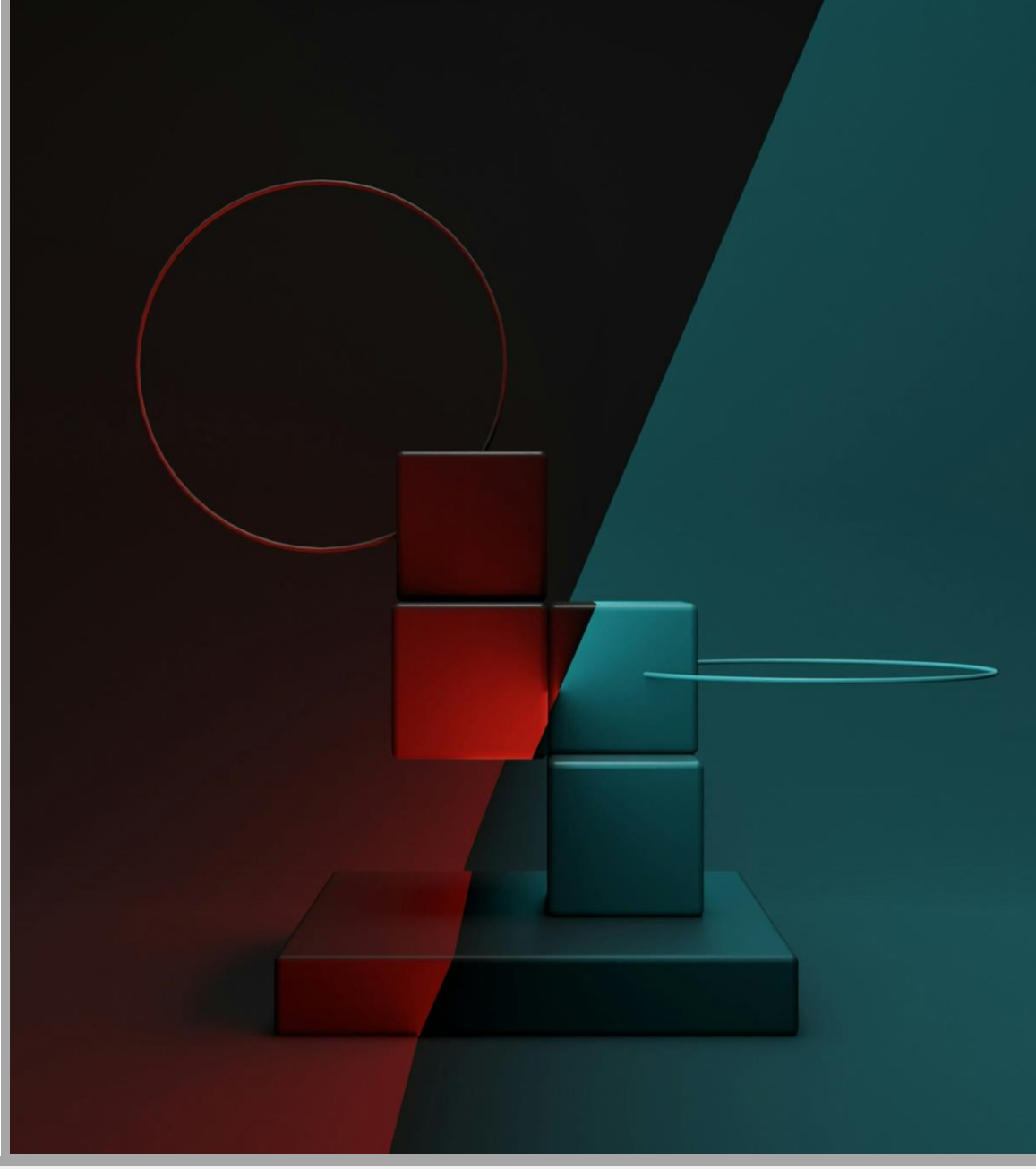
AI-InnoScEnCE

AI Tools in Research and Teaching

90-Minute Workshop

Tuesday, 30th September 2025 (Online via Zoom)



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Today‘s Agenda

Introduction

Core Concepts, Ethical Frameworks, and Principles of Prompt Engineering.

