



TEXT TO INTELLIGENCE – THE FUTURE OF KNOWLEDGE GRAPHS

Dr Robert Hercock, Chief Research Scientist, British Telecommunications Security Research Practice

Webinar

Monday, 12 April 2021, 11:00 BST

A Word From Today's Chairman



Professor Michael Mainelli

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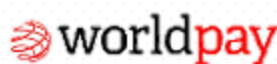
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Today's Agenda



- 11:00 – 11:05 Chairman's Introduction
- 11:05 – 11:25 Keynote Presentation – Dr Robert Hercock
- 11:25 – 11:45 Questions & Answers

Today's Speakers



Dr Robert Hercock

Chief Research Scientist

British Telecommunications Security Research Practice

Poll 1: What is the most promising application for Knowledge Graphs?

- A. Enterprise search
- B. Graph Databases
- C. AI Enhancement
- D. Data governance
- E. Salmon fishing

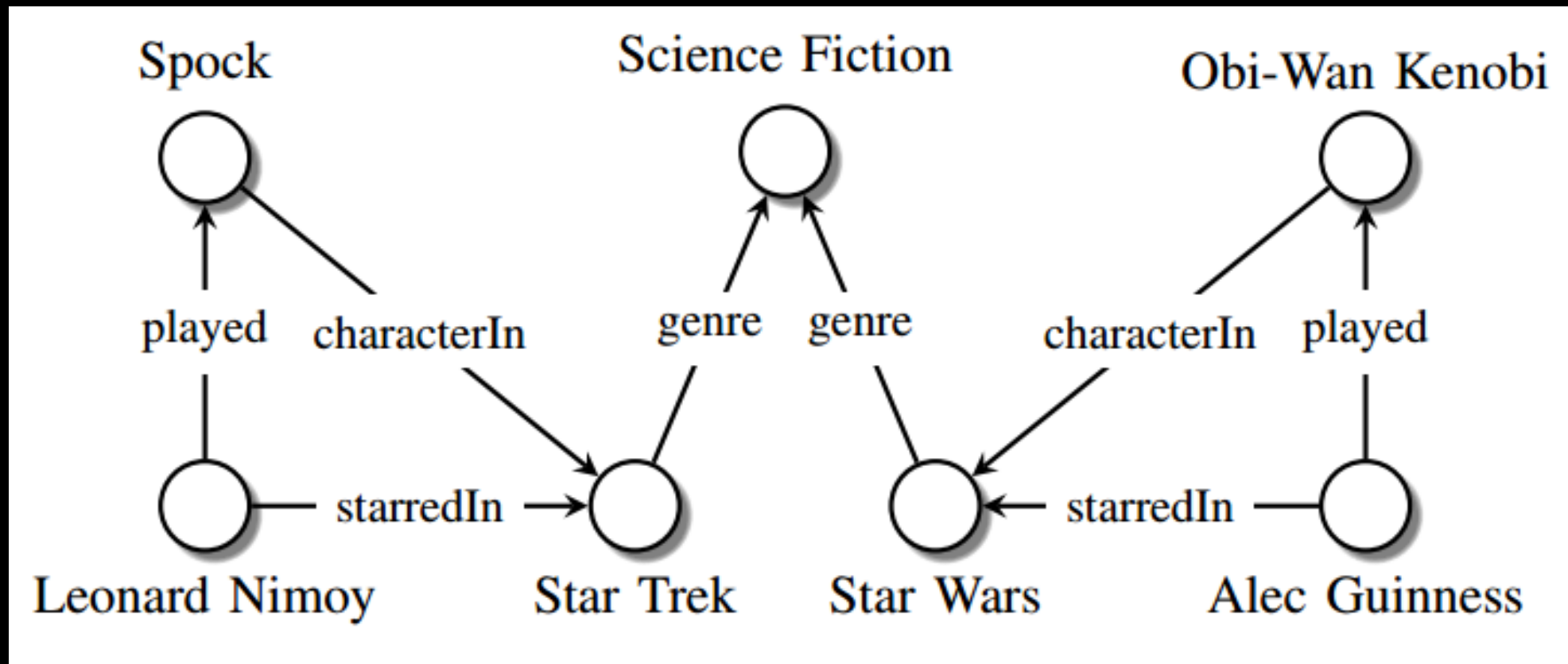
Text to Knowledge

Dr Robert Hercock

April 2021

History

- In 1960, Semantic Networks were invented to address the growing need for a knowledge representation framework that can capture a wide range of entities
- In 2001, Tim Berners-Lee coined the term Semantic Web which is an application of Semantic Network combined with the Web.



