

A RISC-V Processor Components CircuiTikZ Library

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Contents

1	Introduction	3
1.1	Motivation	3
1.2	Usage	3
2	Component List	4
2.1	Memory Components	4
2.2	Arithmetic Components	4
2.3	Multiplexers	5
2.4	Control Units	5
2.5	Miscellaneous Components	6
3	Keys	8
3.1	CircuiTikZ keys	8
3.2	Special node keys	8
4	Examples	10
4.1	Single-Cycle RISC-V Processor	10
4.2	Multi-Cycle RISC-V Processor	10
4.3	Pipelined RISC-V Processor	11

1 Introduction

1.1 Motivation

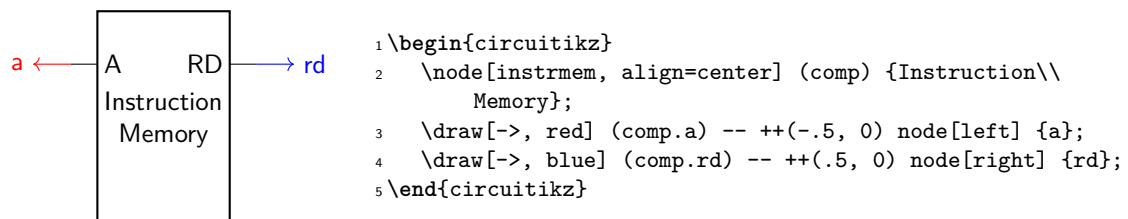
This CircuiTikZ library offers some components to efficiently draw RISC-V processors in \LaTeX . The library was designed with the goal of resembling the RISC-V processor schematics as presented in ‘Digital Design and Computer Architecture: RISC-V Edition’ by Sarah L. Harris and David Harris.

1.2 Usage

To use the predefined components, you must include the library `riscvproc`. Your preamble should look like this:

```
...  
\usepackage{tikz}  
\usepackage{circuitikz}  
\usetikzlibrary{riscvproc}  
...
```

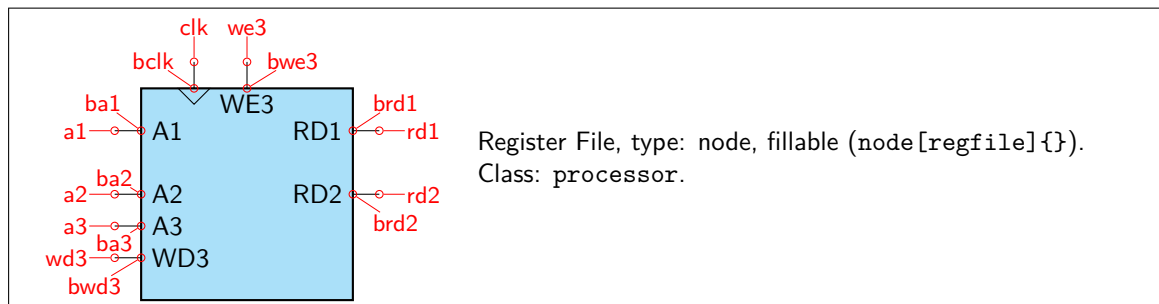
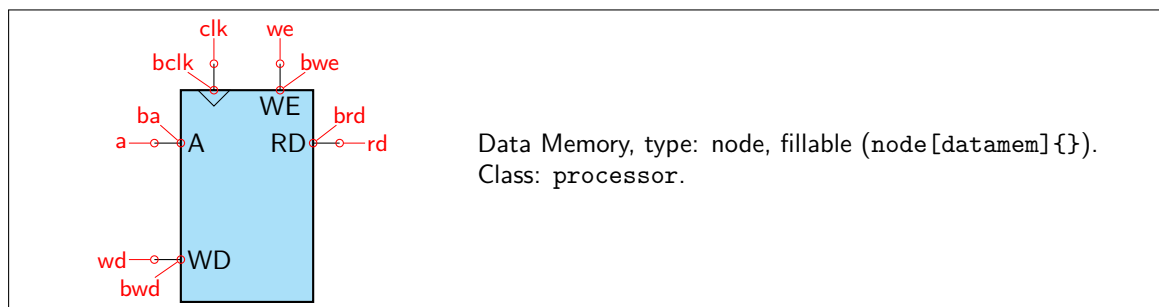
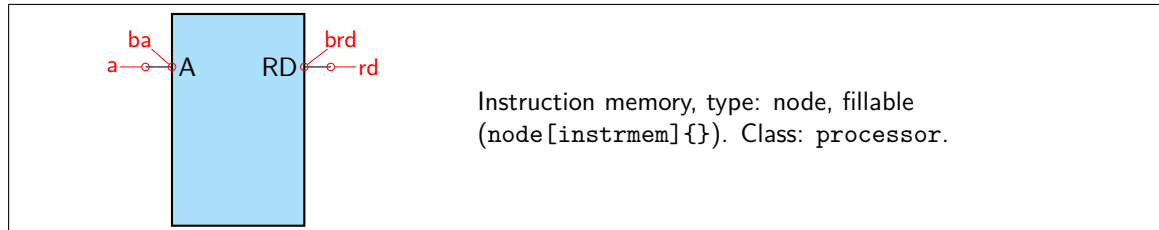
Components are then available in `circuitikz` environments:



