



Biolmage.IO Chatbot

Powered by Large Language Models and AI Agents

Caterina Fuster-Barceló, UC3M

Wanlu Lei, Ericsson & KTH

Benedict Diederich, Leibniz-IPHT Jena

Songtao Cheng, KTH

Wei Ouyang, KTH

June 11th, 2024

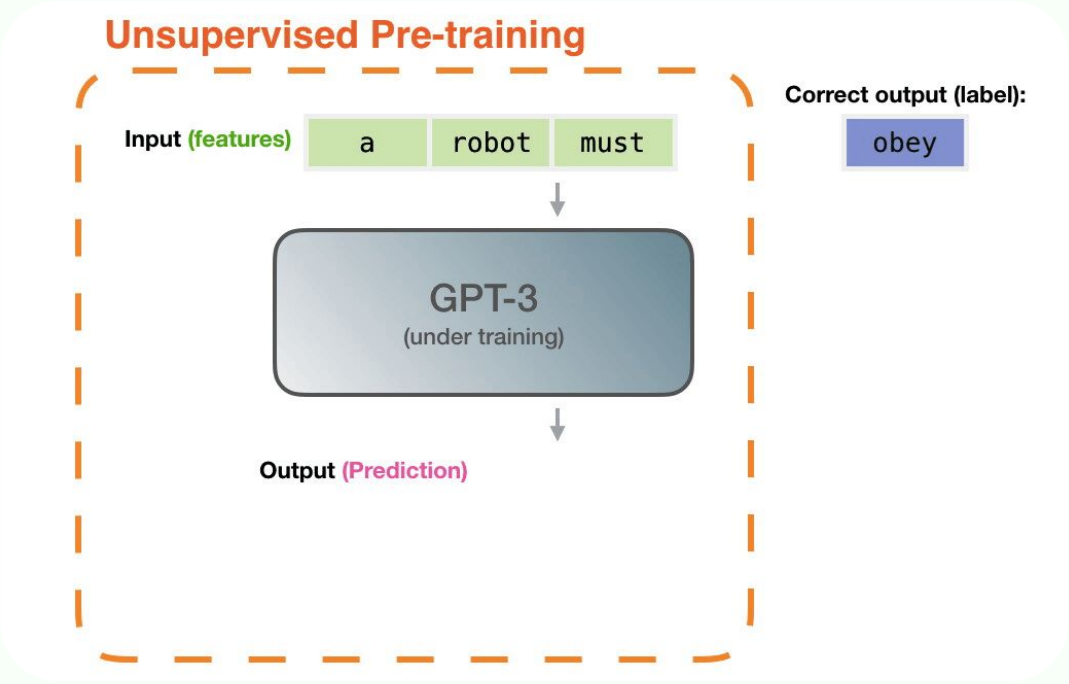
Large Language Models



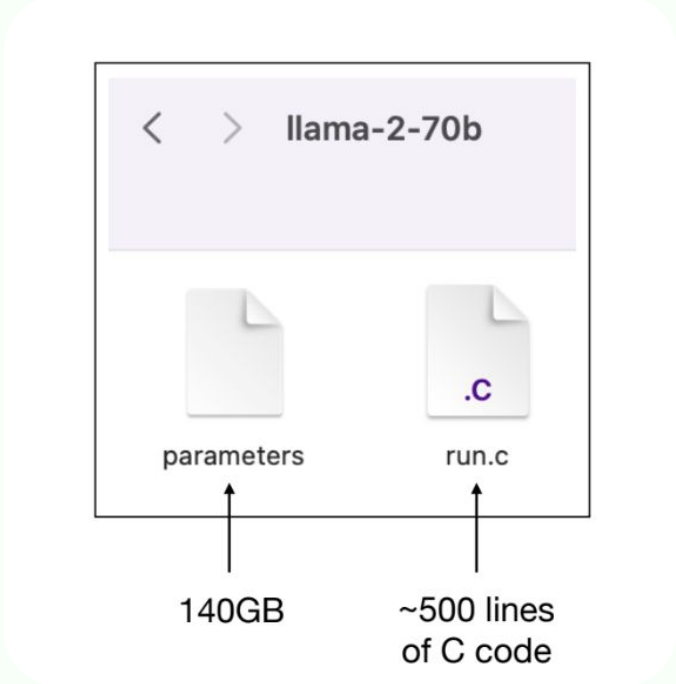
Generated by DALL.E 3

Large Language Models

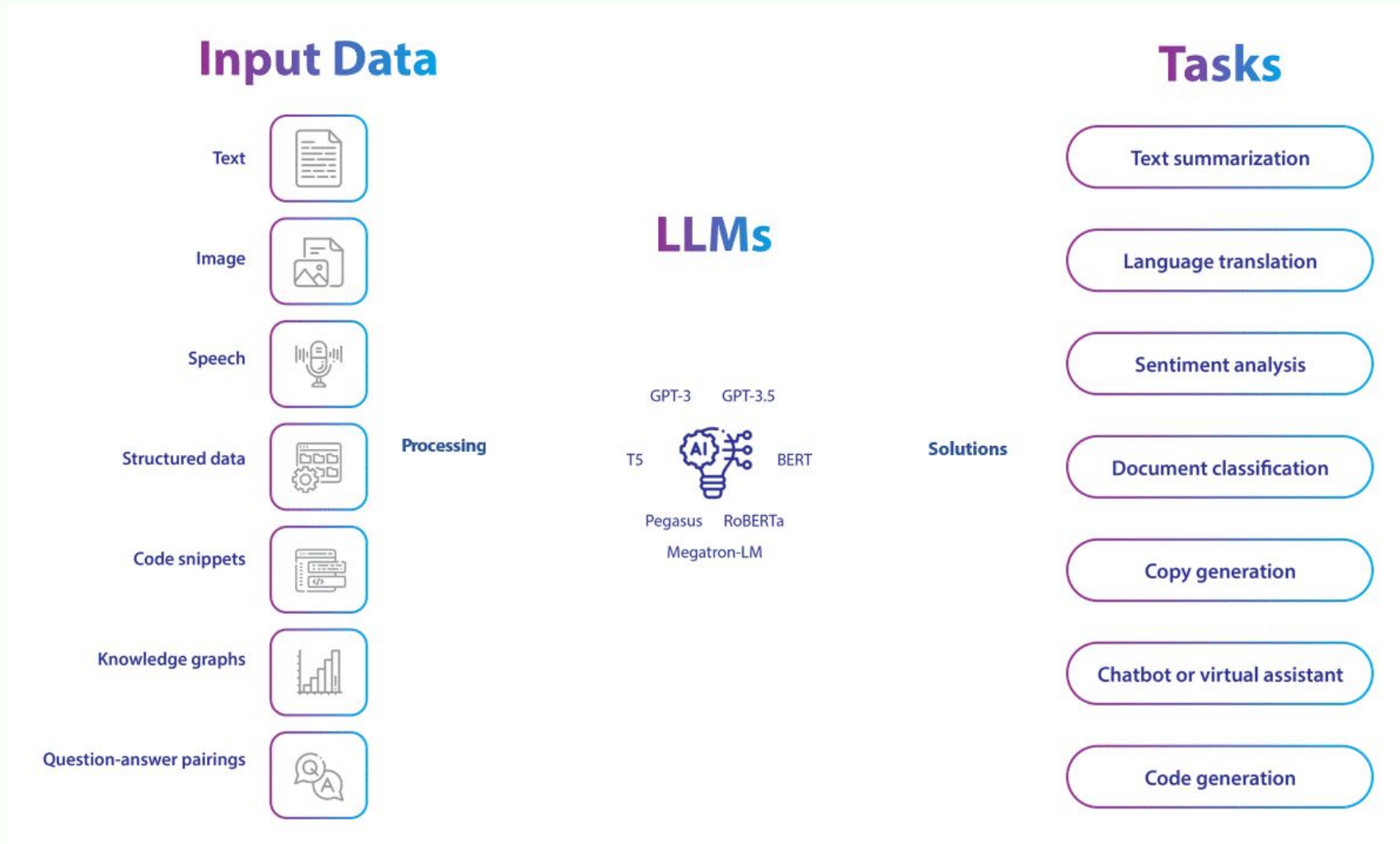
Next-Token-Prediction



