Course Project Guidelines

CSC415: Introduction to Reinforcement Learning

Contents

1 Overview and Requirements

The final project requires implementing, evaluating, and documenting a novel research study related to one of the main topics of the course. The goal is to demonstrate **novelty**, **significant depth**, and **rigorous experimentation**.

1.1 Novelty Requirements

Your project must satisfy at least **ONE** of the following criteria:

- **Answer an Open-Ended Question:** Address a question that is unanswered or partially answered in the existing literature (e.g., exploring a new method or one left for future work by a prior paper).
- **Design a Method:** Propose non-trivial modifications at the component or algorithm level with proper justifications. The modifications need not always lead to performance improvements, but you must provide a deep analysis of success or failure modes.
- **Novel Application:** Apply an existing method to an underexplored application domain where the adaptation is non-trivial.

Novelty does NOT require:

- Building a new method that meets the standard of top-tier machine learning conferences.
- Achieving state-of-the-art performance.

1.2 Topic Selection

A list of research topics will be provided (refer to the topics from Assignment 1). For your final project, you must:

1. Select a topic from this provided list, OR
2. Have a custom topic explicitly approved by the instructor.

Note: It is strictly advisable to **build upon previous baselines established in Assignment 1**. Using these established baselines allows for direct comparison and ensures a fair evaluation.

2 Timeline and Grading

The final project accounts for a significant portion of your course grade.

Component	Due Date	Weight
Project Proposal	Feb 24	5%
Final Presentation	April 2	10%
Final Report	Mar 24	25%

2.1 Project Groups

Projects may be completed individually or in teams of up to **3 people**. We encourage group work, with the expectation that the overall contribution is commensurate with the group size.

2.2 Honor Code & AI Policy

You are allowed to collaborate with AI tools (e.g., GitHub Co-Pilot, ChatGPT) for boilerplate code or debugging. However, for essential components (e.g., implementing RL algorithms like PPO), you should write the code independently. You must clearly document which parts of your work were assisted by AI tools. Additionally, **all deliverables (Proposal, Presentation slides, Final Report) must include an AI Declaration Appendix** detailing the specific tools used and their purpose. Refer to the course syllabus for the AI policy.

3 Project Proposal

The Project Proposal is the first milestone. Its purpose is to define your research direction, demonstrate that you have surveyed the existing literature extensively, and outline a feasible technical plan.

3.1 Format Requirements

- **Length:** 2-3 pages (excluding references).
- **Submission:** Single PDF per group.
- **Content:** Must include the four sections outlined below.

3.2 Proposal Content

1. **Introduction and Objectives:**
    - Clearly define the problem statement and its significance.
    - State specific objectives (e.g., "Improve sample efficiency in sparse reward environments").
    - Define the scope and specific environments (e.g., Atari, MuJoCo).
2. **Extensive Related Works:**
    - **Survey:** Conduct a broad literature survey. You must go **significantly beyond** the 3 papers assigned in Assignment 1.
    - **Synthesis:** Do not just list papers. Group them by approach and explicitly identify the gap your project addresses.
3. **Technical Outline:**
    - **Method:** Describe your proposed algorithm or modification.
    - **Baselines:** List specific algorithms for comparison (Assignment 1 baselines recommended).
    - **Experiments:** Briefly describe your validation plan.
4. **Team Contribution:**
    - Assign specific roles (e.g., Literature Review, Coding, Experiments) to team members.
    - Provide a rough timeline.

(See Appendix A for the Proposal Grading Rubric)

4 Final Presentation

Groups will give a formal oral presentation of their work during the final week of the course.

4.1 Format

- **Duration:** 10 minutes presentation + 5 minutes Q&A.
- **Expectation:** All group members must participate.

4.2 Content

Your presentation should cover:

1. **Motivation:** What is the problem and why is it important?
2. **Method:** High-level overview of your approach/algorithm.
3. **Results:** Key findings from your experiments (plots, tables).
4. **Analysis:** Why did it work/fail? What did you learn?

(See Appendix B for the Presentation Grading Rubric)

5 Final Report

The final report requires you to document your entire research process.

5.1 Format Requirements (ICLR Style)

Your final report must be formatted using the **ICLR (International Conference on Learning Representations)** LaTeX template.

- **Template Link:** https://github.com/ICLR/Master-Template (or search "ICLR Conference Template" on Overleaf).
- **Strict Page Limit:** **9 pages** for the main text, including all figures and tables. References and Appendices do not count toward this limit.
- **Penalty:** Submissions exceeding the 9-page main text limit will be **penalized 10% per extra page**.
- **Formatting:** Do not deviate from the template (margins, font size) to gain space. Such modifications can result in a penalty.

5.2 Report Content (ICLR Structure)

Your paper must include the following sections:

- **Abstract:** Concise summary of the problem, method, and key results.
- **Introduction:** Clear statement of the problem, motivation, and contributions.
- **Related Work:** Incorporate the comprehensive survey from your proposal.
- **Methodology:** Precise mathematical formulation of your approach.
- **Experiments:** The core of the project.

  - **Baselines:** Comparison against strong, standard baselines.
  - **Ablation Studies:** You **must** isolate specific components to analyze their impact.
  - **Rigour:** Use multiple random seeds (3-5) and include error bars.
- **Discussion:** Critical analysis of results, limitations, and failure modes.
- **Conclusion:** Summary and future work.
- **Team Contributions:** A detailed section breaking down individual contributions.

(See Appendix C for the Final Report Grading Rubric)

5.3 The Code

Submit your code as a Github repository link or a zipped folder.