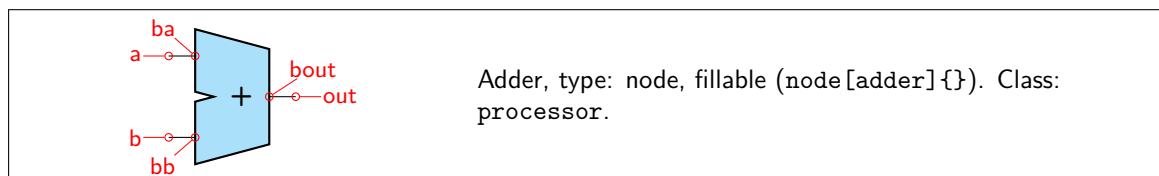
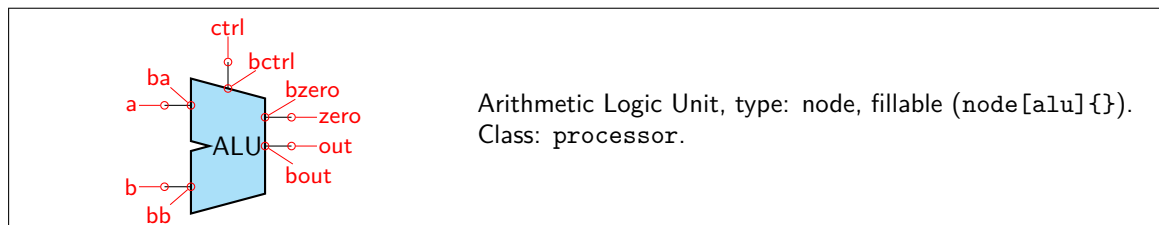
```
1\begin{circuitikz}  
2  \node[instrmem, align=center] (comp) {Instruction\\  
    Memory};  
3  \draw[->, red] (comp.a) -- ++(-.5, 0) node[left] {a};  
4  \draw[->, blue] (comp.rd) -- ++(.5, 0) node[right] {rd};  
5\end{circuitikz}
```

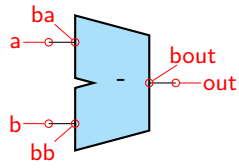
2 Component List

2.1 Memory Components



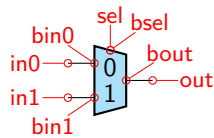
2.2 Arithmetic Components



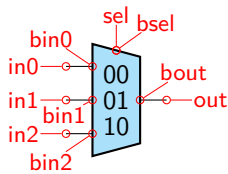


Subtractor, type: node, fillable (node[subtr]{}). Class: processor.

