An overview of SQL

Dec 2017

I THINK WE SHOULD BUILD AN SQL DATABASE.
UH-OH
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DOES HE UNDERSTAND WHAT HE SAID OR IS IT SOMETHING HE SAW IN A TRADE MAGAZINE AD?
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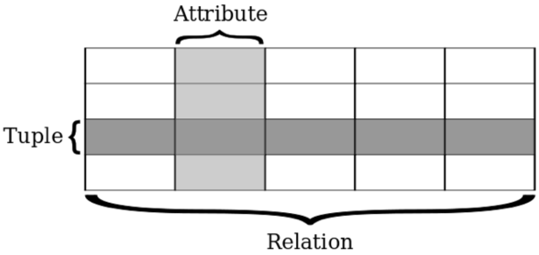
WHAT COLOR DO YOU WANT THAT DATABASE?
I THINK MAUVE HAS THE MOST RAM.

Structured Query Language

- Pronounced “Sequel”
  - Originally called Sequel but changed for trademark reasons
- Dates to 1974
  - Written by IBM (Chamberlin and Boyce)
  - Based on “A Relational Model of Data for Large Shared Data Banks” by Edward Codd
  - First commercialised by Oracle
  - Standardised in 1986

Relational terminology (from Codd)

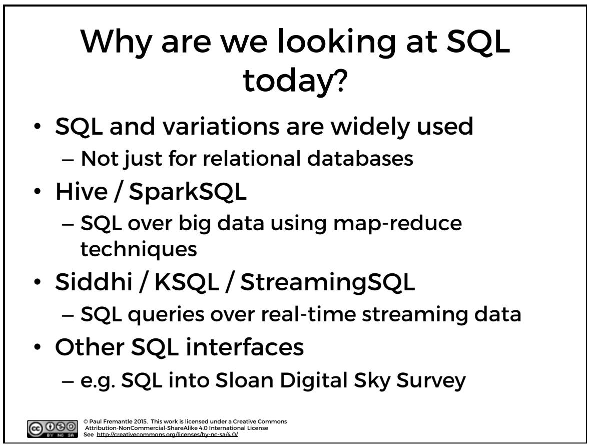


Relational Database

- Every row in a table has the same attributes (columns)
  - Relations are either tables or views on those tables
- A primary key for each row uniquely identifies it
- A foreign key points to another table's primary key

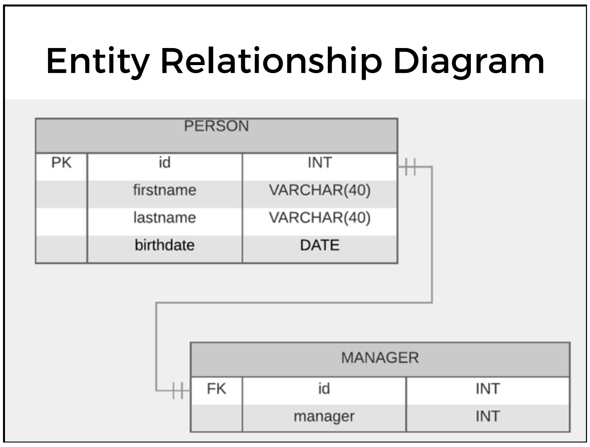
Relational database

Id	Firstname	Lastname	birthdate
2587	John	Hopkins	5/12/1973
7789	Henry	Gleeson	1/5/1985
22398	Eleanor	Richardson	10/6/1996



Why are we looking at SQL today?

