Is Math even useful IRL?

Problem Recontextualization and Solving with Wolfram API & ChatGPT4 as Tutors.

Use Case Title:

Is Math even useful IRL? Problem Recontextualization and Solving+Tutoring with Wolfram & ChatGPT4

Description:

Using Wolfram & ChatGPT4, motivate university students by transforming conventional math problems into personalized "real-world" scenarios. This approach acquaints them with industry-specific problems they *could* face post-graduation. Whether you're exploring complex equations for quantitative trading strategies or optimizing sustainable but efficient farming practices, engage in personalized tutoring sessions.

Tutorial for Use and Best Practices:

1. **Initiating the Conversation with ChatGPT**
2.
3. *Switch to GPT-4 with the Wolfram Alpha plugin activated.*
4.
5. *Type into ChatGPT:*
   "Imagine you're a specialist in [Future desired job / industry post-grad here]. To make this problem more engaging, rephrase it in the context of [Future desired job/industry post-grad here]. Ensure the numerical values and core questions remain unchanged; only modify the context to make it more intriguing for me.
6. Find the answer with Wolfram first. Instead of directly providing the answer, keep asking me questions until I give you my input. Do it in a step-by-step manner. End your first response by starting with the first step and providing the formula and the given.

7. The Math Problem
   "[Paste math problem directly—problems not properly formatted due to the conversion from Latex work fine as they can be understood by ChatGPT]""
8.
9. *Best Practices:*
10.
11. If you have a niche interest like me, you can simplify the concept.
12.
13. I am interested in Semantic Decoding, so I simply added "(converting thoughts to words)" in the first line after the [Future Job] text. ChatGPT was able to contextualize the problem well.
14.
15. Keep extra specifications in the next prompt. This prompt contains several instructions and details (to conserve GPT4's 50 chats every three hours limitation).
16.
17. Be mindful of token limitations, as overly long prompts may cause ChatGPT to miss some instructions.
18.
19. **Reviewing and Asking Follow-Up Questions**
20.
21. If you are not fully familiar with a formula yet, ChatGPT can *take a step back* and help you review/master a mathematical concept first. It will not "get tired and reveal the answer". You can then resume back to the problem.

e.g

22.
23. Learning how to work with exponents and square roots before solving problems with algebra.
24.
25. Mastering elementary derivative functions before problem-solving with partial derivatives.
26.
27. Fully validate the answer by following up with a prompt to:
28.
29. “Validate my answer with Sage Math (Python) code.”
30.
31. You can run the python code in multiply ways:
32.
33. The most convenient is within Sage Math’s website. No logins required and relevant-to-Sage-Math libraries are installed.
34.

1.
2. If you need more flexibility and prefer to not install Sage on your own, you can use CoCalc to work within Notebooks with Sage, IPython, LaTeX on the cloud.
3.
4. I recommend CoCalc because of its built-in GPT 3.5 code analyzer and “bug fix” feature.

```
In [2]: # CoCalc Example by Carl Kho for AI Classroom Challenge 2023
        print(9+10)
        print("9" + 10)

Out[2]: Help me fix this...
        19
        ---------------------------------------------------------------------------
        TypeError                                 Traceback (most recent call last)
        Cell In [2], line 3
              1 # CoCalc Example by Carl Kho for AI Classroom Challenge 2023
              2 print(Integer(9)+Integer(10))
        ----> 3 print("9" + Integer(10))
        File /ext/sage/10.1/src/sage/rings/integer.pyx:1762, in sage.rings.integer.Integer.__add__()
           1760         return y
           1761
        -> 1762     return coercion_model.bin_op(left, right, operator.add)
           1763
           1764 cpdef _add_(self, right):
        File /ext/sage/10.1/src/sage/structure/coerce.pyx:1269, in sage.structure.coerce.CoercionModel.bin_op()
           1267     # We should really include the underlying error.
           1268     # This causes so much headache.
        -> 1269     raise bin_op_exception(op, x, y)
           1270
           1271 cpdef canonical_coercion(self, x, y):
        TypeError: unsupported operand parent(s) for +: '<class 'str'>' and 'Integer Ring'
```

1.
2.
3. You can run the code through GPT-4's "Advanced Data Analysis" but they will additionally consume your 50 messages every three hours.
4.
5. The option to run locally or on Google Colab stands as well of course, but you have to [install Sage Math] yourself.
6.
7. After solving the problem, you can ask ChatGPT to summarize all the steps you have taken to review (formatted so you can directly copy-paste to Notion or Google Docs)
8.
9. "Provide a concise summary of the steps we've taken so far, particularly focusing on the mathematical steps taken. Format it in non-latex for easy copying and pasting into applications like Notion or Google Docs."
10. *Sample notes pasted in Notion*

Problem Context:
We're exploring the accuracy of a device named "MindWrite" that translates human thoughts into written words. The function `f(x,y) = x * e^(y^2)` represents the translation accuracy based on clarity of thought (`x`) and emotional intensity (`y`).

