

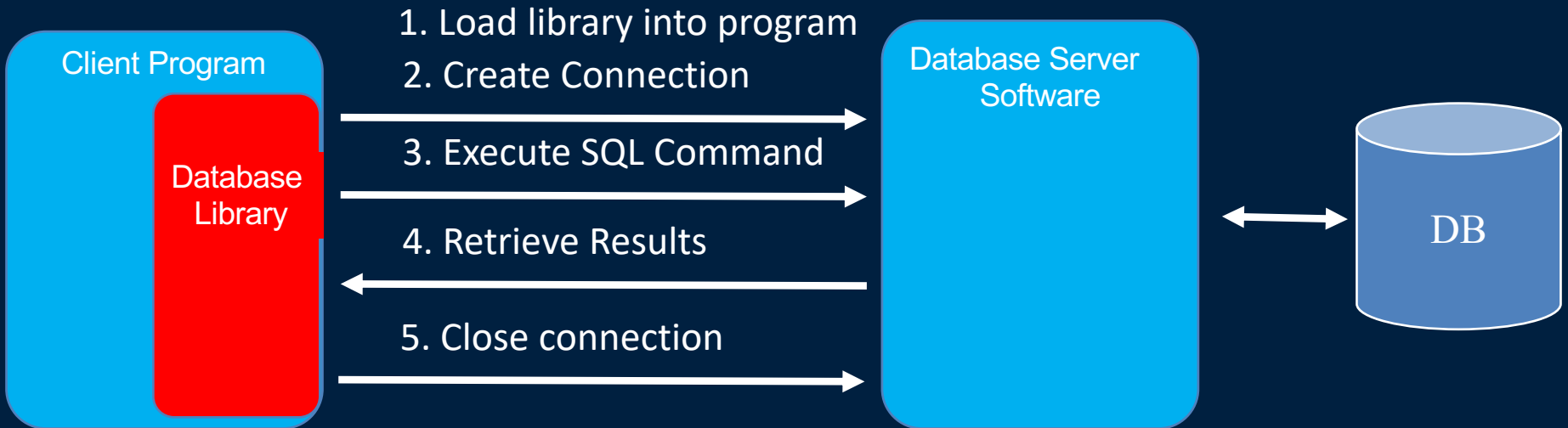
Hosting and Data Wrangling

COSC 304 – Introduction to Database Systems





Review: SQL Programming Architecture



- 1) Load Library Error:
- Library not found in path
 - Wrong library

- 2) Create Connection Errors:
- Invalid server URL
 - Incorrect user/password
 - Network issues
 - Wrong library

- 3) Execute SQL Errors:
- Incorrect SQL
 - Wrong database/table
 - Improper library use

- 4) Retrieve Results Errors:
- Wrong column name
 - Wrong column index
 - Off-by-one
 - Improper library use

- 5) Close Connection:
- FORGET TO DO IT!



Database Hosting – Where's the Server?

Database hosting selects the machine where the database software executes. Choices:

- Local machine (`localhost`)
- On-premise physical or virtual machine (`cosc304.ok.ubc.ca`)
- Cloud-based hosting (physical/virtual/container) as a service on platforms such as Amazon, Microsoft Azure, Google, Digital Ocean.

Database host must be accessible over the Internet by the clients that connect to it.

Running a Database on localhost

Running a database on your machine (`localhost`) is easy. Steps:

- Download and install database software (MySQL, PostgreSQL, etc.)
- Configure and start the database server software

Advantages:

- Full control over database and install process

Disadvantages:

- May not be easy to connect to by clients depending on machine
- Must take time to install/configure database software

Running a Database On-Premise

Running "On-Premise" is when the database is deployed on a (virtual) machine controlled by the organization.

This is often done for security and for performance.

Advantages:

- Data does not leave organization.
- Potential for higher performance.

Disadvantages:

- Organization responsible for deploying, configuring, maintaining, and securing both hardware and database software.

Cloud Databases

Cloud databases are databases hosted by a service provider that allow for easy setup, administration and scaling.

