

The language of prompting: What linguistic properties make a prompt successful?

Alina Leidinger*, Robert van Rooij and Ekaterina Shutova

Institute for Logic, Language and Computation, University of Amsterdam

Abstract

The latest generation of LLMs can be prompted to achieve impressive zero-shot or few-shot performance in many NLP tasks. However, since performance is highly sensitive to the choice of prompts, considerable effort has been devoted to crowd-sourcing prompts or designing methods for prompt optimisation. Yet, we still lack a systematic understanding of how linguistic properties of prompts correlate with task performance. In this work, we investigate how LLMs of different sizes, pre-trained and instruction-tuned, perform on prompts that are semantically equivalent, but vary in linguistic structure. We investigate both grammatical properties such as mood, tense, aspect and modality, as well as lexico-semantic variation through the use of synonyms. Our findings contradict the common assumption that LLMs achieve optimal performance on lower perplexity prompts that reflect language use in pretraining or instruction-tuning data. Prompts transfer poorly between datasets or models, and performance cannot generally be explained by perplexity, word frequency, ambiguity or prompt length. Based on our results, we put forward a proposal for a more robust and comprehensive evaluation standard for prompting research¹.

1 Introduction

NLP has witnessed a rapid succession of large pre-trained language models (LLMs) being released accompanied by reports of impressive performance on a multitude of tasks (Brown et al., 2020; Touvron et al., 2023; Zhang et al., 2022, i.a.). Many works show that increasing model scale decreases pre-training loss and improves downstream task performance *on average* (Brown et al., 2020; Rae et al., 2022). However, this does not hold in general across all samples and instructions (Ganguli et al.,

2022; Sanh et al., 2022). Mounting evidence of performance variability (Köksal et al., 2022; Gonen et al., 2022, i.a.) has been met with an abundance of proposed methods for automatic prompt² generation (Shin et al., 2020; Gao et al., 2021; Liu et al., 2023, i.a.) paired with an ongoing discussion on the superiority (or inferiority) of expert-written prompts over generated ones (Logan IV et al., 2022; Webson and Pavlick, 2022). Fundamentally, such variability in performance across prompting strategies raises the question of how LLMs process prompts based on language seen during training. Do they conform to linguistic intuition and respond better to lower perplexity prompts featuring straight-forward sentence structures, frequent and less ambiguous words, or language that has been seen during instruction-tuning?

To test this hypothesis, we examine prompting performance variability in LLMs through the lens of linguistics. To the best of our knowledge, we conduct the first controlled study of LLM performance variability across semantically equivalent prompts that differ in linguistic structure. Specifically, we manually construct parallel sets of prompts that vary systematically in grammatical mood, tense, aspect and modality (550 prompts in total³). We study the influence of word frequency and ambiguity by exchanging content words for alternative synonyms. We evaluate five LLMs of different sizes, both instruction-tuned and not instruction-tuned: LLaMA 30b (Touvron et al., 2023), OPT 1.3b, 30b (Zhang et al., 2022) and OPT-IML 1.3b and 30b (Iyer et al., 2022). We focus on understanding of instructions, and therefore, evaluate our models in a zero-shot fashion. We experiment with six datasets for three different tasks: sentiment classification, question answering and natural language inference (NLI). For the instruction-tuned models, our choice of tasks cov-

* Corresponding author: a.j.leidinger@uva.nl.

¹All resources are available at: https://github.com/aleidinger/language_of_prompting/

²We use the terms *prompt* and *instruction* interchangeably.

³We release all prompts for all tasks in Appendix D.

ers the fully supervised, cross-dataset and cross-task setting.

Overall, we observe large performance variation due to changes in linguistic structure of the prompt (§5); and this holds even for instruction-tuned models on seen tasks. Furthermore, contrary to previous findings (Gonen et al., 2022), model performance does not appear to correlate with perplexity of the prompts (§6). Further, we find no correlation between performance and prompt length, word sense ambiguity or word frequency. In many cases more complex sentence structures and rare synonyms outperform simpler formulations. Our findings contradict the universal assumptions that LLMs perform best given low perplexity prompts featuring words which we assume (or know) to be frequent in pre-training and instruction-tuning data. This stresses the need for further research into the link between statistical distribution of language at different training stages and model behaviour.

With regards to evaluation practices in the field, our work highlights the limitations of benchmarking multiple models on single, fixed prompts and reporting best-case performance. Prompts generally transfer poorly between datasets even for the same model, let alone across models (§5.2). Instruction-tuning (§5.3) or increasing model size (§5.4) do not preclude the possibility of considerable performance variation, even on seen tasks. These findings, coupled with the fact that many works do not release their prompts, make the results of existing evaluations less reliable and difficult to reproduce. In Section 7, we put forward a proposal for a more robust and comprehensive evaluation framework for prompting research.

2 Related work

Instability in prompting Papers accompanying newly released models, rarely report prompts used for their evaluation and, typically, do not evaluate on multiple prompts (Brown et al., 2020; Chowdhery et al., 2022; Rae et al., 2022). Sanh et al. (2022) stand alone in reporting performance variation across prompts at the release of T0.

To date, few works have investigated robustness to different prompt formulations. Ishibashi et al. (2023) show that machine-generated prompts are not robust to token deletion or reordering. Webson and Pavlick (2022) evaluate pre-trained and instruction-tuned models on NLI in the few-shot setting. They find that while instruction-

tuning helps robustness against prompt variation, instruction-tuned models respond favourably even to misleading instructions. Shaikh et al. (2023) show that GPT-3 scores drastically worse on bias and toxicity challenge sets with the addition of ‘*Let’s think step by step.*’ to a given prompt for chain-of-thought reasoning (Kojima et al., 2022). Razeghi et al. (2022) find that performance on arithmetic tasks correlates with frequency of integers in the training data. Perhaps closest to our work, Gonen et al. (2022) find that lower perplexity of the prompt correlates with higher performance for OPT (Iyer et al., 2022) and BLOOM (Scao et al., 2022) on a variety of different tasks.

In priming or in-context learning, LMs profit from being shown the required input-output format, the distribution of inputs and the label space, while ground truth labels don’t seem to be required (Min et al., 2022). Performance is also sensitive to the ordering of demonstration examples (Lu et al., 2022; Zhou et al., 2022; Zhao et al., 2021). Chinchilla performs better on abstract reasoning tasks when test samples cater to prior knowledge acquired through pretraining (Dasgupta et al., 2022).

Prompting evaluation practices. Cao et al. (2022) point out that evaluating models on the same prompt does not make for a direct comparison, since models’ exposure to different pretraining data results in different responses to individual prompts. Ishibashi et al. (2023) find that machine-generated prompts do not achieve equal performance gains across datasets for the same task. Holtzman et al. (2021) posit that subpar performance of LMs is due to different viable answers outside the answer choices competing for probability mass (“surface form competition”), reducing the score for the correct answer among answer choices. They mediate this using Domain Conditional PMI. Zhao et al. (2021) observe that models overpredict label words that occur more frequently in a prompt, at its end, or are frequent in the pretraining data. They propose fitting an affine function to the LM scores, so that answer options are equally likely for ‘content-free’ dummy examples.

Contrary to other works (Gonen et al., 2022; Sorensen et al., 2022; Liao et al., 2022) we do not aim at proposing prompt selection methods or calibrate predictions. While many (semi-)automatic approaches to generating prompts have been proposed (Liu et al., 2023; Shin et al., 2020; Jiang et al., 2020; Gao et al., 2021, i.a.), we resort to crafting

prompts manually so as to maintain fine-grained control over sentence structures in our prompts. Logan IV et al. (2022) provide evidence that manually written prompts (Schick and Schütze, 2021) can yield better result than automatically sourced prompts. Further, Ishibashi et al. (2023) point out that automatically generated prompts contain atypical language use, punctuation or spelling mistakes and generalise poorly across datasets. To isolate the effect of individual instructions we restrict ourselves to the zero-shot setting and do not include any demonstration examples in-context. Indeed, LMs have been shown to perform reasonably well in the few-shot setting given unrelated or misleading instructions (Webson and Pavlick, 2022). Similarly, we abstain from prompt-tuning on demonstration examples, so as to not introduce additional sources of variance (Cao et al., 2022).

3 Tasks and datasets

To draw robust conclusions across tasks, we conduct experiments on multiple datasets, namely Stanford Sentiment Treebank (SST-2; Socher et al., 2013) and IMDB (Maas et al., 2011) (Sentiment Analysis), SuperGLUE (Wang et al., 2019) Recognizing Textual Entailment (RTE; Wang et al., 2018) and CommitmentBank (CB; De Marneffe et al., 2019) (NLI), Boolean Questions (BoolQ; Clark et al., 2019) and AI2 Reasoning Challenge Easy (ARC-E; Clark et al., 2018) (Question Answering). Our guiding principle in choosing datasets was to have a diverse set of tasks on which pre-trained models such as LLaMA or OPT achieve above-chance performance in the zero-shot setting (Iyer et al., 2022). For OPT-IML, our choice covers the supervised, cross-dataset, and cross-task setting. The OPT-IML models have been instruction-tuned on IMDB and SST using prompts from PromptSource (Sanh et al., 2022) and FLAN (Wei et al., 2021). They have been tuned on QA datasets such as SciQ, but not on BoolQ or ARC-E (Iyer et al., 2022) which we use. All textual entailment tasks (including RTE and CB) are fully-held out during training of OPT-IML (Iyer et al., 2022).

4 Method

4.1 Models

We examine both pretrained-only and instruction-tuned models in this study. The former category is represented by LLaMA 30b (Touvron et al., 2023) and OPT 1.3b and 30b (Zhang et al., 2022). In

	prop.	prompt
mood	inter.	Do you find this movie review positive?
	indic.	You find this movie review positive.
	imper.	Tell me if you find this movie review positive.
aspt.	active	Do you find this movie review positive?
	pass.	Is this movie review found positive?
tense	past	Did you find this movie review positive?
	pres.	Do you find this movie review positive?
	future	Will you find this movie review positive?
modality	can	Can you find this movie review positive?
	could	Could you find this movie review positive?
	may	May you find this movie review positive?
	might	Might you find this movie review positive?
	must	Must you find this movie review positive?
	should	Should you find this movie review positive?
synonymy	would	Would you find this movie review positive?
	apprai.	Do you find this movie appraisal positive?
	comm.	Do you find this movie commentary positive?
	criti.	Do you find this movie critique positive?
	eval.	Do you find this movie evaluation positive?
	review	Do you find this movie review positive?

Table 1: Examples of variation of linguistic properties

the latter category, we consider OPT-IML 1.3b and 30b (Iyer et al., 2022)⁴. We make use of the HuggingFace transformers library (Wolf et al., 2020) for all our experiments.

4.2 Prompting setup

For our Sentiment Classification and NLI datasets, we map the label space to target words yes/no or yes/no/maybe in the case of two or three classes respectively. This was found to yield the best performance by Webson and Pavlick (2022) among alternative mappings. For question answering tasks, answer options are listed in a multiple-choice fashion using letters A, B or A, B, C, D which serve as target words. Additionally, we follow Gonen et al. (2022)’s advice regarding punctuation in prompts and add the postamble, e.g. “Choices: yes or no? Answer:” to every prompt, as this was found to aid zero-shot performance and reduce surface-form competition (Holtzman et al., 2021). Each prompt is evaluated on 500 random samples for each dataset. For datasets belonging to the same task, we keep the set of prompts fixed⁵.

All our experiments are carried out in a zero-shot setting. Following Sanh et al. (2022); Webson and Pavlick (2022); Wei et al. (2021), we predict by recording which target word is assigned the largest log probability among all target words—regardless of whether that target word receives overall the

⁴To showcase similar performance variability for encoder-models, we include results on Flan-T5 (Chung et al., 2022) in Appendix C.

⁵For a full test sample with answer options see App A.

largest log probability across the entire vocabulary. We choose accuracy as our evaluation metric⁶.

4.3 Linguistic variation in prompts

To contrast linguistic properties in prompts, we manually formulate parallel sets of prompts which differ in grammatical mood, tense, aspect or modality, systematically and one at a time. We present an example in Table 1 and the full list of prompts⁷ for all tasks in Appendix D.

For example, in the case of mood, we design three sets of 10 prompts each which are identical, except that they are phrased either as a question, an order or a statement. The resulting sets of interrogative, indicative and imperative prompts are all in present tense and active voice, so as to guarantee a controlled setting. We proceed similarly for aspect by formulating two sets of active and passive prompts (all in interrogative mood, present tense) and tense by crafting prompts in simple past, present and future (all in active voice, interrogative mood). We also vary the degree of certainty in our instructions, while maintaining a minimal edit distance, by introducing different epistemic modals (example in Table 1). Here, all prompts are in active voice, present tense, interrogative mood. Lastly, we ask how model behaviour is linked to word sense ambiguity and word frequency. We thus replace content words in interrogative prompts with synonyms of varying word sense ambiguity and frequency.

Statistical tests & analysis We employ non-parametric tests, to quantify whether any observed performance variation between sets of prompts is indeed statistically significant. Specifically, we use the Friedman Two-Way Analysis of Variance by Ranks Test (Friedman, 1937) and the Wilcoxon Signed Rank Test (Wilcoxon, 1992) for paired samples. We investigate the influence of prompt length, perplexity, word sense ambiguity and frequency on accuracy by computing the Spearman Rank-Order Correlation Coefficient (Spearman, 1961) and the Pearson Correlation Coefficient (Pearson, 1895).

5 Results

5.1 Performance variability

Our results per task are presented in Tables 2, 3, 4.

⁶Run times and compute resources are detailed in App B.

⁷Our prompts are loosely inspired by prompts in PromptSource (Sanh et al., 2022). However, we restrict ourselves to simple sentence structures consisting only of one main clause.

Mood. As expected, LLMs generally respond more favourably to instructions phrased as questions or orders rather than statements, with the exception of LLaMA and OPT-IML 30b on BoolQ. However, we do not find that prompts in interrogative mood generally outperform imperative ones or vice versa. In most cases, instruction-tuning did not broaden the gap between indicative and interrogative/imperative prompts dramatically. Notably, we find cases where an individual indicative prompt performs best across all prompts (e.g. Table 9 details that ‘This movie review makes people want to watch this movie.’ achieves the highest accuracy of 97.6% for OPT-IML 1.3b on IMDB.).

Aspect. The hypothesis that active sentence constructions are simpler, shorter, more prevalent in the data and thus yield better performance was generally not confirmed. No model shows a clear preference for instructions phrased in active vs. passive voice across all datasets, with the exception of OPT-IML 1.3b for which active voice works consistently better, albeit not always significantly. Interestingly, for all other models, passive prompts generally yield better results on BoolQ. For our 30b models, we find active prompts to be superior only for RTE and ARC-E (Tables 3, 4).

Tense. Similarly, the hypothesis that prompts in present tense perform best, since they cater in particular to prompts seen during instruction-tuning, was only confirmed for CB. (In two cases, future prompts performed on par or slightly better.) On the other datasets our results proved to be more mixed. None of the tenses outperforms others for SST and IMDB, across models. On occasion, future and past prompts considerably outperformed present prompts, e.g. for OPT-IML 30b on IMDB (> 96% acc. (past/future) vs. 89% acc. (present)) or similarly for OPT 30b on SST. On BoolQ and ARC-E results varied less, with observed differences under 2.5 percentage points.

Modality. Replacing different modal verbs in an instruction also results in considerable performance variation with differences up to 10 and 17 points on SST for LLaMA on ‘must’ vs. ‘would’ or OPT 30b on ‘may’ vs. ‘might’ (Table 2). For OPT-IML 1.3b and 30b, such variation is reduced on SST with average accuracies falling within the range of 92.23% – 93.03% for both sizes. However, instruction-tuning doesn’t preclude the possibility of significant performance variation also for larger

		LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
		SST	IMDB	SST	IMDB	SST	IMDB	SST	IMDB	SST	IMDB
mood	indicative	82.53*	91.58*	64.98*	71.88*	64.3*	91.92*	76.2*	69.97	91.07*	71.33*
	interrogative	83.35*	89.79*	87.98	58.38*	92.8	92.15*	79.9	69.95	92.25*	89.93
	imperative	83.65	92.42	76.85*	74.08	92.25*	92.92	79.08*	66.98*	92.68	87.5*
aspt.	active	81.9	89.17	81.75*	64.35	93.3	93.2	69.5*	71.1	92.25*	91.25*
	passive	78.25*	93.0	85.8	60.85*	92.8	93.15	71.0	70.3	92.55	92.75
tense	past	80.8*	94.67	71.05*	80.53	86.95*	94.85	85.8*	82.66*	91.68*	96.12
	present	83.35	94.42	87.98	79.69*	92.8	94.7	79.9*	84.04	92.25	89.93*
	future	85.72	93.0*	76.6*	80.79	88.37*	94.88	87.35	83.79*	92.18*	96.15
modality	can	85.22*	90.33*	83.0*	64.78*	92.5*	90.78*	77.45*	73.5*	92.83	89.12
	could	84.75*	91.38*	77.47*	67.12*	92.42	90.2*	70.97*	74.02	92.68*	87.58*
	may	84.62*	87.12*	82.63*	65.17*	92.35	90.83*	82.3*	71.1*	92.55*	87.38*
	might	83.85*	91.25*	77.18*	69.72	92.25	91.1*	65.98*	72.7*	92.92	85.58*
	must	75.52*	90.62*	85.6*	59.77*	92.55*	91.73	82.9	67.95*	92.6*	88.0*
	should	82.92*	91.33*	85.47*	63.08*	92.78*	90.05*	81.32*	70.15*	92.73*	88.25*
	would	85.97	92.54	86.05	62.12*	93.03	91.55	74.03*	71.25*	92.3*	85.25*
synonymy	appraisal	81.63*	93.0	87.49*	60.46	93.17*	90.46*	76.26*	73.2	93.23	92.86
	commentary	81.6*	92.95	86.37*	60.23	92.91*	88.03*	64.34*	71.86*	92.97*	93.09
	critique	84.4	92.29*	85.66*	58.94*	92.46*	91.11*	68.63*	71.46*	92.43*	91.8*
	evaluation	83.63*	92.0*	89.89	52.34*	93.29	91.74*	78.26*	70.23*	92.49*	91.26*
	review	82.97*	92.95	87.94*	56.94*	92.97*	93.23	80.77	68.97*	92.17*	88.8*
null prompt		83.2	72.8	41.2	64.2	12.8	93.0	65.8	74.8	37.0	86.2
chance		50	50	50	50	50	50	50	50	50	50

Table 2: Average accuracy per prompt in categories mood, aspect, tense, modality, synonymy on SST and IMDB (Sentiment Classification). Highest accuracy per category for each model and dataset marked in bold. Significant lower results per category marked with an asterisk. The null prompt contains no instruction.

		LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
		BoolQ	ARC-E	BoolQ	ARC-E	BoolQ	ARC-E	BoolQ	ARC-E	BoolQ	ARC-E
mood	indicative	72.0	73.18	62.08	27.6	63.04	31.87	54.38*	29.68*	65.72	68.78*
	interrogative	67.75*	75.43	61.92	28.77	64.25	31.53	60.4	31.72	63.44*	68.28
	imperative	64.58*	74.65	62.72	27.52	63.7	34.1	60.52	30.47*	64.81	69.16
aspt.	active	67.6*	75.76	62.05*	29.15	64.1	31.86	61.5	36.73	62.3	66.68
	passive	73.9	72.98*	62.55	28.14	63.55*	30.05*	61.55	32.41*	63.3	64.17*
tense	past	66.83*	75.0	59.28*	28.02*	49.15	29.23*	63.69	28.4	66.35	70.96*
	present	67.03*	72.68*	59.13*	28.19	49.5	30.2*	63.3*	27.92	67.13	71.11*
	future	67.43	73.03*	59.61	27.93*	49.07*	30.3	63.03*	28.15*	66.91*	71.19
modality	can	64.5*	73.82*	61.75*	28.02*	63.62	31.41*	62.13	34.42	63.75*	67.22*
	could	63.75	73.82*	61.88	28.27*	63.25	31.28*	61.38	33.92	63.5*	67.47*
	may	62.62*	74.21*	62.13	28.27	64.0	31.78	60.5*	32.41*	63.5*	67.89
	might	63.5	75.52*	61.88	28.39*	63.88*	31.41	60.38*	32.79*	62.5*	67.73
	must	65.0*	75.79*	62.0	28.27*	63.5*	30.53*	57.38*	29.27*	65.38	67.64*
	should	67.75	75.65	61.87	28.77	64.13	30.4*	58.88*	29.77*	63.88*	68.9
	would	67.12	77.09	61.5	28.39*	64.0	30.03*	60.62*	34.67	64.0*	68.23*
synonymy	proper	66.02*	75.93	62.72	27.32	63.76*	33.56*	61.68	32.13	63.9	68.67
	right	62.76*	76.1	62.64	27.1*	63.94*	34.08	61.12*	31.77*	64.44*	68.11*
	correct	62.9*	76.16	62.28*	27.65*	63.78*	33.82	60.3*	31.73*	64.24*	68.21*
	appropriate	67.24	75.85*	62.64*	27.73	63.98	33.34*	61.32*	32.31	64.5	68.91
	answer	61.82*	76.18	62.33*	27.71*	63.82*	33.69	60.07*	31.94	64.15*	68.47
synonymy	reply	62.93*	75.43*	62.22*	27.73*	63.91	33.42	60.73*	31.28*	64.64	67.81
	response	65.98	76.39	62.35*	27.35*	63.85	32.94*	61.45	31.64*	64.31*	68.3
	solution	62.73*	73.11*	63.02	28.02	63.89*	33.14*	60.6	30.89*	64.33*	67.55*
	null prompt	64.0	75.0	61.5	26.13	68.0	29.29	68.0	28.28	72.0	63.64
chance		50	25	50	25	50	25	50	25	50	25

Table 3: Average accuracy per prompt in categories mood, aspect, tense, modality, synonymy on BoolQ, ARC-E (Question Answering). Highest accuracy per category for each model and dataset marked in bold. Significant lower results per category marked with an asterisk. The null prompt contains no instruction.

models of eg. 4 percentage points of OPT-IML 30b on IMDB and CB. On QA (Table 3) and NLI (Table 4) datasets, we find numerous examples of drops in accuracy by up to 5 percentage points.

Synonymy. Perhaps most surprisingly, replacing content words with non-standard synonyms does not generally hurt performance, but rather improves it. In particular, for SST and IMDB the content

		LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
		RTE	CB	RTE	CB	RTE	CB	RTE	CB	RTE	CB
mood	indicative	53.28*	49.7*	47.9*	51.9*	58.55*	62.27*	51.18*	46.77*	67.96*	79.67
	interrogative	57.6*	53.53	48.0	58.17	58.95*	62.33	51.04*	59.33	69.58*	75.47*
	imperative	57.68	52.4	47.35*	52.13*	60.4	61.4	52.4	59.27*	70.22	80.1
aspt.	active	60.62	53.68	52.9*	56.28*	55.65	59.88	52.38	58.56	69.5	70.84
	passive	60.46*	53.08*	53.0	57.0	54.95	59.88*	51.8*	55.56*	69.16	68.56*
tense	past	53.11	51.0*	52.15	58.0	65.63*	62.17*	52.15	60.3	70.7*	72.13*
	present	52.96*	51.63	51.16*	58.73	65.9	62.43*	52.08	60.53	71.78	74.23
	future	52.51	48.93*	52.1	55.87*	65.2*	62.63	51.43*	60.53	70.72	71.58*
modality	can	60.55*	53.07*	54.04	56.6*	56.12	61.83*	53.17	59.07*	71.65*	74.53*
	could	61.37*	53.37	53.17*	58.2	56.38	62.37*	51.5*	58.97*	70.7*	74.33*
	may	60.18*	52.27*	54.75	58.07*	54.58*	64.03	52.28*	56.6*	72.17*	73.6*
	might	60.37*	51.87*	53.5*	57.03*	54.29*	63.13*	51.53*	56.43*	72.2	72.3*
	must	57.25*	50.43	54.25*	54.93*	52.92*	61.73	51.23*	56.33*	70.62	70.53*
	should	58.38*	49.57*	54.04*	55.93*	55.67	60.7*	51.07*	60.73	71.55	71.3*
	would	62.75	51.63*	53.75*	56.03*	54.17*	60.43*	51.55*	60.17*	71.0*	74.87
syn.	assertion	57.1	52.0	50.8	58.6	66.8*	58.6	53.4	67.8	74.3	78.2
	claim	55.5*	49.6*	49.6	58.6	68.0	60.6	51.9*	66.0*	74.4	78.8
syn.	entailment	55.4	42.4*	50.1*	55.4*	63.6	60.4*	49.0*	46.0	70.2	75.2
	implication	54.8*	54.4	51.0	60.2	64.1	63.8	50.0	46.4	69.9	75.0
	null prompt	45.0	55.2	40.0	57.6	46.5	61.6	46.6	66.8	41.2	79.2
	chance	50	33.3	50	33.3	50	33.3	50	33.3	50	33.3

Table 4: Average accuracy per prompt in categories mood, aspect, modal verbs, synonymy on RTE, CB (Question Answering). Highest accuracy per category for each model and dataset marked in bold. Significant lower results per category marked with an asterisk.

word ‘review’ does not guarantee optimal performance (Table 2). This holds even for OPT-IML 30b which has been trained on instructions from FLAN and PromptSource most of which contain the word ‘review’. Instead rare synonyms such as ‘appraisal’ and ‘commentary’ yield better performance. Similarly, on BoolQ and ARC-E we did not find that prompts containing the words ‘correct’ and ‘answer’ worked best—even if many of the prompts in FLAN and PromptSource contain those words and none of the other synonyms we tested. Notably often, models respond more favourably to the rarer synonym ‘appropriate’ (See Table 3).

5.2 Prompt transfer

When evaluating on a fixed prompt for different models and datasets, one tacitly assumes that prompts are to some extent ‘universal’. Our results largely contradict this assumption (Tables 9, 11, 13). We found numerous cases in which a prompt performed optimally for one model on one dataset, but gave staggeringly poor results on other datasets. For instance, the best prompt for OPT-IML 1.3b on IMDB yields 97.6% accuracy, but barely above chance performance on SST. Similarly, we saw large drops in performance when transferring optimal prompts from IMDB to SST and vice versa for LLaMA 30b, OPT 1.3b and OPT 30b.

Prompts that were optimal for one model and dataset also transferred poorly to other models. We found many cases of drops by more than 20 percentage points on SST and IMDB or 5 percentage points on BoolQ and CB.

5.3 The relation between robustness and instruction-tuning

Instruction-tuning holds promise of improved performance *and* robustness, but how robust can we expect our results to be? In line with previous works, we find our instruction-tuned models to perform more reliably on seen tasks than their pre-trained counterparts of the same size. For OPT 30b, accuracy can vary by 10 points or more for SST and IMDB. For OPT-IML 30b this gap narrows, but remains non-negligible. While performance on SST stabilises between 91% and 93% for SST, we still see performance in the range 85 – 92% on IMDB (Table 2). ARC-E is not part of the instruction-tuning tasks for OPT-IML 30b and performance here varies by 5 percentage points (Table 3). Similarly, performance on RTE and CB varies significantly with accuracies in the ranges 67.96 – 72.2% and 68.56 – 80.1% respectively (Table 4).

5.4 The relation between robustness and model size

We find numerous examples of increased model size not leading to increased stability. For instance,

changing ‘*must*’ to ‘*might*’ results in a performance drop by 17 percentage points for OPT 30b on SST (Table 2). Overall, when comparing OPT-IML with OPT at 1.3b and 30b, the gap between best and worst prompts closes only for RTE, is stable for BoolQ, ARC-E and SST and widens for IMDB, and CB e.g. from 5 to 12pp (Tables 9, 11, 13).

6 Analysis

Since accuracy varies considerably, we now analyse whether higher accuracy can be explained by lower prompt perplexity, prompt length, or the use of less ambiguous or more frequent words in the prompt. We present correlation results in Table 5.

Prompt perplexity Following Gonen et al. (2022), we average across perplexity for 500 random test samples each accompanied by the instruction in question. We find that perplexity scores often reflect linguistic intuition, e.g. they are lower for prompts in imperative vs. indicative mood or prompts containing ‘*answer*’ vs. other synonyms (see Appendix E). Surprisingly however, we do not find lower perplexity to correlate significantly with higher accuracy across models or datasets (Table 5). For LLaMA 30b, *higher* perplexity correlates with higher accuracy (except on IMDB and BoolQ). OPT-IML 30b performs better given higher perplexity prompts. Overall, our findings contradict Gonen et al. (2022) and indicate that the success of high or low perplexity prompts is particular to any combination of dataset and model.

Frequency of synonyms We approximate word frequency as the number of occurrences in the 14b Intelligent Web-based Corpus (Davies and Kim, 2019). In general, we do not find that frequent synonyms lead to better performance (Table 5). For BoolQ and ARC-E, correlation between word frequency and accuracy oscillates around zero with no clear preference for frequent synonyms emerging. For SST and IMDB, infrequent synonyms tend to work better for OPT IML 30b. For OPT, correlation is positive for SST and negative for IMDB’s longer sentences. For LLaMA correlation coefficients are mostly around zero. On RTE and CB, more frequent synonyms lead to better performance except for LLaMA and OPT 1.3b on RTE.

Ambiguity of synonyms We quantify word sense ambiguity as the number of word senses in WordNet (Miller, 1995). Intuitively, one would expect more ambiguous synonyms to pose greater

difficulty for LLMs and to lower accuracy. We largely do not find this to be the case (Table 5). While correlation between accuracy and degree of ambiguity is generally around zero for BoolQ and ARC-E, on CB it is positive for all models. For SST and IMDB, OPT-IML 30b performs better on less ambiguous prompts, potentially due to its size, while the opposite is true of OPT-IML 1.3b.

Prompt length Overall, none of our models perform better on longer or shorter prompts (in number of tokens) across all tasks (Table 5). For LLaMA 30b and OPT 1.3b, longer prompts result in significantly higher accuracies only for IMDB and BoolQ. Performance of OPT-IML 1.3b correlates positively with prompt length (except on SST and CB). For OPT-IML 30b results are mixed.

7 Lessons learnt and way forward

7.1 Implications of our research

Instability in prompting Our findings clearly demonstrate the instability of prompt-based evaluation (§5) that is rarely featured in performance reports. For any model and task, differences in performance can be considerable at even the slightest change in wording or sentence structure.

The connection between data distribution and model behaviour Our findings should be taken as an invitation to revisit the common assumption that LLMs respond best to lower perplexity prompts containing simple and frequent words and grammatical structures. We find numerous cases where LLMs do not learn from the data distribution in the way one would assume based on perplexity scores and linguistic intuition (§6). This calls for further investigation into the interplay between model behaviour and the distribution of language use during pretraining and instruction-tuning.

The effect of instruction-tuning Contrary to prevailing opinion, the above holds also for comparatively larger instruction-tuned LLMs. Our results indicate that instruction-tuning should not be taken as a panacea to performance instability without further investigation (§5.3). While it does overall improve performance and robustness, performance can still vary by over 5pp on seen tasks.

Limitations of current evaluation practices Importantly, our work highlights the limitations of benchmarking LLMs on the same prompt for a given task, or only a small set of prompts, which

		LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
task		ρ_s	ρ_p	ρ_s	ρ_p	ρ_s	ρ_p	ρ_s	ρ_p	ρ_s	ρ_p
ppl. vs acc.	SST	0.23*	0.3*	0.27*	0.16	0.49*	0.22*	0.11	0.21*	-0.02	0
	IMDB	-0.17*	-0.07	-0.06	0.04	-0.06	0.02	-0.37*	-0.18*	0.18*	0.13
	BoolQ	-0.02	0.02	-0.21*	-0.3*	-0.04	-0.17*	0.22*	0.17*	0.13	0.06
	ARC-E	0.2*	0.16*	-0.07	-0.04	-0.14*	-0.15*	-0.12	-0.12	0.11	0.07
	RTE	0.15	0.16*	0.08	0.08	-0.07	-0.0	-0.28*	-0.13	0.05	0.51*
	CB	0.46*	0.17*	0.43*	0.29*	0.15*	0.58*	-0.59*	-0.47*	-0.12	0.42*
amb. vs acc.	SST	0.06	0.01	0.23	0.07	0.1	0.03	0.35*	0.21	-0.17	-0.3
	IMDB	0.08	0.09	-0.07	-0.09	0.53*	0.53*	-0.08	-0.12	-0.35*	-0.57*
	BoolQ	-0.11	-0.09	0.06	0.04	-0	0.02	-0.02	0.03	-0.04	-0.01
	ARC-E	0.06	0.05	-0.16	-0.21	-0.03	0.09	-0.1	-0.03	-0.14	-0.09
	CB	0.12	0.4	0.1	0.25	0.22	0.39	0.41	0.21	0.05	0.08
	RTE	-0.24	-0.36	-0.2	-0.14	0.59	0.43	0.39	0.15	0.27	0.14
freq. vs acc.	SST	0.09	0.02	0.2	0.1	0.05	0.05	0.11	0.19	-0.43*	-0.35*
	IMDB	-0.03	0.07	-0.43*	-0.18	0.39*	0.5*	-0.18	-0.14	-0.47*	-0.6*
	BoolQ	-0.11	-0.08	0.06	0.05	0.05	0.06	-0.08	0.03	-0.01	0.04
	ARC-E	0.02	0.05	-0.05	-0.19	-0.03	0.12	-0.02	0.02	-0.04	-0.04
	CB	0.12	0.4	0.1	0.25	0.22	0.39	0.41	0.21	0.05	0.08
	RTE	-0.24	-0.36	-0.2	-0.14	0.59	0.43	0.39	0.15	0.27	0.14
len. vs acc.	SST	-0.23*	-0.37*	-0.27*	-0.19	-0.16	0.06	-0.14	-0.27*	0.14	0.23*
	IMDB	0.15	0.05	0.16	0.19	0.23*	0.39*	0.54*	0.47*	-0.14	0.03
	BoolQ	0.11	0.06	0.1	0.2	-0.09	0.18	0.16	0.19	-0.27*	-0.26*
	ARC-E	-0.14	-0.13	-0.0	-0.02	0.27*	0.32*	0.24*	0.25*	-0.15	-0.08
	RTE	-0.47*	-0.45*	-0.46*	-0.55*	0.13	0.11	-0.08	-0.17	-0.31*	-0.1
	CB	-0.38*	-0.33*	-0.4*	-0.41*	-0.27*	-0.19*	0.03	0.22*	0.43*	0.35*

Table 5: Spearman (ρ_s) and Pearson correlation coefficients (ρ_p) of (1) perplexity, (2) word sense ambiguity, (3) frequency of synonyms, and (4) prompt length against accuracy. Significant results ($p < 0.05$) marked with an asterisk.

is the current practice. Large variability in performance (§5) and a lack of transparency around used prompts make evaluations unreliable and hard to reproduce. Individual prompts are not transferable across datasets or models (§5.2). Instruction-tuning does not appear to solve these problems (§5.3).