Objective:
Find the gradient of `f(x,y)` at the point `(1,0)` .

Steps:

1. **Function Definition:**
   - Given function: `f(x,y) = x * e^(y^2)`
2. **Partial Derivative with respect to x:**
   - Differentiated `f` with respect to `x` treating `y` as constant.
   - Result: `df/dx = e^(y^2)`
3. **Partial Derivative with respect to y:**
   - Differentiated `f` with respect to `y` treating `x` as constant.
   - Used chain rule for differentiation.
   - Result: `df/dy = 2 * x * e^(y^2) * y`
4. **Evaluate the Gradient at (1,0):**
   - Plugged in `x=1` and `y=0` into the partial derivatives.
   - `df/dx` at `(1,0)` = `1`
   - `df/dy` at `(1,0)` = `0`
   - Gradient at `(1,0)` = `[1, 0]`

Conclusion:
The gradient of `f(x,y)` at the point `(1,0)` is `[1, 0]` .

1.
2.

3. *Best Practices:*
4.
5. Mastery lies in practice. Feel free to ask it to generate a new question—it will remember the prompt.
6.
7. It is natural to occasionally feel like you're "cheating" when using AI assistance for math problems. However, remember that your primary goal is to learn and build intuition/practical problem-solving skills.
8.
9. AI is a tool to aid in your learning journey, especially when your schedule is busy. Focus on gaining knowledge and experience rather than dwelling on any feelings of guilt.
10.
11. Numbers alone can be confusing. ChatGPT can help you interpret the numbers qualitatively. Again, feel free to clarify as much as possible. ChatGPT will not judge you.
12.
13. Shortcuts in Math and code are common. If you are confident enough, you can ask ChatGPT to teach you shortcuts.
14.
15. Wolfram Alpha tends to skip on the formula and process. However, ChatGPT can break down the steps taken to get to the answer. I highly recommend you do that.
16.

Impacts on Learning:

Positive Impacts:

Engagement and Relevance: By converting abstract math problems into industry-specific scenarios, students can immediately see the real-world relevance of what they're learning. This boosts motivation and helps them see the practical applications of mathematical concepts.

Personalized Learning: Every student has unique interests and career aspirations. This method caters to individual preferences, making math more relatable and interesting.

Deepened Understanding: By breaking down problems step-by-step and ensuring students are actively involved in the problem-solving process, they gain a more profound understanding of mathematical concepts.

Learning at One's Own Pace: The AI doesn't rush or slow down based on a fixed curriculum. It caters to the student's pace, ensuring they fully grasp each concept before moving on.

Skill Solidification through Discrepancy Resolution: Occasionally, discrepancies between Wolfram Alpha's solutions and Sage Math's results may arise. Resolving these differences requires students to dive deeper into the problem, enhancing their coding and mathematical skills in the process.

Limitations:

Over-reliance on AI: There's a risk that students might become overly dependent on AI tools, potentially hampering their ability to solve problems independently.

Interpretation of Real-World Scenarios: Not all real-world scenarios provided by the AI might align perfectly with actual industry challenges.

Loss of Basic Skills: If used excessively, students might skip foundational learning and focus solely on applied problems, leading to potential gaps in basic mathematical knowledge.

Ethical Considerations:

Data Privacy: Using online platforms raises concerns about data privacy. It's crucial to ensure that personal information isn't unintentionally shared or stored.

Academic Integrity: While the tool is great for learning, there might be temptations to use it for assignments or exams. The AI can still skip straight to the answers when prompted. It is under the users' hands to be aware of academic guidelines and use the tool ethically.

Accessibility: Not all students might have access to premium versions of these AI tools, potentially creating a disparity in learning experiences.

Bias and Accuracy: Like all AI models, there's a chance of biases in responses or occasional inaccuracies—even with plugins. It is essential to cross-check information and not take everything at face value.

Link to an Example:

[Example ChatGPT Conversation]