

Single Day Event

Fusing LLMs' Capabilities into Data Science IDEs to Enhance Clinical Data Analysis and Reporting

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LLMs are being adopted in medical research, yet LLMs are NOT reliable at some tasks...

- LLMs being adopted in many medical/clinical research tasks:

- **Literature** search, understanding, summary
- Medical **writings** (protocol, CSR, etc.) assistance/acceleration
- Health information **consultation**...

- BUT, LLMs are NOT reliable at:

- Mathematics (e.g.: which is larger: 9.11 or 9.9)
- Logic Reasoning (e.g.: Reversal Curse)

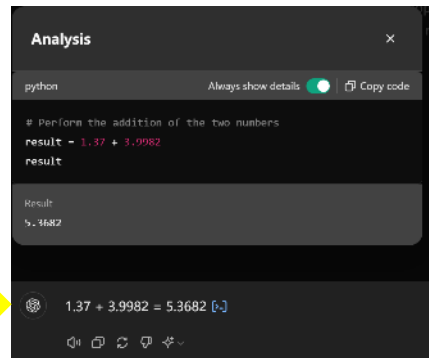
- WHY?

- LLMs, i.e.: Large Language Models, are trained for language-related tasks.
- For other tasks, our proposition is to:

Leverage the strengths of both LLMs and domain-specific tools



Example of very basic mistakes happened in LLMs (might have been fixed)



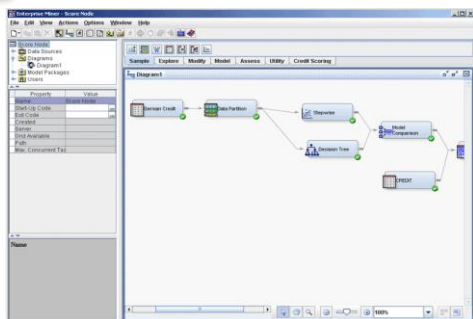
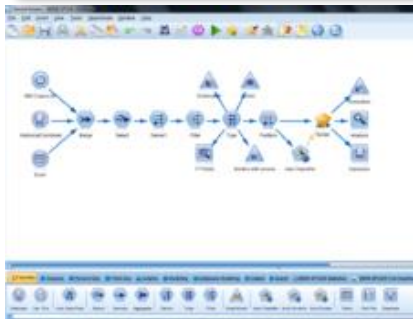
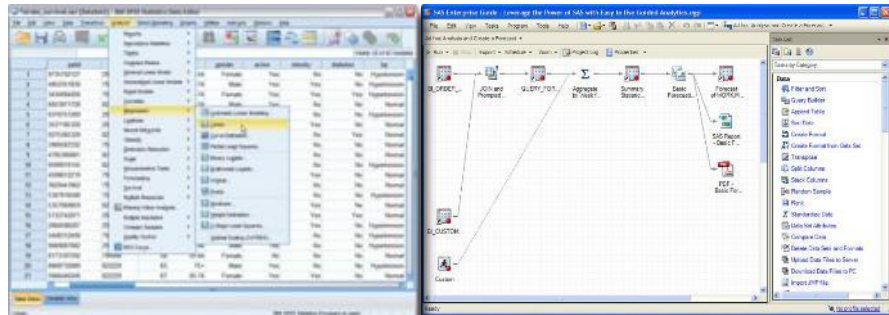


