Principles & Latest Trends in Generative AI

Minute Interactive Workshop

Focus on Practical Prompting & Multimodal Analysis

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Workshop Agenda

- Principles of Generative AI
- Agentic AI(Latest Trends)
- Hands-On 1: Prompt Engineering
- Hands-On 2: The Pro Prompt
- Hands-On 3: Multimodal Data Analysis
- Hands-On 4: Agentic AI
- Limitations & Safety of AI

From AI to Generative AI: The Evolution and Relationship

AI learned to think, Machine Learning learned from data, Deep **Learning learned** complex patterns,
and Generative AI learned to create — powered by LLMs and foundation models.

Artificial Intelligence (AI)
1950s–

The idea of machines that can think and solve problems like humans.

Machine Learning (ML)
1990s–

Computers learn from data without **explicit programming.**

Neural Networks
1980s–

Inspired by the human brain, networks of connected nodes (neurons).

Deep Learning (DL)
2010s–

Multi-layer neural networks learn complex patterns from large data.

Transformer
2017–

Attention mechanism revolutionized NLP and sequence modeling.

Large Language Models (LLM)
2018–

Massive pre-training on text data (e.g., GPT).

Generative AI
2020s–

Creates new content (text, image, audio, video, code, etc.) using foundation models.

Key Technological Milestones

Stage	Main Idea / Innovation	Example / Impact
AI	Rule-based reasoning, expert systems	Early AI programs, expert systems
Machine Learning	Learning from data (algorithms, statistical models)	Regression, classification, clustering
Neural Networks	Brain-inspired networks	Perceptron, MLP
Deep Learning	Multi-layer networks, feature learning	CNN (vision), RNN/LSTM (sequence data)
Transformer	Attention mechanism	BERT, GPT (NLP)
LLM	Large-scale pre-training on text data	GPT-3, GPT-4, Llama
Generative AI	Generate new content (text, image, audio, video, code)	ChatGPT, Stable Diffusion, DALL·E, Sora

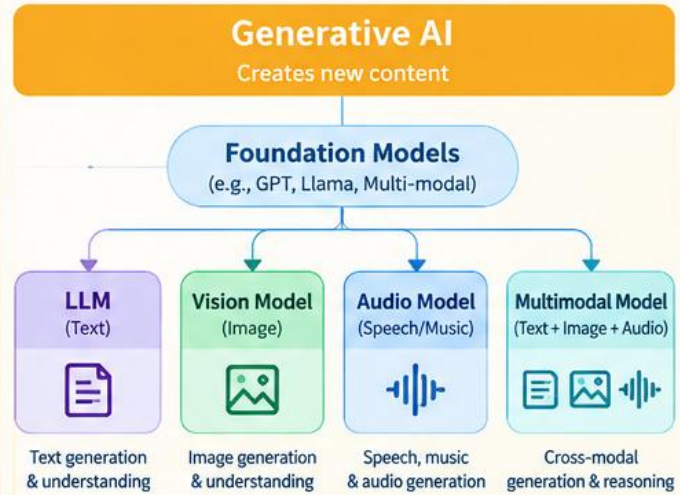
A Closer Look: LLM in the AI Landscape

LLM
(Large Language Model)
- Transformer-based
- Trained on massive text data
- Good at understanding and generating language

Important part of Generative AI
LLM is one of the key models that enables generative AI, especially for text.

Not the same as Generative AI
Generative AI is a broader concept that includes multiple model types (e.g., text, image, audio, video).