- Include a `README.md` with reproduction instructions.
- Ensure all dependencies are listed in `requirements.txt`.

Appendix A: Project Proposal Grading Rubric (5%)

Component	Needs Improvement (<60%)	Proficient (60-80%)	Excellent (80-100%)	Score
1. Introduction & Objectives (20 pts)	Problem statement is vague or trivial. Objectives are unrealistic. No mention of environment.	Problem is defined. Objectives are clear but standard. Scope is reasonable.	Problem is well-motivated and clearly articulated. Objectives are ambitious yet feasible. Scope is perfectly defined.	
2. Extensive Related Works (35 pts)	Cites only the 3 papers from Assignment 1. Lists abstracts without synthesis. Fails to identify gap.	Cites 5+ relevant papers. Summarizes adequately. Identifies a general gap.	Comprehensive survey synthesizing the field. Clearly categorizes approaches and identifies a specific, meaningful gap.	
3. Technical Outline (30 pts)	Method is technically flawed or vague. No baselines mentioned.	Proposed method is sound. Standard baselines identified. Experimental plan is basic.	Method is detailed and technically novel. Strong baselines (building on Assign 1) identified. Rigorous experimental plan.	
4. Team Contribution (15 pts)	Roles undefined or unequal. No timeline.	Roles assigned generically. Timeline present but vague.	Clear, equitable division of labor. Detailed timeline with realistic milestones.	

Appendix B: Final Presentation Grading Rubric (10%)

Component	Needs Improvement (<60%)	Proficient (60-80%)	Excellent (80-100%)	Score
Content & Clarity (40 pts)	Problem unclear. Talk is disorganized or confusing. Slides are cluttered or unreadable.	Clear structure. Good flow. Slides are readable. Covers essential points adequately.	Compelling narrative. Professional visual aids. Complex technical concepts explained clearly and concisely.	
Technical Depth (30 pts)	Surface-level description only. Failed to explain the "how" or "why" of the method.	Explains method and results well. Some analysis provided.	Demonstrates deep understanding. Insightful analysis of results and ablations.	
Q&A Handling (30 pts)	Unable to answer basic questions. Defensive or dismissive. Only one member answers everything.	Answers most questions correctly. Some hesitation. Most members participate.	Answers are precise and insightful. Demonstrates mastery of the topic. Balanced participation from all members.	

Appendix C: Final Report Grading Rubric (25%)

Component	Needs Improvement (<60%)	Proficient (60-80%)	Excellent (Publication Quality) (80-100%)	Score
		CONTENT & METHODOLOGY (40 Points)		
Motivation & Problem (10 pts)	Problem is undefined or trivial. No justification for why RL is the right tool. Introduction is confusing.	Problem is clearly stated. Motivation is valid but standard. Contextualizes the work adequately.	Compelling motivation identifying a clear gap in literature. Problem formulation is mathematically precise and engaging.	
Methodology & Novelty (15 pts)	Method is technically flawed or a trivial copy-paste. Math contains major errors.	Method is sound and correctly implemented. Novelty is minor (e.g., hyperparam tuning) but valid. Math is mostly correct.	Method demonstrates innovation (new architecture, loss, or application). Mathematical derivation is rigorous and error-free.	
Related Work (15 pts)	Only cites the 3 papers from Assign 1. Missing key references or SOTA baselines.	Incorporates survey from proposal. Cites relevant papers but acts as a list rather than a synthesis.	Comprehensive synthesis of the field beyond the initial list. Clearly distinguishes this work from prior art.	
		EXPERIMENTS & RESULTS (35 Points)		
Experimental Rigour (15 pts)	Tested on only 1 seed. No error bars. Baselines are missing or unfair (weak). Evaluation metric is inappropriate.	Tested on multiple seeds (3+). Includes standard baselines. Plots are readable but may lack detailed statistical analysis.	Robust evaluation (5+ seeds) with error bars/shading. Baselines are strong and fair. Statistical significance is discussed.	
Ablation Studies (10 pts)	No ablation studies performed. The "why" of the performance is unexplained.	Basic ablations included (e.g., changing learning rate). Some attempt to isolate the contribution of components.	Comprehensive ablations isolating specific components (e.g., "effect of replay buffer size"). Deep insight into causality.	
Analysis of Results (10 pts)	Descriptive only ("Agent A got score 10"). No insight into failure modes or unexpected behaviors.	Discusses results and general trends. Acknowledges limitations but analysis is surface-level.	Critical analysis of *why* the method worked/failed. Discusses sample efficiency, stability, and edge cases deeply.	
		PRESENTATION & REPRODUCIBILITY (25 Points)		
Abstract & Conclusion (5 pts)	Abstract is vague or too long. Conclusion just restates abstract.	Abstract summarizes key points. Conclusion summarizes findings.	Abstract is punchy and precise. Conclusion synthesizes findings and proposes insightful future work.	
Writing & Structure (10 pts)	Does not follow ICLR template. Typos, poor grammar, or incoherent structure. Exceeds page limit.	Follows ICLR format. Writing is clear and structured. Minor typos or formatting issues.	Publication-quality writing. Professional figures (vector graphics). Excellent flow and narrative structure.	

Component	Needs Improvement (<60%)	Proficient (60-80%)	Excellent (Publication Quality) (80-100%)	Score
Code & Reproducibility (10 pts)	Code does not run. Missing dependencies or README. "Spaghetti code".	Code runs with some effort. README explains basic usage. Code is functional but messy.	Clean, modular, well-documented code. One-step reproduction script provided. README is comprehensive.	