Transformer + Weights



How can LLMs help with Biolmaging?



Challenges in Using LLMs

- **Knowledge Cutoff**
- **Hallucination**
- **Bias**
- **Poor Reproducibility**
- ...

How to make LLMs more reliable?

Biolmage.IO Chatbot: A Community-Driven AI Assistant for Integrative Computational Bioimaging

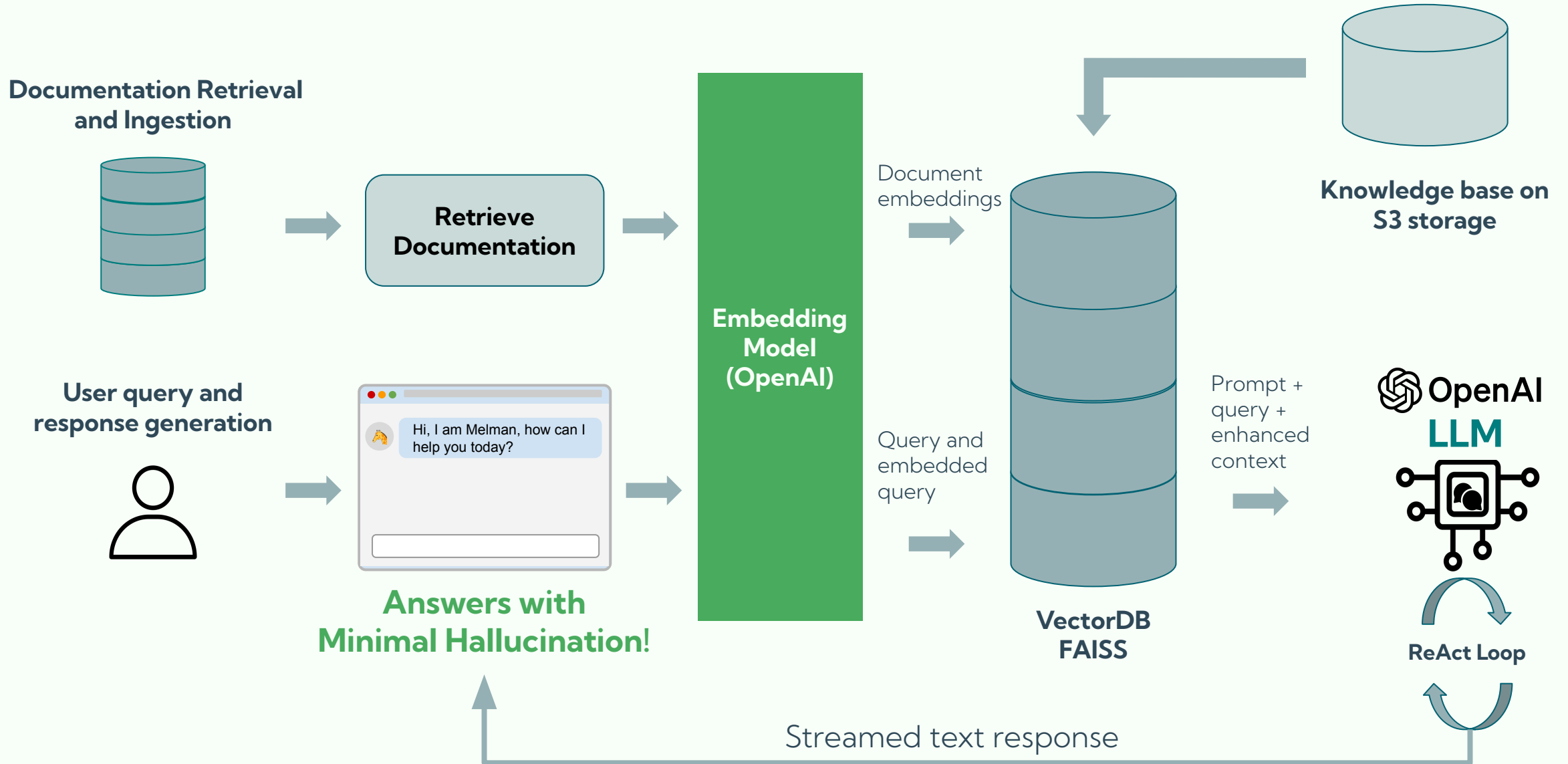
Wanlu Lei, Caterina Fuster-Barceló, Gabriel Reder, Arrate Muñoz-Barrutia
and Wei Ouyang



