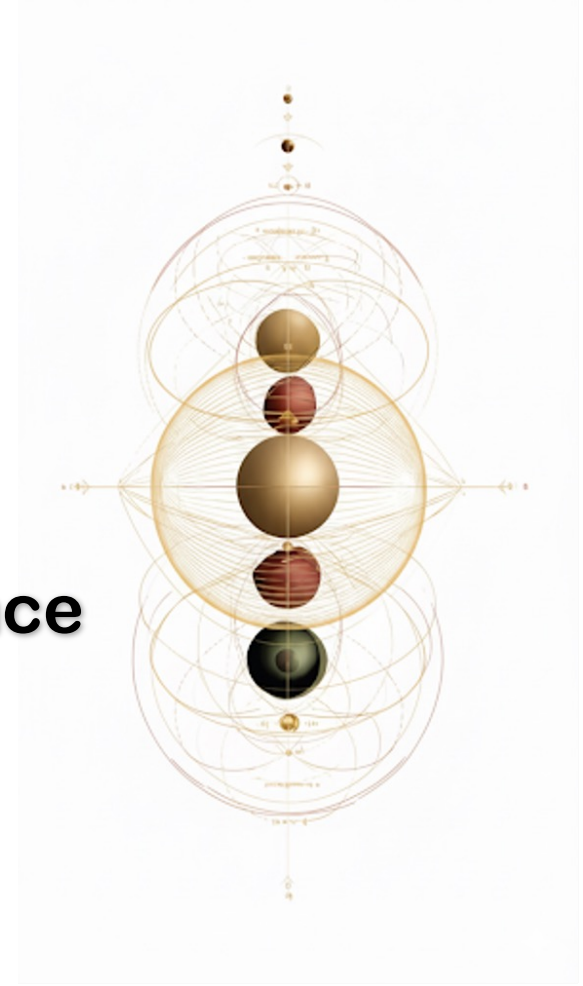
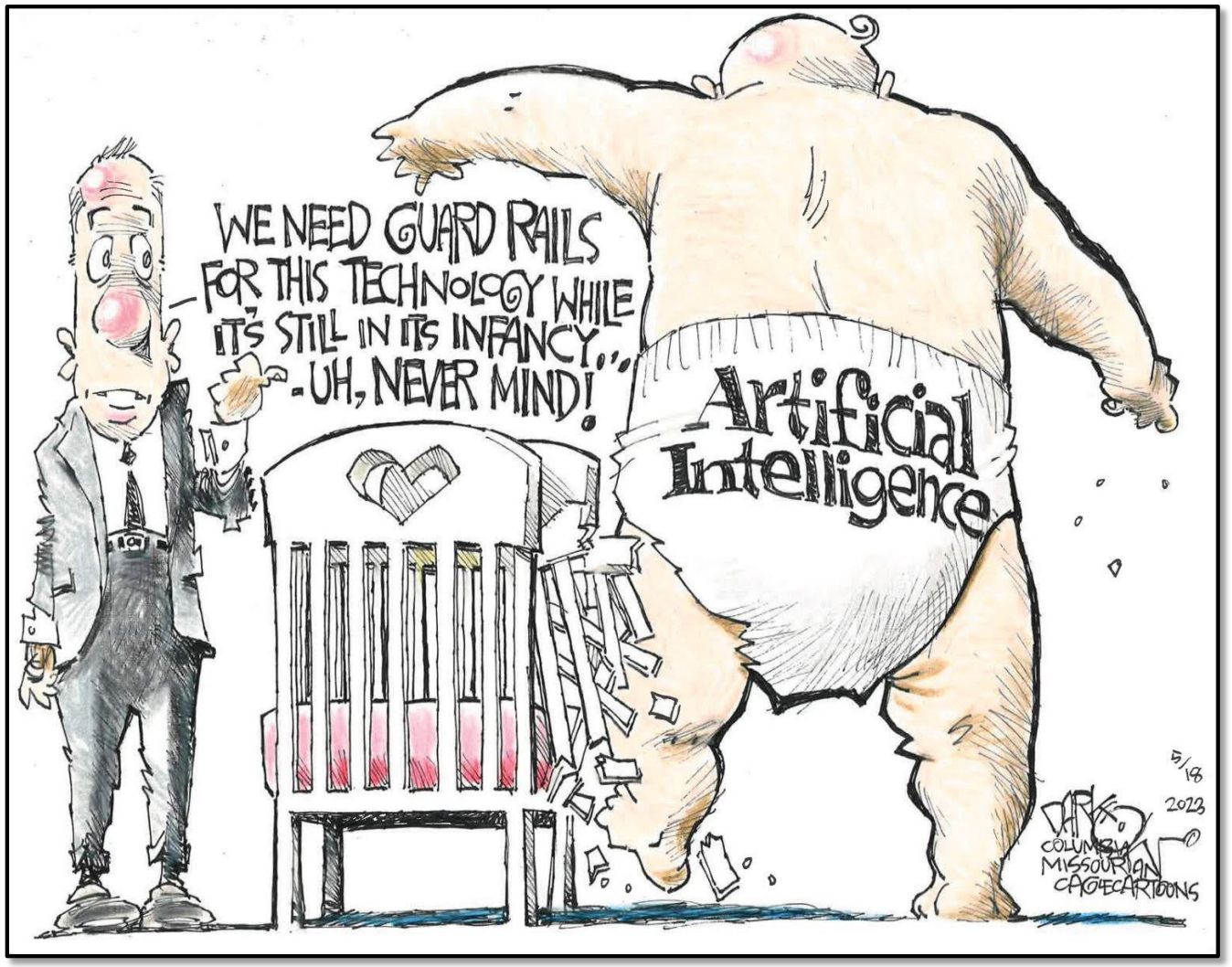
Further Experiments in Artificial Intelligence





Demis Hassibis

Nobel Prize in Chemistry (2024)

(Alpha Fold – Protein Structure Prediction)

CEO Google Deepmind

Cognitive Neurosience

Geoffrey Hinton

Nobel Prize in Physics (2024)

(Backpropagation in AI Training)

University of Toronto

Cognitive Psychology

Instructor: James P. Jarrard

Professional

Department of Defense Education Activity (DoDEA/DoDDS)

Knowledge Manager for Peace Corps (HQ/DC) – 2000-2002

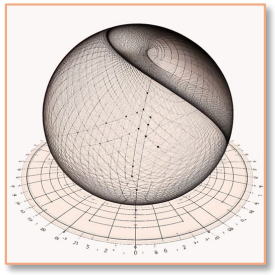
Adjunct Professor – Boston University, University of Maryland

Education

University of Southern California (MS), Michigan State University (BA)

Language Experience

German (6 years), Japanese (3 years), ASL (2 years)



