

AI as a Critical Co-Pilot

A good practice for developing
judgment, creativity,
collaboration, and accountability
in AI-enabled learning

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UNIVERSITY
OF BEIRUT**



Disclaimer

I don't have any fundings or grants from any High Tech company.

Education 1.0 to 4.0

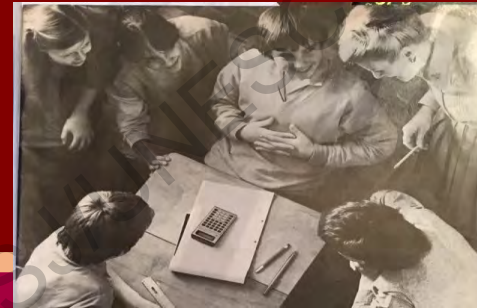
Education 1.0

Teacher Late 18th century centered learning



Education 2.0

First Half 20th century
Teacher centered, some distance learning



Education 3.0

Second Half 20th century
Teacher centered, some active learning

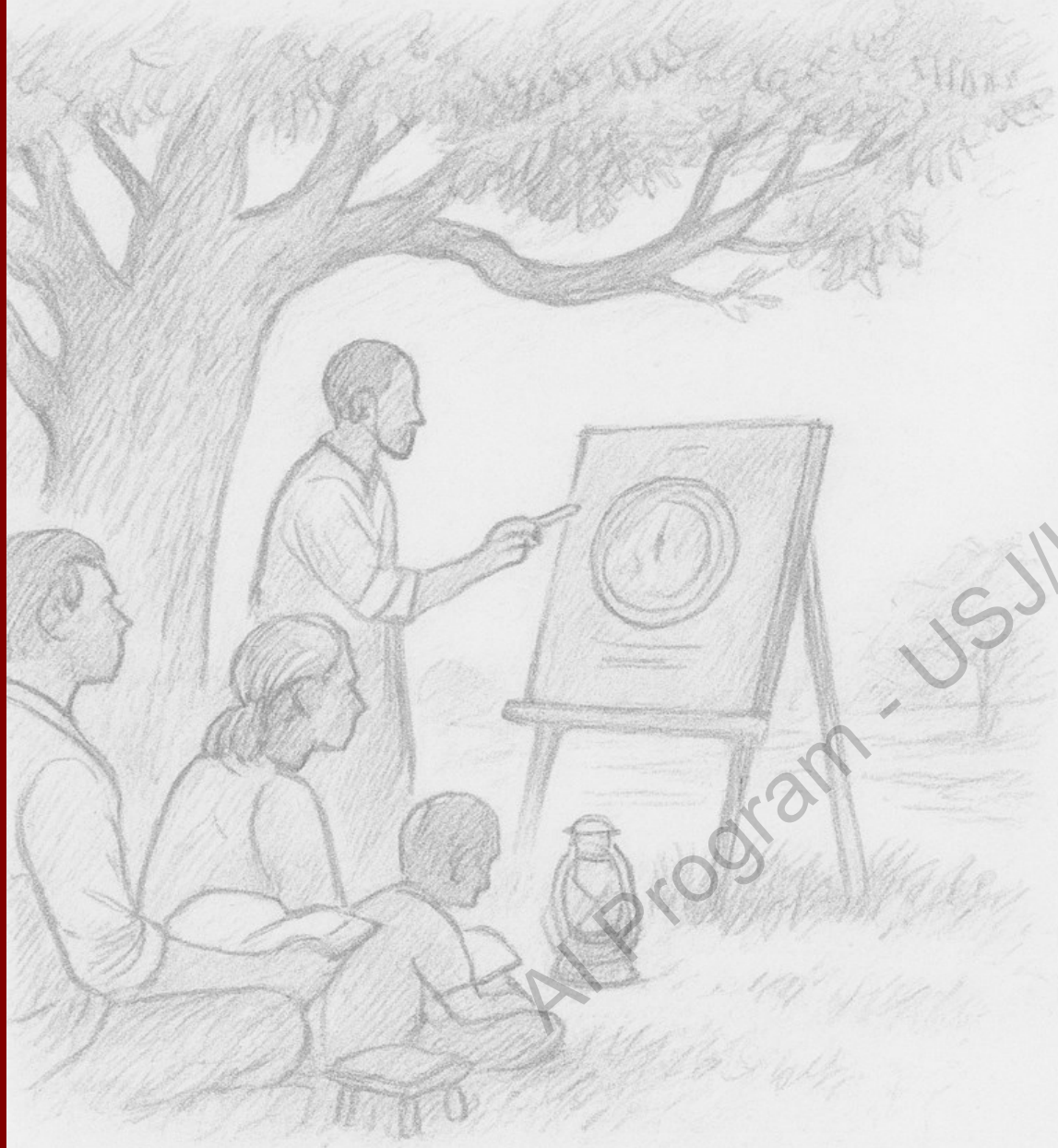


Education 4.0

21st century
Student-centered, technology based, competency/Skills focused and active learning



