Paper Writing Workshop

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Content

- Purpose of Paper Writing
- Types of Paper Writing
- Identifying Your Audience
- Defining Your Problem Statement
- Anatomy of a Research Paper
- Other Important Pieces of a Research Paper
Why do we write papers?

- Reporting experiments
- Summarizing findings that contributes new knowledge to a body of knowledge
- Aggregating information about historical work done within a body of knowledge or specific subdomain
Paper Writing Tool

- Text Editor
  - MS Word
  - Latex
- Reference Tool
  - Mendeley
  - Zotero
- Spell Checker
Types of Paper Writing

- School Paper
  - Experiment Reports
- Conference/Workshop Paper
  - Surveys
  - Research Proposal
  - Research Report (Publishable Paper)
Paper Styles from Major Computing Conferences

Formatting Instructions For NeurIPS 2021

Abstract

This document provides a basic paper template and submission guidelines. Authors must include a single paragraph, ideally between 6 sentences, that summarizes the motivations and impact of their research. The abstract is not double-counted toward the total number of pages. The abstract should be centered on the page and formatted in 10-point font. The abstract should have a maximum of 200 words.

1. Electronic Submission

Submissions to NeurIPS 2021 will be electronically handled via the web at https://openreview.net. Detailed information about the submission process and FAQs are available on the conference website at https://neurips.org.

The guidelines below will be enforced for oral presentations and camera-ready copies. There is a brief summary:

• Submission may be 8 pages.
• Authors may include up to 3 additional pages in their camera-ready copy.
• If accepted, authors may include up to 6 additional supporting pages.
• Papers may not exceed 8 pages, and all supporting materials should be combined into a single PDF file.

ICML Format

Submission and Formatting Instructions for International Conference on Machine Learning (ICML 2020)

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ICLR Format

Formatting Instructions for ICLR 2021

Abstract

The abstract paragraph should be numbered (1-200 words) and placed centrally on the first page. Authors must provide their instructions in a single paragraph, ideally between 6 sentences, that summarizes the motivations and impact of their research. The abstract is not double-counted toward the total number of pages. The abstract should be centered on the page and formatted in 10-point font. The abstract should have a maximum of 200 words.

1. Submission of conference papers to ICLR 2021

Papers to be submitted to ICLR 2021 must be prepared according to the instructions presented here. Authors are required to use the ICLR 2021 submission website at https://openreview.net. Detailed information about the submission process and FAQs are available on the conference website at https://iclr.cc.

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1.0 Retrieval of styles files

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1.0.1 Submission of conference papers to ICLR 2021

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1.0.2 Retrieval of styles files

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The file iclr2021_conference.pdf contains these instructions and illustrates the various features. The file iclr2021_conference_small.pdf is a small-point version with all titles and section heads in 10-point typeface, and the file iclr2021_conference_for_reviewers.pdf contains the same text as iclr2021_conference.pdf. Both files are formatted to fit into the landscape mode (9.5 inches x 12 inches) and maintain a fixed 1-inch margin throughout the text. For double-column papers, this is not possible. The layout is intended to provide a good content-to-page ratio for conference proceedings which are not agreed in advance. For final publication, authors must submit their final version as described above. Other details regarding the submission of conference papers can be found in the ICLR 2021 submission guidelines at https://iclr.cc.

1.0.3 General formatting instructions

The text must be centered within a margin of 1 inch (3 cm) on both sides and 1.5-inch (4 cm) at the top and bottom. The title page must be formatted with a fixed 14-point Times New Roman in the portrait orientation. Paragraphs are separated by 1.67 lines spaces, with standard indentation of 32 characters. Footnotes are to be used sparingly, in small caps and left-aligned. All pages should start at 1 inch (2.5 cm) from the left margin of the page.
Expectation for IDL Project Paper

- Use the [NeurIPS paper format](#) for your reports
- Structure your paper in accordance with the anatomy described in subsequent slides
- Include links to your code repositories or notebooks
- Reference and Include license to datasets (if not proprietary to you)
Knowing your audience helps to know the level of details to include in your research paper.
Who is your Audience?

- People with similar background or within similar domain as the author’s
- People that can reproduce the work you have done, following your provided appropriate methodology
Problem Statement Definition

- Must have element of novelty (new work)
- Must be feasible. How would the problem be solved?
- Must be ethical (approved by a designated ethics board)
Anatomy of a Technical Paper

- Abstract
- Introduction
- Related Work (Literature review)
- Methodology
  - Dataset Description
- Experiment, Results, Discussion
- Conclusion
- References
Anatomy of a Research Paper

ABSTRACT

- The shortest section of a paper about 100 - 150 words
- Executive Summary of Paper
- States the research problem/question
- Researcher’s contribution and answer to the research question
- How the answer was tested
- The impact of the research work
- Contains keywords about the research
Abstract

In value-based reinforcement learning methods such as deep Q-learning, function approximation errors are known to lead to overestimated estimates of Q-values, which can negatively impact both the actor and the critic. Our algorithm builds on Double Q-learning by taking the maximum estimated value between a pair of critics to mitigate overestimation. We show the connection between large networks and overestimation bias, and suggest learning policy updates to reduce potential error and further improve performance. We evaluate our method on the suite of OpenAI gym tasks, outperforming the state of the art in every environment tested.