- Database as a service – databases hosted by provider, provide monitoring, backup, fail-over, high-availability, and ability to scale.

Examples: Amazon RDS, Microsoft Azure, Google CloudSQL, Digital Ocean

Ideal for: Quick start without a server, minimal administration, scaling without expertise

Creating MySQL Instance on Amazon

1) Sign in to AWS Management Console.

- <https://console.aws.amazon.com/rds>

2) Select database engine/version.


3) Select database instance size (CPU/memory/storage) and user/password configuration.


4) Configure advanced settings (network accessibility).


5) **Verify price** and Create Database.


Select engine


Engine options


☐ Amazon Aurora


☒ MySQL


☐ MariaDB


☐ PostgreSQL


☐ Oracle


☐ Microsoft SQL Server


MySQL

MySQL is the most popular open source database in the world. MySQL on RDS offers the rich features of the MySQL community edition with the flexibility to easily scale compute resources or storage capacity for your database.

- Supports database size up to 16 TB.
- Instances offer up to 32 vCPUs and 244 GiB Memory.
- Supports automated backup and point-in-time recovery.
- Supports cross-region read replicas.

☐ Only enable options eligible for RDS Free Usage Tier [info](#)

Cancel Next

Reference:

docs.aws.amazon.com/AmazonRDS/latest/UserGuide/CHAP_Tutorials.WebServerDB.CreateDBInstance.html

Creating PostgreSQL on Digital Ocean

Sign in to Digital Ocean.

- <https://cloud.digitalocean.com>

Option #1: User Managed DB

- Create a Droplet.
- Select droplet size and region.
- Login to droplet and install/configure PostgreSQL.

Option #2: Managed DB

- Select Databases and Click Create a Cluster.
- Determine size and region.
- Record login and URL info.

Choose a database engine

A database cluster runs a single database engine that powers one or more individual databases.

PostgreSQL (11) | MySQL (Notify me when available) | Redis (Notify me when available)

Choose a cluster configuration

You will be able to add, remove, or resize nodes at any time after the cluster is created.

NODE PLAN: \$15/mo (1 GB RAM / 1 vCPU / 10 GB Disk)

STANDBY NODES: \$0/mo (No standby node)

Choose a datacenter

Tip: Generally, choose the datacenter where your application Droplets are located. If the database cluster is located in a different datacenter, added latency may slow performance.

New York (1, 2, 3) | Amsterdam (1, 2, 3) | San Francisco (1, 2) | Singapore (1)

Toronto | Bangalore

Database Hosting Question

Question: How many of the following statements are **TRUE**?

- 1) Hosting a database on-premise is always better than hosting in the cloud.
- 2) Database as a service is when the database instance is managed for you by the cloud service provider.
- 3) It is possible to get a virtual machine from a cloud host and install your own database software on it.
- 4) On-premise hosting is always cheaper than cloud hosting.

A) 0 **B) 1** **C) 2** **D) 3** **E) 4**

Data not in Databases

Databases make it easy and efficient to store and query data, but often people do not use them.

Data not in databases is present in the following forms:

- Text files (CSV, tab separated)
- Structured text files (JSON, XML)
- Microsoft Excel and Microsoft Access
- Custom file formats (text or binary)

How to handle such data?

Everything in a Database?

There are many reasons why data does not reside in a database:

- Cost/time to import it
- Lack of expertise to create/maintain database
- Data has limited long-term value
- Existing format is sufficient for use case

