

# CAPSTONE PROJECT

## AI-POWERED LATEX DIAGRAM GENERATOR FOR ACADEMIC RESEARCH

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# OUTLINE

- **Problem Statement**
- **Technology used**
- **Wow factor**
- **End users**
- **Result**
- **Conclusion**
- **Git-hub Link**
- **Future scope**
- **IBM Certifications**

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# PROBLEM STATEMENT

Researchers and academic writers often face significant challenges when creating diagrams in LaTeX, especially using the TikZ package. Writing TikZ code manually is time-consuming, requires technical expertise, and is prone to errors. This slows down the research documentation process and creates a steep learning curve for those unfamiliar with LaTeX graphics. There is a strong need for a user-friendly, intelligent tool that can simplify and automate this task.

## Proposed Solution:

I propose an AI-powered intelligent agent that automatically converts natural language descriptions and sketches into professional TikZ code for LaTeX documents. This agent will support real-time feedback, accept refinement commands in plain English, and produce publication-ready diagrams, eliminating the need for manual coding and significantly enhancing productivity for academic researchers.

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# 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

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# WOW FACTORS

**Natural Language to TikZ:** Generate LaTeX diagrams from plain English.

**Sketch Recognition:** Turn rough hand-drawn sketches into structured TikZ code.

**Real-Time Refinement:** Update diagrams instantly with plain English commands.

**Publication-Ready:** Produces clean, high-quality diagrams for academic papers.

**No Coding Needed:** No prior LaTeX or TikZ experience required.

**Deploy Anywhere:** Web, desktop, or Overleaf-integrated support.

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## END USERS

- **Academic Researchers**

For thesis, paper, and journal diagram automation.

- **Professors & Educators**

For creating lecture notes, slides, and visual explanations.

- **Students (UG/PG/PhD)**

For simplifying LaTeX assignments and project reports.

- **Research Institutions & Universities**

For streamlining documentation and publication workflows.

- **Technical Writers & LaTeX Enthusiasts**

For enhancing productivity and accuracy in LaTeX graphics.

# RESULTS

Upgrade

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Dallas ▾

AS

⋮

Share feedback

β

Unsaved

📁 ▾

New agent +

Deploy

🔗

Agent preview

AS

You: 10:34 PM

Create a flowchart that explains the process of supervised learning.

👤

AI-Powered LaTeX Diagram Generator for Academic Research 10:34 PM

As a LaTeX Diagram Generator AI, I can help you create a TikZ code for a flowchart that explains the process of supervised learning. Here's a basic outline of the steps involved:

1. **Data Collection:** Gather a labeled dataset for training.

2. **Data Preprocessing:** Clean and format the data, handle missing values, normalize/standardize features.

3. **Model Selection:** Choose a suitable supervised learning algorithm (e.g., linear regression, decision trees, support vector machines).

4. **Training:** Feed the preprocessed data into the selected model. The model learns to map inputs to outputs.

5. **Model Evaluation:** Assess the model's performance using appropriate metrics (e.g., accuracy, precision, recall, F1-score).

6. **Hyperparameter Tuning:** Optimize model parameters for better performance.

7. **Prediction:** Use the trained model to predict outcomes for new, unseen data.

8. **Model Deployment:** Integrate the model into a production environment for real-world use.

Here's a simple TikZ code snippet to get you started:

Type something...

🔗

🔗

## Agent preview

Here's a simple TikZ code snippet to get you started:

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

\begin{document}

\begin{tikzpicture}[node distance = 2cm, auto]
\tikzstyle{block} = [rectangle, draw, fill=blue!20, text width=5em,
text centered, rounded corners, minimum height=4em]
\tikzstyle{line} = [draw, -latex']

\node [block] (data) {Data Collection};
\node [block, below of=data] (preprocess) {Data Preprocessing};
\node [block, below of=preprocess] (select) {Model Selection};
\node [block, below of=select] (train) {Training};
\node [block, below of=train] (evaluate) {Model Evaluation};
\node [block, below of=evaluate] (tune) {Hyperparameter Tuning};
\node [block, below of=tune] (predict) {Prediction};
\node [block, below of=predict] (deploy) {Model Deployment};

