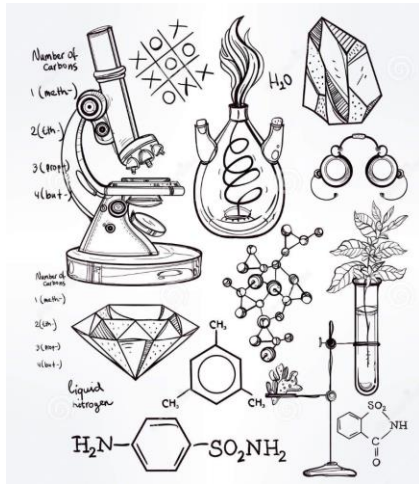# Relational databases
SQL language – Lab's

ISEN – M1

Vincent Bracq

Forewords

- This lab guide is intentionally redacted in English like SQL is

- Tables used in this lab allow for management of employees working in departments and being involved in project tasks and/or sales operations

- Tables are hosted by a DB2 database management system in the cloud called Db2 OC
  - OC stands for On Cloud

- To access DB2 tables, a user interface is needed, this SQL lab propose two options a or b:
  a. Use DbVisualizer which propose a freeware version
  b. used a web console integrated to Db2 OC

- Alternatively, all SQL interfaces of your choice is acceptable if that one support DB2

ISEN | école d'ingénieurs

Lab agenda

1. Preparation phase
   a. Installation of SQL user interface on laptop (may be useful later on in your cursus)

   or

   b. Go to the Web interface of Database cloud service Db2 OC

2. How to access data thru SQL
   a. Connect to database

   or

   b. Explore Db2 WOC web interface

3. Answer to questions using SQL statements

Step 1.a

Installation of a SQL user interface on laptop

Connection to database

Answer to questions using SQL statements

dbVisualizer installation

- Go to https://dbvis.com/download/10.0 and download the version you need (Win, Linux, macOs…)
- Better to download package embedding a JVM

- Install downloaded product

- Launch DbVisualizer

Step 1.b

Go to the Web interface of Database cloud service Db2 OC

Explore Db2 OC web interface

Answer to questions using SQL statements

Db2 On Cloud

- Database used for this hands on is located on Cloud, in London
- Service name is Db2 On Cloud (Db2 OC)

- Hands on may be done using a web console

- Go to :
https://bv7e8rbf0shslbo0krsg.db2.cloud.ibm.com/crn%3Av1%3Abluemix%3Apublic%3Adashdb-for-transactions%3Aeu-de%3Aa%2Ffb1cfa31aeee4fe387b305cd4aa4bfd6%3Affdb40f2-d2a5-468e-9f08-b07ffe57fdb6%3A%3A/console/index.html

- Enter credentials provided and click Sign In
  - User and Password ➔written on whiteboard in classroom

SIGN IN

IBM Db2 on Cloud

Username

Enter your username

Password

Enter your password

Sign in →

Sign in via IBMid

Db2 On Cloud

- The burger icon ☰ offers options
  - Explore tables
  - Run SQL
  - Etc. , be curious!

