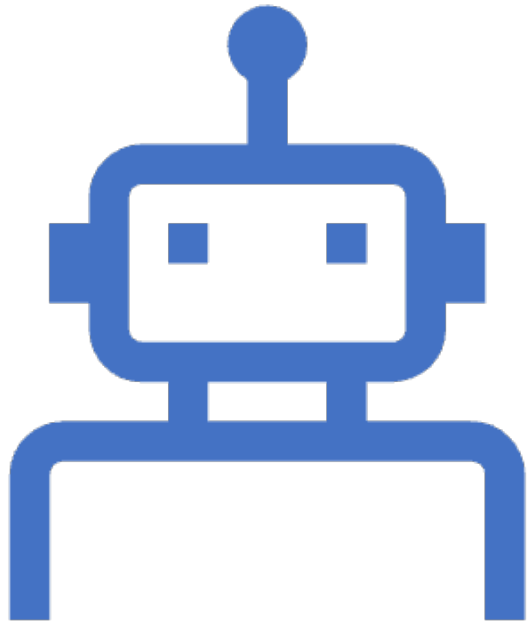# Can ChatGPT Write a SIP?

Artificial Intelligence for Air Agencies*

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* Content of this presentation: 90% Zac, 10% ChatGPT

LADCO | LAKE MICHIGAN AIR DIRECTORS CONSORTIUM

Topics

- Review different types of artificial intelligence (AI) tools that are applicable to air quality planning

- Explore examples of AI-use in air quality research and organizational management

- Large language model (LLM) best practices
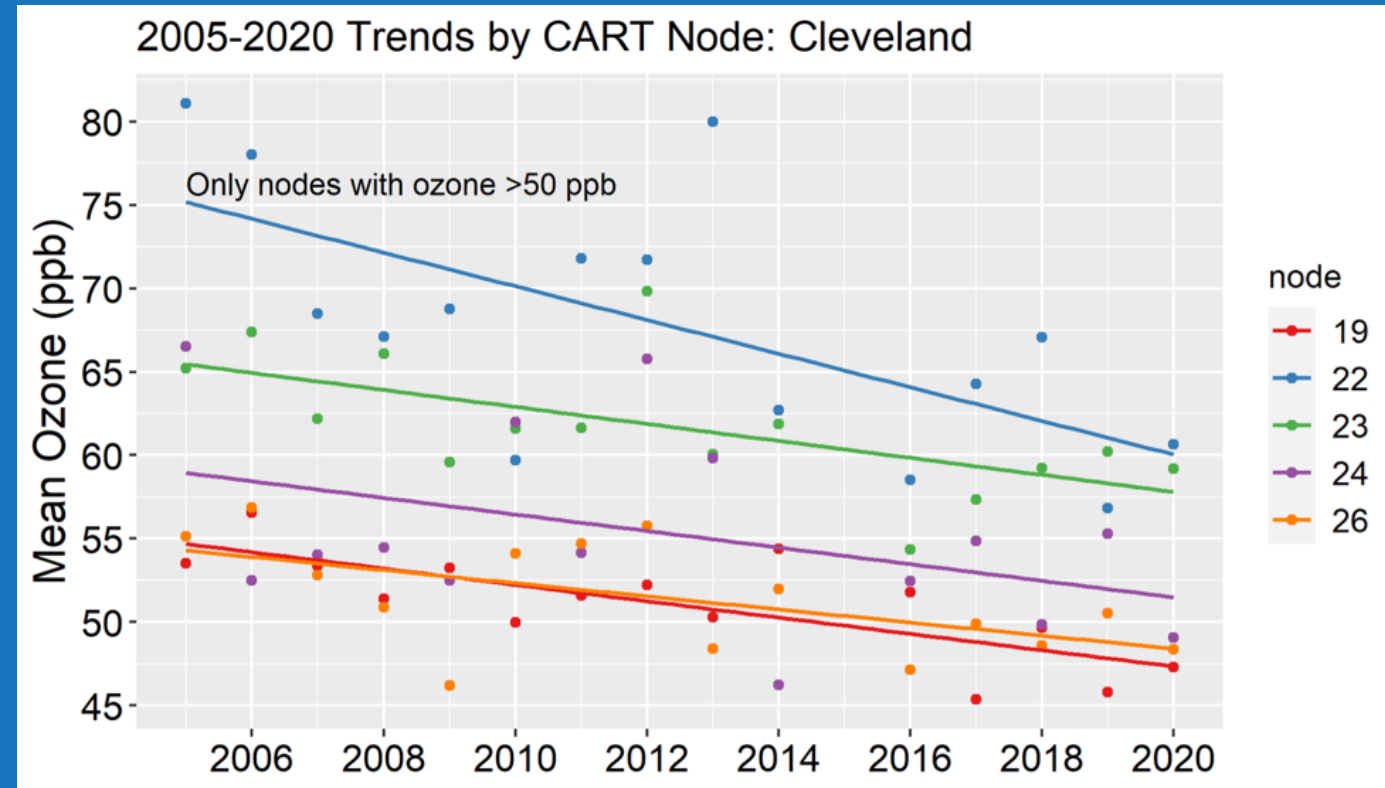
- AI considerations