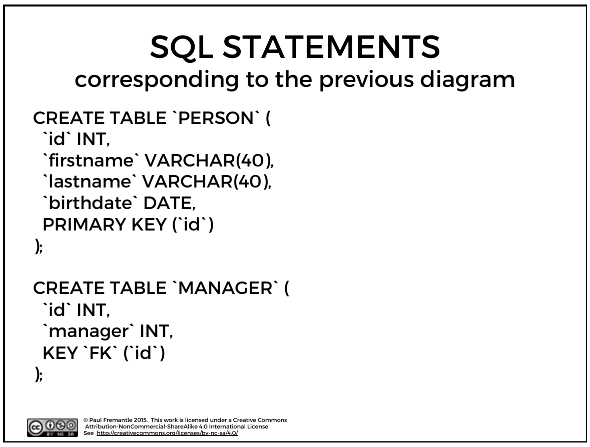
- SQL and variations are widely used
  - Not just for relational databases
- Hive / SparkSQL
  - SQL over big data using map-reduce techniques
- Siddhi / KSQL / StreamingSQL
  - SQL queries over real-time streaming data
- Other SQL interfaces
  - e.g. SQL into Sloan Digital Sky Survey



Entity Relationship Diagram

PERSON		
PK	id	INT
	firstname	VARCHAR(40)
	lastname	VARCHAR(40)
	birthdate	DATE

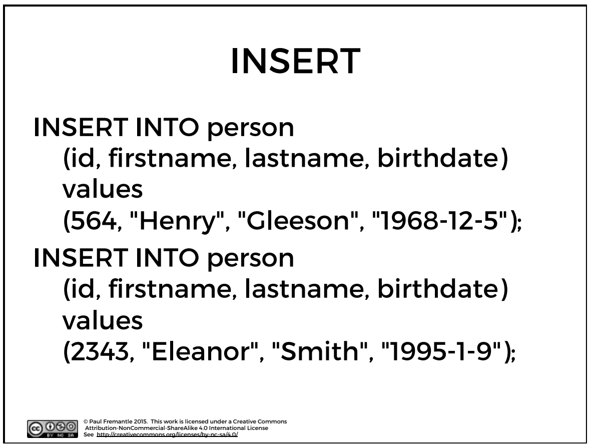
MANAGER		
FK	id	INT
	manager	INT



SQL STATEMENTS

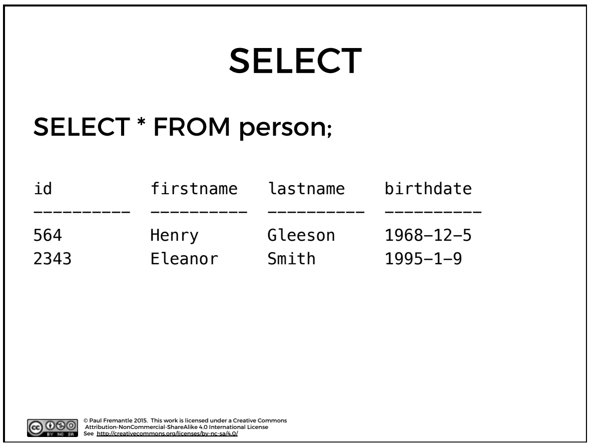
corresponding to the previous diagram

```
CREATE TABLE `PERSON` (
  `id` INT,
  `firstname` VARCHAR(40),
  `lastname` VARCHAR(40),
  `birthdate` DATE,
  PRIMARY KEY (`id`)
);

CREATE TABLE `MANAGER` (
  `id` INT,
  `manager` INT,
  KEY `FK` (`id`)
);
```



INSERT

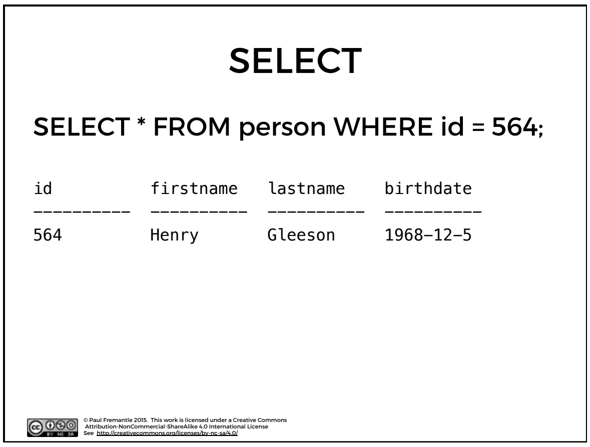
```
INSERT INTO person
   (id, firstname, lastname, birthdate)
   values
   (564, "Henry", "Gleeson", "1968-12-5");
INSERT INTO person
   (id, firstname, lastname, birthdate)
   values
   (2343, "Eleanor", "Smith", "1995-1-9");
```