- Run SQL will be our interface for you to train your new SQL skills
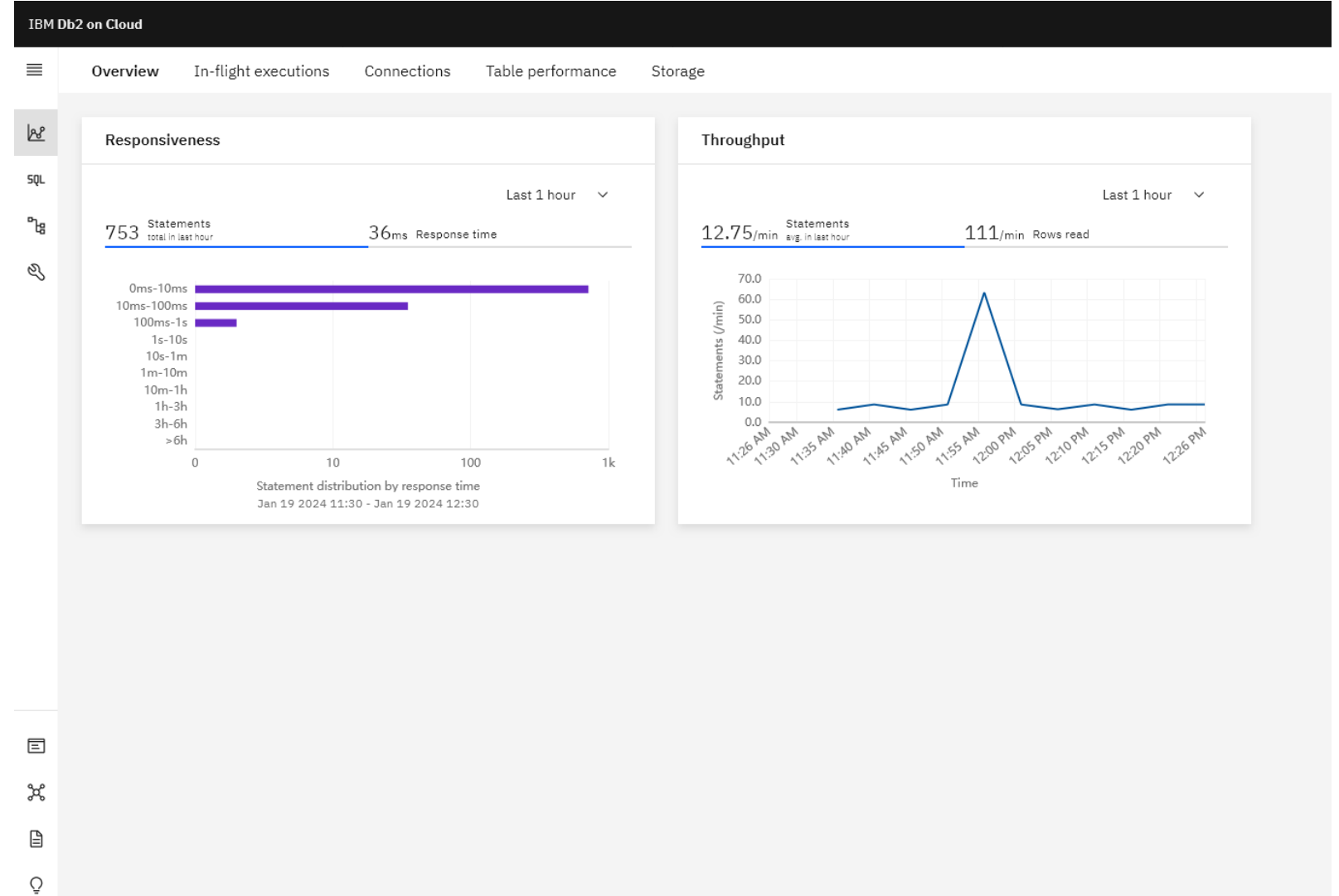
Step 2.a

Installation of SQL user interface on laptop

Connect to database

Answer to questions using SQL statements

Connect to database - parameters

- A connection to DB2 on cloud database should be defined

- Parameters needed to do so are:
  - Server TCP/IP name ➔ ffdb40f2-d2a5-468e-9f08-b07ffe57fdb6.bv7e8rbf0shslbo0krsg.databases.appdomain.cloud
  - TCP/IP port ➔ 31937
  - Database name ➔ bludb
  - JDBC driver type ➔ DB2
  - User ➔ the one written on whiteboard in classroom
  - Password ➔ the one written on whiteboard in classroom
  - Add driver property ➔ sslConnection=true (using tab properties in connection panel)

Connect to database – build connection definition

- A connection should be defined in DbVisualiZer
  - Select Tools > Connection Wizard…

