Knowledge Graphs: Connecting the Dots for Smarter AI

Making AI Smarter with Linked Information

Today's Agenda

Understanding Knowledge Graphs

What they are and why they matter

AI Applications

How they make AI smarter and more useful

Healthcare Focus

Real-world applications in medical settings

Interactive Exploration

Building connections together

The Problem: Information Overload

In today's digital world:

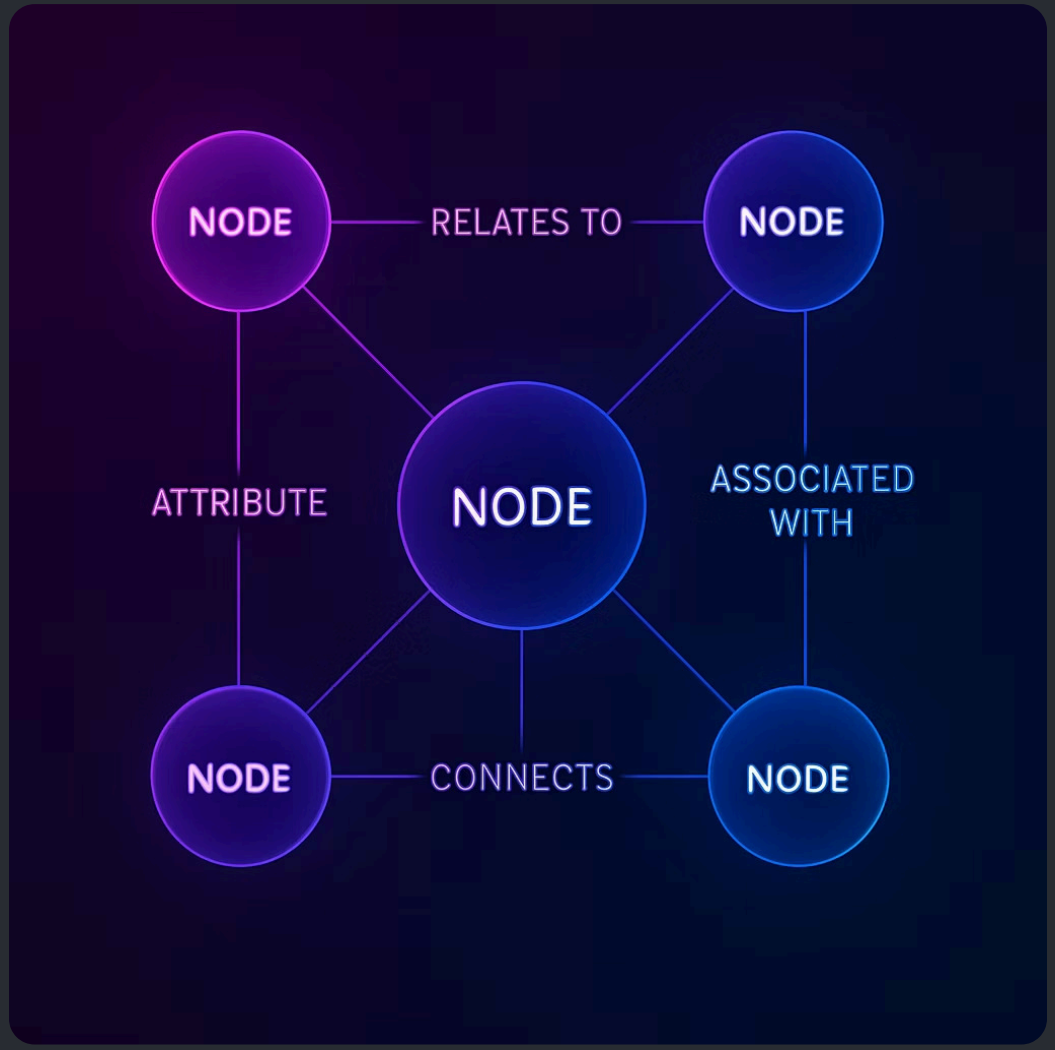
- Information is scattered and disconnected
- Data exists in isolated silos
- Context is often missing
- Humans naturally connect ideas, but traditional AI struggles

Knowledge Graphs: A Definition

A **knowledge graph** is a network that represents information as:

- **Nodes**: Entities or things (people, places, concepts)
- **Edges**: Relationships between things (connects, treats, located in)

Think of it as a giant mind map for computers that mirrors how our brains connect ideas.