Under the Tree: Then and Now



THEN: LEARNING UNDER A
TREE

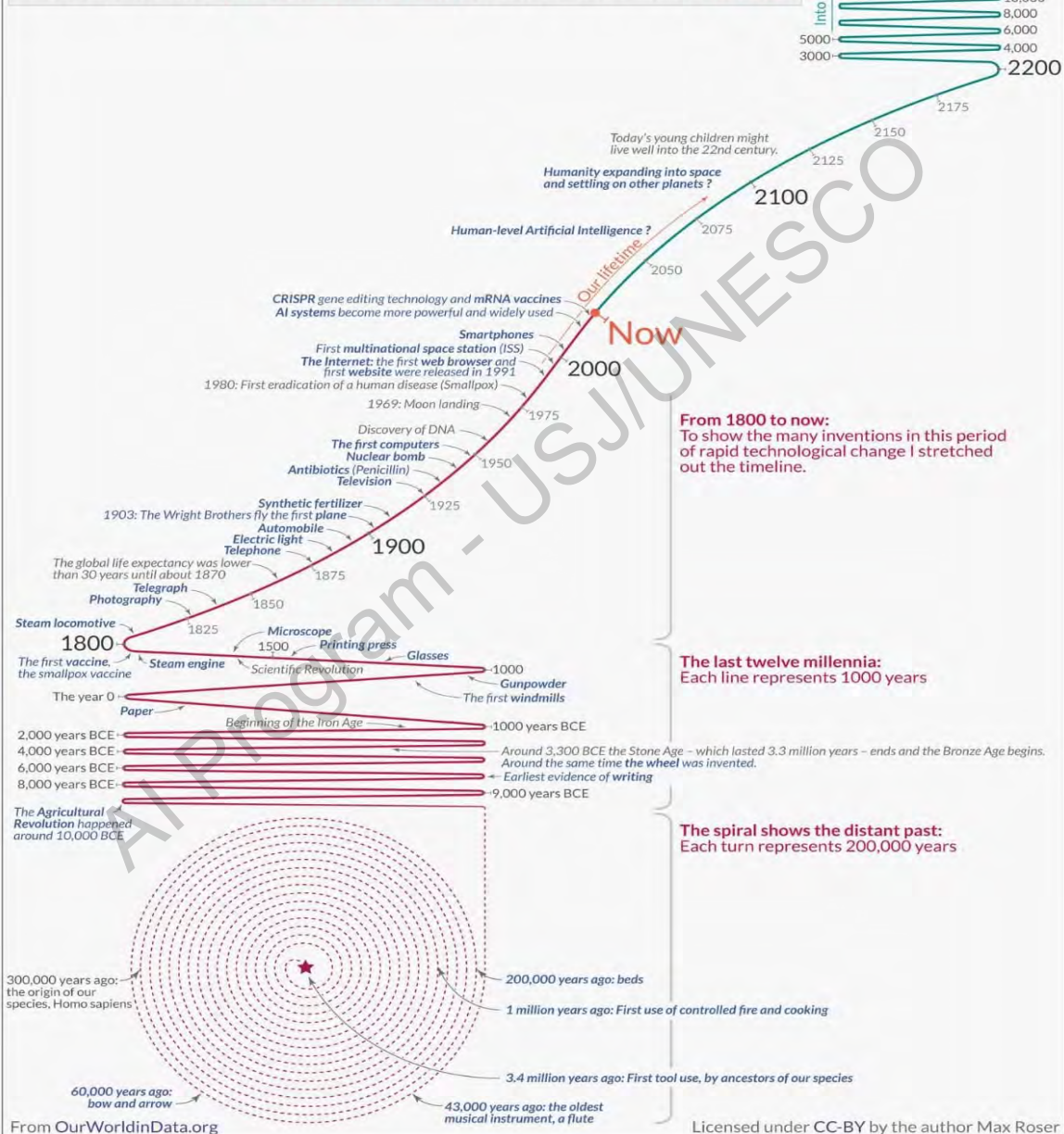


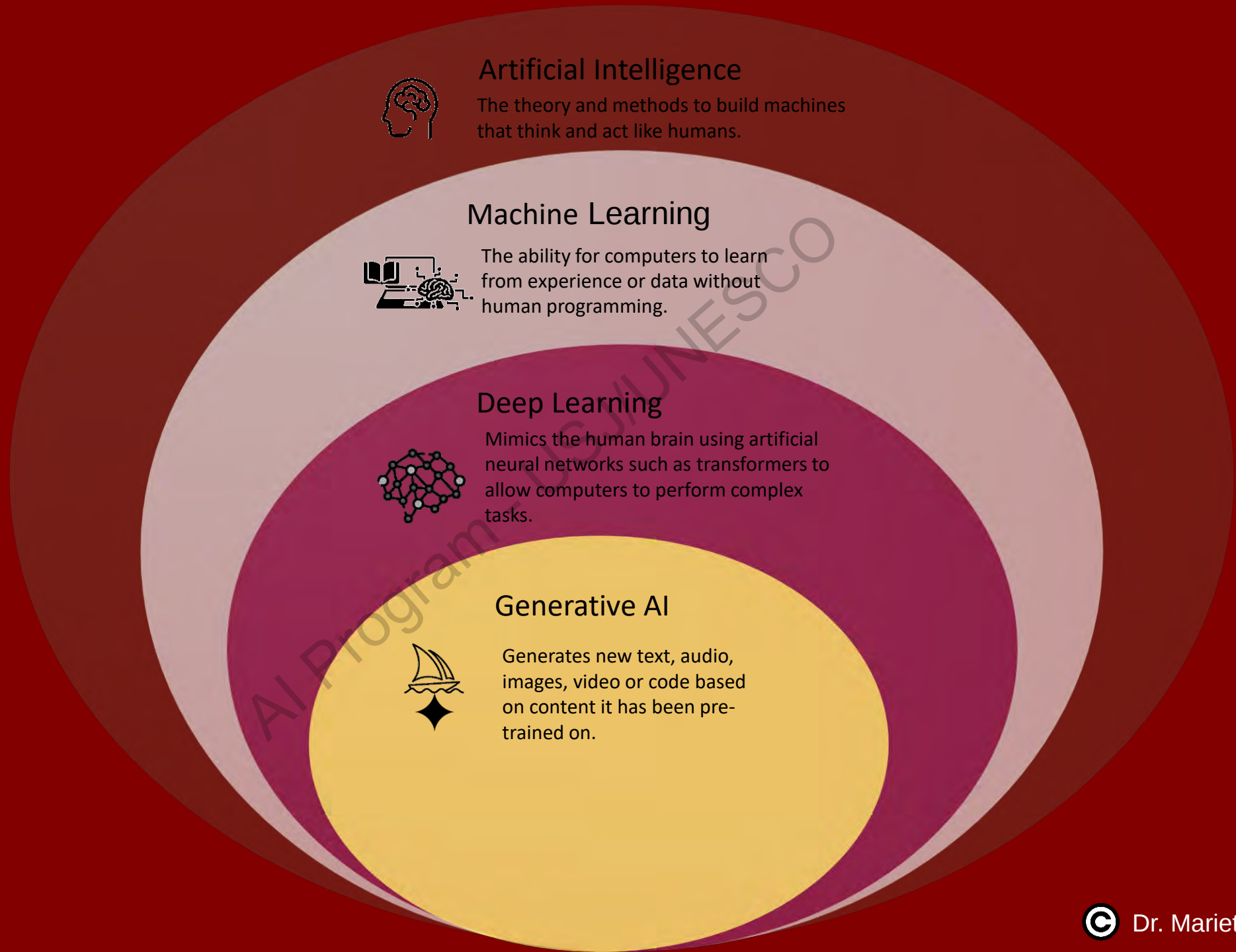
NOW: LEARNING ANYWHERE—
EVEN UNDER A TREE

A long-term timeline of technology

Our World
in Data

From the distant **past**, to **our lifetime**, and into the distant **future**.