  - Give a name to your connection
  - Click Next

  - Select DB2 for database Drive
  - Click Next

©Vincent Bracq 2012-2025

Connect to database – build connection definition

- Enter settings

  - Database server
  - Database port
  - Database name
  - Database Userid
  - Database Password

  - Add property sslConnection set to true via tab

  - Click Finish

- If configuration is OK then message of success displayed

SQL execution environment

- Go to SQL Commander to execute SQL statements:
  - Select SQL Commander > New SQL Commander
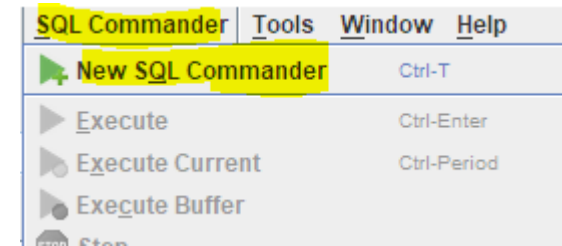
  - Write statements in upper window

  - Execute using ▶ Icon

  - Consult results in lower window

  - You can now answer to questions!

Step 2.b

Go to the Web interface of Database cloud service Db2 OC

Explore Db2 OC web interface

Answer to questions using SQL statements

SQL interface

- SQL statements may be executed from web console
  - Burger icon > Run SQL
- Enter SQL statement in upper side section
- Click Run to launch SQL
  - All statements
  - Or just selected ones
- In case of multiples statements, separate then using a semi colon (;)

