Leveraging Azure AI and Python for Data-Driven Decision Making

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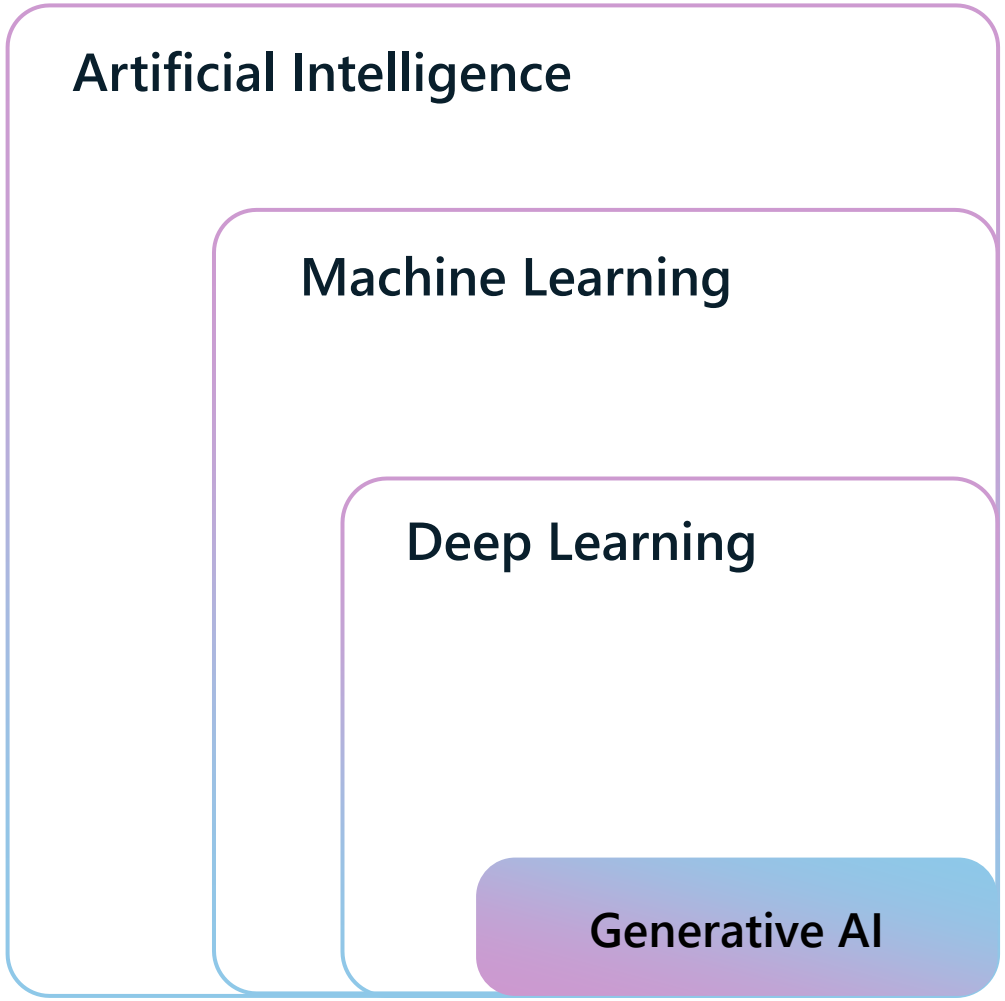
What are we going to discuss?

- Generative AI evolution
- Understand definitions of Generative AI (GenAI) key terms
- Why GenAI and **Your SQL Database?**

What are we going to demo?

- Copilot: Built-in capability to interact with SQL Server and LLM
  - SSMS
  - VS Code
  - Azure Portal
- Azure SQL Database
  - Keyword search with Large Language Model (LLM)
  - Integrated Vectorization, Semantic ranker using Azure AI Foundry
  - Vector Search using T-SQL
  - Chat with data utilizing LLM and Python notebooks
- SQL Server 2025
  - Vector data type (Preview)
  - OpenAI Vector Search using:
    - External rest endpoint
    - External Model
    - AI_GENERATE_EMBEDDINGS built-in function
    - VECTOR Index
    - VECTOR_SEARCH function

This is a new moment for AI



1950s

Artificial Intelligence

the field of computer science that seeks to create intelligent machines that can replicate or exceed human intelligence

1959

Machine Learning

subset of AI that enables machines to learn from existing data and improve upon that data to make decisions or predictions.

