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Abstract

Please create a copy of this template for your write-up. Follow the format instructions in Section 6 to write your report. A typical machine learning paper is 8 pages (not including references). You can find more resources on the How to ML Papers.

Hints on writing:

- Each paragraph should convey one main message, typically in the beginning sentence of the paragraph (topical sentence).

- Use simple sentences with fewer compounds or clauses. The simpler, the better. Avoid passive tense and use active tense.

- Use PDF for your figures to ensure the resolution of your images.

- The captions of Figures and Tables should contain sufficient details to be self-explanatory (readers can understand the figure without referring to the text).

Please read the instructions below carefully and follow them faithfully. You can keep the section headers but delete the instructional texts.

1 Introduction

Introduce the problem that you are trying to solve and write 1-2 paragraphs for each of the sub-sections. Provide a high-level summary in this section instead of detailed descriptions.

Problem Definition. Describe what is the problem you want to solve in concise language. You may use figures to help your explanation.

Problem Significance. Explain why is your problem relevant to generative AI. How is your project useful to deep learning and our society if you can solve it.

Technical Challenge. Why is this project that you are proposing difficult? Think about challenges from (1) data gathering (2) model design (3) implementation (4) engineering (5) evaluation.

State-of-the-Art. Find and cite (use BibTex) state-of-the-art works or papers that have tried to solve a similar problem (use Google Scholar to search). Point out the limitations of the state-of-the-art.

Contributions. Summarize your contributions to this problem with bullet points.

- Contribution 1: solve a novel problem

- Contribution 2: improve the generative AI performance

- · · ·

2 Related Work

Provide a detailed discussion of the state-of-the-art using the references that you have found. The description can overlap with the state-of-the-art sub-section in the Introduction but should contain more technical details. Pick 2 or 3 topics that are adjacent to your problem. For example, if you are trying build a better deep generative model for speech synthesis, then the related topics can include (1) deep generative models and (2) speech synthesis.

Related Topic 1 [Replace with the topic keywords]. Write a few sentences summarizing the key ideas of each of the related works from State-of-the-Art in the previous section. Highlight the technical differences between the related work and your proposed method.

Related Topic 2 [Replace with the topic keywords].

3 Methodology

Problem Setting. Formally introduces the problem setting and notation (Formalism) for your method. Highlights any specific assumptions that are made that are unusual. You are encouraged to use figures or equations to better explain the input and output.

Idea Summary. Summarize your idea to solve the problem. How is it different from the state-of-the-art method? Is there any risk associated with your idea? Provide alternative solutions if your idea does not work out.

Description. Explain in the mathematical language of your methodology. Use the (probabilistic) notations introduced in the problem definition, and explain what distributions your generative AI model is learning (Hint: a distribution over high-dimensional data). Which generative model do you plan to use to learn this distribution? Draw an overview figure to illustrate the details of your idea.

Implementation. Provide technical details for your implementation. What deep learning framework did you use (Keras, Tensorflow or Pytorch)? Did you implement your model based on an existing codebase? If yes, pls include the reference and highlight your contribution to the codebase. What model architectures have you tried? What engineering tricks (e.g. BatchNorm, Drop-Out, Early Stopping) did you implement? How did you tune the hyper-parameters?

4 Experiments

Datasets and Tools. List the datasets or tools you used for this project. Only describe the datasets that you have used in the experiments. Provide details in numbers about the size, and dimension of the datasets. Provide links to these resources if available.

Baselines. List the baseline methods that you plan to include for comparison. Explain your rationale for choosing these baselines. They can be publicly available solutions from existing papers or even open-source projects on Github. Provide references for these baselines.

- Baseline 1 [reference]: 1-2 sentences summary of the baseline.
- Baseline 2 [reference]:1-2 sentences summary of the baseline.
- . . .

Evaluation Metrics. What are the evaluation metrics that will be used to quantify the performance? Can you think of quantitative metrics to compare your method with the baselines?

Quantitative Results. Report quantitative results that you have achieved with the baselines. Report quantitative results of your final implementation of the proposed idea. Highlight the method that has the best performance compared to baselines in boldface.

