

FUNDAMENTALS OF AI-AUGMENTED ENGINEERING: A CONVERSATIONAL APPROACH

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Problem



Model



Compute



Analyze



Validate



Improve

*The engineering workflow you will use throughout this book
by Taner & Sebnem Onsay,*



CONTENTS OF CHAPTER 1:

PART:

- 1** **Engineering problem solving in the age of AI**
The question that frames the whole course 
- 2** **The AI-augmented engineering workflow — end to end**
One falling ball, all six stages 
- 3** **From model to algorithm to program**
Your first Python — read as engineering, not syntax 
- 4** **AI as tutor & programming coach**
How you'll actually use AI in Weeks 1–2 
- 5** **Break the AI**
Polished, confident, wrong — prove it 

Short break roughly halfway. Discussion and quick activities throughout — this is not a 3-hour monologue.

CHAPTER - 1

PART 1 · ≈ 25 MIN

Engineering Problem Solving in the Age of AI

1

What does an engineer still need to know?

Problem

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Model

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Compute

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Analyze

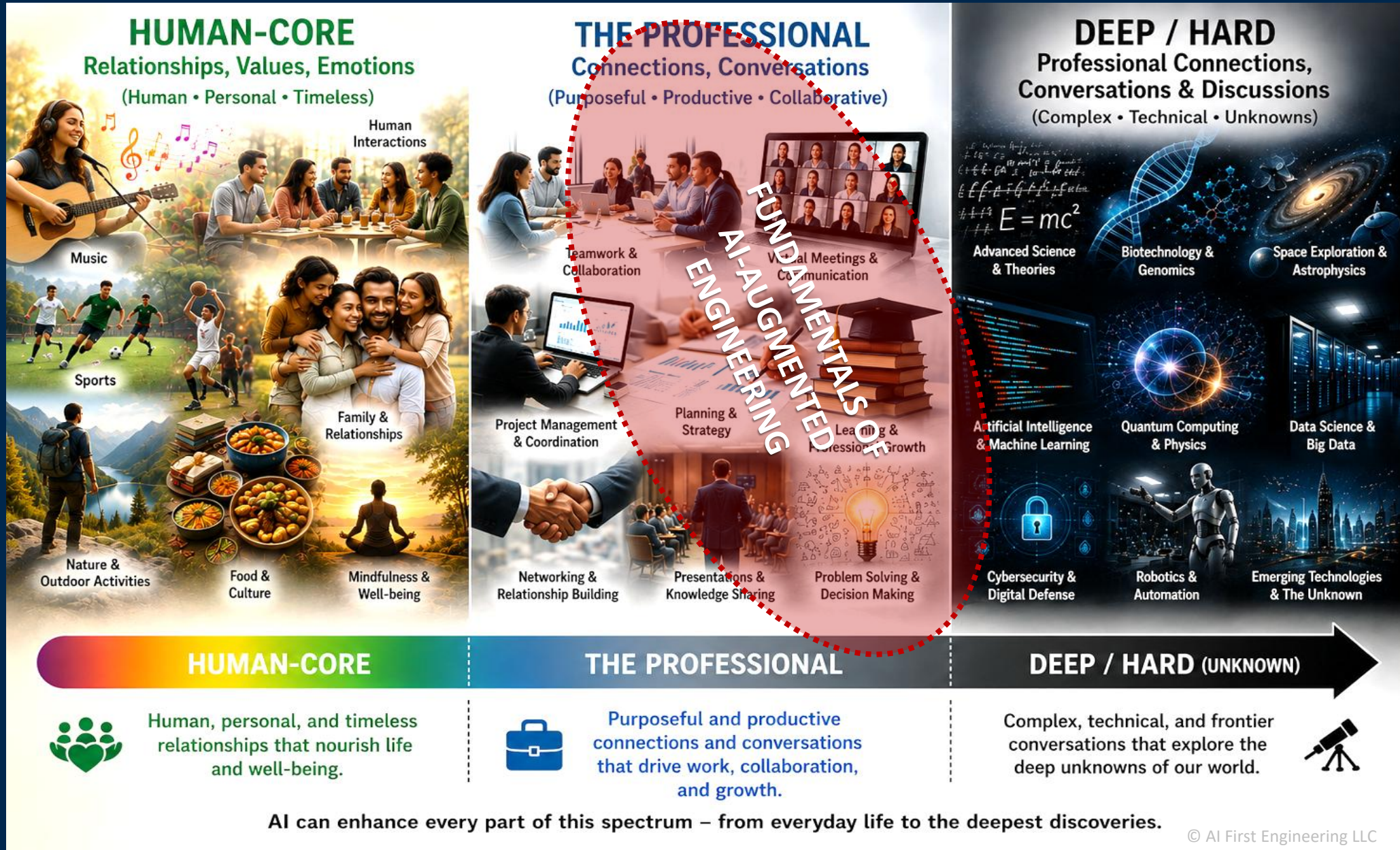
›

Validate

›

Improve

AI's Impact Increases Across the Human-to-Technical Spectrum





DISCUSS

**If AI can write the code and answer
technical questions
what does an engineer
need to know and do?**



Talk to a neighbor quickly for a minute. There is no answer key on the next slide.



Can AI actually do engineering?



Can AI solve engineering problems?



Can AI write correct code?



Can AI select the right equations?



Can AI make good assumptions?