- Have a look to your results
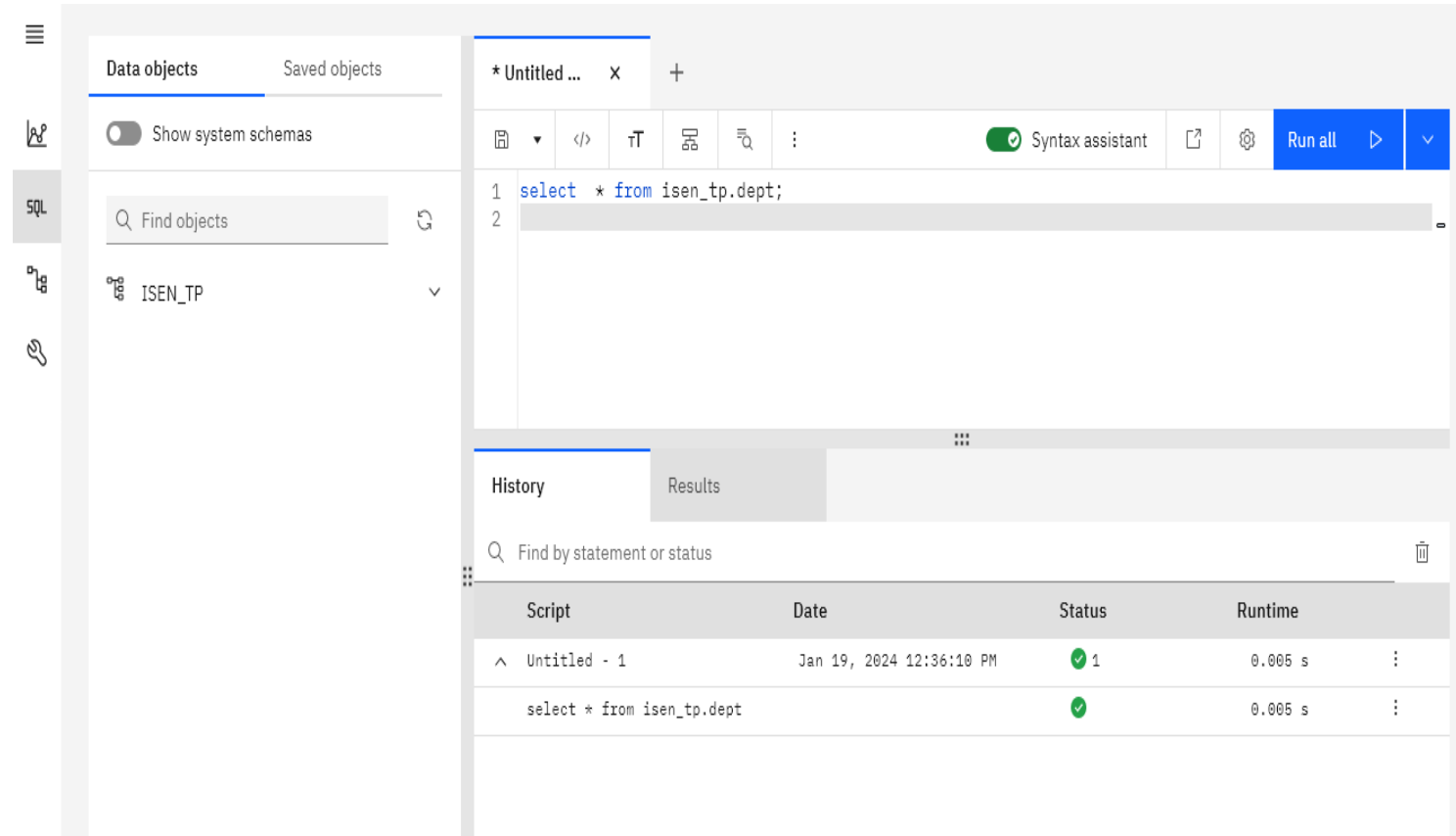
Step 3

Installation of SQL user interface on laptop

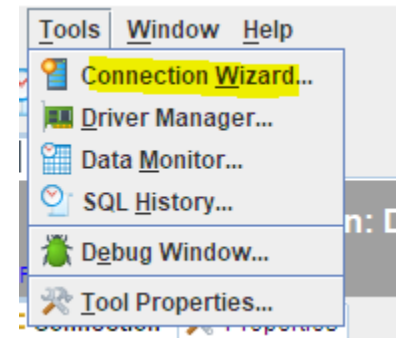Connect to database

Answer to questions using SQL statements

Environment

- All tables to be used have ISEN_TP for schema name, hence do select …. From ISEN_TP.<table_name>
- Tables used:

Table name	Usage	Relations
EMPLOYEE	All employees working for the company	An employee work in a department (WORKDEPT)
DEPARTMENT	All departments where employees work or not	Each department has a manager (MGRNO) Each department has an administrative department it depends on (ADMRDEPT)
PROJECT	All projects managed by the company	Each project has a project manager (RESEMP) Each project is managed by a department (DEPTNO)

- Db2 SQL documentation provided here:
  - https://www.ibm.com/support/knowledgecenter/SS6NHC/com.ibm.swg.im.dashdb.sql.ref.doc/doc/c0004100.html
    (see Queries section, probably the on you need)
- Use your brain to discover how tables are defined and in relation with each other see
  - https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.5.0/com.ibm.db2.luw.apdv.samptop.doc/doc/r0001094.html