You are encouraged to use figures or tables to better organize your results. If you don't have any baselines to compare with, you can also include the simplest solution you can think of to start

with. Examples of quantitative results can include sample quality scores, model likelihood, run-time comparison, downstream supervised-learning prediction performance, etc. Remember to include standard deviation over multiple random runs.

Qualitative Results.   Report qualitative results that you have achieved with the baselines. Report qualitative results of your final implementation of the proposed idea. Explain the qualitative differences between your method and the baselines. You are encouraged to use figures or tables to better organize your results. If you don't have any baselines to compare with, you can also include the simplest solution you can think of to start with.. Example qualitative results can include visualization of the generated samples, an interactive demo page, visualization of the learned model, etc.

5   Conclusion and Discussion

Provide a few sentences to summarize your project.

Achievements.   What problem did you solve? What is the significance of your contribution? Did you contribute to dataset curation, algorithm improvement or model development? Summarize your achievement in quantitative terms. We value the effort that you have devoted to this project.

Lessons Learned.   What did you learn from this project? If given more time, what aspects and how would you improve your project development? Brainstorm in different aspects including selecting problems, literature survey, team formulation and technical implementation. What advice would you give to future students who will work on this course project?

6   General formatting instructions

The text must be confined within a rectangle 5.5 inches (33 picas) wide and 9 inches (54 picas) long. The left margin is 1.5 inch (9 picas). Use 10 point type with a vertical spacing (leading) of 11 points. Times New Roman is the preferred typeface throughout, and will be selected for you by default. Paragraphs are separated by ½ line space (5.5 points), with no indentation.

The paper title should be 17 point, initial caps/lower case, bold, centered between two horizontal rules. The top rule should be 4 points thick and the bottom rule should be 1 point thick. Allow ¼ inch space above and below the title to rules. All pages should start at 1 inch (6 picas) from the top of the page.

For the final version, authors' names are set in boldface, and each name is centered above the corresponding address. The lead author's name is to be listed first (left-most), and the co-authors' names (if different address) are set to follow. If there is only one co-author, list both author and co-author side by side.

Please pay special attention to the instructions in Section 8 regarding figures, tables, acknowledgments, and references.

7   Headings: first level

All headings should be lower case (except for first word and proper nouns), flush left, and bold.

First-level headings should be in 12-point type.

7.1   Headings: second level

Second-level headings should be in 10-point type.

7.1.1   Headings: third level

Third-level headings should be in 10-point type.

Paragraphs   There is also a \paragraph command available, which sets the heading in bold, flush left, and inline with the text, with the heading followed by 1 em of space.

8   Citations, figures, tables, references

These instructions apply to everyone.

8.1   Citations within the text

The natbib package will be loaded for you by default. Citations may be author/year or numeric, as long as you maintain internal consistency. As to the format of the references themselves, any style is acceptable as long as it is used consistently.

The documentation for natbib may be found at

> http://mirrors.ctan.org/macros/latex/contrib/natbib/natnotes.pdf

Of note is the command \citet, which produces citations appropriate for use in inline text. For example,

    \citet{hasselmo} investigated\dots

produces

> Hasselmo, et al. (1995) investigated. . .

If you wish to load the natbib package with options, you may add the following before loading the neurips_2022 package:
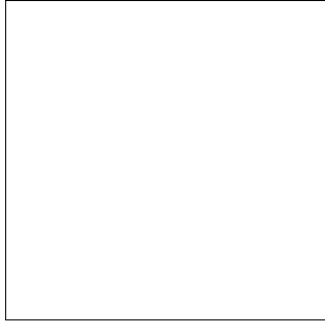
Figure 1: Sample figure caption.

```
\PassOptionsToPackage{options}{natbib}
```

If `natbib` clashes with another package you load, you can add the optional argument `nonatbib` when loading the style file:

```
\usepackage[nonatbib]{neurips_2022}
```

As submission is double blind, refer to your own published work in the third person. That is, use "In the previous work of Jones et al. [4]," not "In our previous work [4]." If you cite your other papers that are not widely available (e.g., a journal paper under review), use anonymous author names in the citation, e.g., an author of the form "A. Anonymous."