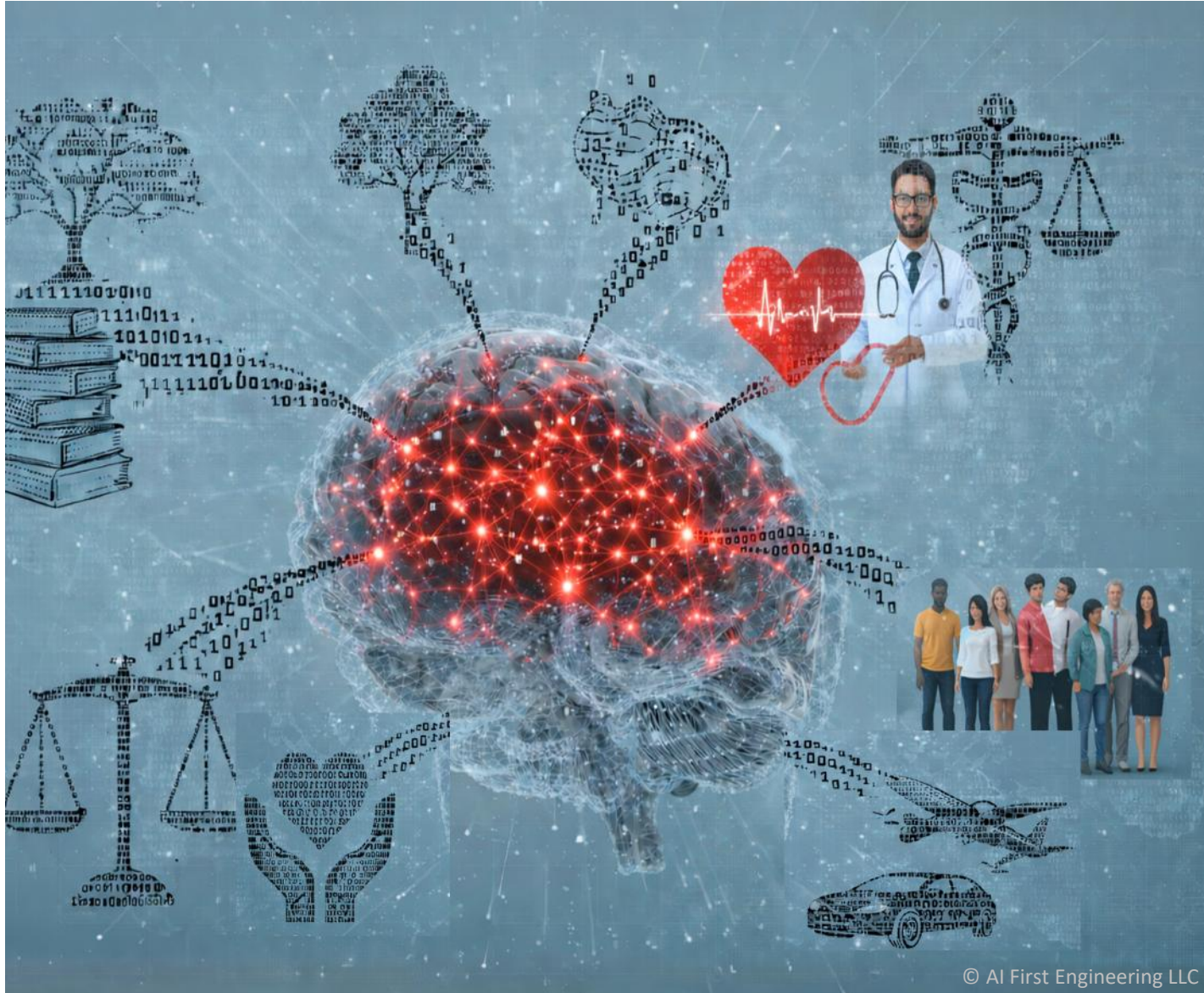


Can AI tell whether its answer makes physical sense?



Who is responsible when the answer is wrong?

Keep your answers. We will test every one of them this semester.



What is AI?

Artificial Intelligence (AI)

- refers to computational systems that can **represent the world, learn from data or experience, and reason to make decisions**, often under uncertainty and often in collaboration with humans.
