Crafting Tech

(Engineering AI Systems)

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NOKIA Bell Labs

Inventing the Future X Network

1925

Creation of Bell Labs
The engineering departments of the American Telephone and Telegraph Company (AT&T) and Western Electric were consolidated into Bell Telephone Laboratories. Their mission was to research and design communication technologies for the rapidly expanding telephone network and to explore fundamental areas of science that could shape the future of the industry. Over the years, many cornerstone technologies of modern society have been invented at Bell Labs and 8 Nobel Prizes have been awarded to its researchers

1930's

1937 NOBEL PRIZE
Electron Diffraction
Demonstrating wave nature of matter

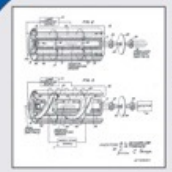
1940's

1948
"A Mathematical Theory of Communications"
By showing that all communications channels – of any type – have a fundamental capacity limit, Claude E Shannon founded the field of information theory

1950's

1954
Solar cells

1956 NOBEL PRIZE
Transistor
To replace the vacuum tube, Bardeen, Brattain and Shockley created a working point-contact transistor. This basic building block for all digital products is the foundation for our information society



1958
LASER
In their 1958 paper, Schawlow and his brother-in-law Townes described in detail a proof of concept for the LASER. The laser enables a wide variety of applications: fiber-optic communications, digital storage, barcode scanners, precision surgery and industrial cutting tools

1960's

1962
Telstar
Transatlantic live TV broadcast via satellite

1970's

1973
UNIX and C Language
Thompson and Ritchie's elegant design made it an immediate hit with the programming community when it was released in 1974. UNIX would later on become the Internet's foundation

1976
Fiber Optic Network
First demonstration of 45 Mbit/s transmission

1977 NOBEL PRIZE
Electronic Structure of Magnets and Glasses

1978
Commercial Cellular Network
Invention of the cellular concept and creation of the first commercial network

1978 NOBEL PRIZE
Cosmic Microwave Background Radiation
Pioneering work on radio communications using the Holmdel Horn Antenna provides support for the Big Bang Theory

1980's

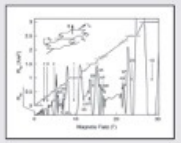
1980
Demonstration of DSP
Large-scale integrated circuit for digital signal processing

1995
Commercial DWDM
Pioneering work on wavelength multiplexing in optical fibers

1990's

1995
Integrated ADSL Chip
After co-inventing ADSL technology, follow-up innovations like vectoring continued to generate world records for high speed data transfer over copper telephone lines, fueling the Internet

1998
Wireless MIMO Spatial Multiplexing
Invention of wireless transmission based on multiple spatial paths



1998 NOBEL PRIZE
Fractional Quantum Hall Effect
Discovery of a novel collective quantum fluid state of matter

1997 NOBEL PRIZE
Laser-Based Cooling and Trapping of Atoms
To understand the fundamental limits of materials and matter

2000's

2006
Software Defined Routing
Predecessor of Software Defined Networks (SDN)

2009 NOBEL PRIZE
CCD
Boyle and Smith's picture phone research realized the enormous potential of the Charge Coupled Device as an imaging device, leading to the invention of the digital photo, video cameras, scanners, satellite surveillance and ultra-sensitive astronomical telescopes

2009
Coherent 100G Optics
Invention of the future of high speed optical communications with coherent processing

2009
World's first standard compliant LTE call

2010's

2011
lightRadio Cube
First demonstration of building block of future small cell wireless networks

2014 NOBEL PRIZE
Fluorescence Microscopy
Ground-breaking work on sub-wavelength optical microscopy leads to super-resolution microscopy at cellular level

2014
XG-FAST
First demonstration of 10 Gbps over copper telephone wires

2015
GreenTouch
International consortium delivers new technologies to improve energy efficiency in wireless networks by more than 10,000X

2015
Optical MIMO-SDM
Pioneering work on utilizing the spatial dimension in fiber, showing greater than 10X increase in optical network capacity

2015
The Future X Network: A Nokia Bell Labs Perspective
First Nokia Bell Labs book written

2016
5G Massive Connectivity
First demonstration of 1M simultaneous, ultra-low latency connections in a single cell for 5G and IoT

The Future

Nokia Bell Labs continues to solve the great industry challenges, producing disruptive innovations for the next phase of human existence