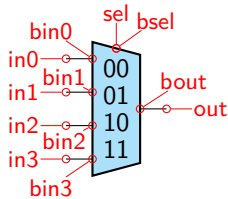
2.3 Multiplexers



Multiplexer, type: node, fillable (node[mux]{}). Class: processor.

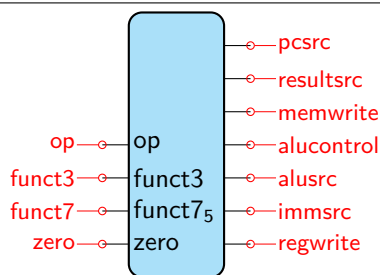


Multiplexer with 3 inputs, type: node, fillable (node[3mux]{}). Class: processor.

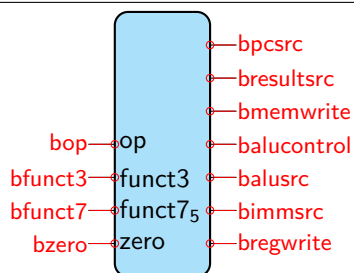


Multiplexer with 4 inputs, type: node, fillable (node[4mux]{}). Class: processor.

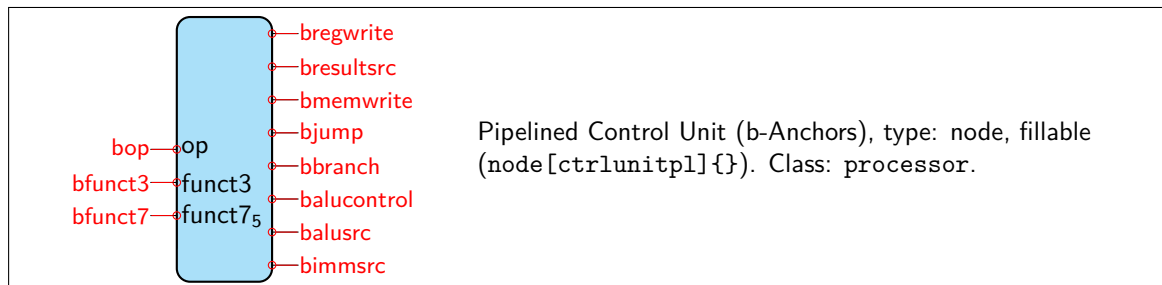
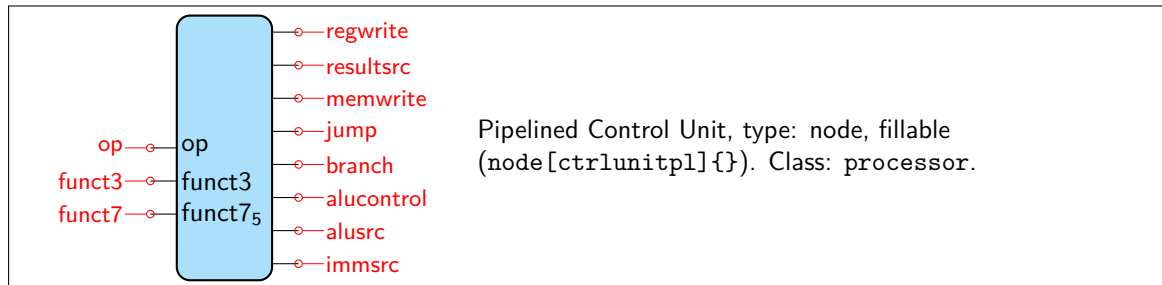
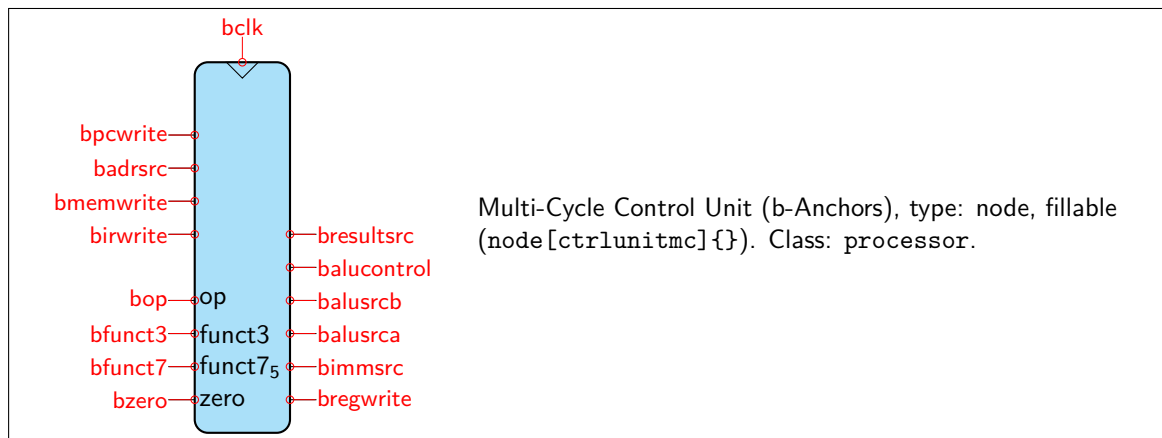
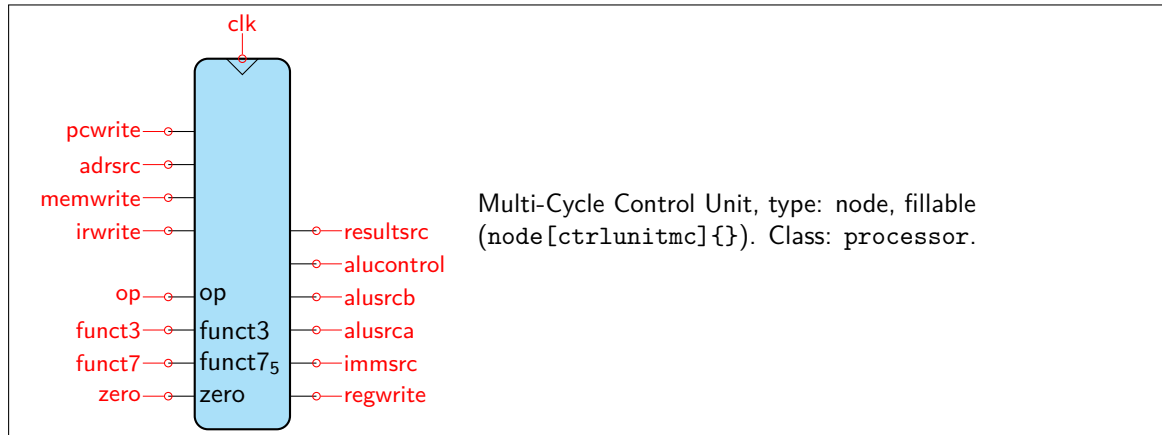
2.4 Control Units



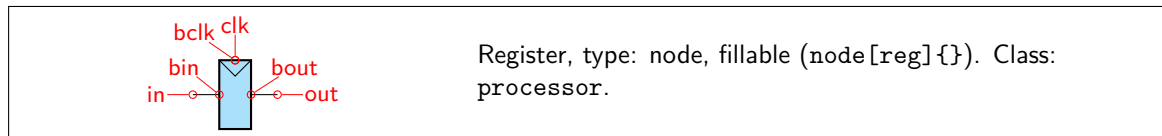
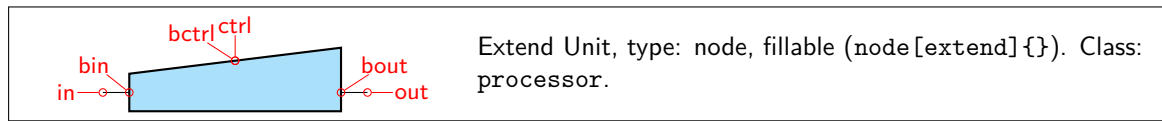
Single-Cycle Control Unit, type: node, fillable (node[ctrlunitsc]{}). Class: processor.