Previous A.I. Seminars

OLLI@SOU

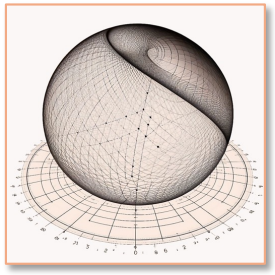
Fall, 2023

Winter, 2024

Fall, 2024

Winter, 2025

Background Materials @ www.talkswithcrows.com



Instructor Biases

Incurably Curious

(Overly) Tech Oriented

Make ‘Quantum’ Logic Leaps

High-Speed Spectrum Cable Services

Apple Environment w/ Extra Memory

Pessimism Averse

Bias Towards Print

Hierarchy of (Adult) Skill Acquisition

Level #1 – Awareness

Level #2 – Initial, Regular Use

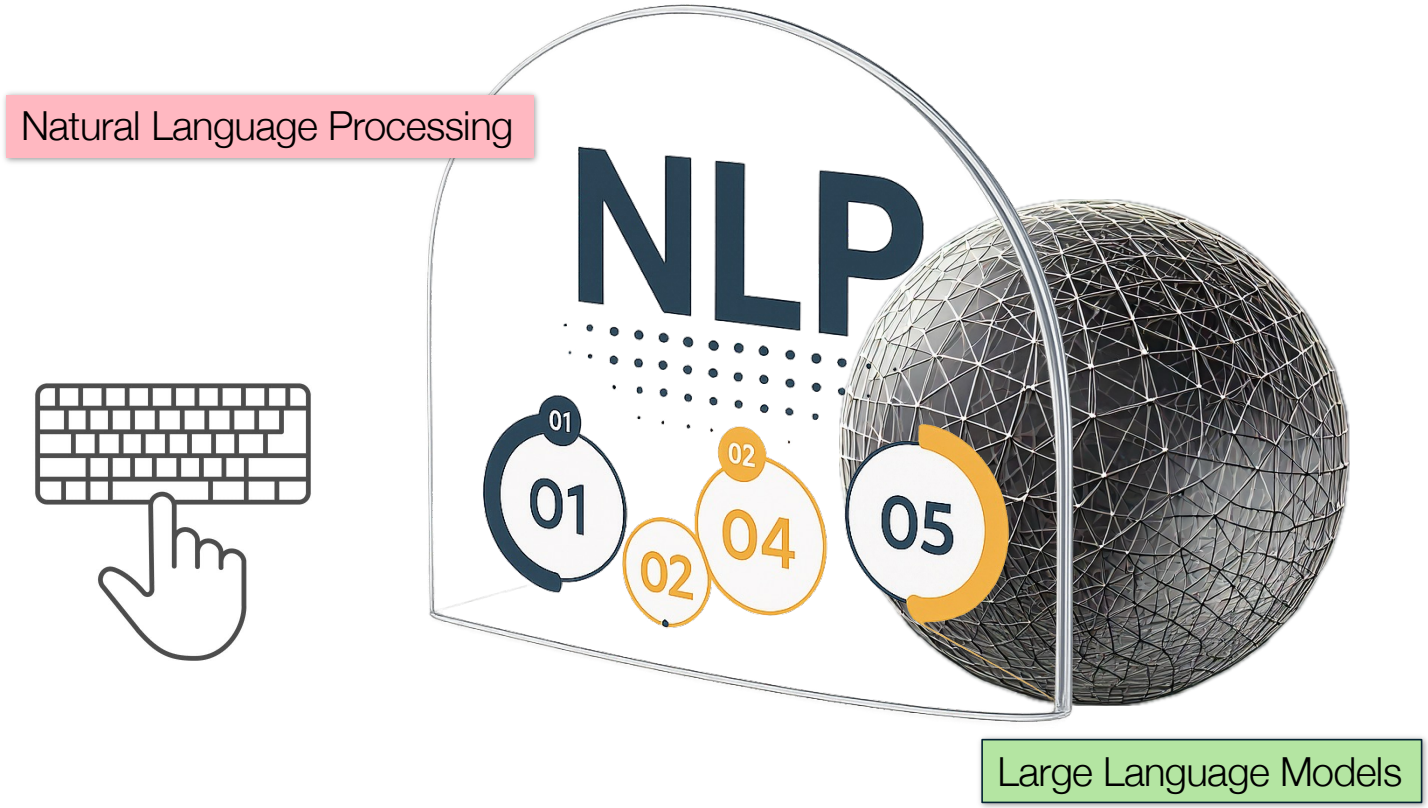
Level #3 – Proficiency

Level #4 – Expertise

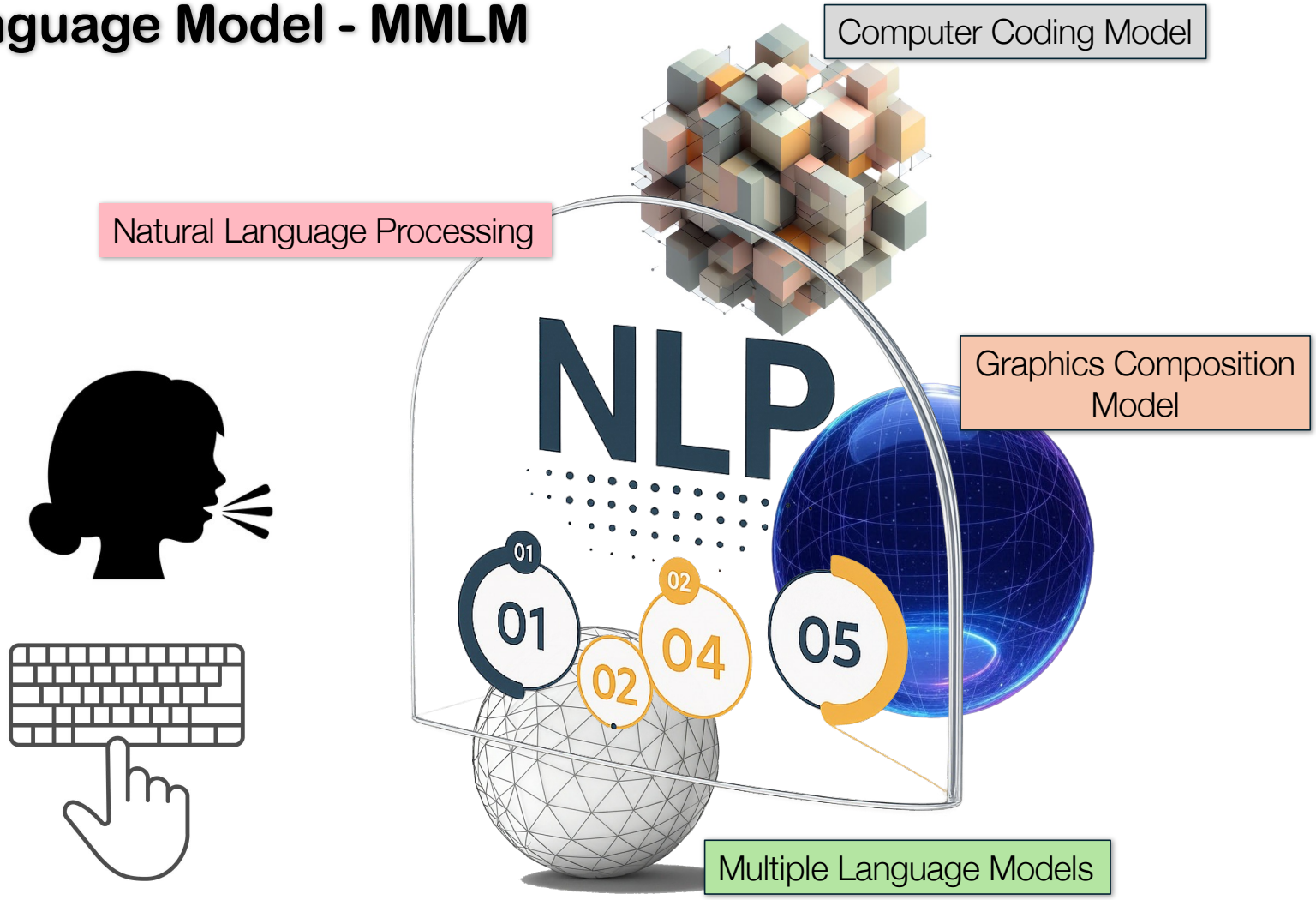
Instructor's Current Professional/Personal Uses

