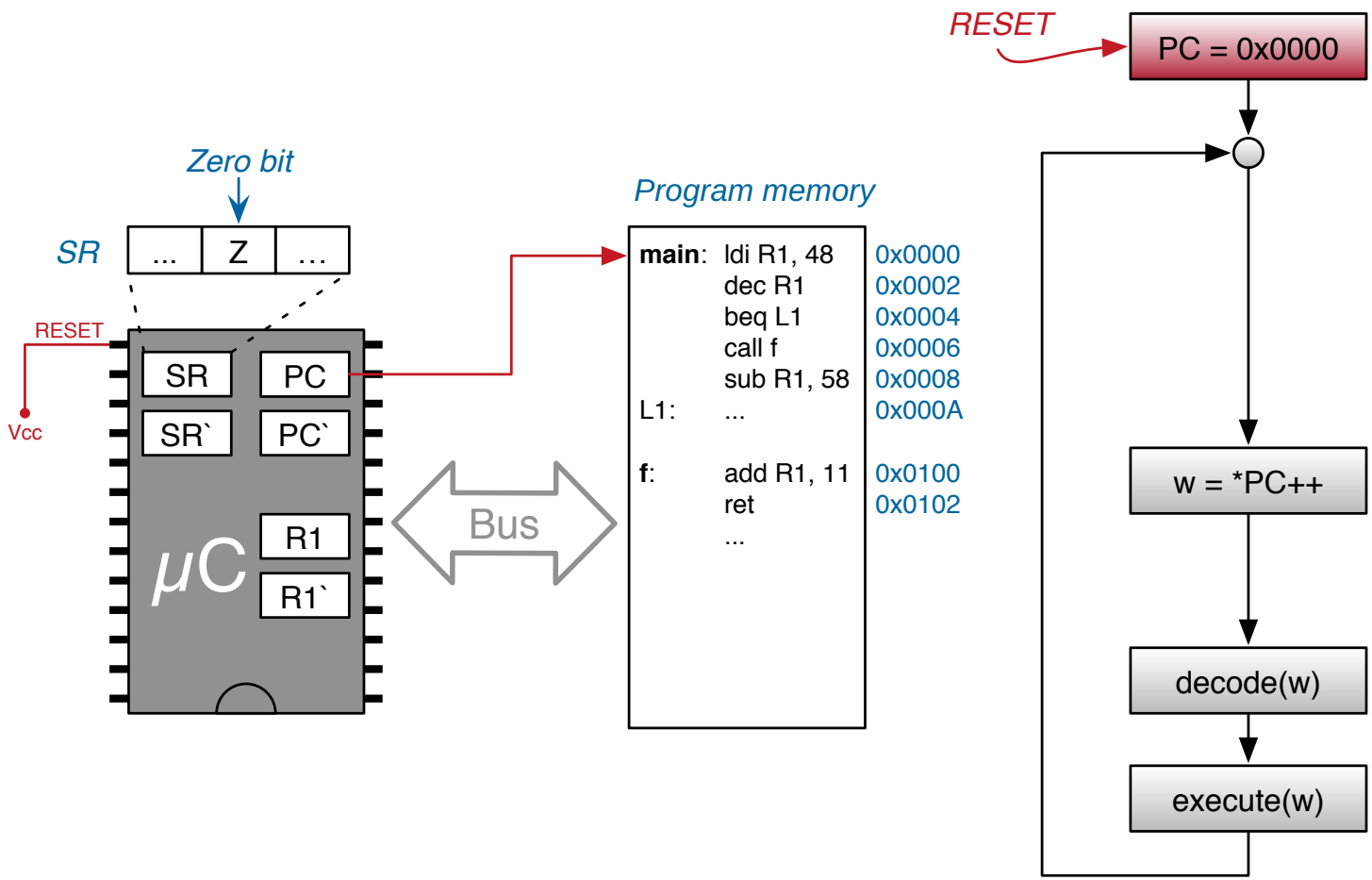

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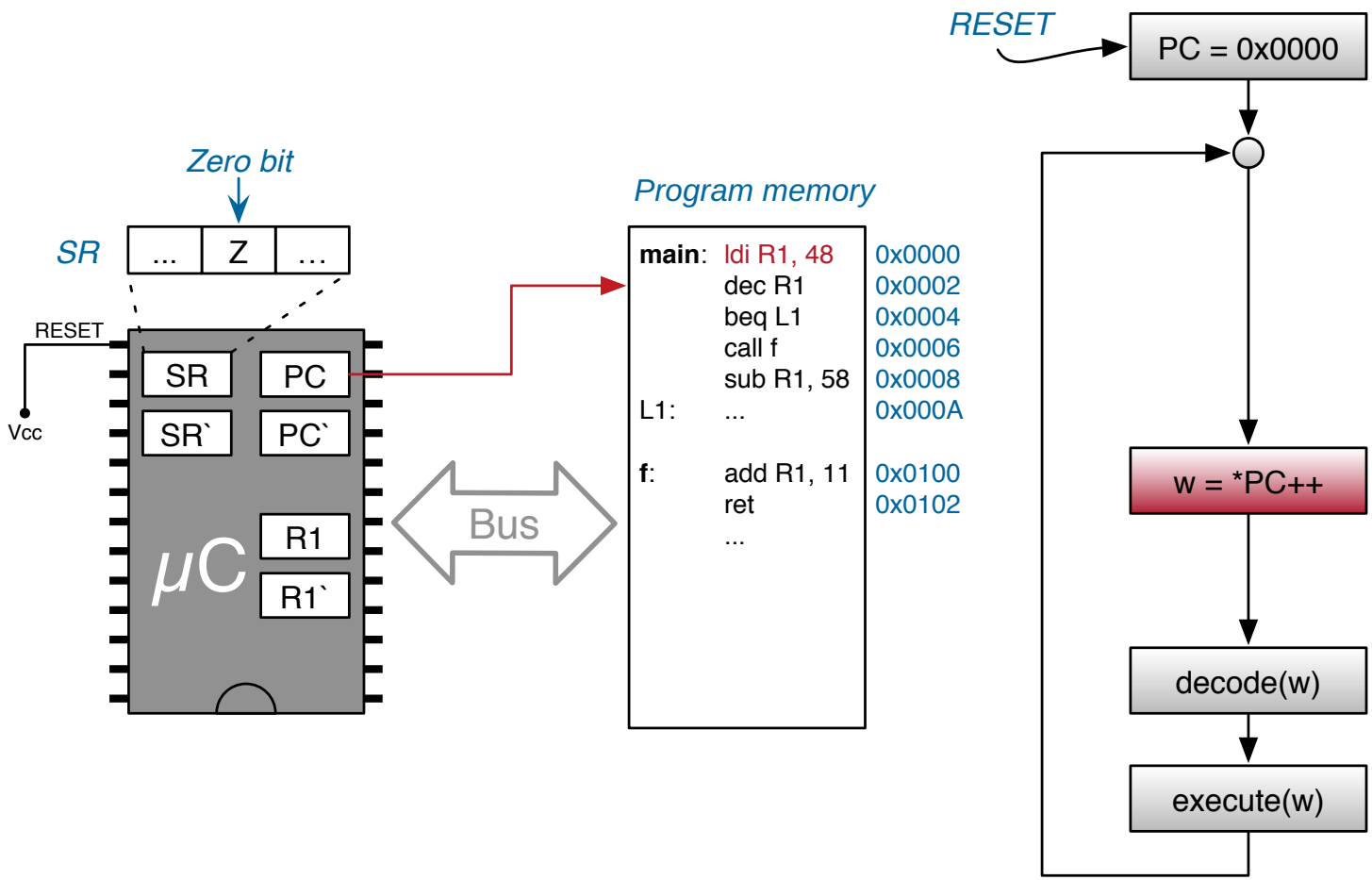