N

Round up

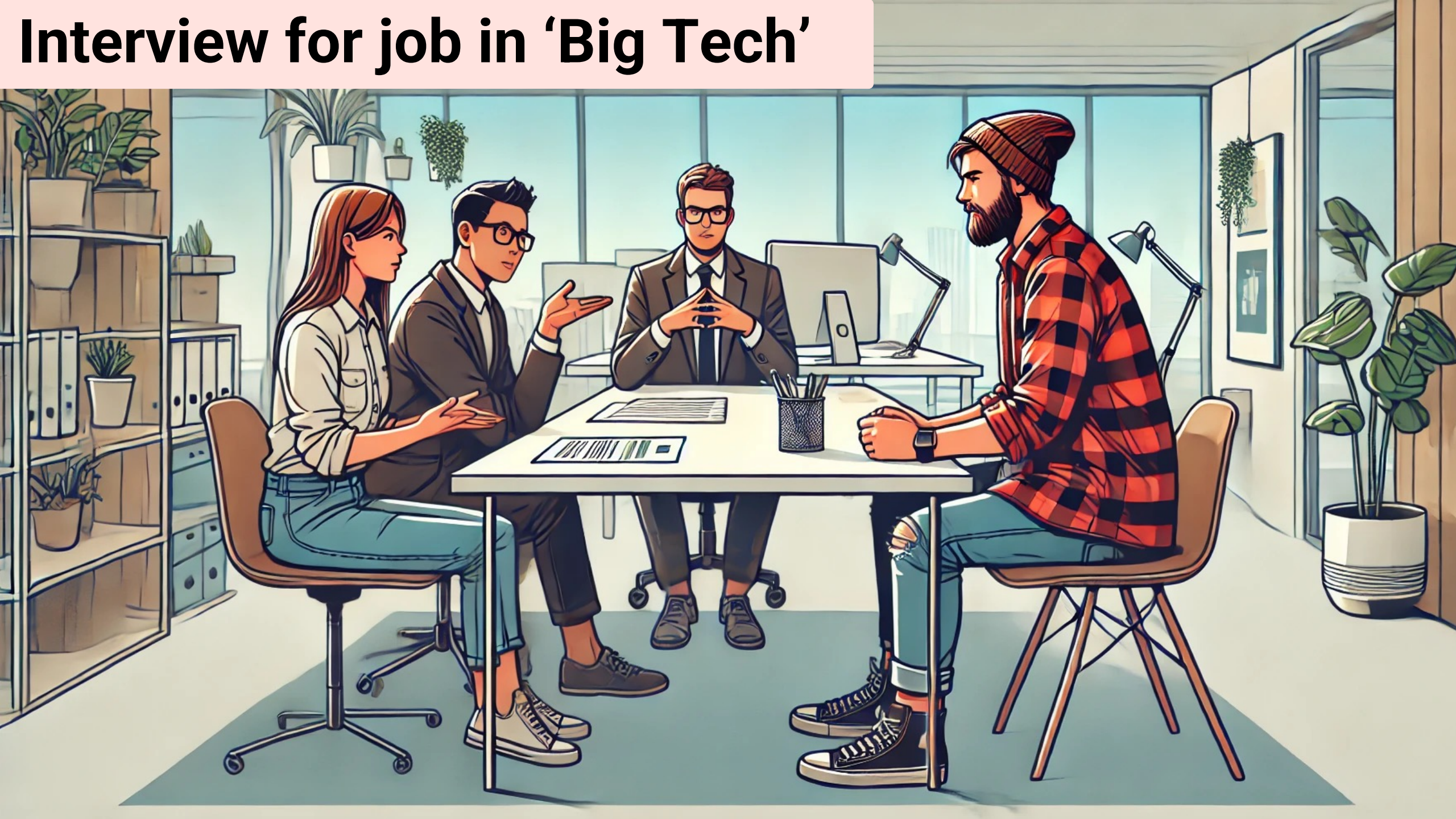
name, past programming,
likes/dislikes

Crafting Tech

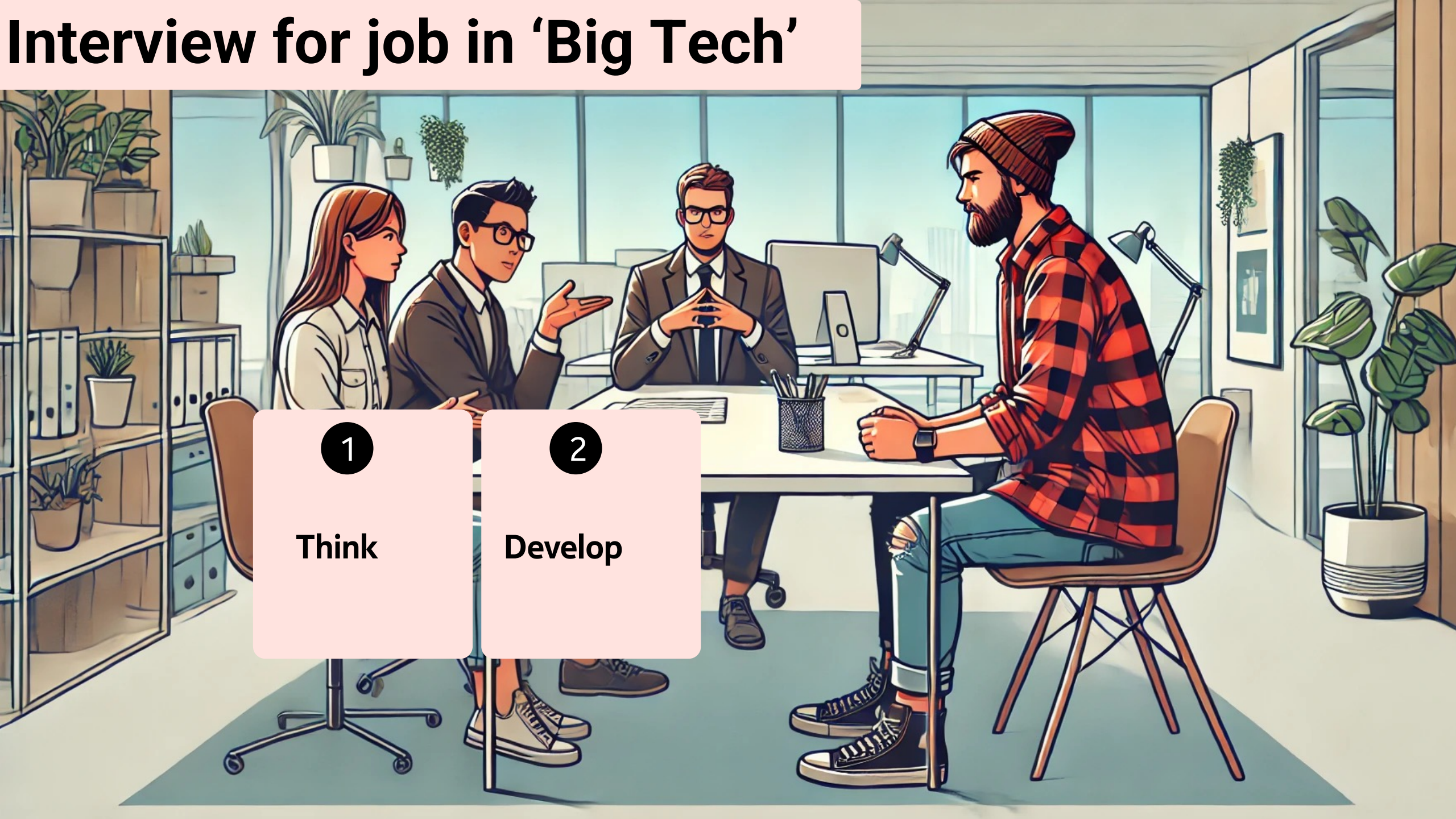
(Engineering AI Systems)

Daniele Quercia

Interview for job in ‘Big Tech’



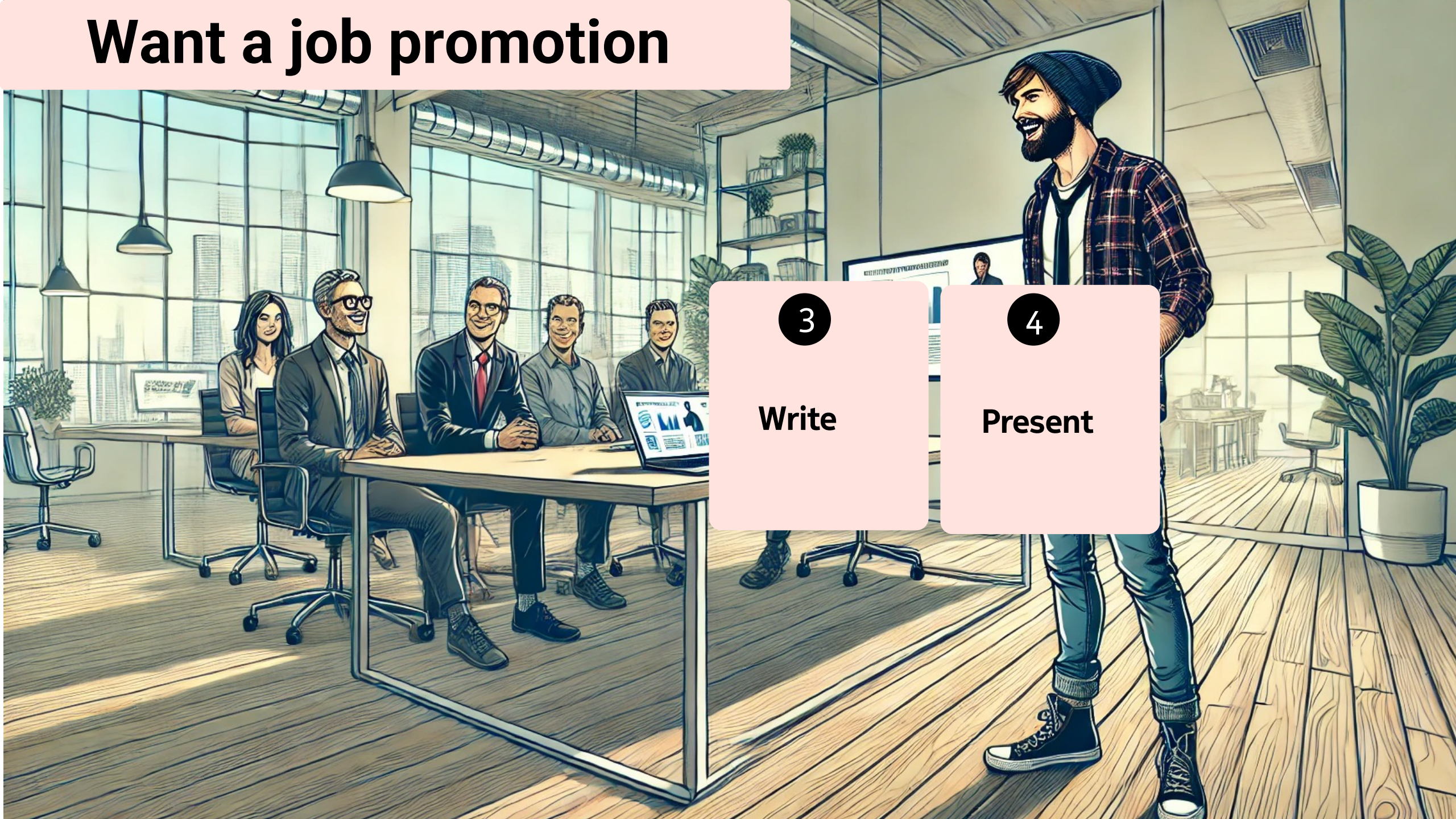
Interview for job in ‘Big Tech’



