GRAPH EMBEDDINGS

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LinkedIn Medium GitHub

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When I was a kid…

02 **THE GOAL**
What are we trying to achieve

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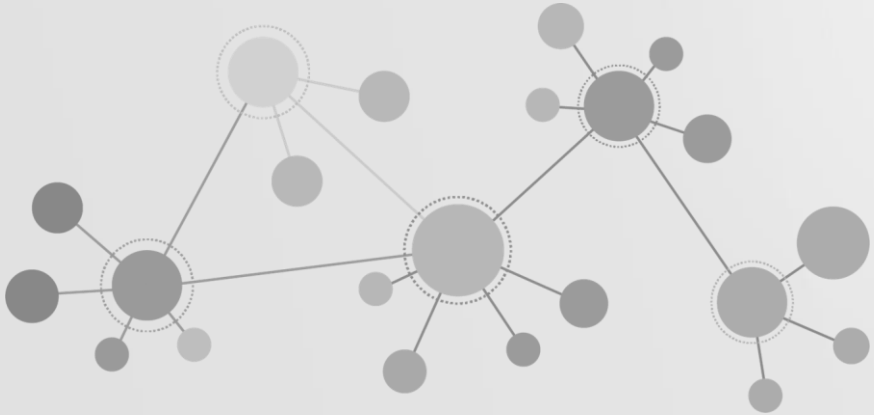
01

Story Time

AI, ML, DL & GRAPHS

IT'S NOT WHAT YOU KNOW…
IT'S WHO YOU KNOW!

Tabular | Text | Images | Audio | Graphs



02

The Goal

APPLICATIONS

APPLICATIONS

FINANCIAL SERVICES

DRUG DISCOVERY

COSTUMER SEGMENTATIONS

CYBER

SEARCH

CHURN

03

GRAPHS

DEEP LEARNING EVOLUTION
DEEP GRAPHS

DEEP LEARNING EVOLUTION

CNNs

Images, Video and more

RNNs

Text, Signals, and more

GNNs

Interactions, Links, Patterns,
Pathfinding, Centrality, Similarity,
Community Detection,
and more…

Scale, Parallel
Visualize, Interpretability

FRUAD DETECTION EXAMPLE

Financial institutions have an existing ML pipeline for identifying fraud and graph-based features improve accuracy

