Spark SQL

DataFrames and Databases

DataFrame & Database table: conceptually equivalent.

Spark makes them interoperable

DataFrames & SQL

- Query existing Spark DataFrames (however created) with SQL
  - Same functionality, different interface
  - Legacy SQL

Read data and persistency

- Load data from Hive / other databases
- Save tables to Hive

Explore the Yelp dataset

```
yelp_df = sqlCtx.load(
source='com.databricks.spark.csv',
header = 'true',
inferSchema = 'true',
path =
'file:///usr/lib/hue/apps/search/examples/collections/solr_configs_yelp_demo/index_data.csv')
```

Register as a SQL table

- DataFrame already has Schema
- Create a temporary table with:

```
yelp_df.registerTempTable("yelp")
```

Run SQL statements

```
filtered_yelp = sqlCtx.sql("SELECT * FROM yelp WHERE useful >= 1")
filtered_yelp
```

```
Out[]: DataFrame[business_id: string, cool: int, date: string, funny: int, id: string, stars: int, text: string, type: string, useful: int, user_id: string, name: string, full_address: string, latitude: double, longitude: double, neighborhoods: string, open: string, review_count: int, state: string]
```

Filtering

```
filtered_yelp.count()
Out[]: 601L
```

```
yelp_df.filter(yelp_df.useful >= 1).count()
Out[]: 601L
```

aggregation

```
sqlCtx.sql("SELECT MAX(useful) AS max_useful FROM yelp").collect()
Out[]: [Row(max_useful)=28)]


yelp_df.agg({"useful":"max"}).collect()
Out[]: [Row(MAX(useful#267)=28)]
```

Join - select - show

```
useful_perc_data.join(
    yelp_df,
    yelp_df.id == useful_perc_data.uid,
    "inner"
).select(useful_perc_data.uid, "useful_perc", "review_count")
```

Register as SQL table

```
useful_perc_data.registerTempTable("useful_perc_data")
```

join

```
sqlCtx.sql(
"""SELECT useful_perc_data.uid, useful_perc,
review_count
FROM useful_perc_data
INNER JOIN yelp
ON useful_perc_data.uid=yelp.id"""
)
```

Performance

- Either DataFrame calls or SQL
- Same under-the-hood optimizer (Catalyst)
- Creates DAG
- Parallel execution
- Creates bytecode

Spark and Hive

Spark and Hive

- copied hive-site.xml to Spark conf/
- Spark read / write to Hive

Hive table to DataFrame

- sqlCtx.sql has access to Hive tables
- Load data uploaded during the Hive class
- Result is a DataFrame

```
customers_df = sqlCtx.sql("SELECT * FROM customers")
customers_df.show()
```

Printout of customers_df

customer_id	customer_fname	customer_lname	customer_email	customer_password	customer_street	customer_city	customer_state	customer_zipcode
1	Richard	Hernandez	XXXXXXXXX	XXXXXXXXX	6303 Heather Plaza	Brownsville	TX	78521
2	Mary	Barrett	XXXXXXXXX	XXXXXXXXX	9526 Noble Embers...	Littleton	CO	80126
3	Ann	Smith	XXXXXXXXX	XXXXXXXXX	3422 Blue Pioneer...	Caguas	PR	00725
4	Mary	Jones	XXXXXXXXX	XXXXXXXXX	8324 Little Common	San Marcos	CA	92069
5	Robert	Hudson	XXXXXXXXX	XXXXXXXXX	10 Crystal River ...	Caguas	PR	00725
6	Mary	Smith	XXXXXXXXX	XXXXXXXXX	3151 Sleepy Quail...	Passaic	NJ	07055
7	Melissa	Wilcox	XXXXXXXXX	XXXXXXXXX	9453 High Concession	Caguas	PR	00725
8	Megan	Smith	XXXXXXXXX	XXXXXXXXX	3047 Foggy Forest...	Lawrence	MA	01841
9	Mary	Perez	XXXXXXXXX	XXXXXXXXX	3616 Quaking Street	Caguas	PR	00725
10	Melissa	Smith	XXXXXXXXX	XXXXXXXXX	8598 Harvest Beac...	Stafford	VA	22554
11	Mary	Huffman	XXXXXXXXX	XXXXXXXXX	3169 Stony Woods	Caguas	PR	00725
12	Christopher	Smith	XXXXXXXXX	XXXXXXXXX	5594 Jagged Ember...	San Antonio	TX	78227
13	Mary	Baldwin	XXXXXXXXX	XXXXXXXXX	7922 Iron Oak Gar...	Caguas	PR	00725
14	Katherine	Smith	XXXXXXXXX	XXXXXXXXX	5666 Hazy Pony Sq...	Pico Rivera	CA	90660
15	Jane	Luna	XXXXXXXXX	XXXXXXXXX	673 Burning Glen	Fontana	CA	92336
16	Tiffany	Smith	XXXXXXXXX	XXXXXXXXX	6651 Iron Port	Caguas	PR	00725
17	Mary	Robinson	XXXXXXXXX	XXXXXXXXX	1325 Noble Pike	Taylor	MI	48180
18	Robert	Smith	XXXXXXXXX	XXXXXXXXX	2734 Hazy Butterf...	Martinez	CA	94553
19	Stephanie	Mitchell	XXXXXXXXX	XXXXXXXXX	3543 Red Treasure...	Caguas	PR	00725
20	Mary	Ellis	XXXXXXXXX	XXXXXXXXX	4703 Old Route	West New York	NJ	07093

```
customers_df.printSchema()
root
 |-- customer_id: integer (nullable = true)
 |-- customer_fname: string (nullable = true)
 |-- customer_lname: string (nullable = true)
 |-- customer_email: string (nullable = true)
 |-- customer_password: string (nullable = true)
 |-- customer_street: string (nullable = true)
 |-- customer_city: string (nullable = true)
 |-- customer_state: string (nullable = true)
 |-- customer_zipcode: string (nullable = true)
```