1. Think
2. Develop

Want a job promotion

Want a job promotion



Paint points

1. Think
2. Develop
3. Write
4. Present

Crafting Tech

(Emerging Topics in AI)

Daniele Quercia

Course

1. How to **present**
2. 20% **Present** Emerging Topics in AI
3. **Think** about a solution
4. **Write** initial solution
5. **Test solution**
   1. Technical
   2. Business
   3. Ethics
6. **Develop & write-up** the solution

Hot Topics in AI

Output

70% **Final Report**

10% **Short video pitch**

Course

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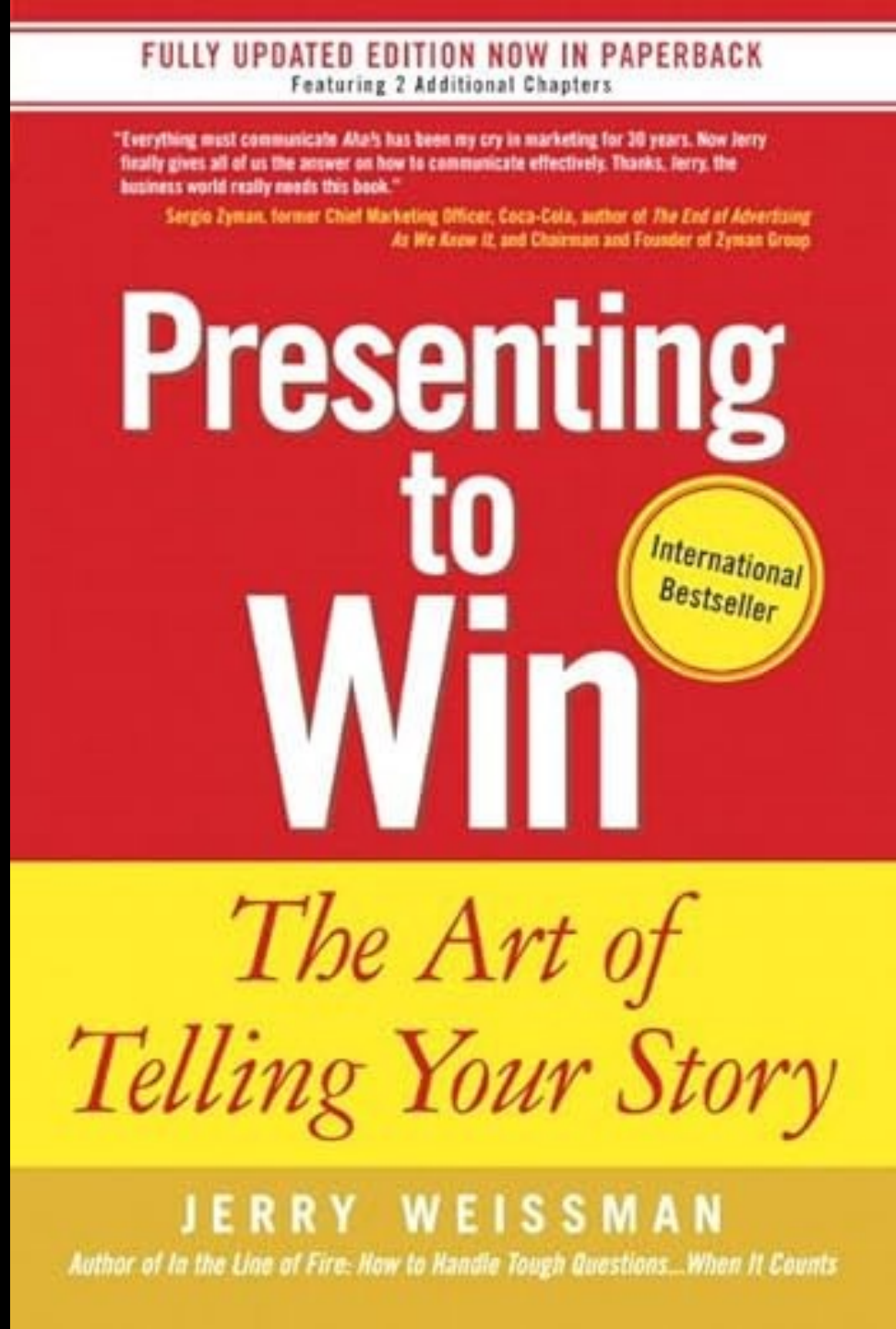
SKILLS

Impactful presentation	Practice presenting Emerging topics in AI	Creative Thinking	Technical Writing	Scientific, business, and ethical assessments	Doing the work