\path [line] (data) -- (preprocess);
\path [line] (preprocess) -- (select);
\path [line] (select) -- (train);
\path [line] (train) -- (evaluate);
\path [line] (evaluate) -- (tune);
\path [line] (tune) -- (predict);
```

Type something...





# RESULTS

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[Share feedback](#) [β](#) [Unsaved](#) [📁](#) [New agent +](#) [Deploy](#) [🔗](#)

### Agent preview

**AS** You: 10:35 PM

Generate a Venn diagram showing the overlap between AI, ML, and Deep Learning.

**AI-Powered LaTeX Diagram Generator for Academic Research** 10:35 PM

As a text-based AI, I'm unable to directly generate visual content such as Venn diagrams. However, I can certainly guide you on how to create one using TikZ in LaTeX, which you can then compile to generate the diagram.

Here's a basic TikZ code snippet for a Venn diagram illustrating the relationship between Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL):

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

\begin{document}

\begin{tikzpicture}[scale=1.5]
  % Outer circle (AI)
  \draw[fill=gray!30] (0,0) circle (2cm) node[text centered, above]
{Artificial Intelligence};

  % Middle circle (ML)
  \draw[fill=gray!70] (1.5,0) circle (1.5cm) node[text centered, above]
{Machine Learning};

  % Innermost circle (DL)
  \draw[fill=gray!90] (1,1) circle (0.5cm) node[text centered, above]
{Deep Learning};
\end{tikzpicture}

\end{document}
```

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### Agent preview

```
\draw[fill=gray!30] (0,0) circle (2cm) node[text centered, above]
{Artificial Intelligence};

% Middle circle (ML)
\draw[fill=gray!70] (1.5,0) circle (1.5cm) node[text centered, above]
{Machine Learning};

% Innermost circle (DL)
\draw[fill=gray!90] (1,1) circle (0.5cm) node[text centered, above]
{Deep Learning};
\end{tikzpicture}

\end{document}
```

This code will create a Venn diagram with three overlapping circles representing AI, ML, and DL. Deep Learning is depicted as the innermost concept, fully contained within Machine Learning, which in turn is fully contained within Artificial Intelligence. This reflects the understanding that Deep Learning is a subset of Machine Learning, which is itself a subset of Artificial Intelligence.

Remember to compile this LaTeX code to generate the actual diagram. You might need to adjust the scale and sizes of the circles to better fit your document or personal preference.

For more complex diagrams or if you need to customize the appearance further, you might consider using dedicated diagramming tools and then converting the result to TikZ code if necessary.

▶ How did I get this answer?

[🔗](#) [▶](#)

# RESULTS

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### Agent preview

[AS](#) You: 10:36 PM

Sketch a neural network with 3 input nodes, 2 hidden layers, and 1 output node

[AI-Powered LaTeX Diagram Generator for Academic Research](#) 10:36 PM

As a text-based AI, I can't directly create visual diagrams, but I can certainly provide you with a TikZ code snippet to represent a neural network with 3 input nodes, 2 hidden layers, and 1 output node. Here's a basic representation:

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

\begin{document}

\begin{tikzpicture}[node distance = 2cm, auto]
% Define styles
\tikzstyle{block} = [rectangle, draw, fill=blue!20, text width=5em,
text centered, rounded corners, minimum height=4em]
\tikzstyle{arrow} = [thick,->,>=stealth]

% Nodes
\node [block] (input) {Input Layer};
\node [block, below of=input] (hidden1) {Hidden Layer 1};
\node [block, below of=hidden1] (hidden2) {Hidden Layer 2};
\node [block, below of=hidden2, text centered] (output) {Output
```

Type something...

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### Agent preview

```
\tikzstyle{arrow} = [thick,->,>=stealth]

% Nodes
\node [block] (input) {Input Layer};
\node [block, below of=input] (hidden1) {Hidden Layer 1};
\node [block, below of=hidden1] (hidden2) {Hidden Layer 2};
\node [block, below of=hidden2, text centered] (output) {Output
Layer};

% Connections
\path [arrow] (input.east) -- ++(1,0) node [near start, above] {3
neurons};
\path [arrow] (input) -- (hidden1);
\path [arrow] (hidden1) -- (hidden2);
\path [arrow] (hidden2) -- (output);
\end{tikzpicture}

