

Studying the Real-world Perturbations in Natural Language When Using LLMs to Generate Code



Introduction

Dear Participant,

We are researchers from the Software Engineering Lab at Zhejiang University, we are now conducting a research project to investigate the robustness of Large Language Models (LLMs) in code generation.

Recently, LLMs have been leveraged to generate source code. Users should write a prompt message as the input to LLMs. The input prompt generally includes a description of the desired function in natural language. For example, *"Generate the code in Python that prints each item of a list"*.

LLMs are sensitive to perturbations over prompts, a slight change in the prompt may lead to considerably different results. However, such perturbations may be common in real-world scenarios and can be introduced by the users unintentionally or intentionally.

In this survey, we are going to present you a series of categories of perturbations in natural language. Please help us to: (1) rate if each category of perturbations is natural and may occur in real-world scenarios of code generation using LLMs; (2) identify if multiple categories of perturbations can co-occur in the same prompt.

The survey takes 10–15 minutes. We will not reveal your identity in any form of the research outcomes. All of the information provided in the survey will be used for research purposes only. If you have further questions, please let us know (Junkai Chen, junkaichen@zju.edu.cn)

Part 1: Information of Participant

1. What is your country/region of residence? *

2. What is your current occupation? *

- ☐ Industrial or freelance professional
- ☐ Academic or industrial researcher
- ☐ Undergraduate/graduate student
- ☐ _____

3. Which of the following best describes your primary job role? *

- ☐ Development
- ☐ Testing
- ☐ Software Project Management
- ☐ Research
- ☐ _____

4. How many years of experience do you have with your primary job role? *

- ☐ 1 year
- ☐ 2 years
- ☐ 3 years
- ☐ 4 years
- ☐ 5 years
- ☐ 6 years
- ☐ 7 years
- ☐ 8 years
- ☐ 9 years
- ☐ 10 years
- ☐ _____

5. Do you have experience in using LLMs (e.g., ChatGPT) to generate code?
*(No matter it's for your work or just for fun) **

- ☐ Yes
- ☐ No

Part 2: Naturalness of Categories of Perturbations

We summarized 25 categories of perturbations in natural languages, and further group the categories into Addition (A1 - A7), Edit (E1 - E7), Deletion (D1 - D4), Swap (S1 - S5), and Paraphrase (P1 - P2).

For each category, please rate if it is natural and may occur in real-world scenarios of code generation using LLMs.

Select **Yes** if you think this category can occur in real-world scenarios;

Select **No** if you don't think this category can occur in real-world scenarios;

Select **Not sure** if you don't have a clear idea on this question.

6. Category A1: Extra Space outside Words *

Example: "Write a function **to replace** ..." -> "Write a function **to replace** ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

7. Category A2: Extra Space inside Words *

Example: "Write a **function** to replace ..." -> "Write a **func tion** to replace ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

8. Category A3: Repeated Words *

Example: "Write a function **to** replace ..." -> "Write a function **to to** replace ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

9. Category A4: Repeated Chars *

Example: "Write a **function** to replace ..." -> "Write a **funnction** to replace ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

10. **Category A5: Synonym Insertion ***

Example: "Write a function to **find** ..." -> "Write a function to **find discover** ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

11. **Category A6: Attaching URL ***

Example: "Write a function to replace ..." -> "Write a function to replace ... **https://google.com**"

- ☐ Yes
- ☐ No
- ☐ Not sure

12. **Category A7: Attaching Interrogation Statements ***

Example: "Write a function to replace ..." -> "Write a function to replace ... **what is what who is who where is where**"

- ☐ Yes
- ☐ No
- ☐ Not sure

13. Do you have comments for **Category A1 - Category A7?** (Optional)

14. **Category E1: Keyboard Typo ***

Example: "**Write** a function to replace ..." -> "**Writr** a function to replace ..."
Note: type another char that is nearby on the keyboard

- ☐ Yes
- ☐ No
- ☐ Not sure

15. **Category E2: Random Char Replacement ***

Example: "Write a function to replace ..." -> "Write a function to replace ..."
Note: replace the char in a word to another random char

- ☐ Yes
- ☐ No
- ☐ Not sure

16. **Category E3: Extra Capital Letter ***

Example: "Write a function to replace ..." -> "Write a function to replace ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

17. **Category E4: Grammatical Person Variation ***

Example: "Write a function that replaces the ..." -> "Write a function that replace the ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

18. **Category E5: Active and Passive Voice Variation ***

Example: "Given a list of numbers, return whether or not they are sorted in ascending order." -> "Given a list of numbers, return whether or not they sort in ascending order."

