ECE 5504
Fall 2023
Project Description

Evaluation Metrics

The project (25%) evaluation contains three parts: proposal (5%), presentation (5%), and report (15%). The project will be evaluated by (1) whether the idea/design makes sense and contributes to a better computer architecture design, (2) whether the evaluation results are solid, and (3) whether the presentation and write-up explain the ideas and results clearly.

Team Forming

For this project proposal assignment and for the final project, you may work in groups of **up to two** CS/ECE 5504 students **(with the expectation that the scope of the project will be proportional to the number of people in the group)**.

1. If working in a group of two, the proposal/presentation/final report should list the contribution of each person.
2. If working in a group of two, you may not switch groups once you have submitted this project proposal assignment.
3. It is highly recommended that a Git repository (e.g., code.vt.edu) be configured for your team to house any tangible artifacts or experimental results, which in turn, you will report on in your final project research paper.

Project Idea Guideline

The project is intended to be open-ended. You are encouraged to come up with different ideas. Below I listed some types of projects:

1. **Design**: Implementing New Designs

In this type of project, you want to implement a new design and evaluate it. The expectations are the following:

Design: The design should not be previously implemented in the baseline design. Although encouraged, the design does not have to be very novel. For example, you can take one design from existing papers, and implement and optimize it.

* I suggest you only touch one component of the design, so it is easier for you to debug.

** If you work in a group of two, I expect you to implement two designs and evaluate them.

Evaluation Metrics: Based on the motivation of your project, you want to pick **one or two** metrics to evaluate. For example, in homework, we show how to measure the CPI or cache hit rate.

* Some designs might not have a quantitative metric. For example, implementing a new performance counter. In that case, you want to show the functionality of your design.

Evaluation platform: Since we use RISC-V in our assignment, I expect you to modify either the RISC-V Rocket core or the RISC-V BOOM core. However, you can also use a different architecture simulator.

Evaluation benchmarks: You should pick at least a benchmark program to evaluate your design. You can write your own benchmark program.

*In prior homework, we have used **Dhrystone, Qsort, Matrix multiplication.**

2. **OPT**: Optimize Architecture Configurations for Specific Applications

In this type of project, you work with existing implementations, however, you want to optimize the architecture configuration for your application.

Design Configuration: You should first read about the baseline RISC-V Rocket core or the RISC-V BOOM core, or other baseline designs, and understand the different configurations. I expect to study **at least 5 different parameters** in the configuration and find a methodology to find the optimal design for your application.

** If you work in a group of two, I expect you to implement two different types of applications and compare them.

Evaluation Metrics: Based on the motivation of your project, you want to pick **one or two** metrics to evaluate. For example, in homework, we show how to measure the CPI or cache hit rate.

* Some designs might not have a quantitative metric. In that case, you want to show the qualitative metric.

Evaluation platform: Since we use RISC-V in our assignment, I expect you to modify either the RISC-V Rocket core or the RISC-V BOOM core. However, you can also use a different architecture simulator.

Evaluation benchmarks: You should pick at least a benchmark program to evaluate your design. You can also write your own benchmark program.

*In prior homework, we have used **Dhrystone, Qsort, Matrix multiplication.**

3. **Freestyle**: Your own Idea

You can also propose your own project ideas. For example, instead of new designs or optimizations, you can work on modeling and analyzing certain aspects (e.g., security) of architecture designs, proposing new benchmarks, etc. For example, you can work on demonstrating Spectre attacks on several machines and analyze the attack and mitigation.
The workload should be comparable with the design and OPT categories.

4. **SoK**: Systemization of Knowledge or Literature Survey

In this type of project, you will select one topic and survey existing works on the topic.
I expect you to read 15 papers alone or 25 papers for a group of two and compare them comprehensively. Typically, you will cite more than 50 papers in the report.
I expect you to compare the main papers using different quantitative and qualitative metrics.