- AI is **not one tool or one algorithm**. It is a **family of approaches** that support thinking, learning, and decision-making.

The Core AI Triad:

- **Representation** – What the system *knows* about the world
- **Learning** – How that knowledge *changes* with data or experience
- **Reasoning** – How decisions are *made* using that knowledge
- **Action** (control, robotics, deployment) emerges when this triad is embedded in a real system.

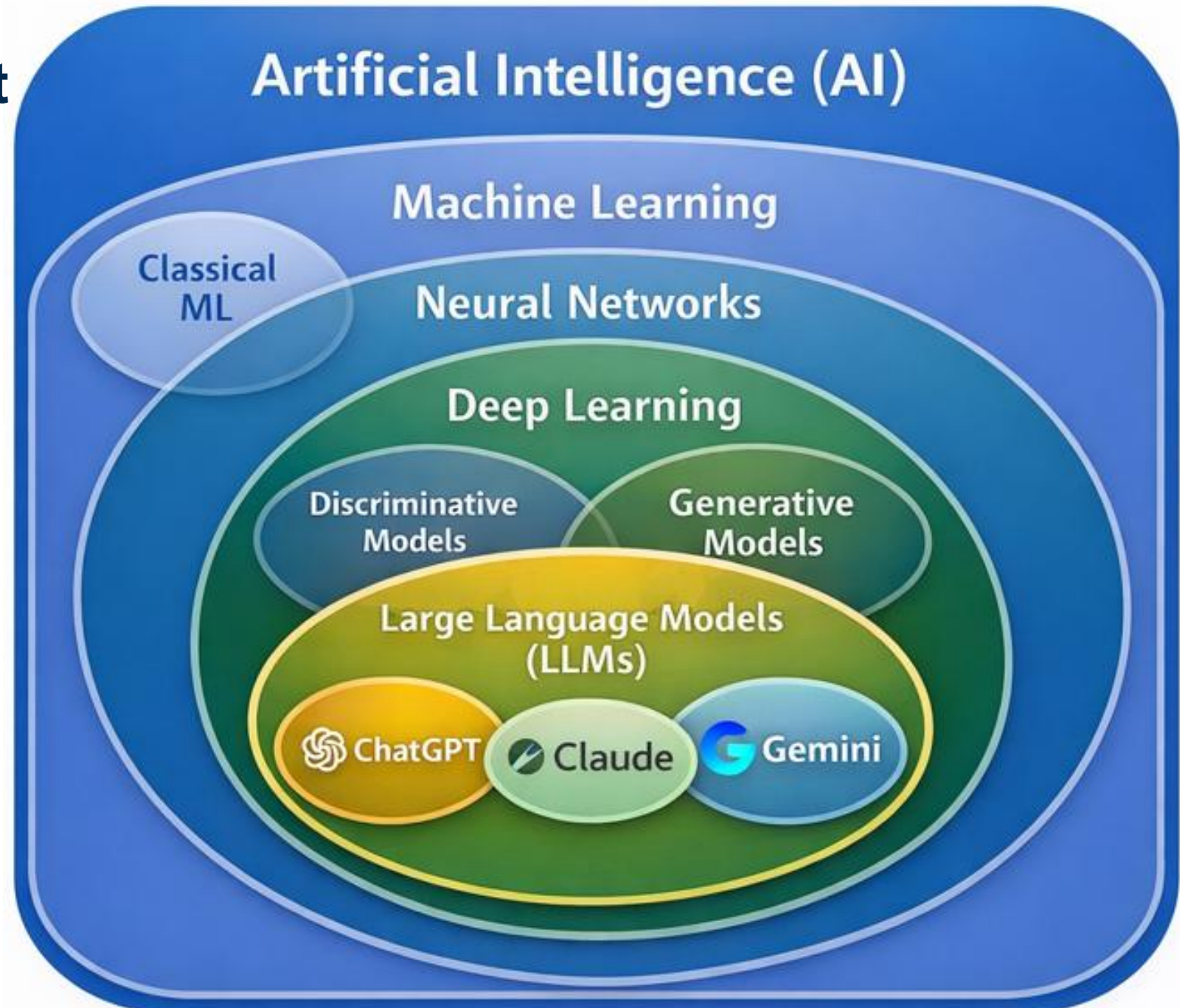
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CLARIFICATION