SELECT

```
SELECT * FROM person;
```

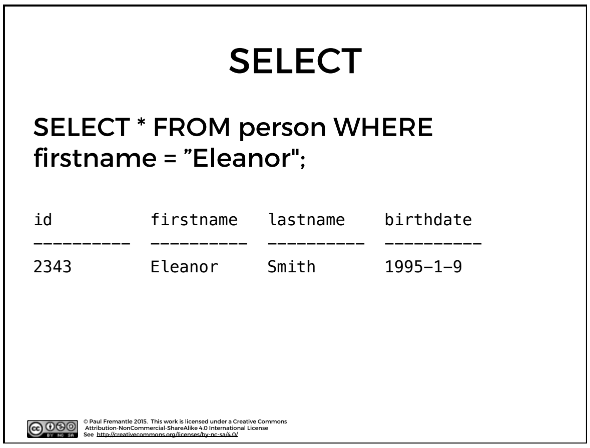
```
id          firstname   lastname    birthdate
----------  ----------  ----------  ----------
564         Henry       Gleeson     1968-12-5
2343        Eleanor     Smith       1995-1-9
```



SELECT

```
SELECT * FROM person WHERE id = 564;
```

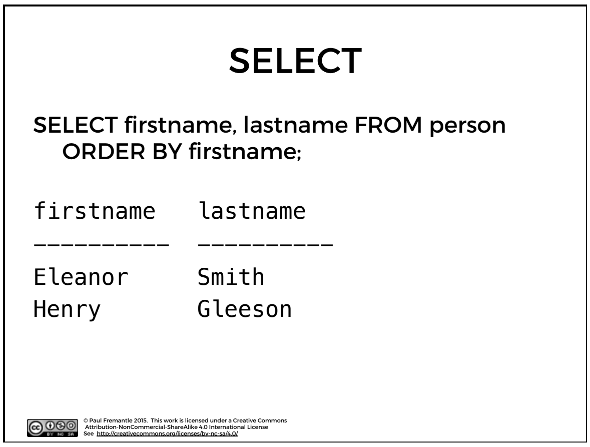
```
id          firstname   lastname    birthdate
----------  ----------  ----------  ----------
564         Henry       Gleeson     1968-12-5
```



SELECT

SELECT * FROM person WHERE firstname = ”Eleanor";

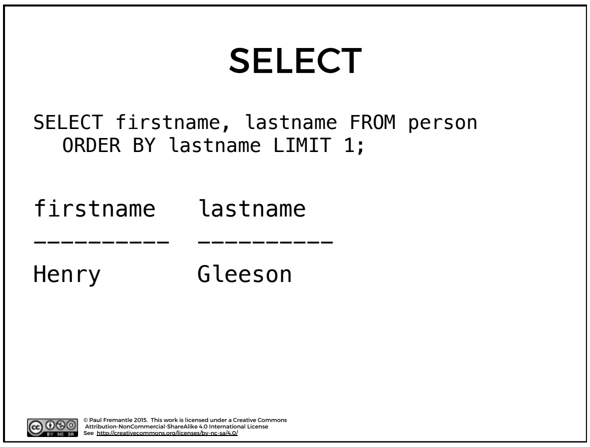
```
id          firstname   lastname    birthdate
----------  ----------  ----------  ----------
2343        Eleanor     Smith       1995-1-9
```



SELECT

SELECT firstname, lastname FROM person ORDER BY firstname;