- Document Summarization
  - Audio-to-Text Transcription Summarization
- Written Composition
  - Finding the 'Right' Word/Phrasing
  - Initial Idea Generation/Outline Production
  - Proposal Format Generation
- Process Design, Analysis, & Improvement
  - Workflow Discovery, Definition, & Redesign
- Marketing – Business/Professional/Personal
- Education – Information Discovery
  - Self-Directed Technical Support
- Computer Programming
  - Video Compositing
  - Self-Directed Technical Support

Large Language Model - LLM



Multimodal Language Model - MMLM



Speed of Processing Increase over Time

Manufacturing Expertise Improvements

Floating-Point (mathematics) Operations per Second (FLOPS)

Year	Processor	Transistor Count	FLOPS	Notable Features
1971	Intel 4004	2,300	~92,600 FLOPS	First commercially available microprocessor.
1974	Intel 8080	6,000	~500,000 FLOPS	Widely used in early personal computers.
1982	Intel 80286	134,000	~2.66 MFLOPS	Introduced protected mode for multitasking.
1993	Intel Pentium	3,100,000	~188 MFLOPS	Superscalar architecture for enhanced speed.
1999	Intel Pentium III	9,500,000	~2.9 GFLOPS	First SSE instructions; improved performance.
2002	Intel Pentium 4	42,000,000	~6.2 GFLOPS	Introduced Hyper-Threading Technology.
2006	Intel Core 2 Duo	291,000,000	~21.1 GFLOPS	First dual-core x86 processor.
2017	AMD Ryzen 7 1800X	4,800,000,000	~384 GFLOPS	High-performance multi-threading CPU.
2020	Apple M1	16,000,000,000	~2.6 TFLOPS	ARM-based chip revolutionized efficiency.
2023	Intel Core i9-13900KS	24,000,000,000	~3.5 TFLOPS	Highest clock speed in a consumer processor.

Historical “Data” Transmission Speeds

65	1870s – Telegraph: 100 ‘words’ a minute (100 x 5 x 8 / 60) = ~65 bps (bits per second)
150	1930s – Teletype: 150 bps
300	1985 – acoustic modem: 300 bps
28800	1990s – digital modems: 9600bps – 28800bps
3,000,000	1995 – digital subscriber line (DSL): 3,000,000 bps
30,000,000	2000 – cable modem (DOCSIS): 30,000,000 bps
100,000,000	2015 – cable modem (DOCSIS 3.0): 100,000,000 bps

“Source Lines of Code” (SLOC)

Software Development Over Time

Microsoft Windows:

- **Windows NT 3.1 (1993):** Approximately 4–5 million SLOC.
- **Windows NT 3.5 (1994):** Around 7–8 million SLOC.
- **Windows NT 4.0 (1996):** About 11–12 million SLOC.
- **Windows 2000 (2000):** Exceeding 29 million SLOC.
- **Windows XP (2001):** Approximately 45 million SLOC.
- **Windows Server 2003 (2003):** Around 50 million SLOC.
- **Windows 10 (2015):** Estimated at 80 million SLOC.

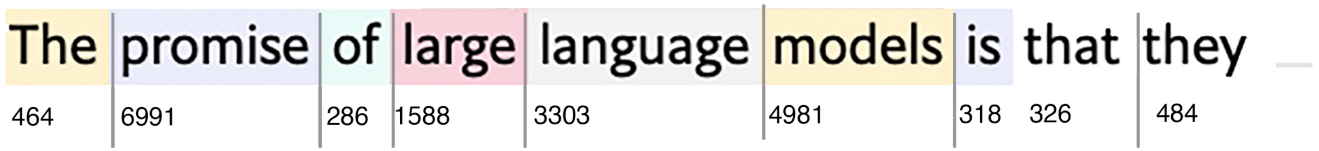
A.I. Models - Number of Parameters

Year	Model	Number of Parameters
2000	Early Neural Models	~1 million
2005	Early Neural Models	~10 million
2010	Early Neural Models	~100 million
2015	Early Neural Models	~100 million
2017	Transformer (base)	65 million
2018	BERT-Large	340 million
2019	GPT-2	1.5 billion
2019	Megatron-LM	8.3 billion
2020	GPT-3	175 billion
2021	Switch Transformer	1.6 trillion
2022	PaLM	540 billion
2023	LLaMA 2	70 billion
2023	GPT-4	~1.8 trillion (estimated)
2024	Llama 3.1	405 billion
2025	DeepSeek-R1	671 billion
2025	Llama 4	~1 trillion (estimated)

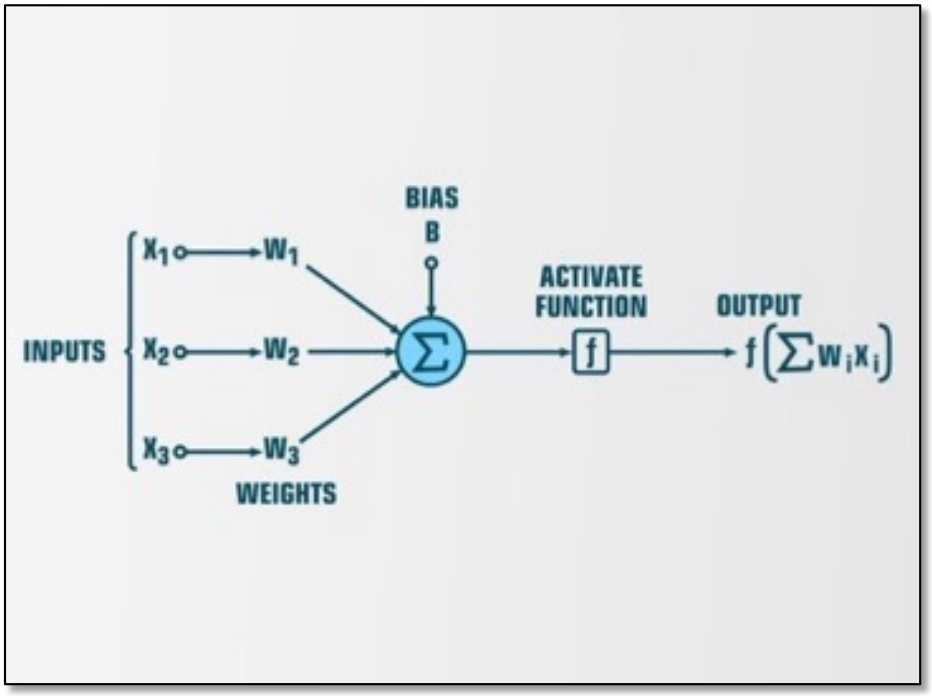
Notes:
- Early models (pre-2017) are approximated based on typical neural network sizes.
- Modern LLMs (post-2017) reflect transformer-based architectures.
- Estimates for unreported models (e.g., GPT-4, Llama 4) are based on reliable sources and trends.

