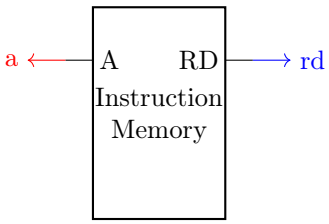
# RISC-V Processor CircuiTi*k*Z Library

March 12, 2025

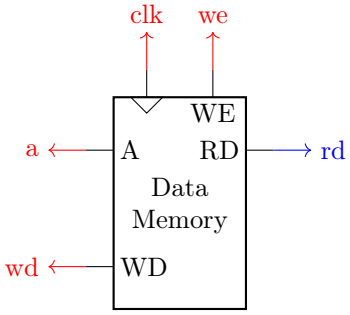
# 1 Components

## 1.1 Instruction Memory



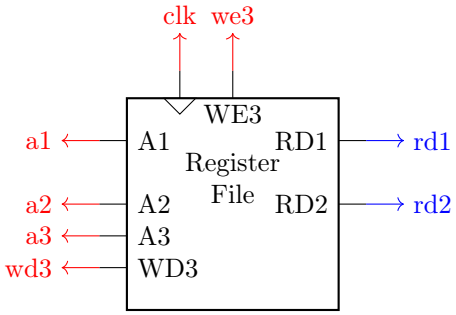

```
\begin{circuitikz}
  \node[instrmem, align=center] (comp) {Instruction
      \\Memory};

  \draw[->, red] (comp.a) -- ++(-.5, 0) node[left] {
      a};
  \draw[->, blue] (comp.rd) -- ++(.5, 0) node[right]
       {rd};
\end{circuitikz}
```

## 1.2 Data Memory



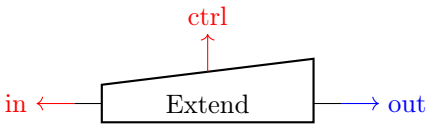

```
\begin{circuitikz}[]
  \node[datamem, align=center] (comp) {Data\\Memory
      };
  \draw[->, red] (comp.a) -- ++(-.5, 0) node[left]
      {a};
  \draw[->, red] (comp.wd) -- ++(-.5, 0) node[left]
       {wd};
  \draw[->, red] (comp.clk) -- ++(0, .5) node[above
      ] {clk};
  \draw[->, red] (comp.we) -- ++(0, .5) node[above]
       {we};
  \draw[->, blue] (comp.rd) -- ++(.5, 0) node[right
      ] {rd};
\end{circuitikz}
```

## 1.3 Register File



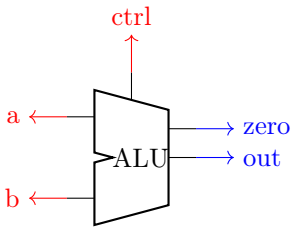

```
\begin{circuitikz}[]
  \node[regfile, align=center] (comp) {
      Register\\File};
  \draw[->, red] (comp.a1) -- ++(-.5, 0)
      node[left] {a1};
  \draw[->, red] (comp.a2) -- ++(-.5, 0)
      node[left] {a2};
  \draw[->, red] (comp.a3) -- ++(-.5, 0)
      node[left] {a3};
  \draw[->, red] (comp.wd3) -- ++(-.5, 0)
      node[left] {wd3};

  \draw[->, red] (comp.clk) -- ++(0, .5)
      node[above] {clk};
  \draw[->, red] (comp.we3) -- ++(0, .5)
      node[above] {we3};
  \draw[->, blue] (comp.rd1) -- ++(.5, 0)
      node[right] {rd1};
  \draw[->, blue] (comp.rd2) -- ++(.5, 0)
      node[right] {rd2};
\end{circuitikz}
```

## 1.4 Extend Unit



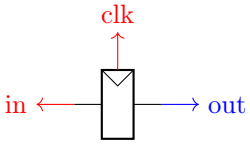

```
\begin{circuitikz}[]
   \node[extend, align=center] (comp) {Extend
       };
   \draw[->, red] (comp.in) -- ++(-.5, 0)
       node[left] {in};
   \draw[->, red] (comp.ctrl) -- ++(0, .5)
       node[above] {ctrl};
   \draw[->, blue] (comp.out) -- ++(.5, 0)
       node[right] {out};
\end{circuitikz}
```

