Machine Learning for Code and Documentation

With Dr. Jin Guo and Avinash Bhat

The McGill Software Technology Lab

Presented by Haley Kwok

- After the presentation, you will know more about:
  - Current code writing tools

  - Large Language Models (LLMs)

  - Norman's Seven Stages of Action to guide the design of writing assistants

  - Comparing different LLMs for performance evaluation and usability

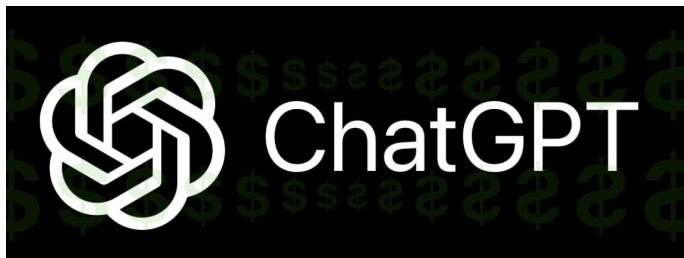What do you do when you have trouble coding?

When was the last time you coded with an AI tool?

In the past…

At the present…
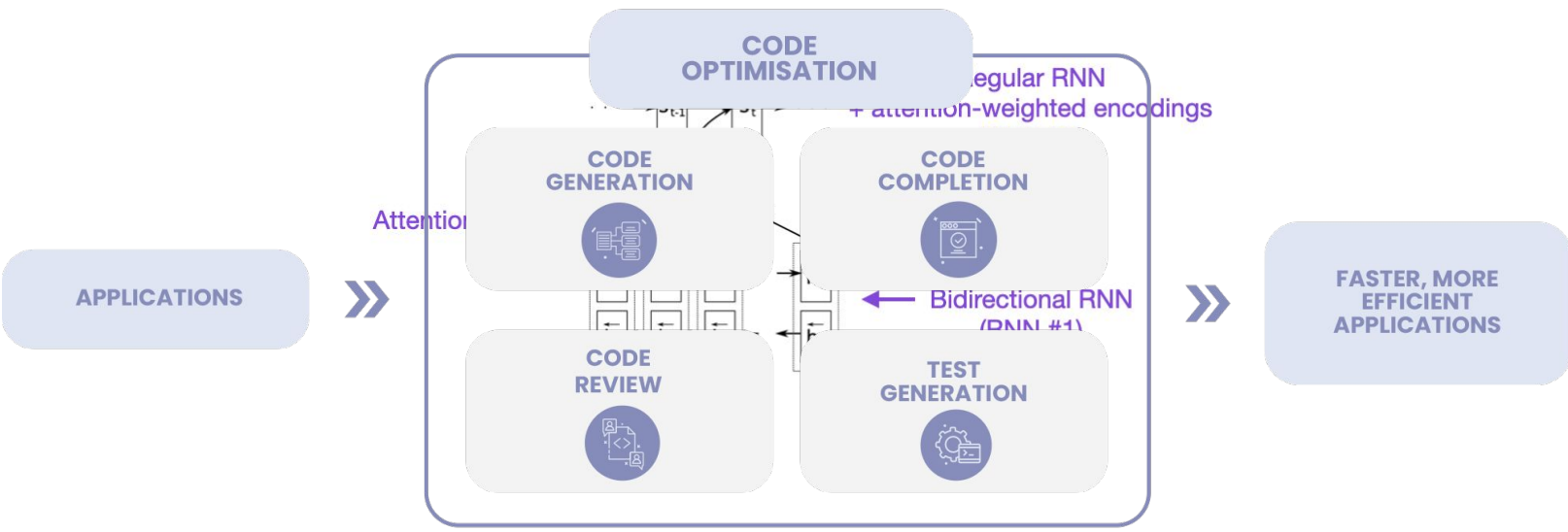
- Introduction to Large Language Models (LLMs)