2017

Deep Learning

a machine learning technique in which layers of neural networks are used to process data and make decisions.

2021

Generative AI

create new written, visual, and auditory content given prompts or existing data.

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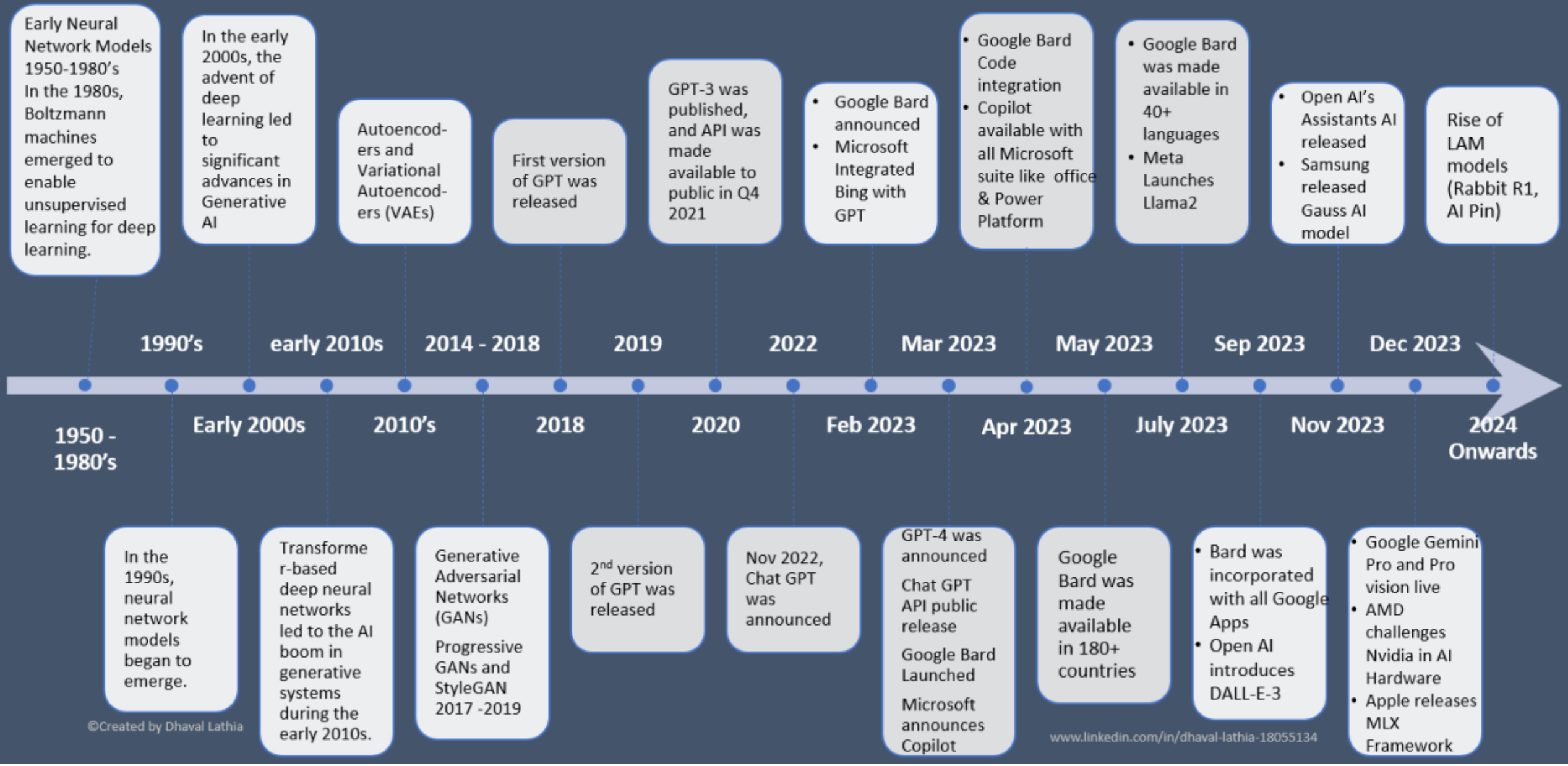
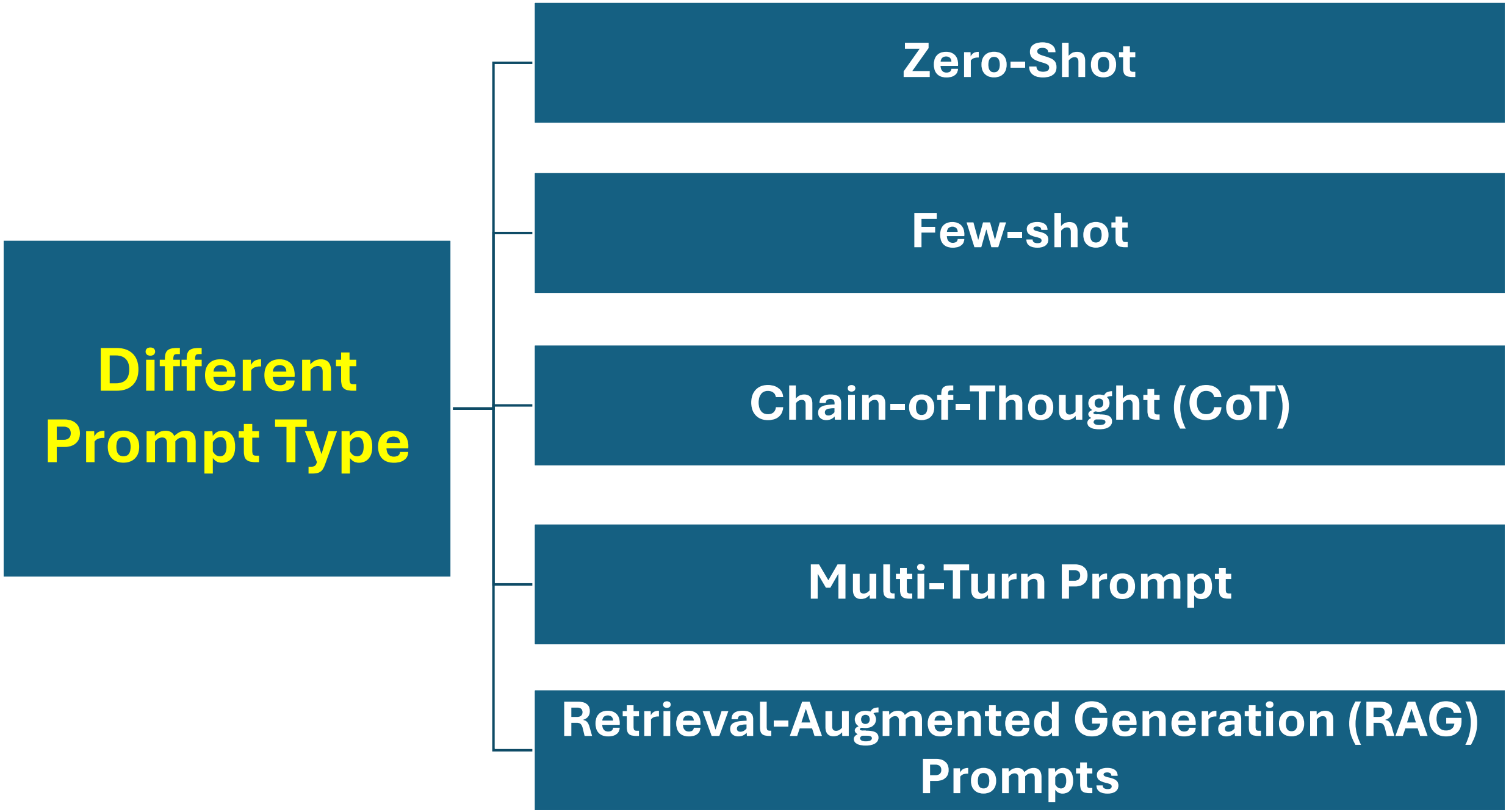
Evolution of Generative AI