Generative AI: Different Model Types

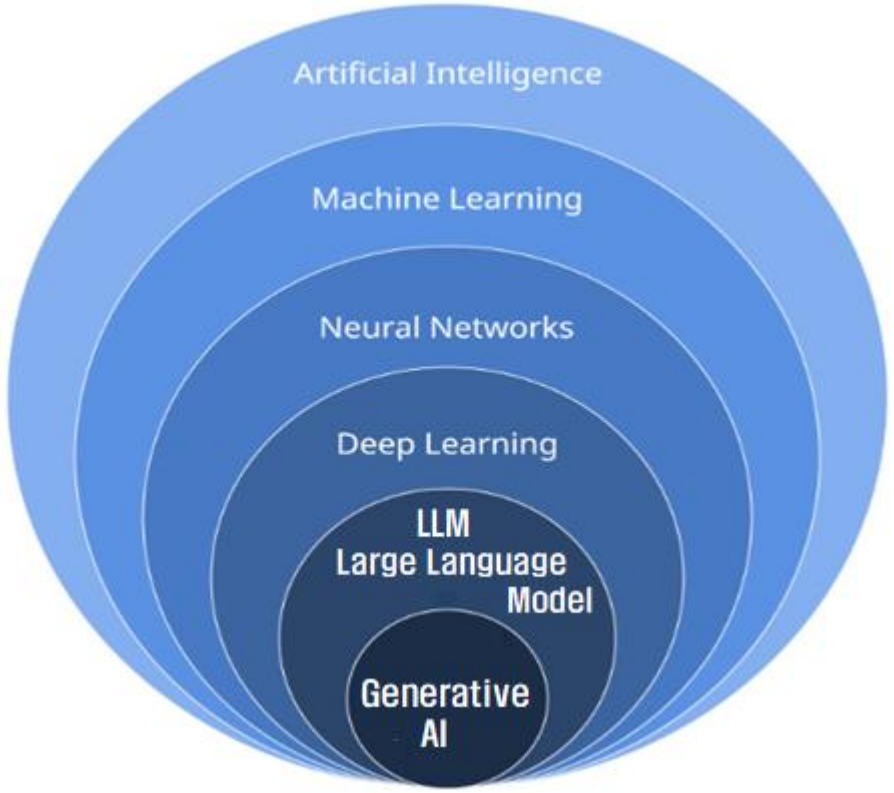


Key Takeaway

LLM is not "inside" Generative AI in a simple hierarchy, but it is a crucial model within the generative AI ecosystem.
The real story is a continuous evolution: AI → ML → Neural Networks → Deep Learning → Transformer → LLM → Generative AI.

Principles of Generative AI

Generative AI doesn't "think" like a human; it is essentially a highly advanced prediction engine. If you give it the phrase "The sky is...", it calculates the mathematical probability that the next word is "blue".



Generative AI(AI ecosystem)

- **Artificial Intelligence (AI):** The broadest concept encompassing all technologies that enable machines to simulate human intelligence.
- **Machine Learning (ML):** A subset of AI that enables computers to learn from large amounts of data by patterns and relationships.
- **Neural Networks (NNs):** A type of ML technique inspired by the human brain to process data and recognize complex patterns.
- **Deep Learning (DL):** A type of machine learning that uses neural networks with multiple layers to learn complex patterns and solve sophisticated problems.
  - **Large Language Models (LLMs):** A specific type of generative AI model trained on vast amounts of human language data to understand and generate human-like text and responses.
  - **Generative AI (GenAI):** A type of AI, primarily based on deep learning, that goes beyond analyzing existing data to generate new content, such as text, images, and audio.

GENERATIVE AI *Processes*

Generative AI is a branch of artificial intelligence that creates entirely new content—such as text, images, audio, and code—by learning underlying patterns from massive datasets. Unlike traditional systems that only analyze or classify existing information, it uses probabilistic reasoning to synthesize original, human-like outputs in response to user prompts.

HOW IT WORKS: LEARNING PATTERNS

Massive Datasets



Learning Underlying Patterns



Massive Datasets

THE USER INPUT & & AI REASONING

User Prompt

"Create a story about a flying cat..."



