

- [LSSC22] Alisa Liu, Swabha Swayamdipta, Noah A Smith, and Yejin Choi. WANLI: Worker and AI Collaboration for Natural Language Inference Dataset Creation. *arXiv preprint arXiv:2201.05955*, 2022.
- [LXL<sup>+</sup>17] Guokun Lai, Qizhe Xie, Hanxiao Liu, Yiming Yang, and Eduard Hovy. Race: Large-scale reading comprehension dataset from examinations. *arXiv preprint arXiv:1704.04683*, 2017.
- [MG18] David Manheim and Scott Garrabrant. Categorizing variants of Goodhart’s Law. *arXiv preprint arXiv:1803.04585*, 2018.
- [MST<sup>+</sup>21] Shahbuland Matiana, JR Smith, Ryan Teehan, Louis Castricato, Stella Biderman, Leo Gao, and Spencer Frazier. Cut the carp: Fishing for zero-shot story evaluation. *arXiv preprint arXiv:2110.03111*, 2021.
- [MTM<sup>+</sup>22] Jacob Menick, Maja Trebacz, Vladimir Mikulik, John Aslanides, Francis Song, Martin Chadwick, Mia Glaese, Susannah Young, Lucy Campbell-Gillingham, Geoffrey Irving, et al. Teaching language models to support answers with verified quotes. *arXiv preprint arXiv:2203.11147*, 2022.
- [NHB<sup>+</sup>21] Reiichiro Nakano, Jacob Hilton, Suchir Balaji, Jeff Wu, Long Ouyang, Christina Kim, Christopher Hesse, Shantanu Jain, Vineet Kosaraju, William Saunders, et al. WebGPT: Browser-assisted question-answering with human feedback. *arXiv preprint arXiv:2112.09332*, 2021.
- [NMS<sup>+</sup>21] Khanh X Nguyen, Dipendra Misra, Robert Schapire, Miroslav Dudík, and Patrick Shafto. Interactive learning from activity description. In *International Conference on Machine Learning*, pages 8096–8108. PMLR, 2021.
- [NR<sup>+</sup>00] Andrew Y Ng, Stuart J Russell, et al. Algorithms for inverse reinforcement learning. In *Icml*, volume 1, page 2, 2000.
- [OWJ<sup>+</sup>22] Long Ouyang, Jeff Wu, Xu Jiang, Diogo Almeida, Carroll L Wainwright, Pamela Mishkin, Chong Zhang, Sandhini Agarwal, Katarina Slama, Alex Ray, et al. Training language models to follow instructions with human feedback. *arXiv preprint arXiv:2203.02155*, 2022.
- [PBSM<sup>+</sup>21] John Poug  -Biyong, Valentina Semanova, Alexandre Matton, Rachel Han, Aerin Kim, Renaud Lambiotte, and Doyne Farmer. DEBAGREEMENT: A comment-reply dataset for (dis)agreement detection in online debates. In *Thirty-fifth Conference on Neural Information Processing Systems Datasets and Benchmarks Track (Round 2)*, 2021.
- [PHS<sup>+</sup>22] Ethan Perez, Saffron Huang, Francis Song, Trevor Cai, Roman Ring, John Aslanides, Amelia Glaese, Nat McAleese, and Geoffrey Irving. Red teaming language models with language models. *arXiv preprint arXiv:2202.03286*, 2022.
- [PKF<sup>+</sup>19] Ethan Perez, Siddharth Karamcheti, Rob Fergus, Jason Weston, Douwe Kiela, and Kyunghyun Cho. Finding generalizable evidence by learning to convince q&a models. *arXiv preprint arXiv:1909.05863*, 2019.
- [PTA<sup>+</sup>21] Hammond Pearce, Benjamin Tan, Baleegh Ahmad, Ramesh Karri, and Brendan Dolan-Gavitt. Can OpenAI Codex and Other Large Language Models Help Us Fix Security Bugs? *arXiv preprint arXiv:2112.02125*, 2021.
- [PTP<sup>+</sup>22] Alicia Parrish, Harsh Trivedi, Ethan Perez, Angelica Chen, Nikita Nangia, Jason Phang, and Samuel R Bowman. Single-turn debate does not help humans answer hard reading-comprehension questions. *arXiv preprint arXiv:2204.05212*, 2022.
- [RLN<sup>+</sup>18] Christian Rupprecht, Iro Laina, Nassir Navab, Gregory D Hager, and Federico Tombari. Guide me: Interacting with deep networks. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pages 8551–8561, 2018.
- [RNSS18] Alec Radford, Karthik Narasimhan, Tim Salimans, and Ilya Sutskever. Improving language understanding by generative pre-training. *URL [https://s3-us-west-2.amazonaws.com/openai-assets/research-covers/language-unsupervised/language\\_understanding\\_paper.pdf](https://s3-us-west-2.amazonaws.com/openai-assets/research-covers/language-unsupervised/language_understanding_paper.pdf)*, 2018.

