rvcodec.js: An Educational Converter for RISC-V Instructions

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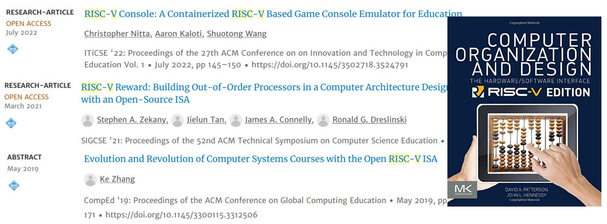
SIGCSE 2023, March 15–18, 2023, Toronto, ON, Canada

UC DAVIS COMPUTER SCIENCE

Motivation

- Increasing usage of RISC-V at undergraduate level



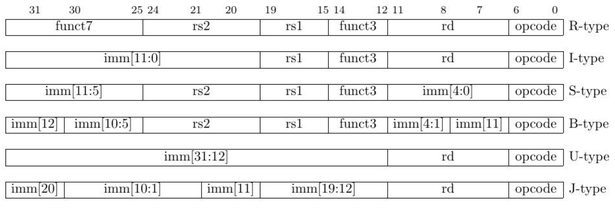
- Vast RISC-V ecosystem, with many educational tools

- However, no RISC-V instruction converter yet!

RISC-V instructions

- https://riscv.org/technical/specifications/
  - Volume 1, Unprivileged Spec v. 20191213
  - Volume 2, Privileged Spec v. 20211203

- Types of RISC-V instructions



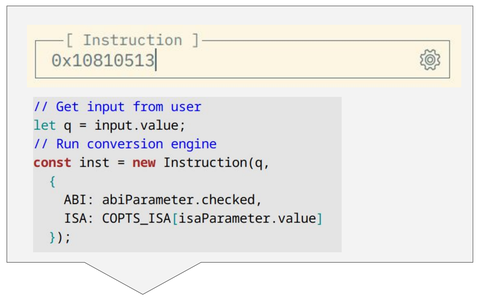
- Encoding is from assembly form to binary form (e.g., `addi a0, sp, 264` => `0x10810513`)
- Decoding is from binary form to assembly form (e.g., `0xFF740EE3` => `beq s0, s7, -4`)

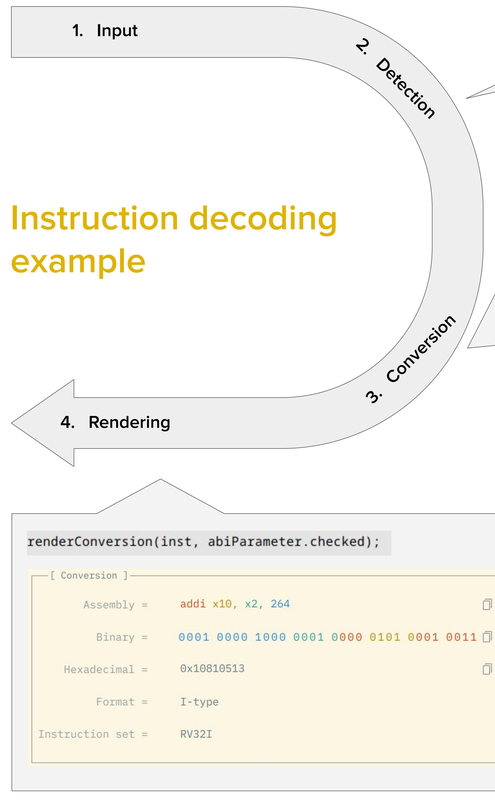
Our tool: rvcodec.js

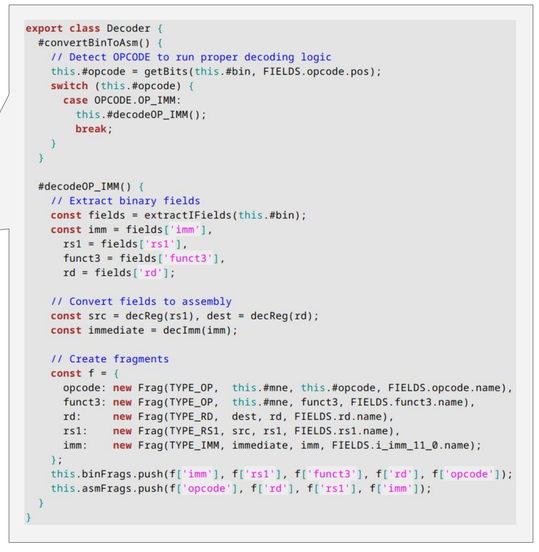
- Static single-page web application with no external dependencies

- User interface (UI) written in HTML + CSS + Javascript
  - Handles user input and conversion parameters
  - Renders converted output and colors matching fields

- Conversion engine written purely in Javascript
  - Contains encoding/decoding logic
  - Builds `Instruction` object from user input
  - Computes list of `Fragments` for coloring matching fields







Features

- Conversion engine
  - Support for all of the base integer ISAs: RV{32,64,128}I + Zifencei + Zicsr
  - Support for all of the mainstream ISA extensions: M, A, F, D, Q, C

- UI/UX
  - Bright colors to visually map the relationships between an instruction's assembly tokens and binary fields
  - Copy buttons for each representation of an instruction
  - Mnemonic completion

- Planned
  - Highlighting of matching assembly tokens and binary fields upon mouse hover
  - Tooltips explaining each binary field upon mouse hover
  - Better responsive UI for small screens

Project

- Tool available online
  - https://luplab.gitlab.io/rvcodecjs

- Source code available under the GNU Affero GPL v3.0
  - We accept contributions! 🤩
  - https://gitlab.com/luplab/rvcodecjs/

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