Emerging Trends and Innovative Methodologies

Generative AI in Teaching and Learning Design

Course content,
learning experiences
and assessment
generation



Learning Analytics for Impact

AI for predictive
analytics to identify
students at risk of
dropping out



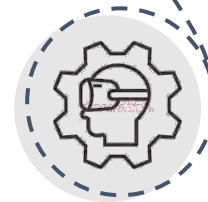
AI for Collaborative Learning

Smart forums, AI
moderation, and
feedback

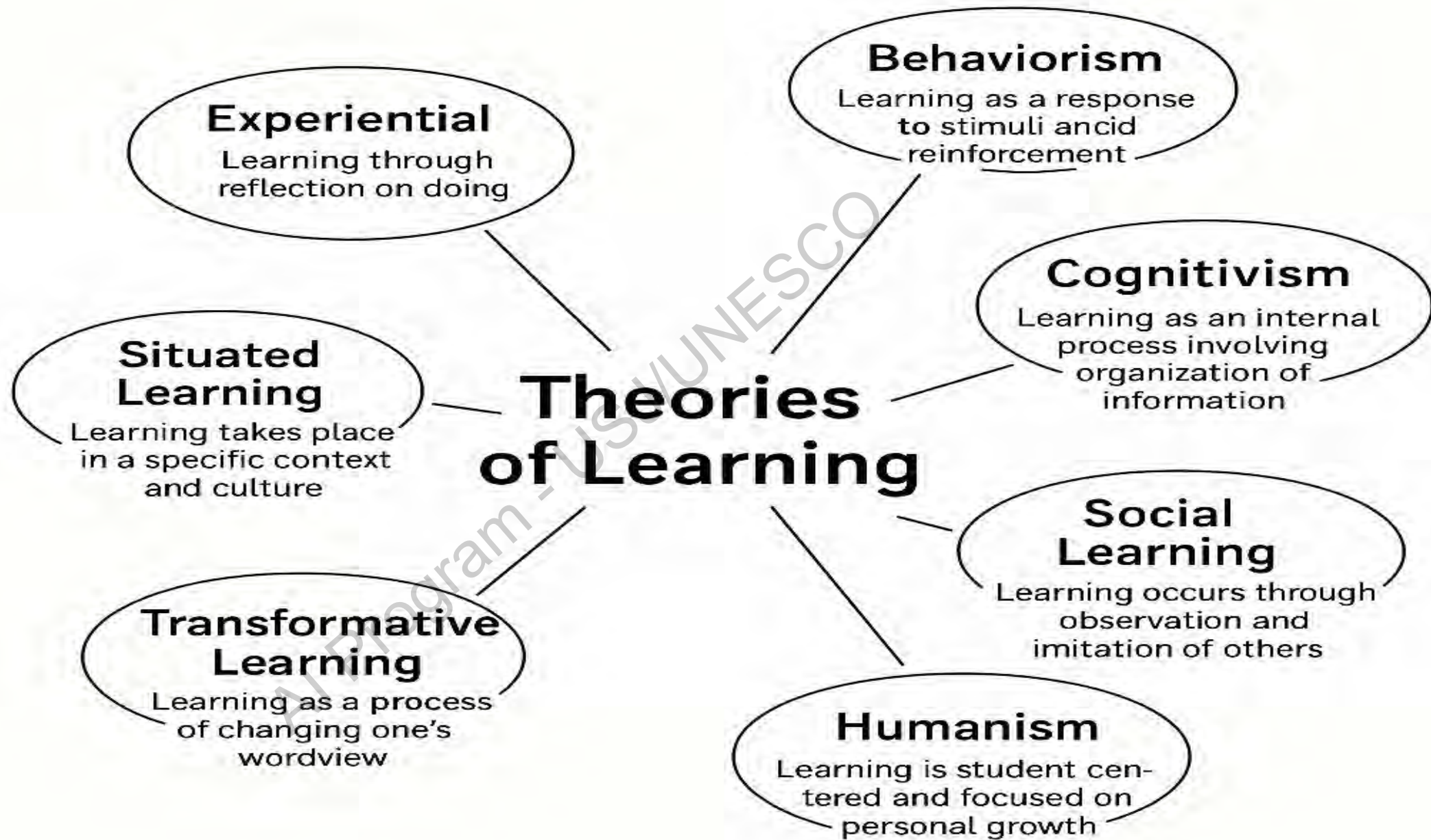


Immersive AI Learning

AI in simulations and
scenario-based
learning



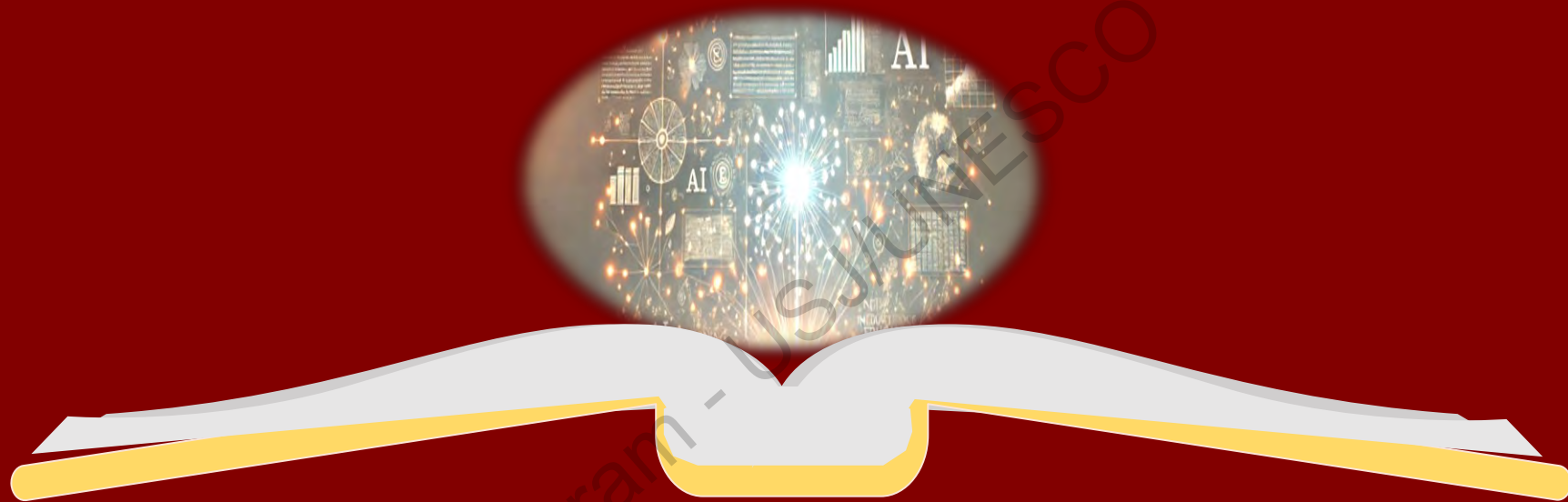
Theories of Learning



Bloom Taxonomy



Pedagogical Theories and AI Reflections



Constructivism

AI simulates environments for experiential learning; adapts to learner inputs

Connectivism

AI enables knowledge networks, semantic search, and collaborative filtering

Social Learning Theory

AI-driven avatars and virtual agents allow modeling of behaviors; AI curated content reflects diverse experiences

Bloom's Taxonomy

AI assesses lower-order tasks and supports higher-order tasks through feedback and co-creation tools

Zone of Proximal Development

AI adjusts difficulty levels dynamically, acting as a digital scaffold.