Patterns in Language

Tokenization

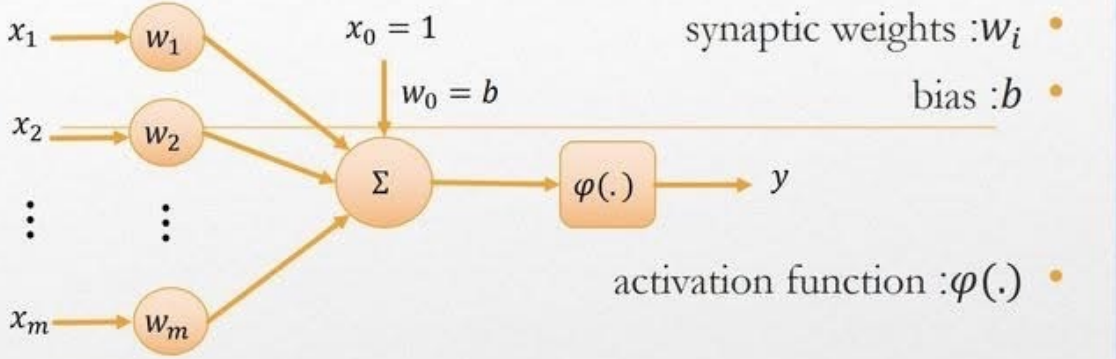


Economist, March 2023


BIAS
B
INPUTS
X1
X2
X3
W1
W2
W3
WEIGHTS
ACTIVATE
FUNCTION
OUTPUT
f(∑WiXi)

https://github.com/ostad-ai/Machine-Learning (machine learning) یادگیری دستگاه

An artificial neuron



- synaptic weights :w_i
- bias :b
- activation function :$\varphi(.)$

- $y = \varphi(\sum_{i=1}^{m} w_i x_i + b) = \varphi(\mathbf{x}^T\mathbf{w} + b) = \varphi(\mathbf{w}^T\mathbf{x} + b)$
  - $\mathbf{x} = [x_1, x_2, \dots x_m]^T$, $\mathbf{w} = [w_1, w_2, \dots, w_m]^T$
- $y = \varphi(\sum_{i=0}^{m} w_i x_i) = \varphi(\mathbf{x}^T\mathbf{w}) = \varphi(\mathbf{w}^T\mathbf{x}), x_0 = 1, w_0 = b$
  - $\mathbf{x} = [x_0, x_1, x_2, \dots x_m]^T$, $\mathbf{w} = [w_0, w_1, w_2, \dots, w_m]^T$
- Common choices for φ: Logistic, ReLU, Tanh, and Linear.

LinkedIn: www.linkedin.com/in/dr-hamed-shah-hosseini , **Twitter**: @chekaad

Neural Network (2)

Initial number of Hidden Layers ('depth') is established at onset of LLM creation

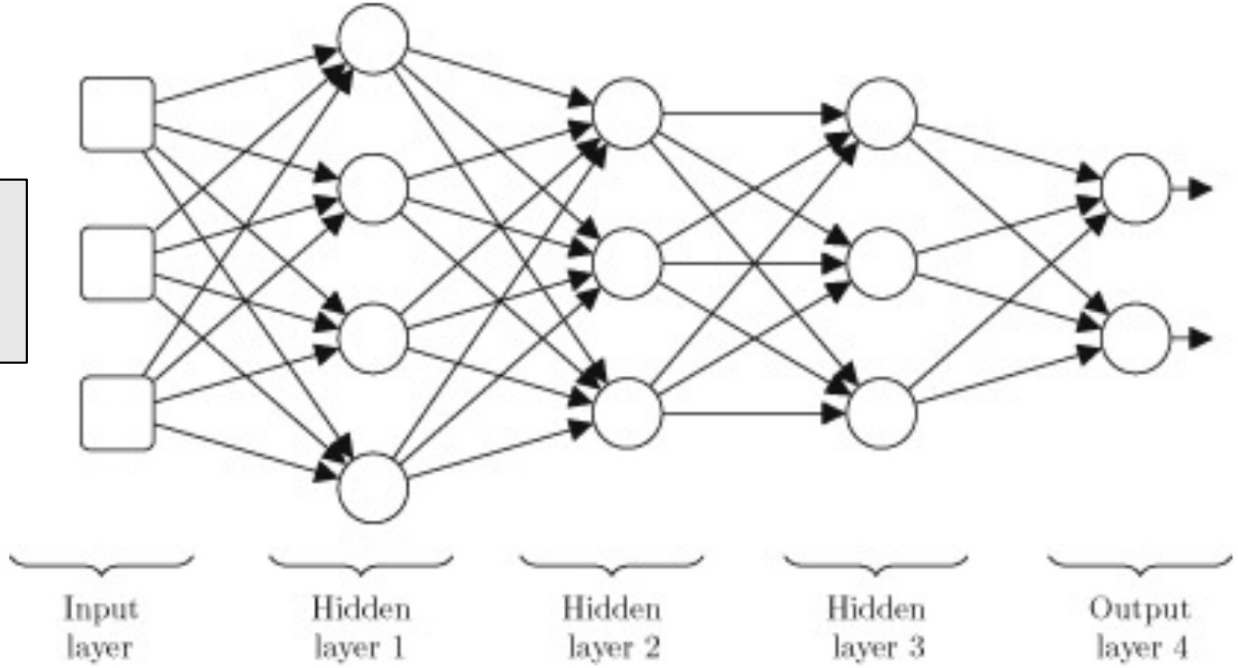
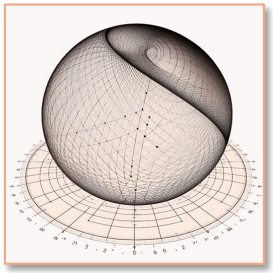


Figure 3.2 Topological illustration of a simple neural network.