[2] Attention Is All You Need (2017) by Vaswani, Shazeer, Parmar, Uszkoreit, Jones, Gomez, Kaiser, and Polosukhin, https://arxiv.org/abs/1706.03762

Motivation

ChatGPT

Write a function that calculates the average salary from a pandas data frame in Python

Here is an example of a function that calculates the average salary from a pandas DataFrame in Python:

Copy code

```python
import pandas as pd

def average_salary(dataframe):
    salary_column = "salary"
    if salary_column in dataframe.columns:
        return dataframe[salary_column].mean()
    else:
        return "Salary column not found in DataFrame."
```

In the past, your articles were checked by Turnitin (Artificial Intelligence/ Digital Library); But now, what the AI writes is checked by you…

Copilot

```python
1    # Write a function that multiplies two numbers and returns the result
2    def multiply(x, y):
3        return x * y
4
5    # Write a function that adds two numbers and returns the result
6    def add(x, y):
7        return x + y
```

How could we deal with the Challenges of LLM-based Writing Assistants: such as coherence, fluency, trustworthiness, ownership, and predictability, which limit their usability for users?
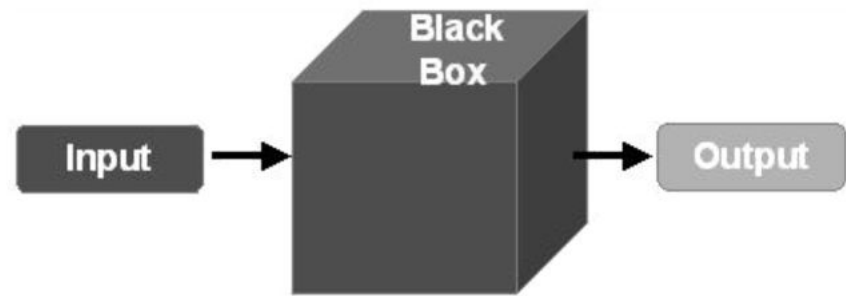
How to ensure effective interaction with LLM-based writing assistants? How existing tools and strategies align with different stages of action and can contribute to improving the usability of such tools?

[4] K. Gero, A. Calderwood, C. Li, and L. Chilton, "A design space for writing support tools using a cognitive process model of writing," *in Proceedings of the First Workshop on Intelligent and Interactive Writing Assistants* (In2Writing 2022), *2022, pp. 11-24*.

[5] Ann Yuan, Andy Coenen, Emily Reif, and Daphne Ippolito. 2022. Wordcraft: Story Writing With Large Language Models. *In 27th International Conference on Intelligent User Interfaces (Helsinki, Finland) (IUI '22)*. Association for Computing Machinery, New York, NY, USA, 841–852. https://doi.org/10.1145/3490099.3511105

[6] Oloff C. Biermann, Ning F. Ma, and Dongwook Yoon. 2022. From Tool to Companion: Storywriters Want AI Writers to Respect Their Personal Values and Writing Strategies. *In Designing Interactive Systems Conference* (Virtual Event, Australia) (DIS '22). Association for Computing Machinery, New York, NY, USA, 1209–1227. https://doi.org/10.1145/3532106.3533506