Status Quo of Clinical Data Analysis: the Tools

TWO approaches: GUI-based vs Programming based

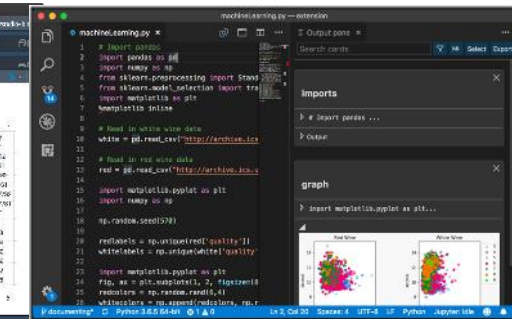
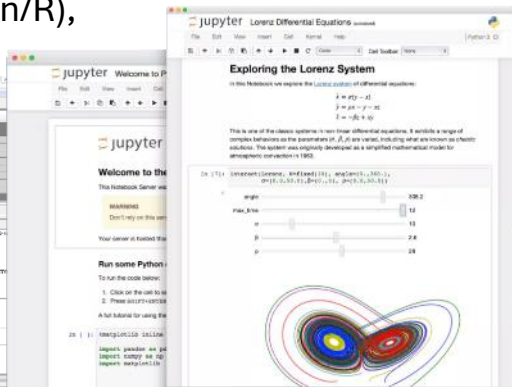
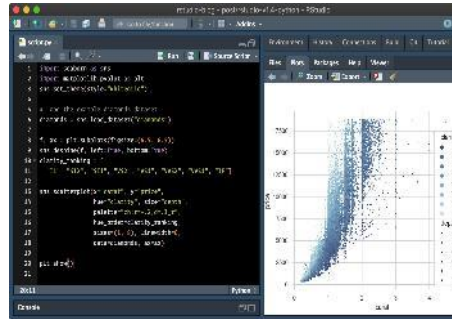
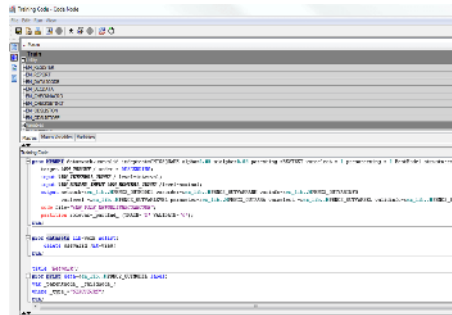
GUI-based

IBM SPSS/SPSS Modeler
SAS Enterprise Miner, KIME, WEKA, etc.



Programming-based

SAS, JupyterLab (Python/R),
R-Studio, vsCode



Pro/Con of Clinical Data Analysis: the Tools

TWO approaches: GUI-based vs Programming based

GUI-based

IBM SPSS/SPSS Modeler
SAS Enterprise Miner, KIME, WEKA, etc.

- ▶ Easy to use with GUI
- ▶ however: laborious, repetitive work (drag and drop, clicks), less reusable
- ▶ Less transparent and control (Source code unavailable, what happened?)

Programming-based

SAS, JupyterLab (Python/R),
R-Studio, VSCode

- ▶ Transparent and more control to process, however:
- ▶ Steep learning curve: master one (or more) programming language and Data Analysis toolkit (SDK)
- ▶ Manually type code in and IDEs (VSCode, RStudio etc.)
- ▶ User Experience: Code Search (from Docs/StackOverflow/...) → Ctrl+C/V...

Dimension	GUI based	Programming based
Usability (User-friendly)	★★★★★	★★
Learning Curve Friendly	★★★	★
Flexibility	★★	★★★★★
Reusability (of pipeline)	★★★	★★★★★ (* depends...)
Reproducibility	★★ (* depends...)	★★★★★ (* depends...)
Collaboration	★★ (* depends...)	★★★★★ (* depends...)

LLMs can help
(LLMs can Program)