AI Tools for Air Quality Planning
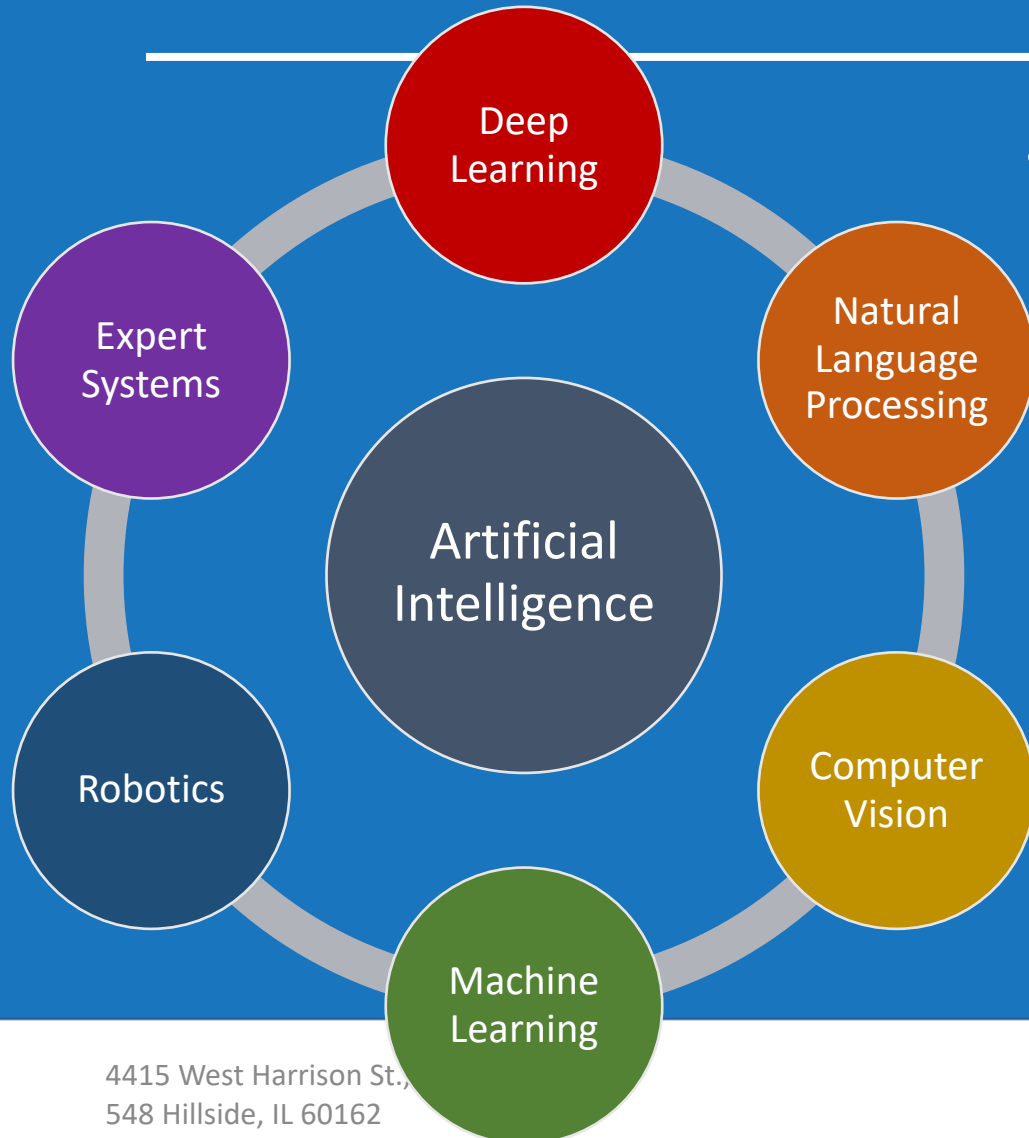
- AI application areas for air programs
  - <u>Operational</u>: human resource tools, chatbots for public engagement/outreach, large language models for comms, translation, automation of data QA or analysis, air quality alert triggers
  - <u>Technical</u>: pattern identification (trends or source attribution), predictions/forecasting, emissions reduction optimization strategies, satellite data/image processing