CONNECTED COMPONENTS

Identify disjointed graphs sharing identifiers

PAGERANK

Measure influence and transactions volumes

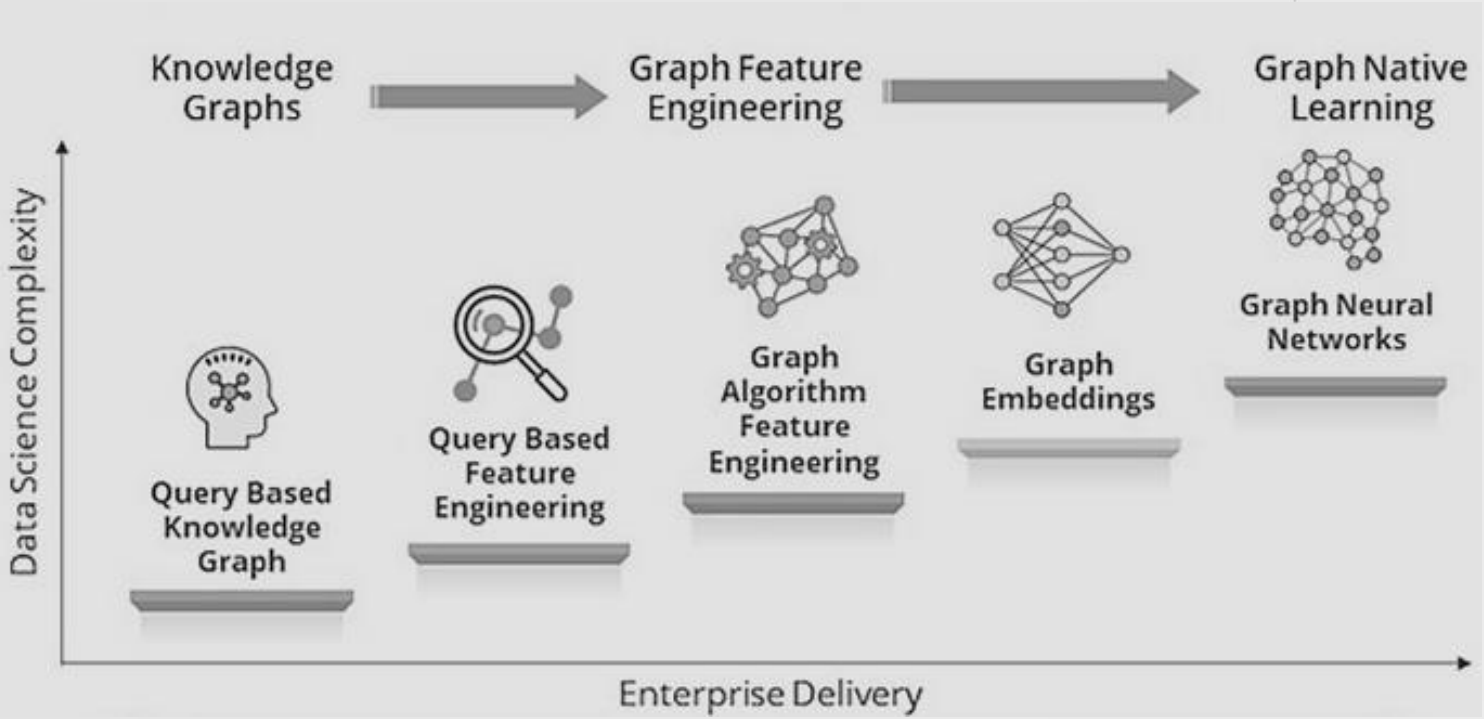
LOUVAIN

Identify communities with high interactional frequency

JACCARD

Measure account similarity based on relationships

GRAPH DATA SCIENCE



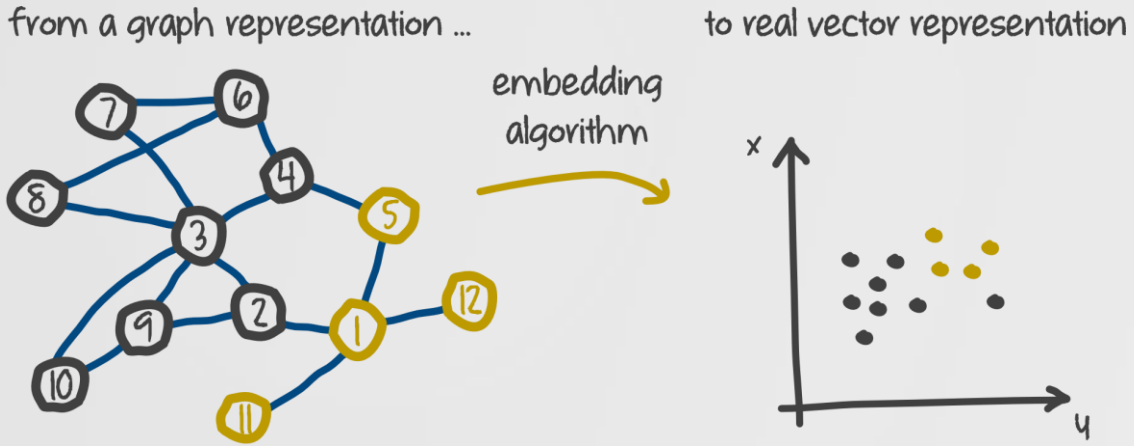
04

EMBEDDINGS