Proposal Guideline

The proposal should be no more than **2 pages** (excluding reference) in IEEE conference format. https://www.ieee.org/conferences/publishing/templates.html

The proposal should contain the following:

1. Abstract (<200 words)
   This summarizes what you are proposing along with expected artifacts and/or outcomes
2. Introduction
   This motivates and frames your project proposal. Why is it important to make your proposal from a technical research perspective? Why you are working on this topic? Why is the topic a big deal?
3. Related Work
   This presents research work that has been done and is related to yours. (Make sure to always cite your sources.) You want to show that you have research-related work in the area and know the existing methods well
   If you select an SoK project, please list related surveys or SoK papers.
   * Since you are only given one week for the proposal, we are not expecting you to have a comprehensive literature review in the proposal. But that is expected in the final project.
4. Proposed Method
   This is where the "meat" of your proposal will be. Articulate what you are proposing in sufficient detail so that it can be followed and reproduced.
   What expectations, if any, do you have with respect to the result(s)?
   You also want to state the design in the baseline architecture.
   If you select an SoK project, please provide a list of references that you plan to read and compare.
5. Evaluation Plan
   How do you plan to evaluate your design? What are the evaluation metrics? What benchmark programs you will be using?
   If you select an SoK project, please list the metric you will use to compare the papers.
6. Timeline
   This will provide a proposed timeline of milestones. You should come up with **a weekly schedule of milestones**, while also making sure to leave sufficient time to transform your proposal write-up into a final project research paper. Please plan from **Nov. 1 - Dec. 14.**
7. References
   This is a list of citations of related work for your proposal.

Presentation Guideline

Each team will be given 5 min to present their project in the class and an additional 1-2 min for Q/A.
The order of presentation will be decided by a random number generator.

The presentation should include the following slides:

1. Title Slides
   include title, author, and date
2. Introduction/Motivation
   Why is this an important problem that needs our attention?
3. Methods/Proposed Design
   For OPT project, present the configuration parameters used. For freestyle project, present the main evaluation target.
   You should use figure to explain your idea.
4. Evaluation Methods
   Where did you implement the design? What benchmark are you using?
   Please also present the challenges in the implementation. Where you get stuck?
5. Preliminary Results
   1-2 plots showing the main takeaway message. (You have space in the final report for more figures that you want to show.)

Like in the paper presentation, if your presentation exceeds 5 minutes, you will get penalized.
There should not be more than 50 words on each slide. Please use bullets instead of paragraphs.

Report Guideline

The submission should be in IEEE conference format.
https://www.ieee.org/conferences/publishing/templates.html
If you work on a Design, OPT, or Freestyle project: For a group of 2, the report should be no more than **6 pages** (excluding reference) If you work on your own, the report should be no more than **4 pages** (excluding reference) in IEEE conference format.
If you select an SoK project: For a group of 2, the report should be no more than **12 pages** (excluding reference) If you work on your own, the report should be no more than **8 pages** (excluding reference) in IEEE conference format.

The proposal should contain the following:

1. Abstract (<200 words)
   This summarizes what you are proposing along with expected artifacts and/or outcomes
2. Introduction
   This motivates and frames your project. Why is it important to do your project from a technical research perspective?
3. Related Work
   This presents research work that has been done and is related to yours.
4. Proposed Method
   This is where the "meat" of your proposal will be. Articulate what you are proposing in sufficient detail so that it can be followed and reproduced. I would expect at least one figure in this section
   You also want to state the design in the baseline architecture.
   If you select an SoK project, please provide a list of references that you plan to read and compare.
5. Evaluation Method
   How do you plan to evaluate your design? What are the evaluation metrics? What benchmark programs you will be using?
6. Evaluation Results
   Show your evaluation results, and discuss whether it matches your expectations.

*Negative results (i.e., results that do not achieve your expectations) are very welcomed. But you should discuss them.

7. Timeline
   Compared with the timeline in your proposal, what is the real timeline for you to conduct your project? Explain why some tasks take longer and some tasks move faster.
8. Contributions of individual (for group project)
9. References
   This is a list of citations of related work for your proposal.