Knowledge Graphs

- A collection of interlinked descriptions of entities – objects, events or concepts.
- Descriptions have formal semantics that allow both people and computers to process them in an efficient and unambiguous manner;
- Entity descriptions contribute to one another, forming a network, where each entity represents part of the description of the entities related to it, and provides context for their interpretation.
- Knowledge graphs, represented in RDF, provide the best framework for data integration, unification, linking and reuse
- Google Knowledge Graph. Google made this term popular with the announcement of its knowledge graph in 2012.
- <https://blog.google/products/search/introducing-knowledge-graph-things-not/>

Old School method

- A graph with nodes and edges is the best method to represent knowledge through language. This is because every piece of knowledge has entities and each entity is related to another in some fashion. The “connections” between the different entities hold key information on the knowledge represented.
- By linguistic definition, a relationship can be found between two entities that are proper nouns (PROPN), one which is a subject (nsubj) and the other being an object (pobj), connected by a preposition (prep) which is the actual “relation”
- A knowledge graph organises data according to an ontology
- I.e. the schema of the knowledge graph
- Knowledge graphs can be created from scratch, e.g., by domain experts, learned from unstructured or semi-structured data sources, or assembled from existing knowledge graphs, typically aided by various semi-automatic or automated data validation and integration mechanisms.

Definition

- “A knowledge graph consists of a set of interconnected typed entities and their attributes.”

Gomez-Perez et al. [Gomez-Perez et al., 2020]

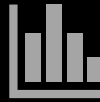
- **Ontology vs Knowledge Graphs**

<https://medium.com/predict/where-ontologies-end-and-knowledge-graphs-begin-6fe0cdede1ed>

Why?



Benefit > knowledge graphs able to find new information that is not explicitly available



Able to derive using an ontology and data within the knowledge graph



Maps to human style of knowledge reasoning



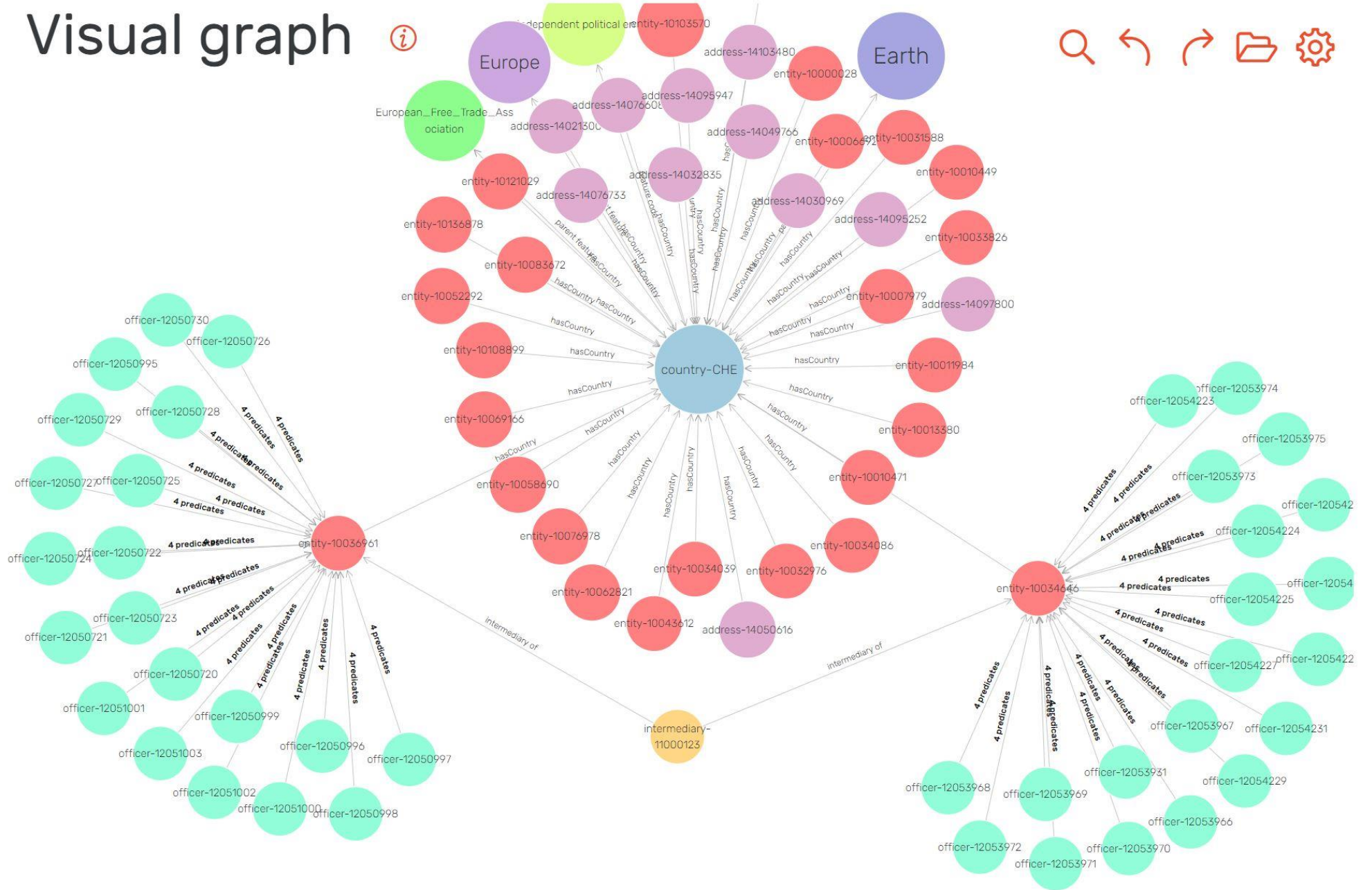
Inherently visual output if required

Poll 2: Which industries will benefit most from Knowledge Graphs?