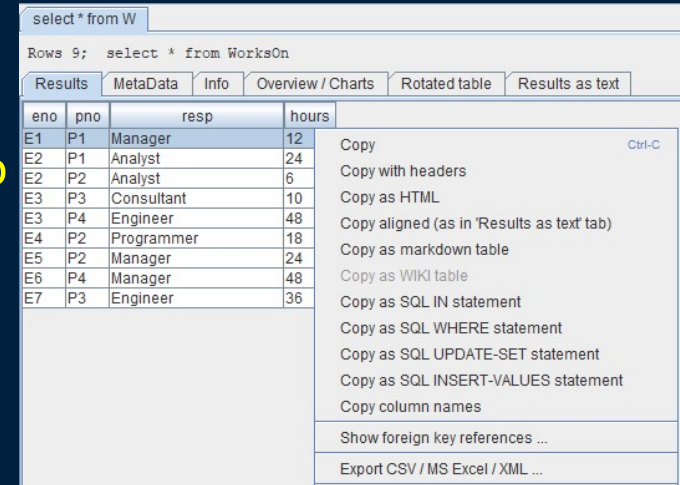
Handling Text Files

Importing text data (CSV files) into a database is so common that most databases have utilities to support it.

- MySQL – `LOAD DATA INFILE "my.csv" INTO TABLE T`
- SQL Server – Import Data task in SQL Server Studio

Exporting from a database into CSV

- MySQL – `SELECT ... INTO OUTFILE`
- SQL Server – Export Data task in SQL Server Studio
- SQuirreL – Execute query, right click on result, and select Export CSV...

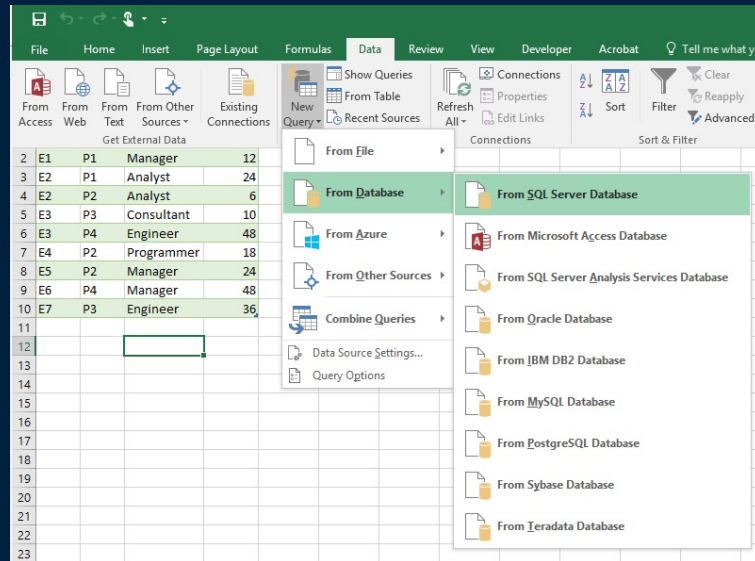


Interfacing with Microsoft Excel

Microsoft Excel is used to store data without using a database. Excel allows importing and exporting data with databases.

Importing data into Excel from a database:

- Data menu, New Query, Select database, write SQL query



Try it!
Open Excel
and import
data from SQL
Server.

Microsoft Access

Microsoft Access is a file-based database designed for a small number of users.

It supports SQL but most interactions are through graphical interface.

Data can be moved between Access and Excel and other databases easily.

Microsoft Access Query Interface

switch
view
button

The screenshot shows the Microsoft Access Query Design View for a query named 'SampleQuery'. The interface includes a ribbon with tabs like File, Home, Create, External Data, Database Tools, and Design. The 'Design' tab is active, showing options for Insert Rows, Delete Rows, Insert Columns, and Delete Columns. The 'Query Setup' group shows 'Show Table' and 'Builder' buttons. The 'Query Type' group shows 'Union', 'Pass-Through', and 'Data Definition' buttons. The 'Results' group shows 'View' and 'Run' buttons. The 'Table Names' group shows 'Property Sheet' and 'Table Names' buttons. The 'Fields' list on the left shows 'Dept', 'Emp', 'Proj', and 'WorksOn' tables. The 'Relationships' diagram in the center shows three tables: 'Proj' (pno, pname, budget, dno), 'WorksOn' (eno, pno, resp, hours), and 'Emp' (eno, ename, bdate, title, salary, supereno, dno). Relationships are shown as lines: 'Proj' to 'WorksOn' (1 to ∞), 'WorksOn' to 'Emp' (∞ to 1). The 'Data Table' at the bottom shows the following data:

Field:	ename	pname	hours	title		
Table:	Emp	Proj	WorksOn	Emp		
Sort:	Ascending					
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Criteria:			>10	'EE' Or 'SA'		
or:						

Annotations in the image include:

- A yellow circle around the 'View' button in the ribbon, with a label 'switch view button'.
- An orange arrow pointing to the 'Field' column header in the data table, with a label 'fields in result'.
- A green arrow pointing to the 'Sort' column header in the data table, with a label 'sorting'.
- Blue circles around the criteria '>10' and ''EE' Or 'SA'', with a label 'selection criteria'.
- Purple text in the center: 'Tables are boxes. Relationships are lines.'

Reporting and Visualization

Database data is consumed by:

- Programs (Java, Python, R, Web) with embedded visualizations
- Stand-alone reporting tools such as Tableau, QlikView, Google Data Studio, Microsoft Reporting Services/Power BI

Visualization allows people to understand and extract information faster and with more accuracy than displaying text and numbers.

All reporting/visualization software interact with the database in essentially the same way: create a connection, build a SQL statement to execute, retrieve results, and visualize.

The difference is how the various tools automate or hide the complexities of connecting and building SQL statements.

Introduction to Tableau

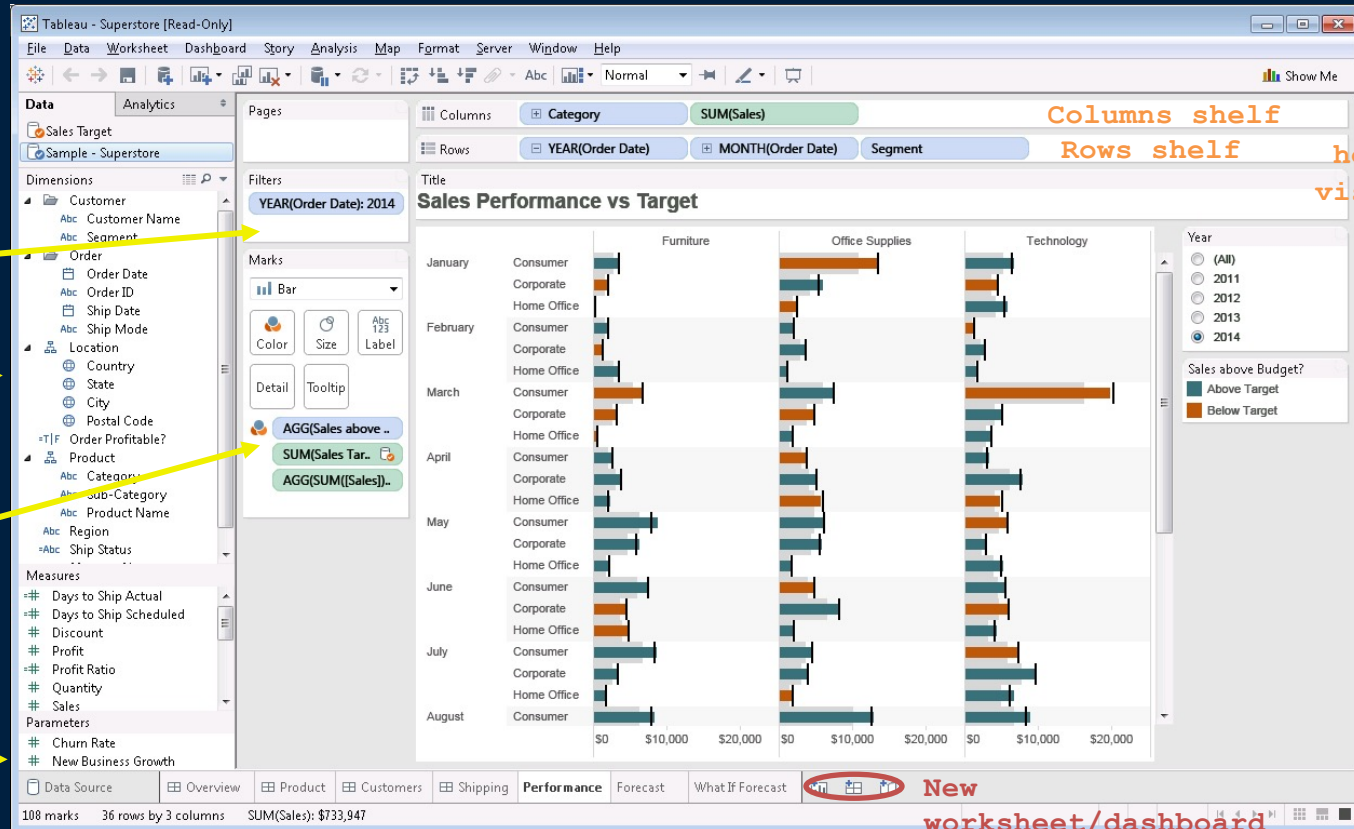
Tableau (<http://www.tableau.com/>) was founded in 2003 as a spin-off from Stanford University by Chris Stolte, Christian Chabot and Pat Hanrahan.

