Faculty of Media Engineering and Technology
German University in Cairo
Dr. Nourhan Ehab

CSEN 903: Advanced Computer Lab, Winter 2025

Lab 0 Manual: Introduction to AI Tools Lab

In this lab series, you'll explore how artificial intelligence is reshaping how we build software, not just by writing programs, but by teaching machines to learn, reason, and even generate new content.

But let's step back.

What is AI?

Artificial Intelligence (AI) refers to the development of computer systems that can perform tasks that typically require human intelligence, such as understanding language, recognizing images, learning from data, making decisions, or generating new content.

How is AI Different from Traditional Coding?

Traditional programming is like giving the machine a strict recipe. AI is more like giving it experience so it can figure things out on its own or with guidance.

	Traditional Coding	**AI**
How it works	You write fixed rules	You teach the model using examples or logic
Behavior	Deterministic	Adaptive
Example task	A calculator, a game score counter	A fraud detector, a chatbot, a recommendation engine

Unlike traditional programming, where we give the computer **exact rules to follow**, AI can either:

- **Learn from examples** (statistical approach), or
- **Reason with knowledge** (symbolic approach)
- **Pattern Recognition** (Machine learning approaches)

The Two Paradigms of AI: Statistical vs Symbolic

1. Statistical AI

This includes machine learning and deep learning. These models **learn patterns from large datasets**. **Examples:**

- Predicting house prices based on features
- Classifying spam emails
- Translating languages

+Good* for** noisy, high-dimensional data ***-Hard to explain decisions

2. Symbolic AI

This includes logic-based systems, rules, and structured knowledge representations, i.e., **knowledge graphs**. **Examples:**

- If "All birds can fly" and "Penguins are birds." → then "Penguins can fly." (Oops! We need an exception rule!)

+Good* for** reasoning, transparency, and domain logic ***-Rigid if the rules are incomplete

3. Neuro-Symbolic AI: The Hybrid Approach

Modern systems often combine both:

- Use **machine learning** to recognize patterns
- Use **knowledge graphs** or logic to refine predictions or explain them

You'll see this hybrid approach in action across multiple labs.

Predictive AI vs Generative AI

This is another important distinction we'll explore.

Predictive AI helps us classify, recommend, or forecast.

Generative AI opens the door to creativity, interaction, and natural language understanding.

Type	What it does	Example
Predictive AI	Analyzes existing data to make decisions or forecasts	Will a customer return?
Generative AI	Creates new content (text, images, code) based on input	Creates new content (text, images, code) based on input

In this lab, you'll learn how to use both.

What You'll Learn in This Lab Series

Each week covers a real tool or concept that AI engineers use daily

Week	Theme	Tools	Learning Objective
1	Data Cleaning	Pandas, Matplotlib	Learn to load, clean, and preprocess datasets, and use visualization techniques to identify patterns and anomalies
2	Statistical ML	Scikit-learn	Train and evaluate supervised ML models. Learn classification, data splitting, and performance metrics
3	Neural Networks	TensorFlow	Implement feedforward neural networks. Define architectures, use activation functions, set loss functions and optimizers, train and evaluate models
4	XAI	SHAP, LIME	Interpret model predictions and overall behavior
5	NLP Foundations	NLTK, Scikit-learn, Hugging Face Transformers	Compare classical NLP pipelines with modern transformer-based models. Understand tokenization, normalization, and the trade-offs

			between interpretability, complexity, and performance.
6	Knowledge Graphs	Neo4j, Cypher	Represent structured knowledge through nodes and relationships. Create and query knowledge graphs
7	NLP and KG Integration	Neo4j, NLP Libraries	Integrate structured knowledge into NLP pipelines. Extract entities from text, link them to a knowledge graph, and compare model performance with and without KG features.
8	RAG and Generative AI	LangChain, Large Language Models (LLMs), StreamLit	Build Retrieval-Augmented Generation (RAG) pipelines. Combine retrievers with LLMs for document-aware question answering. Compare grounded vs. hallucinated responses.

Note: ALL LABS WILL CONTAIN A GRADED TASK; either In-Lab or Take-Home.

Course Grading Scheme

There are three main Assessments in this course: the In-Lab graded task, the Take-Home graded task, and the project, with grade distributions 25%, 15%, and 60% respectively. The In-Lab garded task is best 3 out of 4. The Take-Home graded task is best 3 out of 4.

Final Project Teaser: Putting It All Together

At the end of the lab, you'll build a complete **AI system** with 3 milestones:

Milestone 1: Prediction

You'll train a predictive model (e.g., forecast product demand) using statistical ML techniques.

Milestone 2: Knowledge Graphs

You'll build a **Knowledge Graph** from domain knowledge and use it to **augment your model**, improving accuracy and/or explainability.

Milestone 3: Generation

You'll create a simple chatbot that uses both your KG and generative models to answer questions or explain insights.

Domains may include:

- International Hotel Booking System
- English Premier League Companion
- Airline Customer Holiday Booking

You'll get to apply what you learn **step by step** and build something real by the end.

Course Regulations

- No cross attendance
- Attendance would be taken twice, once for each slot.
- Attendance is upon completing the guided task, and the graded task (if any)
- In-Lab graded task must be completed during the lab
- In-Lab graded task must be submitted through the relevant link **before** the lab instructor leaves the lab.
- Any medical cases, Advising conflicts, or other extreme circumstances must be communicated and approved by your lab instructor and course supervisor immediately.
- No compensations for any task, for any reason
- No attendance compensation
- The lab manuals will be posted a week in advance, you are expected to read the manual before the lab.
- Office hours for the project should be scheduled according to the schedule posted per milestone
- All project and content related questions would only be handled through piazza https://piazza.com/class/mfbbvuylkwe3ov
- All logistics issues would be handled through the course email csen903w25@gmail.com

We're all looking forward to working with every and each one of you ;)