Fundamentals of Data Structure

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Slides are prepared from

1. Data Structures and Algorithms in Java, 6th edition, by M. T. Goodrich, R. Tamassia, and M. H. Goldwasser, Wiley, 2014

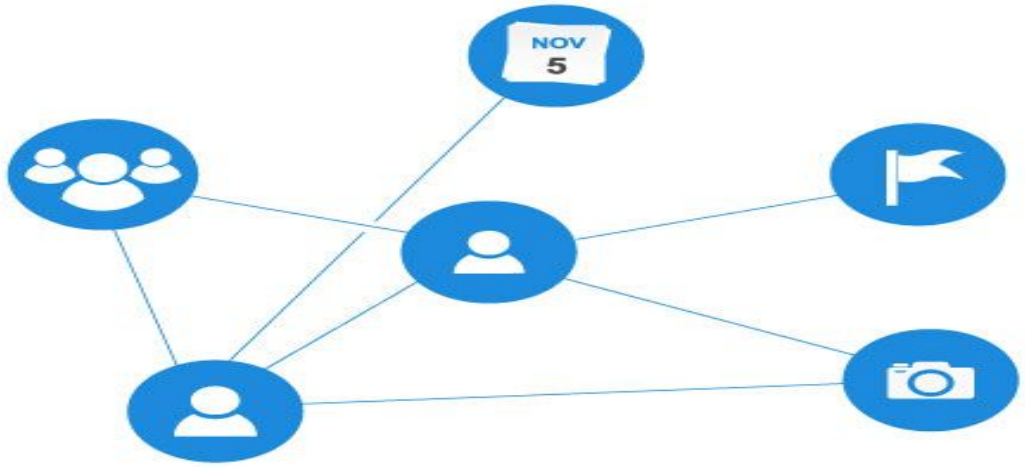
2.https://leapgraph.com/graph-data-structures-applications

3. https://ahrefs.com/blog/google-knowledge-graph/

THE REAL-LIFE APPLICATIONS OF GRAPH DATA STRUCTURES

- Graphs are the ultimate abstraction for many real world problems and today
- The best applications of graphs are when they capture arbitrary high-value relationships in data that would otherwise be lost
- Some of the best use cases for Graph Data Structures are in
  - Social Graph APIs such as Facebook's Graph API,
  - Recommendation Engines such as Yelp's GraphQL Api,
  - Path Optimization Algorithms such as Google Maps Platform (Maps, Routes APIs) and Car Navigations,
  - Web Analytics and Scientific Computations

