
Photo: Unsplash

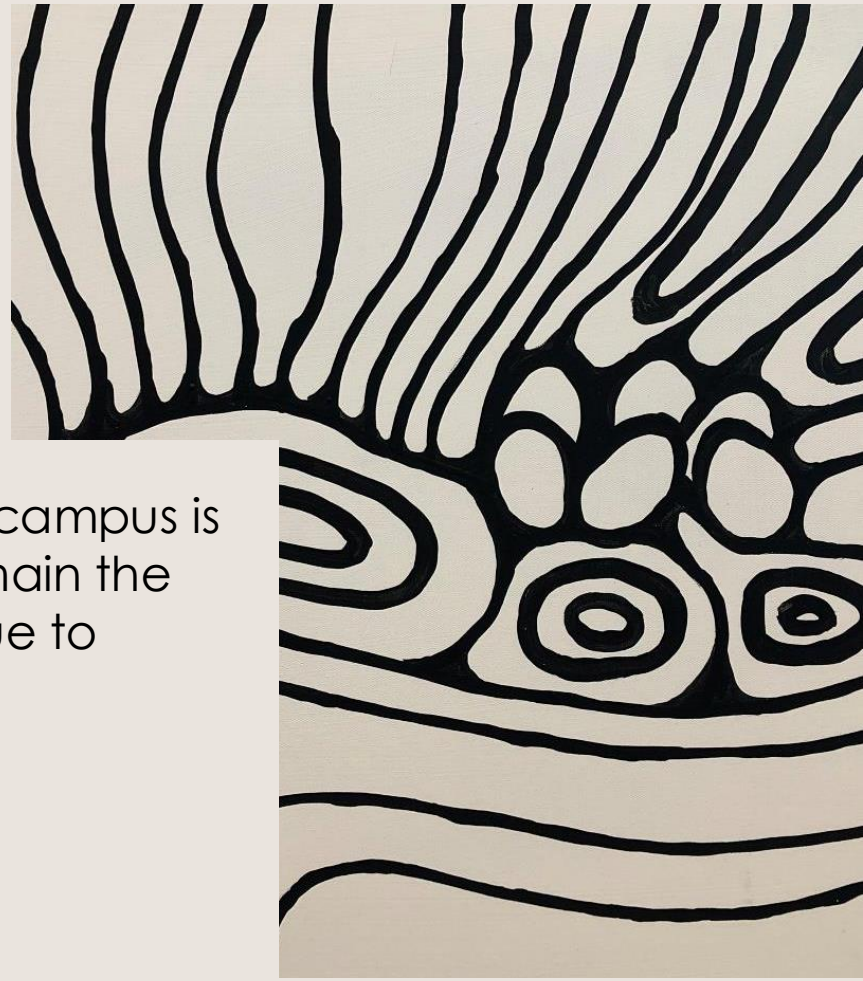
Topic Ten: Other Types of Databases

INMT5526: Business Intelligence

Tristan W. Reed
UWA Business School

Acknowledgement of country

The University of Western Australia acknowledges that its campus is situated on Noongar land, and that Noongar people remain the spiritual and cultural custodians of their land, and continue to practise their values, languages, beliefs and knowledge.



Artist: Dr Richard Barry Walley OAM

This week and its lab

- We will be spending some more time working on the Topic 9 Lab.
  - Yes, this is as it is a very big one – you will need to spend some of your own time on it;
  - Most people should get fair way through it, but it is a very big (and fun) one;
  - The tough part is doing all of the data preparation and cleaning;
  - It will be relatively straightforward to do the visualisation.
- Care should still be taken in ensuring you build the dashboard in a meaningful and aesthetically pleasing manner that communicates the point well.
  - This is good (and your last) practice for the Group Assignment!

Other types of databases

THE UNIVERSITY OF WESTERN AUSTRALIA

- We will now move on to looking at other types of databases, but first, we must remember how they differ from relational databases.
- Spend a short time talking to the people next to you to answer these questions:
  - What is the main difference between NoSQL databases and (traditional) relational ones?
  - What is the main difference between a document database and a relational one?
  - Is a document database a NoSQL database and vice-versa?
  - When would a graph database usually be used?

Other types of databases

THE UNIVERSITY OF WESTERN AUSTRALIA

- What is the main difference between NoSQL databases and relational ones?
  - NoSQL databases do not have a fixed schema – each observation can be different.
  - Observations are generally referred to as ‘records’.
- What is the main difference between a document database and a relational?
  - Data is not stored in tables but in multiple queryable ‘documents’ of records.

Other types of Databases

THE UNIVERSITY OF WESTERN AUSTRALIA

- Is a document database a NoSQL database and vice-versa?
  - In practice, document databases are NoSQL databases, but NoSQL databases can exist outside of this (i.e. be non-document based).
- When would a graph database usually be used?
  - When the (most) important element of the database is the relationship between the data elements and the properties of it (the relationships).