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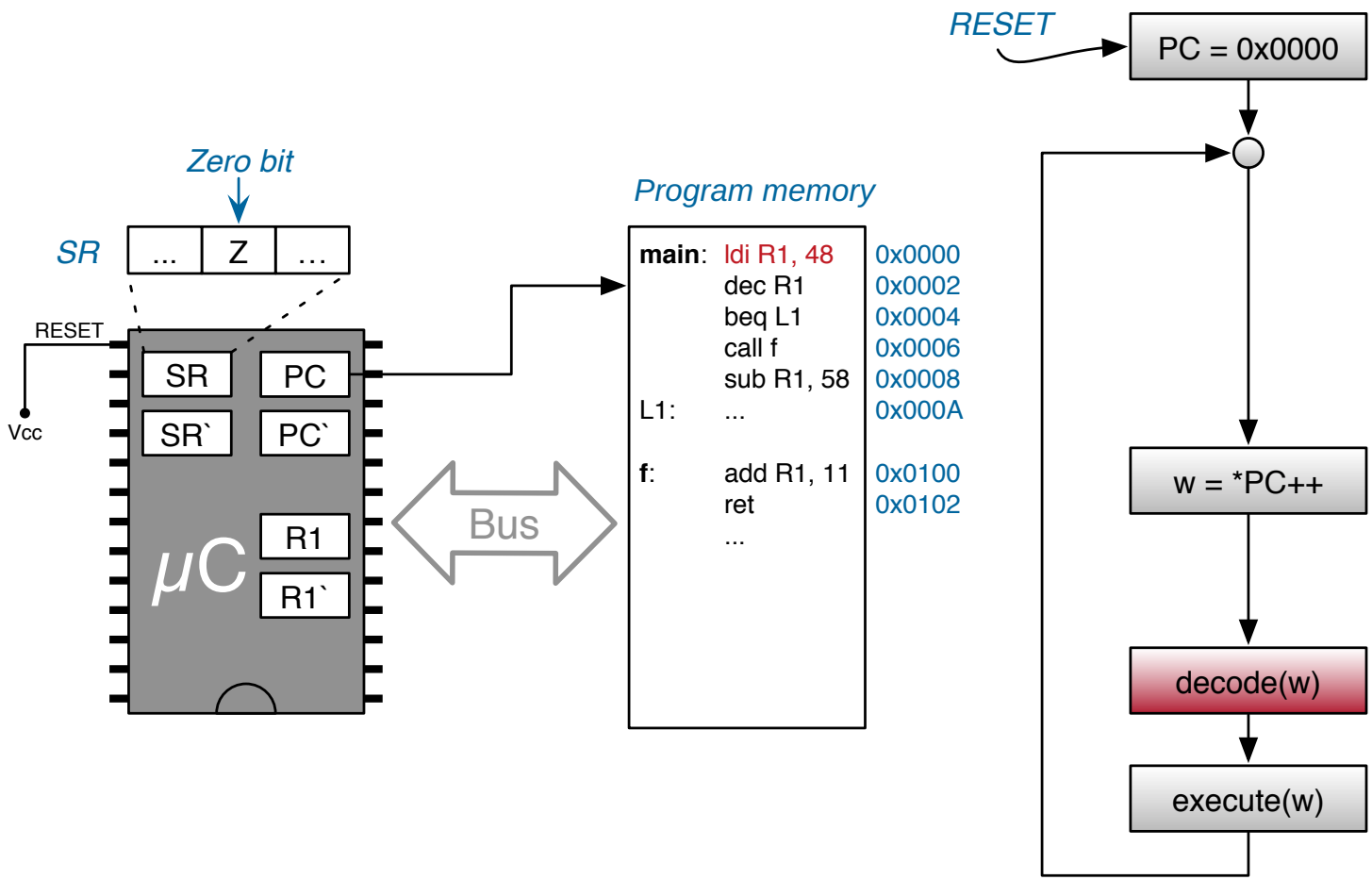