Processing Brain



Probabilistic Reasoning

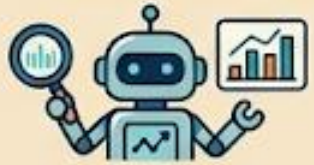
WHAT IT DOES: CREATING NEW CONTENT



Entirely New Content

Synthesizes Original, Human-Like Outputs

Traditional AI vs. Generative AI



Only Analyzes or Classifies Existing Data
(e.g., Is this a cat?)



Creates & Synthesizes New Data from Scratch
(e.g., Draw a new cat)

RAG (Retrieval-Augmented Generation)

The Three-Step Workflow of RAG

1. Retrieval



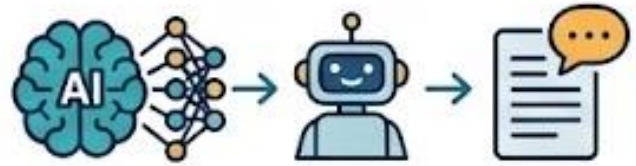
Searches an indexed repository of external documents (PDFs, manuals, news, etc.) to find the most relevant text segments (chunks) based on a user's question.

2. Augmentation



Packages the retrieved information together with the user's original query to construct an enriched prompt for the LLM.

3. Generation



The LLM generates a coherent, factually accurate response grounded in the provided reference material.

Key Reasons to Use RAG

Mitigating Hallucinations



Mitigating Hallucinations

Significantly reduces false or misleading statements by grounding answers in verifiable source documents.

Access to Up-to-Date Information



Access to Up-to-Date Information

Incorporates the latest data dynamically as new documents are added, without costly model retraining.

Leveraging Proprietary & Private Data



Leveraging Proprietary & Private Data

Enables organizations to securely utilize internal technical documentation and private specialized knowledge.

Concept of RAG

Retrieval-Augmented Generation (RAG) is an AI framework that fetches relevant information from external knowledge bases before generating a response.

By referencing verified source documents rather than relying solely on internal training data, it effectively minimizes hallucinations and provides up-to-date, domain-specific answers.

WHAT ARE AI TOKENS?

How Artificial Intelligence reads and processes text.

They + are + un + forget + table + .

1 token | 1 token | 1 token | 1 token | 1 token | 1 token

1 Word isn't always 1 Token

AI breaks text into smaller chunks called 'tokens' to understand meaning and patpatterns.



How They Work

Tokens can be whole words, sub-words, or even single characters. Common words might be 1 token, while rare or long words get split into multiple tokens.



Why It Matters (Context Window)

AI models have a "token limit" (Context Window)—the maximum amount of text they can remember and process at one time.



The Token Economy

AI usage and costs (API pricing) are measured in tokens, both for what you send (input) and what the AI writes (output).

Rule of Thumb: 100 English words ≈ 75-140 tokens depending on complexity.

Concept of Token

- **Tokens, AI Service Pricing: Most AI APIs, including ChatGPT (OpenAI), Claude, and Gemini, charge based on the number of tokens used for both user inputs (input tokens) and AI-generated responses (output tokens)**
- **Processing Speed: AI generates responses one token at a time, so the more tokens it needs to generate, the longer it takes to complete the response(Time).**
- **Context Window: Each model has a maximum number of tokens it can process at once. Exceeding this limit may cause earlier conversation details to be lost or prevent processing long documents in a single input(Volume of Memory)**

- High Token Usage:

"Read through this attached coastal management report and explain to me everything it says regarding sea surface temperature trends and the methodology they used."

- Token-Efficient:

"Extract only: 1) SST trend values, 2) Analysis methodology from the text below. Output as short phrases."

WHAT IS TRUE MULTIMODALITY IN AI?

Processing different types of data natively and simultaneously.

The Inputs (Sensory Processing)

- Text
- Vision
- Audio
- Video
- Code / Data

Native & Simultaneous Understanding

Traditional pipeline

Input → Text Converter (OCR/TTS) → AI → Output (siloed)

True Multimodality

Inputs → Direct Unified Processing → Outputs (Integrated and dynamic)

The AI understands all modalities together as a single context, just like a human.

