

Department of Computer Science  
CSC 444  
Fall 2023

## Project Guidelines

2 pp abstract, with references, due by email to  
schubert@cs.rochester.edu by Tue. Nov. 14  
Project due Wed. December 13, 5pm

The project should be a small research undertaking, with the research motivation, ideas, approach, and goals clearly stated, and pursued as far as possible. You may pursue your idea independently, or jointly with a classmate (i.e., teams of two are fine; the report for teams should be accompanied by a brief note on who did what). Some of you may succeed in actually obtaining some interesting results, and evaluating and reporting these, and others may only get partway, but minimally you should end up with a report that is in the form of a research proposal, such as a researcher might send to a funding agency like the National Science Foundation (Intelligent Systems Division, especially the Robust Intelligence Program.) If you are an MS student, this might become something you could develop further, as an MS research project.

Proposals (with partial results) typically contain

1. An Introduction, providing the motivation and a sketch of the approach (perhaps with a quick, simple example), scientific merit and expected (or actual) novel contributions of the project, and a preview of the rest of the proposal;
2. A Related Work section, properly citing, briefly describing and discussing previous published work with similar goals, mentioning what they accomplished and what's lacking (in relation to the proposed work);
3. A section on the Proposed Approach or technical framework;
4. A Research Plan, and any steps taken to implement the proposed approach;
5. Preliminary (or anticipated) results;
6. Plan for remaining / further work;
7. References (properly formatted, corresponding to the citations).

An example of a fifteen-page proposal will be made available, but the report expected from you wouldn't be nearly as long – probably less than half as long, in terms of the number of words. But it'll give you an idea of organization, text formatting, citations, proper reference format, etc. Use some document creation environment, such as Latex or Word. (Good things to learn, if you're not acquainted already!)

The topic should tie in with the subject matter of CSC 444, i.e., it should have something to do with (reliable) reasoning and/or planning. It could either be concerned with reasoning / planning in a quantified logic or a STRIPS-like or other logical planning framework (this would require previous exposure to this style of AI), or, in view of the

current exciting LLM and other DNN developments, it could be about somehow combining the strengths of LLM/DNN approaches with the strengths of logical, combinatorial reasoning and / or sound planning. Another possibility is learning to transduce English statements (perhaps the kind we might use to state reasoning / planning problems) into a logical form that could be used for reasoning. If you're interested, the instructor could also supply an idea about how to learn to understand language (mapping it to an internal structured form) more like the way children learn (rather than from terabytes of text). However, that would be quite adventurous and challenging!

The important thing is to pick something you find interesting, so that you'll feel motivated and optimistic in pursuing your idea! Be sure to make clear which of the ideas and opinions you present are your own, and which ones are taken from your sources (**which of course should be properly cited**). For any programs you develop, be sure to motivate and explain your approach (in relation to your readings), to document the code clearly, to show ample examples of what the program does, to discuss its capabilities and limitations and what has been learned.

In all cases, provide a concluding section that summarizes your perspective on the work studied and carried out, and on promising directions for further work.

In accord with the above guidelines, grading will be based on

- *effort* (breadth and depth of study and research demonstrated by the project),
- *cogency* (quality of organization and writing, clarity and persuasiveness of the presentation, quality and performance of the programs, if any), and
- *originality* (independence of viewpoint, critical judgement, insight, ability to formulate and develop ideas).

## Sources

Good sources for background readings might include the following:

- The main and supplementary texts for the class.
- Some recommended “jumping ahead in CSC444” readings:
  - Kyle Mahowald, Anna A. Ivanova, Idan A. Blank, Nancy Kanwisher, Joshua B. Tenenbaum, and Evelina Fedorenko, “Dissociating language and thought in large language models: A cognitive perspective”, arXiv:2301.06627v1 [cs.CL], Jan. 16, 2023. [An important paper on LLMs!]
  - Jason Wei, Xuezhi Wang, Dale Schuurmans, Maarten Bosma, Brian Ichter, Fei Xia, Ed Chi, Quoc Le, and Denny Zhou, “Chain-of-Thought Prompting Elicits Reasoning in Large Language Models”, arXiv:2201.11903v6 [cs.CL] 10 Jan 2023. 36th Conference on Neural Information Processing Systems (NeurIPS 2022).
  - Aman Madaan and Amir Yazdanbakhsh (Google Research), “Text and patterns: For effective chain of thought it takes two to tango”, arXiv:2209.07686v2 [cs.CL] 13 Oct 2022.