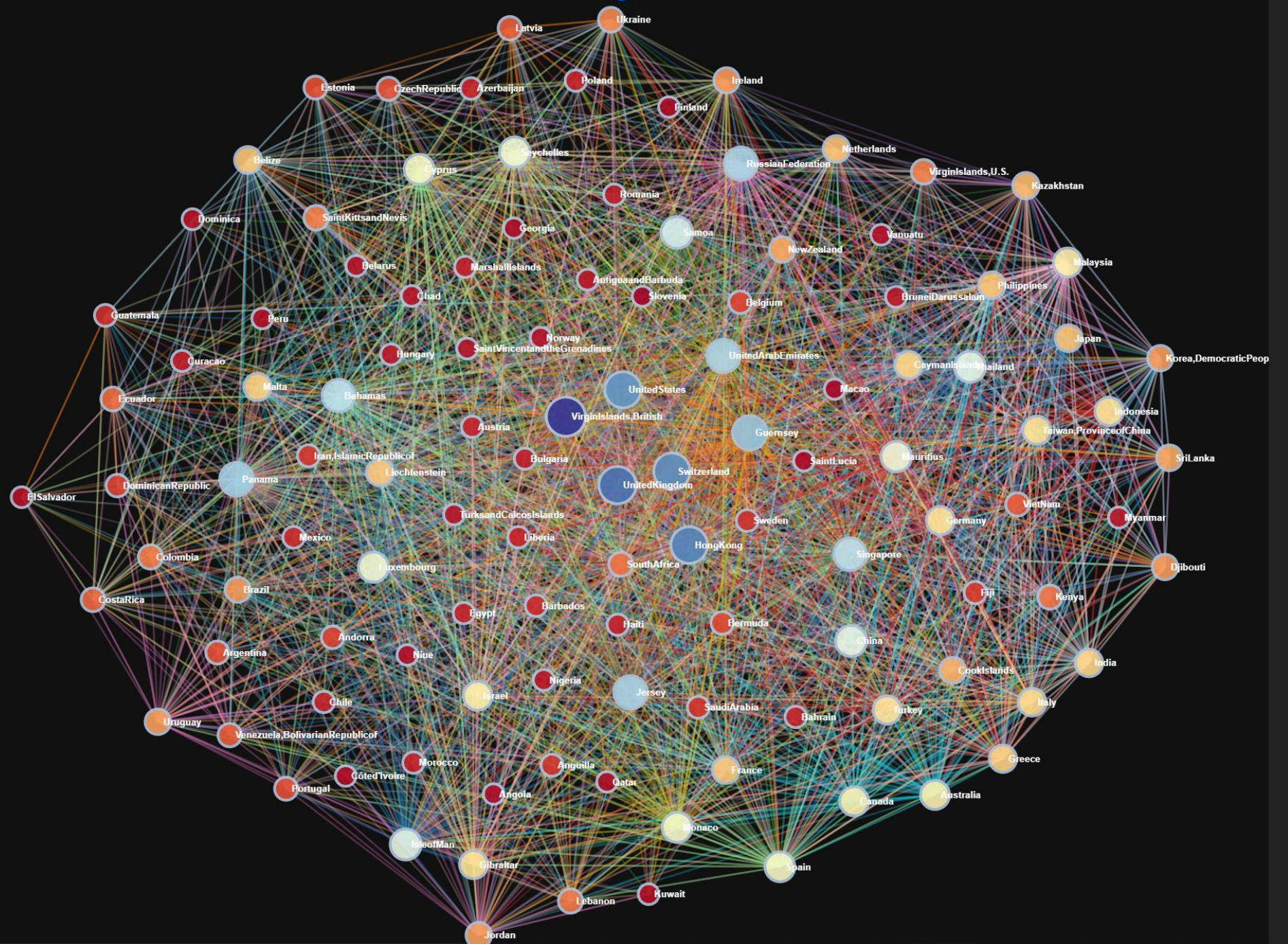
- A. Finance
- B. Insurance
- C. ICT
- D. Health/Pharma
- E. Space Tourism

Panama Leak papers

Visual graph



Links between states in Panama papers



Poll 3: What are the main challenges in deploying Knowledge Graphs?