Feature Learning Technique

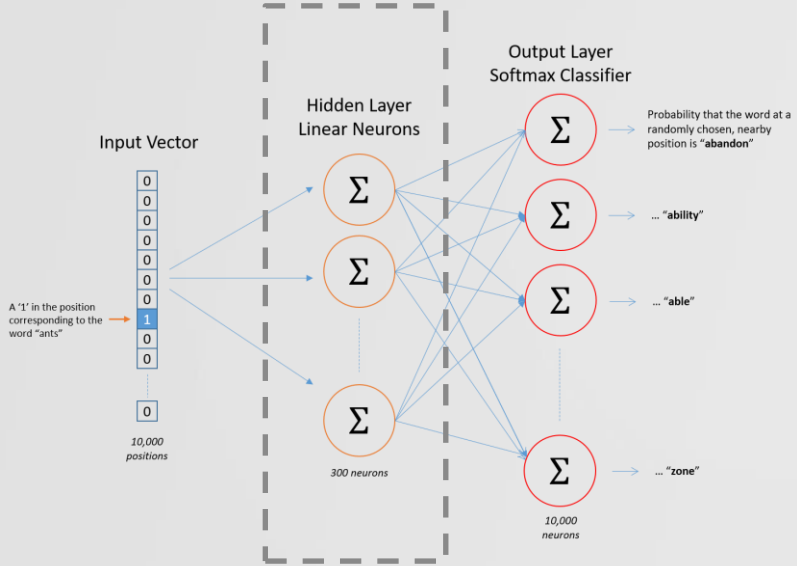
WHAT IS EMBEDDINGS?

A way of mapping something into a fixed length vector
that captures key features while reducing the dimensionality



WORD EMBEDDING MOTIVATION

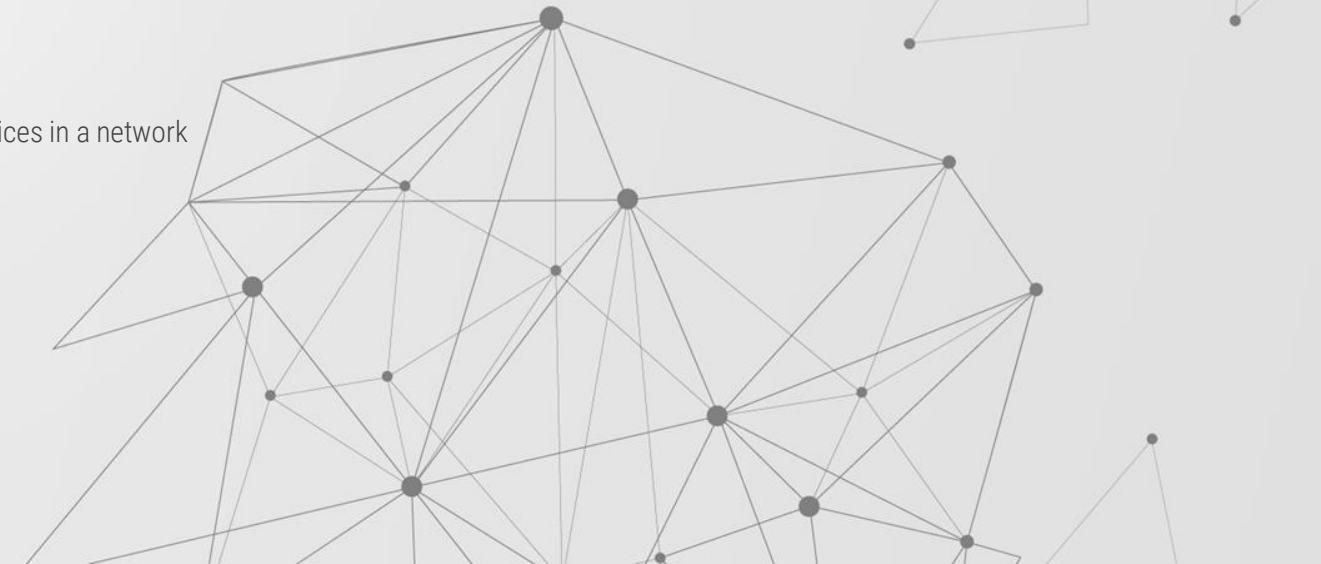
How to represent words in a mathematical way?
How similar two words are?
Similar meaning?



