

Interactive AI for Computer Algebra

*An Agentic Assistant for
ore_algebra*

Lixin Du

Institute for Algebra · JKU



Scan to play!



[huggingface.co/spaces/LixinDu/
ore-algebra-assistant](https://huggingface.co/spaces/LixinDu/ore-algebra-assistant)



Motivation

Task: How to compute the Least Common Left Multiple (LCLM) of two linear differential operators? For example, the LCLM of $(x + 3) D_x + 2$ and $x D_x + 3$.

Tools: *ore_algebra* (SageMath),
OreTools, *DEtools*, *gfun* (Maple),
HolonomicFunctions (Mathematica), etc.

Question: Could we ask a Large Language Model (LLM) to generate code for a specialized software package, such as *ore_algebra*? **Yes!**

Live Demo — Interactive AI Interface

>>Deploy⋮

ore_algebra Assistant

Try an example:

- Compute the least common left multiple of $(x+3)*Dx + 2$ and $x*Dx + 3$ in $QQ[x][Dx]$
- Compute the symmetric product of two shift operators $Sx^2 - x$ and $x*Sx^3 - 2$ in $QQ[x][Sx]$
- Guess a recurrence from 200 terms of $\sum_{k=0}^n \text{binomial}(n-k, k)*\text{binomial}(2*k, k)$ in $ZZ[n][Sn]$

↑

Generated Code & Citations — Full Transparency

Computation

Task workflow: B. Operator Algebra → Compute GCRD Or LCLM

▼ SageMath Code

```
from ore_algebra import OreAlgebra
R.<x> = QQ['x']
A.<Dx> = OreAlgebra(R, 'Dx')
P = (x+3)*Dx + 2
Q = x*Dx + 3
L = P.lclm(Q)
print(L)
```

Citations

- [1] UnivariateOreOperator.lclm (src/ore_algebra/ore_operator.py:1136)



Code

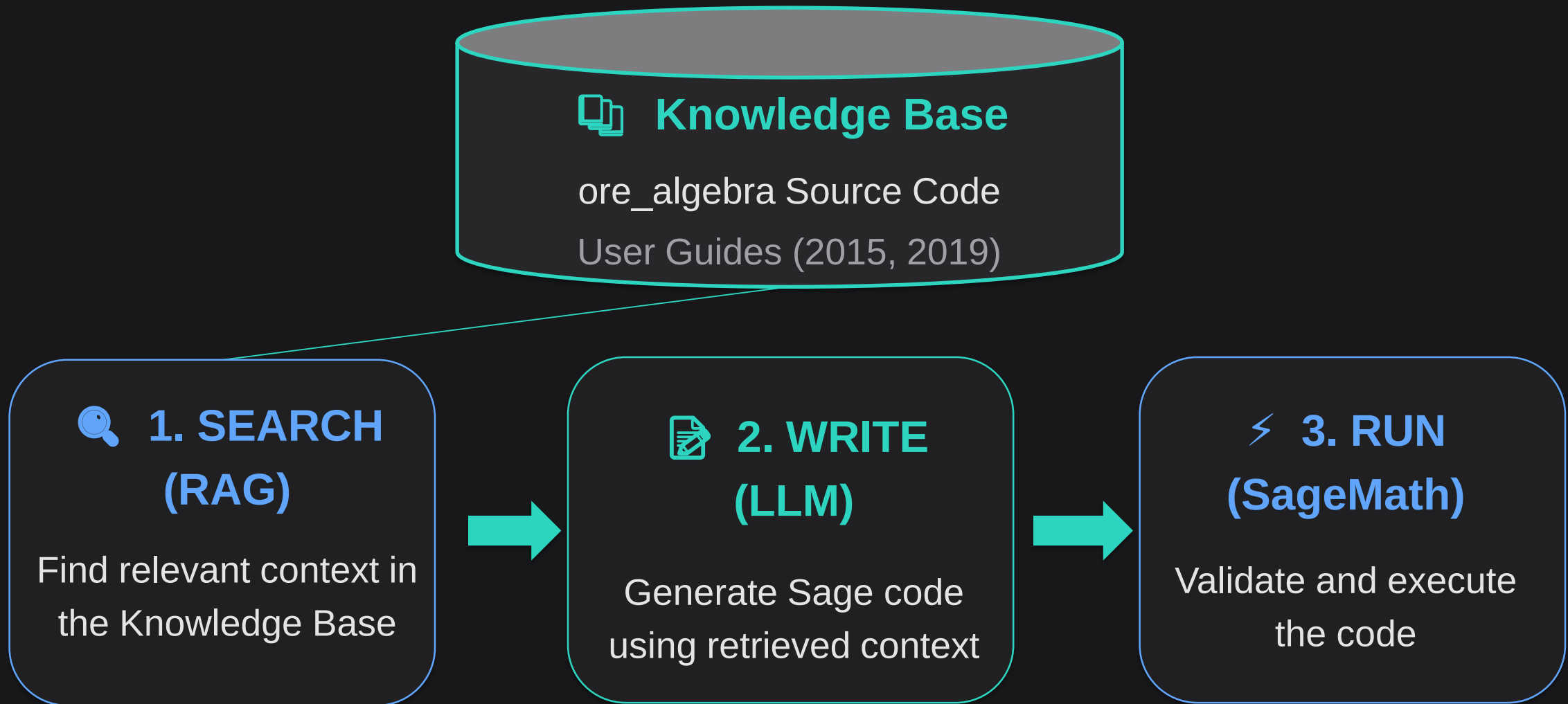
- SageMath script



Citations

- Source files & line numbers

How it Works — Retrieval-Augmented Generation (RAG)



More Examples for ore_algebra

- Factorize the **indicial polynomial** of $x D_x^3 + (6x - 1) D_x^2 - 5$ at $x=0$ in $\mathbb{Z}[x][D_x]$.
- **Guess** a recurrence from the Motzkin numbers $[1,1,2,4,9,21,51,127,323,835,2188]$ in $\mathbb{Z}[n][S_n]$.
- Compute **telescopers** and **certificates** for the annihilating ideal generated by: $L1 = (1 + k) S_k + (k - 2n)$, $L2 = (2 - 3k + k^2 + 6n - 4kn + 4n^2) S_n - (2 + 6n + 4n^2)$ in $\mathbb{Z}[n, k][S_n, S_k]$ with respect to $S_k - 1$.



GitHub: ore-algebra-agentic-rag-assistant



Hugging Face Space: ore-algebra-assistant

Scan to Try!



Thank you!