PART I

Research Applications

- Accelerating Literature Reviews and Data Analysis.
- Overview of AI Research Tools and Recommendations.

PART II

Teaching Environments

- Streamlining Course Design and Content Creation.
- Strategies for AI-Assisted Feedback and Personalized Learning.

PART III

Live Demonstration of AI Tools

- Source-Grounded Inquiry with Google's NotebookLM.
- Generating Instructional Materials with Large Language Models.

Conclusion

Future Trajectories of AI in Academia and Interactive Q&A.

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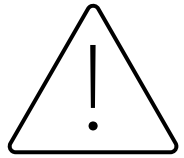

Disclaimer:

This is a technical demonstration of what current tools and services are capable of. We do not recommend generating content with AI without any oversight or alignment. Please be careful and keep in mind that you use these tools at your own risk.

Are you already using AI for Research or Teaching?

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Your students certainly do!

Higher Education Policy Institute

The proportion of students using generative AI tools such as ChatGPT for assessments has jumped **from 53% last year (2024) to 88% this year (2025)**[1]

The University of Oxford says it has become the first UK institution of its kind to offer **access to the education version of artificial intelligence (AI) tool ChatGPT to all of its students and staff.**[2]

Harvard's undergraduate survey of 326 students found that **87.5% now use AI in their studies**, representing one of the highest adoption rates documented among elite institutions. This aligns with the Digital Education Council's international survey of 4,000 students from 16 countries, which found 86% AI usage

1: https://www.hepi.ac.uk/reports/student-generative-ai-survey-2025/ (24.09.2025)
2: https://www.bbc.com/news/articles/cpvl0lr387xo (24.09.2025)
3: https://www.researchgate.net/publication/381125745_Harvard_Undergraduate_Survey_on_Generative_AI (24.09.2025)
4: https://www.digitaleducationcouncil.com/post/digital-education-council-global-ai-student-survey-2024 (24.09.2025)

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Defining AI and Its Relevance to Higher Education

Defining AI for our Workshop

- In general, AI refers to "***computational systems designed to perform tasks that typically require human intelligence***" such as learning, reasoning and problem-solving
- Our focus is on **Generative AI**
  - AI models capable of creating novel content
  - Learning patterns from vast datasets
  - Capable of advanced reasoning and content generation engines

The Core Opportunity: **AI as a Multiplier for Academics**

- **Task Automation:**
  Citation formatting, article summarization, or transcription
- **Enhanced Ideation:**
  Brainstorming research questions, exploring alternative theoretical perspectives, and generating novel project concepts
- **Facilitating Personalized Education:**
  Support tailored learning paths, resources, and feedback mechanisms
- **Large-Scale Data Analysis:**
  Analyze complex datasets with increased speed and efficiency

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Responsible AI Use

The use of powerful AI tools necessitates a robust ethical framework that prioritizes human oversight and academic integrity.

Transparency

Understand the strengths and limits of any AI tool you use, and don't view it as an error-free "black box."

Accountability

You retain ultimate responsibility for the final work. AI is a tool; the scholarly integrity and accuracy of the output are incumbent upon you.

Fairness & Bias Mitigation

AI models are trained on extensive datasets. Critically evaluate all AI outputs for potential bias or unfair representations.

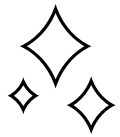
Data Privacy & Security

Never upload sensitive, confidential, or personally identifiable information to public AI platforms.

Critical Issues for the Modern Academic

Plagiarism vs. AI Assistance
Using AI for ideation, outlining, or rephrasing own text poses hidden dangers. Submitting AI-generated text as original work might be plagiarism.

Accuracy and “Hallucinations”
AI models can generate factually incorrect information or fabricate sources **with confidence**. All claims, data, and citations derived from AI must be rigorously verified.



Copyright & Intellectual Property
The legal landscape concerning AI-generated content is evolving. Exercise caution when using such content for publication and adhere to the terms of service for all tools.

