
CAPSTONE PROJECT

AI-POWERED LATEX DIAGRAM GENERATOR FOR ACADEMIC RESEARCH

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OUTLINE

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PROBLEM STATEMENT

Academic researchers and writers often struggle when creating diagrams in LaTeX, particularly using the TikZ package. Manually writing TikZ code is not only time-consuming but demands a high level of technical proficiency and is vulnerable to coding errors. This complexity leads to delays in documentation, poses a steep learning curve for newcomers, and detracts from overall productivity. There is a pressing need for a smart and accessible solution that simplifies and streamlines this process.

Proposed Solution:

To address this challenge, I propose an AI-powered intelligent assistant designed to automatically generate TikZ diagrams from natural language descriptions and rough sketches. This system offers real-time feedback, allows users to make refinements using plain English commands, and produces publication-ready LaTeX graphics. By eliminating manual coding, it significantly enhances the efficiency and accessibility of academic documentation—empowering researchers with fast, intuitive, and high-quality diagram creation.

TECHNOLOGY USED

IBM cloud lite services

Natural Language Processing (NLP)

Retrieval Augmented Generation (RAG)

IBM Granite model

IBM CLOUD SERVICES USED

- IBM Cloud Watsonx AI Studio
- IBM Cloud Watsonx AI runtime
- IBM Cloud Service
- IBM Granite(via watsonx.ai studio)
- IBM Cloud Object Storage IBM AI Tools

WOW FACTORS

Natural Language to Code Effortlessly convert plain English descriptions into precise TikZ diagrams for LaTeX documents.

Sketch-to-TikZ Conversion Transform hand-drawn sketches into clean, structured code for accurate diagram representation.

Dynamic Refinement Modify and fine-tune diagrams using real-time, conversational English—no need to touch the code.

Academic-Grade Output Generate high-resolution, publication-ready diagrams suitable for journals, theses, and reports.

No Prior Experience Required Designed for all users—no LaTeX or TikZ expertise necessary to create professional visuals.

Flexible Deployment Accessible via web, desktop, and seamlessly integrated with platforms like Overleaf for smooth workflow.

END USERS

- **Academic Researchers** Automate complex diagrams for theses, journal articles, and research papers.
- **Professors & Educators** Create visually engaging lecture notes, slides, and classroom content with ease.
- **Students (Undergraduate, Postgraduate, PhD)** Simplify LaTeX-based assignments, project documentation, and academic submissions.
- **Research Institutions & Universities** Boost productivity and streamline publication workflows across departments.
- **Technical Writers & LaTeX Enthusiasts** Improve precision, speed, and aesthetics in diagram creation without manual coding.

RESULTS

The screenshot shows the IBM watsonx Build interface. The top bar indicates the project is "AI-Powered LaTeX Diagram Generator for Academic Research" under the "Agent Lab" workspace. The "Build" section is active, showing the "Setup" tab. The "Name" field is "AI-Powered LaTeX Diagram Generator for Academic Research". The "Description" field contains "Generate LaTeX TikZ code for academic diagrams based on user-provided descriptions." The "Icon" field shows a robot icon. The "Placeholder image" field shows a diagram of a building with a magnifying glass. The "Quick start questions" field contains "Add up to 4 quick start questions that your users can select." The "Configuration" section at the bottom shows the "Framework" as "LangGraph" and the "Architecture" as "ReAct".

The screenshot shows the IBM watsonx Build interface. The top bar indicates the project is "AI-Powered LaTeX Diagram Generator for Academic Research" under the "Agent Lab" workspace. The "Build" section is active, showing the "Configuration" tab. The "Framework" is "LangGraph" and the "Architecture" is "ReAct". The "Instructions" field contains a list of instructions: "Convert natural language descriptions into professional TikZ code", "Interpret rough sketches and generate LaTeX-ready diagrams", "Accept plain English refinements and update diagrams in real-time", and "Deliver publication-quality visuals for use in journals and papers". The "Knowledge" section is empty. The "Tools" section shows two buttons: "Add a tool" and "Create custom tool". The "Added tools (3)" section lists three tools: "Google search", "DuckDuckGo search", and "Wikipedia search", each with a description and a trash icon.

RESULTS

IBM watsonx

Upgrade ⓘ 🔔 Mani Prasoon Miryala's Acc... Dallas MM

Projects / AI-Powered LaTeX Diagram Generator for Academic Research / Agent Lab

Share feedback ⓘ Unsaved 📄 New agent + Deploy 🚀

Build

AI Model: granite-3.3-8b-instruct

Agent preview

Setup

Name

AI-Powered LaTeX Diagram Generator for Academic Research

Description 83/100

Generate LaTeX TikZ code for academic diagrams based on user-provided descriptions.

Icon

Placeholder image

Quick-start questions

Add up to 4 quick start questions that your users can select.