<https://doi.org/10.48550/arXiv.2310.18351>

Key Idea: Retrieved Augmented Generation (RAG)

Using RAG to augment LLMs with a Community Knowledge Base



Bioimage Analysis Documentation, Databases & Tools



Documentation & Books

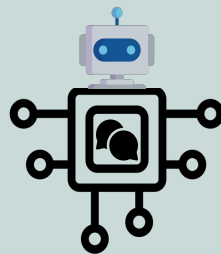


Online Databases & Services



AI models & Analysis tools

LLM-powered Chat Assistant



User's profile

Conversation context

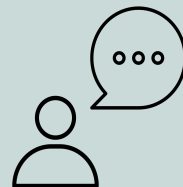
User's query

User
Query

General Q&A

Learning & Education

Coding & Analysis



Biolmage.IO ChatBot Assistants

Biolmage Seeker (Melman)

An assistant specializing in searching through **bioimage analysis tools**, including the Biolmage Model Zoo, the Biolmage Archive, biii.eu, and others, to provide **comprehensive support** in bioimaging.

Biolmage Tutor (Nina)

Your tutor for **learning about bioimage analysis and AI**. Nina is the perfect guide, offering detailed explanations and support throughout your learning journey.

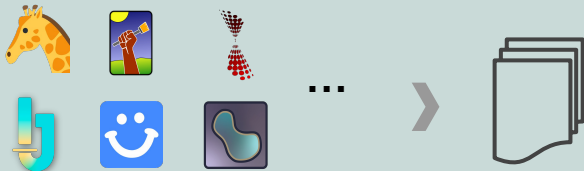
Biolmage Analyst (Bridget)

Offers tools to **analyze your images directly** or helps you construct a Python pipeline for advanced image processing tasks.

Biolmage GPT (Skyler)

Facilitates the **integration of bioimaging tools and workflows**, making it easier to apply advanced analysis techniques in your research

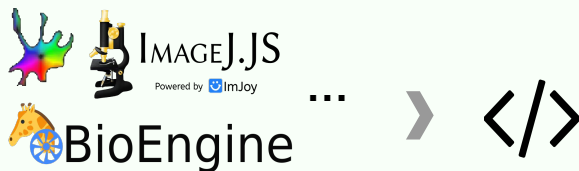
Bioimage Analysis Documentation, Databases & Tools



Documentation & Books

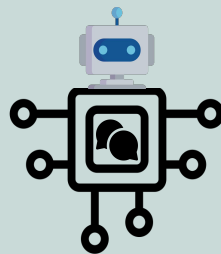


Online Databases & Services



AI models & Analysis tools

LLM-powered Chat Assistant

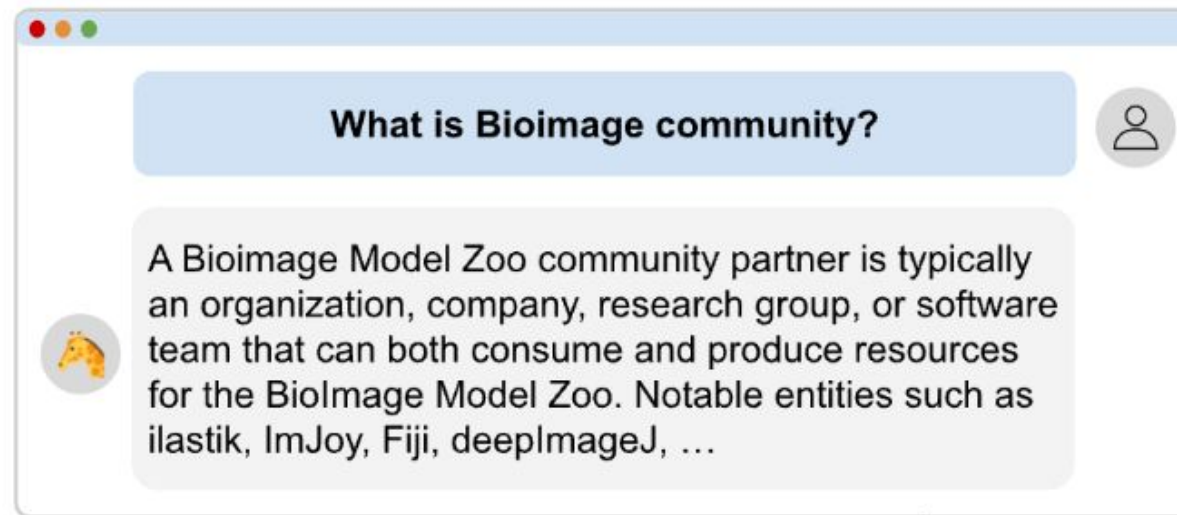


User's profile

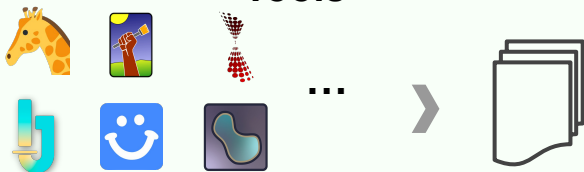
Conversation context

User's query

Searching in Documentation



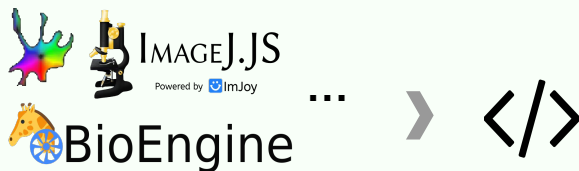
Bioimage Analysis Documentation, Databases & Tools



Documentation & Books

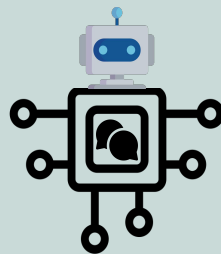


Online Databases & Services



AI models & Analysis tools

LLM-powered Chat Assistant



User's profile

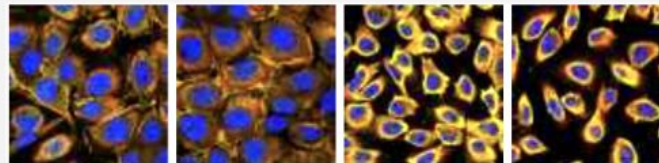
Conversation context

User's query

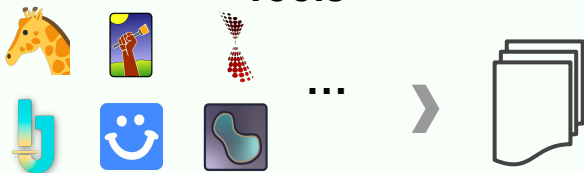
Exploring the Human Protein Atlas

Tell me about PML protein and show me cell images.