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Air Pollution Planning: AI Examples

- Predictive models
  - Machine learning
  - Classification and Regression Tree (CART), Generalized Linear Models (GLM)
- Uses
  - Classify and identify predictors of air pollution
  - Normalize trends
  - Estimate background conditions
  - Estimate smoke or dust impacts

2005-2020 Trends by CART Node: Cleveland

Only nodes with ozone >50 ppb

Mean Ozone (ppb)

node
- 19
- 22
- 23
- 24
- 26

Credit: Angie Dickens @ LADCO

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Public Outreach: AI Examples

- **Chatbots**
  - Provide real-time air quality updates and health advisories tailored to locations or user-needs
- **Natural Language Processing**
  - Develop public notices in multiple languages
  - Role-play audiences for public meetings to practice outreach messaging ("Sentient AI)

Air Pollution Planning: Coding and Visualization

- Chatbots like Chat-GPT write, debug, and optimize great software code!

- Ask a chatbot to review raw data and suggest the best way to visualize

- Port legacy code to new languages
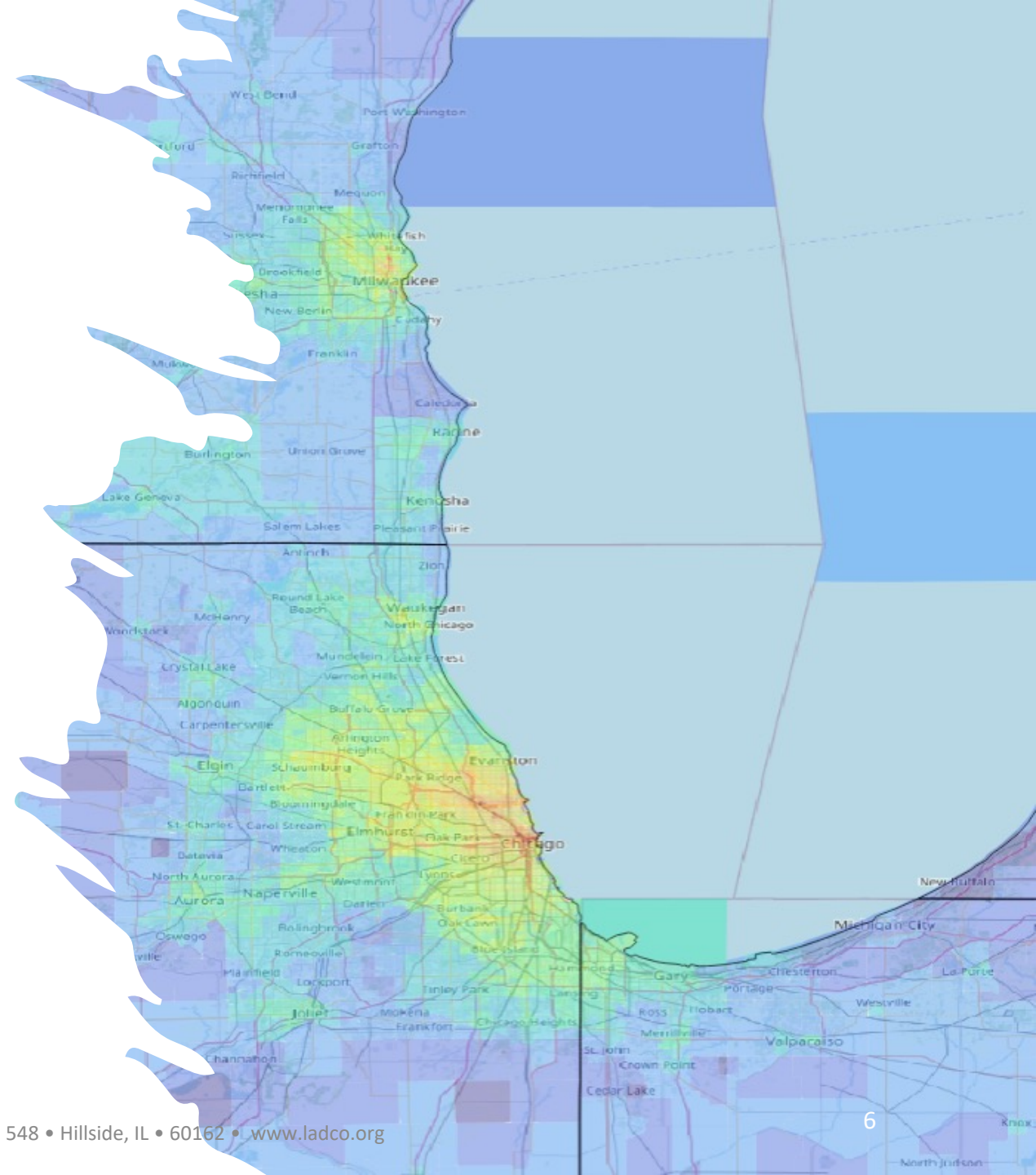
Why is the sky blue? Ask a Chatbot