https://www.linkedin.com/pulse/evolution-generative-ai-dhaval-lathia-cfnie/

PROMPT


Different Prompt Type
Zero-Shot
Few-shot
Chain-of-Thought (CoT)
Multi-Turn Prompt
Retrieval-Augmented Generation (RAG) Prompts

TOKEN


PROMPT
+
GROUNDING

RETRIEVAL AUGMENTED GENERATION (RAG)

VECTOR

EMBEDDING

Why Generative AI and **Your Data?**

Get smarter with your data

Precise

Tailored

Faster

Intelligent

Interactive

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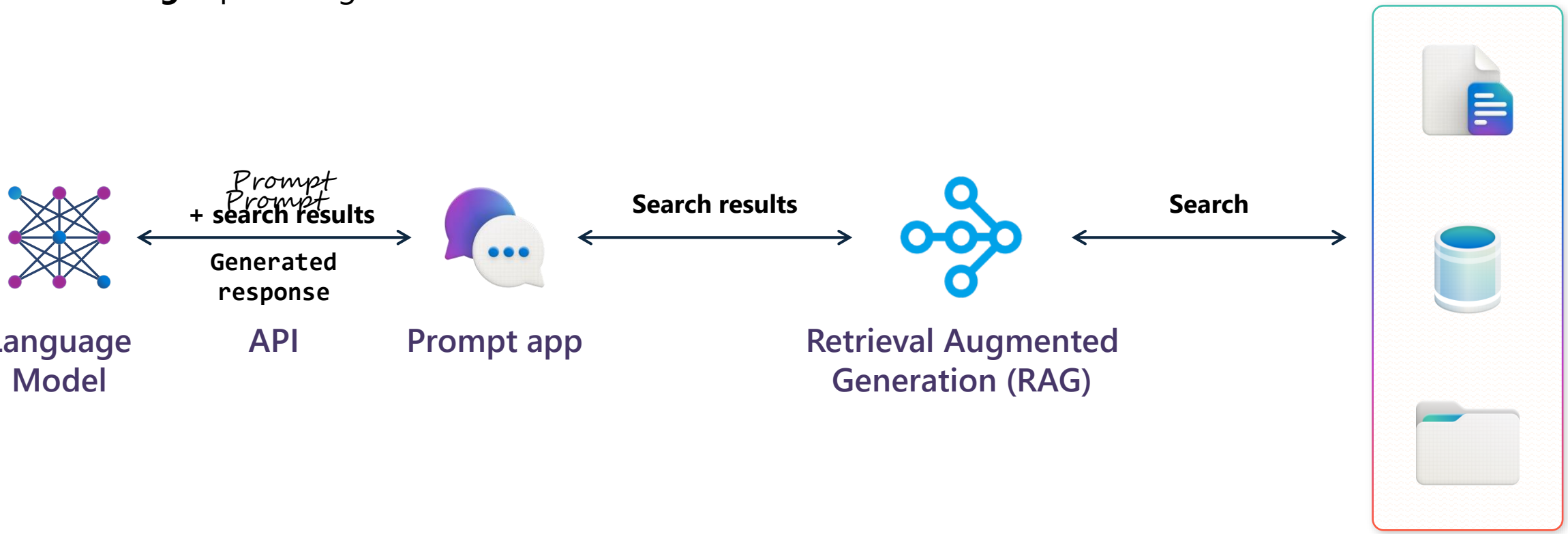
Let’s get grounded on prompts