8.2 Footnotes

Footnotes should be used sparingly. If you do require a footnote, indicate footnotes with a number[1] in the text. Place the footnotes at the bottom of the page on which they appear. Precede the footnote with a horizontal rule of 2 inches (12 picas).

Note that footnotes are properly typeset *after* punctuation marks.[2]

8.3 Figures

All artwork must be neat, clean, and legible. Lines should be dark enough for purposes of reproduction. The figure number and caption always appear after the figure. Place one line space before the figure caption and one line space after the figure. The figure caption should be lower case (except for first word and proper nouns); figures are numbered consecutively.

You may use color figures. However, it is best for the figure captions and the paper body to be legible if the paper is printed in either black/white or in color.

8.4 Tables

All tables must be centered, neat, clean and legible. The table number and title always appear before the table. See Table 1.

Place one line space before the table title, one line space after the table title, and one line space after the table. The table title must be lower case (except for first word and proper nouns); tables are numbered consecutively.

Note that publication-quality tables *do not contain vertical rules.* We strongly suggest the use of the `booktabs` package, which allows for typesetting high-quality, professional tables:

<div align="center">

`https://www.ctan.org/pkg/booktabs`

</div>

This package was used to typeset Table 1.

---

[1]Sample of the first footnote.
[2]As in this example.

Table 1: Sample table title

	Part		
Name	Description	Size (μm)	
Dendrite	Input terminal	$\sim$100	
Axon	Output terminal	$\sim$10	
Soma	Cell body	up to 10^6	

9 Final instructions

Do not change any aspects of the formatting parameters in the style files. In particular, do not modify the width or length of the rectangle the text should fit into, and do not change font sizes (except perhaps in the **References** section; see below). Please note that pages should be numbered.

10 Preparing PDF files

Please prepare submission files with paper size "US Letter," and not, for example, "A4."

Fonts were the main cause of problems in the past years. Your PDF file must only contain Type 1 or Embedded TrueType fonts. Here are a few instructions to achieve this.

- You should directly generate PDF files using `pdflatex`.
- You can check which fonts a PDF files uses. In Acrobat Reader, select the menu Files>Document Properties>Fonts and select Show All Fonts. You can also use the program `pdffonts` which comes with `xpdf` and is available out-of-the-box on most Linux machines.
- The IEEE has recommendations for generating PDF files whose fonts are also acceptable for NeurIPS. Please see `http://www.emfield.org/icuwb2010/downloads/IEEE-PDF-SpecV32.pdf`
- `xfig` "patterned" shapes are implemented with bitmap fonts. Use "solid" shapes instead.
- The `\bbold` package almost always uses bitmap fonts. You should use the equivalent AMS Fonts:

  ```
  \usepackage{amsfonts}
  ```

  followed by, e.g., \mathbb{R}, \mathbb{N}, or \mathbb{C} for $\mathbb{R}$, $\mathbb{N}$ or $\mathbb{C}$. You can also use the following workaround for reals, natural and complex:

  ```
  \newcommand{\RR}{I\!\!R} %real numbers
  \newcommand{\Nat}{I\!\!N} %natural numbers
  \newcommand{\CC}{I\!\!\!\!C} %complex numbers
  ```

  Note that `amsfonts` is automatically loaded by the `amssymb` package.

If your file contains type 3 fonts or non embedded TrueType fonts, we will ask you to fix it.

10.1 Margins in LaTeX

Most of the margin problems come from figures positioned by hand using `\special` or other commands. We suggest using the command `\includegraphics` from the `graphicx` package. Always specify the figure width as a multiple of the line width as in the example below:

```
\usepackage[pdftex]{graphicx} ...
\includegraphics[width=0.8\linewidth]{myfile.pdf}
```

See Section 4.4 in the graphics bundle documentation (`http://mirrors.ctan.org/macros/latex/required/graphics/grfguide.pdf`)

A number of width problems arise when LaTeX cannot properly hyphenate a line. Please give LaTeX hyphenation hints using the `\-` command when necessary.