Logical data model of SAMPLE_TP tables
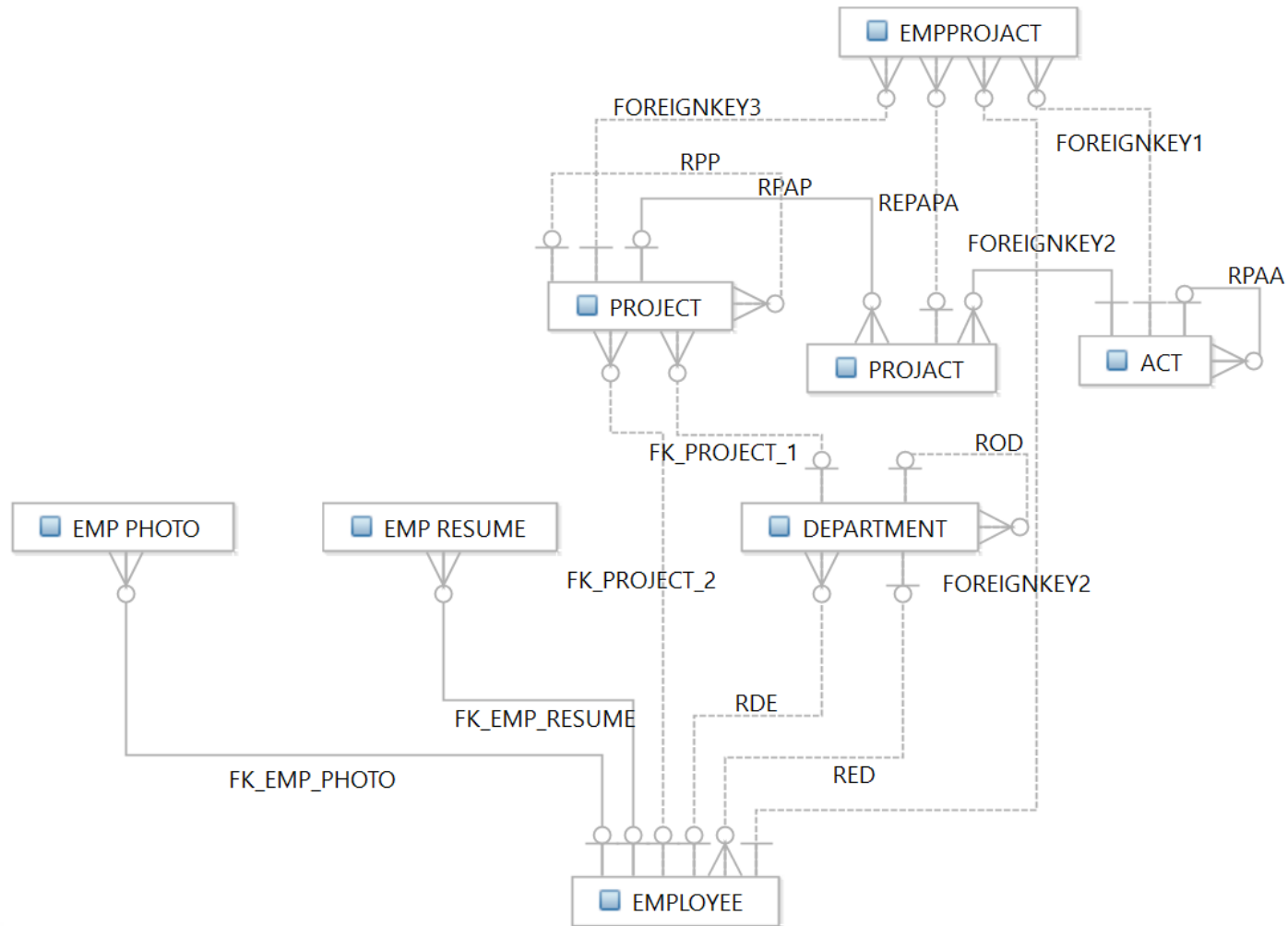
Query one table

- List of all employees with first name, last name and Salary

FIRSTNME	LASTNAME	SALARY
CHRISTINE	HAAS	152750.00
MICHAEL	THOMPSON	94250.00
SALLY	KWAN	98250.00
JOHN	GEYER	80175.00
IRVING	STERN	72250.00

- Same list ordered by last name descending

FIRSTNME	LASTNAME	SALARY
MASATOSHI	YOSHIMURA	44680.00
KIYOSHI	YAMAMOTO	64680.00
HELENA	WONG	35370.00
JAMES	WALKER	50450.00
MICHAEL	THOMPSON	94250.00
IRVING	STERN	72250.00

- List of female employees

FIRSTNME	LASTNAME	SALARY
CHRISTINE	HAAS	152750.00
SALLY	KWAN	98250.00
EVA	PULASKI	96170.00
EILEEN	HENDERSON	89750.00
DELORES	QUINTANA	73800.00
HEATHER	NICHOLLS	68420.00

- How many employees in the company?