The Outputs (Dynamic Creation)

- Images / Art
- Written Response
- Audio / Speech
- Code
- Actions / Motion

Integrated Understanding

No separate translators or converters. Subtitles, images, and audio are parsed directly within the same neural network.

Simultaneous Processing

It doesn't just read text; it sees, hears, and acts at the same time.

Rich Output Generation

AI can answer in spoken words while generating a matching visual or coding the logic.

Concept of True Multimodality

- Moving beyond the traditional text box.
- Real-time processing of text, audio, images, and video simultaneously.
- Use Case: Analyzing live camera feeds of damaged coastal walls or infrastructure for instant safety assessments.



The shift from text-only to Multimodal inputs

Prompt(Example of Multimodality)

Analyzing live camera feeds of damaged coastal walls or infrastructure for instant safety assessments

1. Site Status Summary & Risk Rating

- **Effective Date/Time:** Immediate Effect as of Sunday, October 21, 2026
- **Target Section:** Seawall/Coastal Wall Armor Unit and Crest Slab Section (Vicinity of Chainage 0+120)
- **Safety Grade: Grade D (Alert - Immediate Action Required)** (AI Confidence Score: 94%)
- **Cross-Validation Results from Video/Image Analysis:**
  - Visual confirmation of extensive longitudinal fractures and backfill separation across the concrete crest deck.
  - Accelerated rebar fracture, exposure to severe marine salinity, and direct wave impact concentration due to displaced Tetrapods (TTP).



Input Data

2. Defect Analysis & Risk Assessment

Category	Defect Type	Severity	Primary Risk Factors
Defect 1	TTP Displacement & Toe Erosion	Critical	Loss of wave-dissipating functionality due to the displacement of 3–4 Tetrapods. Direct wave forces impacting the lower concrete section threaten to cause further loss of foundation stones and rapid cavity expansion beneath the slab.
Defect 2	Wall Spalling & Severe Cracking	High	Structural cracking exceeding 2.5 m in length and complete section dislocation. Critical risk of the entire crest slab overturning and collapsing seaward under wave pressure during the upcoming high tide.

3. Immediate Action Protocol

① [Immediate Action] Access Restriction & Site Safety Control
1.Full Closure of Coastal Boardwalk & Adjacent Roads: Deploy physical security fencing and hazardous area cordon lines spanning 100 meters in both directions from Chainage 0+120.
2.Emergency Alert Broadcast: Interface with the municipal Disaster and Safety Countermeasures Headquarters and traffic control systems to broadcast pedestrian/vehicle detour alerts.

② [Complete Before High Tide] Wave-Overtopping Mitigation & Emergency Rockfill Reinforcement
1.Emergency Geobag Placement: Temporarily install large-capacity geobags (1-ton class) across fractured seawall gaps and scoured toe voids to prevent seawater infiltration and form a temporary barrier.
2.Enhanced Video Monitoring: Lock and zoom PTZ optical CCTV units onto the fracture plane at Chainage 0+120, activating real-time structural displacement tracking algorithms.

③ [Detailed Diagnosis] Technical Engineering Survey
1.GPR & 3D Scanning: Mobilize 3D Ground Penetrating Radar (GPR) and drone-based LiDAR scanning at low tide to map internal cavities beneath the rear deck slabs.
2.Structural Integrity Review: Urgently determine engineering remediation measures, evaluating slab lifting/reconstruction versus subsurface pressure grouting.
System Status: ACTION_EXECUTED
Automated alerts and operational directives have been transmitted to the Municipal Maritime Affairs Division, Disaster Safety Situation Room, Jurisdiction Police Department, and On-Site Maintenance Task Force.

Agentic AI

THE EVOLUTION OF AI: FROM TEXT RESPONSE TO AUTONOMOUS AGENCY

The Past: Chatbots

- The shift from Chatbots to AI Agents.
- Answering questions (Passive).