1. Introduction

In reinforcement learning problems with discrete action spaces, the issue of value estimation as a result of function approximation is well-known. However, similar issues with actor-critic methods in continuous domains have been largely left unaddressed. In this paper, we show overestimation bias and the accumulation of error in temporal difference methods are present in an actor-critic setting. Our proposed method addresses these issues, and greatly improves the current state of the art.

Overestimation bias is a property of Q-learning in which the maximization of a noisy value estimate leads to a conservative estimation (Stew and Schwartz, 1995). In a function approximation setting, this result is analytically given by the nature of temporal difference learning (Sutton, 1990), in which an estimate of the value function is updated using the estimate of a subsequent state. We focus on the actor-critic learning setting, which allows for the propagation of timing error, as it updates the target value estimate, which is shown to be causal.

Given the connection of noise in value estimation bias, this paper considers a number of approaches that address variance reduction. First, we show that target networks, a common approach in deep Q-learning methods, are critical for variance reduction by reducing the accumulation of errors. Second, we address the coupling of value and policy by introducing policy updates that rely on value estimates. Finally, we introduce a novel regularization strategy, where a MADDPG-style actor learns to achieve similar action estimates to further reduce variance.

Our contributions are aligned to the state of the art actor-critic method for continuous control, Deep Deterministic Policy Gradient (DDPG) (Lillicrap et al., 2015), in form of Twin Delayed Deep Deterministic policy gradient (TD3) (Fujimoto et al., 2018).
Anatomy of a Research Paper - The Abstract

Playing Atari with Deep Reinforcement Learning

Volodymyr Mnih  Koray Kavukcuoglu  David Silver  Alex Graves  Ioannis Antonoglou
Duan Wierstra  Martin Riedmiller
DeepMind Technologies
{vlad, koray, david, alex.graves, ioannis, daan, martin.riedmiller} @ deepmind.com

Abstract

We present the first deep learning model to successfully learn control policies directly from high-dimensional sensory input using reinforcement learning. The model is a convolutional neural network, trained with a variant of Q-learning, whose input is raw pixels and whose output is a value function estimating future rewards. We apply our method to seven Atari 2600 games from the Arcade Learning Environment, with no adjustment of the architecture or learning algorithm. We find that it outperforms all previous approaches on six of the games and surpasses a human expert on three of them.

1 - Researcher’s contribution to answering research question
2 - How the research was tested
3 - Impact of the research work

Anatomy of a Research Paper

INTRODUCTION

- Extended form of the abstract.
- Gives background and sets tone for the research work
- Starts from broad issues to very specific area of research
- Goal: Provides context to research question
Writing a Great Introduction

- Summarize current understanding of research about the subject topic till date
- State the purpose of your research problem
- Highlight set of questions that would be answered by your research
- Briefly explain the methodology & what the study might reveal
- Summarize the structure of the remainder of the paper
Anatomy of a Research Paper

RELATED WORK

- This covers historical work done on the related research problems and/or related techniques.
- Categorize previous works into themes
- Summarize themes in a coherent format
Components of Literature Review

- Overview of the subject matter under consideration
- Categorize sources (related works) into different themes.
- Discuss the distinctiveness of each source and its similarities with other sources.
Anatomy of a Research Paper

METHODOLOGY

- Highly technical and contains technical jargon about the subject matter
- Covers overview of experiments to be done to answer the research question
- Reproducible to get documented results.
- Does not have to be named Methodology - dive straight to its components
Components of Methodology - Model Description

- Model Description
  - Describe clearly the model architecture
  - Cover the key areas about objective of the modelling approach
    - Minimizing a Loss function
    - Maximizing a Reward Function
  - Use mathematical expressions to describe the model as needed
Components of Methodology - Dataset Description

- What dataset would be used
  - Type: Speech, Image, Video, 3D point clouds, and so on
  - Data Mode: Single Mode, Multimodal
- How was the dataset collected?
- Are there preprocessing done - either by you or from the data source
- How do you intend to use the data
- State overall statistics of the dataset e.g. length of dataset, training to validation proportion, etc
Components of Methodology - Baseline & Evaluation Metrics

- What baseline are you selecting?
  - Is this a state-of-the-art, competitive existing baseline
  - Are you implementing a baseline from scratch? Why?