7.2 Recommendations

Based on the lessons learnt in our study, we put forward a proposal for a more robust and comprehensive evaluation framework for LLM prompting.

Collect prompts that represent linguistic variability. In order to obtain a robust and accurate estimate of model performance, one needs to account for linguistic variability of prompts, ideally in a controlled and rigorous manner. This can be accomplished by collecting sets of candidate prompts that are representative of core linguistic structures.

Use semi-automatic approaches such as controlled paraphrasing (Iyyer et al., 2018) to generate prompts that vary in grammatical constructions in a systematic way.

Replace content words with synonyms to diversify vocabulary. Our results on synonyms point to a simple method for expanding prompt sets to cover a more diverse vocabulary. This enables controlled investigation of the link between word sense

ambiguity, frequency, and model behaviour.

Generate a sufficiently large set of prompts.

Given the high levels of performance variability between different prompts (up to 17 pp, as observed in our experiments), it is crucial to experiment with a sufficiently large set of prompts, so as to obtain statistically reliable estimates of performance, independent of individual prompt formulations.

Include estimates of performance mean and variance based on a large set of prompts for a more accurate picture of model capabilities.

Treat prompts as hyperparameters. When choosing a single prompt for evaluation, select it per model and dataset on a held-out development set.

Standardize and report metrics characterising the prompt set and its impact on performance.

For prompt collections, report metrics such as perplexity, degree of ambiguity, and their distribution. Analyse how these correlate with performance metrics or log probabilities of true labels using correlation coefficients (Gonen et al., 2022).

Use mixed effects models (Gelman and Hill, 2006) to analyse how prompt characteristics influence model performance per dataset and sample (Lampinen et al., 2022).

8 Conclusion

We evaluated five LLMs, both pretrained and instruction-tuned, on parallel sets of prompts that systematically differ in grammatical mood, aspect, tense, modality and use of synonyms. We find that there is no favoured sentence structure that performs best across models and tasks. Prompts generally transfer poorly across datasets and models. We find considerable performance variation, which can still persist even for larger instruction-tuned LLMs on seen tasks and is not explained by perplexity, word sense ambiguity or word frequency.

Limitations

In this work, we experiment with LLMs of up to 30b parameters that are able to perform a variety of tasks in a zero-shot fashion. We did not include larger open-source LMs or OpenAI’s GPT-3 due to (computational) cost. Further at the time of writing, the OpenAI API provides only the top 5 log probabilities given any input. This stands potentially at odds with the evaluation procedure of making a prediction based on which answer option receives the highest log probability, independently of whether that answer option occurs in the top 5 log probabilities. We did not include results for smaller variants of OPT (IML) and LLaMA, since they did not perform significantly above chance across all our tasks in the zero-shot setting in initial experiments.

So as to not introduce an additional source of variation in our experiments and observe the effect of linguistic variation in as much isolation as possible, we did not include experiments on in-context learning or priming (Lu et al., 2022; Zhou et al., 2022; Zhao et al., 2021; Min et al., 2022). We focus on the zero-shot setting only, so that models can infer a given task only based on an instruction without any demonstrations.

Future experiments could include more experiments on other architectures such as encoder-decoder models, e.g. T5 (Raffel et al., 2020), T0 (Sanh et al., 2022) or Flan-T5 (Chung et al., 2022), or multilingual models, e.g. bloom (Scao et al., 2022) or bloomz (Muennighoff et al., 2022). Investigating model behaviour based on linguistic properties in languages that are morphologically richer than English would equally pose an interesting avenue for further research.

In future research, we would also like to draw a comparison with an instruction-tuned version

of LLaMA. At the time of writing, we are only aware of models such as Vicuna⁸ and Alpaca⁹ which are trained on data generated by OpenAI text-davinci-003 or interactions with human users, unlike OPT-IML which has been fine-tuned on a large collection of NLP tasks. We did thus not include Vicuna and Alpaca in our experiments so as to avoid a skewed comparison.

Ethics & broader impact

In this work, we analyse LLM behaviour given a variety of linguistic properties provided to them as prompts. We uncover that models process language which varies in word sense ambiguity, frequency, perplexity, and length of expression in unexpected ways. Based on our findings, we provide recommendations for reliable and robust evaluation practices. Providing recommendations for prompt engineering from a linguistic point of view is not the decided aim of this study and indeed any recommendations that could be derived from our results appear localised to the context of a particular models or dataset. We publicly release our set of 550 prompts in Appendix D, as a basis for further research on LLM behaviour through the lens of linguistics.

While our work does not include tasks close to real-world applications such as hate speech detection, our findings indicate that performance on such tasks might also vary considerably under different instructions. We thus advise NLP practitioners working on sensitive applications with very large LMs to carefully evaluate model performance across a broader range of semantically equivalent instructions. In particular, evaluation reports should include measures of performance variability across prompts, seeds and demonstration examples. Further, prompts that have been engineered based on a particular model and dataset should not be transferred to other datasets or domains, since in general universality of optimal prompts cannot be assumed. Developers of LLMs for hate speech detection and related tasks should account for instabilities, particularly when using LLMs for automatic annotation.

⁸<https://github.com/lm-sys/FastChat>

⁹<https://crfm.stanford.edu/2023/03/13/alpaca.html>

Acknowledgements

We thank our anonymous reviewers for their insightful comments. The work for this publication is financially supported by the project, ‘From Learning to Meaning: A new approach to Generic Sentences and Implicit Biases’ (project number 406.18.TW.007) of the research programme SGW Open Competition, which is (partly) financed by the Dutch Research Council (NWO).

References

- Tom Brown, Benjamin Mann, Nick Ryder, Melanie Subbiah, Jared D Kaplan, Prafulla Dhariwal, Arvind Neelakantan, Pranav Shyam, Girish Sastry, Amanda Askell, et al. 2020. Language models are few-shot learners. *Advances in neural information processing systems*, 33:1877–1901.
- Boxi Cao, Hongyu Lin, Xianpei Han, Fangchao Liu, and Le Sun. 2022. [Can prompt probe pretrained language models? understanding the invisible risks from a causal view](#). In *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, pages 5796–5808, Dublin, Ireland. Association for Computational Linguistics.
- Aakanksha Chowdhery, Sharan Narang, Jacob Devlin, Maarten Bosma, Gaurav Mishra, Adam Roberts, Paul Barham, Hyung Won Chung, Charles Sutton, Sebastian Gehrmann, Parker Schuh, Kensen Shi, Sasha Tsvyashchenko, Joshua Maynez, Abhishek Rao, Parker Barnes, Yi Tay, Noam Shazeer, Vinodkumar Prabhakaran, Emily Reif, Nan Du, Ben Hutchinson, Reiner Pope, James Bradbury, Jacob Austin, Michael Isard, Guy Gur-Ari, Pengcheng Yin, Toju Duke, Anselm Levskaya, Sanjay Ghemawat, Sunipa Dev, Henryk Michalewski, Xavier Garcia, Vedant Misra, Kevin Robinson, Liam Fedus, Denny Zhou, Daphne Ippolito, David Luan, Hyeontaek Lim, Barret Zoph, Alexander Spiridonov, Ryan Sepassi, David Dohan, Shivani Agrawal, Mark Omernick, Andrew M. Dai, Thanumalayan Sankaranarayanan Pilla, Marie Pellat, Aitor Lewkowycz, Erica Moreira, Rewon Child, Oleksandr Polozov, Katherine Lee, Zongwei Zhou, Xuezhi Wang, Brennan Saeta, Mark Diaz, Orhan Firat, Michele Catasta, Jason Wei, Kathy Meier-Hellstern, Douglas Eck, Jeff Dean, Slav Petrov, and Noah Fiedel. 2022. [PaLM: Scaling Language Modeling with Pathways](#). ArXiv: 2204.02311.
- Hyung Won Chung, Le Hou, Shayne Longpre, Barret Zoph, Yi Tay, William Fedus, Eric Li, Xuezhi Wang, Mostafa Dehghani, Siddhartha Brahma, et al. 2022. Scaling instruction-finetuned language models. *arXiv preprint arXiv:2210.11416*.
- Christopher Clark, Kenton Lee, Ming-Wei Chang, Tom Kwiatkowski, Michael Collins, and Kristina Toutanova. 2019. Boolq: Exploring the surprising difficulty of natural yes/no questions. In *Proceedings of the 2019 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Volume 1 (Long and Short Papers)*, pages 2924–2936.
- Peter Clark, Isaac Cowhey, Oren Etzioni, Tushar Khot, Ashish Sabharwal, Carissa Schoenick, and Oyvind Tafjord. 2018. Think you have solved question answering? try arc, the ai2 reasoning challenge. *arXiv:1803.05457v1*.
- Ishita Dasgupta, Andrew K. Lampinen, Stephanie C. Y. Chan, Antonia Creswell, Dharshan Kumaran, James L. McClelland, and Felix Hill. 2022. [Language models show human-like content effects on reasoning](#). ArXiv:2207.07051 [cs].
- Mark Davies and Jong-Bok Kim. 2019. The advantages and challenges of "big data": Insights from the 14 billion word iweb corpus. *Linguistic Research*, 36(1):1–34.
- Marie-Catherine De Marneffe, Mandy Simons, and Judith Tonhauser. 2019. The commitmentbank: Investigating projection in naturally occurring discourse. In *proceedings of Sinn und Bedeutung*, volume 23, pages 107–124.
- Milton Friedman. 1937. The use of ranks to avoid the assumption of normality implicit in the analysis of variance. *Journal of the american statistical association*, 32(200):675–701.
- Deep Ganguli, Danny Hernandez, Liane Lovitt, Amanda Askell, Yuntao Bai, Anna Chen, Tom Conerly, Nova Dassarma, Dawn Drain, Nelson Elhage, Sheer El Showk, Stanislav Fort, Zac Hatfield-Dodds, Tom Henighan, Scott Johnston, Andy Jones, Nicholas Joseph, Jackson Kernian, Shauna Kravec, Ben Mann, Neel Nanda, Kamal Ndousse, Catherine Olsson, Daniela Amodei, Tom Brown, Jared Kaplan, Sam McCandlish, Christopher Olah, Dario Amodei, and Jack Clark. 2022. [Predictability and Surprise in Large Generative Models](#). In *2022 ACM Conference on Fairness, Accountability, and Transparency*, pages 1747–1764, Seoul Republic of Korea. ACM.
- Tianyu Gao, Adam Fisch, and Danqi Chen. 2021. [Making pre-trained language models better few-shot learners](#). In *Proceedings of the 59th Annual Meeting of the Association for Computational Linguistics and the 11th International Joint Conference on Natural Language Processing (Volume 1: Long Papers)*, pages 3816–3830, Online. Association for Computational Linguistics.
- Andrew Gelman and Jennifer Hill. 2006. *Data analysis using regression and multilevel/hierarchical models*. Cambridge university press.
- Hila Gonen, Srinu Iyer, Terra Blevins, Noah A Smith, and Luke Zettlemoyer. 2022. Demystifying prompts in language models via perplexity estimation. *arXiv preprint arXiv:2212.04037*.

- Ari Holtzman, Peter West, Vered Shwartz, Yejin Choi, and Luke Zettlemoyer. 2021. [Surface form competition: Why the highest probability answer isn't always right](#). In *Proceedings of the 2021 Conference on Empirical Methods in Natural Language Processing*, pages 7038–7051, Online and Punta Cana, Dominican Republic. Association for Computational Linguistics.
- Yoichi Ishibashi, Danushka Bollegala, Katsuhito Sudoh, and Satoshi Nakamura. 2023. [Evaluating the robustness of discrete prompts](#). In *Proceedings of the 17th Conference of the European Chapter of the Association for Computational Linguistics*, pages 2373–2384, Dubrovnik, Croatia. Association for Computational Linguistics.
- Srinivasan Iyer, Xi Victoria Lin, Ramakanth Pasunuru, Todor Mihaylov, Dániel Simig, Ping Yu, Kurt Shuster, Tianlu Wang, Qing Liu, Punit Singh Koura, et al. 2022. Opt-impl: Scaling language model instruction meta learning through the lens of generalization. *arXiv preprint arXiv:2212.12017*.
- Mohit Iyyer, John Wieting, Kevin Gimpel, and Luke Zettlemoyer. 2018. [Adversarial example generation with syntactically controlled paraphrase networks](#). In *Proceedings of the 2018 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Volume 1 (Long Papers)*, pages 1875–1885, New Orleans, Louisiana. Association for Computational Linguistics.
- Zhengbao Jiang, Frank F. Xu, Jun Araki, and Graham Neubig. 2020. [How can we know what language models know?](#) *Transactions of the Association for Computational Linguistics*, 8:423–438.
- Takeshi Kojima, Shixiang Shane Gu, Machel Reid, Yutaka Matsuo, and Yusuke Iwasawa. 2022. Large language models are zero-shot reasoners. In *Advances in Neural Information Processing Systems*.
- Abdullatif Köksal, Timo Schick, and Hinrich Schütze. 2022. Meal: Stable and active learning for few-shot prompting. *arXiv preprint arXiv:2211.08358*.
- Andrew Lampinen, Ishita Dasgupta, Stephanie Chan, Kory Mathewson, Mh Tessler, Antonia Creswell, James McClelland, Jane Wang, and Felix Hill. 2022. [Can language models learn from explanations in context?](#) In *Findings of the Association for Computational Linguistics: EMNLP 2022*, pages 537–563, Abu Dhabi, United Arab Emirates. Association for Computational Linguistics.
- Chonghua Liao, Yanan Zheng, and Zhilin Yang. 2022. Zero-label prompt selection. *arXiv preprint arXiv:2211.04668*.
- Pengfei Liu, Weizhe Yuan, Jinlan Fu, Zhengbao Jiang, Hiroaki Hayashi, and Graham Neubig. 2023. Pre-train, prompt, and predict: A systematic survey of prompting methods in natural language processing. *ACM Computing Surveys*, 55(9):1–35.
- Robert Logan IV, Ivana Balazevic, Eric Wallace, Fabio Petroni, Sameer Singh, and Sebastian Riedel. 2022. [Cutting down on prompts and parameters: Simple few-shot learning with language models](#). In *Findings of the Association for Computational Linguistics: ACL 2022*, pages 2824–2835, Dublin, Ireland. Association for Computational Linguistics.
- Yao Lu, Max Bartolo, Alastair Moore, Sebastian Riedel, and Pontus Stenetorp. 2022. [Fantastically ordered prompts and where to find them: Overcoming few-shot prompt order sensitivity](#). In *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, pages 8086–8098, Dublin, Ireland. Association for Computational Linguistics.
- Andrew L. Maas, Raymond E. Daly, Peter T. Pham, Dan Huang, Andrew Y. Ng, and Christopher Potts. 2011. [Learning word vectors for sentiment analysis](#). In *Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics: Human Language Technologies*, pages 142–150, Portland, Oregon, USA. Association for Computational Linguistics.
- George A Miller. 1995. Wordnet: a lexical database for english. *Communications of the ACM*, 38(11):39–41.
- Sewon Min, Xinxin Lyu, Ari Holtzman, Mikel Artetxe, Mike Lewis, Hannaneh Hajishirzi, and Luke Zettlemoyer. 2022. [Rethinking the role of demonstrations: What makes in-context learning work?](#) In *Proceedings of the 2022 Conference on Empirical Methods in Natural Language Processing*, pages 11048–11064, Abu Dhabi, United Arab Emirates. Association for Computational Linguistics.
- Niklas Muennighoff, Thomas Wang, Lintang Sutawika, Adam Roberts, Stella Biderman, Teven Le Scao, M Saiful Bari, Sheng Shen, Zheng-Xin Yong, Hailey Schoelkopf, et al. 2022. Crosslingual generalization through multitask finetuning. *arXiv preprint arXiv:2211.01786*.
- K Pearson. 1895. Notes on regression and inheritance in the case of two parents proceedings of the royal society of london, 58, 240-242. *K Pearson*.
- Jack W Rae, Sebastian Borgeaud, Trevor Cai, Katie Millican, Jordan Hoffmann, Francis Song, John Aslanides, Sarah Henderson, Roman Ring, Susannah Young, Eliza Rutherford, Tom Hennigan, Jacob Menick, Albin Cassirer, Richard Powell, George Van Den Driessche, Lisa Anne Hendricks, Maribeth Rauh, Po-Sen Huang, Amelia Glaese, Johannes Welbl, Sumanth Dathathri, Saffron Huang, Jonathan Uesato, John Mellor, Irina Higgins, Antonia Creswell, Nat McAleese, Amy Wu, Erich Elsen, Siddhant Jayakumar, Elena Buchatskaya, David Budden, Esme Sutherland, Karen Simonyan, Michela Paganini, Laurent Sifre, Lena Martens, Lorraine Li, Adhiguna Kuncoro, Aida Nematzadeh, Elena Gribovskaya, Domenic Donato, Angeliki Lazaridou,