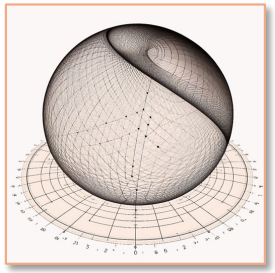
"Deep Learning" (2019) by John D. Kelleher
MIT Press Essential Knowledge Series



Potential Biases

What to Watch for in A.I. Performance

- Individual Mindsets
- Cultural Mindsets
- Sex and/or Gender Biases
- Race and/or Ethnicity Expectations
- Caste
- Training Corpus Proportions
- Epistemology of Ignorance
- Anthropic Limitations



Potential Risks

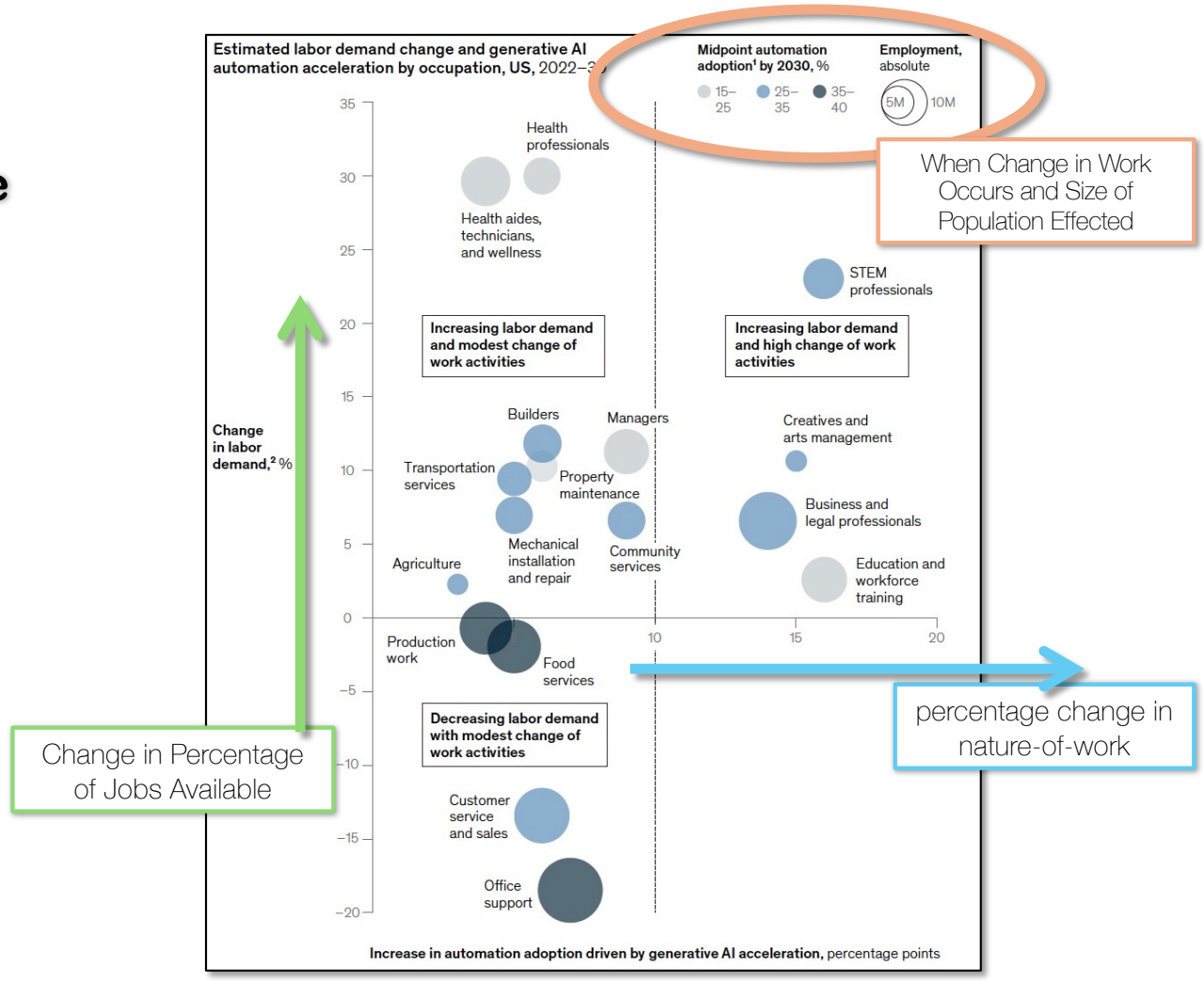
- Legal Risks
- Reputational Risks
- Contextual Risks
- Circumstantial Risks
- Values-Alignment (Business Implications)
- Computational Risks

  Non-Productive Use of Resources

  Energy Utilization

Employment Impact of Artificial Intelligence

Not only work replaced and jobs lost, but also work enhanced and jobs created.



McKinsey, 2023

Vocabulary – Acronyms - Nomenclature

Prompt

Inference

LLM – MMLM – SLM

Multimodal

NLP

AGI

RAG

Token

Hallucinations

Algorithm

Corpus

Compute

API

Vocabulary – Acronyms - Nomenclature

Models

Frontier Models

(values) Alignment

Workflow

Coding

Backpropagation

Bias (Social Bias vs. technical 'bias' (re: weight & bias in neuron))

Cognitive Load

RLHF (Reinforcement Learning from Human Feedback)

Enthusiastic Affirmation

Effective Altruism (EA)

Theory of Mind (ToM)

Vocabulary – Acronyms - Nomenclature

Context – Attention

Persistent Memory (scenarios – research w/ constant preface, or iterative edit of image)

Contextual framing (context setting, Custom Instructions, Persistent Instructions, Session Parameters)

Suite of Products

Constraints (legal, medical)

Context vs. Symbolism/Algorithmic/if…then

Agent/Agentic

Scale – Hyperscale

Doomer – Boomer

p(doom) – probability of doom scenario

Vocabulary – Acronyms - Nomenclature

Artifact

Markdown (.md, LaTeX, Lilypond)

Model Collapse

Misinformation vs. Disinformation

Emergent Behavior (unexpected behavior arising in large models)

Augmentation (augment human work, not replace humans)

Vector Database

Software Products Use Planned for this Seminar

Google Gemini / NotebookLM

Anthropic Claude

OpenAI ChatGPT

Microsoft Copilot

Meta AI

Perplexity

xAI Grok

Apple Intelligence

Open Source AIs (Poe)

MS Designer

Canva

Gamma AI

Google Labs

Apple Playground

Presentation Creation with Artificial Intelligence

Canva GAMMA

Topic: Theory of Mind (Applicability to A.I.)

Theory of Mind

Understanding others' thoughts and intentions cognitively

Theory of Mind Overview

Understanding Minds in Humans and AI

Theory of Mind Definition

Theory of Mind is the ability to attribute beliefs, desires, and intentions to oneself and others.

Role in Human Cognition

ToM is essential for empathy, social communication, and understanding complex social interactions.

Philosophical Foundations

Historically called 'folk psychology,' ToM is a foundational concept in human cognition and interpersonal understanding.

Development in Children

Theory of Mind Emergence

Theory of Mind development is highlighted by 'false-belief' tests showing understanding of others' differing beliefs.

Foundation of Social Cognition

Theory of Mind is foundational for interpreting and predicting others’ intentions and behaviors.

Growth of Empathy

Older children develop more sophisticated perspective-taking and empathy reflecting maturation of Theory of Mind.

Neuroscience of Theory of Mind

Social Brain Network

Theory of Mind relies on a network of brain regions called the Social Brain Network enabling social cognition.