Configuration

Framework

LangGraph

Architecture

ReAct

You: 01:33 PM

Make a UML class diagram with classes: Car, ElectricCar, and Engine.

AI-Powered LaTeX Diagram Generator for Academic Research 01:33 PM

As a LaTeX Diagram Generator AI, I can help you create a UML class diagram using TikZ code. Here's a basic representation of your request:

```
\documentclass{article}
\usepackage{tikz}
\usetikzlibrary{shapes,arrows}

\begin{document}

\begin{tikzpicture}[node distance = 2cm, auto]
\tikzstyle{class} = [rectangle, draw, fill=blue!20, text centered, text width=2cm]

\node [class] (Car) {Car};
\node [class, below of=Car] (ElectricCar) {ElectricCar};
\node [class, below of=ElectricCar] (Engine) {Engine};

\path [arrow] (Car) --> (Engine);
\path [arrow] (ElectricCar) --> (Engine);
\end{tikzpicture}

\end{document}
```

This code will generate a simple UML class diagram with three classes: Car, ElectricCar, and Engine. There's a dependency from both Car and ElectricCar to Engine, indicating that an Engine is a component of both Car and ElectricCar.

Please note that this is a basic representation. Depending on your specific needs, you might want to add attributes and operations to your classes, or use more advanced TikZ features for a more detailed and customized diagram.

If you need further customization or have additional requirements, please let me know!

Type something...

RESULTS

The screenshot displays the IBM watsonx AI interface for an "AI-Powered LaTeX Diagram Generator for Academic Research". The interface is divided into two main sections: "Build" and "Agent preview".

Build Section:

- Configuration:** Framework is set to "LangGraph" and Architecture is set to "ReAct".
- Instructions:** A list of instructions is provided, including "Convert natural language descriptions into professional TikZ code", "Interpret rough sketches and generate LaTeX-ready diagrams", "Accept plain English refinements and update diagrams in real-time", and "Deliver publication-quality visuals for use in journals and papers".
- Knowledge:** A section for adding knowledge, currently empty.
- Tools:** A section for adding tools, currently empty. Buttons for "Add a tool" and "Create custom tool" are visible.
- Added tools (3):** Three tools are listed: "Google search", "DuckDuckGo search", and "Wikipedia search", each with a brief description and a trash icon for removal.

Agent preview Section:

- User Input:** "Draw a labeled free-body diagram of a block on an inclined plane."
- AI Response:** The AI states it cannot directly draw diagrams but can guide the user on how to create a labeled free-body diagram using LaTeX and the TikZ package. It provides a basic representation of the diagram using LaTeX code.
- LaTeX Code:** The code defines a document class, loads the TikZ package, and uses the `\usetikzlibrary{shapes.geometric, arrows}` command. It then defines a block on an inclined plane and draws a free-body diagram with forces labeled N (Normal force), mg (weight), and f (friction).
- Explanation:** The AI explains that the LaTeX code will generate a simple diagram with a block on an inclined plane. The forces labeled are:
 - N : Normal force

RESULTS

The screenshot shows the TeXstudio interface. The left pane displays the LaTeX source code for a document titled 'article'. The code defines three nodes: 'Car', 'ElectricCar', and 'Engine', all as blue rectangles. 'ElectricCar' is positioned below 'Car', and 'Engine' is positioned below 'ElectricCar'. Two arrows are drawn from 'Car' and 'ElectricCar' to 'Engine'. The right pane shows the rendered output, which is a diagram with three blue rectangular boxes labeled 'Car', 'ElectricCar', and 'Engine' stacked vertically. Arrows point from 'Car' and 'ElectricCar' to 'Engine'. The status bar at the bottom indicates 'Recompile' and '1 / 1'.

RESULTS

Deployed AI Agent

The screenshot shows the IBM Watsonx deployment interface for an AI-powered LaTeX diagram generator. The top navigation bar includes the IBM Watsonx logo, an 'Upgrade' button, and user account information. The main header displays the deployment name 'AI-POWERED LATEX DIAGRAM GENERATOR FOR ACADEMIC RESEARCH' with a green 'Deployed' status and an 'Online' indicator. Below the header, there are tabs for 'API reference', 'Test', 'Evaluations', and 'Preview', with 'Preview' being the active tab. The main content area shows a chat interface where a user has asked to 'Draw a labeled free-body diagram of a block on an inclined plane.' The AI agent has responded with a LaTeX TikZ code snippet that generates a free-body diagram of a block on an inclined plane. The code defines a coordinate system, places a blue block, and draws force vectors (normal, gravity, tension) with labels. A right-hand sidebar titled 'About this deployment' provides details such as the deployment ID, serving name, software and hardware specifications, and tags. At the bottom of the chat area, there is a text input field with the placeholder 'Type something...'.