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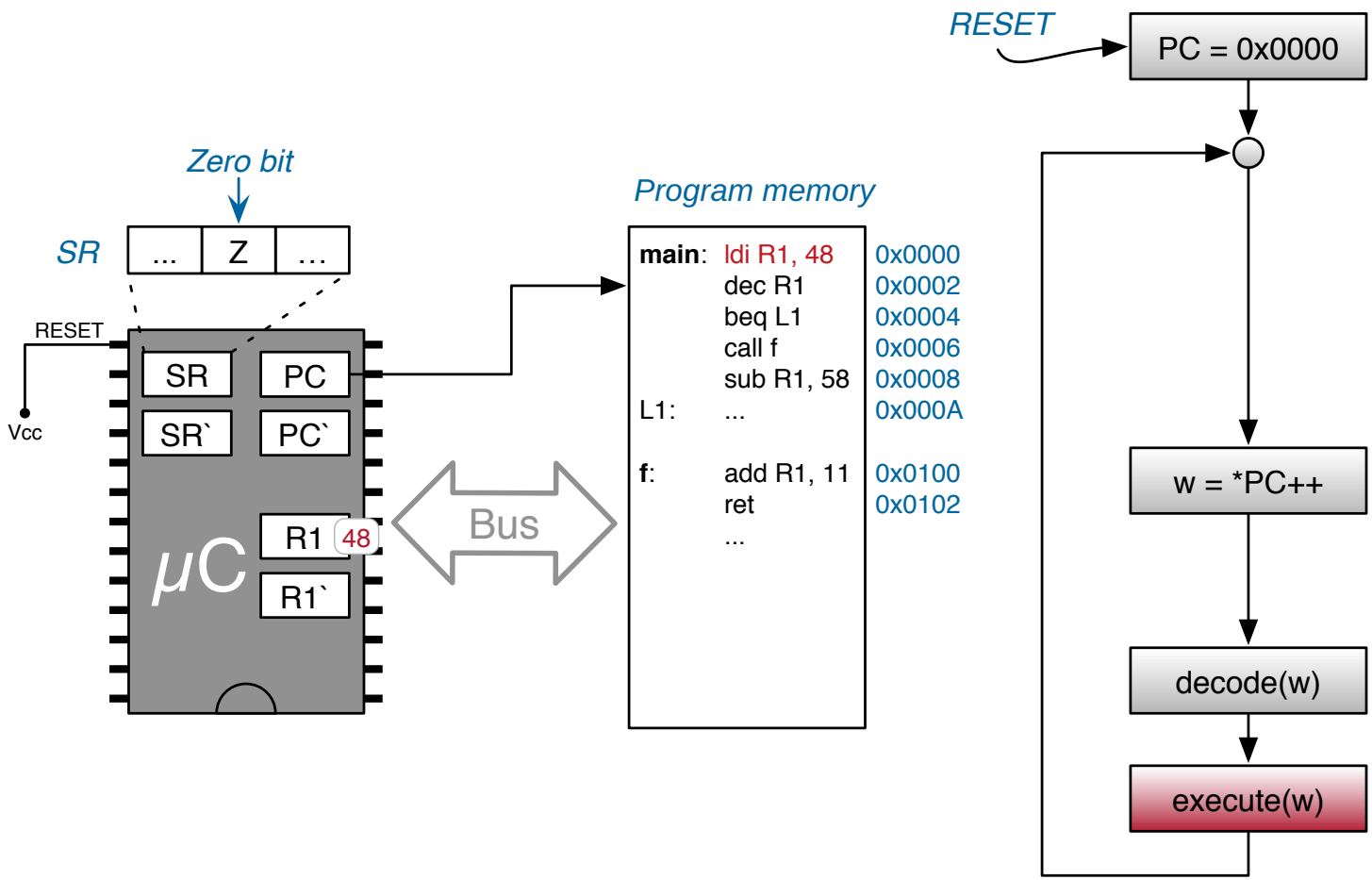

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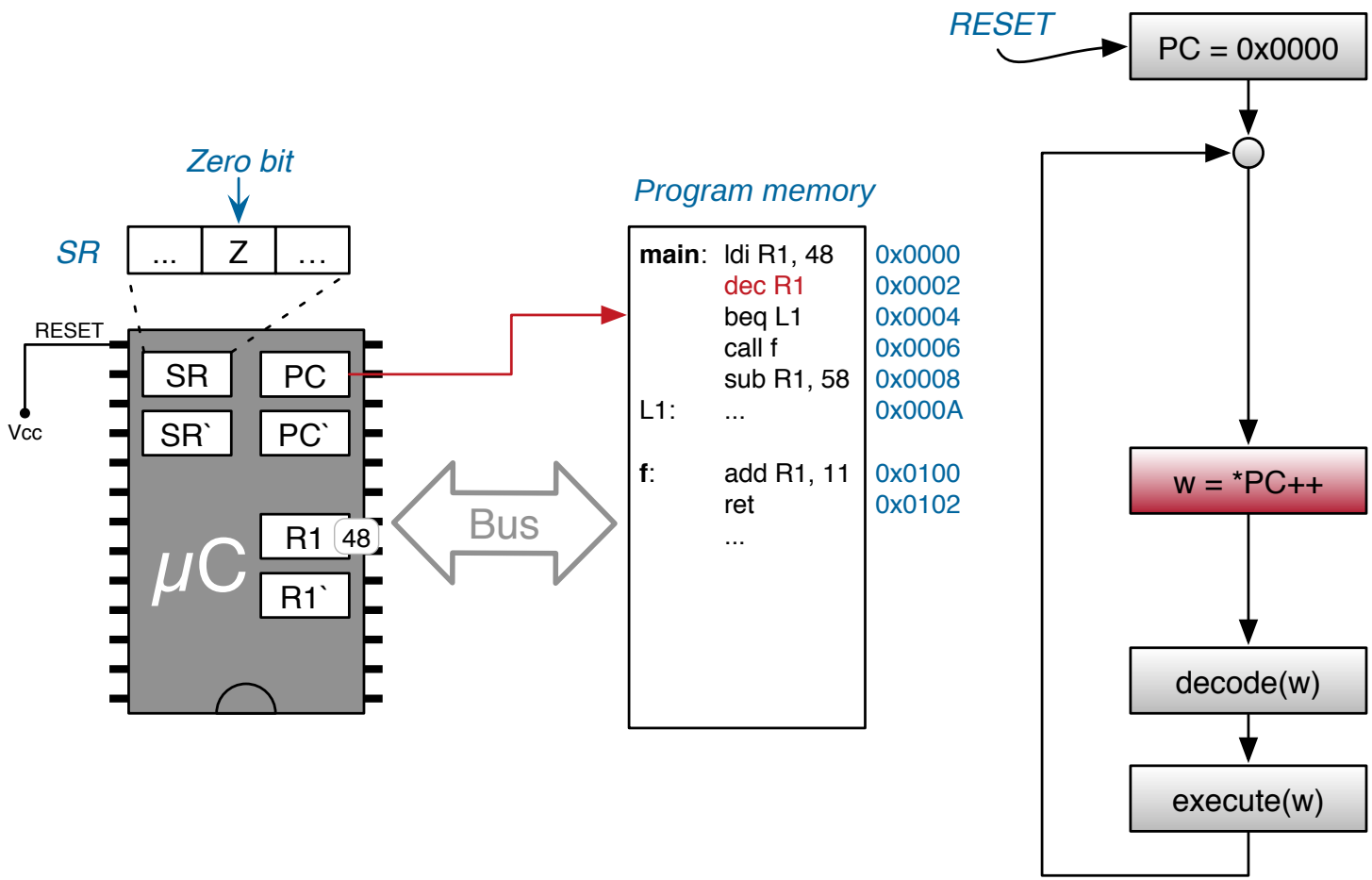