- A. Data cleaning/preparation
- B. Shortage of skilled people
- C. Lack of enterprise awareness of potential
- D. Automating creation and maintenance
- E. Brexit

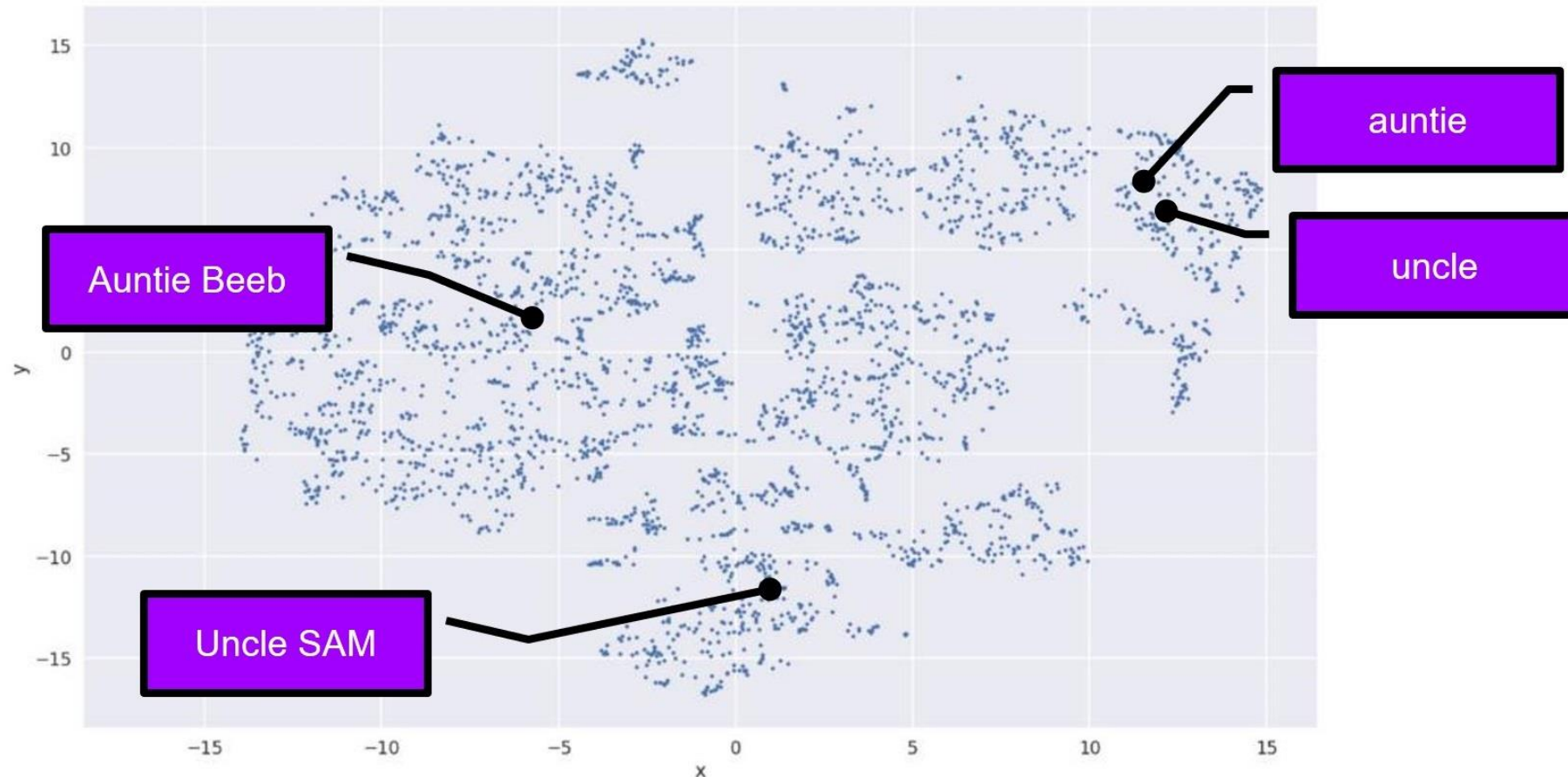
Next Generation > NLP > Graphs

- Building KG is hard. Lets automate the process.
- Past decade has seen explosion in AI and NLP capabilities
- NLP can now digest large volumes of unstructured text and mine it for structured KG
- Still challenging but more fun