## 1.5 Arithmetic Logic Unit



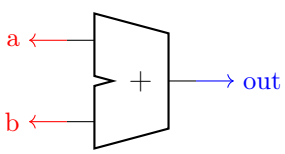

```
\begin{circuitikz}[]
   \node[alu, align=center] (comp) {ALU};
   \draw[->, red] (comp.a) -- ++(-.5, 0) node[left] {a};
   \draw[->, red] (comp.b) -- ++(-.5, 0) node[left] {b};
   \draw[->, red] (comp.ctrl) -- ++(0, .5) node[above] {
       ctrl};
   \draw[->, blue] (comp.out) -- ++(.5, 0) node[right] {
       out};
   \draw[->, blue] (comp.zero) -- ++(.5, 0) node[right]
       {zero};
\end{circuitikz}
```

## 1.6 Register



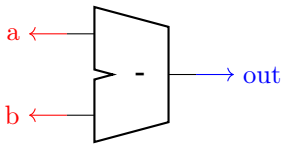

```
\begin{circuitikz}[]
   \node[reg, align=center] (comp) {};
   \draw[->, red] (comp.in) -- ++(-.5, 0) node[left] {in};
   \draw[->, red] (comp.clk) -- ++(0, .5) node[above] {clk
       };
   %\draw[->, red] (comp.en) -- ++(0, -.5) node[below] {en
       };
   \draw[->, blue] (comp.out) -- ++(.5, 0) node[right] {out
       };
\end{circuitikz}
```

## 1.7 Adder



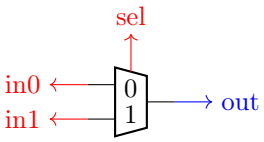

```
\begin{circuitikz}[]
   \node[adder, align=center] (comp) {};
   \draw[->, red] (comp.a) -- ++(-.5, 0) node[left] {a};
   \draw[->, red] (comp.b) -- ++(-.5, 0) node[left] {b};
   \draw[->, blue] (comp.out) -- ++(.5, 0) node[right] {
       out};
\end{circuitikz}
```

## 1.8 Subtractor



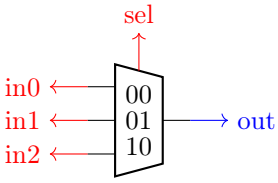

```
\begin{circuitikz}[]
   \node[sub, align=center] (comp) {};
   \draw[->, red] (comp.a) -- ++(-.5, 0) node[left] {a};
   \draw[->, red] (comp.b) -- ++(-.5, 0) node[left] {b};
   \draw[->, blue] (comp.out) -- ++(.5, 0) node[right] {
       out};
\end{circuitikz}
```

## 1.9 Multiplexer



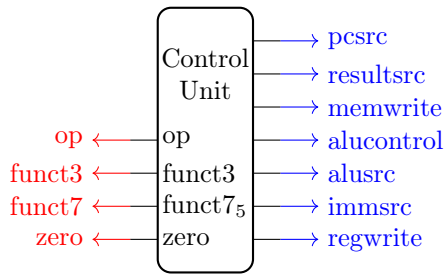

```
\begin{circuitikz}[]
   \node[mux, align=center] (comp) {};
   \draw[->, red] (comp.in0) -- ++(-.5, 0) node[left] {in
       0};
   \draw[->, red] (comp.in1) -- ++(-.5, 0) node[left] {in
       1};
   \draw[->, red] (comp.sel) -- ++(0, .5) node[above] {sel
       };
   \draw[->, blue] (comp.out) -- ++(.5, 0) node[right] {
       out};
\end{circuitikz}
```