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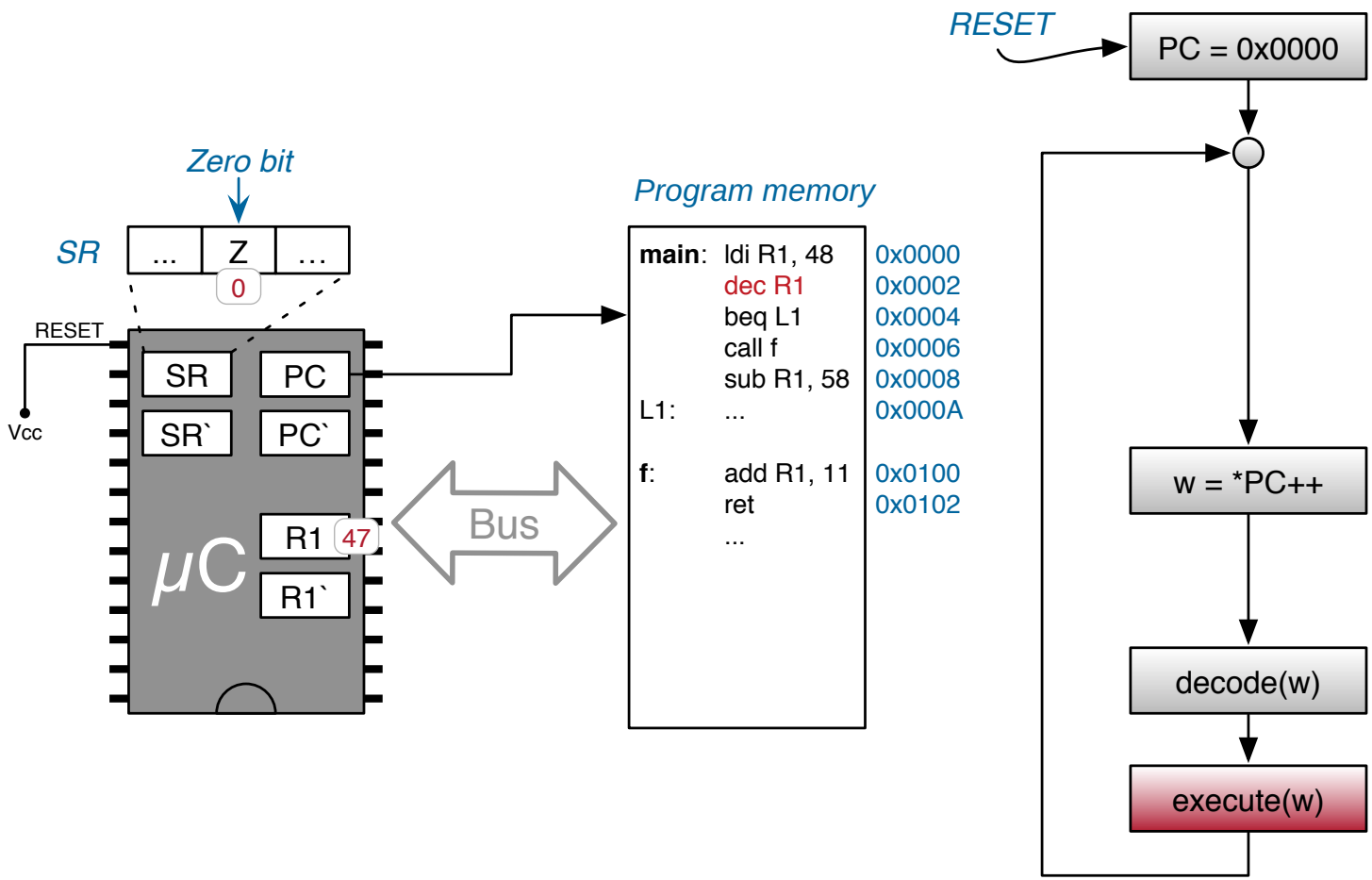

w: **dec** <R>
R –= 1
if(R == 0) Z = 1
else Z = 0

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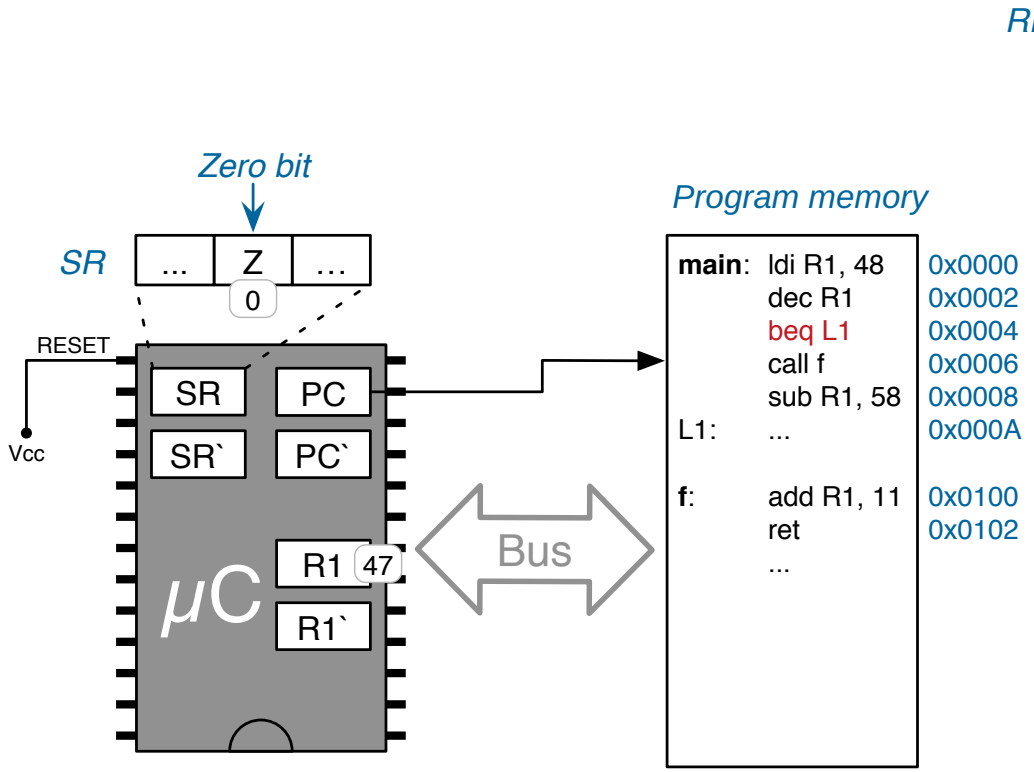