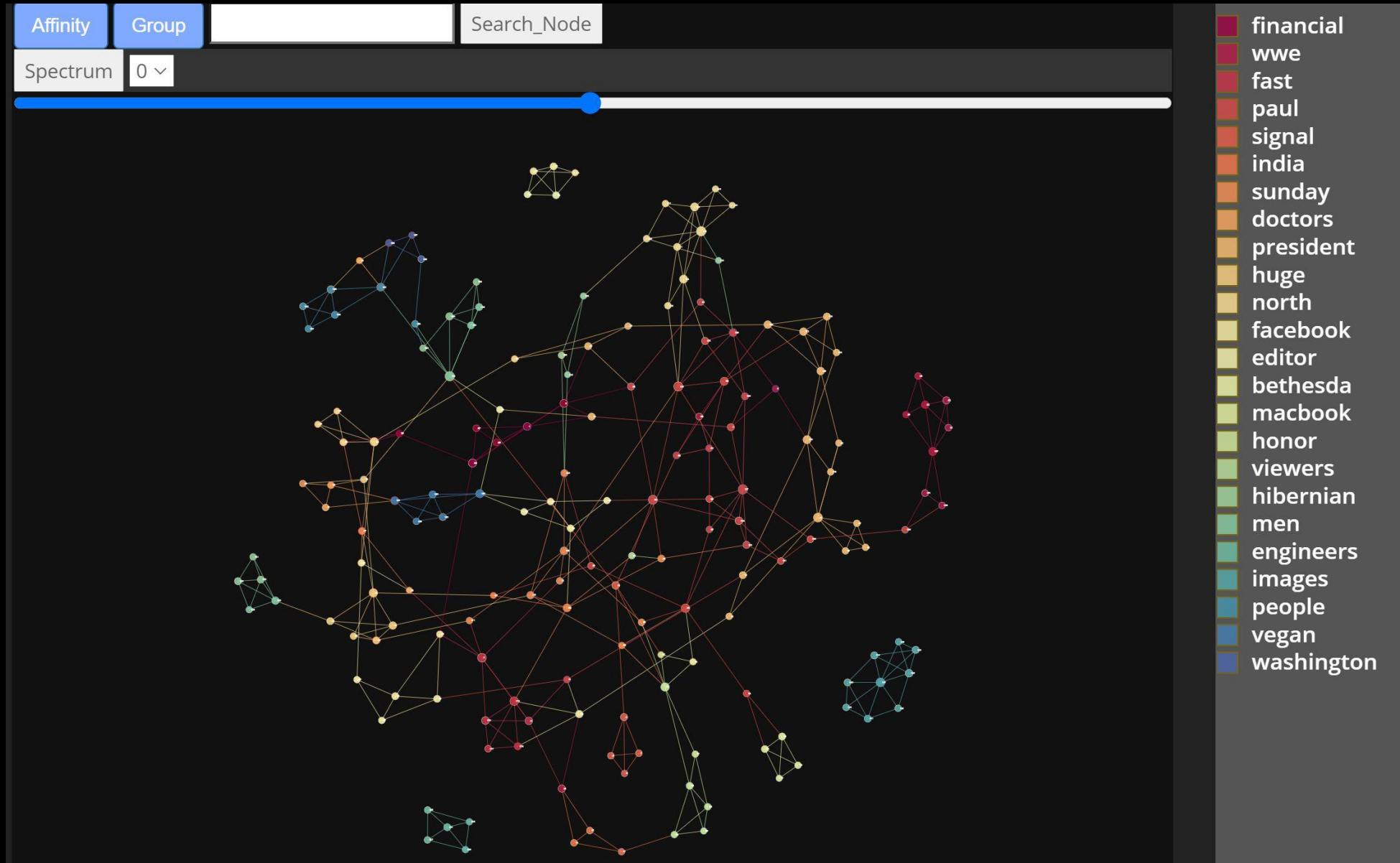
Word Vector Embedding (e.g. Word2Vec)

REPRESENTING WORDS AS VECTORS

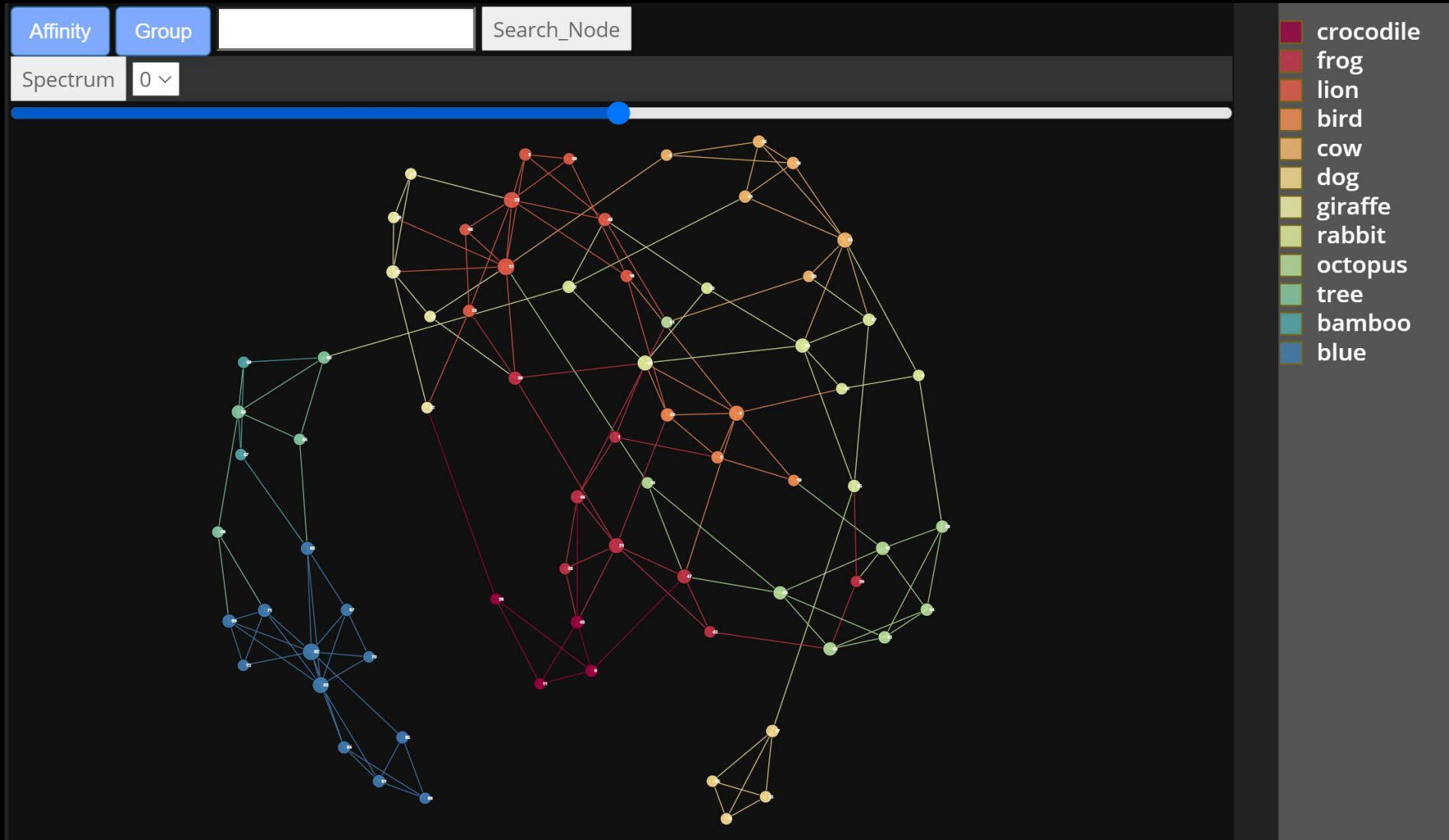
word2Vec, Word Embeddings, BERT, RankBrain