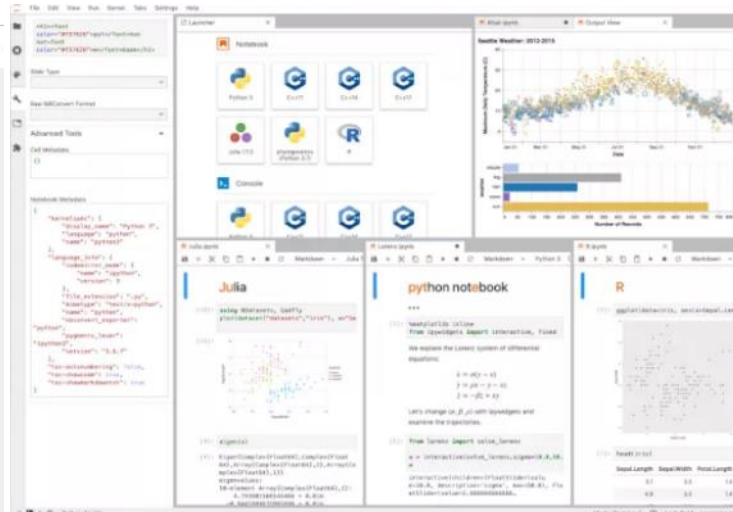
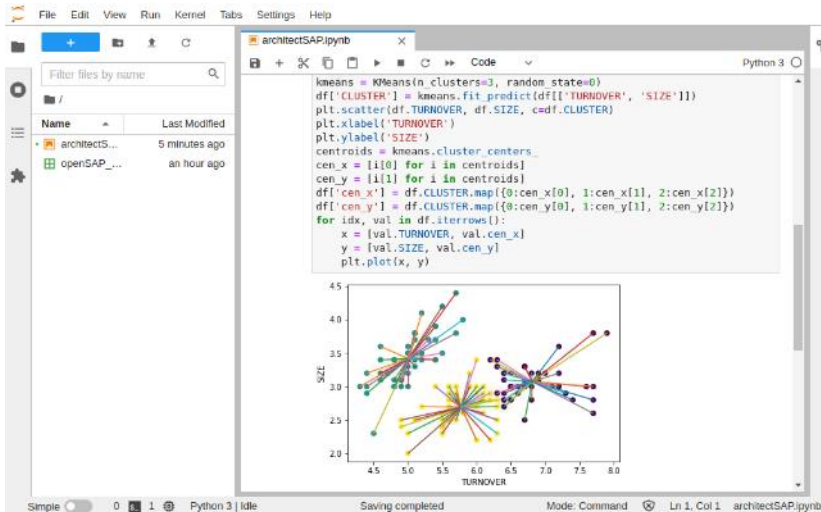




Standing on the shoulder of giant - Jupyter Notebook: Web-based Open Source Interactive IDE for R/Python/...

A web-based application that allows users to create and **share** documents that contain **live code**, **visualizations**, **explanatory text** and **equations**.

- ▶ Enables **interactive data science** and scientific computing across 40+ languages (Python, R, etc.)
- ▶ Enables users to analyze in an **iterative manner (agile practice)**.
- ▶ Open source ecosystem, many extensions developed by active community developer



Code + Text

Use Cases:

- ▶ Programming
- ▶ Reporting
- ▶ Sharing
- ▶ Collaboration
- ▶ Validation



Enhancing Jupyter Notebook with LLM

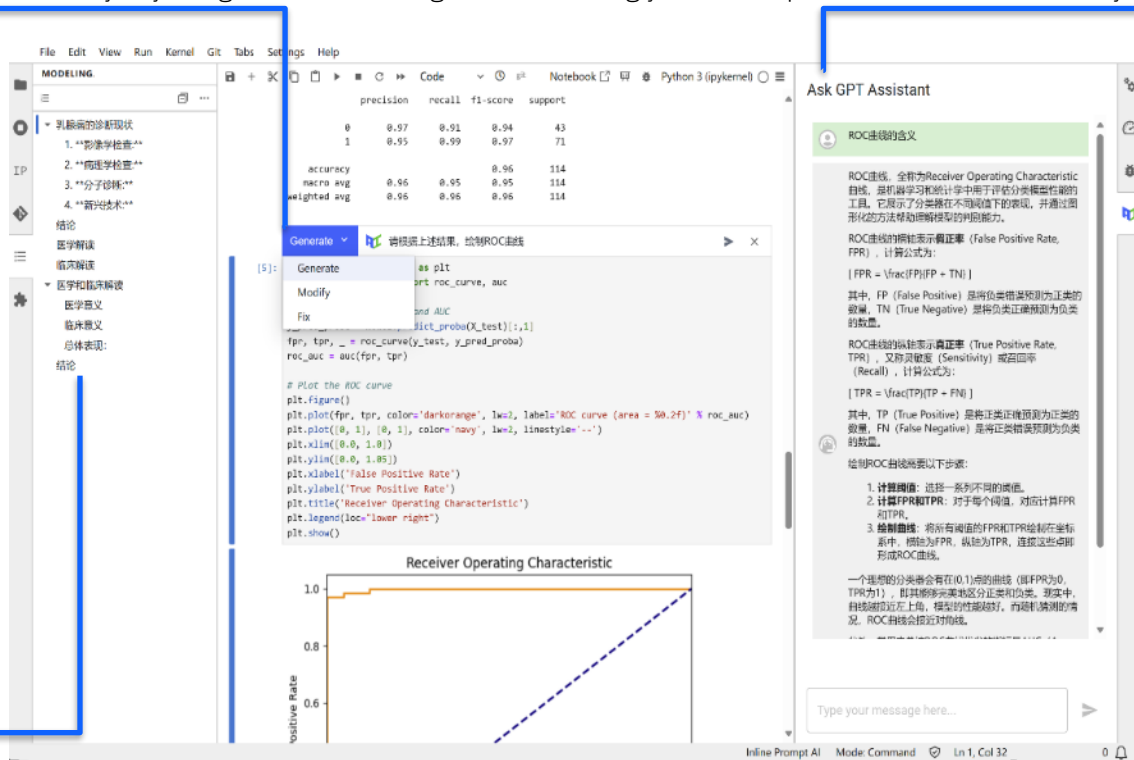
Examples: Reporting / Writing

Embeds LLM interactions, with real-time awareness of the data analysis context, and dynamically adjusts generation strategies.

Integrates 20+ LLM APIs, with a built-in Copilot, allowing you to ask questions to the models anytime.

- A personalized LLM assistant who knows your existing work in the notebook + general knowledge like ChatGPT.
Help users to write: interpret results, draft Research Proposals/protocol, etc.
- A personalized Data Scientist assistant who can help users program, analysis data, draft analysis report.

The UI/UX that data scientists are most familiar with.