- There are a growing number of code libraries to develop apps or interfaces to AI
  - GPT-3, GPT-4, BERT, LaMDA, BLOOM
- Chatbots: off-the-shelf websites that provide free or subscription access to large language models
  - Chat GPT, Google Gemini, Microsoft Copilot, Anthropic Claude

Chatbot Prompt Best Practices

Be specific
Vague questions will produce vague answers

Provide Context
Provide enough context so that the chatbot can give a meaningful answer

Natural Language
Address the bot like it's intelligent to get more accurate and useful responses

Style
Specify the preferred style of the response, e.g., formal, casual, educational

Objective
Indicate the intent of the content, e.g., press release or technical report

Role
Specify the role for the bot to assume, e.g., scientists or public relations officer

Tone
Tailor the question to the response, e.g., "Please suggest…" for a formal response

Avoid ambiguity
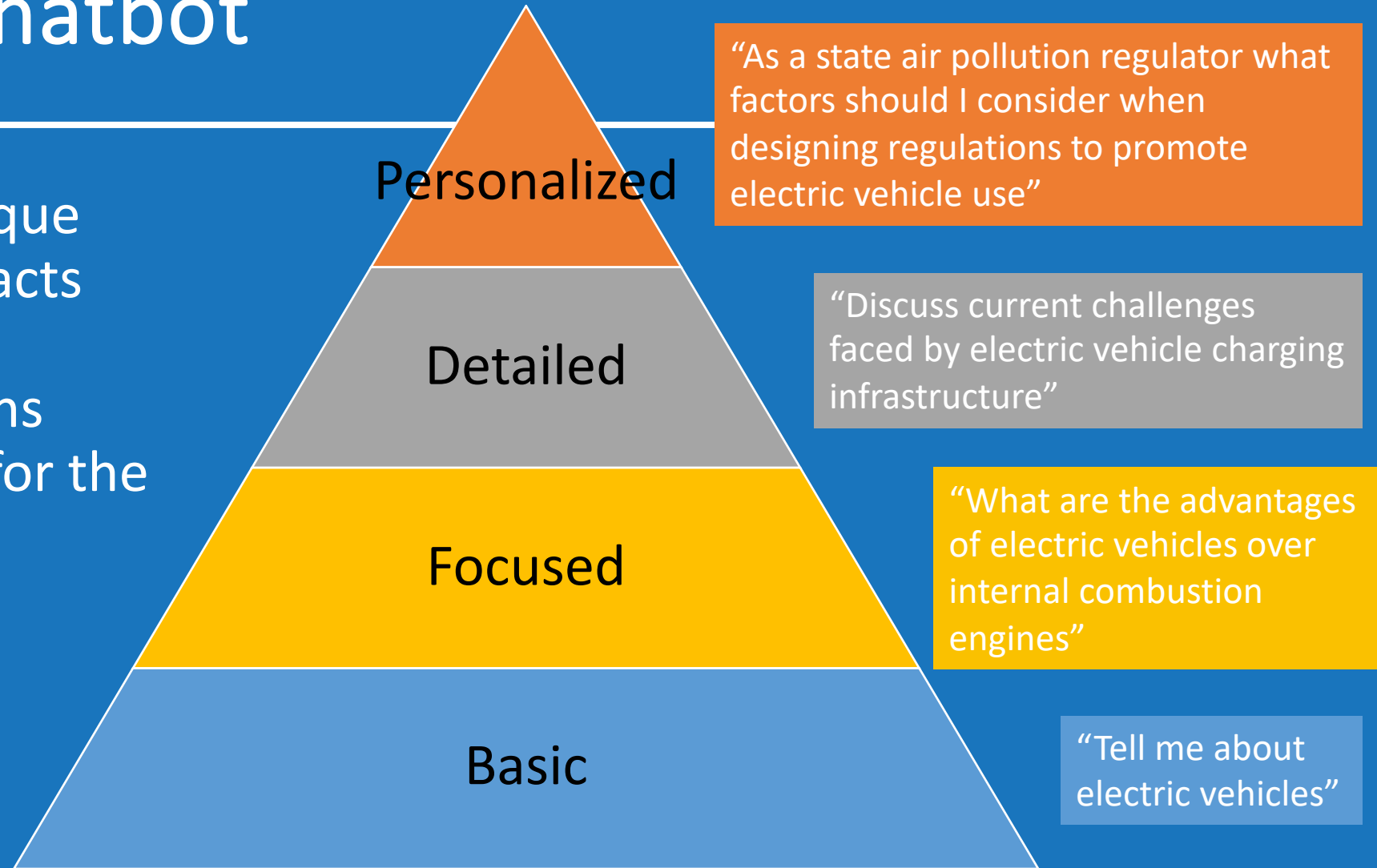Be specific and avoid words with multiple or nuanced meanings

Keywords
Key words will help the bot understand the context and train accordingly

Prime
Use simple questions in series to get more accurate responses

Sources: Amazon and LinkedIn

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Priming a Chatbot

- Priming is a technique where a user interacts with the LLM for a number of iterations before prompting for the desired output.
- Pyramid approach

Personalized

"As a state air pollution regulator what factors should I consider when designing regulations to promote electric vehicle use"

Detailed

"Discuss current challenges faced by electric vehicle charging infrastructure"

Focused

"What are the advantages of electric vehicles over internal combustion engines"

Basic

"Tell me about electric vehicles"

Source: Prompt Engineering Institute

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Hands On Exercises: Free Play Ideas

Draft permitting notice	Letter of Recommendation	Other application ideas
• Translate this notice to Arabic (copy and past into the chatbot)	• Tell me about the University of Michigan graduate program in environmental engineering • Write a letter of recommendation for the Master's program in environmental engineering	• Write software code, generate job interview questions, review or summarize text/articles, translation, blog content generation, meeting agenda organization, travel itinerary planning (Hint: ask ChatGPT for ideas)

Caveat Emptor

Hallucinations
- LLMs just make things up rather than acknowledging ignorance

Black box
- Exact details of how the models arrive at answers is unknown, even to the developers

