

# Final Project

The final project for 1951Q is an opportunity to apply what you've learned about program analysis in an open-ended setting. You will work in groups of 1-4 over the next month culminating in a writeup of the project.

## Project Ideas

Here's a non-exhaustive list of project archetypes to choose from:

- **Implement an existing technique for the Rice language:** take an existing tool / framework / research concept and re-implement it specifically for the Rice language. This lets you explore sophisticated ideas in a simplified setting. Some examples:
  - Implement an e-graph optimizer for Rice using [egg](#).
  - Implement a meta-tracing JIT for Rice using [RPython](#).
  - Implement a GPU backend for Rice using [MLIR](#).
  - Rewrite all your program analyses using a Datalog engine like [Souffle](#), [Egglog](#), [Ascent](#), or [Datafrog](#).
  - Implement static race detection for Rice (along with some concurrency primitives) using the technique in [RacerD](#).
  - Implement a [CodeQL backend](#) for Rice.
  - Implement the [Language Server Protocol](#) for an incrementalized version of Rice using [salsa](#).
- **Contribute to a production-grade compiler:** find a limitation or open issue of a realistic compiler and implement a fix. This can be speculative implementations (e.g., implement symbolic execution for Rust) or actual fixes (e.g., issue #XXXX on Github). The latter should require less implementation than the former, but it is expected that you seriously attempt to get an actual fix merged into the compiler. Some examples:
  - [Integer range analysis](#) (Rust, #76579)
  - [Dataflow and diagnostics](#) (Rust, #98470)
  - [Dataflow memory usage](#) (Rust, #81124)

You can find many more ideas by trawling the issue trackers with the right label filters. For example:

- [Julia issue tracker for optimizations](#)
  - [LLVM issue tracker for dataflow](#)
  - [Python issue tracker for JIT](#)
- **Incorporate program analysis into research:** if you already have a research project, this final can be a great opportunity to build upon the project in a manner related to the course. Here's some fun examples of program analysis across several domains:

- **Graphics:** “Geometry Types for Graphics Programming”, “Generating Renderers Without Writing a Generator”, “Fast, Modular and Differentiable Shader Programming”
- **Fabrication:** “A Compiler for 3D Machine Knitting”, “A Lineage-Based Referencing DSL for Computer-Aided Design”, “Carpentry Compiler”
- **Psychology:** “A Domain-Specific Probabilistic Programming Language for Reasoning about Reasoning”, “Probabilistic Models of Cognition”
- **Machine Learning:** “Static Analysis of Shape in TensorFlow Programs”, “Torchy: A Tracing JIT Compiler for PyTorch”
- **Data Science:** “Expressing and Checking Statistical Assumptions”, “HiPy: Extracting High-Level Semantics from Python Code for Data Processing”
- **Privacy:** “PrivGuard: Privacy Regulation Compliance Made Easier”, “Paralegal: Practical Static Analysis for Privacy Bugs”, “RuleKeeper: GDPR-Aware Personal Data Compliance for Web Frameworks”

## Project Proposal

**Due: 11/11/25 at 11:59pm** (NO EXTENSIONS!)

**Submission link:** email Will ([will\\_crichton@brown.edu](mailto:will_crichton@brown.edu))

Your final project will consist of a technical portion (code, pull requests, theory, etc.) and a written portion (description, evaluation). Your first goal is to find your teammates, pick a topic, and write up a proposal (1 page maximum) for your project. Your proposal must incorporate the following elements:

- **Title:** name of your project.
- **Group members:** who’s involved.
- **Description:** 2-3 paragraph description of the project motivation, goals, and plan.
- **Deliverables:** A rough outline of what should be completed by the end of the project. For example: a PR filed to a repo, an analyzer that passes particular test cases, an X% speedup on a particular benchmark.
- **Timeline:** week-by-week timeline of projected work, including assignments of tasks to individual group members. The tasks should cover approximately 10 hours per week per group member.

One member of your group should send a PDF of your proposal to Will before the project deadline, with all teammates CC’d.

## Project Checkpoint

**Due: 11/25/25 at 11:59pm** (NO EXTENSIONS!)

**Submission link:** email Will ([will\\_crichton@brown.edu](mailto:will_crichton@brown.edu))

I’ll put more details about the checkpoint here soon.

## Project Writeup

**Due: 12/11/25 at 11:59pm** (NO EXTENSIONS!)

**Submission link:** email Will ([will\\_crichton@brown.edu](mailto:will_crichton@brown.edu))

I'll put more details about the writeup here soon.