The PML (Promyelocytic Leukemia) protein, also known as MYL, RNF71, or TRIM19, is a nuclear body scaffold protein. It is primarily located in nuclear bodies and is involved in various biological processes... Here are some cell images.



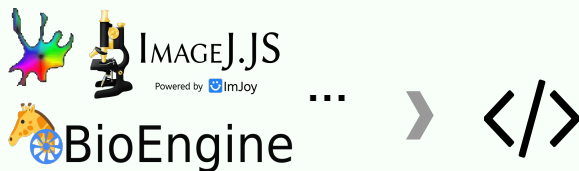
Bioimage Analysis Documentation, Databases & Tools



Documentation & Books

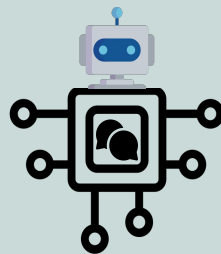


Online Databases & Services



AI models & Analysis tools

LLM-powered Chat Assistant



User's profile

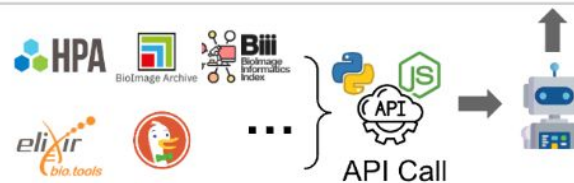
Conversation context


User's query


Querying the BioImage Archive


Please find dataset with cell Images at G1 phase

I found a dataset titled "mRNA of the G1/S repressor WHI5 is found at similar levels throughout the cell cycle" that might be relevant to your search for cell images at the G1 phase... [Access the study.](#)



 Biolmage.IO Chatbot Biolmage Seeker (Melman) ?

 Hi there! I'm Melman. I am help you navigate the bioimaging tools and provide information about bioimaging. How can I help you today?


Ready to chat! Type your message and press enter!

A Send Edit Profile Reset Feedback Options

Warning: Biolmage.IO Chatbot can make mistakes. Consider checking important information.

Tips: Customize your profile to get personalized answers based on your background.

If you find our chatbot helpful for you, please consider cite us: [arXiv 2310.18351](#)

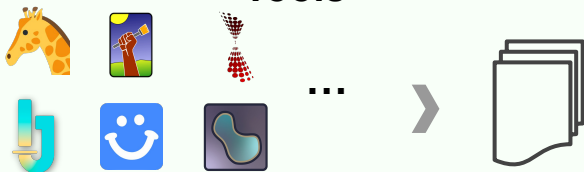


[Disclaimer for Biolmage.IO Chatbot](#)

[Github](#) [bioimageio-chatbot 0.1.97](#)

[pypi package 0.1.97](#)

Bioimage Analysis Documentation, Databases & Tools



Documentation & Books

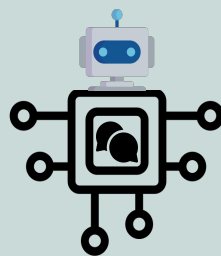


Online Databases & Services



AI models & Analysis tools

LLM-powered Chat Assistant

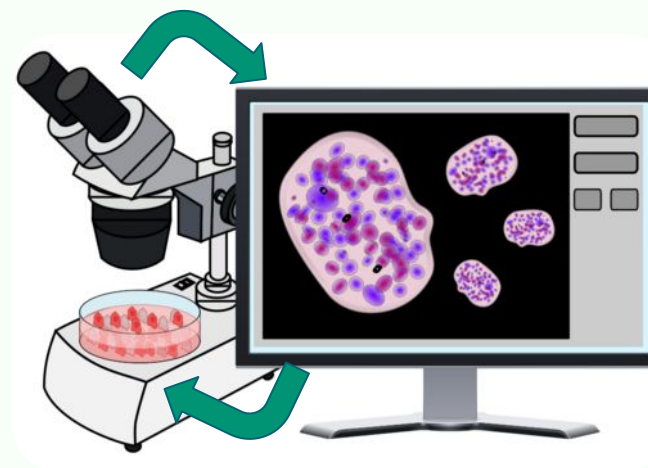


User's profile

Conversation context

User's query

Automated Image Analysis & Smart Microscopy



Biolmage.IO Chatbot Biolmage Analyst (Bridget) ▾

Hi there! I'm Bridget, I can help you with your image analysis tasks. Please mount your data folder and let me know how I can assist you today.

👍👎
Ready to chat! Type your message and press enter!

[Send](#) [Mount Files](#) [Code Interpreter](#) [Edit Profile](#) [Reset](#) [Feedback](#) [Options](#)

Warning: Biolmage.IO Chatbot can make mistakes. Consider checking important information.