Psychological Theories and AI's Influence

Cognitive Load Theory

AI manages information overload



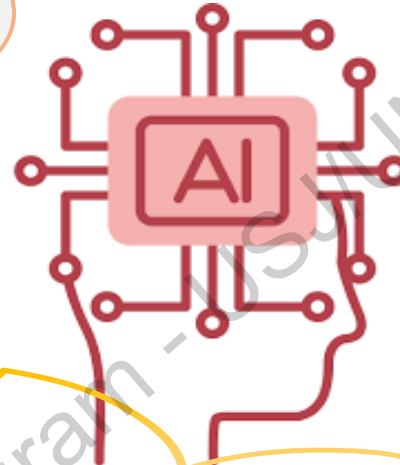
Motivation Theories

AI enhances intrinsic motivation



Metacognition

AI fosters self-reflection and self-assessment



Behaviorism

Gamified AI environments provide rewards



Flow Theory

AI adjusts challenge levels



Novel Perspectives on the Value Created by Learning Organizations in the AI Era

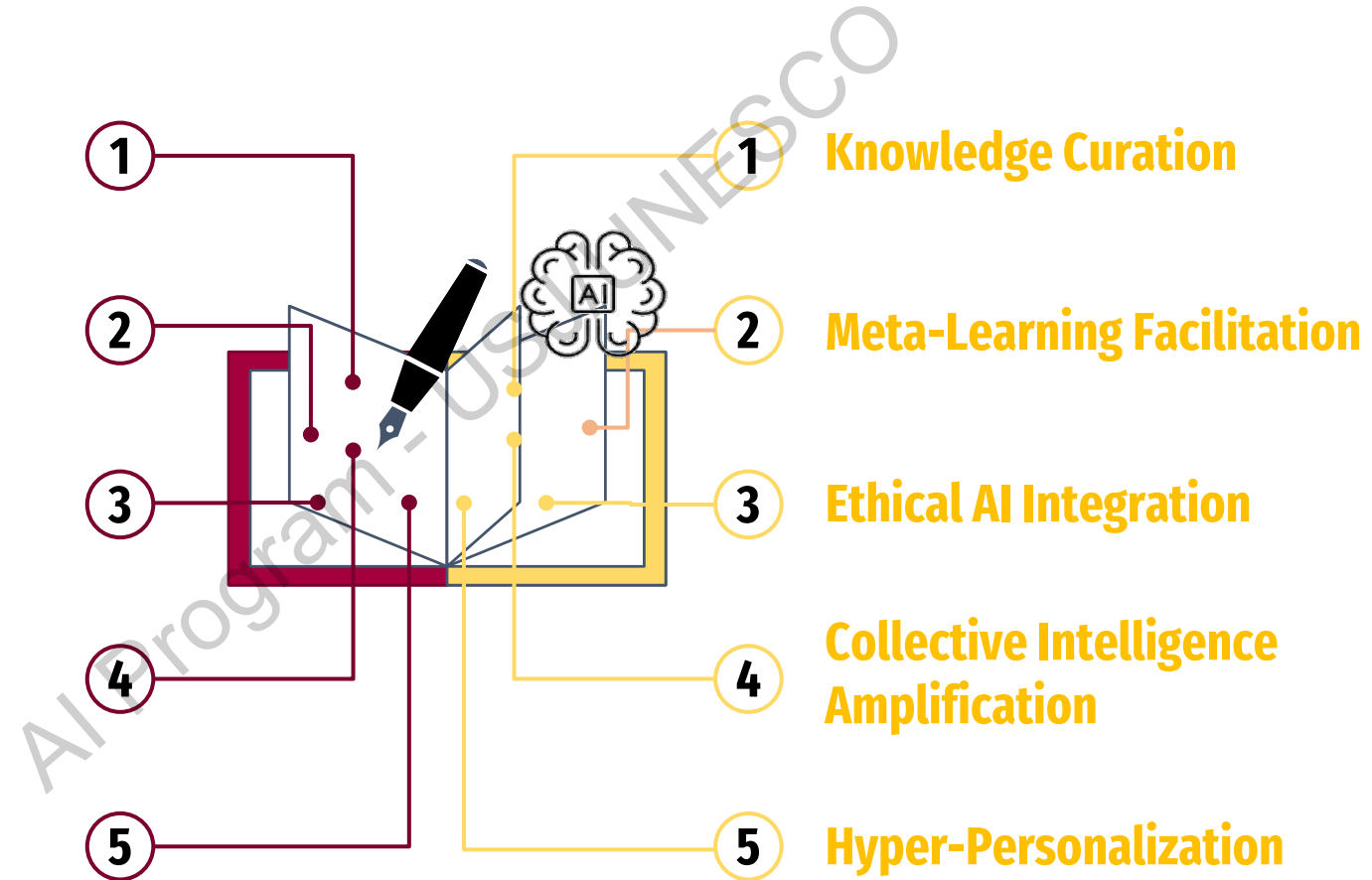
Knowledge Transmission

Learner Skill Development

Capacity Building for Practice

Organizational Learning

Access to Learning





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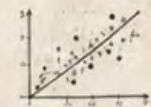
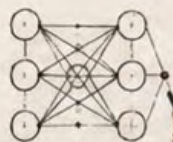
18 Years of Teaching AI

Now Teaching AI Using AI

From teaching algorithms
to teaching judgment.

THEN
Teaching AI
(Foundations)

$$y = f(x)$$
$$\theta = \underset{\theta}{\operatorname{argmin}}, \mathcal{L}(\theta)$$
$$\sigma(z) = \frac{1}{1 + e^{-z}}$$



NOW
Teaching AI
Using AI

Prompt
Ask intelligently.
Be clear and specific.

AI OUTPUT

Critique
Check assumptions.
Test the evidence.
Look for bias.

Validate
Test widely.
Cross-check.
Document.

HUMAN OVERSIGHT

- ✓ Ethics
- ✓ Responsibility
- ✓ Context
- ✓ Impact

DECISION LOG

- ✓ Questioned
- ✓ Verified
- ✓ Synthesized
- ✓ Decided



2006
Algorithms
& Models



2015
Applications
& Impact



2024+
Judgment
& Stewardship



FROM KNOWING
THE TOOLS



TO QUESTIONING
THE ANSWERS



TO SHAPING A
BETTER FUTURE

AI is powerful.
Judgment is human.

The goal is not AI-proof teaching. It is AI-responsible learning.



AI should not reduce learning to faster answers.
It should raise the standard for explanation, verification, and responsibility.

The AI classroom plot twist

When answers become instant, the course must make thinking visible.

The “Ethos–Tech Nexus” frames AI teaching as technical mastery joined to ethical discernment: students must design, interrogate, and defend intelligent systems.

AI should raise the standard, not lower the effort.



The Good Practice

AI is integrated as a learning partner — but every output must be questioned, verified, and defended.

CORE IDEA

Explore

Use AI to generate explanations, alternatives, code hints, and questions.

Verify

Test claims against theory, data, experiments, and course concepts.

Explain

Defend assumptions, model choices, code behavior, and ethical implications.

AI should expand student agency — not replace intellectual responsibility.

The Missing-Cell Challenge

Incomplete notebooks turn AI from a shortcut into a reasoning test.

EECE490/690 · pre_lab.ipynb