Single-Cycle Control Unit (b-Anchors), type: node, fillable (node[ctrlunitsc]{}). Class: processor.



2.5 Miscellaneous Components



3 Keys

3.1 CircuiTikZ keys

The desired CircuiTikZ key can be set via `\ctikzset{processor/<key>=value}`. E.g. if one wishes to set the line width of all components to 4, the line `\ctikzset{processor/thickness=4}` would have to be included in the specific circuitikz picture. A list of all CircuiTikZ keys can be found in Table 1. A list of component families can be found in Table 2.

Key	Description	Default value
<code>scale</code>	Sets scale for all processor components.	1
<code>thickness</code>	Sets line width for all processor components.	2
<code>font</code>	Sets font family for all labels of processor components.	<code>\rmfamily</code>
<code>memory/height</code>	Sets height for all memory components.	2
<code>memory/width</code>	Sets width for all memory components except <code>regfile</code> .	1.25
<code>control/heightsc</code>	Sets height for <code>ctrlunitsc</code> .	2.5
<code>control/heightmc</code>	Sets height for <code>ctrlunitmc</code> .	3.5
<code>control/width</code>	Sets width for control components.	0.9
<code>control/radius</code>	Sets border radius for control components.	5
<code>arith/height</code>	Sets height for arithmetic components.	0.9
<code>arith/width</code>	Sets height for arithmetic components.	0.7
<code>arith/slope</code>	Sets slope for arithmetic components in degrees.	15
<code>extend/height</code>	Sets height for big side of extend components.	0.6
<code>extend/width</code>	Sets height for extend components.	2
<code>extend/slope</code>	Sets slope for extend components in degrees.	7
<code>mux/slope</code>	Sets slope for multiplexers in degrees.	15
<code>misc/smallheight</code>	Sets height for small components.	0.65
<code>misc/smallwidth</code>	Sets width for small components. Also affects the CLK input triangle.	0.3
<code>misc/leadlen</code>	Sets length for input and output leads.	0.25

Table 1: List of CircuiTikZ keys

Component family	Component list
memory components	<code>instrmem</code> , <code>datamem</code> , <code>regfile</code>
control components	<code>ctrlunitsc</code> , <code>ctrlunitmc</code>
arithmetic components	<code>alu</code> , <code>add</code> , <code>subtr</code>
extend components	<code>extend</code>
small components	<code>mux</code> , <code>reg</code>

Table 2: List of component families

3.2 Special node keys

Some keys are also defined as Tikz keys and can therefore be directly passed to nodes likes shown in Figure 1. A list of all these keys can be found in Table 3.