Medial Prefrontal Cortex Role

The mPFC helps differentiate our own thoughts from those of others, crucial for social understanding.

Temporoparietal Junction Function

The TPJ facilitates perspective-taking by allowing individuals to infer others' mental states.

Mindreading and Social Cues

These brain regions enable mindreading, helping humans interpret social cues and relationships.

AI Observing Human Behavior

Behavior Interpretation by AI

AI analyzes text, voice, and movement to infer human beliefs and desires using advanced data processing.

Practical AI Applications

Self-driving cars predict pedestrian actions, and chatbots assess emotions to provide therapeutic support.

Limits of AI Understanding

AI lacks consciousness and genuine understanding, relying on statistical patterns to simulate mind theory.

Philosophical Questions

AI's capabilities raise important questions about intelligence nature and machine understanding limits.

Humans Attributing Minds to AI

Human-like AI Behavior

AI systems display human-like behaviors that lead people to perceive them as having mental states or minds.

Engineered vs Emergent Behaviors

Engineered behaviors are explicitly programmed, while emergent behaviors develop through machine learning without direct coding.

Philosophical Implications

Anthropomorphizing AI raises questions about true intelligence, consciousness, and agency in machines.

Key Takeaways

Theory of Mind Importance

Theory of Mind enables empathy and effective social communication among humans.

Neuroscientific Insights

Brain regions like mPFC and TPJ are critical for mindreading and understanding others' thoughts.

AI and Mindreading Mimicry

AI mimics Theory of Mind using behavioral analysis but lacks true consciousness or understanding.

Human Interpretation of AI

Humans attribute beliefs and desires to AI, reflecting complex interactions between perception and machine behavior.

A Science Behind Effective ‘Prompts’