05

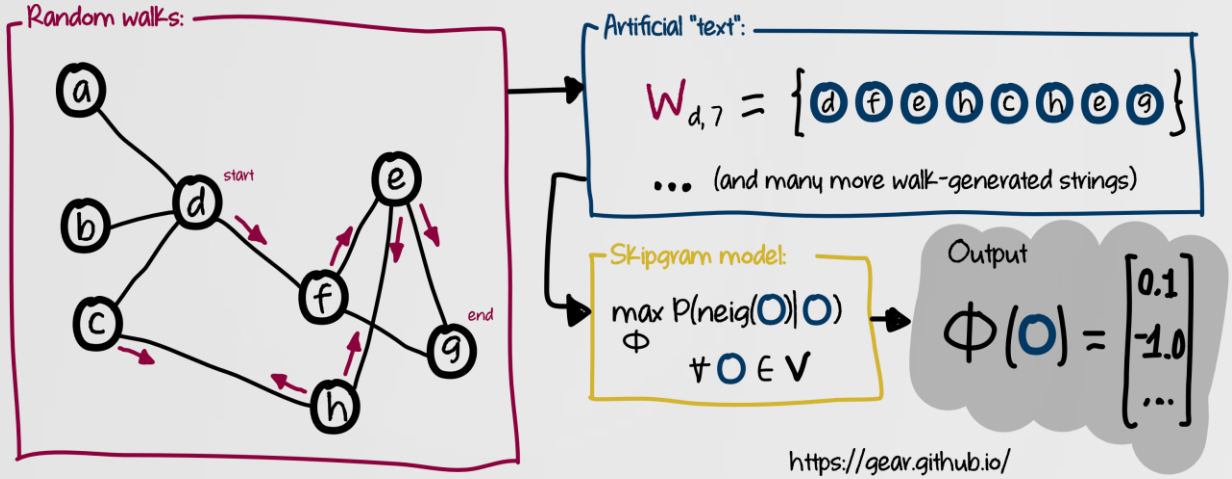
DEEPWALKS

A novel approach for learning
latent representations of vertices in a network



FROM NODES TO EMBEDDINGS

Run short fixed-length random walks starting from each node
Optimize embedding using SGD



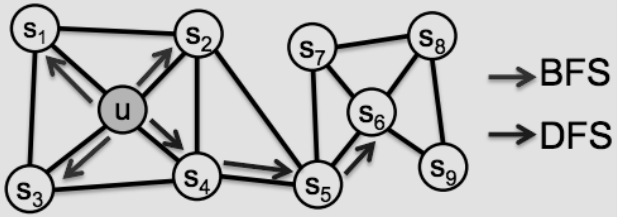
BIAS 2-ORDER RANDOM WALKS

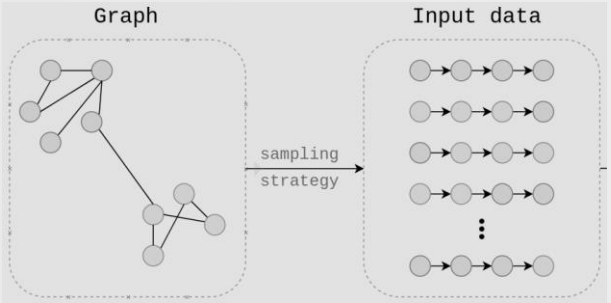
ATTRIBUTES WEIGHTS AND MORE

Node2Vec

Random walks Algorithm to generate vector representations of nodes on a graph, and learns low-dimensional representations for nodes

BFS
DFS





Q: WHY NOT STOP HERE?

MATRIX FACTOTIZATION
Massive memory footprint
Computationally intense

RANDOM WALKS
Local-Perspective only
Assume similarity by closeness

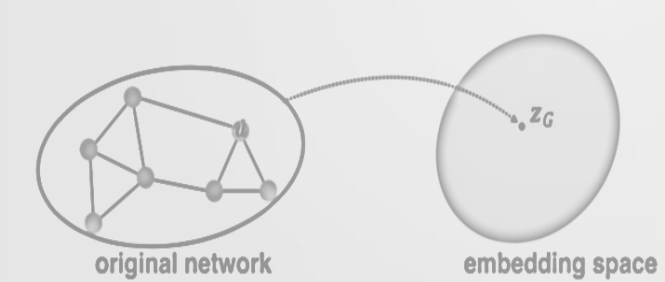
06

GRAPH EMBEDDINGS

EMBED AN ENTIRE GRAPH

WHY TO EMBED AN ENTIRE GRAPH?