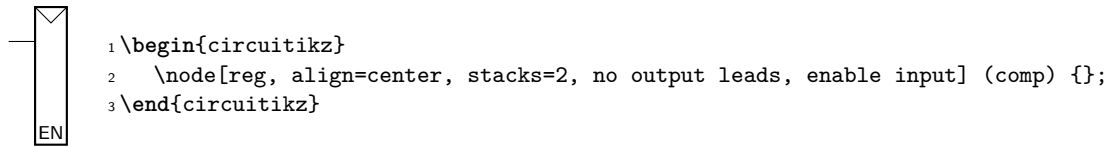


Figure 1: Passing options to a node

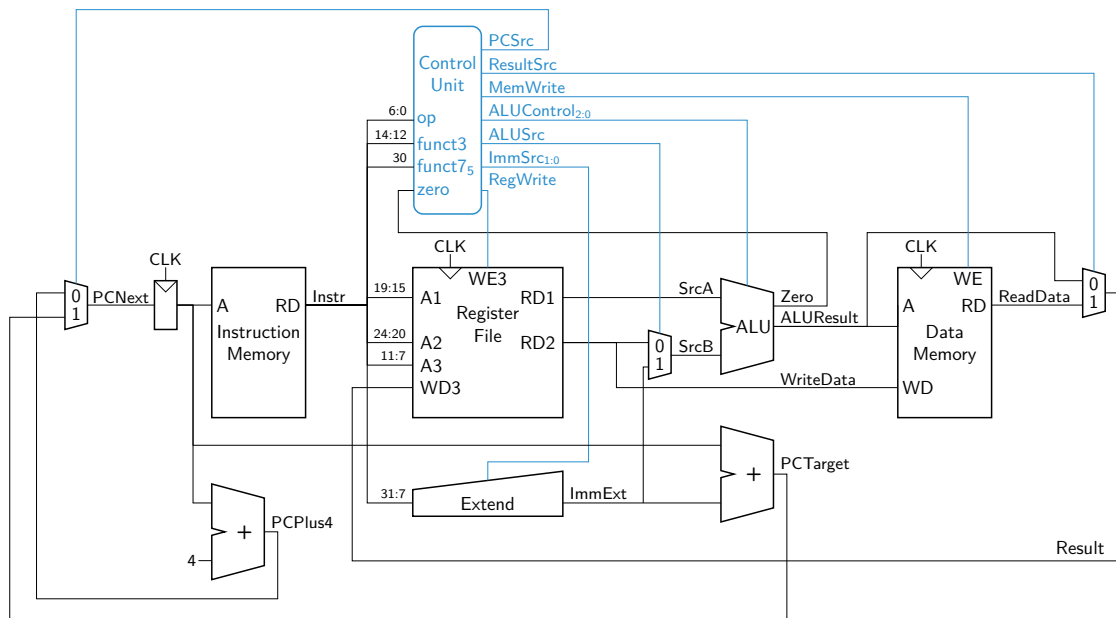
Key	Description	applicable to
input leads	Specifies whether to draw input leads.	all components
output leads	Specifies whether to draw output leads.	all components
leads	Specifies whether to draw leads at all.	all components
stacks	Sets height of a register in multiples of the default height, allows for stretched registers.	reg
enable input	Specifies whether to draw an enable input or not. This also gives two new anchors, en and ben.	reg

Table 3: List special node keys

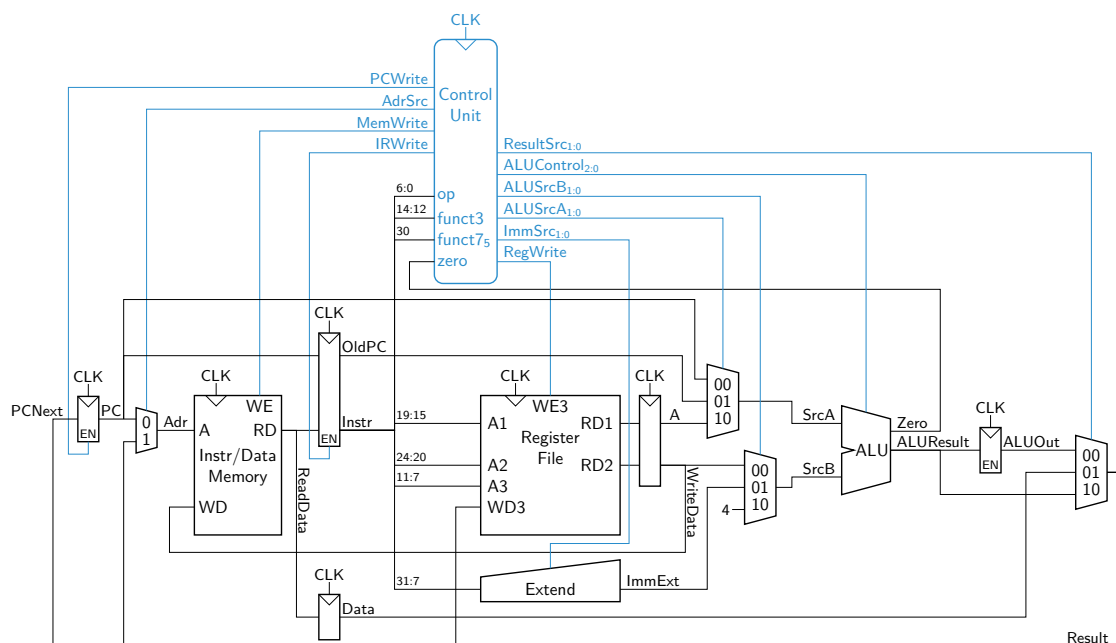
More keys might be added in future.

