
Formatting Instructions For NeurIPS 2023

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Affiliation

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Abstract

1 Chloe

2 The abstract paragraph should be indented 1/2 inch (3 picas) on both the left- and
3 right-hand margins. Use 10 point type, with a vertical spacing (leading) of 11 points.
4 The word **Abstract** must be centered, bold, and in point size 12. Two line spaces
5 precede the abstract. The abstract must be limited to one paragraph.

6 A short description of your goals, task, model, and (for the final report) results.
7 The abstract should make the motivations and the scope of your project clear so
8 that readers can decide whether they are interested in reading your work.

9 1 Introduction

10 Gabriel

11 A description of the motivation behind your work, why the task you chose is interesting/important,
12 and a summary of your (proposed) approach. The problem that you want to solve should be clearly
13 stated in the introduction: especially the input and output of your model and the format of the input
14 and output. This section should also make it clear why your deep learning approach is reasonable for
15 this problem.

16 2 Background and related work

17 Chloe

18 A summary of the background material that students of CSC413 would not already be familiar with.
19 A description of related work done in the area, and how your approach compares with theirs.

20 If your project builds on previous work, clearly distinguish what they did from what your new
21 contribution is. Also, include a 1-2 sentence summary of other closely related papers. We realize you
22 might not know about all related papers (or have time to carefully read all related papers), and that's
23 OK for this project. Using bibtex is annoying at first, but Google Scholar can give you the bibtex
24 entries.

25 3 Data

26 Taha

27 The dataset used in your model. Include any key exploratory figures that will help readers evaluate
28 the difficulty of your problem and interpret the performance of your model.

29 3.1 Datasets

30 For this project, we decided to use the following datasets:

31 Math Dataset

32 The MATH dataset consists of 12,500 (7,500 training and 5,000 test) problems from mathematics
33 competitions including the AMC 10, AMC 12, AIME, and more. Many of these problems can
34 be collected from aops.com/community/c3158_usa_contests. These competitions span decades and
35 assess the mathematical problem-solving ability of the best young mathematical talent in the United
36 States. [1]

37 NuminaMath-CoT

38 The Numina Math CoT dataset has approximately 860k math problems, where each solution is
39 formatted in a Chain of Thought (CoT) manner. The sources of the dataset range from Chinese high
40 school math exercises to US and international mathematics olympiad competition problems. [2]

41 NuminaMath-TIR

42 The Numina Math TIR dataset is a more specific version of the CoT dataset, where 70k problems
43 are selected, with a focus on numerical outputs and integers. Tool-integrated reasoning (TIR) plays
44 a crucial role in this dataset, where the solution to each problem is a sequence of steps that can be
45 executed by a computer program. [3]

46 3.2 Data Formatting

47 The data for the Math Dataset is formatted as a JSON file, with each problem containing the following
48 fields:

- 49 • problem: The text of the problem
- 50 • level: The difficulty level of the problem (Level 1 up to Level 5)
- 51 • type: The type of math problem (e.g. algebra, geometry, etc.)
- 52 • solution: The solution to the problem

53 The data for the Numina Math CoT and TIR datasets are formatted as a JSON file, with each problem
54 containing the following fields:

- 55 • An array of objects, where the first object contains
 - 56 – content: The text of the problem
 - 57 – role: the role assigned to the person who can access this data (user)
- 58 • The second object contains
 - 59 – content: The solution to the problem
 - 60 – role: the role assigned to the person who can access this data (assistant)

61 We intend to use these datasets to train our model to solve mathematical problems. We will preprocess
62 the data into one format, to ensure that can be used by our model. We will also split the test data into
63 validation and test sets to evaluate the performance of our model.

64 4 Model architecture

65 Everyone

66 A description of your (proposed) model architecture. Please propose an architecture during the
67 proposal phase, but it's okay to change your architecture. In the final report, this section should have
68 enough details to reproduce the work, including all hyperparameters and 3 training settings that you
69 used.

70 Selected model: PaLM2

71 Google PaLM2 = transformers + modifications: <https://arxiv.org/pdf/2204.02311>

72 Attempt to combine this with PaLM2:
 73 SympyGPT: Transformers for symbolic integration proofs: <https://arxiv.org/html/2410.02666v1>
 74 Better with word problems? Architecture: PaLM, GPT4: [http://research.google/blog/minerva-solving-](http://research.google/blog/minerva-solving-quantitative-reasoning-problems-with-language-models/)
 75 [quantitative-reasoning-problems-with-language-models/](http://research.google/blog/minerva-solving-quantitative-reasoning-problems-with-language-models/)
 76 We could also combine the two models (unlikely but look into it):
 77 Standard Transformers Architecture: <https://arxiv.org/abs/1706.03762>

78 5 Model architecture figure

79 Takia

80 A figure that helps show the overall model or idea. The idea is to make your paper more accessible,
 81 especially to readers who are starting by skimming your paper. You must create a new figure, not
 82 just use someone else's, even with attribution. Be careful that all figure text are legible, and are
 83 approximately the same size as the main text.