[7] Maliheh Ghajargar, Jeffrey Bardzell, and Love Lagerkvist. 2022. A Redhead Walks into a Bar: Experiences of Writing Fiction with Artificial Intelligence. In Proceedings of the 25th International Academic Mindtrek Conference (Tampere, Finland) (Academic Mindtrek '22). Association for Computing Machinery, New York, NY, USA, 230–241. https://doi.org/10.1145/3569219.3569418
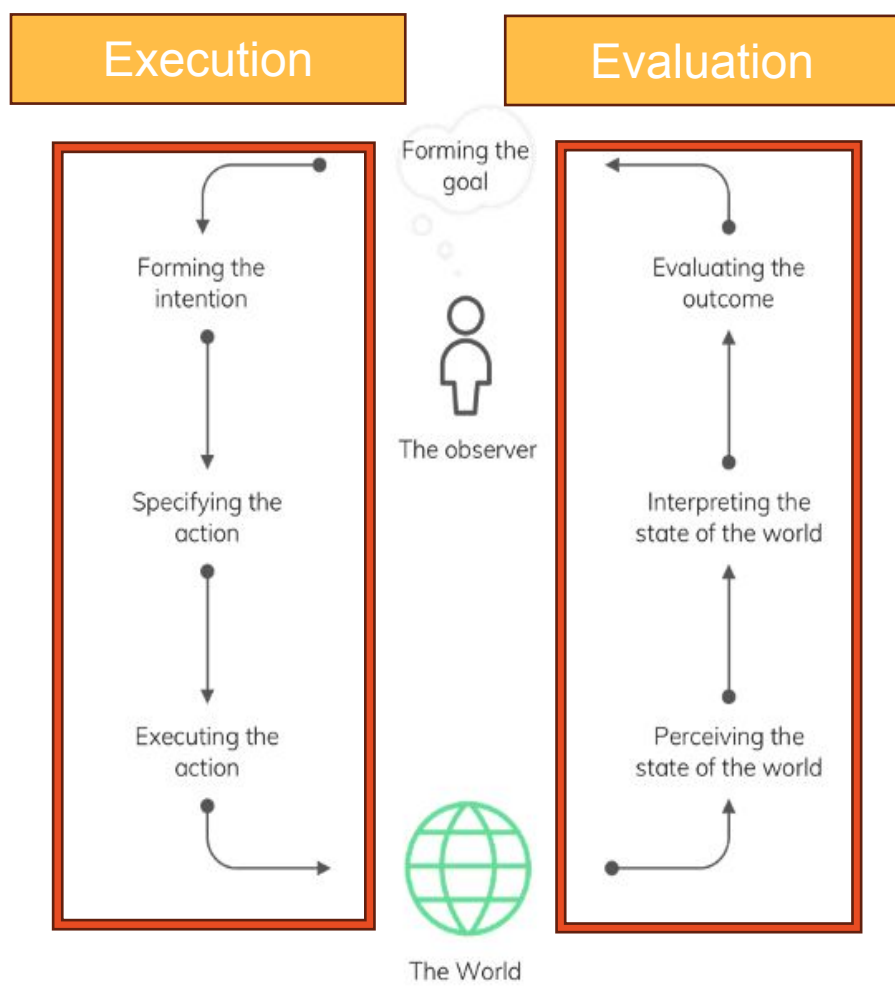
Motivation

Problem

1. Challenges of LLM-based Writing Assistants
2. Improving tools usability

1. how each stage of action can be relevant in a particular context

2. LLM Comparison

Solution

Execution

Evaluation

Forming the goal

The observer

Forming the intention

Specifying the action

Executing the action

Evaluating the outcome

Interpreting the state of the world

Perceiving the state of the world

The World

LLM: ChatGPT, Copilot

Norman's Seven Stages of Action [8]

- As a way to guide the design of LLM-supported writing assistants.
- Breaks down the user's interaction into distinct stages, from setting a goal to evaluating the results.

[8] D. A. Norman, *The psychology of everyday things*, Basic books, 1988.

- ## Comparison of the model quality

- Compare models based on two different criteria:

- High-level content -> meaning of a piece of text

E.g.,

Asking for an explanation of a complex scientific concept,

comprehensive and accurate explanation

comprehensive and accurate explanation

- Low-level editing -> how effectively they handle fine-grained changes & modifications within text (models' proficiency in making specific, detailed changes to the text)

E.g.,

Modify individual words, phrases, sentence structures, punctuation, and grammar

low-level editing can be useful for refining and polishing existing text, making it more grammatically correct, concise, and well-structured

- ## Logic Behind

User Interaction

Initial Guidance

After 10s

Main Interface

Welcome to the Machine Learning Tools and Documentation page.
Below are the instructions you need to follow before utilizing the tool:
1. To initiate file upload, simply select the desired file from your local storage by clicking the "Upload File" button.
2. Process the uploaded file by activating the "Process File" button.
3. Once your file has been processed, you can input your text within the designated "Enter Text" box.
4. Employ the "Generate" button to produce code and documentation based on the input text, utilizing the Hugging Face GPT-2 model.
5. The resulting text will be showcased in the "Generated Text" box. Remember to review the provided guidelines before proceeding.