The Evolution of AI:
From Chatbots to AI Agents

The **SHIFT**

- From answering questions to executing autonomous tasks.
- Agents break down complex goals, search the web, utilize tools, and complete multi-step workflows independently.

The Future: AI Agents



- Executing autonomous tasks (Active).
- Agents:
  - Break down complex goals. — Multi-Steps
  - Search the web.
  - Utilize tools.
  - Complete multi-step workflows.



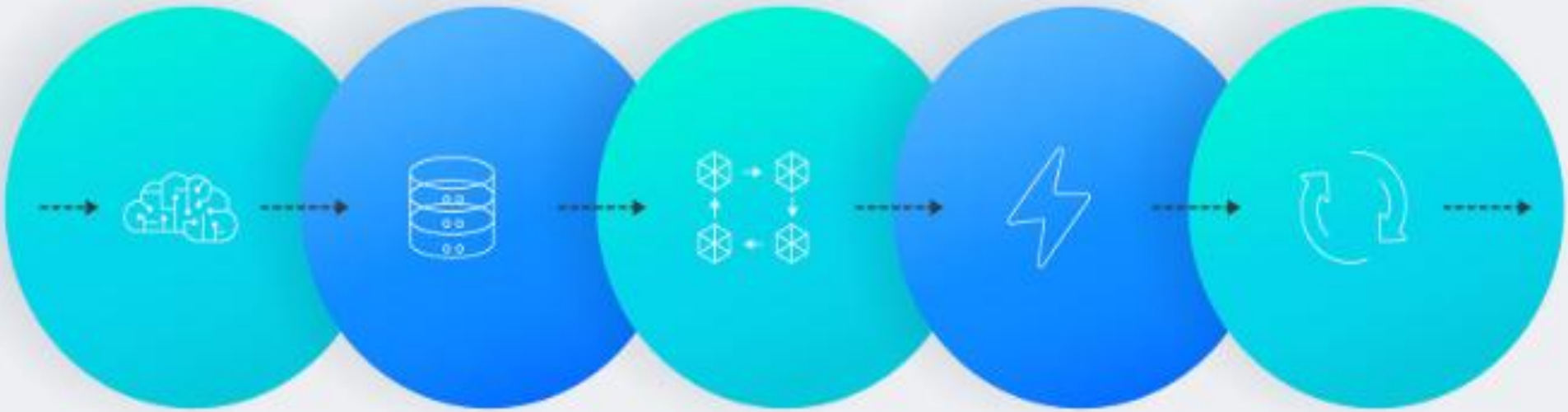


Independently.



AI Agent Workflow

End-to-end autonomous AI system workflow
for modern enterprises



Input

Initiation of tasks from diverse data sources.

Output

Delivering intelligent reports and automation.

1

Understand

Interpreting user intent and gathering context.

2

Retrieve

Accessing relevant data from internal sources.

3

Reason

Analyzing information using advanced logic models.

4

Action

Taking strategic actions through integrated APIs.

5

Learn

Continuous improvement via feedback loop systems.

Generative AI & Agentic AI

Dimension	Generative AI	Agentic AI
Primary Role	Content generation (text, cod e, imagery, etc.)	Goal-oriented problem solving and workflow execution
Operational M odel	Single-turn request & response (Prompt-> Output)	Multi-step autonomous loop (Goal -> Plan-> Execute->Evaluate->Complete
Autonomy Level	Low (requires step-by-step guidance from the user)	High (determines intermediate steps indepe ndently given a high-level goal)
Tool Utilization	Primarily relies on internal model weights (or basic search integration)	Actively invokes external tools (APIs, cal culators, web browsers, database queries, code interpreters)