IBM watsonx Upgrade ? ? Mani Prasoon Miryala's Acc... Dallas MM

Deployment spaces / AI-POWERED LATEX DIAGRAM GENERATOR FOR ACADEMIC RESEARCH / AI-POWERED LATEX DIAGRAM GENERATOR FOR ACADEMIC RESEARCH /

AI-POWERED LATEX DIAGRAM GENERATOR FOR ACADEMIC RESEARCH Deployed Online

API reference Test Evaluations **Preview**

New chat +

You 02:13 PM

Draw a labeled free-body diagram of a block on an inclined plane.

AI-POWERED LATEX DIAGRAM GENERATOR FOR ACADEMIC RESEARCH 02:13 PM

As a LaTeX Diagram Generator AI, I can help you create a free-body diagram for a block on an inclined plane using TikZ code. Here's a basic example:

```
\documentclass{article}
\usepackage{tikz}

\begin{document}

\begin{tikzpicture}
\draw[thick,->] (0,0) -- (4,0) node[anchor=north west] {$x$};
\draw[thick,->] (0,0) -- (0,3) node[anchor=west] {$y$};

\node[draw, thick, fill=blue, circle, inner sep=1pt] (block) at (1,1) {};

\draw[thick,-latex] (1,1) -- node[pos=0.6, above] {$F_N$} (1,2);
\draw[thick,-latex] (1,1) -- node[pos=0.6, below right] {$F_g$} (2,1);
\draw[thick,-latex] (1,1) -- node[pos=0.6, below left] {$F_{||}$} (1,0);
\draw[thick,-latex] (1,1) -- node[pos=0.6, above right] {$F_{\perp}$} (2,1.5);

\node at (0.5,3.5) {$N$};
\node at (2.5,0.5) {$F_g$};
\node at (1.5,0.5) {$F_{||}$};
\node at (1.5,1.5) {$F_{\perp}$};
\node at (1.5,0) {$F_g$};
\end{tikzpicture}
```

Type something...

About this deployment

Name [Edit](#)

AI-POWERED LATEX DIAGRAM GENERATOR FOR ACADEMIC RESEARCH

Description [Edit](#)

Generate LaTeX TikZ code for academic diagrams based on user-provided descriptions.

Deployment Details

Deployment ID: [e55edc55-8d9e-4e...](#)

Serving name: [Edit](#)

No serving name.

Software specification: [runtime-24.1-py3.11](#)

Hardware specification: [Extra extra small: 1 CPU and 2 GB RAM](#)

Copies: [1](#)

Tags [Edit](#)

[wsg-agent](#)

Associated asset [Edit](#)

[AI-POWERED LATEX DIAGRAM GENER...](#)

[71bca72a-d459-4fba-af4b-3c53846f1e8a](#)

Last modified: 1 minute ago

Created on: Aug 5, 2025

CONCLUSION

- **Streamlines Diagram Creation** Automatically converts natural language and rough sketches into professional TikZ diagrams, removing the hassle of manual coding.
- **Accelerates Research Output** Speeds up academic workflow by enabling fast, high-quality diagram generation—saving valuable time for researchers, students, and educators.
- **Democratizes Access** Makes advanced LaTeX graphics available to all users, regardless of technical skill, through intuitive commands and real-time feedback.

FUTURE SCOPE

- **Voice-Controlled Diagram Generation** Enable hands-free interaction through speech-to-text input, enhancing accessibility and speeding up the design process.
- **Multilingual Command Support** Accept natural language inputs in multiple languages, empowering researchers worldwide to work in their preferred linguistic environment.
- **Seamless Overleaf Integration** Embed real-time TikZ diagram rendering and editing directly into Overleaf for streamlined LaTeX workflow management.
- **Context-Aware Diagram Suggestions** Automatically recommend suitable diagrams based on adjacent LaTeX content and semantic analysis of the document.
- **Real-Time Collaborative Editing** Facilitate simultaneous editing by multiple users, making it ideal for team-based research and co-authoring scenarios.
- **AI-Guided Layout Optimization** Provide intelligent layout suggestions to improve clarity, aesthetics, and readability of complex diagrams.
- **Multi-Format Export Capability** Support exports in TikZ, PNG, SVG, and PDF formats for flexible use across publications, presentations, and teaching materials.