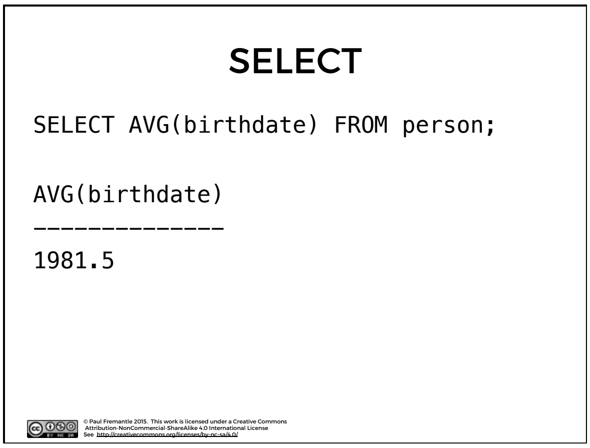
```
firstname   lastname
----------  ----------
Eleanor     Smith
Henry       Gleeson
```



SELECT

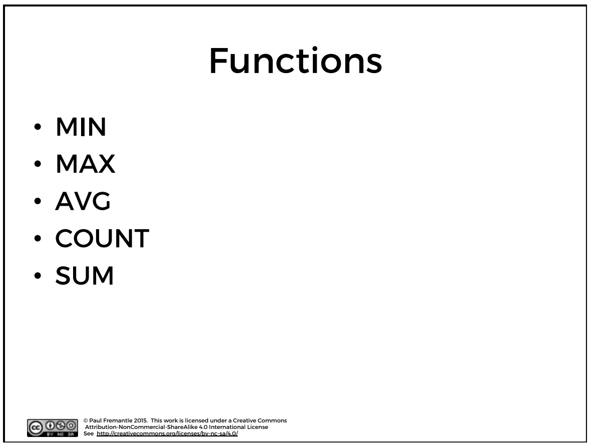
```
SELECT firstname, lastname FROM person
  ORDER BY lastname LIMIT 1;
```

```
firstname   lastname
----------  ----------
Henry       Gleeson
```



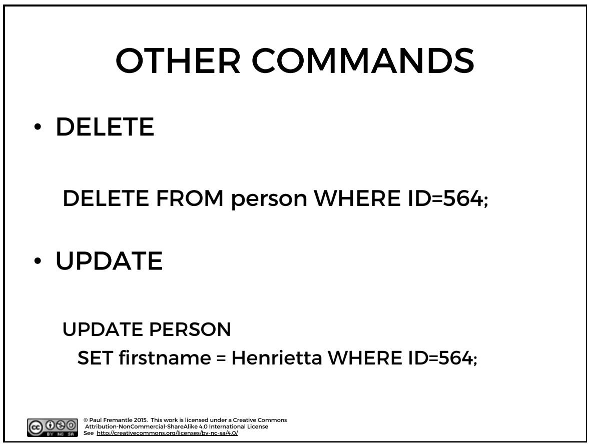
SELECT

```
SELECT AVG(birthdate) FROM person;

AVG(birthdate)
--------------
1981.5
```