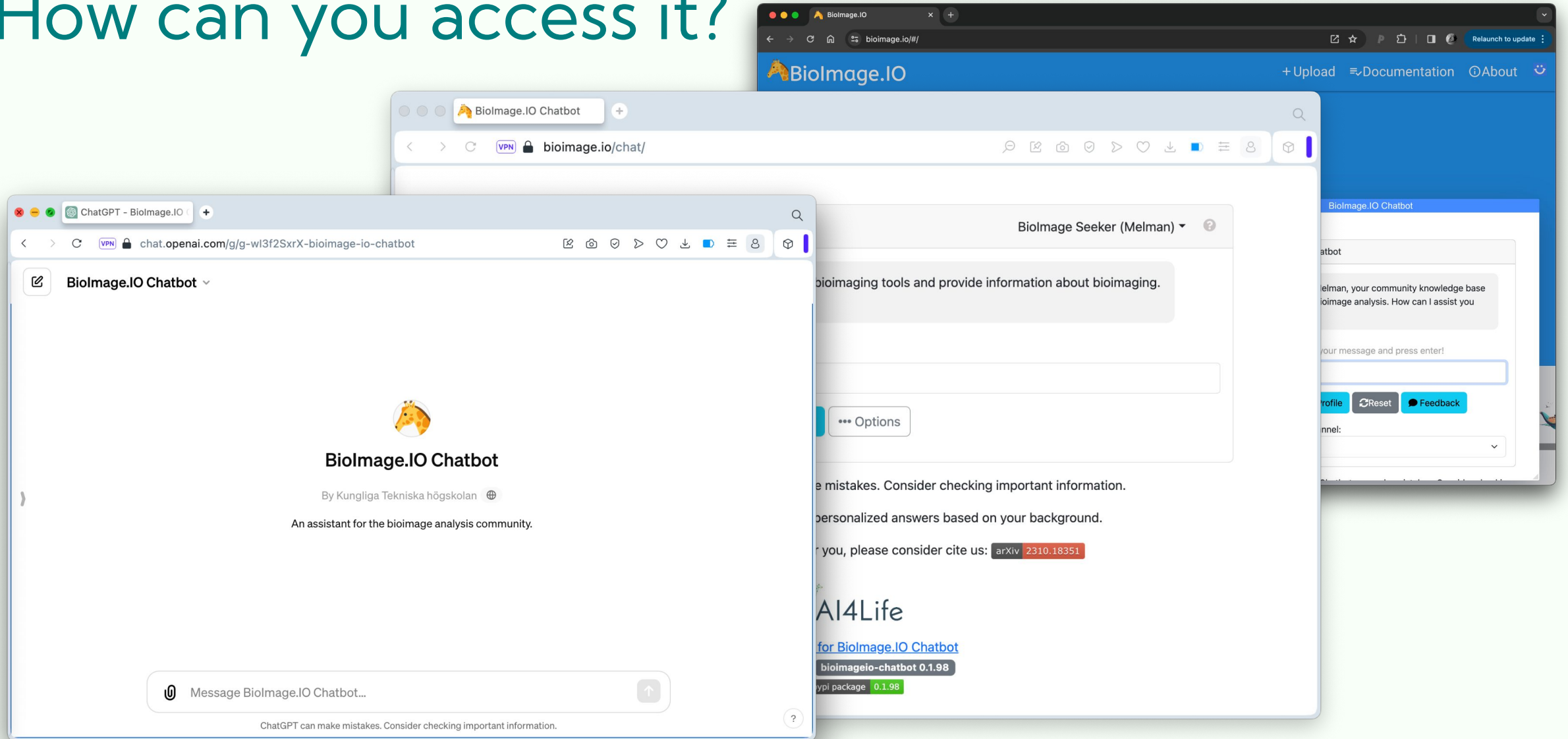
Tips: Customize your profile to get personalized answers based on your background.

If you find our chatbot helpful for you, please consider cite us: [arXiv 2310.18351](#)



[Disclaimer for Biolmage.IO Chatbot](#)

How can you access it?



Custom ChatGPT Assistant

Live Demos!

Benedict Diederich, Leibniz-IPHT Jena


Songtao Cheng, KTH


Live Demo for Chatbot Controlled OpenUC2


The screenshot displays the OpenUC2 software interface, which is divided into several functional areas:

- Image Display (Left Panel):** Contains a menu bar (File, View, Plugins, Window, Help) and a central image area. To the left of the image are 'layer controls' with sliders for opacity (1.00), contrast limits, gamma (1.00), and a dropdown for colormap (grayclip). Below these are 'image shift controls' with a 'Reset' button and a 'Shift distance' set to 1 px. At the bottom left is a 'layer list' showing 'Live: WidefieldCamera'. A scale bar for 200 units is visible at the bottom right of the image area.
- Chatbot Window (Top Right):** Titled 'Biolmage.IO Chatbot' with a user dropdown 'Biolmage GPT (Skyler)'. It shows a message: 'Hi there! I'm Skyler. How can I help you today?' and a prompt: 'Ready to chat! Type your message and press enter!'. Buttons for 'Send', 'Edit Profile', 'Reset', and 'Feedback' are at the bottom.
- Control Panels (Bottom Right):** Includes tabs for 'Figure-based Scan', 'Tile-based Scan', 'Camera-based Scan', and 'Stage Mapping'. The 'Tile-based Scan' panel has input fields for 'Number of Tiles X' (10), 'Number of Tiles Y' (10), 'Step Size X' (384.0), and 'Step Size Y' (384.0). It also features checkboxes for 'Stitch Ashlar', 'Flip X', and 'Flip Y', and 'Start' and 'Step' buttons.
- Navigation and Settings (Top and Left):** The top bar includes 'Hypha', 'ROI Scan', 'MCT', and 'Autofocus'. A vertical sidebar on the left contains 'Scripting', 'Hardware Control', and 'Image Display'.

Example: Chatbot extension for Controlling Microscopes





 Biolmage.IO Chatbot

 Hi there! I'm Melman, your community knowledge base assistant for bioimage analysis. How can I assist you today?



Ready to chat! Type your message and press enter!

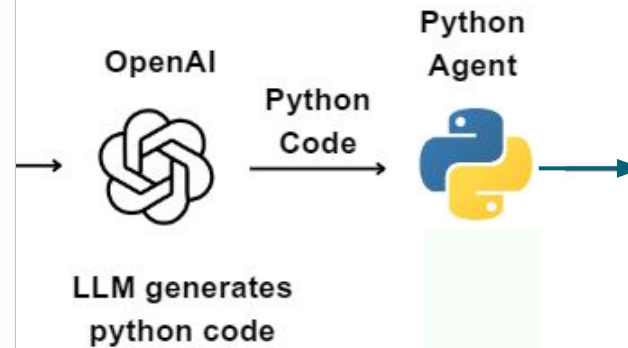
Hi, please move 5000,0,0 along the X, Y, and Z axis and take a picture. Then move back and snap a picture.