- [RWC<sup>+</sup>19] Alec Radford, Jeffrey Wu, Rewon Child, David Luan, Dario Amodei, and Ilya Sutskever. Language models are unsupervised multitask learners. *OpenAI Blog*, 1(8):9, 2019.
- [SB22] Andreas Stuhlmüller and Jungwon Byun. Supervise Process, not Outcomes. <https://ought.org/updates/2022-04-06-process>, 2022.
- [SBA<sup>+</sup>21] Noam Slonim, Yonatan Bilu, Carlos Alzate, Roy Bar-Haim, Ben Bogin, Francesca Bonin, Leshem Choshen, Edo Cohen-Karlik, Lena Dankin, Lilach Edelstein, et al. An autonomous debating system. *Nature*, 591(7850):379–384, 2021.
- [SCC<sup>+</sup>22] Jérémy Scheurer, Jon Ander Campos, Jun Shern Chan, Angelica Chen, Kyunghyun Cho, and Ethan Perez. Training language models with natural language feedback. *arXiv preprint arXiv:2204.14146*, 2022.
- [Sha92] Adi Shamir. IP=PSPACE. *Journal of the ACM (JACM)*, 39(4):869–877, 1992.
- [SOW<sup>+</sup>20] Nisan Stiennon, Long Ouyang, Jeffrey Wu, Daniel Ziegler, Ryan Lowe, Chelsea Voss, Alec Radford, Dario Amodei, and Paul F Christiano. Learning to summarize with human feedback. *Advances in Neural Information Processing Systems*, 33:3008–3021, 2020.
- [SRE<sup>+</sup>20] William Saunders, Ben Rachbach, Owain Evans, Zachary Miller, Jungwon Byun, and Andreas Stuhlmüller. Evaluating arguments one step at a time. <https://ought.org/updates/2020-01-11-arguments>, 2020. Accessed 11-January-2020.
- [TVCM18] James Thorne, Andreas Vlachos, Christos Christodoulopoulos, and Arpit Mittal. Fever: a large-scale dataset for fact extraction and verification. *arXiv preprint arXiv:1803.05355*, 2018.
- [VSP<sup>+</sup>17] Ashish Vaswani, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N Gomez, Łukasz Kaiser, and Illia Polosukhin. Attention is all you need. In *Advances in neural information processing systems*, pages 5998–6008, 2017.
- [Wes16] Jason E Weston. Dialog-based language learning. *Advances in Neural Information Processing Systems*, 29, 2016.
- [WOZ<sup>+</sup>21] Jeff Wu, Long Ouyang, Daniel M Ziegler, Nisan Stiennon, Ryan Lowe, Jan Leike, and Paul Christiano. Recursively summarizing books with human feedback. *arXiv preprint arXiv:2109.10862*, 2021.
- [WWS<sup>+</sup>22a] Xuezhi Wang, Jason Wei, Dale Schuurmans, Quoc Le, Ed Chi, and Denny Zhou. Self-consistency improves chain of thought reasoning in language models. *arXiv preprint arXiv:2203.11171*, 2022.
- [WWS<sup>+</sup>22b] Jason Wei, Xuezhi Wang, Dale Schuurmans, Maarten Bosma, Ed Chi, Quoc Le, and Denny Zhou. Chain of thought prompting elicits reasoning in large language models. *arXiv preprint arXiv:2201.11903*, 2022.
- [ZCP17] Amy X Zhang, Bryan Culbertson, and Praveen Paritosh. Characterizing online discussion using coarse discourse sequences. In *Eleventh International AAAI Conference on Web and Social Media*, 2017.
- [ZNC<sup>+</sup>22] Daniel M Ziegler, Seraphina Nix, Lawrence Chan, Tim Bauman, Peter Schmidt-Nielsen, Tao Lin, Adam Scherlis, Noa Nabeshima, Ben Weinstein-Raun, Daniel de Haas, et al. Adversarial training for high-stakes reliability. *arXiv preprint arXiv:2205.01663*, 2022.
- [ZYY<sup>+</sup>21] Ming Zhong, Da Yin, Tao Yu, Ahmad Zaidi, Mutethia Mutuma, Rahul Jha, Ahmed Hassan Awadallah, Asli Celikyilmaz, Yang Liu, Xipeng Qiu, et al. QMSum: A new benchmark for query-based multi-domain meeting summarization. *arXiv preprint arXiv:2104.05938*, 2021.

# Appendix

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