Input your files

LLM supported by Hugging Face

Output the codes with reference, ideally

Code and Documentation

Upload Files:

Choose files   No file chosen

Process Files

Enter Text:

Type your input text here... This textbox will allow you to upload files or enter text in the input box, and the output will be generated using the GPT-2 model. If files are uploaded, the content of each file will be used as input for the GPT-2 model. If no file is uploaded, the input text will be used directly for generation. The output will be displayed in a separate output box.

Generate

Demonstration

1. To initiate file upload, simply select the desired file from your local storage by clicking the "Upload File" button.

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5. The resulting text will be showcased in the "Generated Text" box. Remember to review the provided guidelines before proceeding.

Discussion and Future Prospects

- Interpretability of model outputs

```
import warnings
# 2018-05-29, PendingDeprecationWarning added to matrix.__new__
# 2020-01-23, numpy 1.19.0 PendingDeprecatonWarning
warnings.warn("Importing from numpy.matlib is deprecated since 1.19.0. " "The
matrix subclass is not the recommended way to represent " "matrices or deal
with linear algebra (see "
"https://docs.scipy.org/doc/numpy/user/numpy-for-matlab-users.html). " "Ple
adjust your code to use regular ndarray. ", PendingDeprecationWarning,
stacklevel=2)
```

Matlib.py

app.py

xxx.py

```
enerated Text:
port warnings

# 2018-05-29, PendingDeprecationWarning added to matrix.__new__
                      lingDeprecatonWarning
                      mpy.matlib is deprecated since 1.19.0. "
                      ot the recommended way to represent "
                      ear algebra (see "
    "https://docs.scipy.org/doc/numpy/user/numpy-for-matlab-users.html). "
    "Please adjust your code to use regular ndarray. ",
    PendingDeprecationWarning, stacklevel=2)

       efmatrix import matrix, asmatrix
                      functions in the numpy namespace with a few
                      oc/source/reference/routines.matlib.rst for details.
# Need * as we're copying the numpy namespace.
from numpy import *  # noqa: F403
```

- Flexibility of the Framework: Not always perfectly fit every situation
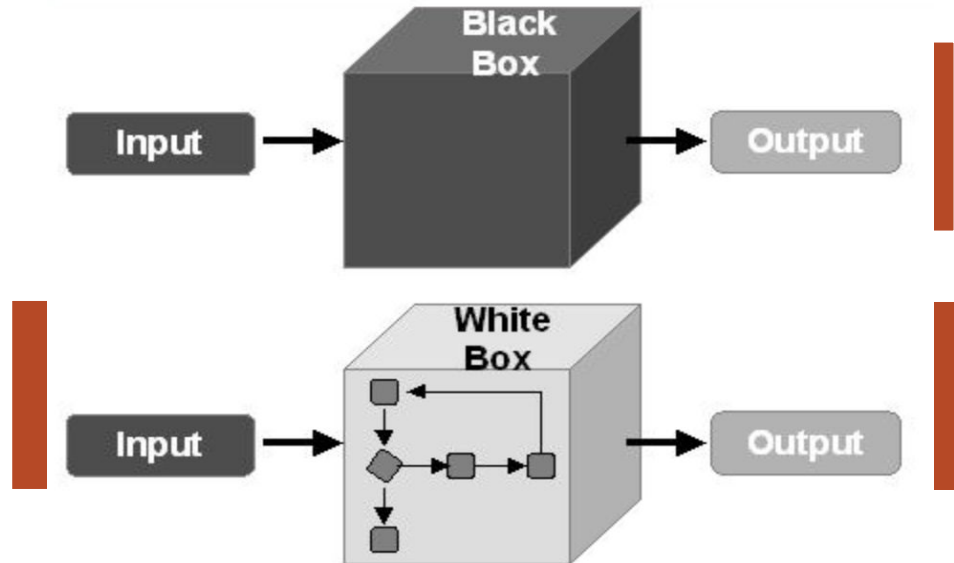
Project Timeline