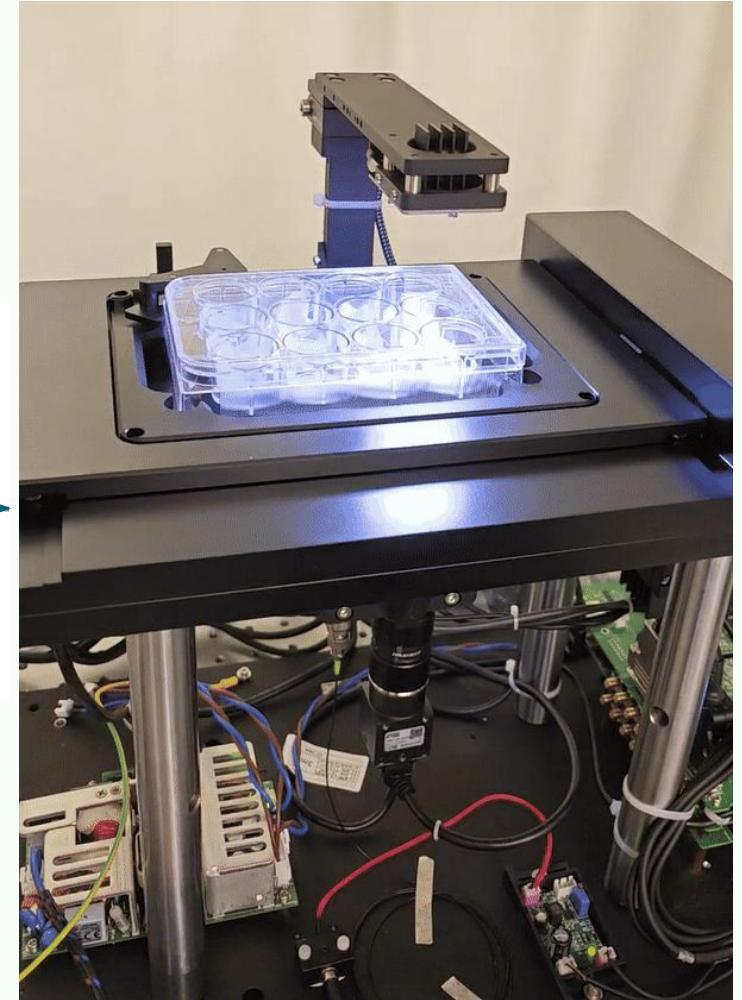
Knowledge Base Channel:

auto

Tips: Customize your profile to get personalized answers based on your background.



[Try it here](#)



Try it yourself!