Run unmodified SQL queries

```
sqlCtx.sql("""select c.category_name,
count(order_item_quantity) as count from order_items oi
inner join products p on oi.order_item_product_id =
p.product_id inner join categories c on c.category_id =
p.product_category_id group by c.category_name
order by count desc
limit 10"""
).show()
```

Most popular categories

category_name	count
Cleats	24551
Men's Footwear	22246
Women's Apparel	21035
Indoor/Outdoor Games	19298
Fishing	17325
Water Sports	15540
Camping & Hiking	13729
Cardio Equipment	12487
Shop By Sport	10984
Electronics	3156

Run unmodified SQL queries

```
sqlCtx.sql("""select p.product_id, p.product_name, r.revenue
from products p inner join
(select oi.order_item_product_id, sum(cast(oi.order_item_subtotal as float)) as
revenue from order_items oi inner join orders o on oi.order_item_order_id =
o.order_id
where o.order_status <> 'CANCELED'
and o.order_status <> 'SUSPECTED_FRAUD'
group by order_item_product_id) r
on p.product_id = r.order_item_product_id
order by r.revenue desc limit 10"""
).show()
```

Top 10 products by revenue

product_id	product_name	revenue
1004	Field & Stream Sp...	6637668.282318115
365	Perfect Fitness P...	4233794.3682899475
957	Diamondback Women...	3946837.004547119
191	Nike Men's Free 5...	3507549.2067337036
502	Nike Men's Dri-FI...	3011600.0
1073	Pelican Sunstream...	2967851.6815185547
1014	O'Brien Men's Neo...	2765543.314743042
403	Nike Men's CJ Eli...	2763977.4868011475
627	Under Armour Girl...	1214896.220287323
565	adidas Youth Germ...	63490.0

Save DataFrames to Hive

registerTempTable only gives temporary SQL-like access to DataFrames

Store permanently to Hive with:

```
yelp_df.saveAsTable("yelp_reviews")
```

Check persistency

- Restart PySpark
- Run: `sqlCtx.sql("SELECT * FROM yelp").show()`
- Fails with "Table not found"