- Arthur Mensch, Jean-Baptiste Lespiau, Maria Tsim-poukelli, Nikolai Grigorev, Doug Fritz, Thibault Sot-tiaux, Mantas Pajarskas, Toby Pohlen, Zhitao Gong, Daniel Toyama, Cyprien De Masson D'autume, Yujia Li, Tayfun Terzi, Vladimir Mikulik, Igor Babuschkin, Aidan Clark, Diego De, Las Casas, Aurelia Guy, Chris Jones, James Bradbury, Matthew Johnson, Blake Hechtman, Laura Weidinger, Iason Gabriel, William Isaac, Ed Lockhart, Simon Osindero, Laura Rimell, Chris Dyer, Oriol Vinyals, Kareem Ayoub, Jeff Stanway, Lorraine Bennett, Demis Hassabis, Koray Kavukcuoglu, and Geoffrey Irving. 2022. Scaling Language Models: Methods, Analysis & Insights from Training Gopher. Technical report. ArXiv: 2112.11446v2.
- Colin Raffel, Noam Shazeer, Adam Roberts, Katherine Lee, Sharan Narang, Michael Matena, Yanqi Zhou, Wei Li, and Peter J Liu. 2020. Exploring the limits of transfer learning with a unified text-to-text transformer. *Journal of Machine Learning Research*, 21:1–67.
- Yasaman Razeghi, Robert L Logan IV, Matt Gardner, and Sameer Singh. 2022. [Impact of pretraining term frequencies on few-shot numerical reasoning](#). In *Findings of the Association for Computational Linguistics: EMNLP 2022*, pages 840–854, Abu Dhabi, United Arab Emirates. Association for Computational Linguistics.
- Victor Sanh, Albert Webson, Colin Raffel, Stephen H Bach, Lintang Sutawika, Zaid Alyafeai, Antoine Chaffin, Arnaud Stiegler, Teven Le Scao, Arun Raja, et al. 2022. Multitask prompted training enables zero-shot task generalization. In *ICLR 2022-Tenth International Conference on Learning Representations*.
- Teven Le Scao, Angela Fan, Christopher Akiki, El-lie Pavlick, Suzana Ilić, Daniel Hesslow, Roman Castagné, Alexandra Sasha Luccioni, François Yvon, Matthias Gallé, et al. 2022. Bloom: A 176b-parameter open-access multilingual language model. *arXiv preprint arXiv:2211.05100*.
- Timo Schick and Hinrich Schütze. 2021. [It’s not just size that matters: Small language models are also few-shot learners](#). In *Proceedings of the 2021 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, pages 2339–2352, Online. Association for Computational Linguistics.
- Omar Shaikh, Hongxin Zhang, William Held, Michael Bernstein, and Diyi Yang. 2023. [On second thought, let’s not think step by step! bias and toxicity in zero-shot reasoning](#).
- Taylor Shin, Yasaman Razeghi, Robert L. Logan IV, Eric Wallace, and Sameer Singh. 2020. [AutoPrompt: Eliciting Knowledge from Language Models with Automatically Generated Prompts](#). In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, pages 4222–4235, Online. Association for Computational Linguistics.
- Richard Socher, Alex Perelygin, Jean Wu, Jason Chuang, Christopher D. Manning, Andrew Ng, and Christopher Potts. 2013. [Recursive deep models for semantic compositionality over a sentiment treebank](#). In *Proceedings of the 2013 Conference on Empirical Methods in Natural Language Processing*, pages 1631–1642, Seattle, Washington, USA. Association for Computational Linguistics.
- Taylor Sorensen, Joshua Robinson, Christopher Rytting, Alexander Shaw, Kyle Rogers, Alexia Delorey, Mahmoud Khalil, Nancy Fulda, and David Wingate. 2022. [An information-theoretic approach to prompt engineering without ground truth labels](#). In *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, pages 819–862, Dublin, Ireland. Association for Computational Linguistics.
- Charles Spearman. 1961. The proof and measurement of association between two things.
- Hugo Touvron, Thibaut Lavril, Gautier Izacard, Xavier Martinet, Marie-Anne Lachaux, Timothée Lacroix, Baptiste Rozière, Naman Goyal, Eric Hambro, Faisal Azhar, Aurelien Rodriguez, Armand Joulin, Edouard Grave, and Guillaume Lample. 2023. [LLaMA: Open and Efficient Foundation Language Models](#). ArXiv:2302.13971 [cs].
- Alex Wang, Yada Pruksachatkun, Nikita Nangia, Amanpreet Singh, Julian Michael, Felix Hill, Omer Levy, and Samuel Bowman. 2019. Superglue: A stickier benchmark for general-purpose language understanding systems. *Advances in neural information processing systems*, 32.
- Alex Wang, Amanpreet Singh, Julian Michael, Felix Hill, Omer Levy, and Samuel Bowman. 2018. [GLUE: A multi-task benchmark and analysis platform for natural language understanding](#). In *Proceedings of the 2018 EMNLP Workshop BlackboxNLP: Analyzing and Interpreting Neural Networks for NLP*, pages 353–355, Brussels, Belgium. Association for Computational Linguistics.
- Albert Webson and Ellie Pavlick. 2022. [Do prompt-based models really understand the meaning of their prompts?](#) In *Proceedings of the 2022 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, pages 2300–2344, Seattle, United States. Association for Computational Linguistics.
- Jason Wei, Maarten Bosma, Vincent Zhao, Kelvin Guu, Adams Wei Yu, Brian Lester, Nan Du, Andrew M Dai, and Quoc V Le. 2021. Finetuned language models are zero-shot learners. In *International Conference on Learning Representations*.
- Frank Wilcoxon. 1992. *Individual comparisons by ranking methods*. Springer.
- Thomas Wolf, Lysandre Debut, Victor Sanh, Julien Chaumond, Clement Delangue, Anthony Moi, Pi-er-ric Cistac, Tim Rault, Remi Louf, Morgan Funtowicz, Joe Davison, Sam Shleifer, Patrick von Platen,

Clara Ma, Yacine Jernite, Julien Plu, Canwen Xu, Teven Le Scao, Sylvain Gugger, Mariama Drame, Quentin Lhoest, and Alexander Rush. 2020. [Transformers: State-of-the-art natural language processing](#). In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing: System Demonstrations*, pages 38–45, Online. Association for Computational Linguistics.

Susan Zhang, Stephen Roller, Naman Goyal, Mikel Artetxe, Moya Chen, Shuohui Chen, Christopher Dewan, Mona Diab, Xian Li, Xi Victoria Lin, Todor Mihaylov, Myle Ott, Sam Shleifer, Kurt Shuster, Daniel Simig, Punit Singh Koura, Anjali Sridhar, Tianlu Wang, and Luke Zettlemoyer. 2022. [OPT: Open Pre-trained Transformer Language Models](#). ArXiv:2205.01068.

Zihao Zhao, Eric Wallace, Shi Feng, Dan Klein, and Sameer Singh. 2021. Calibrate before use: Improving few-shot performance of language models. In *International Conference on Machine Learning*, pages 12697–12706. PMLR.

Denny Zhou, Nathanael Schärli, Le Hou, Jason Wei, Nathan Scales, Xuezhi Wang, Dale Schuurmans, Olivier Bousquet, Quoc Le, and Ed Chi. 2022. Least-to-most prompting enables complex reasoning in large language models. *arXiv preprint arXiv:2205.10625*.

A Example prompt

In this section, we give an example prompt for sentiment classification featuring a random input sample from SST-2.

<p><u>Prompt:</u> <i>Do you want to watch this movie based on this movie review?</i></p> <p><i>An entertaining British hybrid of comedy, caper thrills and quirky romance.</i> <i>Choices: yes or no? Answer:</i></p> <p><u>Answer choices:</u> <i>yes, no</i></p> <p><u>True answer:</u> <i>yes</i></p>
--

B Average runtime

On average, evaluating LLaMA, OPT or OPT-IML 30b on all prompts for one dataset took approximately two hours using four NVIDIA A100 GPUs. Evaluating OPT or OPT-IML 1.3b on all prompts for one dataset took around 15 minutes using one GPU.

C Performance variability in encoder-decoder models

In preliminary experiments we also considered encoder-decoder models, e.g. Flan-T5 (Chung et al., 2022). We later restricted our experimental setup to decoder-only models, since they are more widely used to-date. To demonstrate performance variability similar to the main results in the paper also for an encoder-decoder model we include illustrative results on mood and synonymy for Flan-T5 (XL) for sentiment classification and NLI in Tables 6, 7, 8.

D Performance per prompt

We list all prompts used in our experiments for sentiment analysis (Table 9), NLI (Table 13) and Question Answering (Table 11) grouped by the grammatical properties we investigate. Properties we investigate are mood (indicative, imperative, interrogative), aspect (active, passive), tense (past, present, future), modality (can, could, may, might, must, should, would), and synonymy (different synonyms per task). Note that the number of prompts

		SST	IMDB	RTE	HANS
mood	ind.	86.6	94.6	86.1	76.4
	inter.	87.3	95.8	88.8	77.5
	imp.	88.2	96.1	90.9	77.3

Table 6: Average accuracy per prompt in category mood (indicative, interrogative, imperative) for Flan-T5 XL on SST-2, IMDB, RTE, HANS. Highest accuracy per dataset marked in bold.

		RTE	HANS
syn.	entailment	95	77
	implication	96	78.4
syn.	assertion	91	81.5
	claim	92.5	81

Table 7: Average accuracy per prompt in category synonymy for Flan-T5 XL on RTE, HANS. Highest accuracy per dataset marked in bold.

		SST	IMDB
synonymy	appraisal	83.4	85.7
	commentary	77.7	80.4
	critique	81.5	85.8
	evaluation	83.7	88.4

Table 8: Average accuracy per prompt in category synonymy for Flan-T5 XL on SST-2, IMDB. Highest accuracy per dataset marked in bold.

per property, eg. for mood vs. aspect, might differ, since not all prompts listed under mood (Eg., ‘*Is this a good movie?*’) can be phrased in active and passive voice. They are thus omitted from active and passive. We detail accuracy per prompt for all models used in our experiments.

E Perplexity per category

In Tables 15, 16, 17, 18, 19, 20 we list perplexity scores for each linguistic property and model in each task.

property	prompt	LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
		SST	IMDB	SST	IMDB	SST	IMDB	SST	IMDB	SST	IMDB
-	<null prompt>	83.2	72.8	41.2	64.2	12.8	93.0	65.8	74.8	37.0	86.2
ind.	You find this movie review positive	84.2	94.0	89.4	62.0	91.4	89.2	87.4	66.2	91.4	59.6
ind.	This is a good movie	82.4	88.33	47.0	77.2	35.8	79.4	53.2	70.6	89.0	66.8
ind.	The label for this movie review is positive	84.2	92.67	58.8	75.6	92.0	92.2	81.8	66.6	90.6	60.8
ind.	You like the movie based on this movie review	85.0	91.67	83.6	64.6	89.2	92.6	82.0	70.0	91.8	73.4
ind.	This movie review makes people think this is a good movie	85.6	91.33	43.8	77.2	46.4	97.2	69.4	75.0	93.0	83.6
ind.	This movie review makes people want to watch this movie	79.8	91.0	54.8	78.4	51.6	97.6	85.4	69.0	91.0	78.2
ind.	This movie review is positive	80.6	92.67	58.0	75.8	63.0	92.0	80.4	67.0	90.4	71.4
ind.	You want to watch this movie based on this movie review	78.4	91.0	84.4	64.2	45.0	95.2	70.0	75.4	91.4	76.8
inter.	Do you find this movie review positive?	90.2	90.3	89.8	49.8	93.6	94.6	89.2	56.6	91.2	85.4
inter.	Is this a good movie	88.0	93.3	88.2	64.2	91.6	80.8	73.8	73.2	92.8	91.6
inter.	Is the label for this movie review positive	86.0	90.0	90.4	59.6	92.8	95.4	85.6	61.2	92.6	93.8
inter.	Do you like the movie based on this movie review	85.8	89.3	89.2	59.6	93.0	90.8	88.2	73.4	92.2	88.2
inter.	Does this movie review make people think this is a good movie	80.4	85.0	79.2	63.0	92.8	94.4	45.4	78.6	92.2	91.0
inter.	Does this movie review make people want to watch this movie	87.0	94.0	88.4	60.6	92.8	93.4	80.0	78.8	92.4	90.0
inter.	Is this movie review positive	88.0	90.7	90.2	54.0	93.8	94.6	89.0	61.2	92.2	92.4
inter.	Do you want to watch this movie based on this movie review	87.0	85.7	88.4	56.2	92.0	93.2	88.0	76.6	92.4	87.0
imp.	Tell me if you find this movie review positive	86.8	94.67	85.8	67.2	93.2	94.0	86.6	60.2	91.8	82.2
imp.	Tell me if this is a good movie	87.4	94.0	73.6	73.6	92.2	84.8	73.0	77.2	92.6	88.0
imp.	Tell me if the label for this movie review is positive	90.0	92.33	76.8	73.8	92.6	94.6	87.0	61.4	93.2	91.0
imp.	Tell me if you like the movie based on this movie review	83.8	95.0	80.0	71.0	92.0	94.2	87.8	69.4	92.6	85.6
imp.	Tell me if this movie review makes people think this is a good movie	70.2	83.67	68.0	81.4	91.8	93.8	39.0	76.0	93.6	90.8
imp.	Tell me if this movie review makes people want to watch this movie	86.8	93.67	75.2	78.6	92.8	93.0	86.6	70.6	92.8	90.8
imp.	Tell me if this movie review is positive	87.4	93.0	80.8	71.6	93.2	94.6	89.4	45.6	92.4	88.4
imp.	Tell me if you want to watch this movie based on this movie review	76.8	93.0	74.6	75.4	90.2	94.4	83.2	75.4	92.4	83.2
active	Do people consider this movie review positive	87.4	91.67	88.4	60.4	93.6	93.6	68.6	68.8	92.0	91.2
active	Do people label this movie review as positive	87.8	89.33	80.0	64.8	93.6	95.0	80.2	64.4	91.6	90.4
active	Do people like this movie	87.4	93.67	81.0	68.0	93.0	90.2	75.2	73.4	93.0	93.0
active	Does this movie review make people think that this is a good movie	65.0	82.0	77.6	64.2	93.0	94.0	54.0	77.8	92.4	90.4
passive	Is this movie review considered positive by people	88.8	94.0	87.6	59.2	93.4	94.4	67.0	67.2	92.0	91.6
passive	Is this movie review labelled as positive by people	85.4	94.33	88.0	60.2	93.2	94.4	69.2	69.6	92.2	91.6
passive	Is this movie liked by people	85.4	91.0	89.8	59.8	92.8	90.6	68.6	72.8	92.6	93.6
passive	Are people made to think by this review that this is a good movie	53.4	92.67	77.8	64.2	91.8	93.2	79.2	71.6	93.4	94.2
can	Can you find this movie review positive	83.2	94.67	87.6	56.0	93.0	93.8	87.6	67.2	92.4	89.33
can	Can this be a good movie	86.8	87.33	85.2	66.8	91.8	79.8	83.2	73.8	93.6	90.67
can	Can the label for this movie review be positive	88.4	93.33	82.6	70.6	92.4	93.2	83.0	68.2	93.2	91.0
can	Can you like the movie based on this movie review	86.6	91.33	88.6	65.2	92.8	92.6	87.4	72.8	92.2	87.67
can	Can this movie review make people think this is a good movie	79.4	89.67	65.8	67.4	92.4	91.0	36.6	81.6	93.4	89.67
can	Can this movie review make people want to watch this movie	84.2	85.33	82.6	68.0	93.0	91.8	75.8	79.2	93.0	88.0
can	Can this movie review be positive	85.4	89.67	83.2	68.0	92.8	91.0	79.8	70.8	92.8	90.33
can	Can you want to watch this movie based on this movie review	87.8	91.33	88.4	56.2	91.8	93.0	86.2	74.4	92.0	86.33
could	Could you find this movie review positive	87.2	93.33	82.6	59.2	93.0	93.4	89.8	62.4	92.4	88.67
could	Could this be a good movie	89.6	87.0	75.8	68.2	91.8	78.8	68.0	77.2	93.4	89.33
could	Could the label for this movie review be positive	86.4	94.67	82.4	68.4	93.0	90.4	78.4	70.0	93.2	90.67
could	Could you like the movie based on this movie review	86.4	91.67	85.4	66.2	93.0	92.8	82.2	73.8	92.0	84.33
could	Could this movie review make people think this is a good movie	67.6	93.67	55.4	70.0	92.8	90.4	29.8	80.6	93.2	89.0
could	Could this movie review make people want to watch this movie	85.0	88.0	74.0	71.8	92.8	91.4	63.8	80.6	92.8	87.67
could	Could this movie review be positive	87.0	89.0	76.0	68.0	92.8	91.2	75.2	71.2	92.4	90.33
could	Could you want to watch this movie based on this movie review	88.8	93.67	88.2	65.2	90.2	93.2	80.6	76.4	92.0	80.67
may	May you find this movie review positive	83.6	85.33	89.2	57.2	92.4	92.0	86.8	65.0	92.2	89.33
may	May this be a good movie	89.4	89.0	82.2	70.0	92.6	83.4	73.8	74.0	93.4	90.67
may	May the label for this movie review be positive	79.8	86.0	80.0	69.4	92.4	89.0	85.0	63.8	92.4	90.0
may	May you like the movie based on this movie review	81.8	86.0	84.6	62.6	92.6	93.0	88.0	73.2	92.0	84.67
may	May this movie review make people think this is a good movie	86.8	88.33	70.6	69.0	93.0	91.6	72.4	75.6	93.0	88.0
may	May this movie review make people want to watch this movie	76.8	81.67	83.6	67.8	93.6	92.6	90.0	72.8	92.4	87.0
may	May this movie review be positive	90.8	88.0	82.8	66.4	92.2	91.4	76.6	70.0	93.0	90.33
may	May you want to watch this movie based on this movie review	88.0	92.67	88.0	59.0	90.0	93.6	85.8	74.4	92.0	79.0
might	Might you find this movie review positive	87.8	90.67	87.6	62.6	93.2	93.8	84.8	66.4	92.0	90.33
might	Might this be a good movie	84.2	89.0	78.4	71.4	92.4	82.6	63.0	77.0	93.4	88.33
might	Might the label for this movie review be positive	89.4	93.0	82.4	69.6	92.6	92.0	53.4	69.0	92.8	91.0
might	Might you like the movie based on this movie review	87.0	91.0	80.8	67.2	91.2	91.8	76.8	73.8	92.8	75.33
might	Might this movie review make people think this is a good movie	62.0	95.0	58.8	76.2	92.4	92.2	30.6	76.4	94.8	89.0
might	Might this movie review make people want to watch this movie	86.2	87.67	76.6	73.2	93.6	93.0	85.8	73.8	92.4	88.0
might	Might this movie review be positive	85.6	90.67	75.4	68.6	93.0	91.4	62.0	69.6	92.8	90.33
might	Might you want to watch this movie based on this movie review	88.6	93.0	77.4	69.0	89.6	92.0	71.4	75.6	92.4	72.33
must	Must you find this movie review positive	81.8	89.33	89.8	51.4	92.6	95.6	89.0	58.2	92.2	90.67
must	Must this be a good movie	78.4	87.0	88.0	65.2	91.4	74.2	81.4	72.6	93.0	84.67
must	Must the label for this movie review be positive	62.6	95.0	82.8	69.2	92.8	94.0	86.0	56.8	93.0	90.33
must	Must you like the movie based on this movie review	73.6	94.33	90.2	59.4	93.0	92.6	89.2	70.0	92.4	86.67
must	Must this movie review make people think this is a good movie	63.2	91.0	71.8	64.6	92.8	95.0	62.0	75.6	93.0	89.0
must	Must this movie review make people want to watch this movie	89.8	86.33	84.6	61.8	93.0	94.2	86.6	73.8	92.6	87.33
must	Must this movie review be positive	66.6	90.0	88.6	54.8	93.4	94.2	80.4	64.8	92.6	89.67
must	Must you want to watch this movie based on this movie review	88.2	92.0	89.0	51.8	91.4	94.0	88.6	71.8	92.0	85.67
should	Should you find this movie review positive	89.6	92.0	88.8	58.0	93.6	93.8	87.2	68.4	92.0	88.67
should	Should this be a good movie	89.2	88.67	87.6	65.4	91.0	73.0	87.0	71.2	93.6	88.67
should	Should the label for this movie review be positive	88.6	94.0	86.6	65.8	93.2	93.2	88.8	56.4	93.4	91.0
should	Should you like the movie based on this movie review	85.8	91.33	82.6	64.8	93.0	92.2	85.2	73.8	92.2	88.67
should	Should this movie review make people think this is a good movie	57.8	94.33	73.2	69.0	92.0	91.4	42.4	79.6	93.0	88.33
should	Should this movie review make people want to watch this movie	82.6	87.33	88.2	63.4	93.2	90.2	84.2	78.8	93.0	87.0
should	Should this movie review be positive	82.4	91.33	89.8	57.2	93.4	93.4	88.6	57.0	92.6	86.67
should	Should you want to watch this movie based on this movie review	87.4	91.67	87.0	61.0	92.8	93.2	87.2	76.0	92.0	87.0
would	Would you find this movie review positive	89.6	95.33	90.6	51.6	93.2	94.2	89.4	57.8	91.6	80.33
would	Would this be a good movie	88.0	90.0	88.2	64.2	91.6	81.4	70.0	76.8	93.2	88.67
would	Would the label for this movie review be positive	88.8	94.33	88.0	65.8	93.2	93.0	89.4	57.6	92.2	89.67
would	Would you like the movie based on this movie review	85.4	93.0	87.2	61.8	93.6	93.4	82.2	75.0	92.2	82.0
would	Would this movie review make people think this is a good movie	71.2	93.0	72.2	68.8	92.8	92.0	27.4	80.8	92.8	85.67
would	Would this movie review make people want to watch this movie	90.2	89.33	86.0	66.6	93.4	92.6	61.4	82.8	92.2	86.33
would	Would this movie review be positive	82.6	91.33	87.4	60.4	93.6	92.8	88.0	62.0	92.2	84.67
would	Would you want to watch this movie based on this movie review	92.0	94.0	88.8	57.8	92.8	93.0	84.4	77.2	92.0	84.67