```
# explain before running

X_train, X_test = _____

baseline = choose_before_complex_model()

metric = justify_metric( _____ )

# where could leakage happen?

student_reflection = "_____"
```

AI may suggest. The student must complete the thought.

Why it is catchy in class

1

A blank cell becomes a checkpoint

Students cannot hide behind generated code

2

The notebook asks “why?”

Assumptions, baselines, leakage, metrics

3

Class time becomes a clinic

Debugging + architectural reasoning, not syntax repetition

Examples: incomplete notebooks · interactive lectures · self-tests · DataCamp scaffolding

a) Spring 25: EECE693 Interactive lectures, which complements with some main online references, the lecture material for each topic in the syllabus

b) Spring 25: EECE693 Test your knowledge and Self Tests for each topic in the syllabus

c) Spring 25: EECE693 Python Notebooks for the hands-on

Topic 3 - Recurrent Neural Networks

- RNN
- LSTM
- Attention
- Transformers
- Visualizing LLM
- Visualizing Attention
 - (Interactive Lecture) Introduction to Recurrent Neural Network
 - (Interactive Lecture) The Basics of RNN
 - (Interactive Lecture) Recurrent Neural Network: Training
 - (Interactive Lecture) RNN Variants, LSTM, GRU, Attention Networks
- RNN hands on session
- RNN hands on session solved notebook

Test your Knowledge

Topic 1 - Deep FeedForward Networks

- NN Practise
- NN Practise Solution
- Test Your Knowledge: Introduction to Feed Forward Neural Networks
- Test your knowledge
- Test Your Knowledge: Components of Feed Forward Neural Networks
- Test Your Knowledge: Feed Forward Neural Networks: Training
- Test Your Knowledge: Feed Forward Neural Networks: Regularization

Topic 2 - Convolutional Neural Networks

Self tests

- Self Test - Basics of Machine Learning
- Self Test - Regression
- Self Test - Decision Trees and Random Forest
- Self Test - SVM
- Self Test - Neural Networks
- NN Solution
- Self Test - Bayesian Models
- Self Test - Unsupervised and RL

Previous Quizzes

- Quiz 1: Basics, GD, Regression, Normal Eq
- Quiz 2: Decision Trees, Random Forests

FeedForward Deep Neural Networks

- Building A Neural Network From Scratch
- Utils
- Building A Neural Network From Scratch (Solution)
- Training the Built Network

Convolutional Neural Networks

- Training the Built Network (Solution)
- Chins with Small Datasets
- Visualizing What CNNs Learn

Lab 2 - Neural Networks

You can upload the given notebooks to your Google Drive to open them directly in Colab. It is highly recommended that you upload the "kaggle.json" file to your Google Colab runtime to be able to download the dataset.