1

How to **present**

. CEOs, Executives
. Highly Adaptable
. Delivering powerful presentations

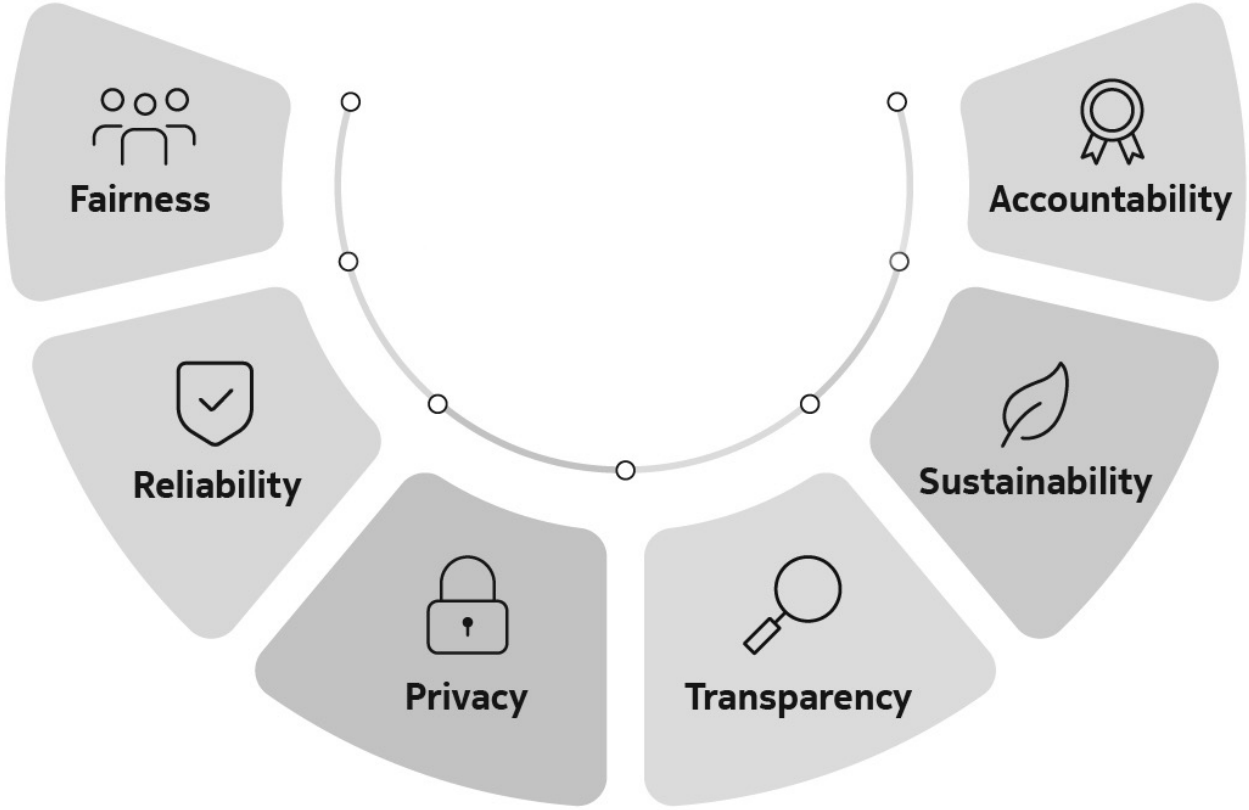


2

Present
Emerging Topics in AI

Hot Topics in AI

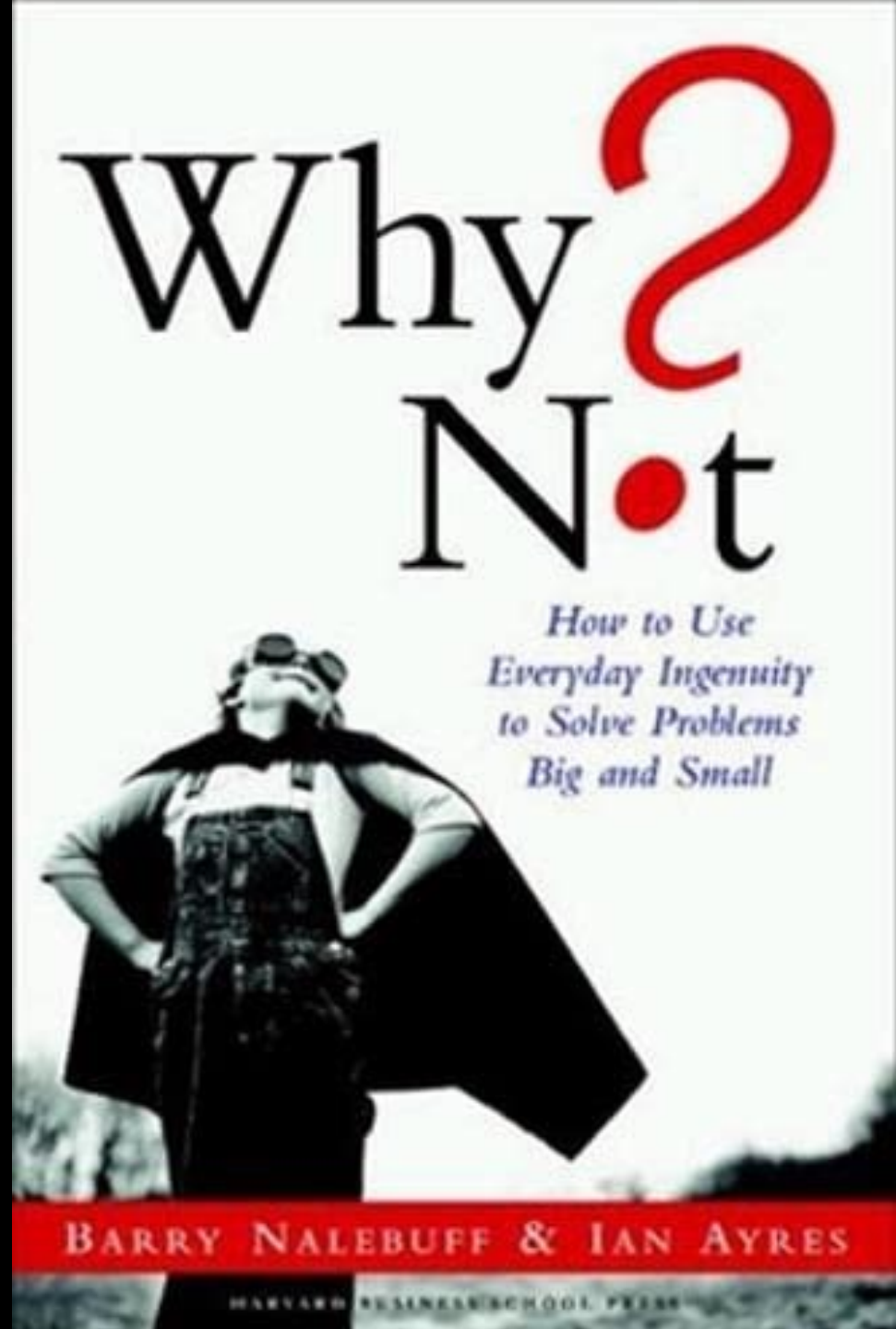
Six Responsible AI Pillars



3

Think about a solution

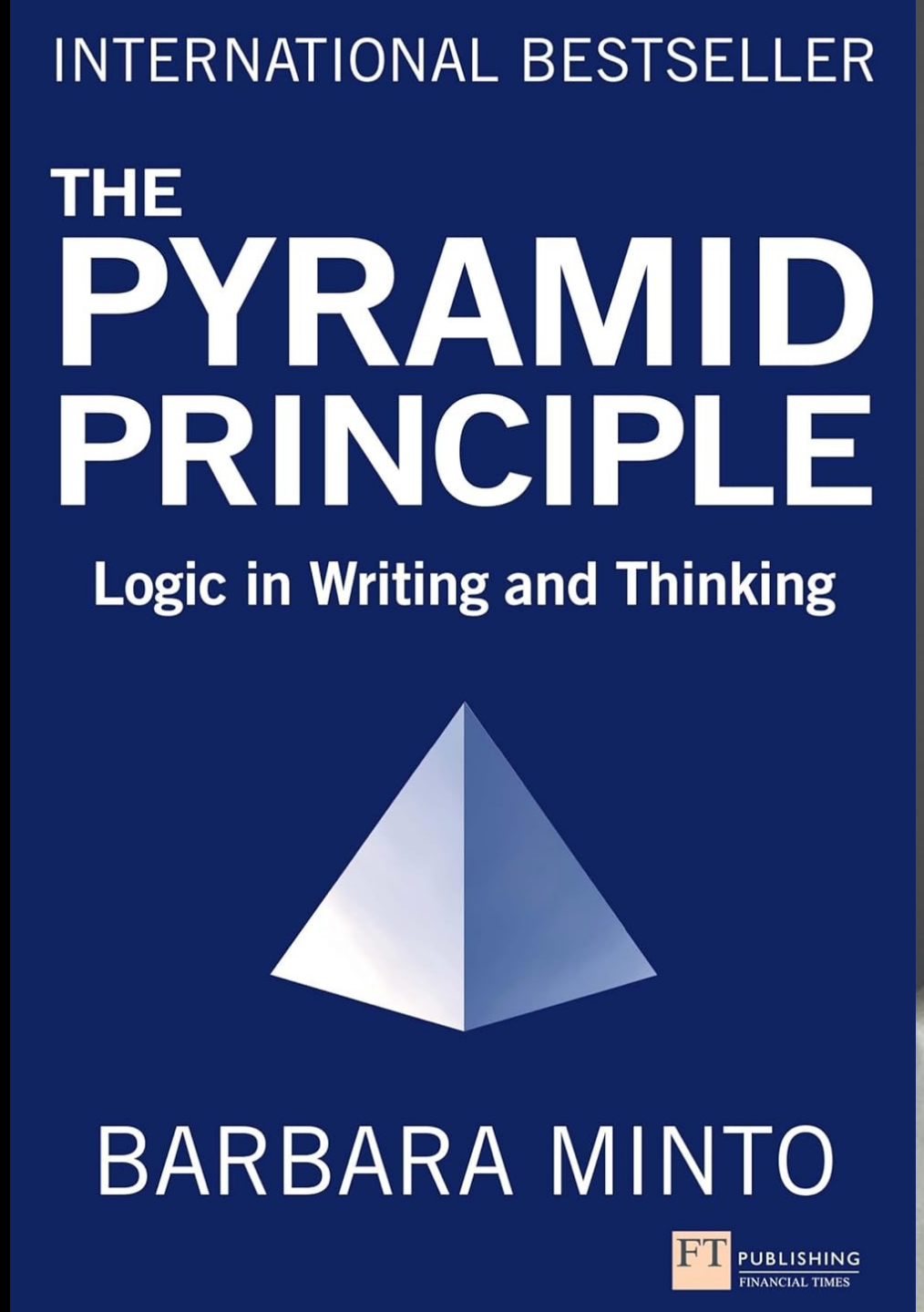
. By two Yale professors
. Roadmap to think about problems