Table 9: Detailed list of prompts for Sentiment Classification with accuracy per prompt on SST and IMDB across all models. Part 1 of 2.

property	prompt	LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
		SST	IMDB	SST	IMDB	SST	IMDB	SST	IMDB	SST	IMDB
appr.	Does this movie appr. make people think this is a good movie	72.8	93.67	79.2	61.6	93.4	89.2	30.6	80.0	93.6	94.0
appr.	Does this movie appr. make people want to watch this movie	89.0	91.67	85.0	65.6	93.4	91.4	69.6	80.8	93.6	92.0
appr.	Is this movie appr. positive	88.2	91.67	88.8	61.0	93.4	90.4	85.0	67.4	92.8	93.6
appr.	Do you find this movie appr. positive	85.2	93.67	90.4	55.2	93.6	91.2	90.6	62.0	92.6	92.0
appr.	Is the label for this movie appr. positive	79.2	91.0	90.0	62.6	93.2	91.8	80.2	69.8	93.8	94.0
appr.	Do you like the movie based on this movie appr.	79.0	94.0	89.6	60.0	92.8	88.2	89.0	75.0	92.4	92.0
appr.	Do you want to watch this movie based on this movie appr.	78.0	95.33	89.4	57.2	92.4	91.0	88.8	77.4	93.8	92.4
comm.	Does this movie comm. make people think this is a good movie	65.8	93.33	78.6	56.4	92.2	84.2	23.2	77.8	90.8	95.6
comm.	Does this movie comm. make people want to watch this movie	88.6	91.33	85.2	59.4	92.8	88.0	39.4	83.2	93.6	92.0
comm.	Is this movie comm. positive	88.4	90.67	86.2	61.2	93.4	90.4	70.2	67.2	94.0	93.8
comm.	Do you find this movie comm. positive	87.6	95.67	89.2	57.0	93.4	91.2	86.6	58.6	93.4	92.0
comm.	Is the label for this movie comm. positive	85.4	92.67	89.2	61.2	93.2	87.6	71.2	64.0	93.8	93.8
comm.	Do you like the movie based on this movie comm.	77.8	94.0	88.0	64.4	92.8	86.4	81.8	73.6	93.4	91.6
comm.	Do you want to watch this movie based on this movie comm.	77.6	93.0	88.2	62.0	92.6	88.4	78.0	78.6	91.8	92.8
critique	Does this movie critique make people think this is a good movie	68.6	93.0	72.8	57.8	91.2	91.2	23.6	80.2	92.6	95.0
critique	Does this movie critique make people want to watch this movie	87.4	90.0	83.4	60.2	92.0	91.6	47.0	83.8	92.2	91.2
critique	Is this movie critique positive	88.8	90.0	87.8	60.4	93.4	91.2	76.6	66.4	92.6	92.8
critique	Do you find this movie critique positive	85.6	93.67	90.6	53.0	93.6	91.8	89.6	56.2	92.0	90.2
critique	Is the label for this movie critique positive	87.2	91.67	88.0	64.0	92.8	93.2	69.8	64.0	92.8	93.6
critique	Do you like the movie based on this movie critique	86.6	94.0	89.4	60.2	93.0	88.6	85.0	73.2	92.6	90.2
critique	Do you want to watch this movie based on this movie critique	86.6	93.67	87.6	57.0	91.2	90.2	88.8	76.4	92.2	89.6
evaluation	Does this movie evaluation make people think this is a good movie	80.6	93.0	88.6	58.2	92.4	89.2	43.8	78.4	93.4	93.6
evaluation	Does this movie evaluation make people want to watch this movie	86.6	88.67	90.2	51.8	93.4	91.0	72.6	80.0	92.8	92.0
evaluation	Is this movie evaluation positive	89.0	90.0	91.2	53.0	93.8	94.4	82.4	66.8	92.2	93.0
evaluation	Do you find this movie evaluation positive	86.4	92.67	90.2	47.6	94.0	93.2	88.4	53.0	91.8	89.2
evaluation	Is the label for this movie evaluation positive	80.6	90.67	90.8	53.6	93.8	94.4	83.4	62.4	92.2	92.2
evaluation	Do you like the movie based on this movie evaluation	83.4	94.33	89.0	52.6	93.0	88.0	88.0	74.2	92.4	89.0
evaluation	Do you want to watch this movie based on this movie evaluation	78.8	94.67	89.2	49.6	92.6	92.0	89.2	76.8	92.6	89.8
review	Do you find this movie review positive	90.2	93.0	89.8	49.0	93.6	94.2	89.2	55.8	91.2	84.4
review	Is the label for this movie review positive	85.8	91.67	90.4	59.2	92.8	94.8	85.6	61.0	92.6	92.8
review	Do you like the movie based on this movie review	80.4	95.33	89.2	59.2	93.0	90.4	88.2	72.6	92.2	87.4
review	Does this movie review make people think this is a good movie	66.4	94.0	79.2	62.2	92.8	93.6	45.4	78.2	92.2	90.0
review	Does this movie review make people want to watch this movie	91.0	90.33	88.4	59.8	92.8	92.8	80.0	78.2	92.4	89.4
review	Is this movie review positive	89.4	90.67	90.2	53.4	93.8	94.0	89.0	61.0	92.2	91.4
review	Do you want to watch this movie based on this movie review	77.6	95.67	88.4	55.8	92.0	92.8	88.0	76.0	92.4	86.2

Table 10: Detailed list of prompts for Sentiment Classification with accuracy per prompt on SST and IMDB across all models. Part 2 of 2.

prop.	prompt	LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
		BoolQ	ARC-E	BoolQ	ARC-E	BoolQ	ARC-E	BoolQ	ARC-E	BoolQ	ARC-E
-	random	50	25	50	25	50	25	50	25	50	25
-	<null prompt>	64.0	75.0	61.5	26.13	68.0	29.29	68.0	28.28	72.0	63.64
ind.	You ans. the q.	81.0	79.17	62.0	30.65	62.5	32.16	66.0	30.3	73.0	65.66
ind.	You choose the best ans. to the q.	60.0	66.67	62.0	29.15	62.5	32.66	60.0	31.31	72.0	64.65
ind.	You choose this ans.	64.0	69.79	62.0	27.14	62.0	33.67	43.0	22.22	69.0	66.67
ind.	This ans. is correct	77.0	75.0	62.5	29.15	63.0	31.16	57.0	27.27	70.0	67.68
ind.	This is the correct ans. to the q.	81.0	76.04	62.5	32.16	63.5	32.66	61.0	33.33	73.0	64.65
ind.	You give me the correct ans.	77.0	79.17	62.0	22.61	64.0	29.65	64.0	35.35	69.0	68.69
ind.	You infer the correct ans.	82.0	73.96	62.0	25.13	64.0	30.15	64.0	33.33	70.0	66.67
ind.	You pick the correct ans.	66.0	75.0	62.0	26.63	63.5	30.65	47.0	30.3	70.0	69.7
ind.	You select the most suitable ans.	68.0	70.83	62.0	29.15	62.0	33.67	47.0	33.33	68.0	68.69
ind.	You solve the q. by choosing the correct ans.	72.0	76.04	61.5	26.63	63.0	35.68	47.0	39.39	72.0	72.73
ind.	You tell me which ans. is correct	63.0	63.54	62.0	25.13	64.5	29.15	61.0	34.34	71.0	65.66
ind.	You think this is the correct ans.	73.0	72.92	62.5	27.64	62.0	31.16	57.0	27.27	71.0	65.66
inter.	Could you ans. the q.	71.0	76.04	62.5	31.16	64.5	34.17	68.0	30.3	69.0	64.65
inter.	Could you choose the best ans. to the q.	59.0	79.17	62.5	29.15	63.0	32.16	68.0	37.37	68.0	64.65
inter.	Which ans. do you choose	66.0	78.12	62.5	28.64	64.0	29.65	62.0	38.38	65.0	63.64
inter.	Which ans. is correct	61.0	73.96	61.5	25.13	65.5	27.64	60.0	32.32	70.0	65.66
inter.	Which is the correct ans. to the q.	76.0	73.96	61.0	28.64	64.5	32.16	67.0	31.31	69.0	64.65
inter.	Could you give me the correct ans.	70.0	71.88	60.5	28.64	64.5	30.65	69.0	40.4	67.0	64.65
inter.	Could you infer the correct ans.	84.0	77.08	61.5	28.14	65.0	31.66	70.0	37.37	69.0	64.65
inter.	Could you pick the correct ans.	69.0	76.04	62.5	28.14	64.5	31.16	66.0	40.4	67.0	65.66
inter.	Could you select the most suitable ans.	63.0	76.04	62.5	31.66	63.0	34.17	67.0	38.38	67.0	64.65
inter.	Could you solve the q. by choosing the correct ans.	70.0	76.04	62.5	28.14	64.0	33.17	69.0	37.37	70.0	64.65
inter.	Could you tell me which ans. is correct	64.0	72.92	61.0	29.15	64.0	30.65	68.0	33.33	69.0	66.67
inter.	What do you think is the correct ans.	60.0	73.96	62.5	28.64	64.5	31.16	62.0	36.36	70.0	66.67
imp.	ans. the q.	65.0	79.17	62.5	32.66	63.5	30.15	66.0	30.3	73.0	67.68
imp.	Choose the best ans. to the q.	65.0	70.83	62.0	28.14	63.0	32.66	68.0	32.32	72.0	65.66
imp.	Tell me which ans. you choose	62.0	73.96	62.5	26.13	65.0	30.15	67.0	37.37	69.0	65.66
imp.	Tell me which ans. is correct	62.0	75.0	62.5	26.63	64.5	29.65	71.0	34.34	71.0	67.68
imp.	Tell me which is the correct ans. to the q.	71.0	71.88	62.0	27.64	64.5	31.16	68.0	36.36	71.0	67.68
imp.	Give me the correct ans.	78.0	73.96	61.0	26.63	64.5	33.17	68.0	34.34	69.0	69.7
imp.	Infer the correct ans.	78.0	76.04	62.5	27.64	66.5	31.66	73.0	33.33	72.0	68.69
imp.	Pick the correct ans.	61.0	77.08	62.0	28.14	64.0	31.16	58.0	32.32	71.0	65.66
imp.	Select the most suitable ans.	62.0	75.0	62.0	28.14	63.0	35.68	70.0	26.26	69.0	67.68
imp.	Solve the q. by choosing the correct ans.	50.0	72.92	62.0	27.64	64.5	34.67	71.0	35.35	71.0	65.66
imp.	Tell me what you think is the correct ans.	59.0	75.0	62.0	28.64	64.5	33.17	70.0	36.36	71.0	65.66
act.	Could you ans. the q.	71.0	74.87	62.5	31.16	64.5	34.17	64.5	33.67	62.0	63.82
act.	Could you choose the best ans. to the q.	59.0	76.96	62.5	29.15	63.0	32.16	61.5	37.19	61.5	66.83
act.	Which ans. do you choose	66.0	78.01	62.5	28.64	64.0	29.65	58.5	37.69	63.0	66.83
act.	Could you give me the correct ans.	70.0	74.35	60.5	28.64	64.5	30.65	62.5	38.19	62.0	65.33
act.	Could you infer the correct ans.	84.0	76.44	61.5	28.14	65.0	31.66	63.0	36.18	62.0	66.33
act.	Could you pick the correct ans.	69.0	77.49	62.5	28.14	64.5	31.16	61.0	38.19	62.0	67.34
act.	Could you select the most suitable ans.	63.0	76.44	62.5	31.66	63.0	34.17	62.0	38.19	62.0	67.84
act.	Could you solve the q. by choosing the correct ans.	70.0	75.39	62.5	28.14	64.0	33.17	64.5	37.69	63.5	66.33
act.	Could you tell me which ans. is correct	64.0	71.73	61.0	29.15	64.0	30.65	60.0	35.68	62.0	68.84
act.	What do you think is the correct ans.	60.0	75.92	62.5	28.64	64.5	31.16	57.5	34.67	63.0	67.34
pass.	Could the q. be ans.ed	74.0	70.68	63.0	31.16	65.0	27.64	63.0	32.16	63.5	60.3
pass.	Could the best ans. to the q. be chosen	74.0	74.35	62.5	27.14	62.5	30.65	61.0	28.14	63.5	63.82
pass.	Which ans. could be chosen	71.0	74.35	62.5	26.63	64.5	30.65	61.5	33.67	65.0	66.83
pass.	Could the correct ans. be given	74.0	72.25	62.5	26.63	63.0	31.66	61.5	32.16	63.0	62.31
pass.	Could the correct ans. be inferred	77.0	66.49	63.0	28.14	64.5	27.14	64.5	32.16	61.5	62.31
pass.	Could the correct ans. be picked	71.0	75.92	63.0	23.62	63.5	29.15	60.0	29.65	64.0	63.32
pass.	Could the most suitable ans. be selected	75.0	70.68	62.5	27.64	62.5	32.16	61.5	33.17	63.5	65.83
pass.	Could the q. be solved by choosing the correct ans.	75.0	71.73	63.5	30.15	63.0	30.65	60.0	34.67	63.0	62.81
pass.	Could it be told which ans. is correct	72.0	75.39	61.0	29.65	62.5	29.65	60.5	31.66	63.5	66.33
pass.	What is thought to be the correct ans.	76.0	78.01	62.0	30.65	64.5	31.16	62.0	36.68	62.5	67.84
can	Which ans. can you choose	61.0	75.92	63.0	29.15	64.0	30.65	60.5	35.68	65.5	66.83
can	Which ans. can be correct	59.5	72.25	61.5	27.14	64.0	29.15	62.5	33.67	63.5	65.33
can	Which can be the correct ans. to the q.	66.5	69.63	60.5	27.14	64.0	32.16	64.0	33.67	62.5	67.34
can	What do you think can be the correct ans.	71.0	77.49	62.0	28.64	62.5	33.67	61.5	34.67	63.5	65.33
could	Which ans. could you choose	64.0	75.92	63.0	30.15	64.5	31.16	62.0	35.18	64.0	66.83
could	Which ans. could be correct	57.0	72.25	61.5	27.64	64.0	28.64	60.5	34.67	63.5	66.33
could	Which could be the correct ans. to the q.	64.0	69.63	61.0	27.64	63.0	32.66	63.0	32.66	62.5	67.84
could	What do you think could be the correct ans.	70.0	77.49	62.0	27.64	61.5	32.66	60.0	33.17	64.0	64.82
may	Which ans. may you choose	62.5	78.01	62.5	28.14	64.0	32.66	58.0	34.17	63.5	66.33
may	Which ans. may be correct	57.5	73.3	62.0	29.15	65.0	30.15	61.0	31.66	64.0	66.83
may	Which may be the correct ans. to the q.	64.0	69.11	61.5	26.63	64.0	32.16	62.0	29.15	63.0	67.34
may	What do you think may be the correct ans.	66.5	76.44	62.5	29.15	63.0	32.16	61.0	34.67	63.5	65.83
might	Which ans. might you choose	63.0	75.39	63.0	28.64	65.0	32.16	61.5	33.17	62.0	66.83
might	Which ans. might be correct	55.5	74.35	61.5	28.64	64.0	29.65	61.0	33.67	63.0	65.83
might	Which might be the correct ans. to the q.	65.0	72.77	61.0	27.64	63.5	31.16	61.0	31.66	62.0	66.83
might	What do you think might be the correct ans.	70.5	79.58	62.0	28.64	63.0	32.66	58.0	32.66	63.0	64.82
must	Which ans. must you choose	63.0	76.96	63.0	27.64	64.0	30.65	57.0	23.62	65.5	67.84
must	Which ans. must be correct	56.5	76.44	62.0	27.64	64.0	28.64	54.5	28.64	66.0	65.83
must	Which must be the correct ans. to the q.	70.5	72.77	60.5	28.14	63.5	32.16	60.5	29.15	66.0	67.84
must	What do you think must be the correct ans.	70.0	76.96	62.5	29.65	62.5	30.65	57.5	35.68	64.0	66.33
should	Which ans. should you choose	69.0	75.92	62.0	31.16	64.5	30.65	56.0	23.12	64.0	68.34
should	Which ans. should be correct	65.5	75.92	61.5	28.64	64.5	29.15	57.0	30.15	64.5	67.84
should	Which should be the correct ans. to the q.	69.0	74.35	61.5	27.14	64.0	30.65	63.5	30.15	62.5	67.84
should	What do you think should be the correct ans.	67.5	76.44	62.5	28.14	63.5	31.16	59.0	35.68	64.5	65.33
would	Which ans. would you choose	62.5	78.01	62.0	28.14	64.0	30.15	59.5	35.18	65.0	66.83
would	Which ans. would be correct	64.0	77.49	61.0	29.15	64.0	28.14	60.5	34.17	64.0	66.83
would	Which would be the correct ans. to the q.	68.5	75.92	60.5	27.14	64.5	31.16	63.0	34.17	62.5	68.34
would	What do you think would be the correct ans.	73.5	76.96	62.5	29.15	63.5	30.65	59.5	35.18	64.5	66.33