Like Our Brain's Connections

Human Brain

Connects related concepts and ideas naturally

Knowledge Graph

Mimics this connection pattern in a structured way

AI System

Uses these connections to understand context and meaning

This approach helps AI "think" more like humans by making meaningful connections between pieces of information.

Context Matters: Apple vs apple

Without Context

AI might confuse:

- Apple (technology company)
- apple (fruit)

Without connections, words are just isolated symbols.

With Knowledge Graph

AI understands relationships:

- Apple → founded by → Steve Jobs
- Apple → creates → iPhone
- apple → type of → fruit
- apple → grows on → tree

How Knowledge Graphs Make AI Smarter

Faster Fact Retrieval

Pre-linked information allows for immediate access to facts without searching the entire internet for each query.

Contextual Understanding

Relationships between entities help AI disambiguate terms and understand user intent more accurately.

Inferential Reasoning

If A→B and B→C in the graph, AI can infer A→C, discovering non-obvious connections.

Real-World Example: Google Search

Google's Knowledge Graph:

- Launched in 2012
- Contains over 500 million facts
- Connects billions of entities and relationships
- Powers the knowledge panels you see in search results

This is why Google can often answer your question directly - the facts are stored in a connected way.

Everyday Encounters with Knowledge Graphs

Search Engines

Quick answers and rich information boxes powered by knowledge graphs

Voice Assistants

Siri and Alexa rely on knowledge graphs to answer factual questions

E-Commerce

"Frequently bought together" suggestions based on product relationship graphs

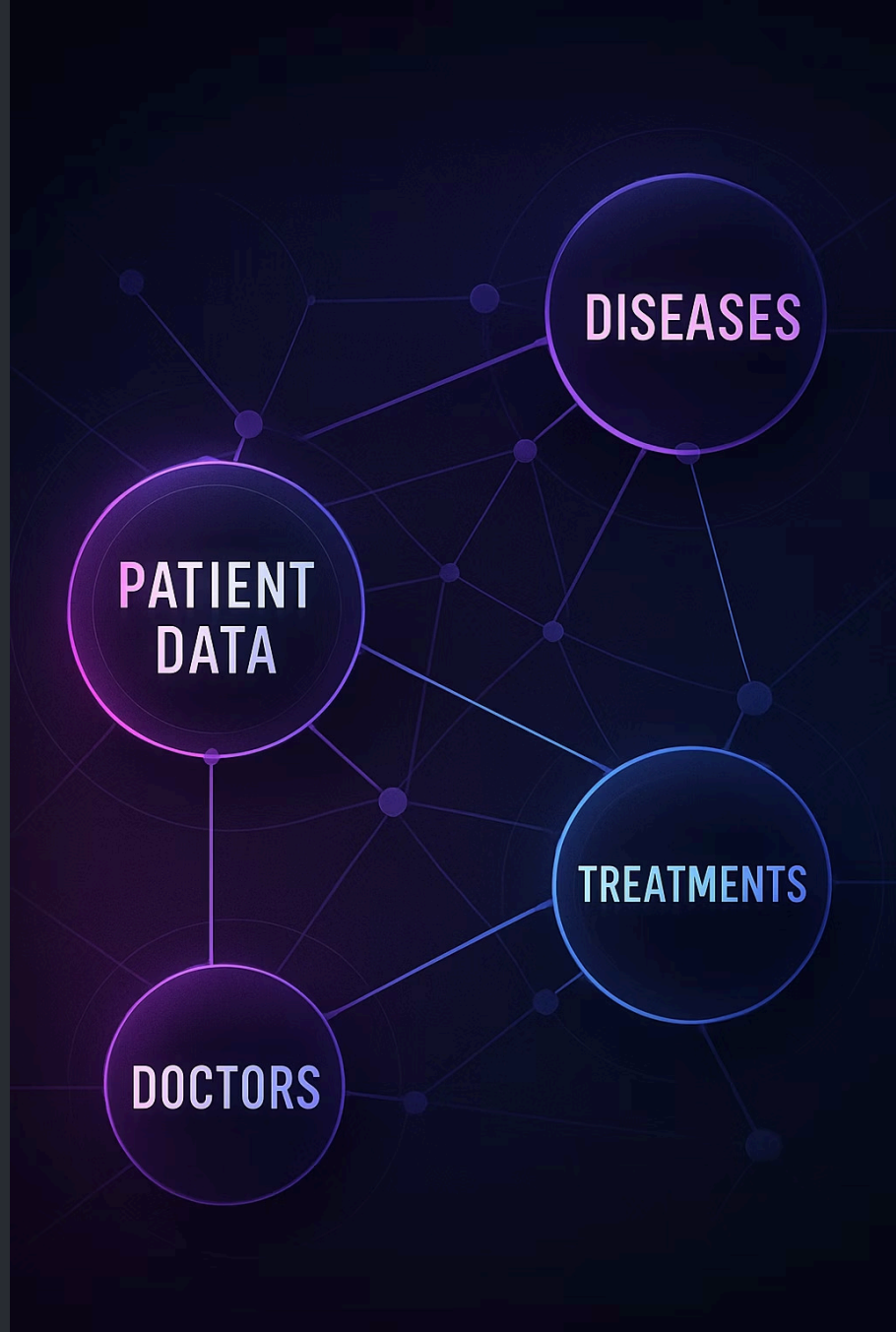
Streaming Services

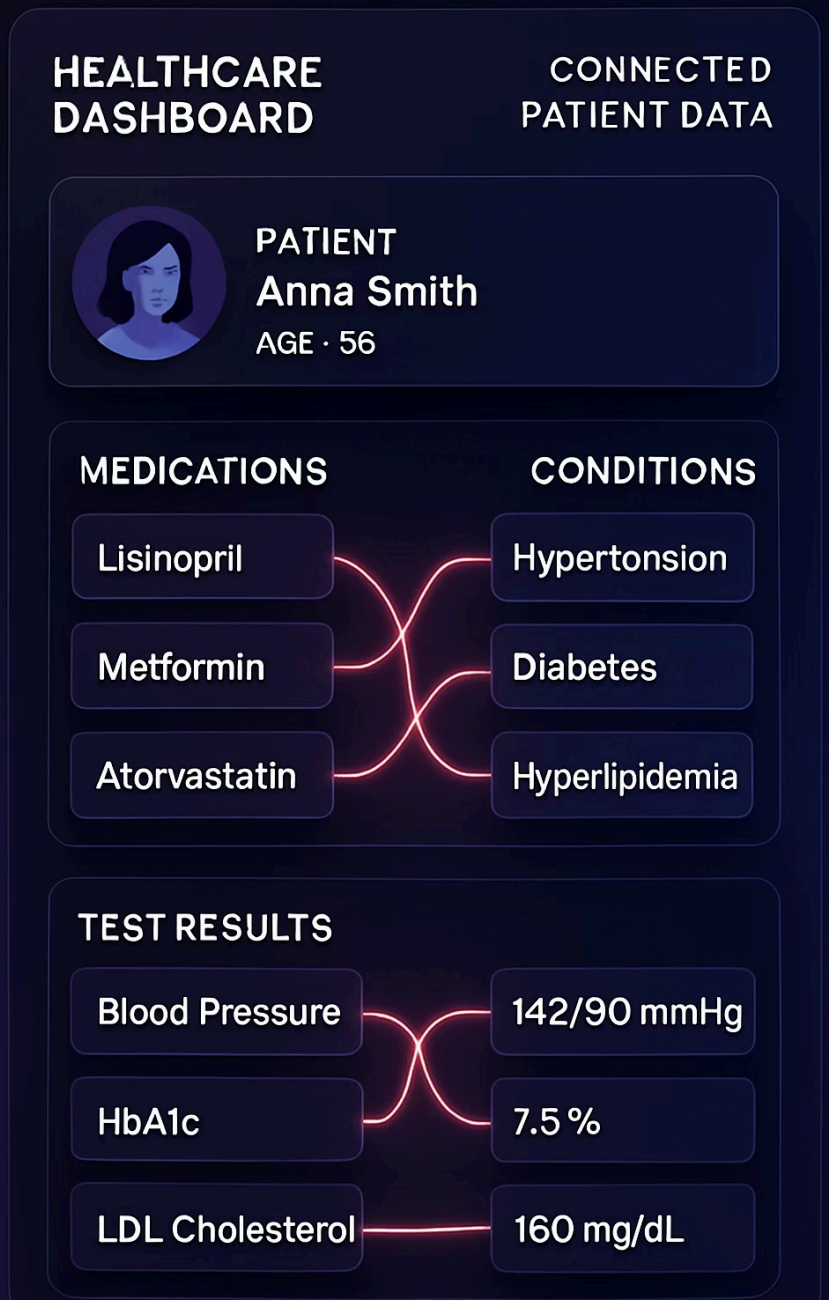
Netflix recommendations connect your preferences to content through complex relationship maps