When we say “AI,” what do we actually mean?

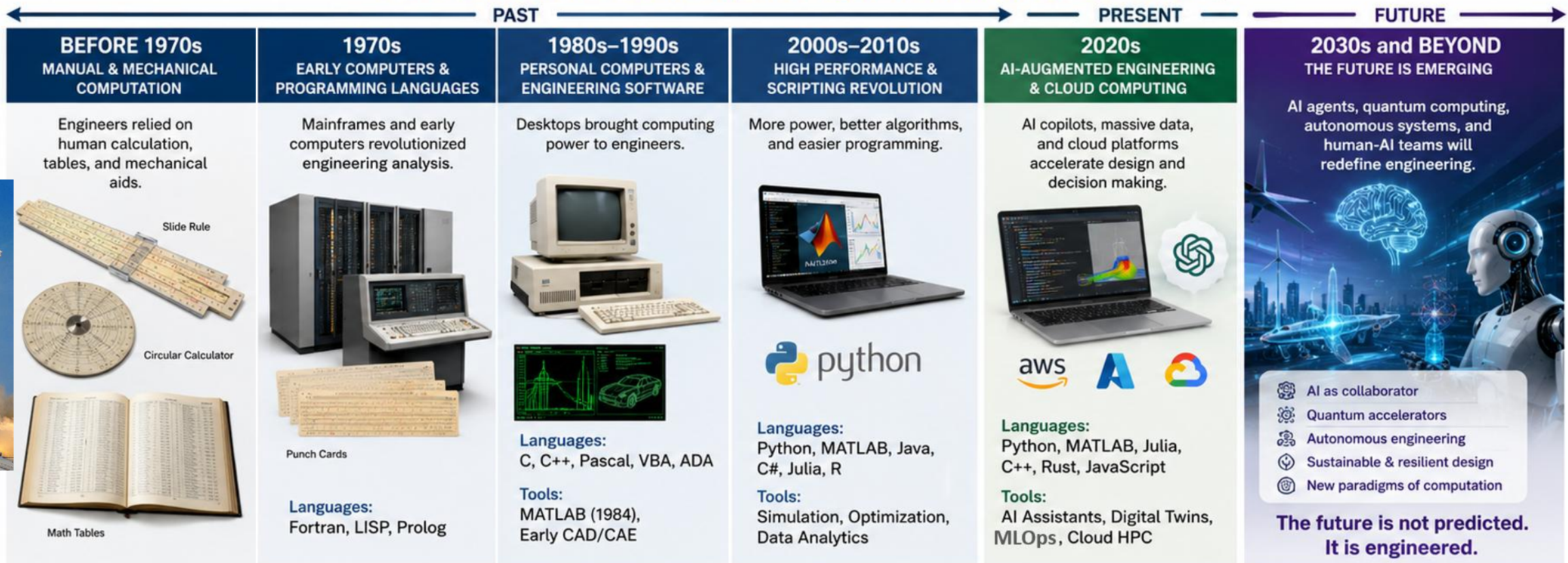
For this course:

ChatGPT, Claude, and Gemini are **AI tools built around large language models (LLMs)**—they are not synonymous with all of **AI**.