Social Graphs

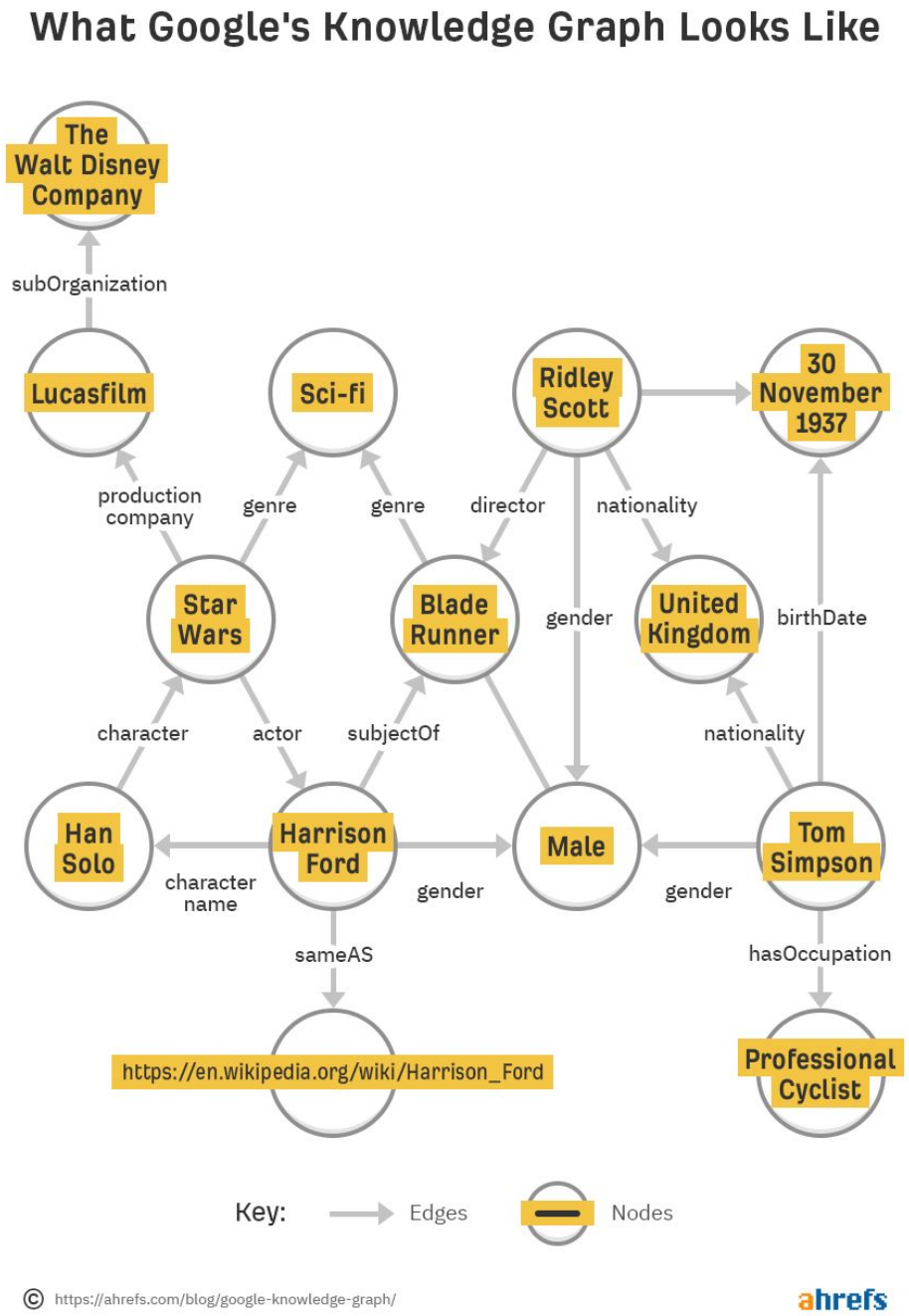


- Social graphs draw edges between you and the people, places and things you interact with online
- Facebook's Graph API: Facebook's Graph API is perhaps the best example of application of graphs to real life problems
- On The Graph API, everything is a vertice or node
  - This are entities such as Users, Pages, Places, Groups, Comments, Photos, Photo Albums, Stories, Videos, Notes, Events and so forth. Anything that has properties that store data is a vertice
- And every connection or relationship is an edge
  - This will be something like a User posting a Photo, Video or Comment etc., a User updating their profile with a their Place of birth, a relationship status Users, a User liking a Friend's Photo etc.
- The Graph API uses this collections of vertices and edges (essentially graph data structures) to store its data

Knowledge Graphs

- A knowledge graph has something to do with linking data and graphs...some kind of graph-based representation of knowledge
- Google's Knowledge Graph: It is a knowledge base of entities and the relationships between them
- An entity: It’s any object or concept that can be distinctly identified. This includes tangibles like people, places, and organizations, and intangibles like colors, concepts, and feelings
- Entities are connected by edges, which describe the relationships between them
- Storing real-world data like this helps Google to understand the meaning behind search queries, which means more relevant results for searchers

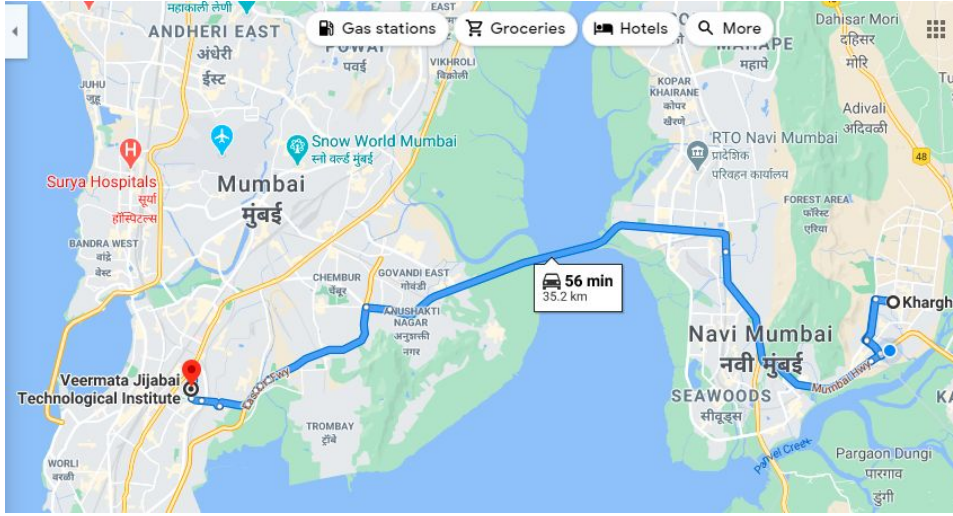
- [Introducing the Knowledge Graph]



Recommendation Engines

- A recommendation engine is a system that suggests products, services, information to users based on analysis of data
- **Yelp's Local Graph**: Yelp connects people with great local businesses. Yelp Dataset Challenge [1] provides students a chance to perform research or analysis on Yelp's data and share discoveries. GraphQL gives you the ultimate flexibility in getting only the data you specify in your API requests
- GraphQL leverages the power of graph data structures by modeling the business problem as a graph within its schema
- On the Local Graph API, Yelp represents your business as a vertice with name, id, alias, is_claimed, is_closed etc. graph properties
- Yelp creates edges with relationships such as the location of a business with a certain name, the opening hours of a business, the reviews of a business, the category of a business
- Using the local graph feature, a yelp app can uses your location to match recommendations of businesses close to you
- Graph Search

Path Optimization Algorithms



- Path optimizations are primarily occupied with finding the best connection that fits some predefined criteria e.g. speed, safety, fuel etc or set of criteria e.g prodecures, routes
- **Google Maps Platform (Maps, Routes APIs)**: Google Maps and Routes APIs are classic Shortest Path APIs. This a graph problem that's very easy to solve with edge-weighted directed graphs (digraphs)
- The idea of a Map API is to find the shortest path from one vertex to every other as in a single source shortest path variant, from your current location to every other destination you might be interested in going to on the map
- Graph Theory application in Google Map