COUNT_OF_EMPLOYEES
43

Query one table

- List of employees, first name, last name and total amount of their wages

  Wages should be named TOT_WAGES

FIRSTNME	LASTNAME	TOT_WAGES
CHRISTINE	HAAS	157970
MICHAEL	THOMPSON	98350
SALLY	KWAN	102110
JOHN	GEYER	84189
IRVING	STERN	75330
EVA	PULASKI	99763
EILEEN	HENDERSON	92730

- What is min, max and average salary for the company?

MIN_SAL	MAX_SAL	AVG_SAL
31840.00	152750.00	58155.357

- List of average salary per gender

GENDER	AVG_SAL
F	63243.684
M	53951.956

- Sum of salary per department ordered by department descending

DEPARTMENT	SUM_SAL
D11	646620
D21	358680
A00	354250
E11	317140
C01	308890
E21	282520
B01	94250

Query one table

- Who earn more than the average salary of the company?

FIRSTNME	LASTNAME	SALARY
CHRISTINE	HAAS	152750.00
MICHAEL	THOMPSON	94250.00
SALLY	KWAN	98250.00
JOHN	GEYER	80175.00
IRVING	STERN	72250.00
EVA	PULASKI	96170.00
EILEEN	HENDERSON	89750.00
THEODORE	SPENSER	86150.00
VINCENZO	LUCCHESSI	66500.00
DELORES	QUINTANA	73800.00

- List of departments having more than 5 employees

DEPARTMENT	NUM_EMP
D11	11
D21	7
E11	7
E21	6

- List of departments without a manager

DEPARTMENT	ISSUE
DEVELOPMENT CENTER	No manger!
BRANCH OFFICE F2	No manger!
BRANCH OFFICE G2	No manger!
BRANCH OFFICE H2	No manger!
BRANCH OFFICE I2	No manger!
BRANCH OFFICE J2	No manger!

Query one table, detailed statistics

- Give statistics about salary and count of employees grouped by department and gender. Use only **1** query!

- Why some columns are null?

Tips: Group by directive has more variations than only a column list.

WORKDEPT	SEX	SUM_SALARY	MAX_SALARY	MIN_SALARY	AVG_SALARY	PERS_COUNT
A00	F	199250	152750.00	46500.00	99625.00	2
A00	M	155000	66500.00	39250.00	51666.67	3
A00	(null)	354250	152750.00	39250.00	70850.00	5
B01	M	94250	94250.00	94250.00	94250.00	1
B01	(null)	94250	94250.00	94250.00	94250.00	1
C01	F	308890	98250.00	68420.00	77222.50	4
C01	(null)	308890	98250.00	68420.00	77222.50	4
D11	F	233270	69840.00	49840.00	58317.50	4
D11	M	413350	72250.00	44680.00	59050.00	7
D11	(null)	646620	72250.00	44680.00	58783.64	11
D21	F	180800	96170.00	37380.00	60266.67	3
D21	M	177880	49180.00	37760.00	44470.00	4
D21	(null)	358680	96170.00	37380.00	51240.00	7
E01	M	80175	80175.00	80175.00	80175.00	1
E01	(null)	80175	80175.00	80175.00	80175.00	1
E11	F	244050	89750.00	35900.00	48810.00	5
E11	M	73090	37750.00	35340.00	36545.00	2
E11	(null)	317140	89750.00	35340.00	45305.71	7
E21	F	35370	35370.00	35370.00	35370.00	1
E21	M	247150	86150.00	31840.00	49430.00	5
E21	(null)	282520	86150.00	31840.00	47086.67	6
(null)	F	1201630	152750.00	35370.00	63243.68	19
(null)	M	1240895	94250.00	31840.00	53951.96	23
(null)	(null)	2442525	152750.00	31840.00	58155.36	42