For image reading and processing check the different Python image libraries you can use: <https://towardsdatascience.com/are-they-different-ea11678f6673ad>

Once finished, you can submit your solution as an HTML file for submission.

Due November 4

Lab 2 Hints

<https://aub.webex.com/join/join?RCID=9Ea4100c43d13c9ef9e4c36de6172207>

Password: 6EeRn3@

d) Fall 22: EECE490/690 — asynchronous support video to help students navigate complex coding assignments

3.2 - Handling Missing Values

We need to fill the gaps in the Age and Embarked columns.

Exercise: Fill the missing Age values with the median age, and

```
##> NA's: 1000 1000 1000 1000
...
##> NA's: 1000 1000 1000 1000
print("Missing values after imputation")
print(df_clean.isnull().sum())
```

3.3 - Converting Categorical Data

Our model needs all input to be numerical. We'll convert Sex and Embarked into numbers using one-hot encoding.

Exercise: Use pd.get_dummies to convert Sex and Embarked to numerical columns. Set drop_first=True to avoid redundant columns.

```
##> NA's: 1000 1000 1000 1000
# Convert categorical variables into dummy/indicator variables
df_model = ...
##> NA's: 1000 1000 1000 1000
df_model.head()
```

c) Spring 25: EECE490/690 Course- Notebooks with incomplete cells for the Hands-on sessions, structured as pre-lab then active learning

The Defense Arena

Learning reward ownership, not just output.

WHY?

Every AI-assisted result
must survive explanation,
evidence, and questioning.

4–5 handwritten synthesis sheets

concept compression

Recorded implementation walk-throughs

student-level ownership

Transparent AI assistance declaration

visible use

Oral defense questions

trade-offs under pressure

Core assessment question: Can the student explain why the result is correct, limited, or wrong?

Flip the Classroom



GANs

Recording link: <https://aub.webex.com/aub/ld>

Password: qSWvzK\$4



GANs notebook



Deep RL



Deep RL Notebook



Zero shot learning



Transfer Learning



Transfer Learning Python Notebook 1



Transfer Learning Python Notebook 2



Siamese Networks



Siamese Networks Notebook



Large Language Models



Federated Learning



One Class Models



U Net



U Net notebook



GNN

Deliverables (One submission per group is enough)

1 Jupyter Notebook Submission

- Download the attached Jupyter Notebook with missing code snippets that you need to complete. Make sure to follow the steps and guidelines provided.

Instructions:

- Complete all missing code sections.
- Provide clear explanations in markdown cells.
- Ensure proper variable naming and comments for readability.
- Do NOT import additional libraries—only use those already included in the provided notebook.
- Make sure to rename the notebook to `EECS693_act1_subnets.ipynb`, where `subnets` is the AUBNet of group members, separated by an underscore.

2 Video Explanation (Max: 5 Minutes)

- Each group must submit a video (max 5 minutes) explaining their solution.
- All members must speak and introduce themselves.
- Clearly explain your approach, results, and key takeaways.

Neural Networks (not unique solution)

regression (line)
binary class (sign)
multi-class (softmax)

$$J = \sum_i E(i) = \sum_i (y_p(i) - y_a(i))^2$$
$$J = \sum_i E(i) = \frac{1}{m} \sum_i y_a(i) \ln(y_p(i)) + (1 - y_a(i)) \ln(1 - y_p(i))$$

or multiclass: $-\frac{1}{m} \sum_{i=1}^m \sum_{n=1}^N y_n^{(i)} \log(h_n^{(i)}) + (1 - y_n^{(i)}) \log(1 - h_n^{(i)})$

$$+ \frac{1}{2m} \sum_{l=1}^{L-1} \sum_{i=1}^{S_l} \sum_{s=1}^{S_{l+1}} (\sigma_{ji}^{(l)})^2$$

Input $X: m \times (n+1)$
Output $y: m \times \mathbb{Z}$

$a_i^{(l)}$ ← from layer $l-1$
 $\sigma_{ji}^{(l)} = \frac{1}{1 + \exp(-a_{ji}^{(l)})}$
 $a_i^{(l)} = \sum_j w_{ji}^{(l)} a_j^{(l-1)} + b_i^{(l)}$

Deep Learning in Industry



Bioinformatics meets Deep Learning



Bioinformatics meets Deep Learning code



Chatbots

The AI Mistake Hunt

Students learn to treat AI output as a suspect — not a verdict.

Bias

Who is missing?

Framing

What values are assumed?

Evidence

What cannot be verified?

Cost

Was a simpler tool enough?

Controlled prompting experiments · cross-model comparison
· usage audits · medical AI risk analysis

Ethical AI becomes a lab practice, not a lecture topic.



Assignment 1

Introduction to Large Language Models

American University of Beirut

Instructor: Prof. Mariette Awad

Shaping the Future of Large Language Models: Vision, Constraints, and Economics

Submission: PDF

Total: 100 points

Why This Assignment

Large Language Models (LLMs) extend beyond algorithmic artifacts. They function as research systems, economic infrastructures, and interventions with societal impact.

This assignment is designed to assess your ability to reason about LLMs under explicit constraints. In particular, it evaluates whether you can:

- Reason systematically under stated assumptions.

Assignment 1: Learning with ChatGPT

- 1) Find a use case where ChatGPT displays a human par performance
 - 2) Find a use case where ChatGPT fails to perform as a human expert
 - 3) Demonstrate through use cases how ChatGPT learns
 - 4) Reflect on how ChatGPT will impact engineering and STEAM education as well as society at large
- And finally why and how you would use ChatGPT

You can use ChatGPT in your assignments as long as you acknowledge it and is able to defend your work. Group work is encouraged. Submit your work in ppt format, few slides for each part of the assignment.