Cost
- The amount of computation to train and run LLMs is massive and growing

Bias
- LLMs training on human language inherit biases from the data, e.g., wealthier countries publish more content
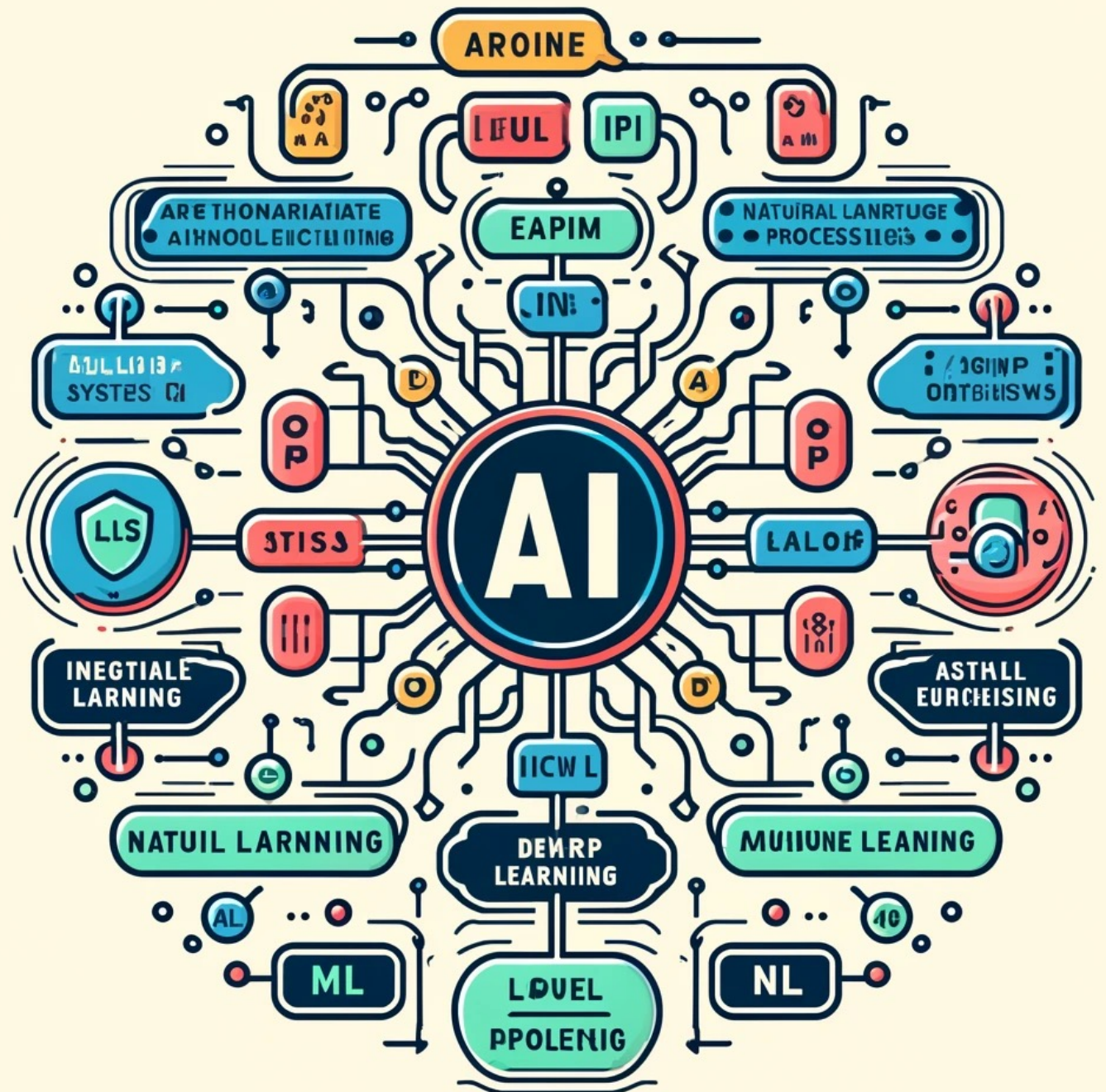
Intellectual property
- Who owns LLM-generated content?

Training Data
- LLM answers are only as good as the data on which they were trained

Me: Please generate a schematic that shows the relationship between AI, ML, language processing, and other types of AI?

ChatGPT4:

Summary

- AI is transforming the workplace

- Intentional planning is needed to harness it for your agency
  - Identify the opportunities
  - Integrate into your workflow

- Use it to help solve your organization's pain points
  - Don't know how to do this? Ask ChatGPT

- Air pollution planning is data and process heavy; complex and non-linear
  - We are an ideal space for AI and machine learning solutions

AI is a Tool

Find the right one
Learn how to use it
Apply it
Check the results
Integrate into your practice
Create new applications