Fine tuning = customizing a trained model
Grounding = providing additional context to a trained model



Prompt Engineering
Better prompt = better responses

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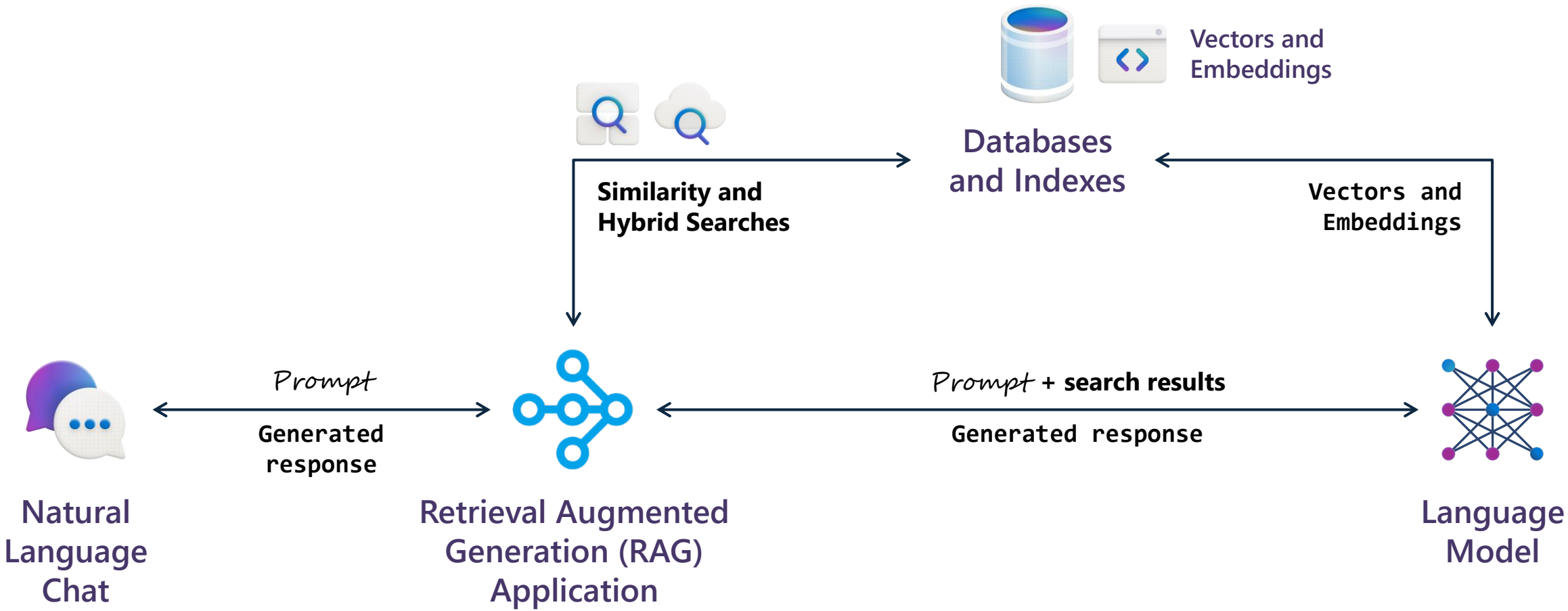
Building Generative AI applications with databases



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Vectors and Embeddings

Feature Vector

Ordered array of numbers typically created by a human to train a model

[Height, Weight, Age, Fur Length, Energy Level]

"dog"

Embedding

Vector generated by a model that has semantic meaning

```
dog: [0.9, 0.3, 0.2, ...]
Image of a dog: [0.9, 0.3, 0.2, ...]
puppy: [0.88, 0.33, 0.21, ...]

"I took the dog for a walk": [1.5, -0.8, 2.1, ...]
```

 "dog"