Table 11: Detailed list of prompts for Question Answering with accuracy per prompt on BoolQ and ARC-E across all models. Part 1 of 2.

prop.	prompt	LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
		BoolQ	ARC-E	BoolQ	ARC-E	BoolQ	ARC-E	BoolQ	ARC-E	BoolQ	ARC-E
pro.	Could you choose the pro. ans. to the q.	62.0	77.15	63.4	27.16	64.0	34.81	62.6	31.39	65.2	67.61
pro.	Which ans. is pro.	67.0	75.89	62.4	25.75	64.2	29.38	58.8	30.38	64.4	68.81
pro.	Which is the pro. ans. to the q.	70.2	73.58	61.8	26.36	63.2	33.8	60.0	30.99	65.0	70.02
pro.	Could you give me the pro. ans.	68.2	73.79	62.4	28.97	64.6	33.8	63.2	32.19	62.0	68.61
pro.	Could you infer the pro. ans.	76.8	76.94	61.6	26.96	64.0	33.8	61.8	31.79	62.8	68.01
pro.	Could you pick the pro. ans.	63.2	79.04	63.4	26.96	63.4	33.8	62.2	31.59	63.6	68.81
pro.	Could you select the pro. ans.	61.2	79.87	63.4	29.18	63.6	34.81	62.6	34.61	63.8	68.61
pro.	Could you solve the q. by choosing the pro. ans.	63.6	76.31	63.4	28.37	63.8	35.21	61.2	32.6	64.6	67.61
pro.	Could you tell me which ans. is pro.	64.6	68.76	62.2	25.96	63.4	31.39	61.8	33.2	63.2	70.22
pro.	What do you think is the pro. ans.	63.4	77.99	63.2	27.57	63.4	34.81	62.6	32.6	64.4	68.41
right	Could you choose the right ans. to the q.	58.6	79.04	63.2	27.36	64.2	33.6	63.8	31.39	65.0	67.4
right	Which ans. is right	50.4	72.75	62.0	26.56	64.6	31.79	58.0	31.59	66.4	68.61
right	Which is the right ans. to the q.	71.0	74.21	61.0	26.56	63.4	33.6	59.6	31.19	65.0	69.01
right	Could you give me the right ans.	69.2	74.84	62.8	27.36	64.6	35.01	63.2	31.79	64.4	68.41
right	Could you infer the right ans.	79.0	77.57	62.0	27.36	64.2	34.0	62.2	29.38	62.8	66.8
right	Could you pick the right ans.	62.8	78.62	63.4	26.36	63.6	34.81	62.2	29.78	64.2	68.21
right	Could you select the right ans.	56.0	79.04	63.4	27.36	63.6	34.21	62.6	35.01	63.8	68.21
right	Could you solve the q. by choosing the right ans.	64.0	77.15	63.4	27.57	64.4	35.21	61.0	32.39	64.4	66.6
right	Could you tell me which ans. is right	59.0	69.39	61.8	27.16	63.6	33.6	60.4	33.4	63.6	69.82
right	What do you think is the right ans.	57.6	78.41	63.4	27.36	63.2	35.01	58.2	31.79	64.8	68.01
corr.	Could you choose the corr. ans. to the q.	61.2	78.2	63.4	27.57	63.6	34.81	63.8	31.79	64.6	67.61
corr.	Which ans. is corr.	56.0	75.68	61.8	25.75	64.4	29.18	55.0	31.19	65.0	68.41
corr.	Which is the corr. ans. to the q.	69.0	73.79	60.4	27.97	63.6	33.4	59.6	29.78	64.4	69.22
corr.	Could you give me the corr. ans.	67.8	74.84	61.4	28.37	64.4	34.21	62.4	32.6	64.2	67.2
corr.	Could you infer the corr. ans.	77.6	77.78	61.8	28.57	64.2	33.6	62.6	30.58	63.0	67.2
corr.	Could you pick the corr. ans.	59.4	78.62	63.2	27.36	63.4	33.8	60.8	30.78	64.0	68.81
corr.	Could you select the corr. ans.	60.0	78.41	63.6	28.57	63.2	35.01	60.0	33.6	64.4	68.01
corr.	Could you solve the q. by choosing the corr. ans.	61.6	77.15	62.6	27.77	63.8	35.61	62.0	32.19	64.4	67.61
corr.	Could you tell me which ans. is corr.	61.4	69.6	61.6	27.36	63.4	33.2	59.2	32.8	63.6	69.22
corr.	What do you think is the corr. ans.	55.0	77.57	63.0	27.16	63.8	35.41	57.6	31.99	64.8	68.81
appr.	Could you choose the appr. ans. to the q.	63.0	77.99	63.4	27.16	64.4	33.6	63.4	30.38	65.0	68.41
appr.	Which ans. is appr.	69.4	75.68	62.4	27.16	63.6	29.98	58.2	32.19	66.6	68.61
appr.	Which is the appr. ans. to the q.	70.6	73.17	61.4	26.56	63.2	33.0	59.2	31.59	65.2	69.82
appr.	Could you give me the appr. ans.	69.4	74.21	62.2	27.57	64.2	34.61	63.2	33.0	63.2	69.01
appr.	Could you infer the appr. ans.	75.2	76.52	61.8	27.97	64.6	32.6	62.4	30.78	62.8	68.41
appr.	Could you pick the appr. ans.	64.4	77.99	63.4	27.57	63.8	34.0	61.8	32.19	64.4	69.62
appr.	Could you select the appr. ans.	62.4	78.41	63.4	28.97	64.0	35.01	62.8	34.21	64.2	68.81
appr.	Could you solve the q. by choosing the appr. ans.	62.8	75.89	63.4	28.57	64.4	34.21	61.8	31.99	64.6	67.61
appr.	Could you tell me which ans. is appr.	67.6	71.28	62.0	27.97	63.8	31.99	60.8	33.2	64.0	70.02
appr.	What do you think is the appr. ans.	67.6	77.36	63.0	27.77	63.8	34.41	59.6	33.6	65.0	68.81
ans.	Could you choose the best ans. to the q.	55.6	76.73	63.4	28.57	63.6	33.6	63.0	32.6	63.4	68.21
ans.	Which ans. do you choose	63.0	78.83	63.0	26.76	63.8	33.6	57.2	33.6	65.2	68.61
ans.	Which ans. is corr.	56.0	75.68	61.8	25.75	64.4	29.18	55.0	31.19	65.0	68.41
ans.	Which is the corr. ans. to the q.	69.0	73.79	60.4	27.97	63.6	33.4	59.6	29.78	64.4	69.22
ans.	Could you give me the corr. ans.	67.8	74.84	61.4	28.37	64.4	34.21	62.4	32.6	64.2	67.2
ans.	Could you infer the corr. ans.	77.6	77.78	61.8	28.57	64.2	33.6	62.6	30.58	63.0	67.2
ans.	Could you pick the corr. ans.	59.4	78.62	63.2	27.36	63.4	33.8	60.8	30.78	64.0	68.81
ans.	Could you select the most suitable ans.	53.6	77.36	63.4	29.18	63.6	35.01	61.4	33.2	63.6	69.82
ans.	Could you solve the q. by choosing the corr. ans.	61.6	77.15	62.6	27.77	63.8	35.61	62.0	32.19	64.4	67.61
ans.	Could you tell me which ans. is corr. 61.4	69.6	61.6	27.36	63.4	33.2	59.2	32.8	63.6	69.22	
ans.	What do you think is the corr. ans.	55.0	77.57	63.0	27.16	63.8	35.41	57.6	31.99	64.8	68.81
reply	Could you choose the best reply to the q.	60.4	75.05	63.6	28.57	64.2	35.61	63.0	29.18	64.2	67.0
reply	Which reply do you choose	59.6	77.57	62.8	27.77	64.6	33.6	54.0	30.58	66.2	68.21
reply	Which reply is corr.	56.8	72.54	60.0	28.17	63.2	28.57	58.2	32.8	66.4	68.41
reply	Which is the corr. reply to the q.	68.4	72.33	61.2	26.56	63.6	33.0	59.8	30.58	65.8	69.01
reply	Could you give me the corr. reply	69.0	75.47	61.6	27.36	64.0	34.0	63.6	32.8	64.0	66.6
reply	Could you infer the corr. reply	77.2	77.57	62.4	26.96	64.0	33.8	62.2	29.18	63.6	66.6
reply	Could you pick the corr. reply	59.0	77.78	63.4	27.97	63.2	33.8	61.6	32.19	63.8	66.6
reply	Could you select the most suitable reply	56.0	76.94	63.2	27.36	64.0	35.21	62.4	30.99	63.6	68.81
reply	Could you solve the q. by choosing the corr. reply	62.8	76.94	63.4	28.97	64.0	34.81	61.4	32.8	64.8	66.8
reply	Could you tell me which reply is corr.	58.4	69.39	60.0	26.76	63.8	30.78	60.0	31.39	63.8	69.42
reply	What do you think is the corr. reply	64.6	78.2	62.8	28.57	64.4	34.41	61.8	31.59	64.8	68.41
resp.	Could you choose the best resp. to the q.	62.8	77.78	63.6	28.17	64.0	33.0	62.4	31.39	63.6	67.2
resp.	Which resp. do you choose	64.0	78.62	62.8	28.57	64.0	33.0	58.6	31.39	65.6	69.62
resp.	Which resp. is corr.	59.2	77.15	60.6	27.36	63.4	27.97	58.8	31.79	65.6	68.21
resp.	Which is the corr. resp. to the q.	68.4	74.21	61.2	26.16	64.0	32.6	62.0	30.99	65.8	70.22
resp.	Could you give me the corr. resp.	71.0	73.79	62.0	28.97	64.2	32.8	62.8	32.19	63.8	67.61
resp.	Could you infer the corr. resp.	77.4	77.57	63.0	26.96	64.2	32.8	62.6	30.38	62.8	66.8
resp.	Could you pick the corr. resp.	66.6	78.83	63.4	26.76	63.6	34.41	61.2	31.19	63.4	67.61
resp.	Could you select the most suitable resp.	63.4	76.94	63.2	27.57	63.6	34.61	62.0	30.18	63.8	69.82
resp.	Could you solve the q. by choosing the corr. resp.	67.8	76.31	63.4	27.16	64.0	36.02	63.4	32.6	64.6	67.2
resp.	Could you tell me which resp. is corr.	60.4	71.28	59.2	25.96	62.8	31.39	61.0	33.2	63.0	69.01
resp.	What do you think is the corr. resp.	64.8	77.78	63.4	27.16	64.6	33.8	61.2	32.8	65.4	68.01
sol.	Could you choose the best sol. to the q.	57.0	74.21	63.2	28.77	64.2	32.8	63.8	29.38	63.6	67.2
sol.	Which sol. do you choose	65.4	75.89	63.6	27.57	64.0	32.39	59.8	29.98	65.0	68.61
sol.	Which sol. is corr.	55.4	64.36	62.4	27.97	62.8	29.18	57.4	29.98	65.6	67.0
sol.	Which is the corr. sol. to the q.	71.4	71.7	62.2	25.75	64.2	33.0	62.8	31.99	66.0	69.62
sol.	Could you give me the corr. sol.	72.6	73.79	62.2	28.17	64.0	33.2	61.0	32.19	62.8	66.8
sol.	Could you infer the corr. sol.	74.2	76.94	62.2	27.36	64.2	33.6	60.0	28.97	63.2	66.6
sol.	Could you pick the corr. sol.	58.4	77.57	63.6	28.97	64.2	33.2	58.8	31.79	64.4	67.2
sol.	Could you select the most suitable sol.	52.2	74.63	63.4	27.97	64.0	33.6	62.4	29.78	63.6	68.21
sol.	Could you solve the q. by choosing the corr. sol.	62.4	75.26	63.4	28.97	64.0	37.02	58.8	32.19	64.6	66.0
sol.	Could you tell me which sol. is corr.	59.0	64.99	63.6	27.77	63.6	32.39	60.8	31.59	63.4	68.41
sol.	What do you think is the corr. sol.	62.0	74.84	63.4	28.97	63.6	34.21	61.0	31.99	65.4	67.4

Table 12: Detailed list of prompts for Question Answering with accuracy per prompt on BoolQ and ARC-E across all models. Part 1 of 2.