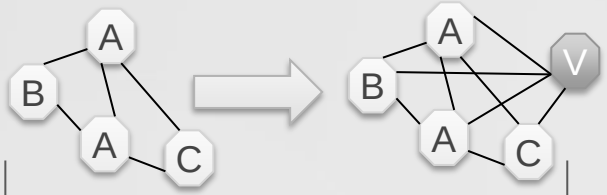
Toxic vs non-toxic molecules
Identify anomalies
And more



TECHNIQUES

EMBEDDINGS SUMATION

$$Z_G = \sum_{V \in G} Z_V$$



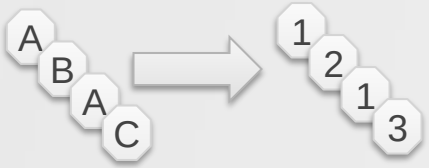
Connect a new node
to all the nodes

VIRTUAL NODE

ANONYMOUS WALKS

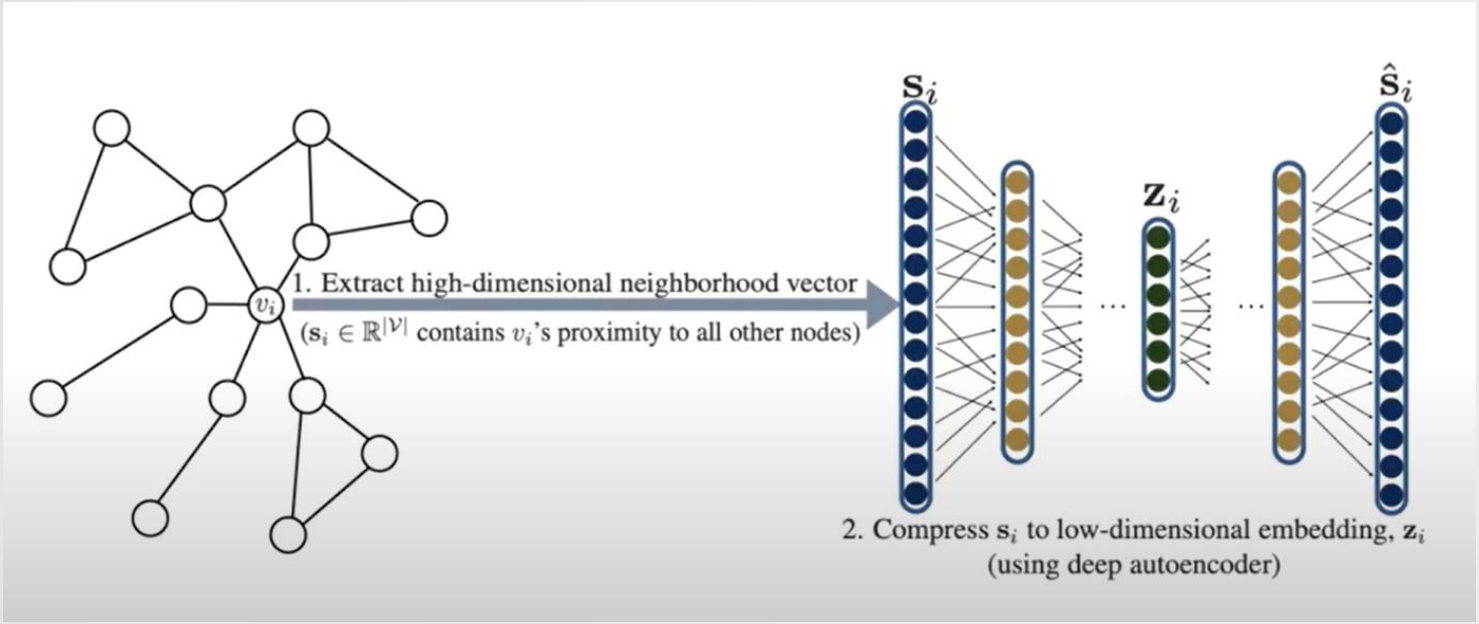
Index the nodes in each walk

Represent by
a sample distribution or
all the distribution



SOTA?