## 1.10 Multiplexer with 3 inputs



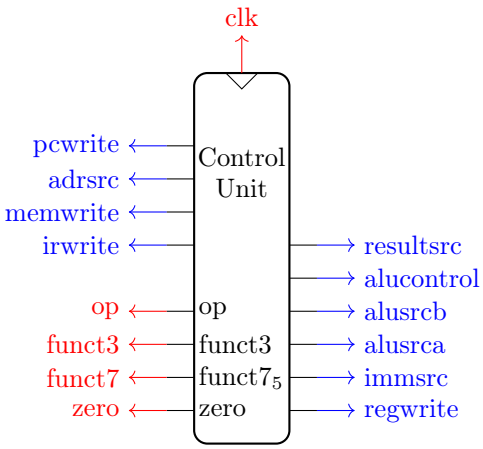

```
\begin{circuitikz}[]
   \node[3mux, align=center] (comp) {};
   \draw[->, red] (comp.in0) -- ++(-.5, 0) node[left] {in
       0};
   \draw[->, red] (comp.in1) -- ++(-.5, 0) node[left] {in
       1};
   \draw[->, red] (comp.in2) -- ++(-.5, 0) node[left] {in
       2};
   \draw[->, red] (comp.sel) -- ++(0, .5) node[above] {
       sel};
   \draw[->, blue] (comp.out) -- ++(.5, 0) node[right] {
       out};
\end{circuitikz}
```

## 1.11 Single-Cycle Control Unit




```
\begin{circuitikz}[]
  \node[ctrlunitsc, align=center] (comp) {
      Control\\Unit};
  \draw[->, red] (comp.op) -- ++(-.5, 0)
      node[left] {op};
  \draw[->, red] (comp.funct3) -- ++(-.5,
      0) node[left] {funct3};
  \draw[->, red] (comp.funct7) -- ++(-.5,
      0) node[left] {funct7};
  \draw[->, red] (comp.zero) -- ++(-.5, 0)
      node[left] {zero};

  \draw[->, blue] (comp.pcsrc) -- ++(.5, 0)
       node[right] {pcsrc};
  \draw[->, blue] (comp.resultsrc) --
      ++(.5, 0) node[right] {resultsrc};
  \draw[->, blue] (comp.memwrite) -- ++(.5,
       0) node[right] {memwrite};
  \draw[->, blue] (comp.alucontrol) --
      ++(.5, 0) node[right] {alucontrol};
  \draw[->, blue] (comp.alusrc) -- ++(.5,
      0) node[right] {alusrc};
  \draw[->, blue] (comp.immsrc) -- ++(.5,
      0) node[right] {immsrc};
  \draw[->, blue] (comp.regwrite) -- ++(.5,
       0) node[right] {regwrite};
\end{circuitikz}
```

## 1.12 Multi-Cycle Control Unit




```
\begin{circuitikz}[]
  \node[ctrlunitmc, align=center] (comp)
       {Control\\Unit};
  \draw[->, red] (comp.op) -- ++(-.5, 0)
       node[left] {op};
  \draw[->, red] (comp.funct3) --
      ++(-.5, 0) node[left] {funct3};
  \draw[->, red] (comp.funct7) --
      ++(-.5, 0) node[left] {funct7};
  \draw[->, red] (comp.zero) -- ++(-.5,
      0) node[left] {zero};
  \draw[->, red] (comp.clk) -- ++(0,.5)
      node[above] {clk};

  \draw[->, blue] (comp.resultsrc) --
      ++(.5, 0) node[right] {resultsrc};
  \draw[->, blue] (comp.memwrite) --
      ++(-.5, 0) node[left] {memwrite};
  \draw[->, blue] (comp.alucontrol) --
      ++(.5, 0) node[right] {alucontrol
      };
  \draw[->, blue] (comp.alusrca) --
      ++(.5, 0) node[right] {alusrca};
  \draw[->, blue] (comp.alusrcb) --
      ++(.5, 0) node[right] {alusrcb};
  \draw[->, blue] (comp.immsrc) --
      ++(.5, 0) node[right] {immsrc};
  \draw[->, blue] (comp.regwrite) --
      ++(.5, 0) node[right] {regwrite};
  \draw[->, blue] (comp.irwrite) --
      ++(-.5, 0) node[left] {irwrite};
  \draw[->, blue] (comp.adrsrc) --
      ++(-.5, 0) node[left] {adrsrc};
  \draw[->, blue] (comp.pcwrite) --
      ++(-.5, 0) node[left] {pcwrite};
\end{circuitikz}
```

## 2 Single-Cycle RISC-V Processor