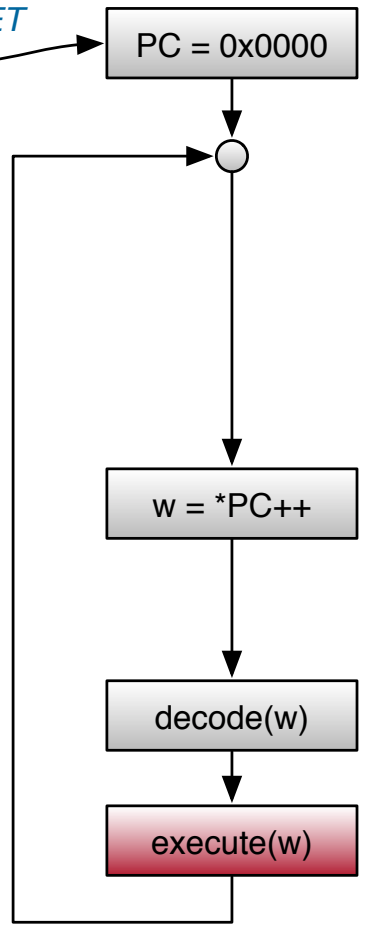

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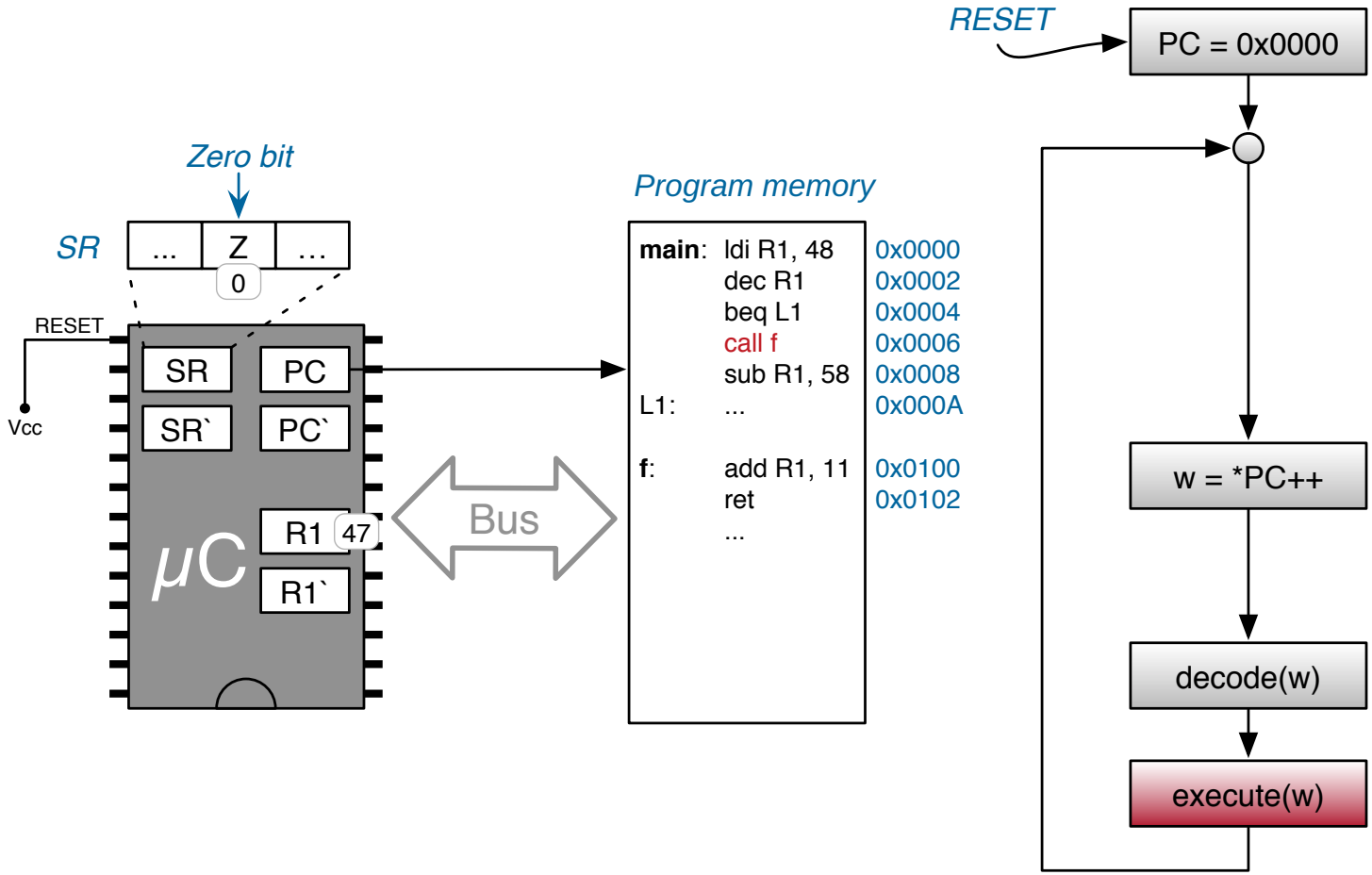

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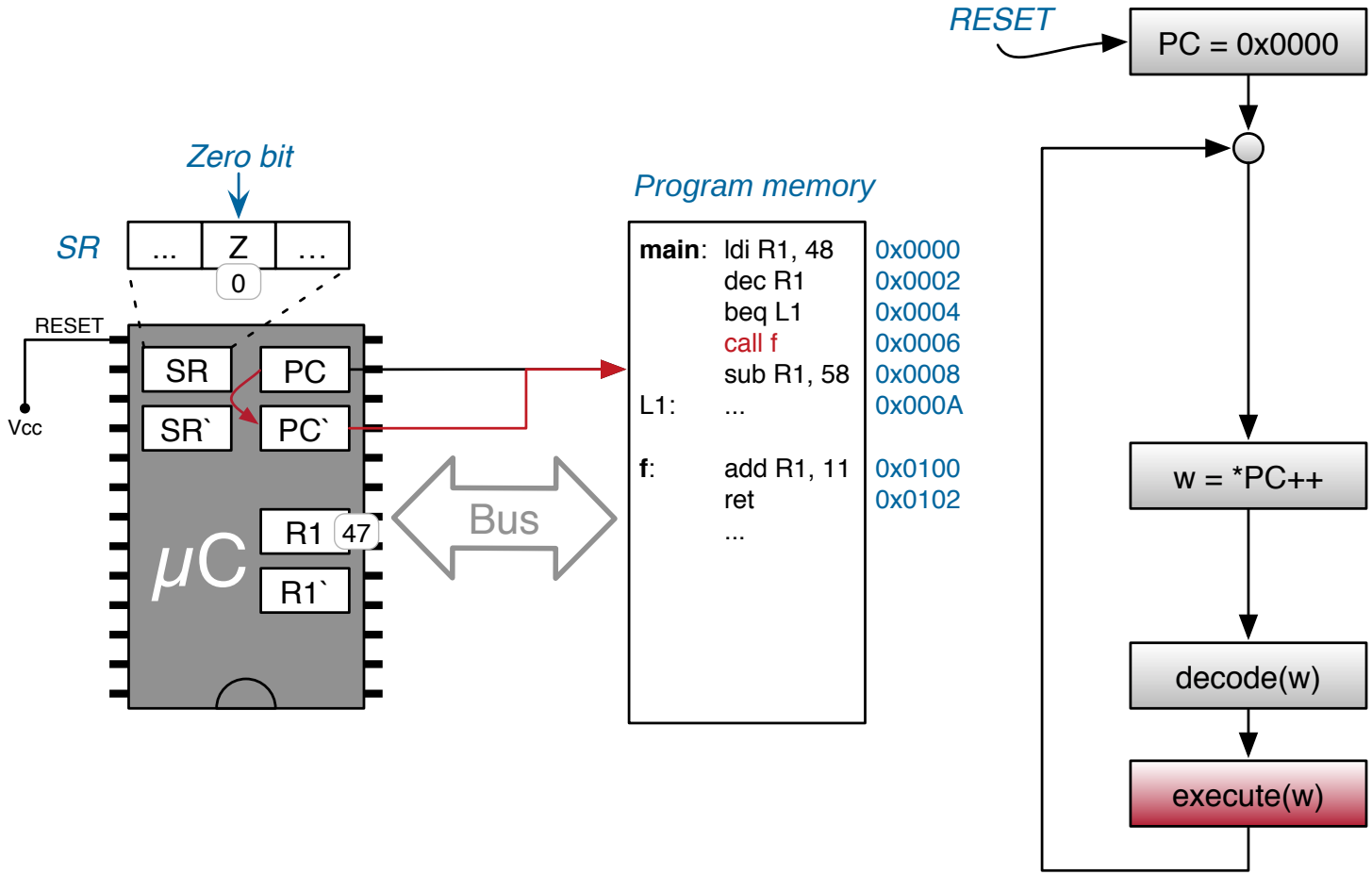