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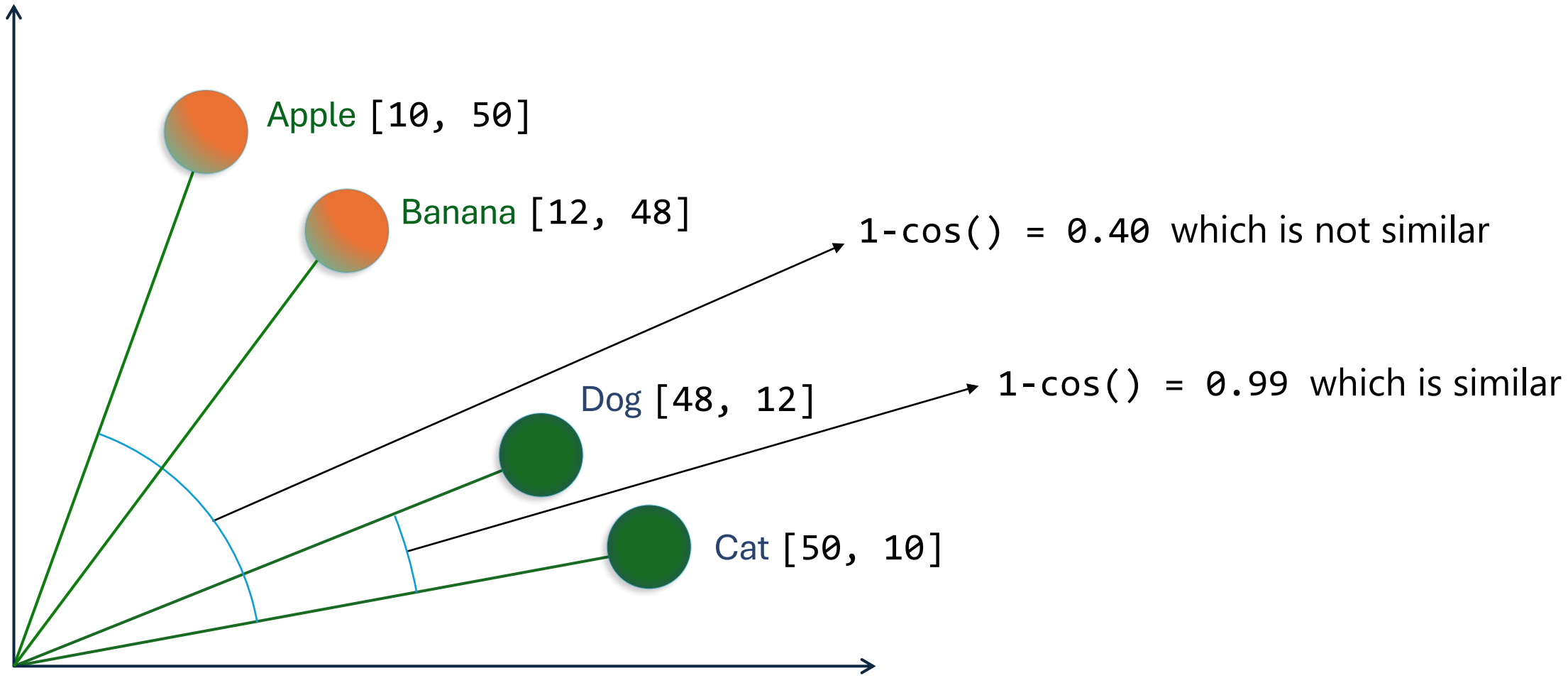
Similarity Searching using Cosine