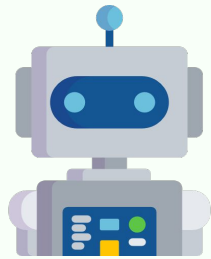
<https://bioimage.io/chat/>

BioImage.IO Chatbot Extensions

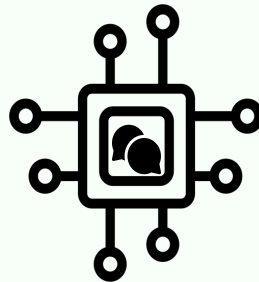
A Community-driven Chatbot

Wanlu Lei, Ericsson & KTH

AI Agent



LLM

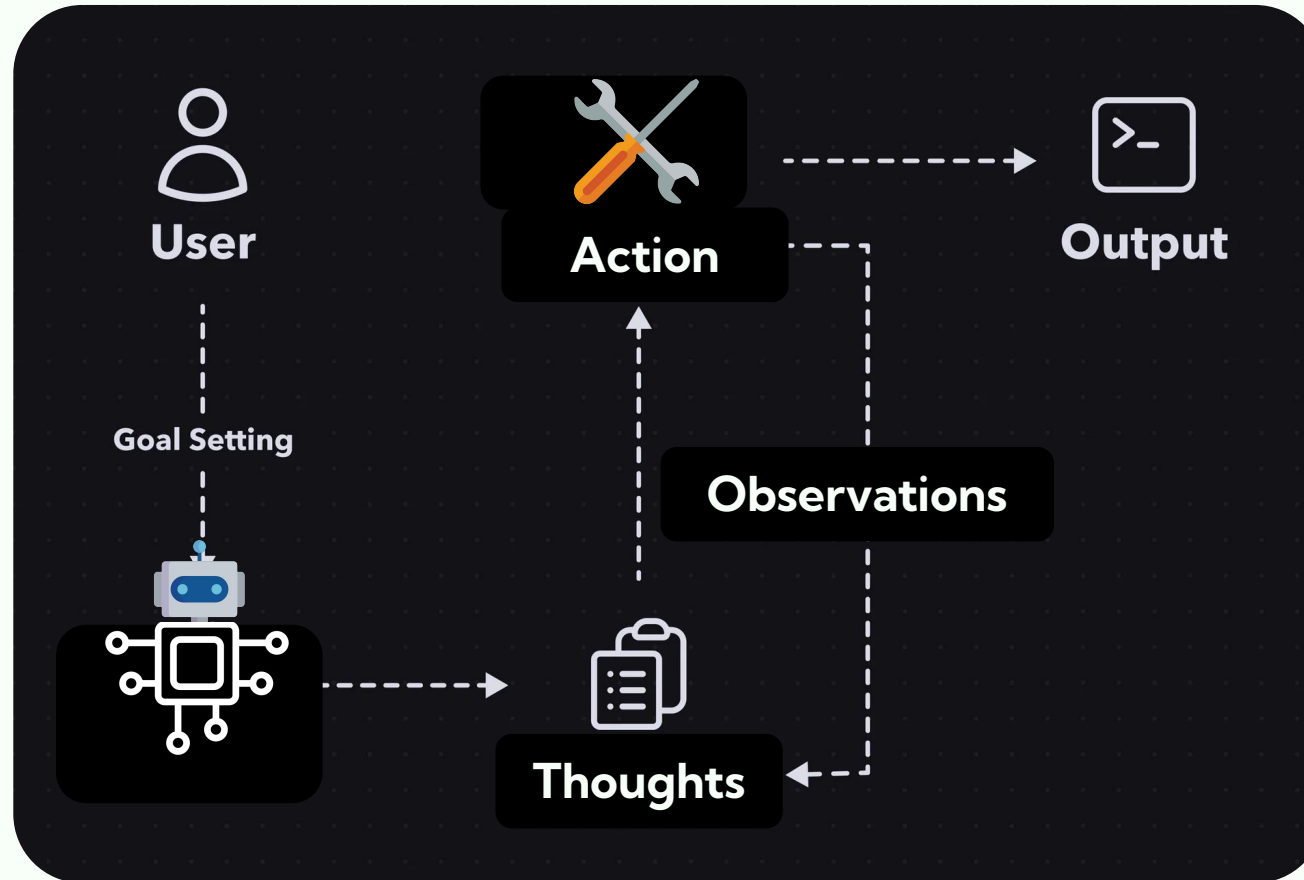


Tools



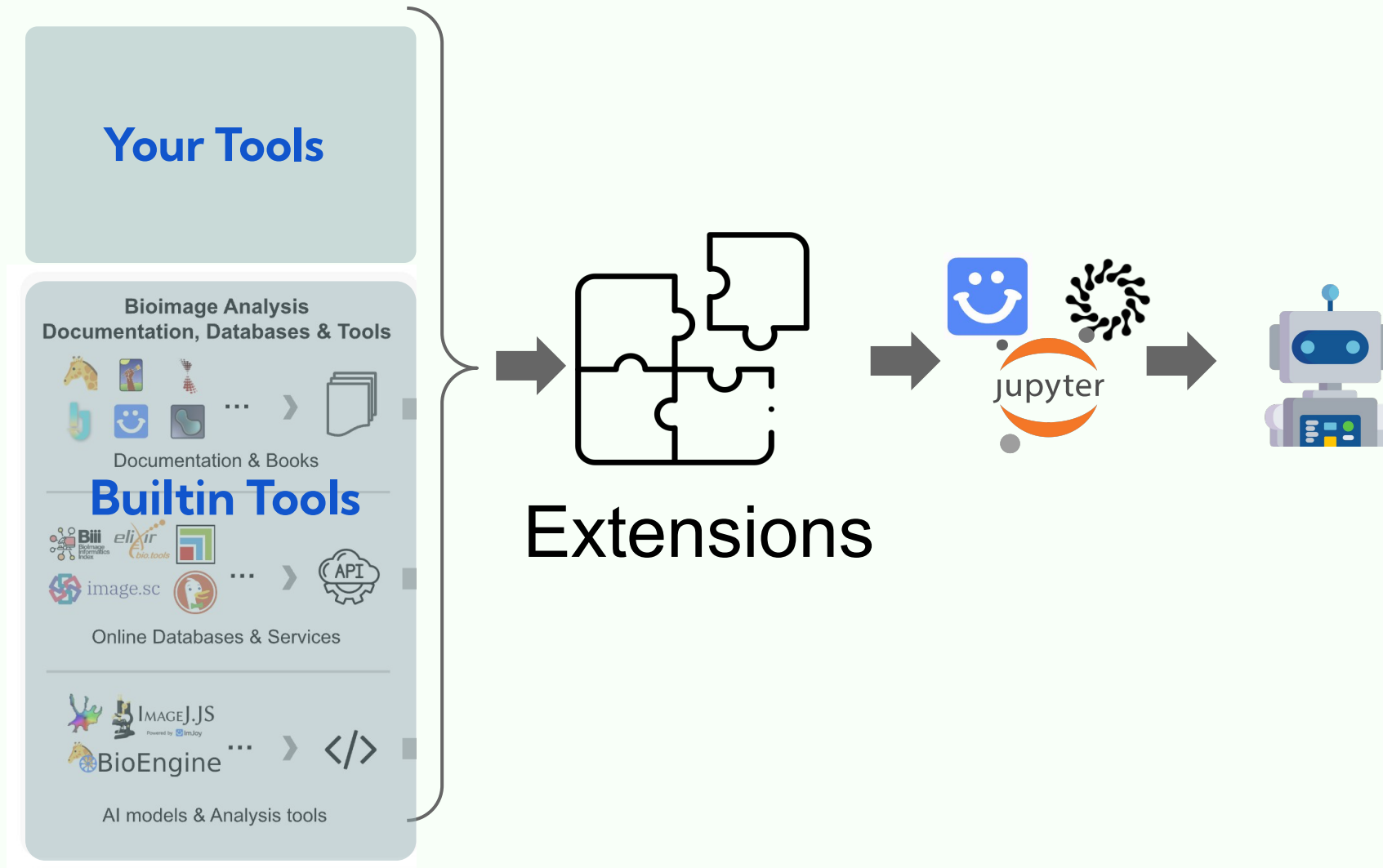
Biolmage.IO Chatbot

ReAct Loop & Agentic Workflow



Yao et. al, 2023 <https://arxiv.org/abs/2210.03629>

Biolmage.IO Chatbot Extension Framework



Two Ways for Building Extensions

Your Tools

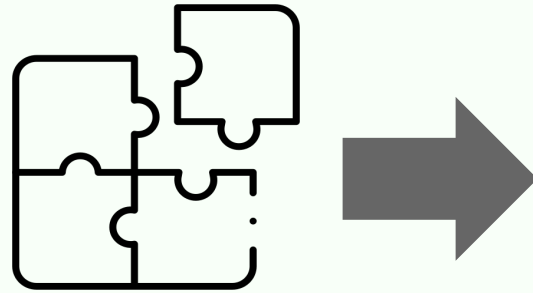
Bioimage Analysis
Documentation, Databases & Tools

Documentation & Books

Builtin Tools

Online Databases & Services

AI models & Analysis tools



Extensions

Option 1: ImJoy Plugins

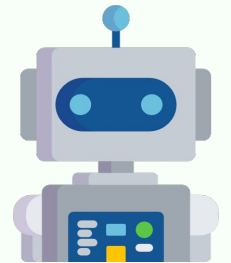


For web and client side tools
E.g. UI, image viewer

Option 2: Hypha Services



For cloud and native tools
E.g. Microscope control, AI models



Microscopy Control Extension

Metadata

Id, name, description...

Tool Functions

```
{  
  move_stage(x, y, z),  
  snap_image(exposure)  
  ...  
}
```