ICLR introduced a new guide on “The Use of Large Language Models (LLMs)” for their conference in 2026 stating that authors should describe the precise role of LLMs in their publication.[1]

1: https://iclr.cc/Conferences/2026/AuthorGuide

Crafting Effective Prompts for Academic Inquiry

- Specificity & Context: Avoid ambiguous queries. Provide **detailed context** and **define the parameters of the desired response**.

Ineffective: "Explain photosynthesis."

Effective: "Explain the process of photosynthesis, detailing the light-dependent and light-independent reactions, for a undergraduate biology audience. Use an analogy to clarify the role of ATP."

- Assign a Persona or Role: Instruct the AI to **adopt a specific professional role** to shape the tone, style, and focus of its response.

Example: "Act as a skeptical peer reviewer and identify the logical weaknesses in the following argument..."

Example: "Act as a curriculum design expert and propose a 5-week module on..."

- Provide Exemplars (Few-Shot Prompting): Supply the AI with a **model of the desired output format and style**.

Example: "I am creating multiple-choice questions. Here is an example of the required format: [x,y,z]. Now, generate five more questions on the topic of [A] in this precise format."

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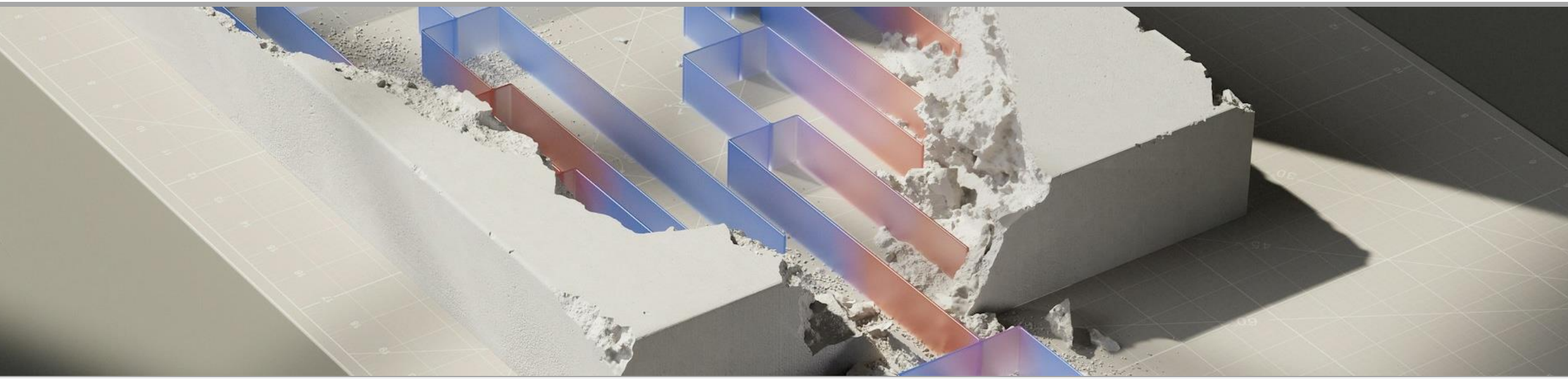
PART I: AI Applications in Research



AI-Powered Literature Reviews

The Challenge:
Exponential growth of scholarly literature presents a significant challenge to **conducting comprehensive and timely reviews**.

Semantic Search

Employing natural language understanding to identify conceptually relevant literature beyond simple keyword matching.

Automated Summarization & Data Extraction

Rapidly extract core arguments, methodologies, and findings from articles, often presenting them in a structured, tabular format for comparison.

Conceptual Mapping

Visualize intellectual connections, identify influential authors, and trace the development of research streams.

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Literature Review Workflow

#1 Data Gathering › **#2 Paper Selection** › **#3 Citation Context** › **#4 Export**

Utilize Elicit, Perplexity or alphaXiv with a detailed research question to generate a synthesized list of relevant papers.

perplexity

Elicit

alphaXiv

Evaluate the AI-generated summaries via Deep-Reasoning Models to identify a core set of 10-15 highly relevant articles.

Claude

OpenAI

Gemini

Employ Scite or Lens.org to analyze the citation context of these key papers (i.e., whether their findings have been supported, contested, or merely mentioned).

scite_

LENS.ORG

Export the curated list to a reference manager (e.g., Zotero, Mendeley).

zotero

MENDELEY

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AI as a Co-Pilot in Data Analysis

We can deploy AI for qualitative and quantitative data analysis – however expert oversight and critical evaluation is essential.