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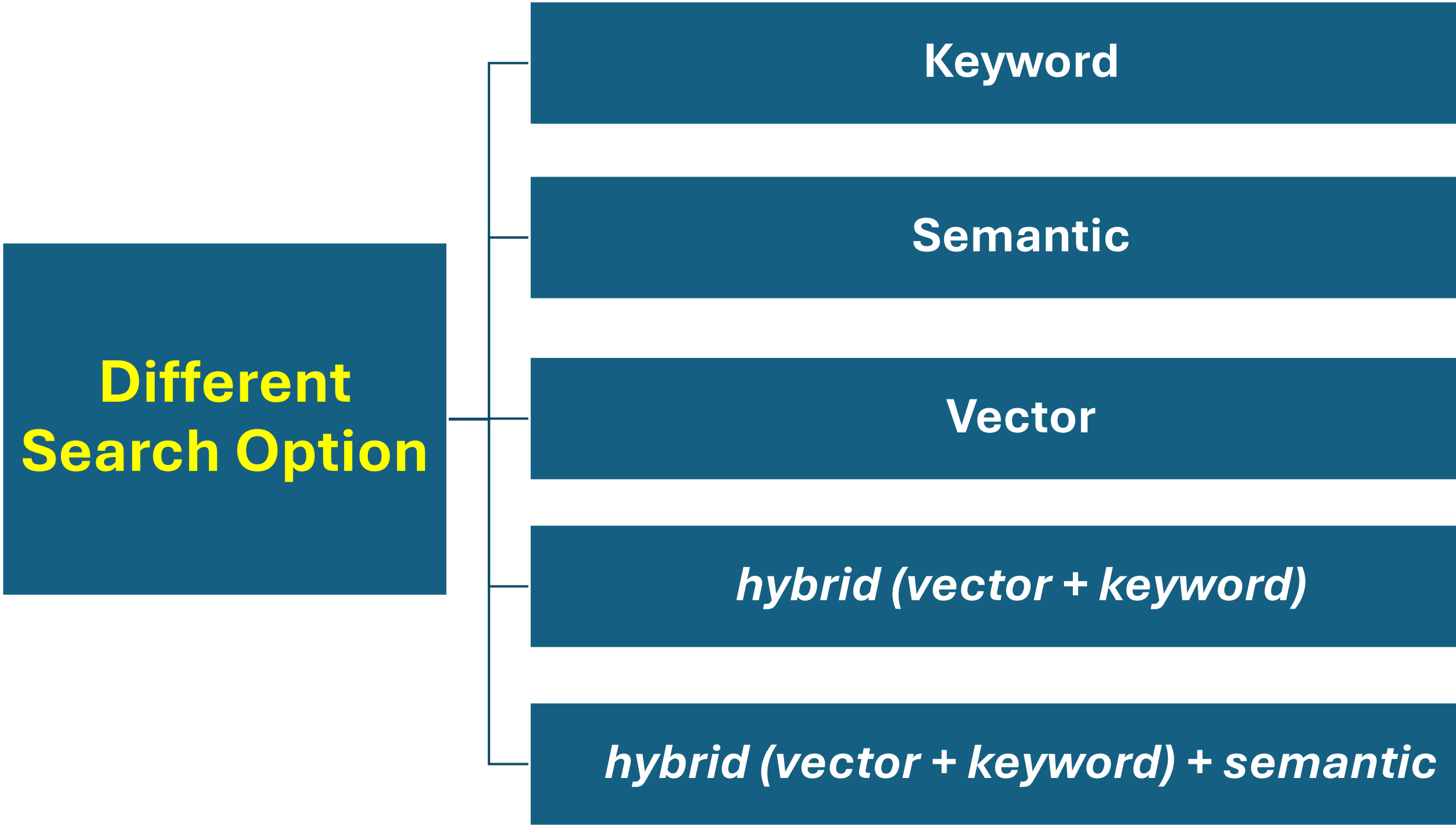
Different Search Option
Keyword
Semantic
Vector
hybrid (vector + keyword)
hybrid (vector + keyword) + semantic

Feature / Type	Keyword Search	Semantic Search	Vector Search
Goal	Match exact words	Match user intent & meaning	Find similar meanings via vector similarity
Tech Behind	Text matching, inverted index	AI models + embeddings	Vector DBs + similarity search
Understands Synonyms?	❌ No	✅ Yes	✅ Yes
Example Query	"bake a chocolate cake"	"make a cocoa dessert"	→ both mapped to similar vectors
Data Format	Raw text	Text + embeddings	Embedding vectors (e.g., 768-d float arrays)
Search Method	Match words	Compare intent	Find closest vectors in embedding space
Speed	⚡ Fast	⚡⚡ Fast	⚡⚡⚡ Fast
Use Case Fit	Simple search, filters	Natural queries, chatbots	Core engine for semantic & AI-powered search

Why use LLM over built-in SQL Server Semantic Search?