The Evolution of Computing & Programming in Engineering

From Slide Rules to AI: Empowering Innovation Across a Century



ENGINEERING IMPACT



Design by experience & theory



Enabled missions like Apollo with pioneering computing



Bridged theory and practical simulation



Complex systems designed and optimized



Data-driven, intelligent, and connected engineering



Human creativity amplified by intelligent machines



The Tools Change.
The Mission Stays.

The goal of engineering is constant:
Understand. Predict. Design. Improve. Make a Better Future.

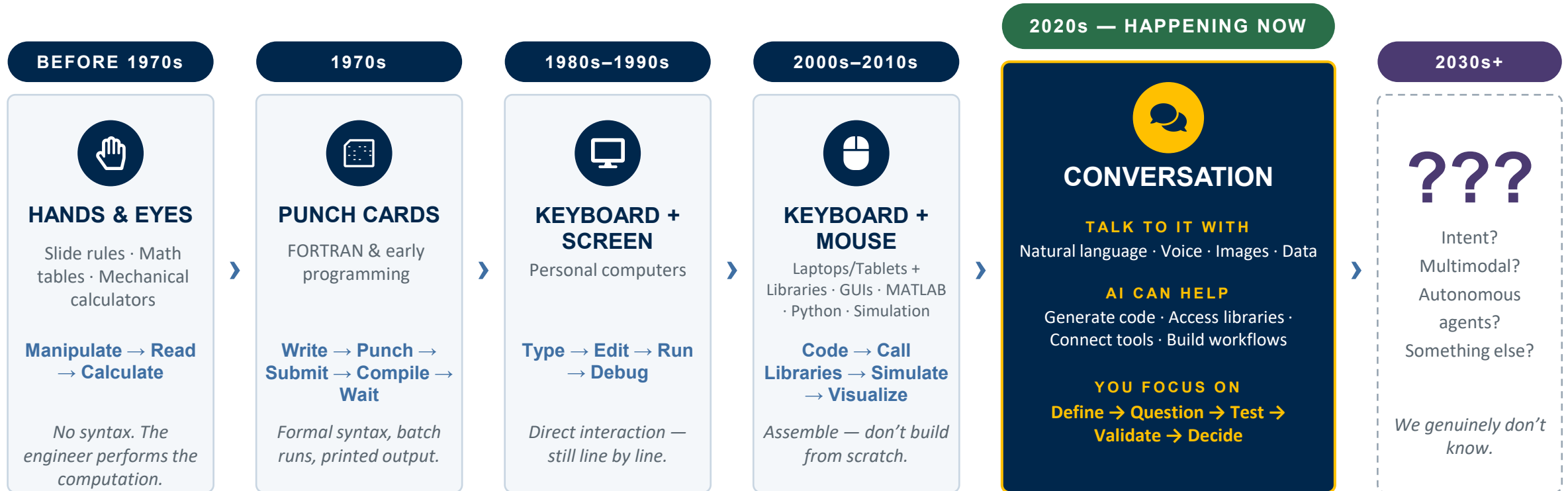


This course prepares you for what comes next.

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How Engineers Communicate with Computers Has Changed