4

Write
initial
solution

. Harvard
Business School
. McKinsey



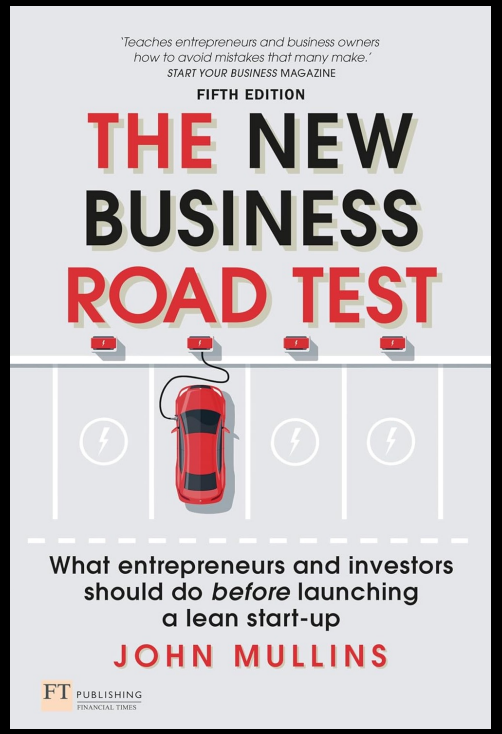
5

Test solution

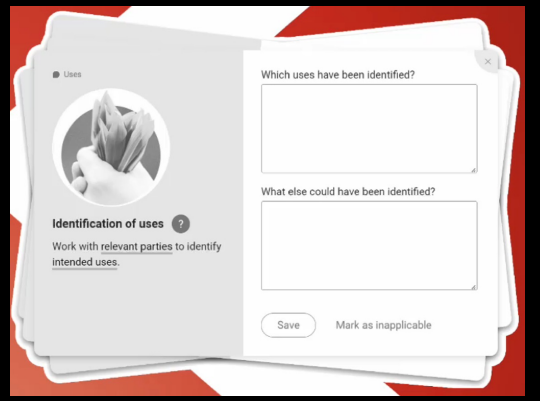
1. Technical
2. Business
3. Ethics

Technical

Business



Ethics



6

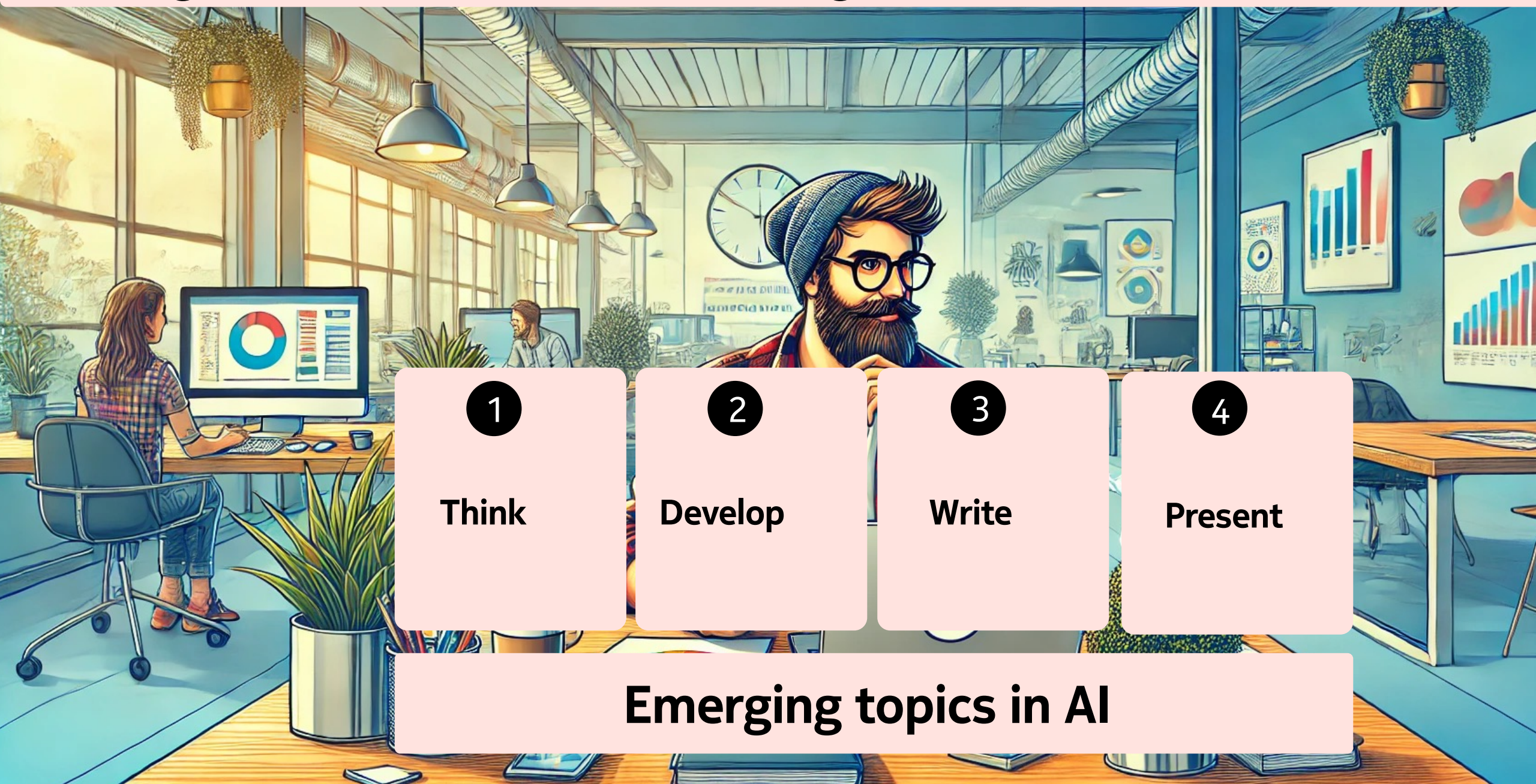
Develop & write-up the solution

~ half of the course

Paint points

1. Think
2. Develop
3. Write
4. Present

Being successful and having fun in tech



1. Think
2. Develop
3. Write
4. Present

Emerging topics in AI

When?