Role / A.I.s Expertise

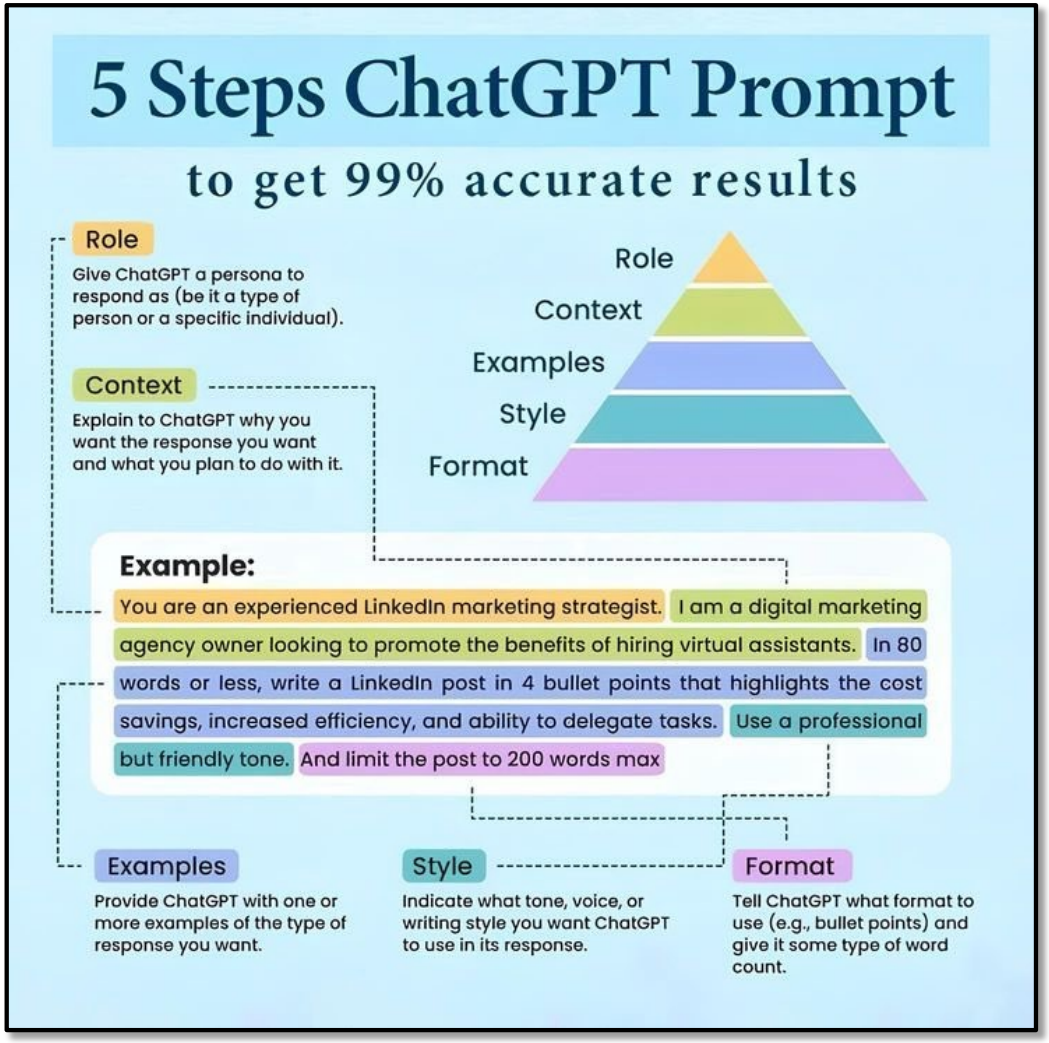
Context

(+) *Prompt*

Examples

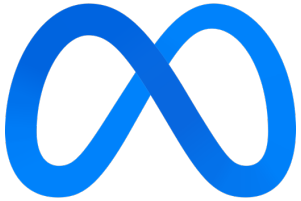
Style

Format



Copy and Editing Prompts / A.I. Software Demonstrated

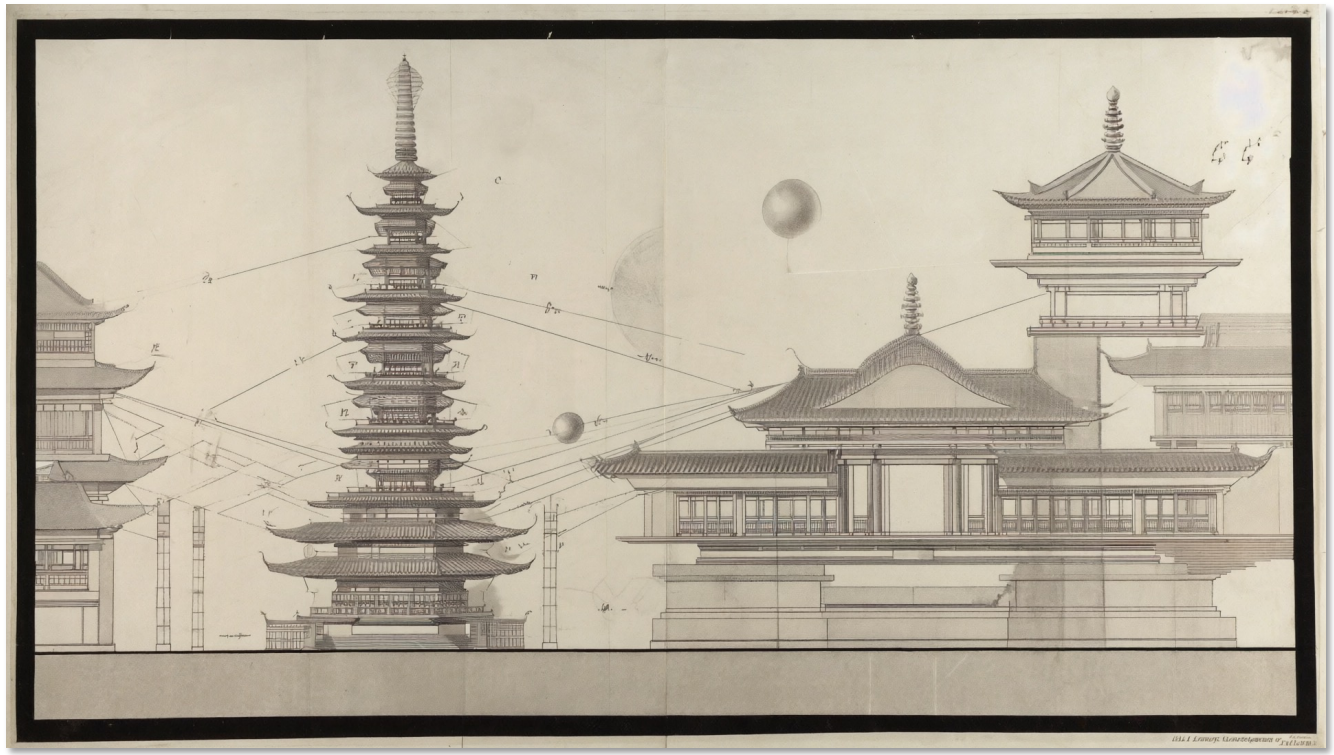
Adobe Firefly (graphics only - multiple models)



Meta AI

xAI Grok

Copy and Editing Prompts

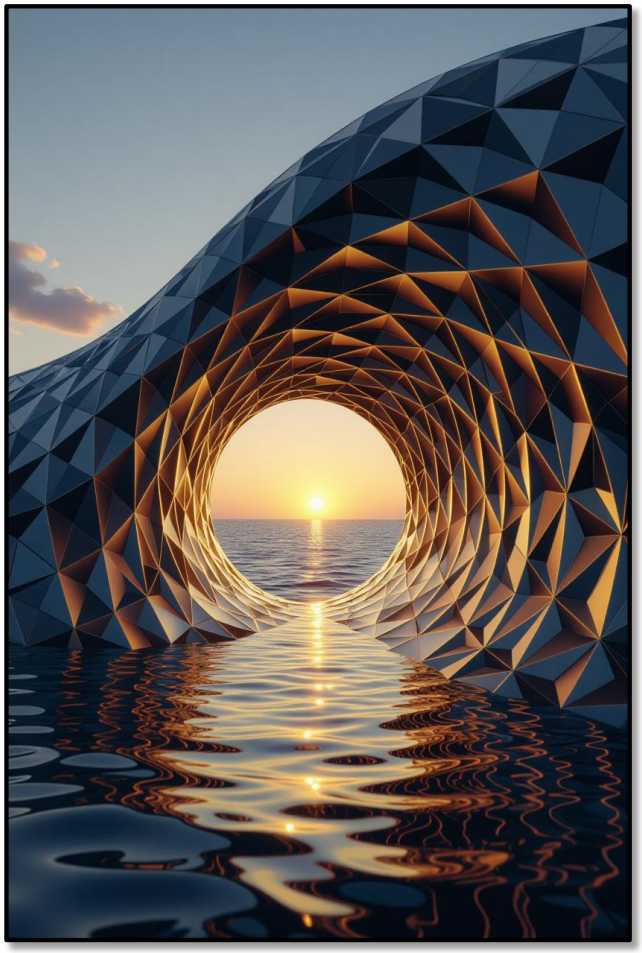


Perspective in Paintings

Copy and Editing Prompts

Possible Prompts in A.I.
Modify to Specific Needs

Prompt Title	Prompt
Market Analysis	Act as a market research analyst. Provide a detailed SWOT analysis for a new [product type] entering the [target market]. Include a competitive landscape and key market trends.
Marketing Strategy	Act as a digital marketing expert. Create a three-month social media content calendar for a [type of company] targeting [target audience]. Focus on increasing engagement and brand awareness.
Sales Pitch	Act as a sales professional. Draft a compelling sales email template to a new prospect in the [industry] sector. The goal is to schedule a 15-minute discovery call. Use a persuasive and concise tone.
Brand Messaging	Act as a brand consultant. Develop a unique value proposition and three core brand messaging pillars for a new [company type].
SEO Content Plan	Act as an SEO specialist. Generate a list of 10 high-volume, low-competition keywords related to [topic]. Create an outline for a 1,500-word blog post for one of the keywords.
Email Campaign	Act as a copywriter. Write a three-part email nurture sequence for new email subscribers. The goal is to introduce them to the brand and encourage a first purchase.
Product Description	Act as a product manager. Write 10 compelling product descriptions for a new line of [product]. Use a descriptive and benefit-driven tone.
Customer Persona	Act as a business strategist. Create a detailed customer persona for a [company type] selling [product/service]. Include demographics, pain points, motivations, and a 'day in the life' scenario.