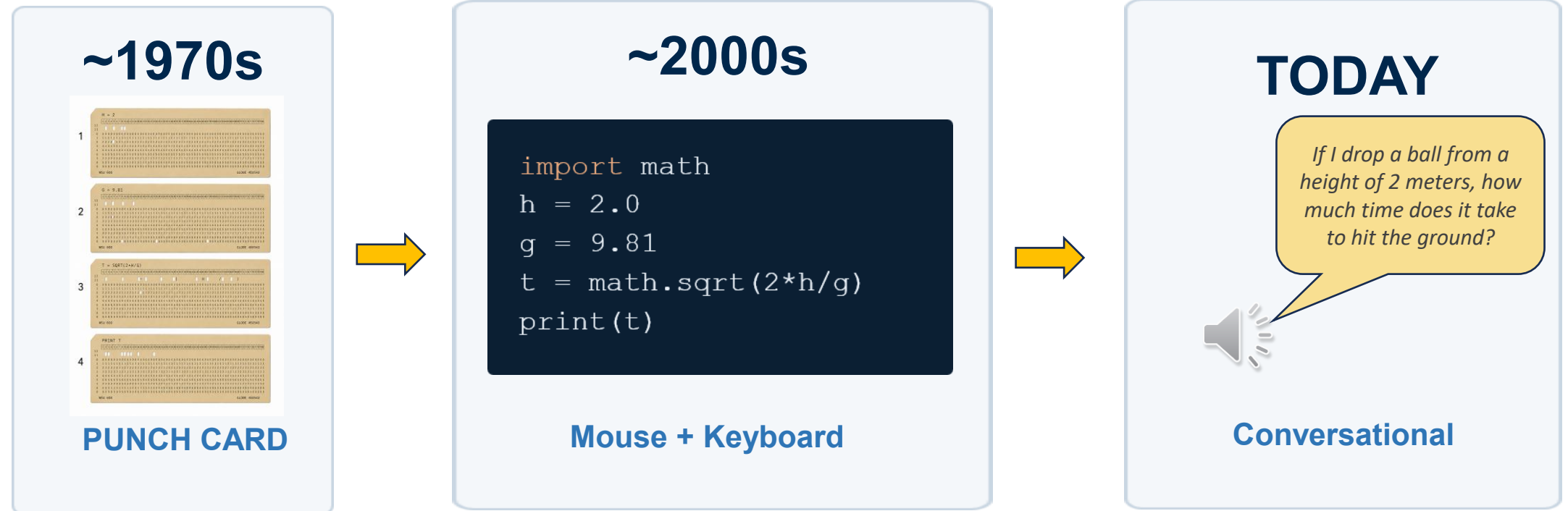


Manual Computation → Writing Syntax → Using Libraries → Expressing Engineering Intent

As implementation becomes easier, engineering judgment becomes more important.



The Same Engineering Task — Three Ways to Communicate with a Computer



Punching Instructions → Writing Code → Using Libraries → Expressing Engineering Intent

As implementation becomes easier, engineering judgment becomes more important.



The Engineer's Role Has Moved Upward

ERA	HOW WE INTERACT WITH COMPUTATION	ENGINEER'S PRIMARY FOCUS
 MANUAL	Hands, slide rules, math tables	Compute & Interpret
 PUNCH CARDS	Formal syntax + batch processing	Program & Debug
 DESKTOP	Keyboard + screen, line by line	Code & Analyze
 MODERN	Code + GUI + libraries	Model & Simulate
 AI-AUGMENTED	Natural language + multimodal conversation	Define, Validate & Decide
 FUTURE	?	Engineering Judgment

COMPUTATION → PROGRAMMING → MODELING → ENGINEERING JUDGMENT

The tools keep changing. The engineer moves closer to the problem — and farther from the mechanics of implementation.

So what should we teach engineers today?

by Taner & Sebnem Onsay,



This is not a Programming Syntax course

⊗ This course **IS NOT**

- Memorizing Python syntax for its own sake
- Three disconnected software-training modules (Excel, Python, MATLAB)
- A course where AI is banned — or blindly trusted
- Becoming a software developer in 14 weeks

✓ This course **IS**

- Understanding fundamental numerical methods and implementing them efficiently
- Applying numerical methods to solve real engineering problems
- One workflow: the problem first, the tool second
- Using AI actively and purposefully — as tutor, coach, and eventually engineering partner
- Learning to question, test, validate, and improve every result

Problem



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HOW YOU'LL BE EVALUATED

You will not be evaluated on whether AI helped you.

You will be evaluated on whether you can explain, test, validate, and defend the work.

AI assistance is normal and encouraged where permitted. Understanding is the deliverable.



Three threads, woven together all semester



Engineering & Mathematics

Problem formulation · physical models · numerical methods · experimental data · simulation · visualization · validation · optimization · decisions



Computational Tools

Excel/VBA · Python · MATLAB — introduced as tools for the problem at hand, never as ends in themselves. Supported setup: Python + VS Code + Jupyter.



AI-Augmented Engineering

AI works alongside you every week. Right now: personal tutor and programming coach. By Week 14: an agentic engineering assistant — with you in charge.

The engineering problem comes first. The computational tool helps us solve it.