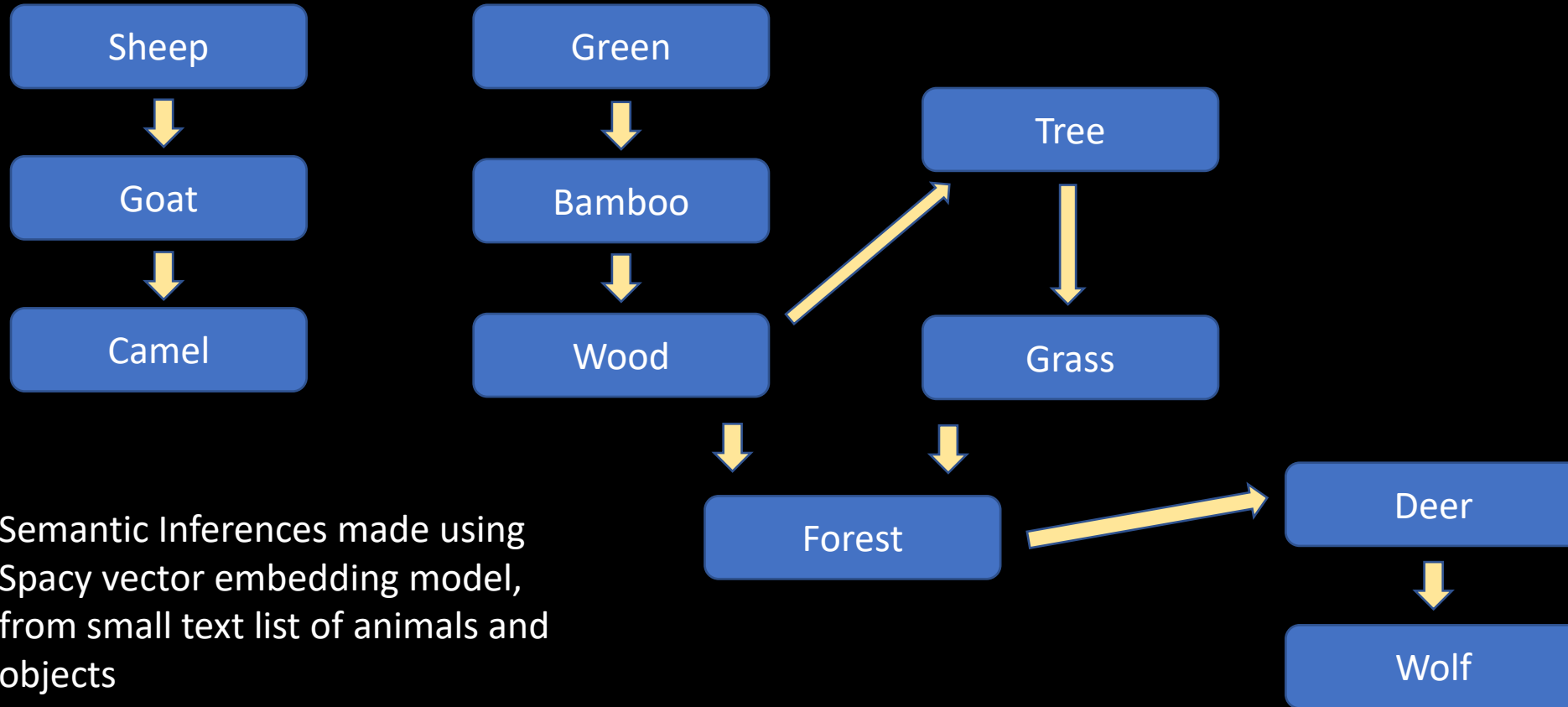
Example nlp > Semantic Graph



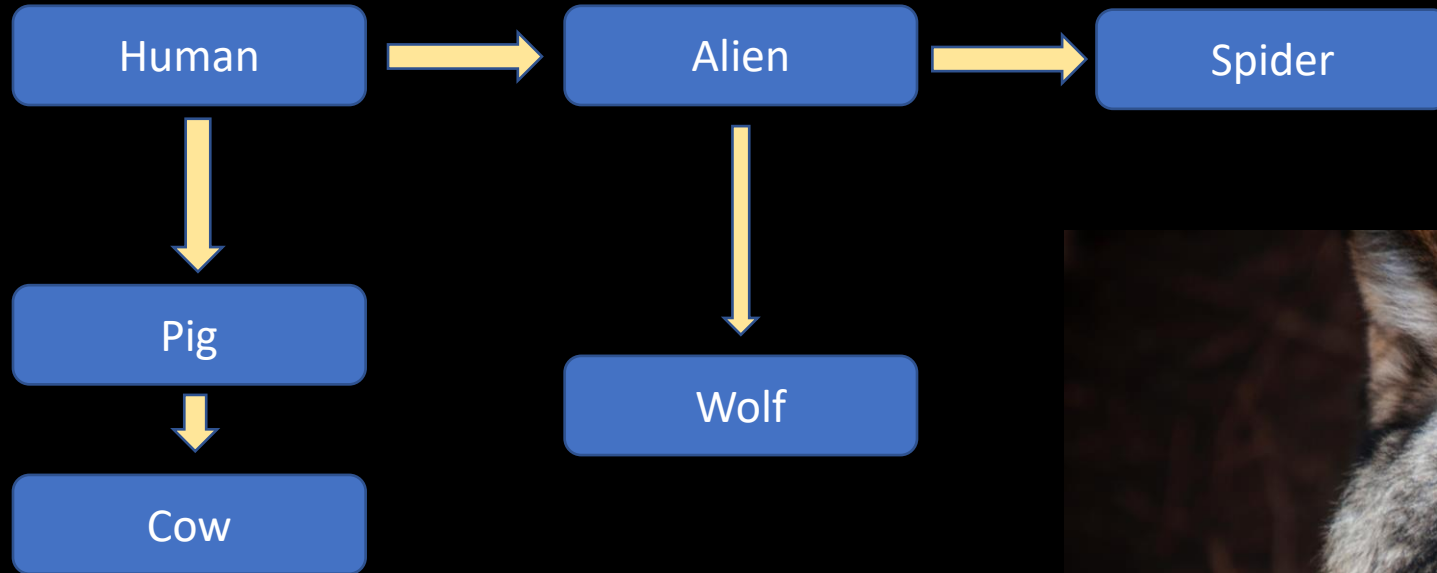
Game time: Labels & Animals

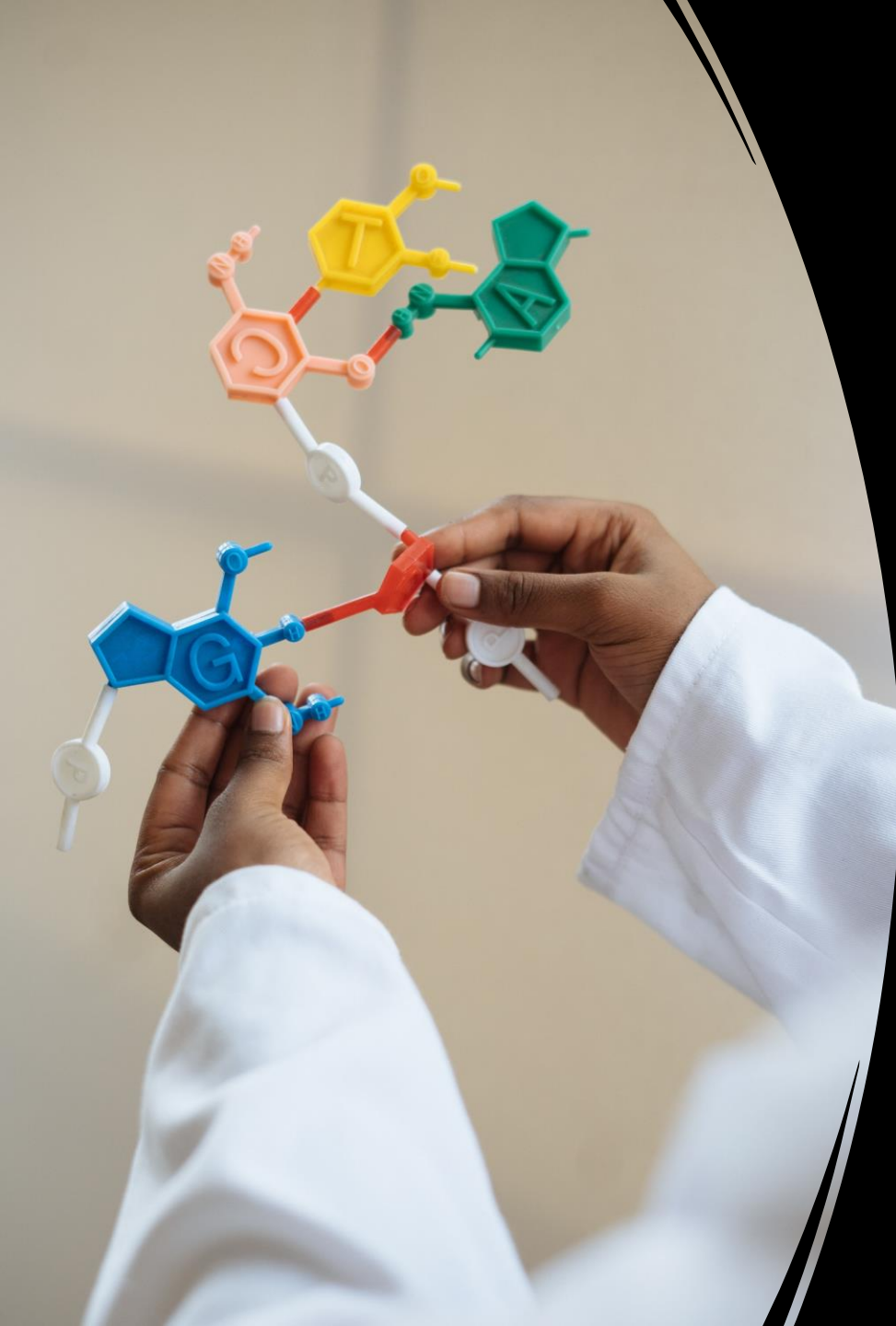


What is connected?



What is connected?





Graph Neural Networks & Deep Learning

- DeepMind > predict the structure of proteins
- Solving protein folding > by directly reasoning about the spatial graph of the folded protein

Summary

- KG field is advancing rapidly, driven by AI and nlp automation
- Value: drives recommender systems, Google KG, EKG, data exploration
- Issues: KG can be hard to implement - need for both data engineers and knowledge engineers that bring domain and ontology modelling expertise
- Exciting open area for research and innovation

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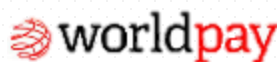
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Forthcoming Events