Generative AI & Agentic AI Examples

- **Generative AI's Response:**
  - **User:** "Draft an itinerary for my business trip to the climate change conference in Seoul next week."
  - **AI:** Instantly generates and outputs a well-structured template and sample schedule, and then finishes its task. (The user must still handle flight bookings and actual calendar scheduling themselves.)
- **Agentic AI's Response:**
  - **User:** "Confirm my schedule to attend the Seoul climate conference next week and take care of all related preparations."
  - **AI's Autonomous Execution Steps:**
    - **Planning:** Breaks down the objective into sequential subtasks: check schedule → search flights/hotels → register calendar entries → prepare trip report.
    - **Tool Invocation:** Queries airline APIs and hotel booking platforms to retrieve optimal options within budget.
    - **Error Recovery:** Detects that flights at the preferred departure time are sold out and autonomously adapts the plan with suitable alternatives.
    - **Task Completion:** Adds confirmed itinerary events to the user's calendar and sends a notification requesting payment approval.

Hands-On 1: Prompt Engineering (The Basics)

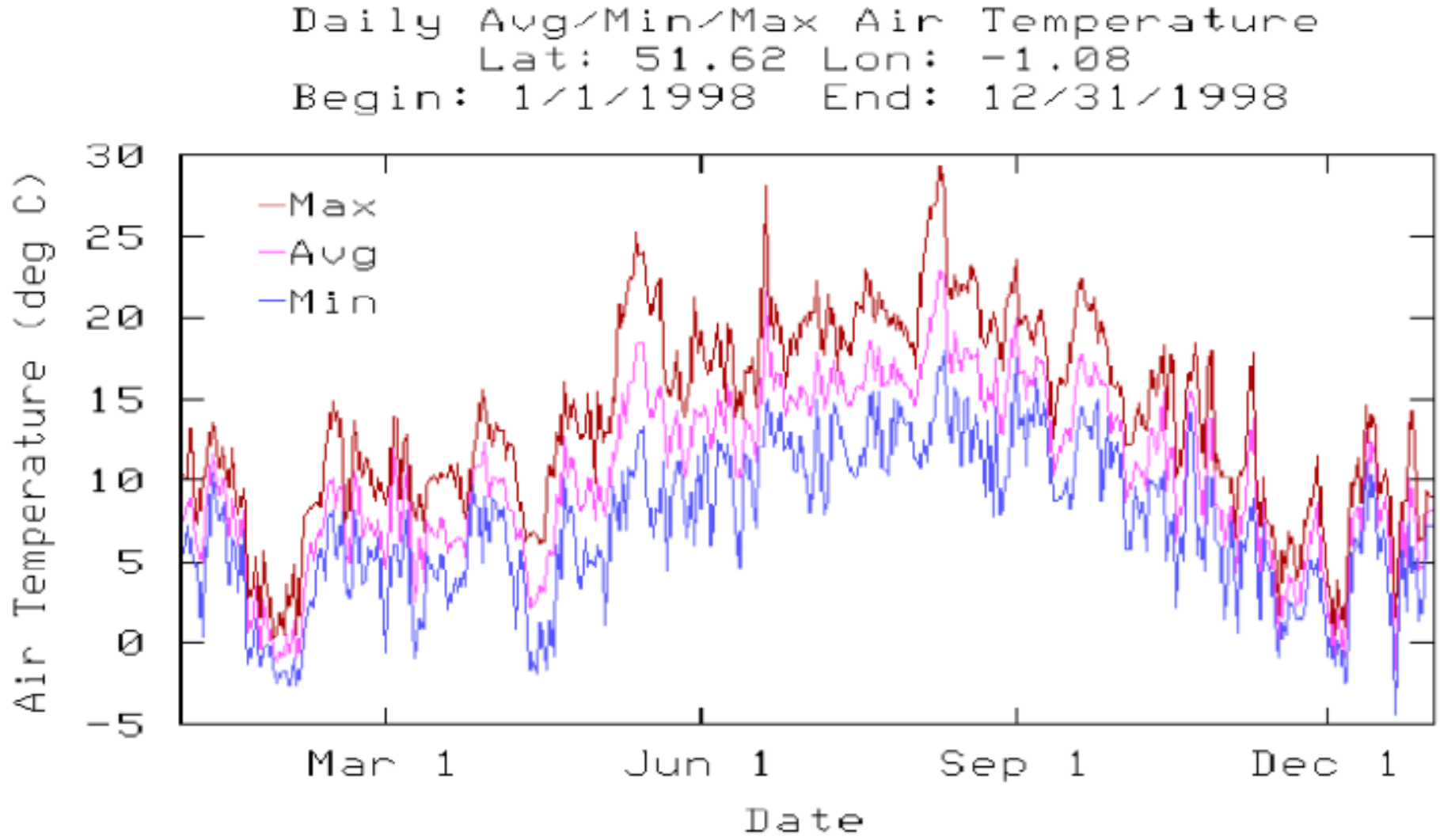
- Scenario: Drafting a policy brief on infrastructure adaptation.
- The Basic Prompt :
- - 'Write a memo about protecting coastal infrastructure from sea-level rise.'
- - Result: A generic, Wikipedia-style essay with no actionable policy value.