- Aman Madaan, Shuyan Zhou, Uri Alon, Yiming Yang, and Graham Neubig, “Language Models of Code are Few-Shot Commonsense Learners”, EMNLP 2022; also arXiv:2210.07128 [cs.CL], Oct 13, 2022.
  - Shunyu Yao, Dian Yu, Jeffrey Zhao, Izhak Shafran, Thomas L. Griffiths, Yuan Cao, and Karthik Narasimhan, [Google DeepMind & Princeton] “Tree of Thoughts: Deliberate Problem Solving with Large Language Models”, arXiv:2305.10601 [cs.CL], May 17, 2023
  - Besta et al., “Graph of Thoughts: Solving Elaborate Problems with Large Language Models”, arXiv:2308.09687 [cs.CL]
  - Lei Wang, Wanyu Xu, Yihuai Lan Zhiqiang Hu, Yunshi Lan, Roy Ka-Wei Lee, and Ee-Peng Lim (Singapore), “Plan-and-Solve Prompting: Improving Zero-Shot Chain-of-Thought Reasoning by Large Language Models”, arXiv:2305.04091v1 [cs.CL] 6 May 2023.
  - Karthik Valmeekam, Sarath Sreedharan, Matthew Marquez, Alberto Olmo, and Subbarao Kambhampati, “On the Planning Abilities of Large Language Models (A Critical Investigation with a Proposed Benchmark)”, arXiv:2302.06706v1 [cs.AI] 13 Feb 2023.
  - Yaqi Xie, Chen Yu, Tongyao Zhu, Jinbin Bai, Ze Gong, Harold Soh, “Translating Natural Language to Planning Goals with Large-Language Models”, <https://www.semanticscholar.org/reader/3ad346ae7af5c30964c4916dbcee798f72e1bdb7>
  - Henry Kautz, The Third AI Summer: AAAI Robert S. Engelmore Memorial Lecture AI Magazine 2022(43), 105125.
  - recent Youtube video, “Yann Lecun, Chief AI Scientist at Meta AI: From Machine Learning to Autonomous Intelligence”, delivered at the Institute for Experiential AI at Northeastern U. (But beware: for Lecun, “intelligence” or “common sense” means predictive behavior in dynamic environments. That’s not what it means in CSC 244.444. But his criticisms of current AI techniques are interesting.)
  - Honghua Zhang, Liunian Harold Li, Tao Meng, Kai-Wei Chang, Guy Van den Broeck, “On the Paradox of Learning to Reason from Data”, arXiv:2205.11502v2 [cs.CL] 24 May 2022.
  - Zhuoran Zheng and Ernest Davis, “Physical reasoning in an open world”, preprint, Advances in Cognitive Systems, 2022. [https://www.researchgate.net/publication/358144560\\_Physical\\_Reasoning\\_in\\_an\\_Open\\_World/references#fullTextFileContent](https://www.researchgate.net/publication/358144560_Physical_Reasoning_in_an_Open_World/references#fullTextFileContent)
  - Erin Gibson and Lane Lawley, “Language-model-based parsing and English generation for Unscoped Episodic Logical Forms”, Poster #201, FLAIRS 2022, Hutchinson Island, Jensen Beach, FL, May 15-18, 2022. DOI: <https://doi.org/10.32473/flairs.v35i.130703>.
- The AAAI Conference Proceedings; currently “AAAI” stands for the Association for the Advancement of AI. Proceedings from early years are archived as *Proc. of the Nat. Conf. on Artificial Intelligence*, sponsored by the Am. Assoc. for AI). This is the main US conference on AI, held annually, and covering the full AI spectrum. This gives you a very good overview of what’s happening on the research frontiers; the articles are sometimes too concise to give you adequate technical depth. The AAAI home page is at <http://www.aaai.org> and you can find past

conference proceedings for both AAAI conferences and other major conferences at <http://www.aaai.org/Library/conferences-library.php> .

- Papers on arXiv – that’s where you get to see the latest work first.
- The *IJCAI* Proceedings; full name: the *Proc. of the Int. Joint Conf. on Artificial Intelligence*. This is the main international AI conference, held in odd-numbered years since 1969. It’s the oldest regular conference in AI, and is comparable in quality and scope to AAAI conferences. The IJCAI home page is at <http://www.ijcai.org/> . As of 2021 year, all the proceedings are accessible online (click on Proceedings, then 2022 or past proceedings)).
- EMNLP (Empirical Methods in Natural Language Processing) proceedings.
- The *AI Journal*; this is a high-quality journal with detailed technical papers in the full range of AI topics, but with past (but now diminished) emphasis on representation, reasoning, and planning. Tables of contents, abstracts, and many articles can be obtained on-line: see the web at URL <http://www.journals.elsevier.com/artificial-intelligence/>
- *JAIR* - the *Journal of AI Research*; this is a high-quality fully on-line journal – a new and helpful trend in journals! But again, reduced “KR&R” coverage. The URL for web access is <http://www.jair.org/>
- NeurIPS Proceedings (Advances in Neural Information Processing (<https://papers.nips.cc/>)) – look for the (occasional!) papers on reasoning.
- Look at <http://www.aiinternational.org/societies.html> for some further AI-oriented organizations (and hence further publications), such as the Eur. Coordinating Comm. on AI, which sponsors the European AI Conferences (ECAI), where further high quality papers may be found; the IEEE Computer Society and their AI-oriented journals; and others.
- Google has of course become a nearly universal tool for finding information on any topic, and often leads you to references you might easily have missed. (In a Google literature search you may come across citeseer (<http://citeseerx.ist.psu.edu/index.jsp>), which is a very good, broad-coverage index of the scientific literature.) *But beware:* Google will often lead you to personal and course pages of variable quality. While these can be very useful, your references should primarily be from the *refereed* literature (plus recent arXiv papers), which is much more reliable. Also, keep in mind that you cannot lift passages from references or sites you locate and insert them in your report as if they were your own words. This would be *plagiarism*, a serious violation of U of R’s academic honesty policy. Express everything you want to say in your own words – even if you feel one of the references (or ChatGPT) says it better (though of course explicit quotation from a book, journal, conference paper, or even website, with a citation, is perfectly ok).