- Tue, 13 Apr (09:00-09:45) Building Resilience In Australia - Lessons For The World
- Wed, 14 Apr (15:00-15:45) War, Terrorism And Hostile Cyber Activity: Consensus And Clarity Within The Cyber Frontier
- Mon, 19 Apr (10:00-10:45) Financial Centres Of The World 2021: Focus On Frankfurt
- Tue, 20 Apr (11:00-11:45) Esop Sofa: Hot Topics In Employee Share Ownership - Newspad Review

Visit <https://fsclub.zyen.com/events/forthcoming-events/>

Papers

- “Knowledge Graphs”, Aidan Hogan, Eva Blomqvist, Michael Cochez, Claudia d'Amato, Gerard de Melo, Claudio Gutierrez, José Emilio Labra Gayo, Sabrina Kirrane, Sebastian Neumaier, Axel Polleres, Roberto Navigli, Axel-Cyrille Ngonga Ngomo, Sabbir M. Rashid, Anisa Rula, Lukas Schmelzeisen, Juan Sequeda, Steffen Staab, Antoine Zimmermann, <https://arxiv.org/abs/2003.02320?source=techstories.org>
- Knowledge Graphs Fundamentals, Techniques, and Applications, By Mayank Kejriwal, Craig A. Knoblock and Pedro Szekely <https://mitpress.mit.edu/books/knowledge-graphs>
- [Ioannidis et al., 2020] Vassilis N. Ioannidis and Xiang Song and Manchanda, Saurav and Li, Mufei and Pan, Xiaoqin and Zheng, Da and Ning, Xia and Zeng, Xiangxiang and Karypis, George. 2020. DRKG — Drug Repurposing Knowledge Graph for Covid-19. <https://github.com/gnn4dr/DRKG/>
- [Negro, 2021] Alessandro Negro. 2021. Graph-Powered Machine learning. Manning Publications.
- [Gomez-Perez et al., 2020] Jose Manuel Gomez-Perez, Ronald Denaux and Andres Garcia-Silva. 2020. A Practical Guide to Hybrid Natural Language Processing. Combining Neural Models and Knowledge Graphs for NLP. Springer International Publishing.

References

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- <https://neo4j.com/use-cases/knowledge-graph/>