Qualitative Data Analysis

- **Automated Transcription**: Services like Whisper or Otter.ai can produce accurate transcripts of audio interviews in a fraction of the manual time.
- **Thematic Analysis & Coding**: Use tools like ChatGPT's Advanced Data Analysis or Claude for preliminary coding of anonymized textual data.
- Example Prompt:
  "Analyze the 10 anonymized interview transcripts provided. Identify the top 5 recurring themes related to remote work, and for each theme, extract 3-5 illustrative quotations."

Quantitative Data Analysis

- **Code Generation & Debugging**: Generate Python or R scripts for statistical analyses, data visualizations, and cleaning procedures.
- **Data Visualization**: Describe a desired visualization in natural language to generate the corresponding code.
- Example Prompt:
  "Given a CSV file with columns 'StudyHours' and 'ExamScore,' generate Python code using the matplotlib library to create a scatter plot and calculate the Pearson correlation coefficient."

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A Comparative Overview of Leading Research Platforms

Different AI tools are optimized for specific research tasks. This guide provides a functional comparison.

Tool	Primary Application	Key Feature	Limitations
NotebookLM	Deep synthesis of **user-provided sources**.	Grounded Q&A; AI exclusively uses uploaded documents. In-line citations.	Not designed for discovering new literature. Requires pre-selection of sources.
Elicit	Literature discovery & data extraction.	"Literature Review" workflow that tabulates findings from multiple papers.	Can be slow with broad queries; optimized for empirical studies.
perplexity	Answering research questions with citations.	Conversational interface with footnotes linking to online sources.	Sources may include non-academic content and require rigorous vetting.
scite_	Understanding the context of citations.	"Smart Citations" classify the nature of citations (supporting, etc.).	Sources may include non-academic content and require rigorous vetting.

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PART II: AI Applications in Teaching

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Streamlining Course Design and Preparation

Large Language Models such as Gemini, ChatGPT, and Claude offer significant versatility for these text-based generation tasks.

"Generate a 14-week syllabus for an undergraduate course titled 'Introduction to Deep Learning.' Include weekly topics, suggest canonical readings, and design a major scaffolded assignment."

This document outlines the curriculum for CS-4XX: Introduction to Deep Learning, an upper-level undergraduate course designed to provide a rigorous and comprehensive entry into the principles and practices of modern artificial intelligence. The course is structured to bridge the gap between foundational theory and practical application, ensuring students not only understand the mathematical underpinnings of neural networks but also gain hands-on experience in building, training, and deploying them.

The curriculum is divided into three thematic parts:

- **Foundations of Neural Networks:** Establishes the core concepts of machine learning, the mathematics of neural networks, and the essential mechanics of model training and optimization.
- **Deep Learning Architectures & Applications:** Explores the cornerstone architectures that power modern AI, including Convolutional Neural Networks (CNNs) for computer vision and Recurrent Neural Networks (RNNs) and Transformers for sequence processing.
- **Advanced Topics & The Bigger Picture:** Introduces students to cutting-edge concepts like generative models and addresses the critical, non-technical aspects of AI, including ethics, bias, and interpretability.

A key feature of the course is a semester-long, scaffolded project where students develop an end-to-end image classification system. This capstone assignment ensures that theoretical knowledge is reinforced through practical problem-solving, culminating in a final report and presentation. Upon completion, students will be equipped with the skills necessary for advanced coursework, research, or entry-level roles in the field of artificial intelligence.