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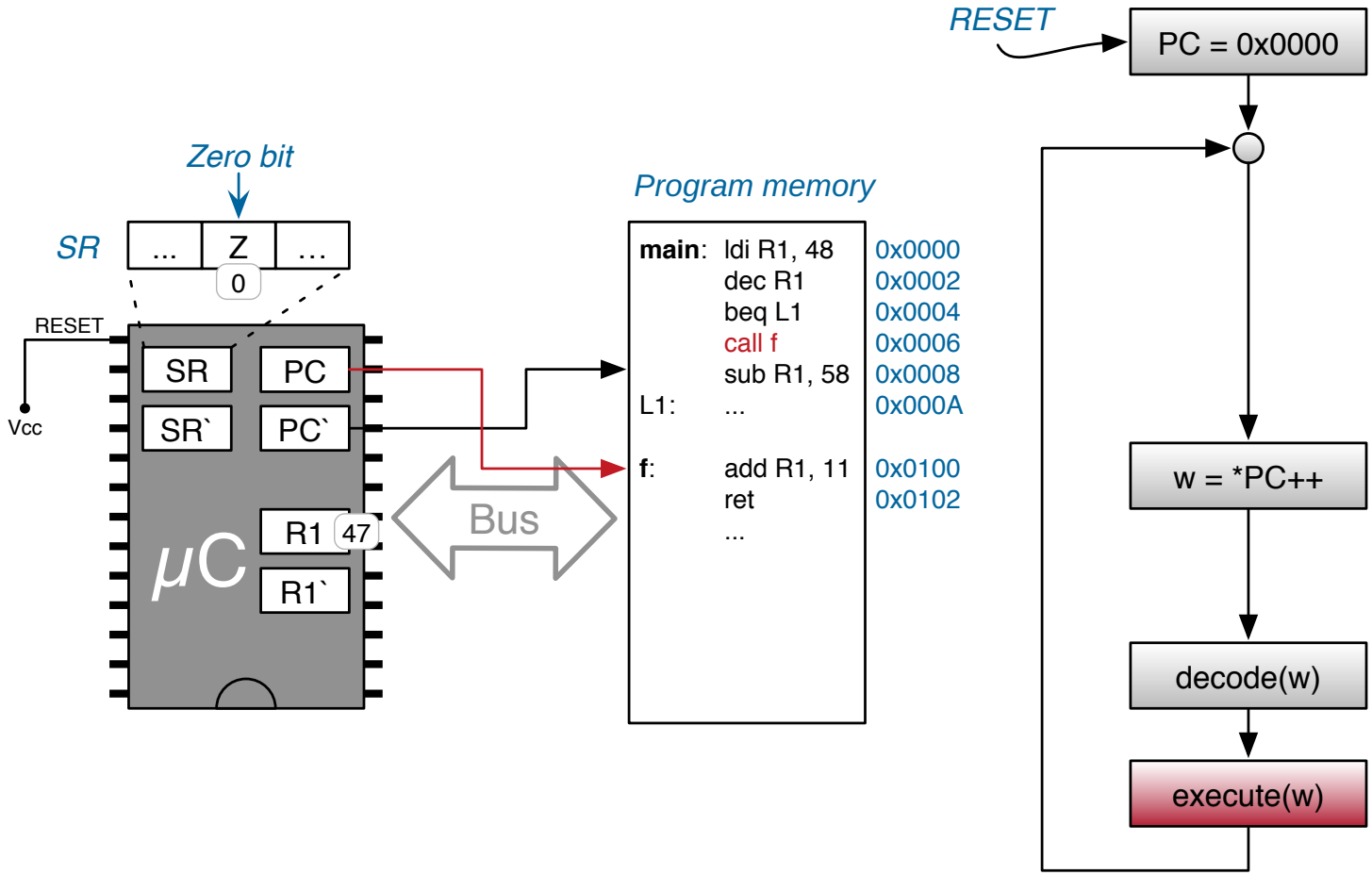