Hands-On 2: The Pro Prompt

- Context | Request | Explanation | Action | Tone | Extras
- The Pro Prompt (Practice this):
- - 'Act as a senior civil engineering consultant [Persona]. I need to request international funding for a new coastal defense project [Context]. Write a 3-paragraph executive summary [Format] highlighting the urgency of sea-level rise and economic benefits [Content]. Use a formal, persuasive tone suitable for the UN Green Climate Fund [Tone].'
- Result: Highly targeted, professional document.

Hands-On 3: Multimodal Data Analysis

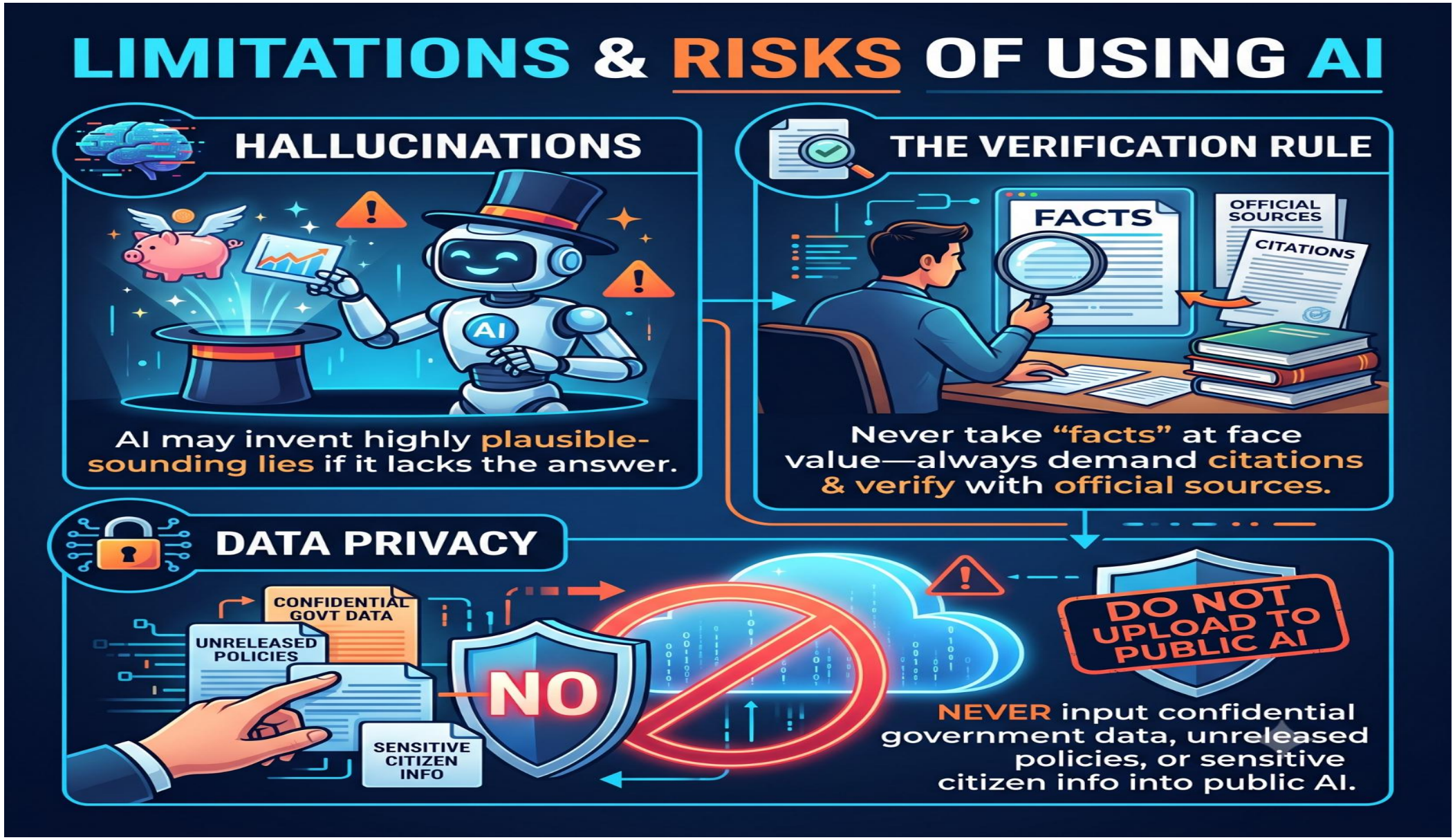
- Using AI's 'Eyes' for Data Insights.
- Step 1: Find a complex chart (e.g., Sea Surface Temperature, or technical charts like Moving Averages).
- Step 2: Upload the image to the AI.
- Step 3: Run the Analysis Prompt:
- - 'Analyze this chart. Extract the main trend over several months, identify any anomalies (spikes/drops), and summarize what this data means for a policymaker in 3 bullet points.'