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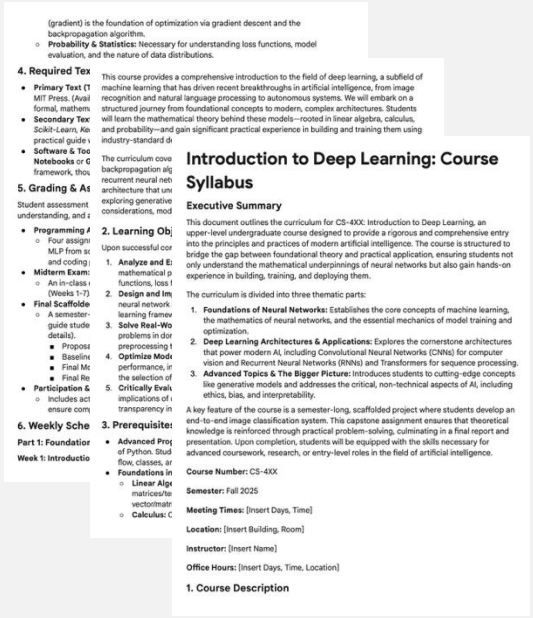
Streamlining Course Design and Preparation

It is even capable of generating not only text but also websites, graphics and much more...

Course Syllabus PDF



Introduction to Deep Learning: Course Syllabus

Executive Summary

This document outlines the curriculum for CS-4XX: Introduction to Deep Learning, an upper-level undergraduate course designed to provide a rigorous and comprehensive entry into the principles and practices of modern artificial intelligence. The course is structured to bridge the gap between foundational theory and practical application, ensuring students not only understand the mathematical underpinnings of neural networks but also gain hands-on experience in building, training, and deploying them.

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Course Number: CS-4XX

Semester: Fall 2025

Meeting Times: [Insert Days, Time]

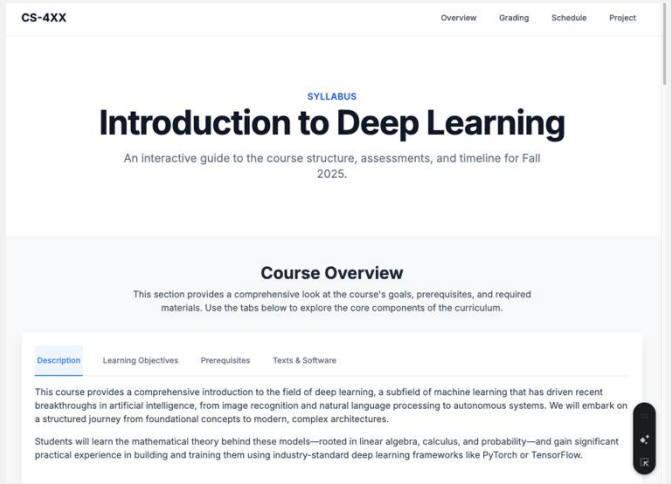
Location: [Insert Building, Room]

Instructor: [Insert Name]

Office Hours: [Insert Days, Time, Location]

1. Course Description

Website



https://g.co/gemini/share/7ecfcba94d69

Podcast

Several audio summaries detailing the key points of the new course or certain parts.

Learning Videos

Custom explanation videos of hard-to-grasp concepts or methods.

Example: AI-produced Knowledge Nuggets

Small Methods or Concepts easily explained in an engaging format

Creating Engaging Student Experiences with AI

Interactive Sessions and Scenario-based Learning

Create custom Assessment Instruments

- **Questionnaire Generation:**
  "Generate a detailed questionnaire for Part I of the CS Deep Learning Course on Foundations of DL".

Questionnaire: Foundations of Deep Learning (Weeks 1-4)

- Section 1: **Intro to ML & The Perceptron**
  1. Multiple Choice: Which statement best describes the relationship between Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL)?
  2. **Short Answer:** You are given a dataset of 10,000 images of cats and dogs, with each image labeled as either "cat" or "dog." What type of machine learning problem is this (Supervised, Unsupervised, or Reinforcement)? Briefly explain why.
  3. **Conceptual Question:** Describe the four essential components of a single Perceptron. What is the role of the "weight" associated with each input?
  4. **Problem Solving (Linear Algebra):** Imagine a Perceptron has two inputs, $x1 = 0.5$ and $x2 = 1.0$. The corresponding weights are $w1 = 0.8$ and $w2 = -0.3$. The bias for this Perceptron is $b = 0.1$. Calculate the weighted sum (the value before the activation function is applied). Show your calculation.
- Section 2: **The MLP & Loss Functions**
  1. ...