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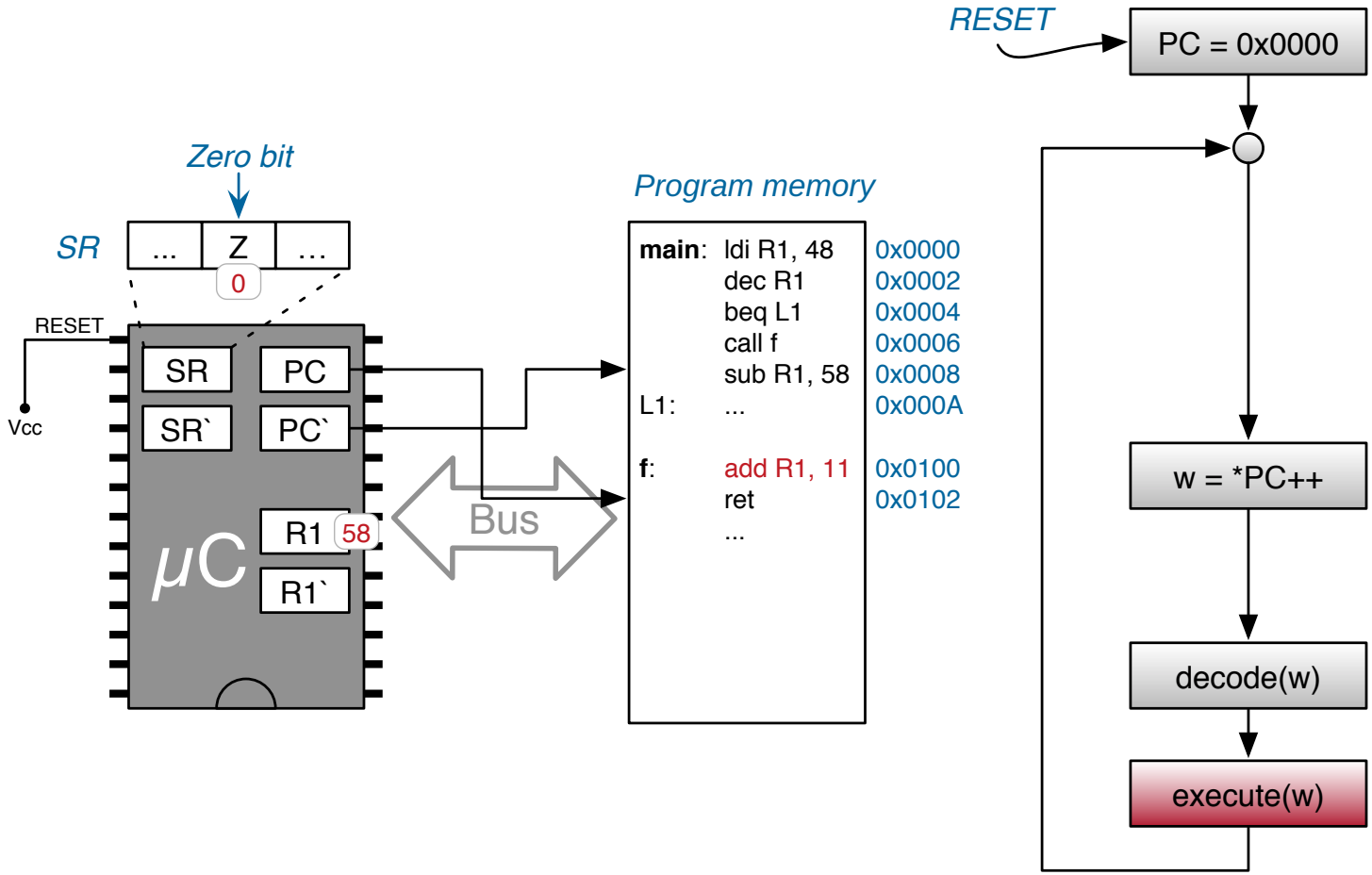

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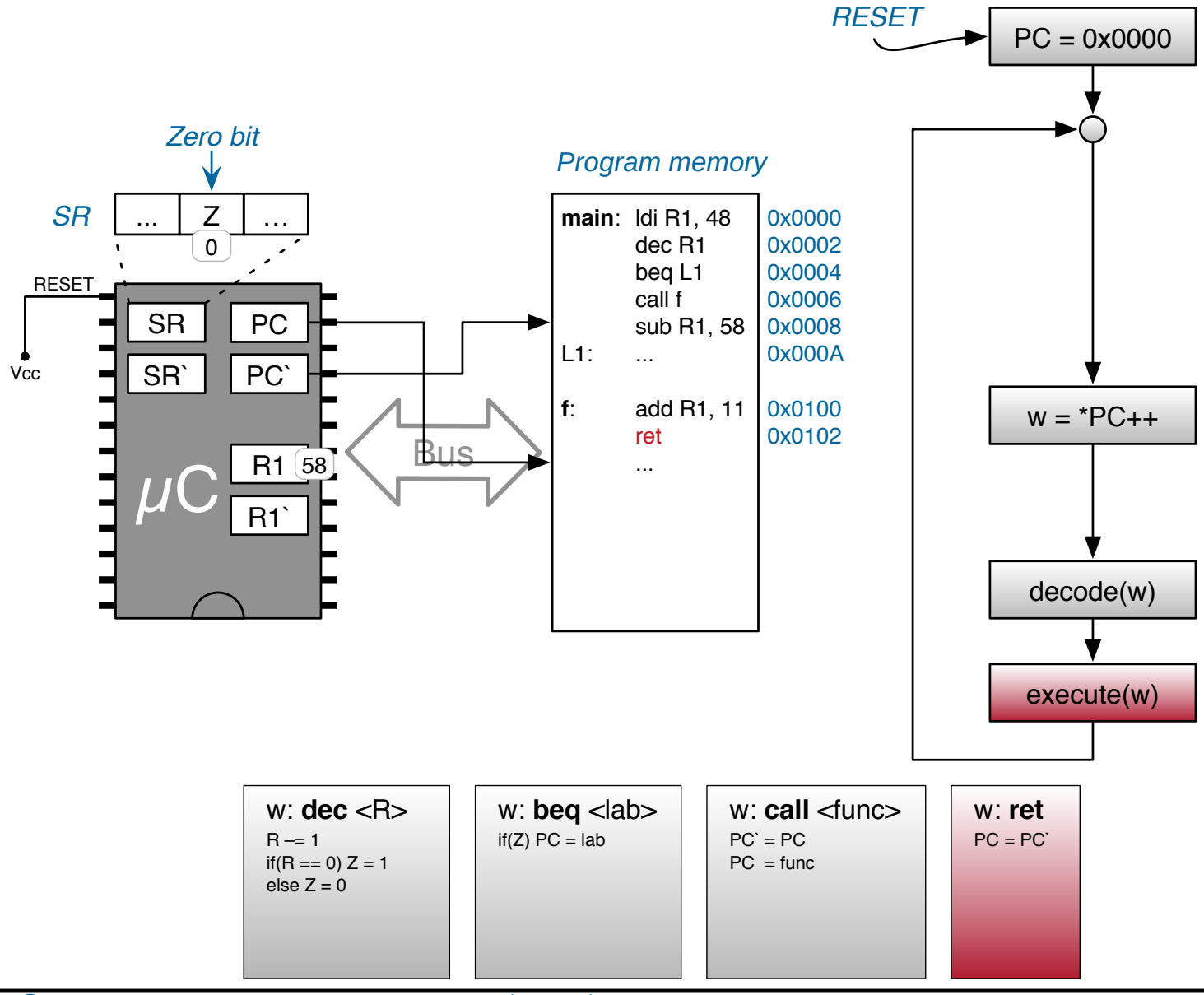