Query more than one table

- List of employees with their name, and department name

FISTNAME	LASTNAME	DEPARTMENT_NAME
CHRISTINE	HAAS	SPIFFY COMPUTER SERVICE DIV.
MICHAEL	THOMPSON	PLANNING
SALLY	KWAN	INFORMATION CENTER
JOHN	GEYER	SUPPORT SERVICES
IRVING	STERN	MANUFACTURING SYSTEMS
EVA	PULASKI	ADMINISTRATION SYSTEMS
EILEEN	HENDERSON	OPERATIONS
THEODORE	SPENSER	SOFTWARE SUPPORT
VINCENZO	LUCCHESSI	SPIFFY COMPUTER SERVICE DIV.
SEAN	O'CONNELL	SPIFFY COMPUTER SERVICE DIV.

- For each department give name of manager

FISTNAME	LASTNAME	DEPARTMENT_NAME
CHRISTINE	HAAS	SPIFFY COMPUTER SERVICE DIV.
MICHAEL	THOMPSON	PLANNING
SALLY	KWAN	INFORMATION CENTER
JOHN	GEYER	SUPPORT SERVICES
IRVING	STERN	MANUFACTURING SYSTEMS
EVA	PULASKI	ADMINISTRATION SYSTEMS
EILEEN	HENDERSON	OPERATIONS
THEODORE	SPENSER	SOFTWARE SUPPORT

Query more than one table

- For each department give name of the administrative department they depend on

DEPARTMENT	ADMINISTRATIVE
SPIFFY COMPUTER SERVICE DIV.	SPIFFY COMPUTER SERVICE DIV.
PLANNING	SPIFFY COMPUTER SERVICE DIV.
INFORMATION CENTER	SPIFFY COMPUTER SERVICE DIV.
DEVELOPMENT CENTER	SPIFFY COMPUTER SERVICE DIV.
MANUFACTURING SYSTEMS	DEVELOPMENT CENTER
ADMINISTRATION SYSTEMS	DEVELOPMENT CENTER
SUPPORT SERVICES	SPIFFY COMPUTER SERVICE DIV.
OPERATIONS	SUPPORT SERVICES
SOFTWARE SUPPORT	SUPPORT SERVICES
BRANCH OFFICE F2	SUPPORT SERVICES

- List of all project: project name, name of project manager and name of department in charge of

PROJECT	MGR_NAME	DEPT_NAME
ADMIN SERVICES	HAAS	DEVELOPMENT CENTER
WELD LINE AUTOMATION	HAAS	DEVELOPMENT CENTER
WELD LINE PLANNING	THOMPSON	PLANNING
QUERY SERVICES	KWAN	INFORMATION CENTER
USER EDUCATION	KWAN	INFORMATION CENTER
OPERATION SUPPORT	GEYER	SUPPORT SERVICES
GEN SYSTEMS SERVICES	GEYER	SUPPORT SERVICES
W L PROGRAMMING	STERN	MANUFACTURING SYSTEMS
GENERAL ADMIN SYSTEMS	PULASKI	ADMINISTRATION SYSTEMS
OPERATION	HENDERSON	OPERATIONS

Query more than one table

- Pair of employees of different gender hired the same day

MRS	MR	DATE
WONG	LEE	2006-02-23 00:00:00

Correlated subquery

- List employees working in a non existing department

EMPNO	FIRSTNME	MIDINIT	LASTNAME	WORKDEPT
200341	ALONE	I	IN THE DARK	E99

- List of employees having a salary less than the average
  Salary of their department

FIRSTNAME	LASTNAME	SALARY
VINCENZO	LUCCHESSI	66500.00
SEAN	O'CONNELL	49250.00
DELORES	QUINTANA	73800.00
HEATHER	NICHOLLS	68420.00
BRUCE	ADAMSON	55280.00
MASATOSHI	YOSHIMURA	44680.00
MARILYN	SCOUTTEN	51340.00
JAMES	WALKER	50450.00
DAVID	BROWN	57740.00
JENNIFER	LUTZ	49840.00

OLAP functions

It's time to stand on its own feet! Try to find the SQL syntax in documentation.