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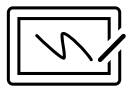
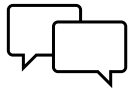
Enhancing Feedback and Grading Efficiency

While AI cannot replace expert judgment, it can streamline formative feedback processes, allowing educators to focus on higher-order student needs.

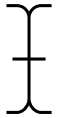


Develop Reusable Feedback Library: Identify common student errors in an assignment. Use AI to generate clear, constructive explanations for these errors to build a reusable feedback library.



Automate Low-Stakes Formative Feedback: For drafts or weekly assignments, employ an AI to provide initial feedback against a predefined rubric.

> Prompt Example: "Evaluate the provided student paragraph against the 'Clarity' and 'Use of Evidence' criteria from the attached rubric. Provide one piece of constructive feedback for each criterion."



Grammar and Style at Scale: Integrate AI-powered tools like Grammarly into the Learning Management System (LMS) to offer students real-time feedback on writing mechanics.

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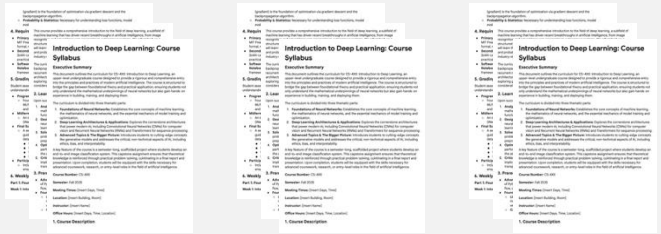
Tailoring Instruction to Individual Student Needs

Evolving from a uniform teaching modality to an adaptive learning environment that responds to individual student progress and preferences.

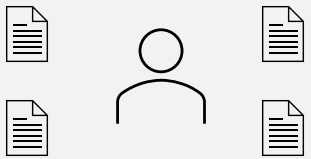
Differentiated Learning Materials

"Adapt the CS Deep Learning Course for three distinct audiences: for Master-Degree Students, for a 2-week Summer-School and for an impulse pitch for deep tech startups."



Personalized Formative Feedback

"Provide feedback on common errors you find in these submissions, also provide substantive, conceptual guidance based on the uploaded grading and teaching guidelines."



AI-Workshop Assistants

Provide real-time suggestions, facilitate brainstorming sessions, and help stakeholders explore potential opportunities

Create a flexible tool that can adapt to different stakeholder needs, enhancing their ability to generate, refine, and evaluate ideas during the workshop.

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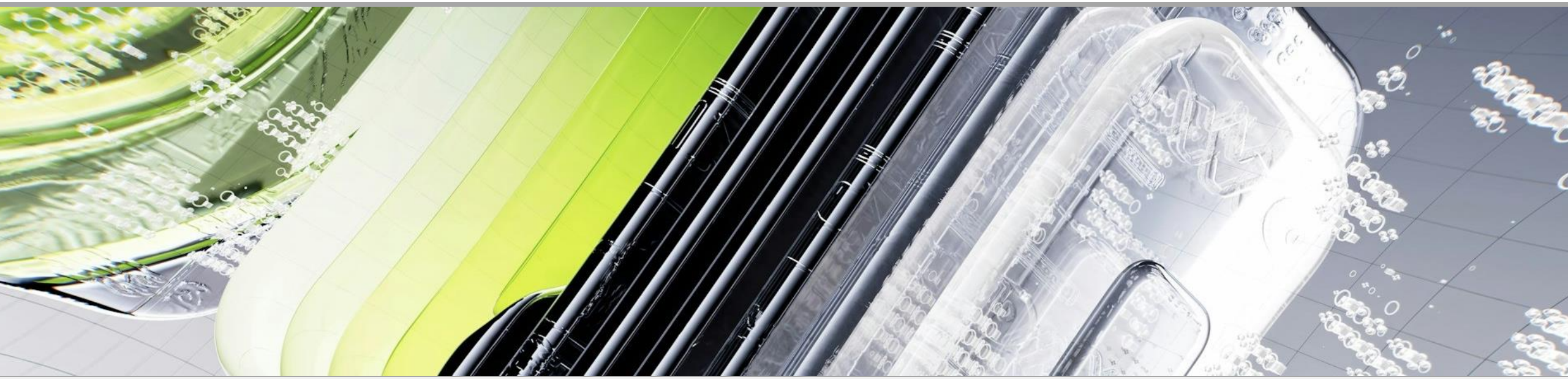
PART III: AI in Practice