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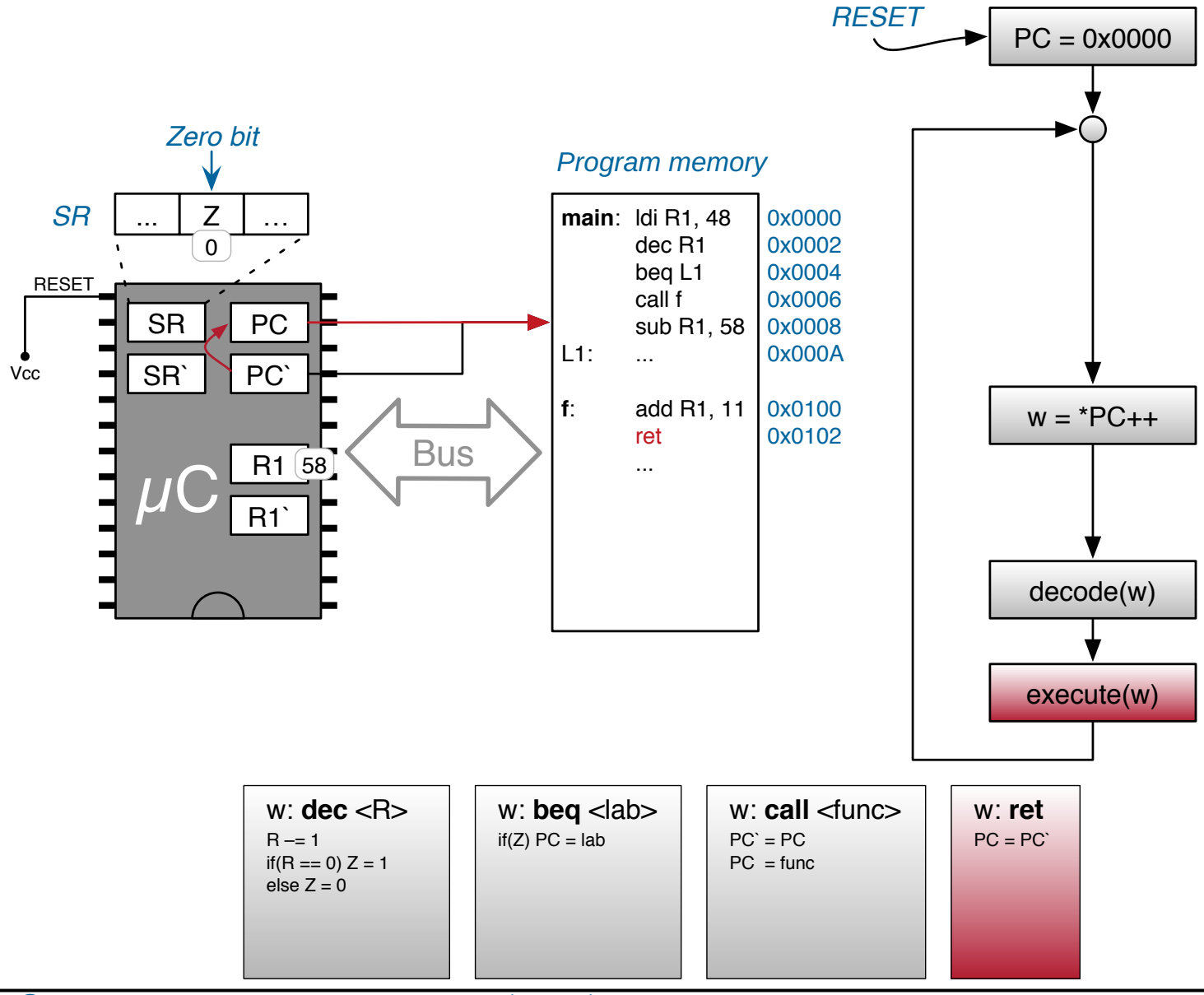

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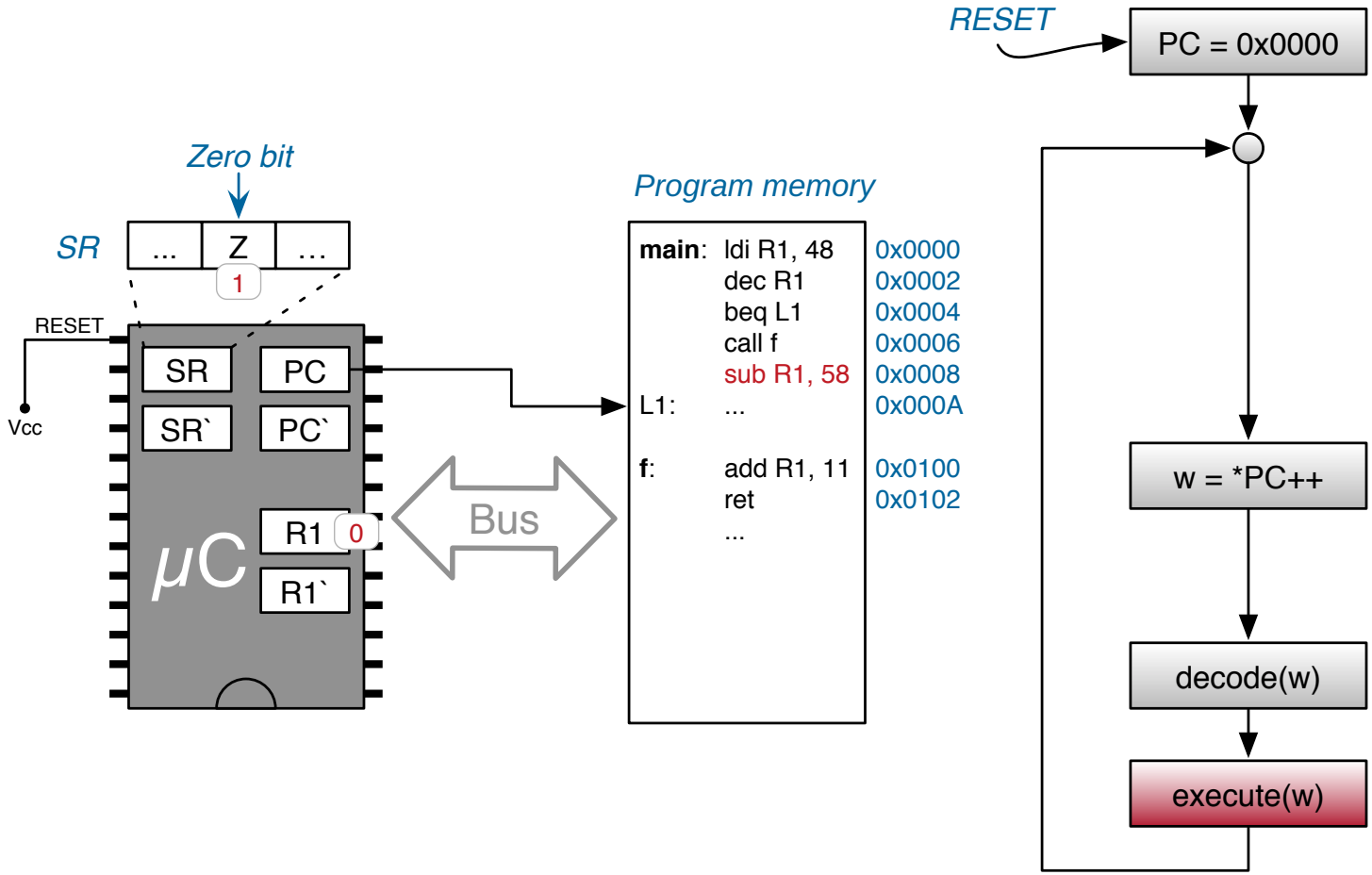

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w: **ret**
PC = PC`