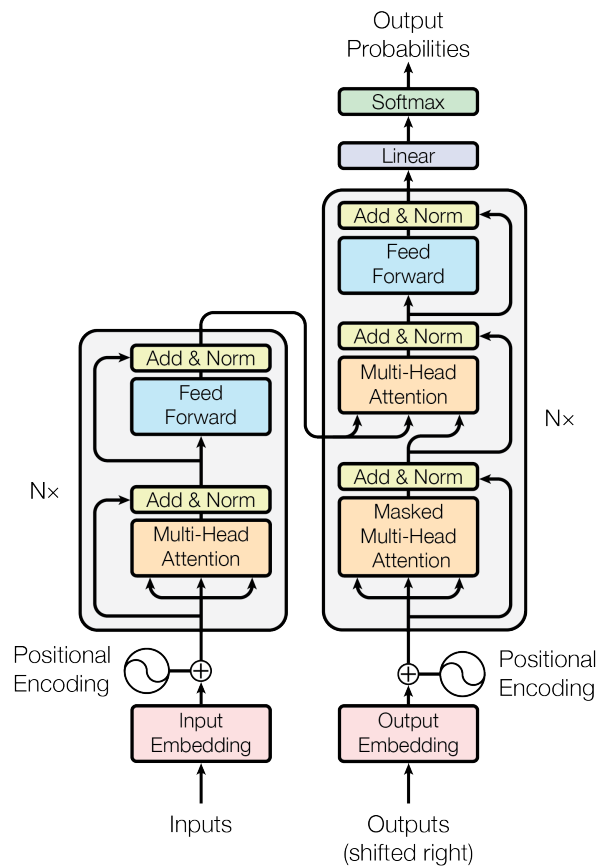


Figure 1: The Transformer - model architecture.

84 6 Ethical considerations

85 Taha

86 Potential ethical issues posed by the use or misuse of your model. Your report should transparently
 87 communicate the known or anticipated consequences of building and using machine learning models
 88 on this task.

89 <https://neurips.cc/public/EthicsGuidelines>

6.1 Ethical Issues

One ethical consideration is the potential for the model to be used to cheat on math assignments/homework. This could encourage students to use the model as a shortcut rather than engaging with the material themselves, which would negatively impact a student's capacity for critical thinking and problem-solving.

Another ethical issue is intellectual property rights, as the model is trained on copyrighted data. The model could inadvertently promote plagiarism if it directly provides solutions that students submit as their own, without understanding the learning process. This could lead to academic dishonesty and undermine the integrity of the educational system.

6.2 Mitigation Strategies

To mitigate the first risk, the model should be used as a learning tool rather than a tool for cheating. For example, the model could be used to generate practice problems for students to solve, or to provide explanations for the solutions to problems. This would help students learn and improve their math skills, rather than using the model to cheat. Therefore, while automation can support learning, it is essential that it complements, rather than replaces, active engagement with the educational process.

To mitigate the second risk, the model should be used in a controlled environment where students are guided on how to use the model appropriately. For example, teachers could provide guidelines on how to use the model to check answers or generate practice problems, rather than using it to directly provide solutions. Furthermore, it is crucial to emphasize the value of understanding the material and using tools as aids rather than shortcuts. This would prevent plagiarism and encourage students to engage with the material and develop their problem-solving skills.

7 Work division

A description of how the work will be divided between the team members, and how the team members will be working together (e.g. meet every week Tuesday 4-5 pm).

Chloe - Background and Related Work, Abstract, Model Architecture

Takia - Model Architecture Figure, Model Architecture

Gabriel - Introduction, Model Architecture

Taha - Data, Ethical Considerations, Model Architecture

The team will work on each part, and meet every weekend for additional discussions.

References

[1] Dan Hendrycks, Collin Burns, Saurav Kadavath, Akul Arora, Steven Basart, Eric Tang, Dawn Song, and Jacob Steinhardt. Measuring mathematical problem solving with the math dataset. *arXiv preprint arXiv:2103.03874*, 2021.

[2] Jia LI, Edward Beeching, Lewis Tunstall, Ben Lipkin, Roman Soletskyi, Shengyi Costa Huang, Kashif Rasul, Longhui Yu, Albert Jiang, Ziju Shen, Zihan Qin, Bin Dong, Li Zhou, Yann Fleureau, Guillaume Lample, and Stanislas Polu. Numinamath. [<https://huggingface.co/AI-MO/NuminaMath-CoT>] (https://github.com/project-numina/aimo-progress-prize/blob/main/report/numina_dataset.pdf), 2024.

[3] Lewis Tunstall Ben Lipkin Roman Soletskyi Shengyi Costa Huang Kashif Rasul Longhui Yu Albert Jiang Ziju Shen Zihan Qin Bin Dong Li Zhou Yann Fleureau Guillaume Lample Jia LI, Edward Beeching and Stanislas Polu. Numinamath tir. [<https://huggingface.co/AI-MO/NuminaMath-TIR>] (https://github.com/project-numina/aimo-progress-prize/blob/main/report/numina_dataset.pdf), 2024.