- 2019 revenue was about \$1.5 billion with over 4000 employees. Bought by Salesforce in 2019.
- The goal of Tableau is "to help people see and understand their data." - Christian Chabot, Tableau CEO

Tableau makes is very easy to construct visualizations from data. It connects to many data sources including: Excel/Access, text files, relational databases.

- Queries are generally built through the graphical interface.

Tableau Workspace Items



Shows Me helps setup visualization

New worksheet/dashboard

Tableau Connecting to MySQL

Tableau - sample

File Data Server Window Help

WorksOn+ (data301)

Connected to MySQL

Server
cosc304.ok.ubc.ca

Database
data301

Table
Enter table name

Dept
Emp
Proj
sales
store
vendor
WorksOn
New Custom SQL

Connection
☒ Live ☐ Extract

Filters
0 | Add...

WorksOn Emp Dept
Proj Dept1

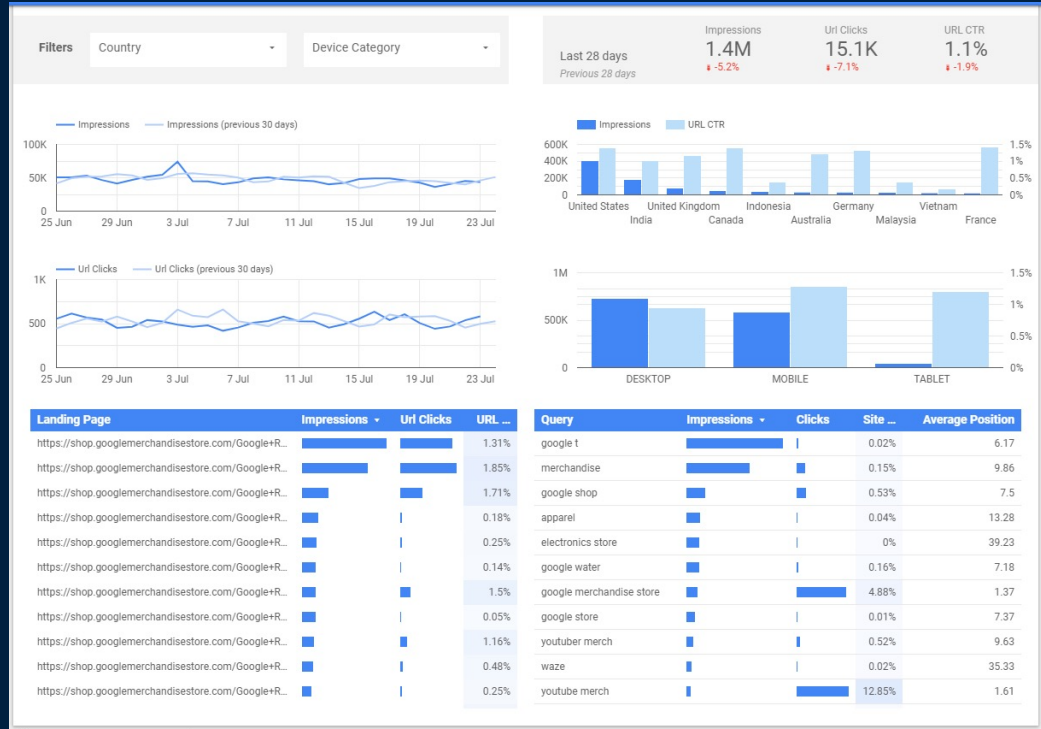
Sort fields: Data source order Show aliases Show hidden fields Rows 11