Photo: Unsplash

THE UNIVERSITY OF WESTERN AUSTRALIA

Topic Ten: MongoDB

INMT5526: Business Intelligence

Tristan W. Reed
UWA Business School

Getting started with MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- This week, we will set up an (individual) MongoDB cloud database for us to investigate querying with to see how it works.
- Visit the MongoDB website (https://www.mongodb.com/cloud) to get started.
  - Click the 'Try Free' button and sign up with an email of your choice.
  - Fill in the form to sign up for Atlas (cloud); you can leave 'Company' blank.
  - You will then need to verify your email via a link in an email.
- If the validation link doesn't work, ignore it, click the link above and log in.
  - Click "Build a Database" under "Deployment – Database" and continue from "Shared".

Getting started with MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- Don't close the page once verified!
  - Click "Continue" and fill out the form (Learn MongoDB, Business Intelligence, JavaScript) and then click "Finish" to move towards creating your database.
  - Select the "FREE"/"Shared" database and click "Create" to build your database.
  - Select "AWS" as the cloud provider and "Sydney" as the region, then click "Create" again to actually create your free database!
- I would also suggest unsubscribing from the "Welcome" (and other) email(s).

Getting started with MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- You will now need to set up the security for your database.
  - Choose an appropriate (secure) username and password for your database, that you will remember for later if needed – you can make them whatever* you want.
  - Then, click "Create User" to create the user.
  - Select "My Local Environment" below and add "IP Address" of "0.0.0.0/0" with a "Description" of "Anyone" below – this is not ideal, but saves issues getting it working.
  - Then, click "Finish and Close" and then "Databases" from the window that appears.
- I would also suggest unsubscribing from the "Welcome" (and other) email(s).

Getting started with MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- Next, you will need to click "Connect" to connect to the database.
  - Select "Connect with the MongoDB Shell" and then select your operating system.
- Please see the guide on LMS as to how to install the MongoDB Shell.
  - It is more complicated than it seems.
- Once installed, connect as described to your MongoDB database.
  - This is catered for in the guide as well.

Creating data in MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- We must first create a collection ("table") to store our many documents:
  - Command is **`db.createCollection("<CollectionName>")`** for **`<CollectionName>`**;
- We can then add one or more documents to the collection:
  - Takes the format **`db.<CollectionName>.insert({attribute: value, attribute: value, …})`**, where **`<CollectionName>`** is the collection that you (just) created.
  - You can specify a list of dictionaries as well – i.e. **`insert([{…}, {…}])`** to save time.
  - It is preferred to use **`insertOne`** and **`insertMany`** for these.

Creating data in MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- In your practical, within your database using MongoDB Shell, create a new collection named "transactions", which we will use for the remaining exercises.
- Insert the first four items of data into the database which you created for the "TransactionItem" table within the MySQL relational database earlier in semester.
  - For the data, see Week 3's lab notes as this information is listed there.

Creating data in MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

```
db.createCollection("transactions")

db.transactions.insert({
  id: 1,
  description: "Basic Widget",
  quantity: 1,
  unitPrice: 123.45,
  totalPrice: 123.45,
  hasGst: true
})
```

… and so forth for the remaining items.

Querying Data in MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- We can use the **`.find()`** command on our data to locate all (or some) of the documents within a specified collection within our MongoDB database.
  - i.e. the full command becomes **`db.<CollectionName>.find().pretty()`** where **`<CollectionName>`** is the name of our collection ('table' or 'database').
  - We use **`pretty()`** to make the output easy to read – will be explained later on.
- Using the brackets next to find, simple queries can be written.
  - i.e. you could write **`.find({id: 1})`** to select only documents where **`id = 1`**.
  - See the next slide for other inequalities that we could use for our queries.

Inequalities with MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- We use various **`$keywords`** to use inequalities in our queries:
  - **`.find({attributeName: {$lt: 1}})`**: less than one;
  - **`.find({attributeName: {$lte: 1}})`**: less than or equal to one;
  - **`.find({attributeName: {$gt: 1}})`**: greater than one;
  - **`.find({attributeName: {$gte: 1}})`**: greater than or equal to one;
  - **`.find({attributeName: {$ne: 1}})`**: not equal to one.
- The format of these JSON-based **`.find`** queries is relatively formularic.

‘In’ Queries using MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- We can also do ‘in’ type queries (as we did with MySQL) to lists of values too:
  - `.find({attributeName: {$in: [1, 2, 3]}})`: value within list of `[1, 2, 3]`;
  - `.find({attributeName: {$nin: [1, 2, 3]}})`: value other than in list `[1, 2, 3]`;

Querying Data in MongoDB

THE UNIVERSITY OF WESTERN AUSTRALIA

- In the lab, you will execute queries to answer the following questions and gather the relevant data from your MongoDB database (within the "transactions" collection):
  - Details on all items with unit prices less than $100;
  - Details on all items which do not have GST;
  - Details on all items with a quantity greater than 1;
  - Details on all items except the one with an ID of 3.
- Remember that we can use **`.pretty()`** on the end of our query, to make the result… pretty and hence easier for us to read and understand.