Tool Schema

Tool Functions

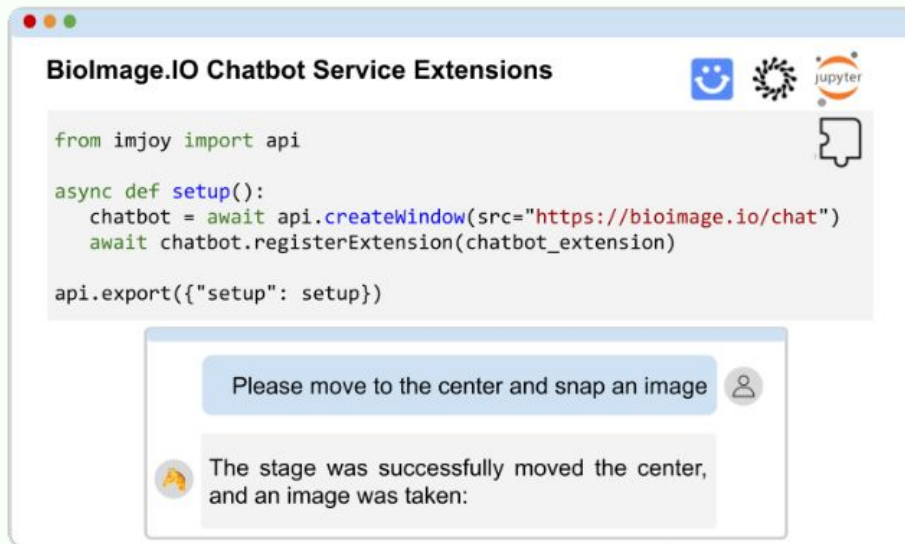
```
async def move_stage(kwargs):  
    config = MoveStageInput(**kwargs)  
    print(config.x, config.y)  
  
    return "success"  
  
async def snap_image(kwargs):  
    config = SnapImageInput(**kwargs)  
    print(config.exposure)  
    await api.showDialog(src="https://bioimage.io")  
    return "success"
```

Tool Schema

```
from pydantic import BaseModel, Field  
  
class MoveStageInput(BaseModel):  
    """Move the microscope stage"""  
    x: float = Field(..., description="x offset")  
    y: float = Field(..., description="y offset")  
  
class SnapImageInput(BaseModel):  
    """Move the microscope stage"""  
    exposure: float = Field(..., description="exposure time")  
  
def get_schema():  
    return {  
        "move_stage": MoveStageInput.schema(),  
        "snap_image": SnapImageInput.schema()  
    }
```

Hands on: Develop BioImage.IO Chatbot Extensions

[Click to Open in Chrome](#)
[\(Incognito mode!\)](#)



```
from imjoy import api

async def setup():
    chatbot = await api.createWindow(src="https://bioimage.io/chat")
    await chatbot.registerExtension(chatbot_extension)

api.export({"setup": setup})
```

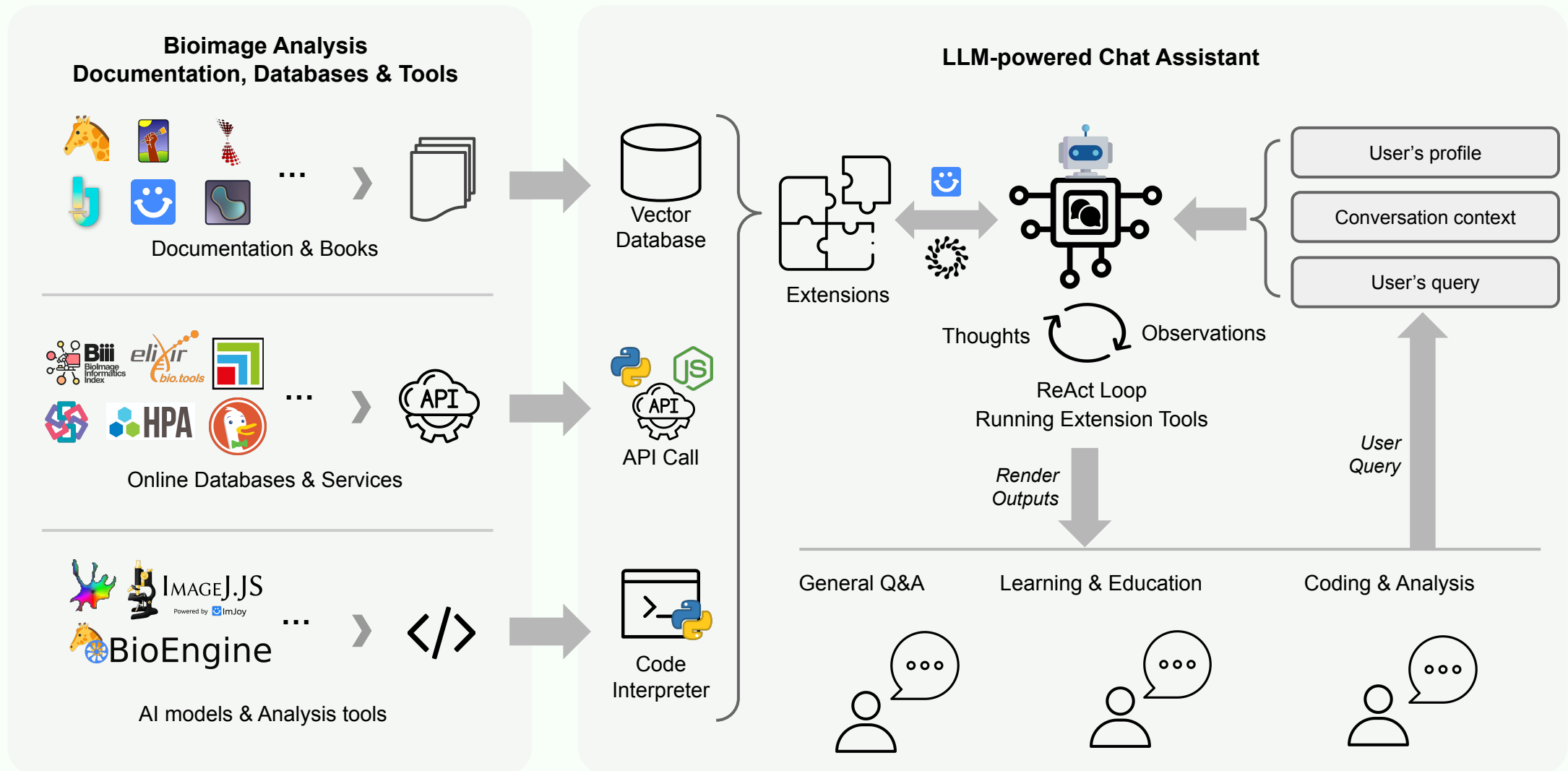
Please move to the center and snap an image

The stage was successfully moved the center, and an image was taken:





BioImage.IO Chatbot: A Community-Driven AI Assistant for Integrative Computational Bioimaging



Contributing to the BioImage.IO Chatbot

<https://github.com/bioimage-io/bioimageio-chatbot>



Developing Extensions



**Adding Tool
Documentation**



**Feedback and User
Experience**



**Sending PR to our GitHub
project**