Knowledge Graphs in Healthcare

Healthcare presents a perfect case for knowledge graphs:

- Massive amounts of complex, interconnected medical data
- Critical need to connect patient information to medical knowledge
- Life-saving potential when patterns are recognised





Healthcare Use Case 1: Patient 360° View

The Challenge

Patient data is typically fragmented across different systems:

- Doctor notes in one system
- Lab results in another
- Medications in pharmacy records

Knowledge Graph Solution

Link all patient data in one comprehensive network:

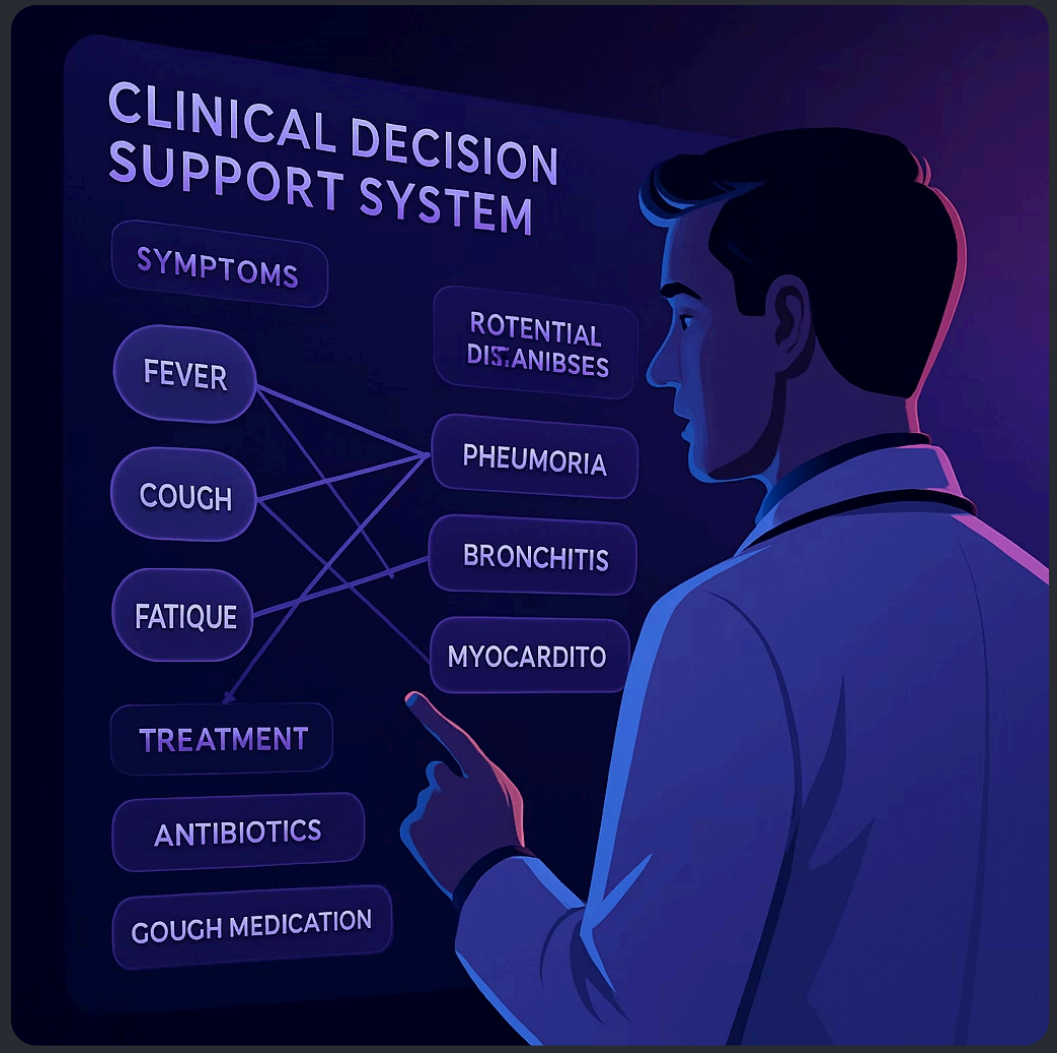
- Connect conditions, medications, allergies, test results
- Automatically flag potential conflicts (e.g., drug allergies)
- Create a holistic view of the patient's health