Example MongoDB Query

THE UNIVERSITY OF WESTERN AUSTRALIA

- Putting it all together, you would get something of the form:
  - **`db.transactions.find({someVal: {$ne: false}}).pretty()`**
  - In this case, we are using the **`transactions`** collection, **`find`**ing where **`someVal`** is **`n`**ot **`e`**qual to **`false`** and then making the result look **`pretty`**.
- We will not be covering more advanced queries in this unit for MongoDB – however, it is certainly possible through combining some of the above constructs!


Photo: Unsplash

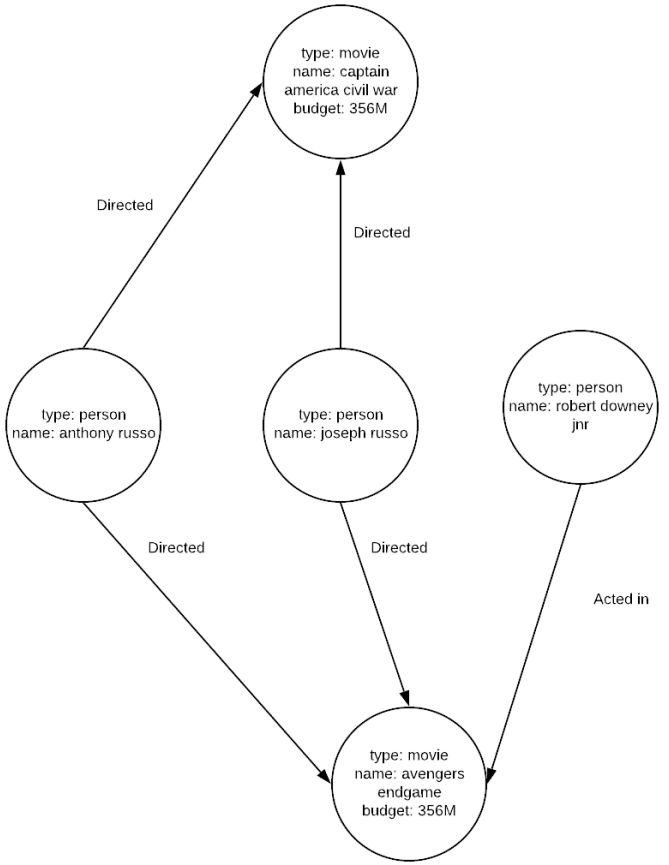
Topic Ten: Graph Databases

INMT5526: Business Intelligence

Tristan W. Reed
UWA Business School

Graph databases

- A graph database is based on the mathematical concept of a graph – *what is that concept?*
  - A collection of nodes (entities – i.e. observations) and edges (directed connections with a meaning that relate two nodes together – i.e. relationships).
  - Technically, this means both nodes and edges hold data!



Clarke, J. (2019). *An Introduction to Graph Databases | by John Clarke | Introduction to Data Science*. [online] Available from: https://towardsdatascience.com/an-introduction-to-graph-databases-cd81a0d5aa12.

Creating a Graph Database

THE UNIVERSITY OF WESTERN AUSTRALIA

- Graph databases can be created using a wide variety of software.
  - Generally, you will load multiple CSV's and map the rows to entities and relationships.
  - This takes a similar format to MySQL's **`LOAD DATA`** command in Neo4J.
- For example, to achieve the Marvel example in the above slide:
  - Load and Create details on each Person – their ID and Name;
  - Load and Create details on each movie – their ID, Name and Budget;
  - Load and Create "Directed" relationships between Persons and Movies;
  - Load and Create "Acted In" relationships between Persons and Movies.

Querying a Graph Database

THE UNIVERSITY OF WESTERN AUSTRALIA

- Queries can range from the simple:
  - Everything: `MATCH (n) WHERE n:Person OR n:Movie or n:Character RETURN n`
- Queries can range to similar to what we would do in a relational database:
  - Select a Movie: `MATCH (m:Movie {name: "captain america winter"}) RETURN m`
- Queries can range to taking advantage of the graph nature of the database:
  - Selecting based on relationship: `MATCH m=(p:Person {name: "anthony russo"}) -[r:Directed]->() RETURN m`

Graph Database Software

THE UNIVERSITY OF WESTERN AUSTRALIA

- There exists many different graph database software packages out there – they differ in a few ways between each other:
  - Some are open-source (and free), whereas others are closed-source (and paid);
  - Some use the Cypher language (seen before) whereas others use SparQL (for querying);
  - Data can be represented in different ways – e.g. RDF, Turtle, other languages.
- Traditionally, graph database software has been difficult to set up and with questionable performance – lately, this has improved somewhat, however!
  - As such, we won't be actually be practicing the setup and use of graph databases, but rather just observing some of the theoretical concerns during this lecture.
- Other types of databases do exist and can be studied here – blockchain?

The End: Thank You

Any Questions? Ask via email (tristan.reed@uwa.edu.au)