- What evaluation metrics would you be using?
  - Clearly define the metrics to be used
  - Demonstrate understanding of how the metrics work
    - Give mathematical formulae if applicable
Anatomy of a Research Paper

EXPERIMENTS, RESULTS & DISCUSSION

- Experiments section should contain details about hyperparameters, how the dataset was used and how evaluation was performed.
- Standard to report metrics in comparison with other work
  - Make sure to report under similar settings. If necessary/possible, run multiple times and report standard deviations.

![Table of results](https://arxiv.org/pdf/2103.14030v2.pdf)
Anatomy of a Research Paper

EXPERIMENTS, RESULTS & DISCUSSION

(Ablations)

- Ablations are *extremely* important.
- How much did each *proposed component* contribute to the final performance?

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Anatomy of a Research Paper

EXPERIMENTS, RESULTS & DISCUSSION

(Ablations)

- Ablations are extremely important.
- How much did each proposed component contribute to the final performance?
- Be careful! Consider relationships between components as well. Sometimes each one can lower performance but together boost performance.

Anatomy of a Research Paper

EXPERIMENTS, RESULTS & DISCUSSION

(Discussion)

- Discussion does not need to be its own section. However, it should outline the overall takeaways from your work.
- Often, these takeaways are fused in with the results & ablations.
Anatomy of a Research Paper

CONCLUSION

- Summary of work done.
- Reiterates the research question and findings from the research work that answers the research question.
- Highlights what possible shortcomings of current work if any, areas for improvement, next steps/future work, possible extensions.
Anatomy of a Research Paper

REFERENCES

“In reference works, as in sin, omission is as bad as willful behaviour”

- Elizabeth McCracken
Referencing Styles

Different Referencing styles depending on the type of paper you are writing and the conference/workshop.

- IEEE Reference style - Most common for engineering papers
  - Conference Paper, Books, Journals are referenced slightly differently
  - Comprehensive guide - [https://owl.purdue.edu/owl/research_and_citation/ieee_style/reference_list.html](https://owl.purdue.edu/owl/research_and_citation/ieee_style/reference_list.html)
- APA - common for social sciences and Humanities disciplines
- MLA - common for English & Media Studies paper
- MHRA
- Harvard
What other things are important?

- Reproducibility
- A good story/narrative
- General points
- “Troubling Trends in Machine Learning Scholarship”
Reproducibility

- When writing your paper, ask yourself: “can someone reproduce my results from reading this paper?”
- If the answer is no, you need to release code or add extra details in the paper or the supplementary.
- If your paper isn’t reproducible, 1) you’ll get emails, 2) the paper won’t be cited, 3) or the next paper will cite and say “we could not reproduce the results of this paper”
Reproducibility

- Whenever possible, include error bars/standard deviations.
- Extremely important in RL, where performance is usually unstable, but even on classification/object detection/language modeling/etc, if there is instability, should report average of multiple runs.
A good story/narrative

- Is there a point existing works have overlooked that you consider?
- Does previous work fail in certain cases (low-resource, certain classes) that your method is better suited for?
- Can you relate your work to some core intuitive notion that will give readers an “aha!” moment?
General points

- A research paper is an argument in support of your work, not just a list of observations.
- The reader should be convinced that your method is better than existing work.
General points

- Try not to make up your own technical terms or make things seem unnecessarily complicated.
- Although it might seem cool, it can confuse readers or annoy ones who are not awed.
- Bad example: “We extract complementary semantics via feature entanglement over space and time.”
- Better example: “Given RGB video, we run a first CNN over the temporal dimension, run a second CNN over the spatial dimensions, and then combine their results.”
“Troubling Trends in Machine Learning Scholarship”

- This is a paper from 2018 that has been trending recently.
- It details some common (bad) trends in ML papers that impede understanding/add noise to research.

“Troubling Trends in Machine Learning Scholarship”

“Explanation vs Speculation”

- Papers should explicitly make clear what is formal reasoning and informal speculation.
- For instance, internal-covariate shift is not clearly stated and has been repeated as fact when it could be false.
- Other papers, as positive examples, have quarantined a "motivation" section for informal intuitions.

“Troubling Trends in Machine Learning Scholarship”

“Failure to Identify the Sources of Empirical Gains”

- Ablations are very important.
- Some papers do not clarify the sources of gains in performance, and other papers have found that actually, hyper-parameter tuning was a more important factor.

“Troubling Trends in Machine Learning Scholarship”

Misuse of Language: Suggestive Definitions

- Some works define equations in a manner that imbues them with human-level priors such as "curiosity" or "fear." Others overstate/incorrectly claim "human-level" performance.
- This is confusing and dangerous for the field.
- What the agent learns is not necessarily the human notion of curiosity - using anthropogenic terms gives laymen unrealistic expectations about AI.

References