- List employees ordered by their salary RANK, name and rank

LASTNAME	RANK
HAAS	1
KWAN	2
PULASKI	3
THOMPSON	4
HENDERSON	5
SPENSER	6
GEYER	7
QUINTANA	8
STERN	9
JOHN	10

Db2 doc available @ https://www.ibm.com/support/knowledgecenter/SS6NHC/com.ibm.swg.im.dashdb.sql.ref.doc/doc/c0004100.html

Select from Select

Remember: result of a select is a table and a table can be located in FROM clause

- Who earn the third most important salary?

LASTNAME	SALARY
PULASKI	96170.00

Db2 doc available @ https://www.ibm.com/support/knowledgecenter/SS6NHC/com.ibm.swg.im.dashdb.sql.ref.doc/doc/c0004100.html

Manipulate dates

- Give exact number of <u>days</u> between today and January 1st, 1970

Today is <u>current date</u> in SQL

Remember dates in SQL statement are strings

Use <u>from sysibm.sysdummy1</u> in your SQL

Days since 1970-01-01
18312

Executed 2020-01-20

- What is the date of February 28th, 2020 plus one day?

1
2020-02-29 00:00:00

- What is the date of February 28th, 2019 plus one day?

1
2019-03-01 00:00:00

- And for February 28th, 1900 plus one day

1
1900-03-01 00:00:00

Creasy, isn't it!

Use view or avoid it!

- A view is in fact a Select statement i.e:
  - Create view salary_sum(a,b) as select workdpet, sum(salary) from isen.employee group by workdept
- Then you may reference a view in Select:
  - Select * from salary_sum

- But how can I use a view if I can't create a view, lack of privilege?

Use view or avoid it!

- Easily, two ways:
  - Select * from (select workdept as a , sum(salary) as b from isen.employee group by workdept)

  Or use a common table expression like this:

  - With tempo (a,b) as (select workdept, sum(salary) from isen.employee group by workdept) select * from tempo

A	B
A00	354250
B01	94250
C01	308890
D11	646620
D21	358680
E01	80175
E11	317140
E21	282520
E99	31840

  - WITH syntax provide a clearer presentation of your SQL statement and allows multiple usage of the common table expression in final Select clause

ISEN | école d'ingénieurs

Recursive SQL

- Suppose the PARTLIST table with three columns:
  - PART being id of a part,
  - SUBPART being one id of a subpart composing the part
  - QUANTITY being number of subparts needed to build the part

  - Note that a subpart may be also made of many subpart

  - You'll use common table expression (WITH clause)

  - Visit Db2 SQL documentation!

PART	SUBPART	QUANTITY
00	01	5
00	05	3
01	02	2
01	03	3
01	04	4
01	06	3
02	05	7
02	06	6
03	07	6
04	08	10
04	09	11
05	10	10
05	11	10
06	12	10
06	13	10
07	14	8
07	12	8

Recursive SQL

- So the question is: give a list of all subparts and subparts of subparts etc. and number needed to build PART number 01?

PART	SUBPART	QUANTITY
01	02	2
01	03	3
01	04	4
01	06	3
02	05	7
02	06	6
03	07	6
04	08	10
04	09	11
05	10	10
05	11	10
06	12	10
06	13	10
07	12	8
07	14	8

- And can we get global number of different subparts needed to build PART number 01?

PART	SUBPART	Total QTY Used
01	02	2
01	03	3
01	04	4
01	05	14
01	06	15
01	07	18
01	08	40
01	09	44
01	10	140
01	11	140
01	12	294
01	13	150
01	14	144