\end{document}
```

This code will generate a simple diagram showing a neural network with an input layer containing 3 nodes, two hidden layers, and an output layer with 1 node. The connections between layers are indicated with arrows.

Remember to compile this LaTeX code to generate the actual diagram. You can adjust the sizes, colors, and text as needed to better fit your document's style. For more complex diagrams, consider using dedicated diagramming tools and converting the result to TikZ code if necessary.

► How did I get this answer?

Type something...

# RESULTS

## Deployed AI Agent

IBM watsonx

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Aditya Sengupta's Account

[Deployment spaces](#) / [AI-Powered LaTeX Diagram Generator for Academic Research](#) / [watsonx Agent](#) /

AI-Powered LaTeX Diagram Generator for Academic Research

✔ Deployed Online

API reference

Test

Preview

New chat +

A

You

12:44 AM

Make an ER diagram showing Students, Courses, and Instructors with relationships.

AI-Powered LaTeX Diagram Generator for Academic Research

12:44 AM

Based on the search results, I was unable to find the exact ER diagram showing Students, Courses, and Instructors with relationships. However, the search results provide some useful information and resources that can help you create an ER diagram for a university database.

Here are some key points to consider when creating an ER diagram for a university database:

- Entities: Students, Courses, Instructors
- Relationships:
  - A student can enroll in many courses (one-to-many).
  - A course can be taken by many students (one-to-many).
  - An instructor can teach many courses (one-to-many).
  - A course is taught by one instructor (one-to-one).

Type something...

About this agent

Name

AI-Powered LaTeX Diagram Generator for Academic Research

Description

Change this particular agent's description

Deployment

Deployment name: No serving runtime-24. Hardware specification: Extra extra specification. Copies: 1

Tags

wx-agent

Associated

watsonx b01ceaad-e1

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# CONCLUSION

- **Simplifies Complex Tasks:** Eliminates the need to manually write TikZ code by converting natural language or sketches into LaTeX diagrams.
- **Boosts Research Productivity:** Saves time and effort for researchers, students, and educators by automating high-quality diagram generation.
- **Enhances Accessibility:** Makes professional diagram creation accessible to non-technical users with real-time feedback and plain English commands.



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## GITHUB LINK

[https://github.com/Naman-Karara/IBM\\_Edunet\\_2025\\_Internship](https://github.com/Naman-Karara/IBM_Edunet_2025_Internship)

# GITHUB LINK


## Mentioned Readme file in GitHub Repository



 README  MIT license