Demo Video

Visit: <https://rws.ailifesci.cn>

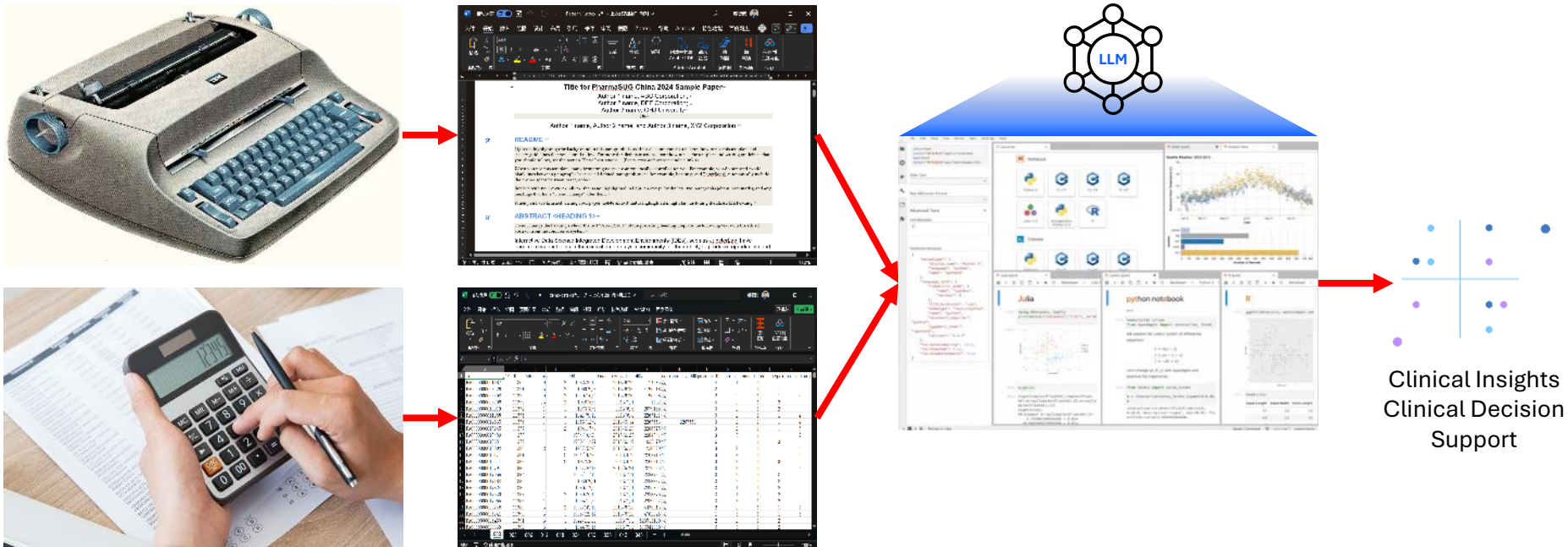


Future Work

- ▶ Notebook generation with human feedback
- ▶ Drafting systematic medical survey/papers
- ▶ Pre-defined statistical analysis pipelines
- ▶ Internet search capabilities
- ▶ UI/UX improvements
- ▶



Discussion – Clinical Data Analysis Process: Our Vision and Proposition



1. Leverage and integrate the **comparative advantages** of LLMs and domain-specific tools (e.g. programming) in different tasks.
2. Develop the right tool to provide **integrated user experience** for different tasks.



Discussion – Future of Clinical Data Analysis Participants and Integration of Experience

(Big) Clinical/medical data will transform medicine,
only if analyzed, interpreted, and acted on.
Take Predictive Modeling as an example*:

Applications of Machine Learning for structured EHR data,
Improve Prognosis / Improve Diagnosis Accuracy /
Improve Accuracy of Prediction Outcomes /

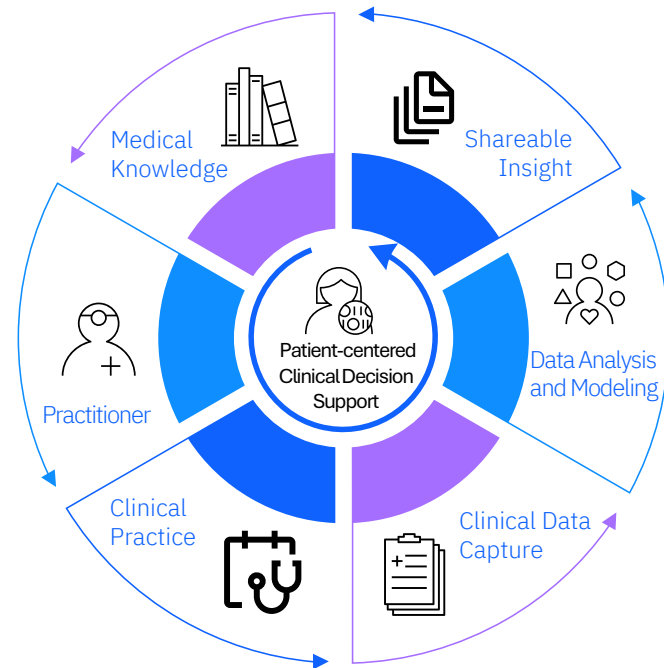
Challenges for applying ML in medical research:

For Data Scientist:

- **Misuse of ML methods: overfitting; multi-collinear / correlated predictors**
- Misinterpret of model results: predictors are not causes

For Clinical Researchers:

- Gap of Data Analysis (e.g.: ML, stats) knowledge/skill



- Both Clinical Researchers and Data Scientists should be involved in the loop!
- Using LLM/tools to accelerate the loop!

Q&A

Thank you!



**The Global Healthcare
Data Science Community**

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