Functions

- MIN
- MAX
- AVG
- COUNT
- SUM



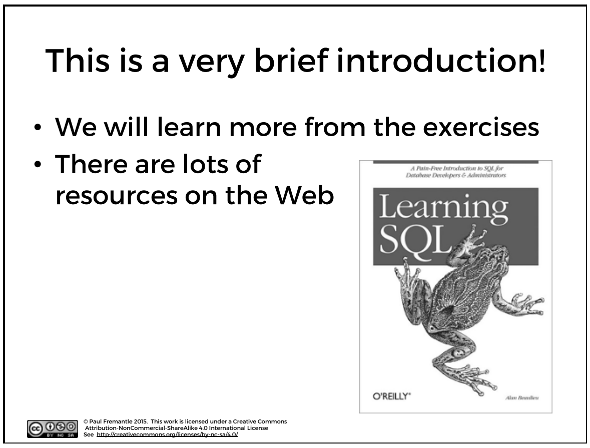
OTHER COMMANDS

- DELETE

```
DELETE FROM person WHERE ID=564;
```

- UPDATE

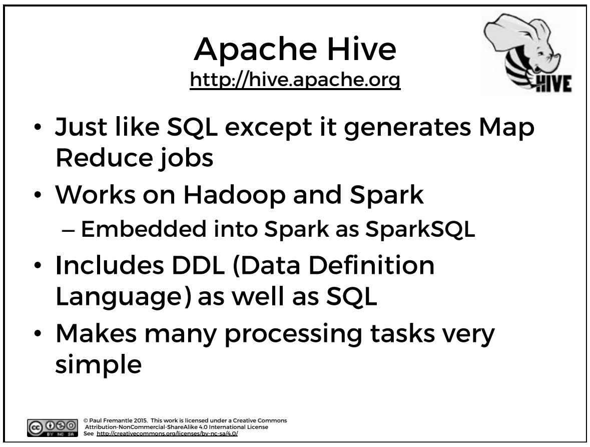
```
UPDATE PERSON
  SET firstname = Henrietta WHERE ID=564;
```



This is a very brief introduction!

- We will learn more from the exercises
- There are lots of resources on the Web

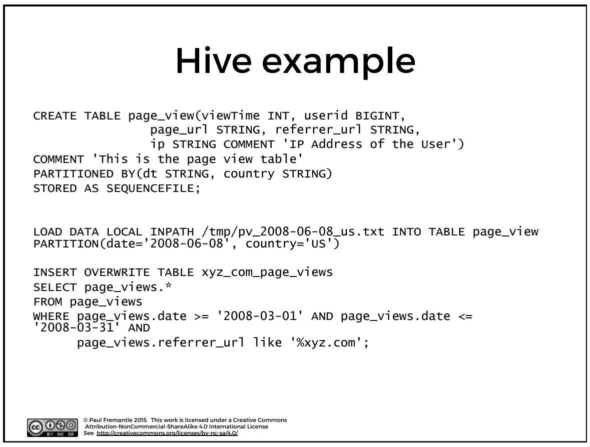
A Pain-Free Introduction to SQL for Database Developers & Administrators
Learning SQL
O'REILLY
Alan Beaulieu



Apache Hive

http://hive.apache.org

- Just like SQL except it generates Map Reduce jobs
- Works on Hadoop and Spark
  - Embedded into Spark as SparkSQL
- Includes DDL (Data Definition Language) as well as SQL
- Makes many processing tasks very simple



Hive example

```
CREATE TABLE page_view(viewTime INT, userid BIGINT,
                page_url STRING, referrer_url STRING,
                ip STRING COMMENT 'IP Address of the User')
COMMENT 'This is the page view table'
PARTITIONED BY(dt STRING, country STRING)
STORED AS SEQUENCEFILE;


LOAD DATA LOCAL INPATH /tmp/pv_2008-06-08_us.txt INTO TABLE page_view
PARTITION(date='2008-06-08', country='US')

INSERT OVERWRITE TABLE xyz_com_page_views
SELECT page_views.*
FROM page_views
WHERE page_views.date >= '2008-03-01' AND page_views.date <=
'2008-03-31' AND
      page_views.referrer_url like '%xyz.com';
```

SparkSQL

- Integrates into existing Spark programs
  - Mixes SQL with Python, Scala or Java
- Integrates data from CSV, Avro, Parquet, JDBC, ODBC, JSON, etc
  - Including joins across them
- Fully supports Apache Hive
  - *If you build it with Hive support*
- Fits into the resilient scalable model of Spark