property	prompt	LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
		RTE	CB	RTE	CB	RTE	CB	RTE	CB	RTE	CB
null		45.0	55.2	40.0	57.6	46.5	61.6	46.6	66.8	41.2	79.2
ind.	Given "[p]" you can assume that "[h]"	51.8	48.8	51.8	53.2	63.8	63.6	50.4	46.4	71.8	77.2
ind.	Given "[p]" the claim "[h]" is correct	48.6	47.2	54.4	52.4	62.6	63.2	50.4	47.6	73.8	81.6
ind.	Given "[p]" you can deduce that "[h]"	52.4	50.8	53.4	54.4	64.0	63.2	50.6	46.0	74.0	80.0
ind.	Given "[p]" it follows that "[h]"	52.0	47.6	52.4	50.8	65.0	62.4	51.6	46.8	71.2	79.2
ind.	Given "[p]" this implies that "[h]"	60.2	48.8	53.2	52.8	63.2	62.8	53.8	48.4	71.2	74.0
ind.	Given "[p]" you can infer that "[h]"	55.2	51.2	53.0	53.2	64.0	62.0	50.8	46.0	73.4	80.0
ind.	Given "[p]" you are justified in saying that "[h]"	50.0	48.0	52.6	52.4	65.2	62.4	51.2	46.4	76.4	84.0
ind.	Given premise "[p]" and hypothesis "[h]" the label is ent.	55.2	64.8	48.6	48.0	64.4	61.2	49.0	46.0	76.4	86.4
ind.	Given "[p]" you can reason that "[h]"	51.0	48.8	54.8	49.6	64.4	62.8	50.0	46.8	73.4	77.2
ind.	The relationship between "[p]" and "[h]" is ent.	49.4	47.2	52.6	54.8	62.0	60.0	48.6	46.4	67.0	74.8
ind.	Given "[p]" it is true that "[h]"	49.0	46.8	52.0	53.6	64.6	60.8	49.2	47.6	75.4	80.4
ind.	"[p]" Using only the above description "[h]" is correct	51.2	46.4	52.4	47.6	63.8	62.8	50.8	46.8	71.2	81.2
inter.	Given "[p]" can you assume that "[h]"?	52.6	56.8	51.0	60.8	65.0	67.2	51.8	56.8	73.0	74.8
inter.	Given "[p]" is the claim "[h]" correct	53.2	48.4	50.8	59.6	67.4	59.6	52.2	66.0	73.4	79.6
inter.	Given "[p]" can you deduce that "[h]"	52.0	57.6	53.6	58.0	64.8	64.0	51.2	60.4	73.8	77.2
inter.	Given "[p]" does it follow that "[h]"	49.0	51.6	50.2	60.0	66.2	62.8	56.4	65.2	68.8	65.6
inter.	Given "[p]" does this imply that "[h]"	53.4	61.6	52.8	60.8	66.0	62.4	52.0	57.6	70.2	68.4
inter.	Given "[p]" can you infer that "[h]"	56.0	76.0	49.0	58.8	65.4	64.8	52.4	56.8	72.0	77.6
inter.	Given "[p]" are you justified in saying that "[h]"	56.2	53.2	50.6	54.8	65.8	59.2	53.4	59.6	75.4	79.6
inter.	Given premise "[p]" and hypothesis "[h]" is the label ent.	53.8	46.4	51.0	49.6	62.8	68.0	49.0	46.4	75.4	81.2
inter.	Given "[p]" can you reason that "[h]"	59.2	59.6	50.8	58.0	64.6	60.8	56.0	67.2	75.2	78.0
inter.	Is the relationship between "[p]" and "[h]" ent.	49.2	35.2	48.4	63.6	63.4	57.6	49.0	46.0	67.8	67.2
inter.	Given "[p]" is it true that "[h]"	59.8	54.0	52.4	56.0	69.2	64.0	57.0	67.2	75.2	77.6
inter.	"[p]" Using only the above description is "[h]" correct	54.0	42.0	52.2	58.0	65.0	57.6	53.2	62.8	70.8	78.8
imp.	Given "[p]" tell me if you can assume that "[h]"	56.4	48.8	53.0	52.0	63.0	66.0	49.2	55.2	77.2	80.0
imp.	Given "[p]" tell me if the claim "[h]" is correct	65.8	56.0	53.6	49.2	64.4	58.0	57.0	69.2	76.8	85.2
imp.	Given "[p]" tell me if you can deduce that "[h]"	54.4	51.2	53.6	54.0	64.4	63.6	49.4	57.2	77.6	80.4
imp.	Given "[p]" tell me if it follows that "[h]"	54.6	49.2	52.6	51.6	64.8	64.4	55.4	60.4	73.4	78.0
imp.	Given "[p]" tell me if this implies that "[h]"	57.2	65.2	52.4	49.6	63.8	62.4	52.2	56.4	71.4	75.2
imp.	Given "[p]" tell me if you can infer that "[h]"	62.2	61.2	52.8	56.0	65.0	64.4	49.8	55.6	76.6	81.6
imp.	Given "[p]" tell me if you are justified in saying that "[h]"	60.6	52.0	53.8	49.2	64.6	57.2	53.0	55.6	78.0	81.2
imp.	Given premise "[p]" and hypothesis "[h]" tell me if the label is ent.	52.2	50.0	53.6	48.4	64.2	64.4	49.0	47.2	75.6	83.2
imp.	Given "[p]" tell me if you can reason that "[h]"	60.6	51.6	52.8	50.4	63.8	61.2	56.0	70.0	77.2	80.4
imp.	Tell me if the relationship between "[p]" and "[h]" is ent.	46.8	34.0	50.8	54.8	63.8	58.0	51.4	49.2	67.4	70.8
imp.	Given "[p]" tell me if it is true that "[h]"	63.2	61.6	52.0	52.8	66.6	64.8	54.6	62.4	76.6	80.8
imp.	"[p]" Using only the above description tell me if "[h]" is correct	58.2	48.0	51.6	57.6	67.6	52.4	55.0	72.8	79.2	84.4
active	Given "[p]" can you assume that "[h]"	52.6	56.8	51.0	60.8	65.0	67.2	51.8	56.8	73.0	74.8
active	Given "[p]" can you conclude that "[h]"	51.4	51.2	51.4	56.8	66.4	62.4	56.8	66.8	71.6	73.6
active	Given "[p]" can you deduce that "[h]"	52.0	57.6	53.6	58.0	64.8	64.0	51.2	60.4	73.8	77.2
active	Given "[h]" does it follow that "[p]"	49.8	38.8	53.6	59.6	59.6	51.2	50.8	49.2	63.0	55.6
active	Given "[p]" can you guess that "[h]"	60.2	65.6	52.8	56.8	65.8	64.8	51.0	72.8	74.8	74.4
active	Given "[p]" does this imply that "[h]"	53.4	61.6	52.8	60.8	66.0	62.4	52.0	57.6	70.2	68.4
active	Given premis can you infer that "[h]"	53.4	47.2	50.0	50.4	52.8	39.6	49.2	45.6	59.2	47.6
active	Given "[p]" can you justifiably say that "[h]"	57.2	51.2	51.4	54.4	65.6	62.0	57.4	63.2	76.0	76.0
active	Given premise "[p]" and hypothesis "[h]" can you label this as ent.	51.2	47.2	49.4	47.2	63.0	64.4	49.0	46.0	76.0	82.8
active	Given "[p]" can you reason that "[h]"	59.2	59.6	50.8	58.0	64.6	60.8	56.0	67.2	75.2	78.0
passive	Given "[p]" can it be assumed that "[h]"	54.4	60.0	52.4	62.8	64.2	67.2	52.4	53.2	71.4	72.8
passive	Given "[p]" can it be concluded that "[h]"	51.2	52.0	50.6	59.6	63.0	64.0	56.6	65.2	70.2	71.2
passive	Given "[p]" can it be deduced that "[h]"	51.6	54.8	51.2	61.2	63.0	62.8	51.4	57.6	71.0	73.2
passive	Given "[h]" is it followed that "[p]"	52.6	38.8	54.6	57.6	60.0	50.0	49.4	49.6	61.4	54.8
passive	Given "[p]" can it be guessed that "[h]"	55.6	54.4	53.6	58.8	64.6	64.4	49.8	59.2	70.2	70.4
passive	Given "[p]" is it implied that "[h]"	55.0	60.4	52.4	61.6	67.8	60.8	50.8	60.0	70.8	71.6
passive	Given premis can it be inferred that "[h]"	51.0	45.6	49.4	47.6	52.0	38.8	49.2	46.8	60.0	48.0
passive	Given "[p]" can it justifiably be said that "[h]"	55.0	53.6	51.6	57.6	64.0	62.0	55.8	60.8	73.4	69.6
passive	Given premise "[p]" and hypothesis "[h]" can this be labelled as ent.	55.6	56.8	50.2	45.6	63.0	66.4	49.0	46.0	75.2	81.2
passive	Given "[p]" can it be reasoned that "[h]"	56.0	54.4	51.8	57.6	65.2	62.4	52.6	57.2	71.0	72.8
past	Given "[p]" did you assume that "[h]"	52.8	54.0	53.0	56.4	63.6	65.2	49.6	56.8	68.2	66.8
past	Given "[p]" was the claim "[h]" correct	51.4	46.8	50.6	60.0	68.2	58.4	50.8	66.4	70.8	74.8
past	Given "[p]" did you deduce that "[h]"	55.2	58.8	52.8	59.2	65.8	61.2	51.4	66.8	70.4	71.6
past	Given "[p]" did it follow that "[h]"	49.8	46.4	51.6	56.8	65.4	62.4	59.0	66.0	67.8	65.6
past	Given "[p]" did this imply that "[h]"	51.0	51.2	52.2	61.2	65.0	64.4	51.6	58.4	70.0	67.6
past	Given "[p]" did you infer that "[h]"	52.2	64.4	51.4	58.4	65.4	63.2	52.0	64.4	69.2	70.8
past	Given "[p]" were you justified in saying that "[h]"	55.4	54.4	51.0	53.2	66.4	63.2	54.0	59.6	74.2	77.6
past	Given premise "[p]" and hypothesis "[h]" was the label ent.	52.8	48.0	53.6	54.4	63.8	65.2	49.0	46.4	74.8	84.8
past	Given "[p]" did you reason that "[h]"	55.4	56.8	52.6	58.4	65.0	64.4	51.6	64.4	70.0	68.0
past	Was the relationship between "[p]" and "[h]" ent.	52.2	34.4	50.2	64.0	63.8	56.0	49.0	46.0	67.2	68.8
past	Given "[p]" was it true that "[h]"	57.4	50.8	53.8	55.2	70.0	63.2	55.2	64.8	75.0	73.2
past	"[p]" Using only the above description was "[h]" correct	51.8	46.0	53.0	58.8	65.2	59.2	52.6	63.6	70.8	76.0
present	Given "[p]" do you assume that "[h]"	47.6	50.8	51.0	57.6	65.8	65.6	49.6	57.6	72.6	72.4
present	Given "[p]" is the claim "[h]" correct	53.2	48.4	50.8	59.6	67.4	59.6	52.2	66.4	73.4	79.6
present	Given "[p]" do you deduce that "[h]"	52.4	55.6	50.6	59.6	66.4	64.4	50.0	66.8	70.8	72.0
present	Given "[p]" does it follow that "[h]"	49.0	51.6	50.2	60.0	66.2	62.8	56.4	64.8	68.8	65.6
present	Given "[p]" does this imply that "[h]"	53.4	61.6	52.8	60.8	66.0	62.4	52.0	58.0	70.2	68.4
present	Given "[p]" do you infer that "[h]"	54.0	64.4	52.0	60.8	66.2	64.0	51.4	65.2	70.6	73.2
present	Given "[p]" are you justified in saying that "[h]"	56.2	53.2	50.6	54.8	65.8	59.2	53.4	59.6	75.4	79.6
present	Given premise "[p]" and hypothesis "[h]" is the label ent.	54.4	50.8	51.4	54.0	63.4	66.8	49.0	46.4	75.2	84.8
present	Given "[p]" do you reason that "[h]"	52.4	52.0	51.6	60.0	66.0	65.2	51.8	66.4	70.6	71.6
present	Is the relationship between "[p]" and "[h]" ent.	49.2	35.2	48.4	63.6	63.4	57.6	49.0	46.0	67.8	67.2
present	Given "[p]" is it true that "[h]"	59.8	54.0	52.4	56.0	69.2	64.0	57.0	66.8	75.2	77.6
present	"[p]" Using only the above description is "[h]" correct	54.0	42.0	52.2	58.0	65.0	57.6	53.2	62.4	70.8	78.8
future	Given "[p]" will you assume that "[h]"	49.6	48.8	52.0	59.2	64.8	66.4	51.0	55.2	72.2	74.0
future	Given "[p]" will the claim "[h]" be correct	55.8	48.4	49.8	49.2	64.0	59.6	52.6	72.4	72.8	78.0
future	Given "[p]" will you deduce that "[h]"	51.0	50.4	52.8	60.4	64.8	63.2	51.2	64.4	71.0	73.6
future	Given "[p]" will it follow that "[h]"	53.6	52.0	51.4	58.0	66.6	62.8	52.8	61.2	69.6	68.4
future	Given "[p]" will this imply that "[h]"	52.6	52.8	53.0	59.6	65.6	64.0	50.0	54.8	70.0	67.2
future	Given "[p]" will you infer that "[h]"	51.4	54.8	53.2	60.8	66.4	65.6	51.0	62.8	70.0	73.6
future	Given "[p]" will you be justified in saying that "[h]"	53.6	48.0	53.0	51.2	65.8	58.8	52.6	59.2	74.0	75.6
future	Given premise "[p]" and hypothesis "[h]" will the label be ent.	52.4	48.0	53.0	48.8	63.2	67.2	49.0	46.0	75.6	82.0
future	Given "[p]" will you reason that "[h]"	52.2	46.4	51.8	55.2	67.4	63.6	51.8	65.2	71.8	71.6
future	Will the relationship between "[p]" and "[h]" be ent.	48.4	40.4	52.0	62.0	62.4	57.6	49.0	47.6	67.6	67.2
future	Given "[p]" will it be true that "[h]"	55.0	49.6	50.8	52.4	66.4	62.0	50.8	59		

