



Architecture

Student Solutions

Exercises Computer Architecture

1 | Architecture

1.1 Stack-Architecture

- a) -
- b) 7 explicit fetch and none implicit
- c) 7 explicit fetch, 4 implicit fetch, 4 implicit store

arc/stack-01

1.2 Stack-Architecture

- a) -
- b) 7 explicit fetch
- c) 7 explicit fetch (with compiler optimizations)
 - 7 explicit fetch, 1 implicit store, 1 implicit fetch (without compiler optimizations)
- d) 7 explicit fetch, 3 implicit store, 3 implicit fetch (without compiler optimizations)

arc/stack-02

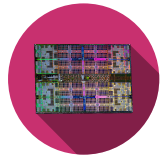
2 | Single-Cycle RISC-V

2.1 Single-Cycle Processor Operation

```
PCScr = '0'  
RegWrite = '1'  
ImmScr[1:0] = "xx"  
ALUSrc = '0'  
ALUControl[2:0] = "010"  
MemWrite = '0'  
ResultScr = '0'
```

arc/scr-01

2.2 Extend Single Cycle with instruction `jal`



```
PCScr = '0'  
RegWrite = '1'  
ImmScr[1:0] = "xx"  
ALUSrc = '0'  
ALUControl[2:0] = "010"  
MemWrite = '0'  
ResultScr = '0'
```

arc/scr-02

2.3 Single Cycle Processor Performance

$$T_{\text{program_single_cycle}} = 75\text{sec} \quad (1)$$

arc/scr-03

3 | Multi-Cycle RISC-V

3.1 Multi Cycle Processor Performance

$$\begin{aligned} \text{CPI}_{\text{load}} &= 5 \text{ cycles} \\ \text{CPI}_{\text{store}} &= 4 \text{ cycles} \\ \text{CPI}_{\text{branch}} &= 3 \text{ cycles} \\ \text{CPI}_{\text{jump}} &= 4 \text{ cycles} \\ \text{CPI}_{\text{alu}} &= 4 \text{ cycles} \\ \text{CPI}_{\text{average}} &= 4.14 \text{ cycles} \end{aligned} \quad (2)$$

arc/mcr-01

3.2 Multi-Cycle Processor Performance

$$T_{\text{program_single_cycle}} = 155.25\text{sec} \quad (3)$$

arc/mcr-02