IBM CERTIFICATIONS

In recognition of the commitment to achieve
professional excellence



Mani prasoon Miryala

Has successfully satisfied the requirements for:

Getting Started with Artificial Intelligence



Issued on: Jul 18, 2025
Issued by: IBM SkillsBuild

Verify: <https://www.credly.com/badges/c82d0d09-ccd0-4cc9-9c65-ebe43dcd1249>



IBM CERTIFICATIONS

IBM **SkillsBuild**

Completion Certificate



This certificate is presented to
Mani prasoon Miryala

for the completion of

Journey to Cloud: Envisioning Your Solution

(PLAN-32CB1E21D8B4)

According to the Your Learning Builder - Plans system of record

Completion date: 19 Jul 2025 (GMT)



This certificate is presented to
Mani prasoon Miryala

for the completion of

Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

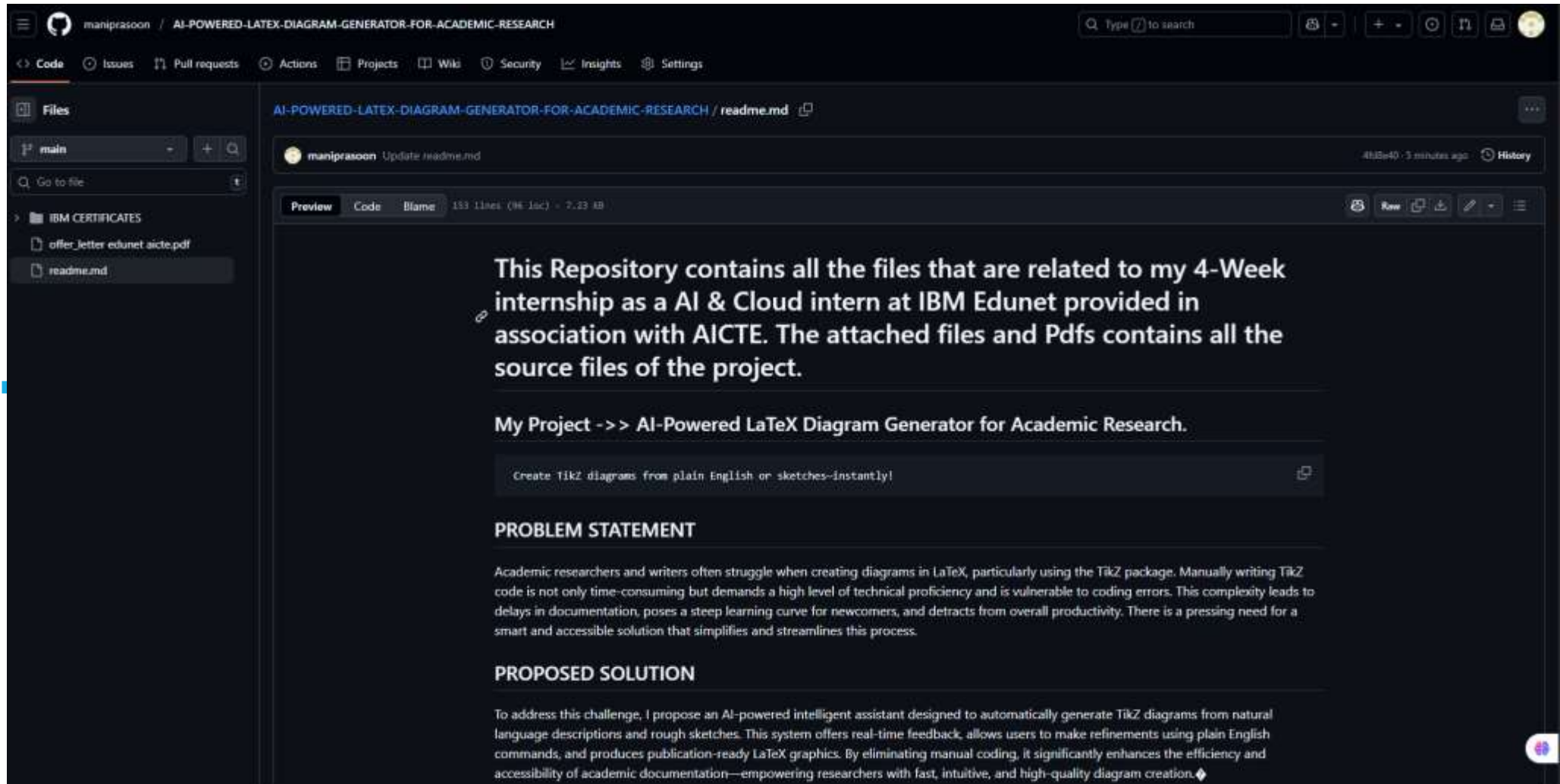
Completion date: 18 Jul 2025 (GMT)

Learning hours: 20 mins



Github link : <https://github.com/maniprasoon/AI-POWERED-LATEX-DIAGRAM-GENERATOR-FOR-ACADEMIC-RESEARCH>

GITHUB (README)



Github link : <https://github.com/maniprasoon/AI-POWERED-LATEX-DIAGRAM-GENERATOR-FOR-ACADEMIC-RESEARCH>



THANK YOU