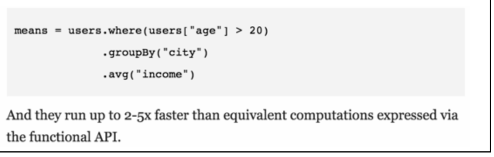
Spark SQL example

```
from pyspark.sql import SQLContext, Row
sqlContext = SQLContext(sc)

lines = sc.textFile("examples/src/main/resources/people.txt")
parts = lines.map(lambda l: l.split(","))
people = parts.map(lambda p: Row(name=p[0], age=int(p[1])))

schemaPeople = sqlContext.createDataFrame(people)
schemaPeople.registerTempTable("people")

teenagers = sqlContext.sql("SELECT name FROM people WHERE age >= 13
AND age <= 19")

teenNames = teenagers.map(lambda p: "Name: " + p.name)
for teenName in teenNames.collect():
  print(teenName)
```

DataFrame

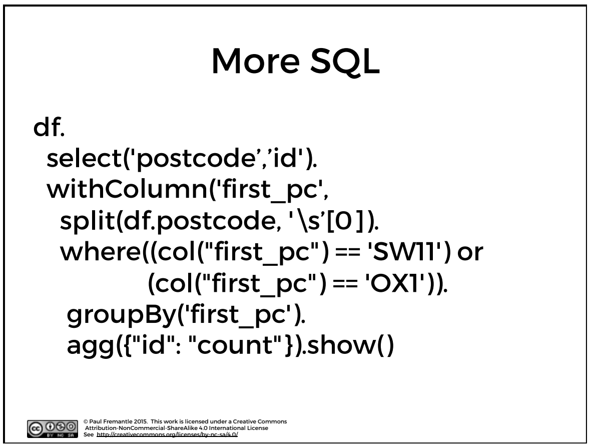
Based on Python and R dataframes

- Column based object used by SQL
- Offers SQL like programming
- Supports algebraic optimisation and code gen
- E.g. in Scala:



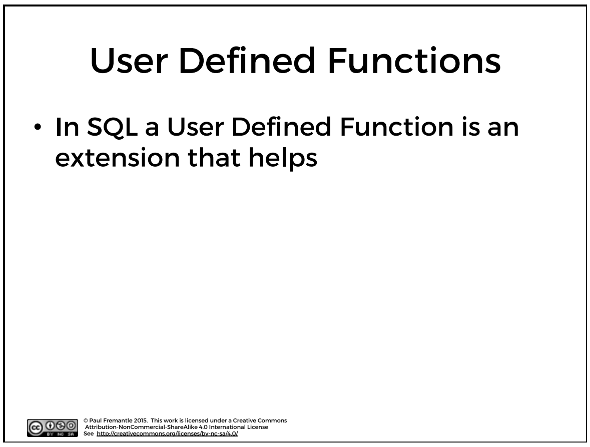
```
means = users.where(users["age"] > 20)
             .groupBy("city")
             .avg("income")
```

And they run up to 2-5x faster than equivalent computations expressed via the functional API.



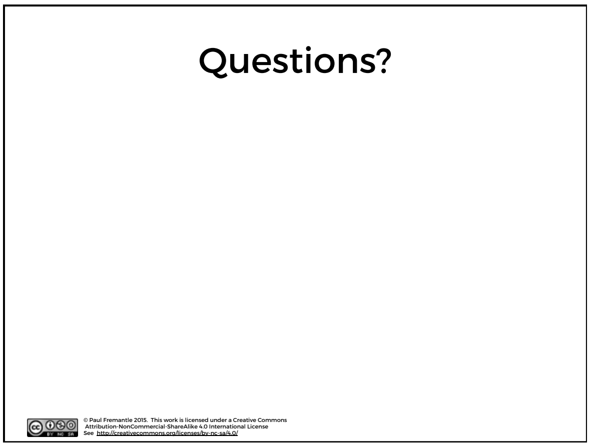
More SQL

```
df.
  select('postcode’,’id').
  withColumn('first_pc',
    split(df.postcode, '\s’[0]).
    where((col("first_pc") == 'SW11') or
              (col("first_pc") == 'OX1')).
     groupBy('first_pc').
     agg({"id": "count"}).show()
```



User Defined Functions

- In SQL a User Defined Function is an extension that helps



Questions?