**This Repo contains all the files that are related to my 4-Week internship as a AI & Cloud intern at IBM Edunet provided in association with AICTE. The above attached files and Pdfs contains all the source files for the project.**

**My Project -> > AI-Powered LaTeX Diagram Generator for Academic Research.**

Create TikZ diagrams from plain English or sketches—instantly!



 README  MIT license

### PROBLEM STATEMENT

Researchers and academic writers often face significant challenges when creating diagrams in LaTeX, especially using the TikZ package. Writing TikZ code manually is time-consuming, requires technical expertise, and is prone to errors. This slows down the research documentation process and creates a steep learning curve for those unfamiliar with LaTeX graphics. There is a strong need for a user-friendly, intelligent tool that can simplify and automate this task.

### PROPOSED SOLUTION

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### IBM CLOUD SERVICES USED

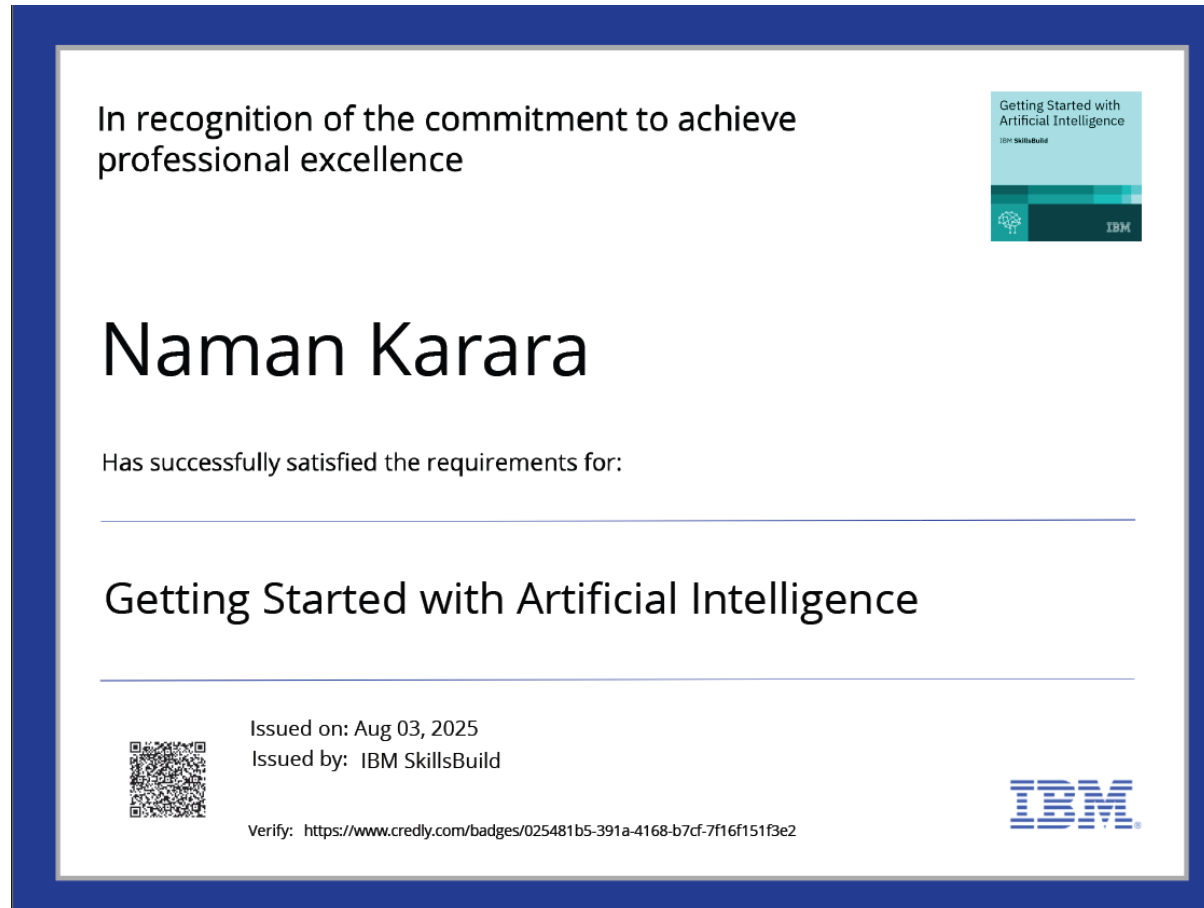
- IBM Cloud Watsonx AI Studio
- IBM Cloud Watsonx AI runtime
- IBM Cloud service

# FUTURE SCOPE

- **Voice-to-Diagram Generation**  
Enable hands-free diagram creation using speech-to-text for accessibility and faster interaction.
- **Multilingual Support**  
Accept input and commands in multiple languages to support global researchers.
- **Overleaf Integration**  
Direct integration with Overleaf for real-time diagram preview and editing within LaTeX environments.
- **Auto-Diagram Suggestions**  
Automatically suggest diagrams based on surrounding LaTeX text or content analysis.
- **Collaborative Editing**  
Allow multiple users to co-edit and refine diagrams in real time for group research projects.
- **AI-Powered Diagram Optimization**  
Intelligent suggestions for better layout, aesthetics, and labeling of diagrams.
- **Export to Multiple Formats**  
Support PNG, SVG, and PDF exports alongside TikZ for broader use in presentations and publications.

# IBM CERTIFICATIONS

## Certificate of Getting Started with AI





## Certificate of RAG with LangChain

IBM **SkillsBuild**

Completion Certificate



This certificate is presented to

Naman Karara

for the completion of

**Lab: Retrieval Augmented Generation with  
LangChain**

(ALM-COURSE\_3824998)

According to the Adobe Learning Manager system of record

**Completion date:** 03 Aug 2025 (GMT)

**Learning hours:** 20 mins

## Journey to Cloud

In recognition of the commitment to achieve  
professional excellence



# Naman Karara

Has successfully satisfied the requirements for:

## Journey to Cloud: Envisioning Your Solution



Issued on: Aug 03, 2025  
Issued by: IBM SkillsBuild

Verify: <https://www.credly.com/badges/09cd4b77-4229-42e6-9de6-cf6e4e7f83d4>





**THANK YOU**