LLMs and Controversial Topics

Edit

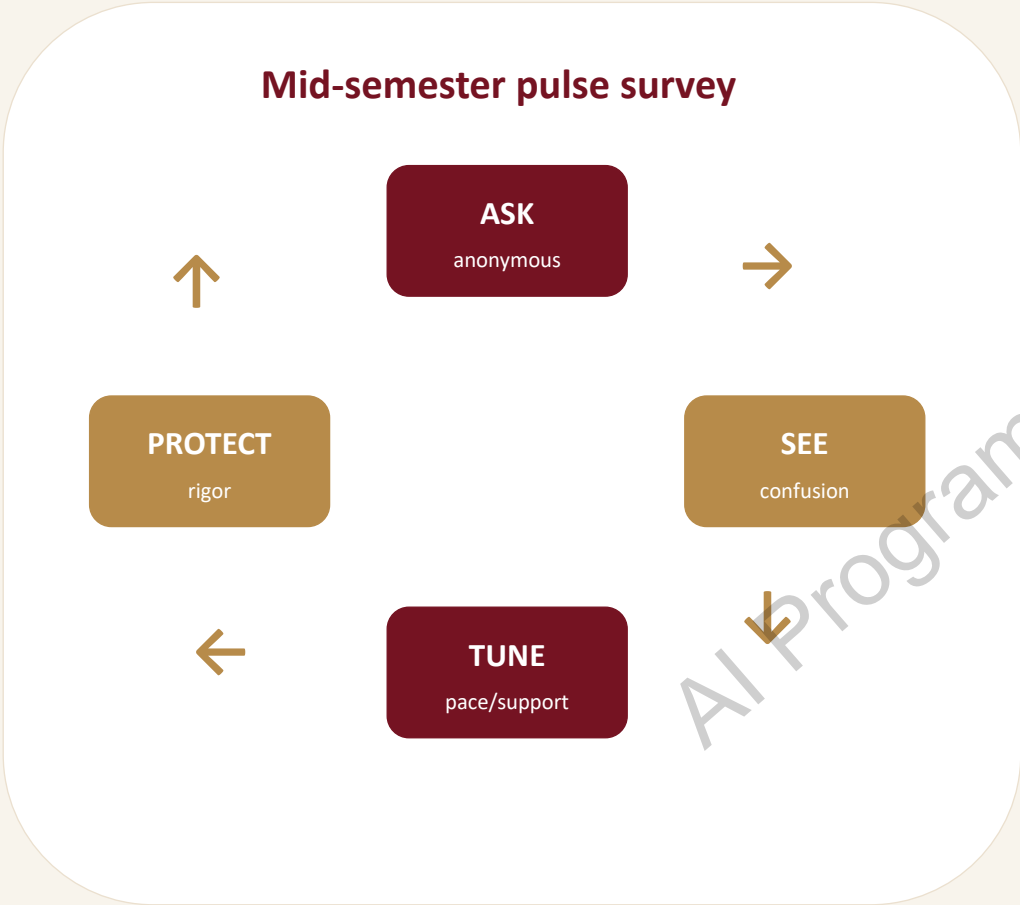
Comparing responses of LLMs created by different regions on controversial topics (such as cultural sensitivity, religion, conflicts, gender, professions, global south, philosophy, bullying, security, etc...) of your choice.

LLMs to include:

- Mistral (Europe)
- ChatGPT, LLAMA (US)
- Deepseek, Kimi (China)
- Jais, Fanar (Gulf)

The Feedback Radar

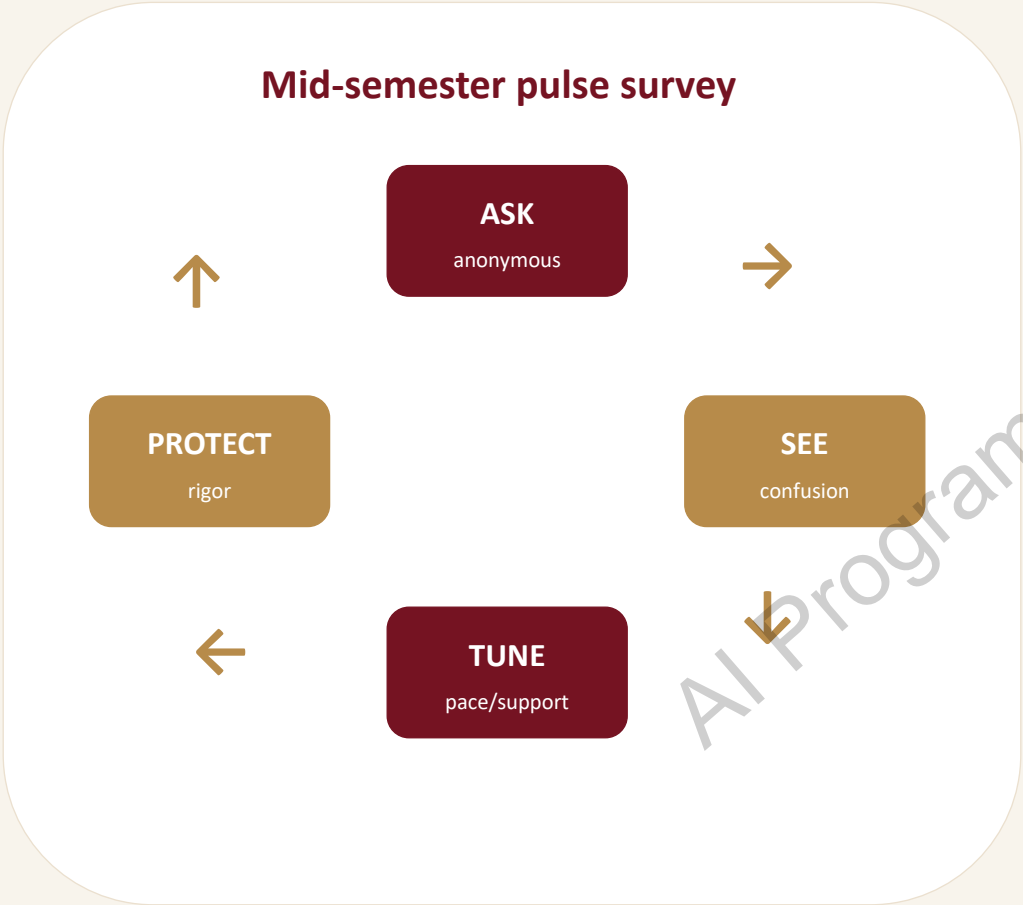
The course learns while students learn.