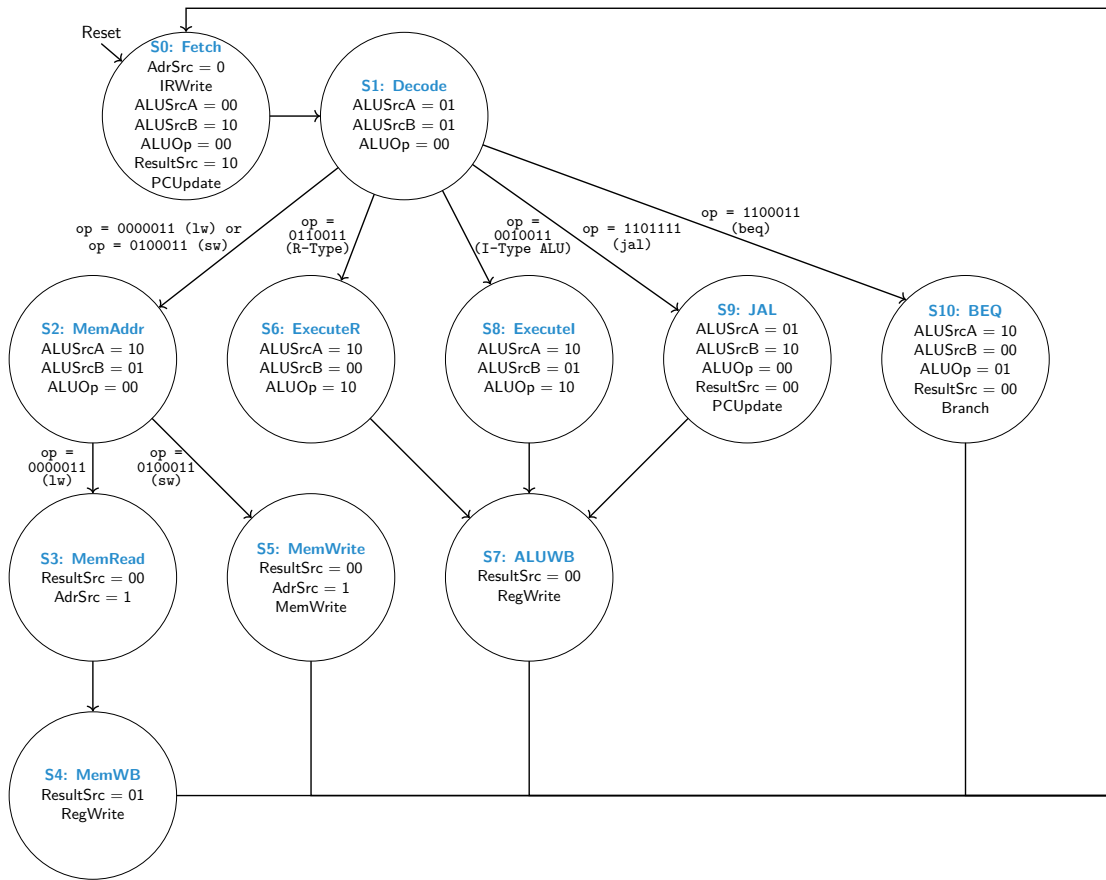
4 Examples

4.1 Single-Cycle RISC-V Processor



4.2 Multi-Cycle RISC-V Processor





4.3 Pipelined RISC-V Processor