Healthcare Use Case 2: Clinical Decision Support

Knowledge graphs help doctors diagnose and treat by:

- Storing medical guidelines as connected facts
- Linking symptoms → conditions → treatments
- Providing evidence-based recommendations

Example: For a diabetic patient, the graph might link high blood sugar + other symptoms to suggest checking for complications and recommend guideline-approved treatments.



Healthcare Use Case 3: Drug Discovery

Research Data Integration

Connect genes, diseases, proteins, and existing drugs from thousands of research papers

Drug Repurposing

Test promising candidates identified through graph analysis, accelerating the discovery process

Pattern Analysis

Identify hidden relationships and potential pathways between seemingly unrelated entities

New Insights

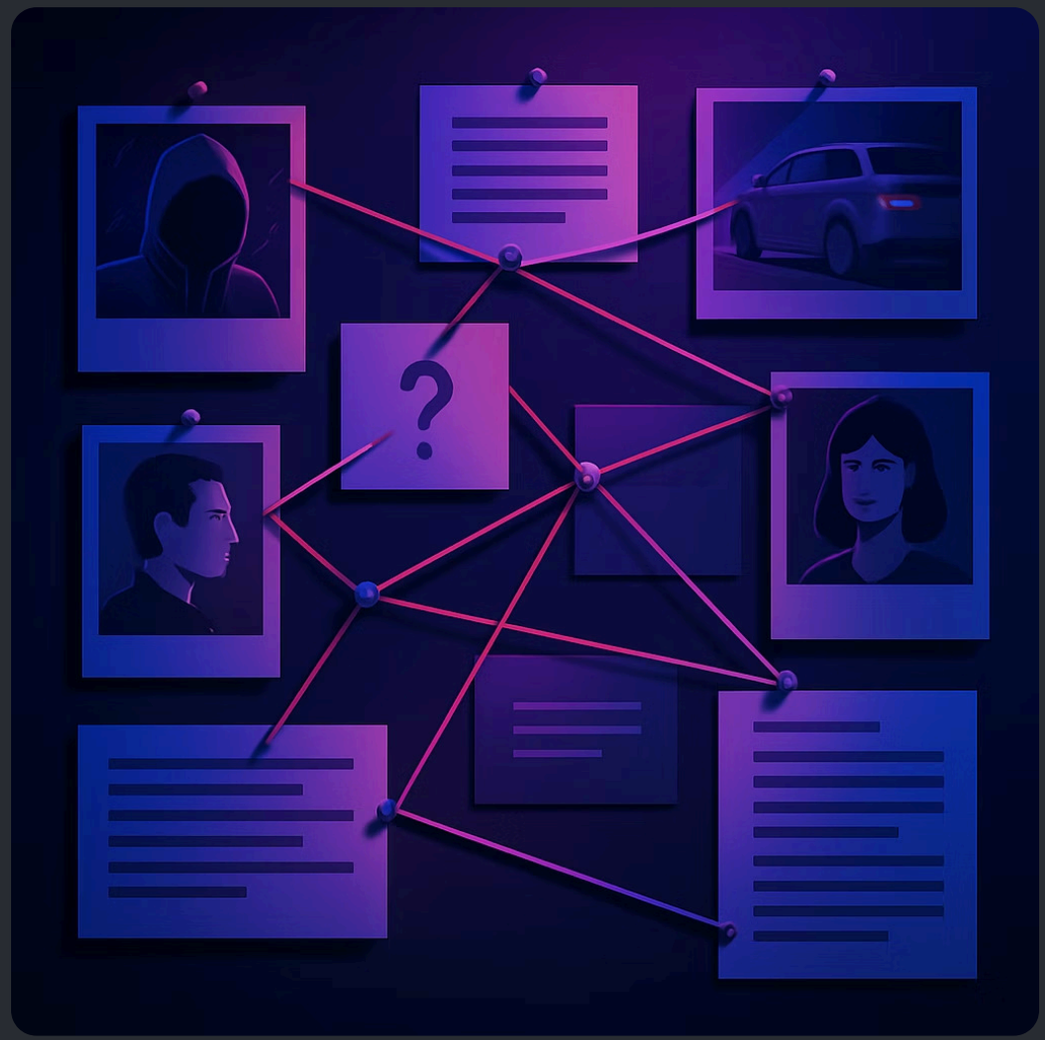
Discover non-obvious connections, such as existing drugs that might treat different conditions