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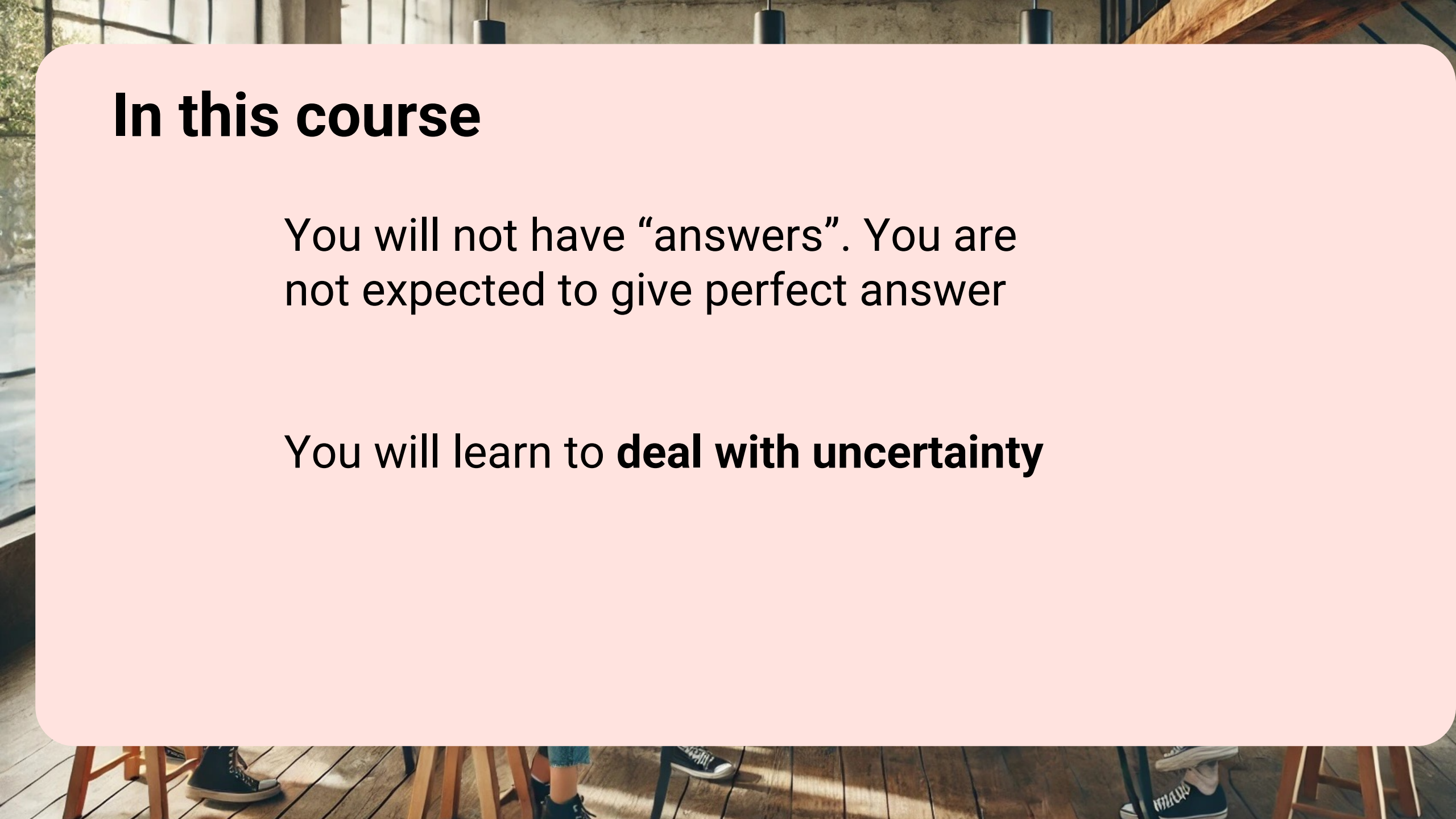

In this course

You will not have “answers”. You are not expected to give perfect answer

You will learn to **deal with uncertainty**

Course Material

*researchswinger.org/**teaching_crafting_tech.html***

teaching

Lecture series on **Crafting Tech** at the Department of Computer Engineering at PoliTO.

timetable!

Timetable

Material
[live tentative timetable]

<projects>

List of Project Proposals

Material
[projects]

P: [first word in the title]

TIMETABLE

Date	Day	Hours	Topic
February 23	Monday	1.5	Course Intro
Febrary 27	Friday		Deadline for Team Formation and Project Preferences
Febrary 23-27	Friday		Reading: Presenting to Win (Chapters 1,2,3,4,5 in this (old) edition)
February 27	Friday	3.0	How to Present Your AI Idea

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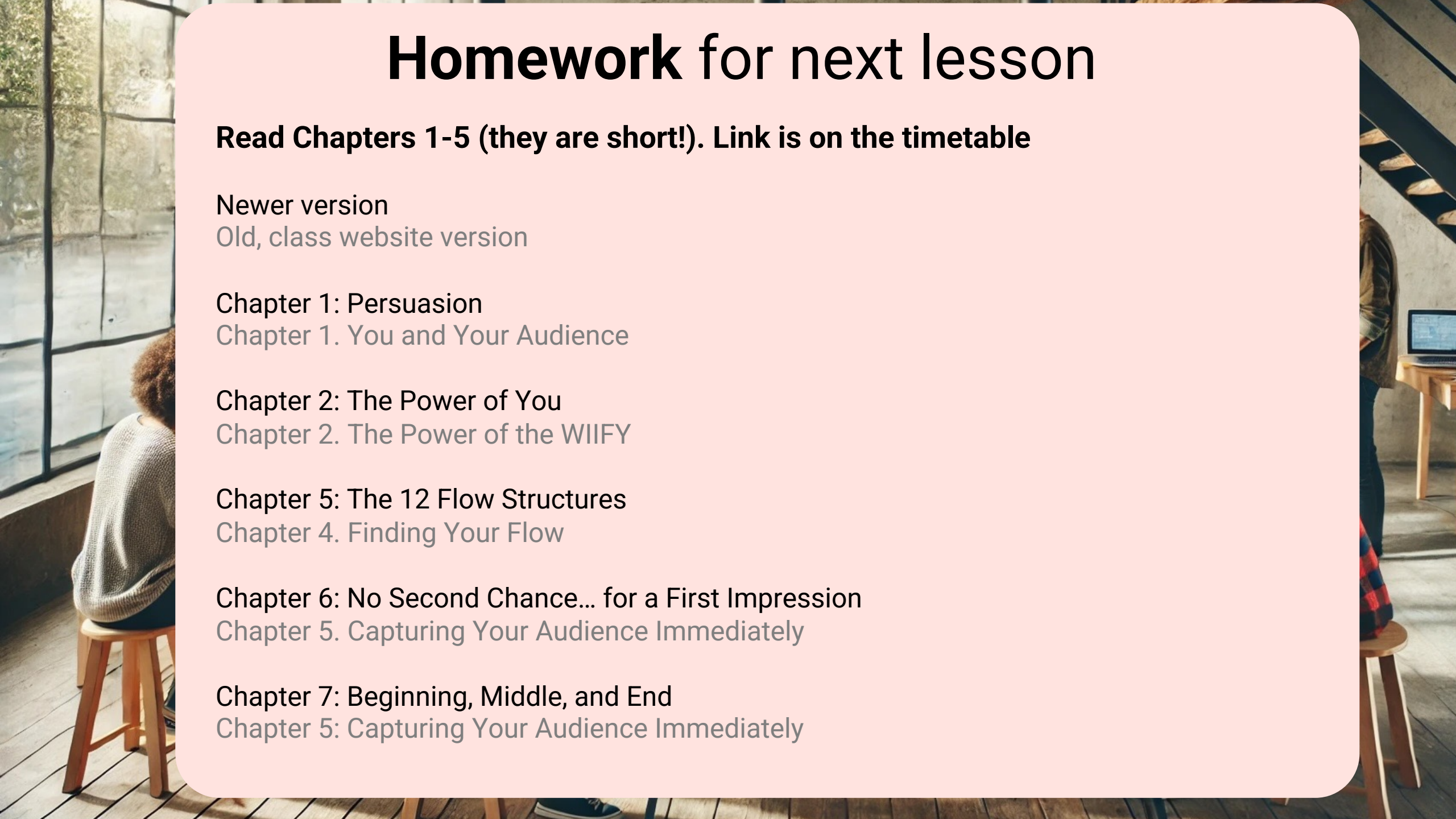
February 27	Friday	3.0	How to Present Your AI Idea
March 2	Monday	1.5	How to Present Your AI Idea
March 2-6			**Reading: Pyramid Principle**
March 6	Friday	3.0	How to Write
March 9	Monday	1.5	How to Write
March 9-27			**Working in team to propose an initial solutions**
March 13	Friday	3.0	Pyramids by Teams 1 and 2
March 16	Monday	1.5	Pyramids by Team 3
March 20	Friday	3.0	Pyramids by Teams 4 and 5
March 23	Monday	1.5	Pyramids by Team 6 / Project Planning
March 27-April 10			**Presenting their initial solutions with preliminary results**
March 27	Friday	3.0	Presentation by Teams 1 and 2
March 30	Monday	1.5	Presentation by Team 3
April 3	Friday		[Easter break]