Dept dno (Dept)	Dept Dname	Dept Mgrno	Dept1 dno (Dept1)	Dept1 dname (Dept1)	Dept1 mgrno (Dept1)	Emp eno (Emp)
null	null	null	D1	Management	E8	E1
D3	Accounting	E5	D1	Management	E8	E2
D3	Accounting	E5	D2	Consulting	E7	E2
D3	Accounting	E5	D2	Consulting	E7	E4
D3	Accounting	E5	D2	Consulting	E7	E5
D2	Consulting	E7	D2	Consulting	E7	E3
D2	Consulting	E7	D2	Consulting	E7	E6

Data Source BarChart_Sales_by_Category Map_Sales_by_State Profit_Sales_Scatter Sales_Profit_Year_Trend SalesDashboard

Google Data Studio

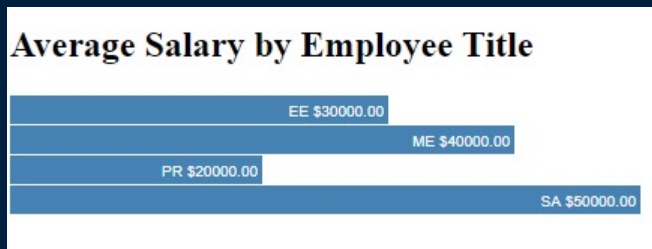
Google Data Studio is a free, cloud-based data analysis and reporting software. <https://datastudio.google.com>



D3

D3 is a JavaScript visualization library that can retrieve and display data from the database.

- Since JavaScript is executing on the client, a REST API or AJAX call to a server to get data is required.



Steps:

- Client retrieves HTML page containing D3 code.
- D3 requests data from server using a URL.
- Server has code in PHP/JSP to return data in JSON format.
- D3 renders data on chart in browser.

Visualization and Reporting Question

Question: How many of the following statements are **TRUE**?

- 1) In Tableau most database interactions are through a graphical interface.
- 2) Tableau allows users to write their own Custom SQL query.
- 3) Google Data Studio is a cloud-based visualization solution.
- 4) D3 is written in Java.
- 5) D3 connects to a database directly to retrieve data.

A) 0 **B) 1** **C) 2** **D) 3** **E) 4**

Conclusion

Database hosting selects the machine where the database software executes.

- Hosting can be on a local machine, on a machine within the organization, or on some cloud service.

Handling text files with databases is common for both import and export of data.

- Databases have specific features for handling CSV/text import and export so often code does not need to be written.

Visualization and reporting is a key use case for database data. All libraries require making a connection and executing a query to get results. Differences are on the user interface and how database details are hidden from the user.

Objectives

- Define database hosting.
- Compare and contrast benefits/challenges with hosting on local machine, on premise, and on a cloud server.
- List some text file formats.
- Be aware of database features and tools that make it easy to import and export data from databases.
- Understand how Excel can both import and export database data.
- Appreciate that Microsoft Access is a simple, file-based database that makes it easy for users to build database and queries through a graphical interface.
- List some different visualization and reporting software and explain their role in a database application architecture.



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