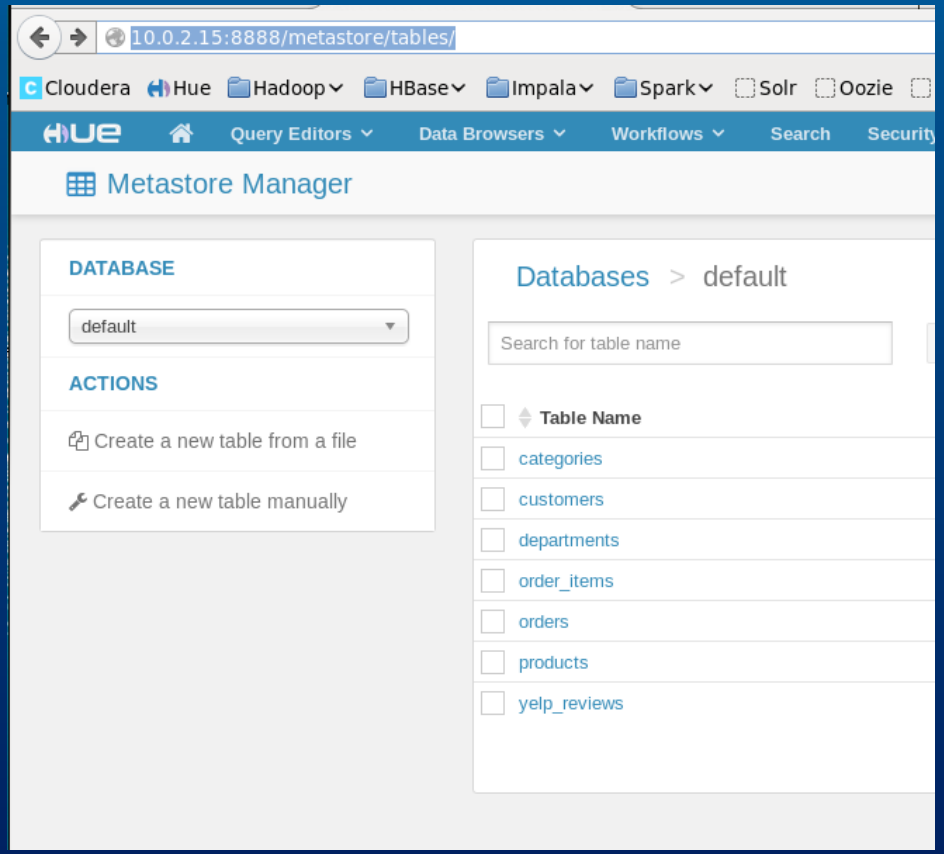
Check persistency

- Restart PySpark
- Run: `sqlCtx.sql("SELECT * FROM yelp_reviews").show()`
- Restores from Hive

