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# Simulated Profiling Environment for Embodied Intelligence (SPEEN)

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Darroll Saddi   Ken Lin   Ryan Li   Matthew Fulde   Jon Lagasca

*University of California, Davis*

Computer Science   Computer Science and Engineering

{dwsaddi, kenlin, ryanli, mfulde, jlagasca}@ucdavis.edu

## Abstract

The Simulated Profiling Environment for Embodied Intelligence (SPEEN) is an open-source platform designed for the quantitative and qualitative evaluation of embodied Large Language Model (LLM) agents by allowing AI agents to perform tasks in a simulated environment. As LLMs are increasingly being integrated into robotics and other embodied systems, there is a growing need for standardized evaluation frameworks that can assess their performance in real-world scenarios. SPEEN attempts to address this need by providing a easily modifiable baseline benchmarking environment allowing researchers to evaluate LLM agents' capabilities in various tasks that map to real-world applications of embodied intelligence, including communication and interactions with a responsive environment. The framework features two complementary evaluation approaches. The first is a structured quantitative benchmarking system comprising diverse scenarios that measure agent capabilities in specific tasks ranging from taking simple actions to cooperative puzzle solving scenarios. The second was designed to be similar to an open-world sandbox environment, allowing for less restrictions on agent behavior and decision-making, and for qualitative assessment of agent decision-making and goal-oriented behavior over extended time periods.

## 1 Early Development

### 1.1 Background

This project was started from the Senior Design Project at UC Davis, where students work with clients in-industry to develop a project that meets their needs. We were particularly interested in working with *Justin Jia* affiliated with *Apple*, who was interested in designing some kind of sandbox environment specifically designed to help test AI programs, to whom we were successfully assigned. Exploratory research and early project discussions with our client led us to focus our work on Large Language Models (LLMs), which will be described in the following section.

### 1.2 Exploratory Research

We identified several problems with the current state of evaluating and testing of artificial intelligence via environmental design. We began with investigating similar projects within this space, and found that projects like NeuralMMO that attempted to provide an open-source environment for measuring the performance of reinforcement learning algorithms. NeuralMMO focused on creating a discretized game environment with large input complexity, requiring agents to learn how to navigate a 2D grid world with a variety of tasks and challenges, including resource management, exploration, as well as combat or even cooperation with other agents. However, as the project continued to be developed and despite the complexity of additional features or environmental constraints added to the environment,

a general conclusion was that highly performant algorithms like Proximal Policy Optimization (PPO), given sufficient compute, could learn to solve the tasks presented in the environment. This led us to focus our efforts away from reinforcement learning and towards LLMs, which are a more recent development in the field of artificial intelligence, and are notable for recent integration of LLM technology into robotics and other embodied systems. One large takeaway from [Joseph], the creator of NeuralMMO, was the following insight on designing benchmarking systems for AI: it is very easy to create an interesting looking simulator. It is very hard, under the constraints of making useful AI research [to create an environment meant for testing and training AI]. . . it is not just a game, it is an AI simulation. This heavily informed our future design processes.

To clarify, we define agentic AI as systems capable of making decisions and taking actions in the world, and to react to challenges and changes in the environment. We further separate our focus onto embodied AI, which is a subset of agentic AI that interacts with a physical world. We argue that this project is embodied AI.

Another fallback within the field of AI benchmarking and research is the lack of a standardized framework for evaluating the performance of LLMs in real-world scenarios. fact check this shit. While there exists several projects that claim to present effective prompting architectures, none of the large ones by NVIDIA, Altera, are open-source, and are applied to the environment of Minecraft which serves as an additional barrier to entry for enthusiasts and researchers.

We concluded that the suitable direction to take our project is in this: *Designing an open-source benchmarking environment specifically designed for evaluating the performance and behavior of embodied AI*. We particularly designed the environment for the testing of Large Language Models, and wanted to make the environment and setup easily modifiable, documented, adhering to best practices, to assist in the project longevity and usefulness.