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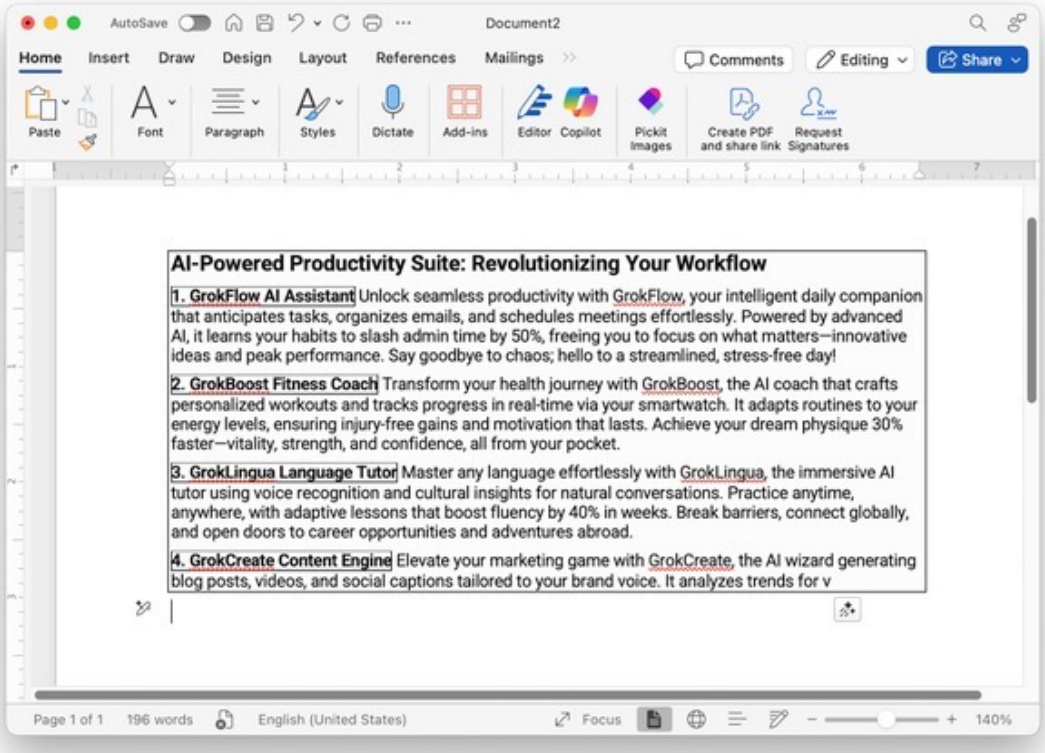
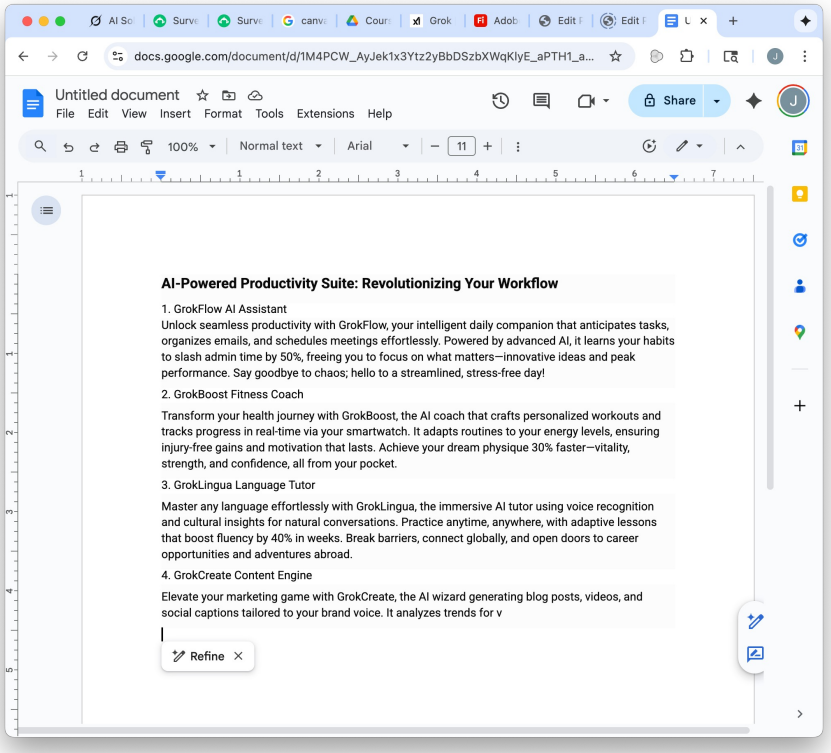


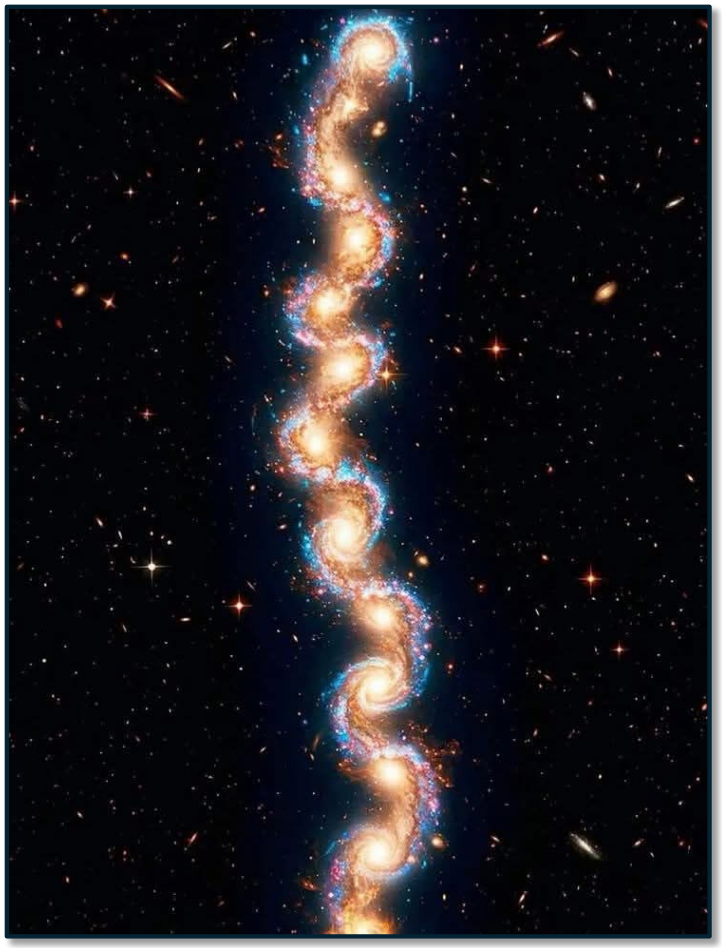
Google Docs



Copy and Editing Prompts

Mathematical Forms Reference Table

Form	Conceptual Description	Mathematical Representation	Example Qualifiers for AI Prompts
Mandelbulb	3D fractal infinity, like quantum foam bubbling into multiverses—mental recursion visualized.	$z(n+1) = z(n)^8 + c$ (triplex power: magnitude and angle in 3D)	Iteration depth, power exponent, color gradient, zoom level
Lorenz Attractor	Chaotic butterfly wings of uncertainty, manifesting quantum-sensitive paths in thought or fate.	$dx/dt = \sigma(y - x)$, $dy/dt = x(\rho - z) - y$, $dz/dt = xy - \beta z$	Parameters (σ,ρ,β), trajectory length, color by velocity, initial conditions
Hydrogen Atom Orbital	Ethereal probability clouds of electrons, quantum manifestations of unseen atomic dances.	$\psi(n,l,m) = R(n,l)(r)\ Y(l,m)(\theta,\varphi)$ from Schrödinger equation	Quantum numbers (n,l,m), isosurface level, color by phase, opacity
Calabi-Yau Manifold (Proj.)	Hidden dimensions unfolding, a quantum string theory vision of curled realities in 3D space.	Ricci-flat: Approximate proj. $x=\cos(u)\cos(v)$, $y=\sin(u)\sin(v)$, $z=\sin(w)$	Dimension slice, folding complexity, color mapping, rotation
Sierpinski Tetrahedron	Infinite self-similar voids, mental constructs of quantum superposition collapsing hierarchies.	Iterative: Divide tetrahedron into 4 smaller, remove center; repeat with scale 1/2	Recursion levels, base size, color per level, transparency
Rössler Attractor	Spiraling chaos streams, evoking quantum flows of consciousness through nonlinear time.	$dx/dt = -y - z$, $dy/dt = x + a\ y$, $dz/dt = b + z(x - c)$	Parameters (a,b,c), time steps, line thickness, phase color



Session #1 - End