Homework for next lesson

Read Chapters 1-5 (they are short!). Link is on the timetable

Newer version
Old, class website version

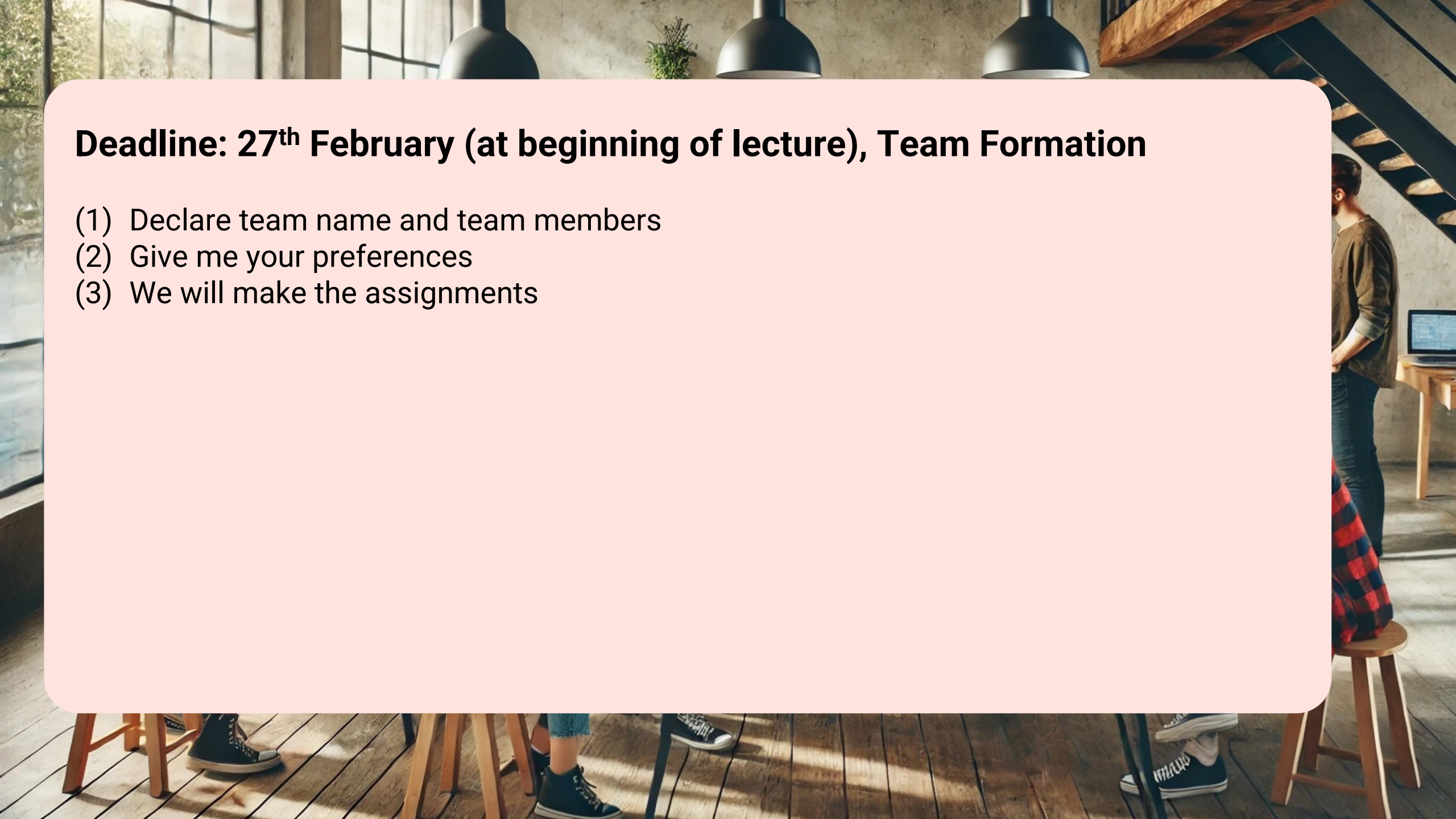
Chapter 1: Persuasion
Chapter 1. You and Your Audience

Chapter 2: The Power of You
Chapter 2. The Power of the WIIFY

Chapter 5: The 12 Flow Structures
Chapter 4. Finding Your Flow

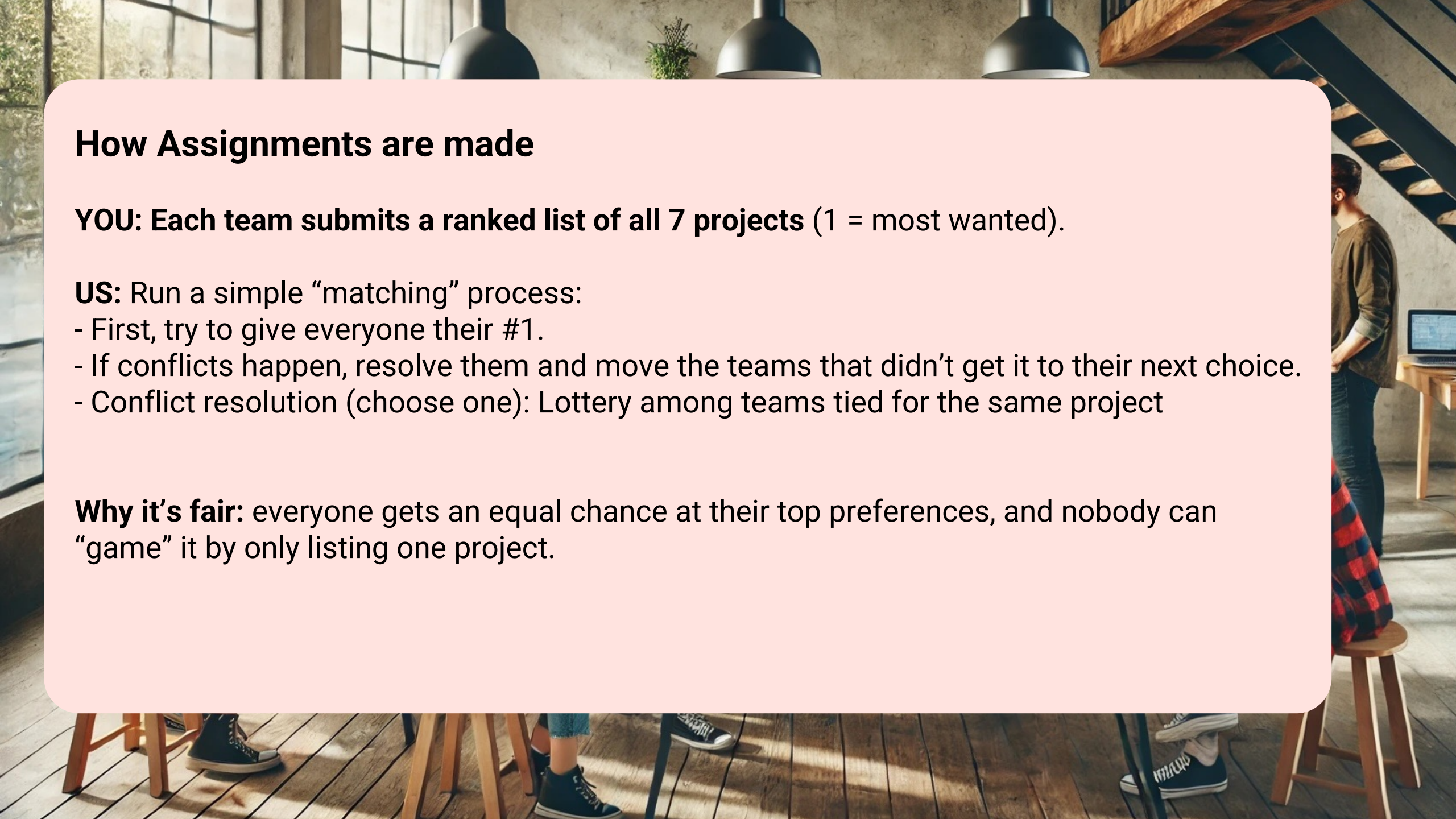
Chapter 6: No Second Chance… for a First Impression
Chapter 5. Capturing Your Audience Immediately