NotebookLM

Live Demo:
Focused Research with Google's NotebookLM

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Live Demo:
Perplexity Labs for Data Analysis

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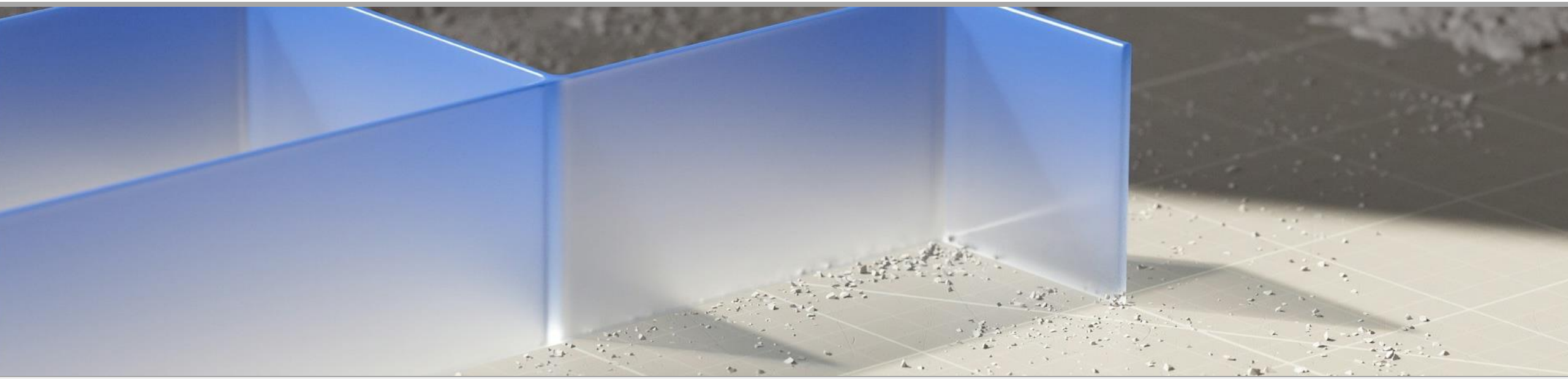
Conclusion



The Evolving Role of AI in Academia

The tools discussed represent the current state-of-the-art, but the field is evolving rapidly, pointing towards more integrated and powerful applications.

- **Hyper-Personalized Learning Paths**: AI systems that curate unique learning pathways for student groups, adapting content modality and difficulty in real-time based on performance data.
- **AI as a Research Collaborator**: A shift from AI as a tool for data analysis to a collaborator that can propose novel hypotheses, assist in experimental design, and identify interdisciplinary research opportunities.
- **Advanced Tutoring Systems**: Ubiquitous access to sophisticated AI tutors capable of providing expert-level, Socratic-style guidance on any subject.
- **Implications for Academia**:
  - Rethinking Assessment: A necessary shift towards assignments that prioritize critical thinking, creativity, and problem-solving skills that are not easily automated.
  - Commitment to Lifelong Learning: A professional imperative for academics to continuously engage with and adapt to emerging technologies.
  - Educating for an AI-Enabled World: An increasing responsibility to teach students how to use these tools effectively, ethically, and critically.

Conclusion

AI as Augmentation: View AI as a tool to augment, not replace, human intellect and expertise. The academic's role in guiding, validating, and synthesizing AI outputs is paramount.

Adopt an Incremental Approach: Begin by integrating AI into one or two high-effort, low-risk tasks. Gradual adoption facilitates effective and sustainable integration into your workflow.

Maintain Critical Oversight: Apply healthy skepticism to all AI outputs. Rigorously verify facts, evaluate for bias, and refine generated content to meet scholarly standards.

Develop Prompting Expertise: The utility of AI is contingent upon the user's ability to craft precise, context-rich prompts. This is a critical skill for leveraging these tools effectively.

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Thank you for your Attention!

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