## Code Needs Comments: Enhancing Code LLMs with Comment Augmentation

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#### Abstract

The programming skill is one crucial ability for Large Language Models (LLMs), necessitating a deep understanding of programming languages (PLs) and their correlation with natural languages (NLs). We examine the impact of pre-training data on code-focused LLMs' performance by assessing the comment density as a measure of PL-NL alignment. Given the scarcity of code-comment aligned data in pre-training corpora, we introduce a novel data augmentation method that generates comments for existing code, coupled with a data filtering strategy that filters out code data poorly correlated with natural language. We conducted experiments on three code-focused LLMs and observed consistent improvements in performance on two widely-used programming skill benchmarks. Notably, the model trained on the augmented data outperformed both the model used for generating comments and the usodel further trained on the data without augmenta-Diction.

#### I Introduction

The development of Large Language Models (LLMs) has made remarkable strides across various domains, including the field of code understanding and generation. Works such as CodeGen (Nijkamp

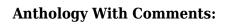
Language	#Chan of Comment	OCTAON.	Common Density
CH	5.48	NO SUB-	.0.1764
Con	6.68	386,086	0.1753
Clean	3.08	\$19,638	0.1583
Jane	129	645,300	0.1917
EuroPearign.	6.30	46/998	0.1352
PHEP	5.10	42.38	0.1207
Pyrthon	9.68	44.10	0.2187
Bladby	(0.948)	5.368	0.1821
Root	1.136	6.448	0.1641
TypeS-arign	2.48	20.19	0.1207
Average	5.30	32,666	0.1670

Table 1: Comment density across ten mainstream programming languages in StarCoder (Li et al., 2023a). #Chars of Comment indicates the number of non-white characters of the code comment. #Chars is the total number of non-white characters. In fact, high quality repositories even have comment density exceeding 40%, such as the case of mini redis. This suggests that the existing code dataset indeed contains too few comments.

2023a), which is currently one of the most popular code LLMs, also mentioned that 8% of their sample data was sourced from natural language datasets related to code. In fact, comments are the natural language components that are inherently related to code. Guo et al. (2022) had conducted ablation experiments to demonstrate that training models on code data with comments leads to improved ability. Moreover, the textbook and exercise data proposed by Gunasekar et al. (2023a), which is considered a

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