Daily Avg/Min/Max Air Temperature
Lat: 51.62 Lon: -1.08
Begin: 1/1/1998 End: 12/31/1998
Max
Avg
Min
Air Temperature (deg C)
30
25
20
15
10
5
0
-5
Mar 1
Jun 1
Sep 1
Dec 1
Date

Hands-On 4: Agentic AI

Confirm my schedule to attend the climate conference in Brisbane next week (Monday to Thursday) from “country name” and take care of all related preparations.

AI Limitations & Safety



Core Principle	Definition & Concept	Implementation & Mitigation Strategies
Fairness&Non-discrimination	AI systems must treat all individuals equitably, free from bias regarding race, gender, age, geography, or socioeconomic status.	• Preprocessing training data and correcting demographic imbalances • Applying bias metrics and fairness-aware algorithms
Transparency& Explainability	The decision-making process and underlying mechanisms of AI must be understandable and traceable by humans.	• Adopting Explainable AI (XAI) frameworks • Documenting data provenance and model architectures
Privacy & Data Protection	AI development and training must not infringe upon personal privacy or intellectual property rights.	• Applying Differential Privacy • Enforcing data anonymization, pseudonymization, and encryption
Safety & Robustness	AI systems must operate reliably, securely, and predictably against adversarial attacks or changing environments.	• Conducting red teaming and adversarial robustness testing • Designing fail-safe mechanisms and multi-stage verification pipelines
Accountability & Responsibility	Legal and ethical responsibility must be clearly attributable when AI causes damage or failure.	• Establishing Human-in-the-Loop (HITL) oversight • Implementing audit trail logging and enterprise AI governance frameworks
Human Autonomy & Societal Well-being	AI must respect human agency, prevent coercion, and promote social sustainability and human flourishing.	• Mandating digital watermarking for synthetic content • Conducting AI Impact Assessments (AIA) and adopting green computing practices

Q&A

Thank you for your attention