Loaded Yelp DataFrame

business_id	cool	date	funny	id	stars	text	type	useful	user_id	name	full_address	latitude	longitude	neighborhoods	open	review_count	state
9yKzy9PApeiPPOUJE...	2	2011-01-26	0	fWKvX83p0-ka4JS3d...	4	My wife took me h...	business	5	rLtl8ZkDX5vH5nAx9...	Morning Glory Cafe	6106 S 32nd St Ph...	33.3907928467	-112.012504578	[]	True	116	AZ
ZRJwVLyzEJq1VAihD...	0	2011-07-27	0	IjZ33sJrzXqU-0X6U...	4	I have no idea wh...	business	0	0a2KyEL0d3Yb1V6ai...	Spinato's Pizzeria	4848 E Chandler B...	33.305606842	-111.978759766	[]	True	102	AZ
6oRAC4uyJCsJl1X0W...	0	2012-06-14	0	IESLBzqUCLdSzSqm0...	4	love the gyro pla...	business	1	0hT2KtfLiobPvh6cD...	Haji-Baba	1513 E Apache Bl...	33.4143447876	-111.913032532	[]	True	265	AZ
_1QQZuf4zZOyFCvXc...	1	2010-05-27	0	G-WvGaISbqqaMHlNn...	4	Rosie, Dakota, an...	business	2	uZetl9T0NcROGOyFf...	Chaparral Dog Park	5401 N Hayden Rd ...	33.5229454041	-111.90788269	[]	True	88	AZ
6ozycU1RpktNG2-1B...	0	2012-01-05	0	1uJFq2r5QfJG_6ExM...	4	General Manager S...	business	0	vYmM4KTsC8ZfQBg-j...	Discount Tire	1357 S Power Road...	33.3910255432	-111.68447876	[]	True	5	AZ
-yxfBYGB6SEqszmxJ...	4	2007-12-13	1	m2CKSsepBCoRYWxiR...	3	Quiessence is, si...	business	3	sqYN3lNgvPbPCTRsM...	Quiessence Restau...	6106 S 32nd St Ph...	33.3907928467	-112.012504578	[]	True	109	AZ
zp713qNhx8d9KCJJn...	7	2010-02-12	4	riFQ3vxNpP4rWLk_C...	4	Drop what you're ...	business	7	wFweIWhv2fREZV_dY...	La Condesa Gourme...	1919 N 16th St Ph...	33.4691314697	-112.04750824	[]	True	307	AZ
hW0Ne_HTHEAgGF1rA...	0	2012-07-12	0	JL7GXJ9u4YMx7Rzs0...	3	Luckily, I didn't...	business	1	1ieuYcKS7zeAv_U15...	Phoenix Sky Harbo...	3400 E Sky Harbor...	33.4347496033	-112.006439209	[]	True	862	AZ
wNUea3IXZWD63bbOQ...	0	2012-08-17	0	XtnfnYmnJYi71yIuG...	3	Definitely come f...	business	0	Vh_DlizgGhSqQh4qf...	Stingray Sushi	2574 E Camelback ...	33.5096054077	-112.025741577	[]	True	163	AZ
nMHhuYan8e3cONo3P...	0	2010-08-11	0	jJAIXA46pU1swYyRC...	4	Nobuo shows his u...	business	1	sUNkXg8-KFtCMQDV6...	Nobuo At Teeter H...	622 E Adams St Ph...	33.4495391846	-112.065666199	[]	True	189	AZ
AsSCv0q_BWqIe3mX2...	1	2010-06-16	1	E11jzpKz9Kw5K7fuA...	4	The oldish man wh...	business	3	-OMlS6yWkYjVldNhC...	Cookiez On Mill	514 S Mill Ave St...	33.4248809814	-111.940200806	[]	False	74	AZ
e9nN4XxjdHj4qtKCO...	1	2011-10-21	0	3rPt0LxF7rgmEUrzn...	4	Wonderful Vietnam...	business	1	C1rHp3dmepNea7Xio...	Lee's Sandwiches	1901 W Warner Rd ...	33.3347129822	-111.874786377	[]	True	192	AZ
h53YuCiIDfEFSJCQp...	1	2010-01-11	0	cGnKNX3I9rthE0-TH...	4	They have a limit...	business	2	UPtysDF6cUDUxq2KY...	Jason's Deli	1065 E Baseline R...	33.3796195984	-111.809425354	[]	True	36	AZ
WGNIYMeXPyoWav1AP...	1	2011-12-23	0	FvEEw1_OsrYdvwLV5...	4	Good tattoo shop....	business	2	Xm8HXE1JHqscXe5BK...	The Lady Luck Tat...	961 E Guadalupe R...	33.3637619019	-111.9272995	[]	True	25	AZ
yc5AH9H71xJidA_J2...	1	2010-05-20	0	pfUwBKYYmUXeiwrhD...	4	I'm 2 weeks new t...	business	1	JOG-4G4e8ae3lx_sz...	Rosie McCaffrey's	906 E Camelback R...	33.5095176697	-112.061569214	[]	True	151	AZ
Vb9FPCEL6Ly24PNxL...	0	2011-03-20	0	HvqmdqWcerVWO3Gs6...	4	Was it worth the ...	business	2	ylWOj2y7TV2e3yYeW...	Z Pizza	13637 N Tatum Blv...	33.6101531982	-111.976852417	[]	False	28	AZ
supigcPNO9IKo6ola...	3	2008-10-12	2	HXP_0Ul-FCmA4f-k9...	3	We went here on a...	business	4	SBbftLzfYYKItOMFw...	1130 The Restaurant	455 N 3rd St Ste ...	33.452796936	-112.069320679	[]	True	86	AZ
O510Re68mOy9dU490...	0	2010-05-03	0	j4SIzrIy0WrmW4yr4...	3	okay this is the ...	business	0	u1KWcbPMvXFEEYkZZ...	Oakville Grocery	15015 N Scottsdal...	33.6246795654	-111.924377441	[]	False	39	AZ
b5cEoKR8iQliq-yT2...	5	2009-03-06	4	v0cTd3PNpYCkTyGKS...	4	I met a friend fo...	business	6	UsULgP4bKA8RMzs8d...	Carlsbad Tavern	3313 N Hayden Rd ...	33.4869194031	-111.908737183	[]	True	262	AZ
4JzzbSbK9wmlOBJZW...	1	2011-11-17	1	a0lCu-j2Sk_kHQsZi...	2	They've gotten be...	business	1	nDBly08j5URmrHQ2J...	Frontier Airlines	Phoenix Sky Harbo...	33.4396476746	-112.026153564	[]	True	13	AZ

quickstart.cloudera:8888/metastore/tables



Conclusion

- Analytics with DataFrames, filtering, aggregation, joins, grouping
- How to add new packages to Spark and modify Hadoop configuration
- Operate on DataFrames with SQL
- Persist DataFrames as Hive tables