- ☐ Yes
- ☐ No
- ☐ Not sure

19. **Category E6: Word Class Variation ***

Example: "Write a function to check for the number of attempts required of ..." -> "Write a function to check for the number of jumps requirement of ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

20. **Category E7: Synonym Substitution ***

Example: "Write a function to **find** the index of ..." -> "Write a function to **locate** the index of ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

21. Do you have comments for **Category E1 - Category E7?** (Optional)

22. **Category D1: Char Deletion ***

Example: "Write a **function** to find ..." -> "Write a **funtion** to find ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

23. **Category D2: Preposition Deletion ***

Example: "Write a function **to** find ..." -> "Write a function find ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

24. **Category D3: Determiner Deletion ***

Example: "Write a function to reverse **the** string and ..." -> "Write a function to reverse string and ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

25. **Category D4: Space Deletion ***

Example: "Write a function to find ..." -> "Write afunction to find ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

26. Do you have comments for **Category D1 - Category D4**? (Optional)

27. **Category S1: Swap Adjacent Chars ***

Example: "Write a function to reverse the string and ..." -> "Write a function to reverse the string and ..."
Note: swap the adjacent chars in a word

- ☐ Yes
- ☐ No
- ☐ Not sure

28. **Category S2: Swap Chars Randomly ***

Example: "Write a function to reverse the string and ..." -> "Write a function to rrvseee the string and ..."
Note: swap two chars in a word randomly

- ☐ Yes
- ☐ No
- ☐ Not sure

29. **Category S3: Middle Random Swap ***

Example: "Write a function to reverse the string and ..." -> "Write a function to rsrveee the string and ..."
Note: re-order the chars inside a word, except for the first and the last char

- ☐ Yes
- ☐ No
- ☐ Not sure

30. **Category S4: Fully Random Swap ***

Example: "Write a function to **reverse** the string and ..." -> "Write a function to **esrveer** the string and ..."
Note: *Totally re-order the chars inside a word*

- ☐ Yes
- ☐ No
- ☐ Not sure

31. **Category S5: Swap Adjacent Words ***

Example: "Write a function **to reverse** the string and ..." -> "Write a function **reverse to** the string and ..."

- ☐ Yes
- ☐ No
- ☐ Not sure

32. Do you have comments for **Category S1 - Category S5?** (Optional)

33. **Category P1: Rephrasing Sentence ***

Example: "**Write a python function to print even numbers from a list of numbers.**" -> "**Generate a python function that can print even numbers from a list of numbers.**"
Note: *Re-phrase the sentence while reserving the same meaning*

- ☐ Yes
- ☐ No
- ☐ Not sure

34. **Category P2: Declarative to Interrogative ***

Example: "**Write a python function to print even numbers from a list of numbers.**" -> "**Can you write a function to print even numbers from a list of numbers?**"
Note: *Transform a declarative sentence to a interrogative one*

- ☐ Yes
- ☐ No
- ☐ Not sure

35. Do you have comments for **Category P1 - Category P2?** (Optional)

Part 3: Co-occurrence of Different Categories of Perturbations

In practice, do you think that multiple categories of perturbations can occur in the same prompt?

- If your answer is yes, another question will pop up to ask you for the possible combinations. For example, you can write:

Combination 1: Category X1 + Category Y2

Combination 2: Category X1 + Category X2 + Category Z1

Combination 3: Category Y2 + Category Z3

You can list several combinations (e.g., 2~5) that may possibly happen in real-world scenarios, don't need to exhaustively list all the possible combinations.

If you think co-occurrence of different categories is possible, but don't have a clear idea for the specific combinations for now, you can leave the pop up question blank.

- If your answer is no, another question will pop up to ask you for the potential reasons.

36. Do you think that multiple categories of perturbations can occur in the same prompt? *

☐ Yes

☐ No

☐ Not sure

37. What are the possible combinations?

You can answer this question following the format of example above or any other format that you are comfortable with (e.g., pure text description).

Here is the list of categories for your convenience.

Category A1: Extra Space outside Words

Category A2: Extra Space inside Words

Category A3: Repeated Words

Category A4: Repeated Char

Category A5: Synonym Insertion

Category A6: Attaching URL

Category A7: Attaching Interrogation Statements

Category E1: Keyboard Typo

Category E2: Random Char Replacement

Category E3: Extra Capital Letter

Category E4: Grammatical Person Variation

Category E5: Active and Passive Voice Variation

Category E6: Word Class Variation

Category E7: Synonym Substitution

Category D1: Char Deletion

Category D2: Preposition Deletion

Category D3: Determiner Deletion

Category D4: Space Deletion

Category S1: Swap Char Adjacently

Category S2: Swap Char Randomly

Category S3: Middle Random

Category S4: Fully Random

Category S5: Swap Adjacent Words

Category P1: Rephrasing Sentence

Category P2: Declarative to Interrogative

38. What are the potential reasons?

Additional Comments

Thank you for your time, the survey is almost done! If you have any other ideas or suggestions related to this survey and our study, please feel free to leave your additional comments here!

39. **Comments** (Optional)