property	prompt	LLaMA 30b		OPT 1.3b		OPT-IML 1.3b		OPT 30b		OPT-IML 30b	
		RTE	CB	RTE	CB	RTE	CB	RTE	CB	RTE	CB
can	Given "[p]" can you assume that "[h]"?	52.6	56.8	51.0	60.8	65.0	67.2	51.8	56.8	73.0	74.8
can	Given "[p]" can the claim "[h]" be correct?	53.8	48.0	50.8	52.4	67.4	57.6	51.8	68.8	74.8	77.6
can	Given "[p]" can you deduce that "[h]"?	52.0	57.6	53.6	58.0	64.8	64.0	51.2	60.4	73.8	77.2
can	Given "[p]" can it follow that "[h]"?	55.6	50.0	51.4	57.6	63.8	63.6	54.2	60.4	69.8	70.0
can	Given "[p]" can this imply that "[h]"?	53.6	56.4	52.0	60.8	65.8	63.2	50.8	51.2	70.6	70.0
can	Given "[p]" can you infer that "[h]"?	56.0	76.0	49.0	58.8	65.4	64.8	52.4	56.8	72.0	77.6
can	Given "[p]" can you be justified in saying that "[h]"?	58.4	51.2	51.2	57.6	66.4	59.6	57.8	62.0	74.2	75.2
can	Given premise "[p]" and hypothesis "[h]" can the label be ent.?	52.2	47.6	52.0	46.8	63.6	64.0	49.0	46.4	75.2	79.6
can	Given "[p]" can you reason that "[h]"?	59.2	59.6	50.8	58.0	64.6	60.8	56.0	67.2	75.2	78.0
can	Can the relationship between "[p]" and "[h]" be ent.?	51.6	38.8	52.8	59.6	64.2	56.8	49.0	47.6	67.4	68.0
can	Given "[p]" can it be true that "[h]"?	54.6	47.2	51.8	55.6	68.4	64.8	56.2	54.8	74.4	74.0
can	"[p]" Using only the above description can "[h]" be correct?	54.2	47.6	53.2	53.2	66.2	55.6	56.4	76.4	71.2	72.4
could	Given "[p]" could you assume that "[h]"?	53.4	58.4	51.2	60.8	65.2	66.8	51.0	56.4	71.6	72.8
could	Given "[p]" could the claim "[h]" be correct?	53.6	47.2	49.6	54.8	66.4	59.2	53.8	72.0	74.0	78.8
could	Given "[p]" could you deduce that "[h]"?	52.0	55.6	50.2	61.6	64.8	66.0	50.2	62.4	73.6	76.0
could	Given "[p]" could it follow that "[h]"?	56.0	48.4	51.6	57.6	64.2	62.4	50.2	54.4	69.8	70.4
could	Given "[p]" could this imply that "[h]"?	53.4	50.0	51.4	60.4	65.4	65.6	49.6	50.4	69.6	68.4
could	Given "[p]" could you infer that "[h]"?	53.6	69.2	51.4	64.4	65.8	64.4	52.0	57.2	72.0	74.8
could	Given "[p]" could you be justified in saying that "[h]"?	59.6	54.0	51.2	60.8	66.2	59.2	53.2	60.8	73.2	75.6
could	Given premise "[p]" and hypothesis "[h]" could the label be ent.?	53.4	57.2	51.4	49.6	62.6	62.8	49.0	46.0	74.0	80.0
could	Given "[p]" could you reason that "[h]"?	57.8	60.8	50.4	58.8	65.6	63.6	54.2	67.2	73.4	77.2
could	Could the relationship between "[p]" and "[h]" be ent.?	50.8	40.4	54.6	60.8	64.0	55.6	49.0	47.2	67.2	68.4
could	Given "[p]" could it be true that "[h]"?	52.2	52.0	51.8	56.0	67.2	64.8	50.6	56.4	73.8	74.0
could	"[p]" Using only the above description could "[h]" be correct?	52.2	47.2	50.0	52.8	64.6	58.0	53.6	77.2	71.0	75.6
may	Given "[p]" may you assume that "[h]"?	52.2	55.6	52.0	62.4	64.4	68.4	51.6	50.0	72.0	70.8
may	Given "[p]" may the claim "[h]" be correct?	55.8	50.0	52.2	53.2	66.2	60.4	54.6	69.2	74.8	79.6
may	Given "[p]" may you deduce that "[h]"?	51.2	58.0	51.8	62.0	64.0	66.0	50.0	51.2	72.0	75.2
may	Given "[p]" may it follow that "[h]"?	54.0	54.4	51.4	61.6	64.2	62.8	54.4	60.0	70.8	70.4
may	Given "[p]" may this imply that "[h]"?	52.2	51.6	52.8	55.2	65.4	66.0	50.6	52.0	70.0	67.6
may	Given "[p]" may you infer that "[h]"?	52.4	64.4	52.4	62.4	64.8	67.2	51.4	55.2	71.0	73.2
may	Given "[p]" may you be justified in saying that "[h]"?	54.6	52.0	52.0	59.6	66.0	60.0	54.2	58.4	73.4	75.6
may	Given premise "[p]" and hypothesis "[h]" may the label be ent.?	54.6	50.4	54.0	52.8	62.6	64.4	49.0	46.4	75.2	81.6
may	Given "[p]" may you reason that "[h]"?	53.2	52.8	52.2	60.4	65.2	64.8	53.2	59.2	71.8	72.0
may	May the relationship between "[p]" and "[h]" be ent.?	50.6	42.4	54.2	59.2	62.6	62.4	49.0	48.8	67.2	69.6
may	Given "[p]" may it be true that "[h]"?	57.0	48.8	51.8	54.8	66.2	66.0	51.2	52.4	74.6	77.2
may	"[p]" Using only the above description may "[h]" be correct?	50.6	46.8	52.8	53.2	64.6	60.0	54.2	76.4	68.4	70.4
might	Given "[p]" might you assume that "[h]"?	56.4	56.4	52.4	58.0	64.8	68.4	52.2	55.6	70.6	68.8
might	Given "[p]" might the claim "[h]" be correct?	52.0	46.8	49.8	56.0	66.6	61.2	52.8	68.4	73.0	77.2
might	Given "[p]" might you deduce that "[h]"?	60.2	57.6	53.0	60.8	65.2	63.6	49.4	57.2	70.6	71.2
might	Given "[p]" might it follow that "[h]"?	56.6	49.2	52.6	57.6	64.8	62.0	51.6	53.6	70.2	70.8
might	Given "[p]" might this imply that "[h]"?	51.6	53.2	53.0	58.8	65.2	66.0	50.8	50.4	70.2	68.0
might	Given "[p]" might you infer that "[h]"?	62.2	66.0	52.8	62.8	66.6	65.6	51.6	55.6	70.8	70.8
might	Given "[p]" might you be justified in saying that "[h]"?	59.2	43.2	52.8	56.0	66.2	58.4	51.8	56.8	73.6	74.8
might	Given premise "[p]" and hypothesis "[h]" might the label be ent.?	55.4	58.8	53.6	52.0	63.8	66.0	49.0	46.4	74.2	79.6
might	Given "[p]" might you reason that "[h]"?	61.4	56.4	52.4	58.4	65.8	64.8	51.6	57.2	70.6	71.6
might	Might the relationship between "[p]" and "[h]" be ent.?	46.0	39.2	53.0	56.0	65.0	56.8	49.2	48.4	67.2	67.6
might	Given "[p]" might it be true that "[h]"?	49.2	48.4	52.4	54.4	67.2	64.8	52.2	53.2	74.6	75.2
might	"[p]" Using only the above description might "[h]" be correct?	51.6	47.2	52.0	53.6	64.2	60.0	53.0	74.4	68.6	72.0
must	Given "[p]" must you assume that "[h]"?	53.2	51.6	51.8	56.4	64.8	61.2	50.0	50.0	69.6	66.0
must	Given "[p]" must the claim "[h]" be correct?	52.0	47.2	49.0	50.0	66.4	57.6	53.2	68.0	71.4	76.8
must	Given "[p]" must you deduce that "[h]"?	55.8	56.0	50.4	59.2	66.0	64.8	51.4	59.2	70.6	70.8
must	Given "[p]" must it follow that "[h]"?	53.8	52.0	51.4	54.4	65.6	60.4	61.4	53.2	68.8	66.4
must	Given "[p]" must this imply that "[h]"?	53.2	48.0	52.0	56.4	66.2	62.0	52.4	53.2	69.8	66.8
must	Given "[p]" must you infer that "[h]"?	54.6	57.6	51.2	58.4	66.6	64.0	54.0	56.8	69.8	70.8
must	Given "[p]" must you be justified in saying that "[h]"?	63.0	49.6	52.0	54.8	66.2	59.6	52.4	55.6	72.4	73.6
must	Given premise "[p]" and hypothesis "[h]" must the label be ent.?	56.6	51.2	52.2	48.8	63.8	65.2	48.8	50.4	74.8	77.6
must	Given "[p]" must you reason that "[h]"?	58.4	52.8	49.8	54.8	65.2	63.2	54.2	53.2	69.8	67.6
must	Must the relationship between "[p]" and "[h]" be ent.?	48.0	41.2	53.4	56.0	62.4	62.8	49.2	48.4	67.6	66.0
must	Given "[p]" must it be true that "[h]"?	49.4	50.0	51.4	55.2	66.8	62.0	56.8	51.6	74.4	69.6
must	"[p]" Using only the above description must "[h]" be correct?	52.4	48.0	53.8	54.8	63.6	58.0	55.0	76.4	68.8	74.4
should	Given "[p]" should you assume that "[h]"?	50.8	50.8	52.2	59.2	63.6	62.8	51.6	59.6	70.6	66.8
should	Given "[p]" should the claim "[h]" be correct?	53.4	48.0	50.2	52.4	65.0	58.8	53.8	68.8	70.2	78.0
should	Given "[p]" should you deduce that "[h]"?	51.2	51.6	52.4	57.2	64.4	64.4	54.0	62.8	69.8	68.0
should	Given "[p]" should it follow that "[h]"?	54.6	53.2	52.0	56.8	64.2	60.0	56.4	61.2	70.2	67.6
should	Given "[p]" should this imply that "[h]"?	54.0	50.8	49.8	56.0	65.8	62.8	52.2	56.8	69.6	66.8
should	Given "[p]" should you infer that "[h]"?	51.6	52.8	51.6	57.2	63.8	63.6	55.8	62.8	69.6	67.6
should	Given "[p]" should you be justified in saying that "[h]"?	53.6	48.4	52.6	55.6	65.4	57.2	54.8	61.6	73.8	72.8
should	Given premise "[p]" and hypothesis "[h]" should the label be ent.?	54.2	52.0	49.4	51.2	62.8	63.6	49.2	50.4	74.6	80.4
should	Given "[p]" should you reason that "[h]"?	52.2	48.0	52.2	57.2	65.0	63.6	55.0	60.8	71.0	70.8
should	Should the relationship between "[p]" and "[h]" be ent.?	50.0	40.8	53.2	60.4	62.6	57.6	49.2	48.8	66.8	69.2
should	Given "[p]" should it be true that "[h]"?	55.8	52.4	51.8	55.6	66.4	59.6	53.6	61.2	71.6	73.6
should	"[p]" Using only the above description should "[h]" be correct?	52.2	46.0	53.0	52.4	65.2	54.4	54.4	74.0	69.4	74.0
would	Given "[p]" would you assume that "[h]"?	54.8	52.4	52.2	55.6	65.6	62.8	51.4	58.4	71.8	74.0
would	Given "[p]" would the claim "[h]" be correct?	62.0	52.4	50.2	59.2	66.4	56.0	54.4	71.2	72.4	79.2
would	Given "[p]" would you deduce that "[h]"?	52.2	50.8	52.4	57.2	65.8	62.4	52.4	65.2	71.2	74.4
would	Given "[p]" would it follow that "[h]"?	56.2	52.8	51.6	53.6	64.8	62.8	53.6	60.0	70.0	70.4
would	Given "[p]" would this imply that "[h]"?	55.2	58.4	50.8	57.6	65.4	60.8	51.8	54.8	70.8	70.0
would	Given "[p]" would you infer that "[h]"?	52.6	58.8	51.0	58.8	66.8	60.4	50.8	63.6	71.0	74.0
would	Given "[p]" would you be justified in saying that "[h]"?	56.0	50.0	52.8	56.8	66.8	57.2	51.8	56.8	73.8	78.4
would	Given premise "[p]" and hypothesis "[h]" would the label be ent.?	53.0	49.2	49.8	48.4	63.2	64.8	49.0	46.0	75.4	80.4
would	Given "[p]" would you reason that "[h]"?	54.6	51.6	52.0	55.6	67.2	64.0	52.6	61.2	71.2	73.6
would	Would the relationship between "[p]" and "[h]" be ent.?	51.0	42.8	51.2	58.8	63.6	54.0	49.2	47.6	67.4	68.4
would	Given "[p]" would it be true that "[h]"?	60.8	53.2	52.2	56.4	66.8	60.4	55.2	59.6	75.2	78.4
would	"[p]" Using only the above description would "[h]" be correct?	56.0	47.2	51.6	54.4	66.6	59.6	54.8	77.6	70.6	77.2
assertion	Given "[p]" is the assertion "[h]" correct?	54.6	52.8	52.0	58.8	66.8	57.6	53.6	69.6	73.6	78.0
assertion	Given "[p]" is the assertion "[h]" true?	53.6	51.2	53.4	58.4	64.2	59.6	53.8	66.0	74.2	78.4
claim	Given "[p]" is the claim "[h]" correct?	53.2	48.4	50.8	59.6	67.4	59.6	52.2	66.0	73.4	79.6
claim	Given "[p]" is the claim "[h]" true?	55.0	50.8	53.2	57.6	66.2	61.6	52.6	66.0	73.6	78.0
ent.	Given premise "[p]" and hypothesis "[h]" is the label ent.?	54.0	49.6	50.0	47.2	62.8	63.2	49.0	46.0	74.2	83.2
ent.	Is the relationship between "[p]" and "[h]" ent.?	49.2	35.2	48.4	63.6	63.4	57.6	49.0	46.0	67.8	67.2
implication	Given premise "[p]" and hypothesis "[h]" is the label implication?	55.8	60.4	52.2	56.0	63.8	65.6	49.6	46.0	73.2	84.0
implication	Is the relationship between "[p]" and "[h]" implication?	53.8	48.4	49.4	64.4	63.6	62.0				

property	LLaMA 30b	OPT 1.3b	OPT-IML 1.3b	OPT 30b	OPT-IML 30b
imperative	12.94	8.64	5.19	5.39	7.75
indicative	13.01	8.68	5.33	5.42	7.76
interrogative	12.99	8.74	5.38	5.41	7.77
active	13.01	8.77	5.39	5.4	7.78
passive	13.0	8.66	5.42	5.4	7.77
past	12.99	8.68	5.33	5.43	7.77
present	12.99	8.71	5.35	5.39	7.77
future	12.98	8.83	5.33	5.43	7.77
can	12.99	8.59	5.31	5.42	7.78
could	12.99	8.6	5.34	5.4	7.78
may	12.99	8.51	5.31	5.39	7.77
might	12.97	8.77	5.36	5.37	7.76
must	12.99	8.48	5.32	5.39	7.76
should	12.99	8.7	5.37	5.39	7.78
would	12.98	8.66	5.35	5.4	7.77
appraisal	12.95	8.74	5.38	5.42	7.76
commentary	12.97	8.73	5.36	5.4	7.76
critique	12.99	8.73	5.36	5.41	7.77
evaluation	12.99	8.74	5.38	5.41	7.77
review	12.99	8.72	5.35	5.4	7.77

Table 15: Perplexity scores for prompts on IMDB

property	LLaMA 30b	OPT 1.3b	OPT-IML 1.3b	OPT 30b	OPT-IML 30b
imperative	13.21	8.7	7.8	7.32	8.34
indicative	13.66	8.99	7.91	7.49	8.52
interrogative	13.53	8.92	8.13	7.44	8.58
active	13.68	8.99	8.17	7.5	8.65
passive	13.57	8.95	8.13	7.5	8.54
past	13.57	8.87	8.03	7.43	8.56
present	13.55	8.88	8.05	7.38	8.57
future	13.5	8.84	7.99	7.4	8.52
can	13.53	8.91	8.03	7.42	8.54
could	13.54	8.9	8.03	7.39	8.59
may	13.58	8.91	8.06	7.41	8.56
might	13.46	8.87	7.98	7.34	8.54
must	13.54	8.88	8.07	7.4	8.52
should	13.54	8.87	8.12	7.36	8.58
would	13.46	8.86	8.05	7.39	8.56
appraisal	13.29	8.95	8.12	7.49	8.51
commentary	13.43	8.91	8.01	7.45	8.54
critique	13.53	8.91	8.09	7.48	8.57
evaluation	13.53	8.92	8.13	7.44	8.58
review	13.5	8.85	8.05	7.37	8.58

Table 16: Perplexity scores for prompts on SST

property	LLaMA 30b	OPT 1.3b	OPT-IML 1.3b	OPT 30b	OPT-IML 30b
imperative	16.25	9.88	7.96	6.31	9.36
indicative	16.4	9.98	8.05	6.35	9.43
interrogative	16.41	9.96	8.08	6.31	9.43
active	15.92	9.74	7.99	6.42	9.21
passive	15.82	9.7	7.93	6.42	9.19
past	16.4	10.03	8.14	6.33	9.44
present	16.4	10.02	8.13	6.31	9.43
future	16.38	10.02	8.12	6.31	9.43
can	16.4	9.96	8.06	6.31	9.42
could	16.39	9.93	8.07	6.31	9.42
may	16.42	9.94	8.07	6.33	9.44
might	16.39	9.95	8.07	6.31	9.43
must	16.41	9.96	8.07	6.32	9.43
should	16.4	9.95	8.09	6.3	9.44
would	16.38	9.94	8.08	6.32	9.41
assertion	16.47	10.05	8.19	6.31	9.43
claim	16.45	10.06	8.2	6.3	9.43
implication	16.29	10.0	8.04	6.39	9.46
entailment	16.25	9.97	8.04	6.38	9.43

Table 17: Perplexity scores for prompts on CB

property	LLaMA 30b	OPT 1.3b	OPT-IML 1.3b	OPT 30b	OPT-IML 30b
imperative	15.53	9.88	8.48	6.34	9.08
indicative	15.7	10.01	8.55	6.38	9.13
interrogative	15.68	9.95	8.57	6.3	9.13
active	15.33	9.74	8.49	6.43	8.99
passive	15.22	9.69	8.42	6.41	8.97
past	15.62	9.84	8.49	6.28	9.12
present	15.61	9.82	8.48	6.27	9.1
future	15.59	9.79	8.46	6.26	9.1
can	15.59	9.87	8.52	6.26	9.1
could	15.58	9.87	8.53	6.26	9.1
may	15.61	9.83	8.53	6.27	9.12
might	15.58	9.87	8.53	6.26	9.11
must	15.6	9.88	8.53	6.27	9.11
should	15.59	9.88	8.56	6.25	9.12
would	15.57	9.88	8.54	6.27	9.09
assertion	15.89	9.84	8.54	6.26	9.12
claim	15.88	9.85	8.54	6.24	9.12
entailment	15.6	9.73	8.35	6.33	9.09
implication	15.64	9.75	8.35	6.34	9.12

Table 18: Perplexity scores for prompts on RTE

property	LLaMA 30b	OPT 1.3b	OPT-IML 1.3b	OPT 30b	OPT-IML 30b
imperative	13.47	8.67	7.34	5.93	8.39
indicative	13.55	8.64	7.32	5.94	8.41
interrogative	13.5	8.63	7.3	5.92	8.4
active	13.48	8.61	7.28	5.87	8.37
passive	13.53	8.64	7.3	5.94	8.39
past	13.48	8.58	7.29	5.9	8.35
present	13.46	8.61	7.29	5.88	8.38
future	13.46	8.58	7.27	5.88	8.41
can	13.43	8.62	7.27	5.87	8.36
could	13.44	8.61	7.28	5.88	8.39
may	13.43	8.61	7.29	5.88	8.41
might	13.44	8.61	7.28	5.88	8.41
must	13.45	8.63	7.25	5.88	8.37
should	13.43	8.6	7.28	5.86	8.43
would	13.41	8.6	7.25	5.86	8.4
appropriate	13.49	8.62	7.3	5.88	8.41
correct	13.47	8.6	7.27	5.86	8.37
proper	13.5	8.63	7.29	5.88	8.41
right	13.47	8.61	7.25	5.87	8.37
answer	13.47	8.61	7.27	5.86	8.37
reply	13.5	8.66	7.33	5.91	8.43
response	13.49	8.63	7.31	5.9	8.42
solution	13.5	8.63	7.3	5.92	8.4

Table 19: Perplexity scores for prompts on ARC-E

property	LLaMA 30b	OPT 1.3b	OPT-IML 1.3b	OPT 30b	OPT-IML 30b
imperative	14.16	8.84	6.77	5.66	8.29
indicative	14.19	8.84	6.81	5.61	8.33
interrogative	14.14	8.82	6.74	5.6	8.26
active	14.14	8.82	6.75	5.6	8.27
passive	14.17	8.84	6.78	5.64	8.28
past	14.15	8.89	6.78	5.6	8.28
present	14.15	8.82	6.75	5.59	8.28
future	14.15	8.89	6.78	5.6	8.28
can	14.15	8.84	6.76	5.59	8.27
could	14.15	8.82	6.76	5.61	8.26
may	14.15	8.82	6.76	5.6	8.28
might	14.15	8.82	6.77	5.6	8.27
must	14.16	8.83	6.76	5.6	8.29
should	14.15	8.82	6.75	5.58	8.28
would	14.14	8.81	6.75	5.59	8.26
appropriate	14.15	8.83	6.75	5.61	8.28
correct	14.14	8.81	6.75	5.59	8.26
proper	14.16	8.83	6.75	5.61	8.28
right	14.14	8.82	6.74	5.6	8.26
answer	14.14	8.82	6.75	5.6	8.27
reply	14.16	8.83	6.79	5.62	8.29
response	14.16	8.83	6.77	5.61	8.28
solution	14.16	8.84	6.77	5.62	8.29

Table 20: Perplexity scores for prompts on BoolQ