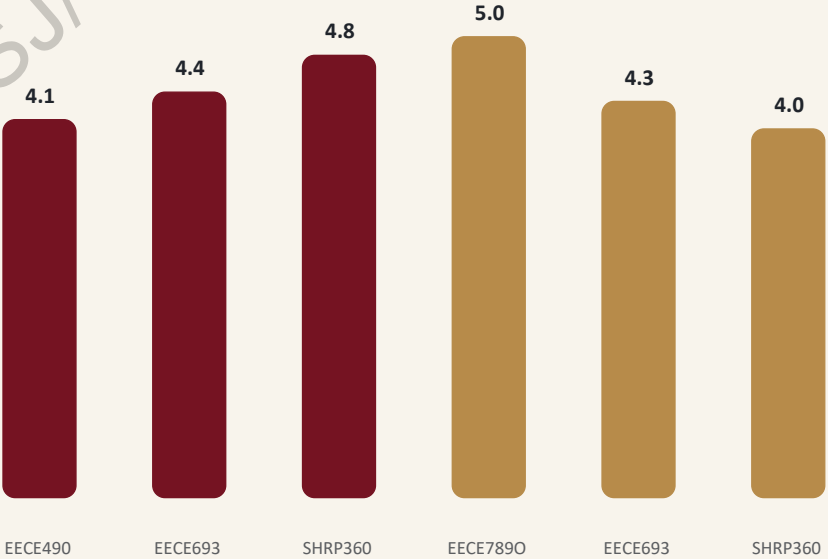
Anonymous Surveys from EECE490/690 and EECE693 for years 2023-2025	
What do you believe the instructor has done especially well so far? 16 responses Course Organization The classes are very interactive and the labs (/assignments) are practical. The course is well paced and flexible, giving us time to prepare & do our best! Class Discussions and hands on sessions The instructor has demonstrated some levels of professionalism with experts while delivering the course at all time. Linking the various topics to actual real-world deep learning applications. You could write: The instructor's enthusiasm when explaining concepts, along with her warm smile, reminds me of my school teacher, making the learning experience more memorable. Adding hands-on sessions after each chapter to complement the theoretical aspect.	What do you believe the instructor has done especially well so far? 12 responses I like how from time to time there's the solving together or the idea of asking someone to explain something the class feels more interactive. I also really find the test your knowledge sections on moodle and the way they affirm whether I understood the material or I need to work more on certain areas Clear explanations and more explanatory materials Great at delivering the message of each topic NA Concepts are made easy to understand. The slides' visuals and content really help a lot, as well as the interactive lectures on moodle. Also, it's good that we have hands-on session. Simplify complex ideas Pace in lessons and labs is good Project organisation
16 responses ...using, well chosen, examples, and stories in challenging situations on learning, this pleasant and effective teaching methods make the material both interesting and accessible. Going through the topics at an extremely manageable pace, giving us students enough time to comfortably revise the material at home and also dedicating lab sessions for practical implementations of said topic. Other than the instructor's excellent knowledge and understanding of the course material. The course project is very well guided with very interesting topics that will for sure increase my interest in this course. Recap all info after watching the interactive lectures I think the instructor has done a great job by introducing new topics instead of repeating what we learned in EECE 490. The course builds on what we already know, and the instructor quickly reviews the old material so we can focus more on learning new and advanced concepts. Dr. Mariette is an amazing professor. She makes the session not the typical lecture-based sessions, more like discussion-based, which makes the course more engaging. She always tries to push our boundaries to think about the implications of what we're working on, and at the same time, how we could dive more into a more mathematical-based approach for research.	13 responses The effort to make the class interactive so it doesn't seem like a dead class. She really cares for us to catch the info well. She is also cool. The instructor showed a lot of knowledge in the material explained. She demonstrated the ideas in a very clear way that made them very understandable. A small note though is that she can be a little bit slower while explaining. Yes The slides are perfect The flow and the way of explaining is very well The instructor "forced" us to understand all the details of all the concepts instead of simply memorizing them. This positively affected the engagement in classes. Other than the instructor excellent understanding and knowledge of the course material, the guidance that is being offered for the project and its importance makes the course more interesting. Also, the project topics provided for us are very interesting and tackle actual world problems.

The Feedback Radar

The course learns while students learn.



Evidence strand: recent ICE scores



Use ICE score with caution: not as the whole story, but as one signal alongside artifacts, reflections, and defenses.

CHATGPT
USER



NON-CHATGPT
USER



AN MIT BRAIN SCAN STUDY FOUND CHATGPT USE LED TO A 47% DROP IN NEURAL ENGAGEMENT, USERS TYPED FASTER, BUT REMEMBERED LESS AND SHOWED WEAKER COGNITIVE PERFORMANCE OVER TIME.

SKILLS FOR AN AI WORLD



CRITICAL THINKING

Evaluating information and arguments, recognizing biases



DIGITAL LITERACY

Using digital tools safely and effectively



DATA LITERACY

Understanding and interpreting data



SOCIAL & EMOTIONAL LEARNING

Empathy, collaboration, and self-awareness



CREATIVITY

Original thinking and problem-solving



ETHICS

Considering the implications of AI on society

Implications for Professional Settings

Strategic Role

Curate responsible AI learning journeys;
position as a hub for AI



Collaboration and Human-AI Partnerships

Promote cross-agency AI co-learning labs



Learning Organizations



Call to Action

Empower professionals to lead with AI

THANK YOU

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AMERICAN
UNIVERSITY
OF BEIRUT

ARTIFICIAL INTELLIGENCE,
DATA SCIENCE,
& COMPUTING HUB



Prof. Mariette Awad

AI-DSC Hub Director| PhD| Certified
Assessor in ethical AI| 2024 Abdul
Hameed Shoman Award for Arab
Researchers | Top 2% Research
Scientist in 2022, 2023| Author of one
of the 5 most downloaded Springer
Nature books 2020