- Natural Language Understanding
- Flexibility and Adaptability
- Enhanced Data Integration
- Advanced Analytics
- Interactive and Conversational
- Scalability


Download

DEMO

Azure Portal
SSMS V21
Visual Studio Code

Reference

- Install Copilot in SQL Server Management Studio
- SQL AI Workshop
- Intelligent applications
- SQL-AI-samples
- azure-sql-db-vector-search
- Vector Search with Azure SQL Database by Muazma Zahid
- Integrated data chunking and embedding in Azure AI Search
- Vector Similarity Search with Azure SQL database and OpenAI by Davide Mauri
- VECTOR_DISTANCE (Transact-SQL)
- Vector data type
- Indexers in Azure AI Search

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THANK
YOU

Reference Slide

Prompt Type	Definition	Example
Zero-Shot Prompts	Tells the model: "Do the thing I want."	Create a recipe for chocolate chip cookies. List all ingredients and steps.
Few-Shot Prompts	Tells the model: "Do the thing I want, here are some examples."	Create a recipe for chocolate chip cookies. Here's an example recipe for oatmeal raisin cookies. Now, create the chocolate chip cookie recipe.
Chain-of-Thought (CoT) Prompts	Directs the model to reason before answering.	Imagine you are creating a recipe. Think through the ingredients and steps before finalizing the recipe. Now, write the complete recipe for chocolate chip cookies.
Multi-Turn Prompts	Involves a back-and-forth interaction where the model builds on previous responses.	User: How do I make chocolate chip cookies? AI: First, gather your ingredients. User: Great, what's the first step? AI: Preheat your oven to 350°F.
Retrieval-Augmented Generation (RAG) Prompts	Involves retrieving information from a database or document to help generate a response.	Using the provided document on baking techniques, answer: What are the best practices for making chewy chocolate chip cookies?

Search option	Retrieval type	Additional pricing?	Benefits
keyword	Keyword search	No additional pricing.	Performs fast and flexible query parsing and matching over searchable fields, using terms or phrases in any supported language, with or without operators.
semantic	Semantic search	Additional pricing for semantic search usage.	Improves the precision and relevance of search results by using a reranker (with AI models) to understand the semantic meaning of query terms and documents returned by the initial search ranker
vector	Vector search	Additional pricing on your Azure OpenAI account from calling the embedding model.	Enables you to find documents that are similar to a given query input based on the vector embeddings of the content.
hybrid (vector + keyword)	A hybrid of vector search and keyword search	Additional pricing on your Azure OpenAI account from calling the embedding model.	Performs similarity search over vector fields using vector embeddings, while also supporting flexible query parsing and full text search over alphanumeric fields using term queries.
hybrid (vector + keyword) + semantic	A hybrid of vector search, semantic search, and keyword search.	Additional pricing on your Azure OpenAI account from calling the embedding model, and additional pricing for semantic search usage.	Uses vector embeddings, language understanding, and flexible query parsing to create rich search experiences and generative AI apps that can handle complex and diverse information retrieval scenarios.

https://learn.microsoft.com/en-us/azure/ai-services/openai/concepts/use-your-data?tabs=ai-search%2Ccopilot#search-types

- **Natural Language Understanding**: Excels at interpreting context and nuances in user queries.
- **Flexibility and Adaptability**: Can be fine-tuned for specific tasks and domains, offering high accuracy.
- **Enhanced Data Integration**: Processes data from multiple sources, including unstructured data.
- **Advanced Analytics**: Performs sentiment analysis, entity recognition, summarization, and more.
- **Interactive and Conversational**: User-friendly for non-technical users, enabling intuitive interactions.
- **Scalability**: Efficiently handles large volumes of data and queries, suitable for enterprise-level applications.