Chapter 7: Beginning, Middle, and End
Chapter 5: Capturing Your Audience Immediately



Deadline: 27th February (at beginning of lecture), Team Formation

(1) Declare team name and team members
(2) Give me your preferences
(3) We will make the assignments



How Assignments are made

YOU: Each team submits a ranked list of all 7 projects (1 = most wanted).

US: Run a simple “matching” process:
- First, try to give everyone their #1.
- If conflicts happen, resolve them and move the teams that didn’t get it to their next choice.
- Conflict resolution (choose one): Lottery among teams tied for the same project

Why it’s fair: everyone gets an equal chance at their top preferences, and nobody can “game” it by only listing one project.

Project Proposals

Project #1

Intersectional Harms in Workplace Incidents

Harms from AI used in workplaces can be worse for people with intersecting identities, such as young women and lower-income people of color.

Prior work has not closely studied how intersecting identities within one person shape the causes and effects of workplace AI incidents.

We address this gap by:

- collecting workplace AI incident reports;
- coding how intersecting identity factors relate to each incident's context, mechanism, and harm, following the procedure in [1]; and
- releasing a dataset and analysis code so others can reproduce our results.
- References

[1] Why AI Harms Can't Be Fixed One Identity at a Time: What 5,300 Incident Reports Reveal About Intersectionality.

Project #2

Identifying AI Risks for Non-Human Life in Urban Spaces

AI systems used in streets, parks, and other urban spaces can change how non-human life moves, feeds, reproduces, and survives in cities. Yet existing work does not provide a clear, systematic map of AI-related harms across the full range of non-human life in urban environments.

We contribute the following:

- Compile a structured list of concrete AI uses in urban spaces.
- Develop a categorization of non-human life in urban spaces.
- Design a method that uses an LLM to elicit risks by asking it to reason from the perspective of a selected non-human being (for example, a cat) for a given AI use.
- Release a dataset and analysis code so others can reproduce our results.
- References

[1] Why AI Harms Can't Be Fixed One Identity at a Time: What 5,300 Incident Reports Reveal About Intersectionality

Project #3

From Chats to Work: Which Roles ChatGPT Plays at Work

To study how artificial intelligence may reshape work, Anthropic mapped Claude queries to occupational tasks to estimate which tasks are most exposed to automation by LLMs. It is not clear whether the same patterns hold for ChatGPT.

We test this by mapping millions of publicly available ChatGPT interaction logs [1] to tasks and skills in the Occupational Information Network (O*NET), including detailed work activities (DWAs). We:

- map ChatGPT interactions to O*NET tasks and DWAs;
- map the same interactions to the roles a chatbot can take (for example, friend, colleague, or trainer), using the role set in [2];
- evaluate both mappings with a human-in-the-loop protocol, with a focus on separating plausible automation targets from spurious matches; and
- release a dataset and analysis code so others can reproduce our results.

[1] WildChat Dataset
[2] Frictionless Love: Associations Between AI Companion Roles and Behavioral Addiction

Project #4

Identifying AI Models Causing Incidents

Mapping the AI models behind incidents in the AI Incident Database matters because it enables systematic, reproducible analysis of harms at the model level, including trend tracking, failure-mode clustering, and accountability.

Prior work has struggled to map models to incidents because incident sources often omit model details or describe them in vague terms, products change their back-end models over time, and multi-model pipelines make attribution uncertain.

We propose a partial mapping of models to incidents where the evidence supports it. We will:

- compile a model list from public model cards and related documentation, following [1];
- extract which models are explicitly mentioned in incident descriptions and sources, and infer likely candidates when the text supports it;
- assess whether a model plausibly contributed to each incident using the methodology in [2], and record an attribution confidence level;
- evaluate the mappings with a human-in-the-loop protocol, with a focus on separating well-supported model attributions from spurious matches; and
- release a dataset and analysis code so others can reproduce our results.

[1] The AI Model Risk Catalog: What Developers and Researchers Miss About Real-World AI Harms
[2] The Quiet Path from Seemingly Minor Design Errors to Workplace AI Incidents

Project #5

Mapping AGI Risks in the Workplace

Mapping the risks of artificial general intelligence (AGI) in the workplace matters because AGI systems could change how work is assigned, checked, and controlled.

Prior work proposes a method for mapping risks from workplace AI agents, but it does not cover AGI systems [1].

We will map workplace risks of AGI by:

- Defining workplace AGI. Review the AGI literature (well beyond [3,4,5,6]) and define the main components of workplace AGI, using a multi-layer framework like Figure 1A in [1]. This includes cases where an AGI hires humans to do tasks on its behalf [2].
- Generating and testing scenarios. Build and use a large language model (LLM) pipeline to generate and validate workplace-grounded AGI risk scenarios, similar to Figure 1B in [1].
- Releasing a dataset and analysis code so others can reproduce our results.

[1] Unaccountable Delegation, Fading Skills: Mapping the Risks of Workplace AI Agents
[2] https://www.wired.com/story/ai-agent-rentahuman-bots-hire-humans/
[3] https://arxiv.org/pdf/2309.10371
[4] https://sciendo.com/2/v2/download/article/10.2478/jagi-2014-0001.pdf
[5] https://arxiv.org/abs/2501.03151
[6] https://ieeexplore.ieee.org/abstract/document/11096544

Project #6

Mapping Systemic Risks of Workplace AI Agents

Mapping second-order (systemic) risks of workplace AI agents matters because these risks could cause catastrophic harms to the economy.

Prior work maps first-order risks from workplace AI agents [1], but it does not map the second-order (systemic) risks that follow from those first-order risks [1].

We will map second-order (systemic) risks of workplace AI agents by:

- Starting from first-order risks. Use the capability and human-interaction risks set out in [1].
- Derive second-order risks. Apply the method in Figure 3 in [2] to generate second-order (systemic) risks as downstream effects of those first-order risks.
- Releasing a dataset and analysis code so others can reproduce our results.

[1] Unaccountable Delegation, Fading Skills: Mapping the Risks of Workplace AI Agents
[2] Agent-Supported Foresight for AI Systemic Risks: AI Agents for Breadth, Experts for Judgment

Project #7

The Personality of Parks

Linking neighborhood park types to residents' personality traits may help explain how local environments relate to individual differences.

Parks have been studied in relation to well-being, but there is little work linking park types to personality traits. [2]

We will:
(1) Combine two datasets: park types in London [1] and personality measures for residents across London neighborhoods [2]

(2) Test whether the presence of specific park types associated with well-being is also associated with neighborhood-level personality traits.

(3) Release the dataset and analysis code so others can reproduce our results.

[1] BBC Personality Dataset
[2] Health-promoting Potential of Parks in 35 Cities Worldwide