Acknowledgments and Disclosure of Funding

Use unnumbered first level headings for the acknowledgments. All acknowledgments go at the end of the paper before the list of references. Moreover, you are required to declare funding (financial activities supporting the submitted work) and competing interests (related financial activities outside the submitted work). More information about this disclosure can be found at: `https://neurips.cc/Conferences/2022/PaperInformation/FundingDisclosure`.

Do **not** include this section in the anonymized submission, only in the final paper. You can use the `ack` environment provided in the style file to autmoatically hide this section in the anonymized submission.

References

References follow the acknowledgments. Use unnumbered first-level heading for the references. Any choice of citation style is acceptable as long as you are consistent. It is permissible to reduce the font size to `small` (9 point) when listing the references. Note that the Reference section does not count towards the page limit.

[1] Alexander, J.A. & Mozer, M.C. (1995) Template-based algorithms for connectionist rule extraction. In G. Tesauro, D.S. Touretzky and T.K. Leen (eds.), *Advances in Neural Information Processing Systems 7*, pp. 609–616. Cambridge, MA: MIT Press.

[2] Bower, J.M. & Beeman, D. (1995) *The Book of GENESIS: Exploring Realistic Neural Models with the GEneral NEural SImulation System.* New York: TELOS/Springer–Verlag.

[3] Hasselmo, M.E., Schnell, E. & Barkai, E. (1995) Dynamics of learning and recall at excitatory recurrent synapses and cholinergic modulation in rat hippocampal region CA3. *Journal of Neuroscience* **15**(7):5249-5262.

Checklist

The checklist follows the references. Please read the checklist guidelines carefully for information on how to answer these questions. For each question, change the default [TODO] to [Yes] , [No] , or [NA] . You are strongly encouraged to include a **justification to your answer**, either by referencing the appropriate section of your paper or providing a brief inline description. For example:

- Did you include the license to the code and datasets? [Yes] See Section 6.
- Did you include the license to the code and datasets? [No] The code and the data are proprietary.
- Did you include the license to the code and datasets? [NA]

Please do not modify the questions and only use the provided macros for your answers. Note that the Checklist section does not count towards the page limit. In your paper, please delete this instructions block and only keep the Checklist section heading above along with the questions/answers below.

1. For all authors...
   (a) Do the main claims made in the abstract and introduction accurately reflect the paper's contributions and scope? [TODO]
   (b) Did you describe the limitations of your work? [TODO]
   (c) Did you discuss any potential negative societal impacts of your work? [TODO]
   (d) Have you read the ethics review guidelines and ensured that your paper conforms to them? [TODO]

2. If you are including theoretical results...
   (a) Did you state the full set of assumptions of all theoretical results? [TODO]
   (b) Did you include complete proofs of all theoretical results? [TODO]

3. If you ran experiments...

(a) Did you include the code, data, and instructions needed to reproduce the main experimental results (either in the supplemental material or as a URL)? **[TODO]**

(b) Did you specify all the training details (e.g., data splits, hyperparameters, how they were chosen)? **[TODO]**

(c) Did you report error bars (e.g., with respect to the random seed after running experiments multiple times)? **[TODO]**

(d) Did you include the total amount of compute and the type of resources used (e.g., type of GPUs, internal cluster, or cloud provider)? **[TODO]**

4. If you are using existing assets (e.g., code, data, models) or curating/releasing new assets...

(a) If your work uses existing assets, did you cite the creators? **[TODO]**

(b) Did you mention the license of the assets? **[TODO]**

(c) Did you include any new assets either in the supplemental material or as a URL? **[TODO]**

(d) Did you discuss whether and how consent was obtained from people whose data you're using/curating? **[TODO]**

(e) Did you discuss whether the data you are using/curating contains personally identifiable information or offensive content? **[TODO]**

5. If you used crowdsourcing or conducted research with human subjects...

(a) Did you include the full text of instructions given to participants and screenshots, if applicable? **[TODO]**

(b) Did you describe any potential participant risks, with links to Institutional Review Board (IRB) approvals, if applicable? **[TODO]**

(c) Did you include the estimated hourly wage paid to participants and the total amount spent on participant compensation? **[TODO]**

A   Appendix

Optionally include extra information (complete proofs, additional experiments and plots) in the appendix. This section will often be part of the supplemental material.