Example: A graph analysis might find a link between Alzheimer's disease and a compound used in a cancer drug, suggesting new treatment possibilities.

The Detective Analogy

A knowledge graph works like a detective's investigation board:

- Individual clues (facts) are pinned to the board
- String connects related clues (relationships)
- Patterns emerge when viewing the whole board
- New connections reveal hidden insights



Just as a detective "connects the dots" to solve a case, knowledge graphs connect information to uncover answers.

Interactive Demo: Building a Mini Knowledge Graph

Pick Two Topics

Choose two seemingly unrelated topics (e.g., "chocolate" and "Olympics")

Identify Entities

Break down each topic into key entities (nodes)

Create Connections

Draw relationships (edges) between related entities

Find Paths

Discover how the two topics connect through intermediate nodes

Visual Analogy: The Knowledge Web

Knowledge graphs can be visualised as:

- **A spider's web** where each strand strengthens the whole structure
- **A constellation** where individual stars form meaningful patterns when connected
- **A city map** showing how to navigate from one location to another

These analogies help us understand how isolated facts become meaningful when properly connected.

A Day in the Life: Knowledge Graphs in Action

Morning

Jane asks her voice assistant about the weather. A knowledge graph connects her location to current weather data.

1

Midday

She searches for symptoms online. A medical knowledge graph helps identify possible conditions and suggests consulting her doctor.

2

Afternoon

Her doctor uses a clinical knowledge graph to identify potential drug interactions with Jane's current medications.

3

Evening

Jane watches a film recommended by her streaming service based on a knowledge graph of her preferences.

4

Knowledge graphs silently power many of our daily interactions with technology.

Benefits of Knowledge Graphs for AI

1

Enhanced Accuracy

Context-aware responses with fewer errors and misunderstandings

2

Deeper Understanding

AI that can reason about information rather than just retrieve it

3

Improved Transparency

Clear sources of information and reasoning paths that can be verified

4

Continuous Learning

New information can be integrated into the existing knowledge structure

Summary: Connecting the Dots

Knowledge Graphs:

- Organize information as a network of connected facts
- Provide context and meaning beyond isolated data points
- Make AI more accurate, helpful, and trustworthy
- Power applications from search engines to healthcare systems

By connecting the dots between pieces of information, knowledge graphs help solve the "data puzzle" and unlock new insights.

Resources & Next Steps

Learn More

- Wikidata Query Service - explore a public knowledge graph
- Google's Knowledge Graph Search API documentation
- Open research papers on healthcare knowledge graphs

Start Building

- Neo4j Graph Database - free community edition
- Protégé - open-source ontology editor
- Python libraries: NetworkX, RDFLib

Questions? Contact us at knowledge-graphs@example.com

Thank you for joining us today!