Using Autoencoders



07

TEST YOURSELF

Q & A

Q: Which of the following is not a step in graph data science?

- Building a knowledge graph
- Using graph algorithm for feature engineering
- Using Kafka for transactional messaging

Q: Louvain is an example of…?

- Centrality
- Pathfinding
- Community Detection

Q: In which task Random Walks are "weaker"?

- Link Prediction
- Node Classification

Q: A graph embeddings is a fixed length vector of…?

- Numbers
- Letters
- Nodes

Q: An embedding is a ____ representation of your data.

- Binary
- Human Readable
- Lower Dimensional

Q: What is a way to embed an entire graph?

- GNNs
- BFS/DFS
- Virtual Node

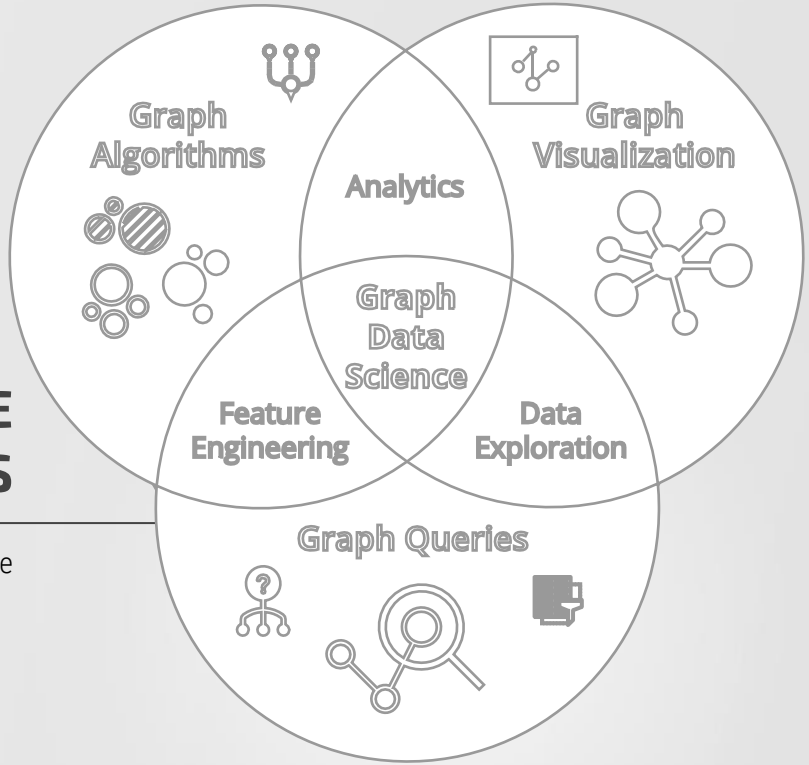
08

CONCLUSIONS

REFERENCES & RELATED WORK

DATA SCIENCE WITH GRAPHS

There's an unique balance



RESOURCES

Relational inductive biases, deep learning, and graph networks
By DeepMind
https://arxiv.org/pdf/1806.01261

DeepWalk: Online Learning of Social Representations
By Bryan Perozzi, Rami Al-Rfou, Steven Skiena
https://arxiv.org/pdf/1403.6652

Anonymous Walk Embeddings
By Sergey Ivanov, Evgeny Burnaev
https://arxiv.org/pdf/1805.11921

Graph Nets library | https://github.com/deepmind/graph_nets

GraphSAGE: Inductive Representation Learning on Large Graphs | http://snap.stanford.edu/graphsage

DeepWalk: Implementing Graph Embeddings in Neo4j | https://neo4j.com/blog/deepwalk-implementing-graph-embeddings-in-neo4j/

THANKS

Does anyone have any questions?

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