1. Langchain, OpenAI, Hugging face
2. Learning on Design: HCI
   - "Systems Analysis and Design"
   - "The Design of Everyday Things"
   - "Human-Computer Interaction"

1. Obtain source code
2. Ensure that the code snippets are diverse by selecting examples from different domains
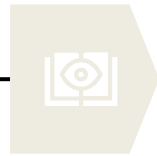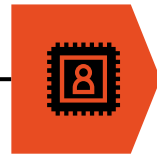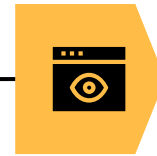
Week   0-3   4-6   7-8   9-10   11-12+

Brainstorming   LLM   LLM Implementation   Source Code   Multi-model
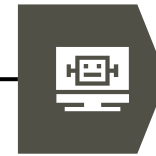
1. Design space for writing support tools – 2. Wordcraft - https://arxiv.org/abs/2107.07430
3. LLM interactions:
4. PromptChainer: https://arxiv.org/abs/2203.06566
5. AI Chains: https://arxiv.org/abs/2110.01691

1. Learned about Langchain:
2. API keys in OpenAI.
3. Understanding Hypothetical Document Embeddings (HyDE)

1. Continue multi-model comparisons
2. Analyze and document the results of the comparison, highlighting the strengths and weaknesses of each model.
3. Code File Highlighting

Reference

[1] https://hinchi-kwok.com

[2] Attention Is All You Need (2017) by Vaswani, Shazeer, Parmar, Uszkoreit, Jones, Gomez, Kaiser, and Polosukhin, https://arxiv.org/abs/1706.03762

[3] Generative AI for Code: what you need to know in 2023 - TurinTech AI

[4] K. Gero, A. Calderwood, C. Li, and L. Chilton, "A design space for writing support tools using a cognitive process model of writing," in Proceedings of the First Workshop on Intelligent and Interactive Writing Assistants (In2Writing 2022), 2022, pp. 11-24.

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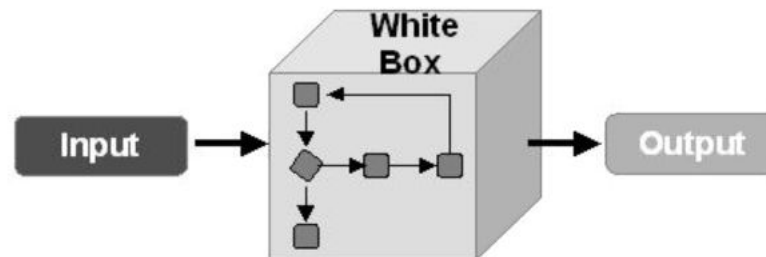
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[8] D. A. Norman, *The psychology of everyday things*, Basic books, 1988.

Contribution

- Curiosity:
    - The application of machine learning techniques to tasks related to software development and documentation
    - How LLM has gained significant attention to automate and enhance various aspects of the software development lifecycle

- Challenge:
    - Investigate the interaction design in intelligent writing assistants supported by LLMs with a focus on human actions (Norman's seven stages of action)
    - To design of LLM-supported intelligent writing assistants and discuss its implication on usability ownership, and predictability
    - Model Comparison

- Change:
    - Explore user actions with LLM-based writing assistants
    - Personalized tasks
    - White Box: Explainability and interpretability of model outputs

Merci beaucoup! Bonne journée!
Thank you very much! Have a good day!

My Website

Embrace CURIOSITY, Confront CHALLENGES, and Drive CHANGE