### 1.3 Retrieval of style files

The style files for NeurIPS and other conference information are available on the website at

<https://neurips.cc>

The file `neurips_2025.pdf` contains these instructions and illustrates the various formatting requirements your NeurIPS paper must satisfy.

The only supported style file for NeurIPS 2025 is `neurips_2025.sty`, rewritten for L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>. **Previous style files for L<sup>A</sup>T<sub>E</sub>X 2.09, Microsoft Word, and RTF are no longer supported!**

The L<sup>A</sup>T<sub>E</sub>X style file contains three optional arguments: `final`, which creates a camera-ready copy, `preprint`, which creates a preprint for submission to, e.g., arXiv, and `nonatbib`, which will not load the `natbib` package for you in case of package clash.

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The formatting instructions contained in these style files are summarized in Sections 2, 3, and 4 below.

## 2 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  $\frac{1}{2}$  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  $\frac{1}{4}$  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 4 regarding figures, tables, acknowledgments, and references.

### 3 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.

#### 3.1 Headings: second level

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

##### 3.1.1 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.

### 4 Citations, figures, tables, references

These instructions apply to everyone.

#### 4.1 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_2025` package:

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



Figure 1: Sample figure caption.

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

```
\usepackage[nonatbib]{neurips_2025}
```

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” and include a copy of the anonymized paper in the supplementary material.

## 4.2 Footnotes

Footnotes should be used sparingly. If you do require a footnote, indicate footnotes with a number<sup>1</sup> 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.<sup>2</sup>

## 4.3 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.

## 4.4 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:

<https://www.ctan.org/pkg/booktabs>

This package was used to typeset Table 1.

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<sup>1</sup>Sample of the first footnote.

<sup>2</sup>As in this example.

Table 1: Sample table title

Part		
Name	Description	Size ( $\mu\text{m}$ )
Dendrite	Input terminal	$\sim 100$
Axon	Output terminal	$\sim 10$
Soma	Cell body	up to $10^6$

## 4.5 Math

Note that display math in bare TeX commands will not create correct line numbers for submission. Please use LaTeX (or AMSTeX) commands for unnumbered display math. (You really shouldn't be using \$\$ anyway; see <https://tex.stackexchange.com/questions/503/why-is-preferable-to> and <https://tex.stackexchange.com/questions/40492/what-are-the-differences-between-align-equation-and-displaymath> for more information.)

## 4.6 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.

## 5 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.
- `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}{\mathbb{R}} %real numbers
\newcommand{\Nat}{\mathbb{N}} %natural numbers
\newcommand{\CC}{\mathbb{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.

### 5.1 Margins in L<sup>A</sup>T<sub>E</sub>X

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 L<sup>A</sup>T<sub>E</sub>X 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/2025/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 automatically hide this section in the anonymized submission.

## References

References follow the acknowledgments in the camera-ready paper. 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.

## A Technical Appendices and Supplementary Material

Technical appendices with additional results, figures, graphs and proofs may be submitted with the paper submission before the full submission deadline (see above), or as a separate PDF in the ZIP file below before the supplementary material deadline. There is no page limit for the technical appendices.

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Please read the checklist guidelines carefully for information on how to answer these questions. For each question in the checklist:

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IMPORTANT, please:

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- **Keep the checklist subsection headings, questions/answers and guidelines below.**
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Question: Do the main claims made in the abstract and introduction accurately reflect the paper’s contributions and scope?

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Question: Does the paper discuss the limitations of the work performed by the authors?

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  - (c) If the contribution is a new model (e.g., a large language model), then there should either be a way to access this model for reproducing the results or a way to reproduce the model (e.g., with an open-source dataset or instructions for how to construct the dataset).
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Answer: **[TODO]**

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Question: For crowdsourcing experiments and research with human subjects, does the paper include the full text of instructions given to participants and screenshots, if applicable, as well as details about compensation (if any)?

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