Building prediction models with Amazon Redshift and Amazon ML

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Lyon Data Science – 07/01/2016

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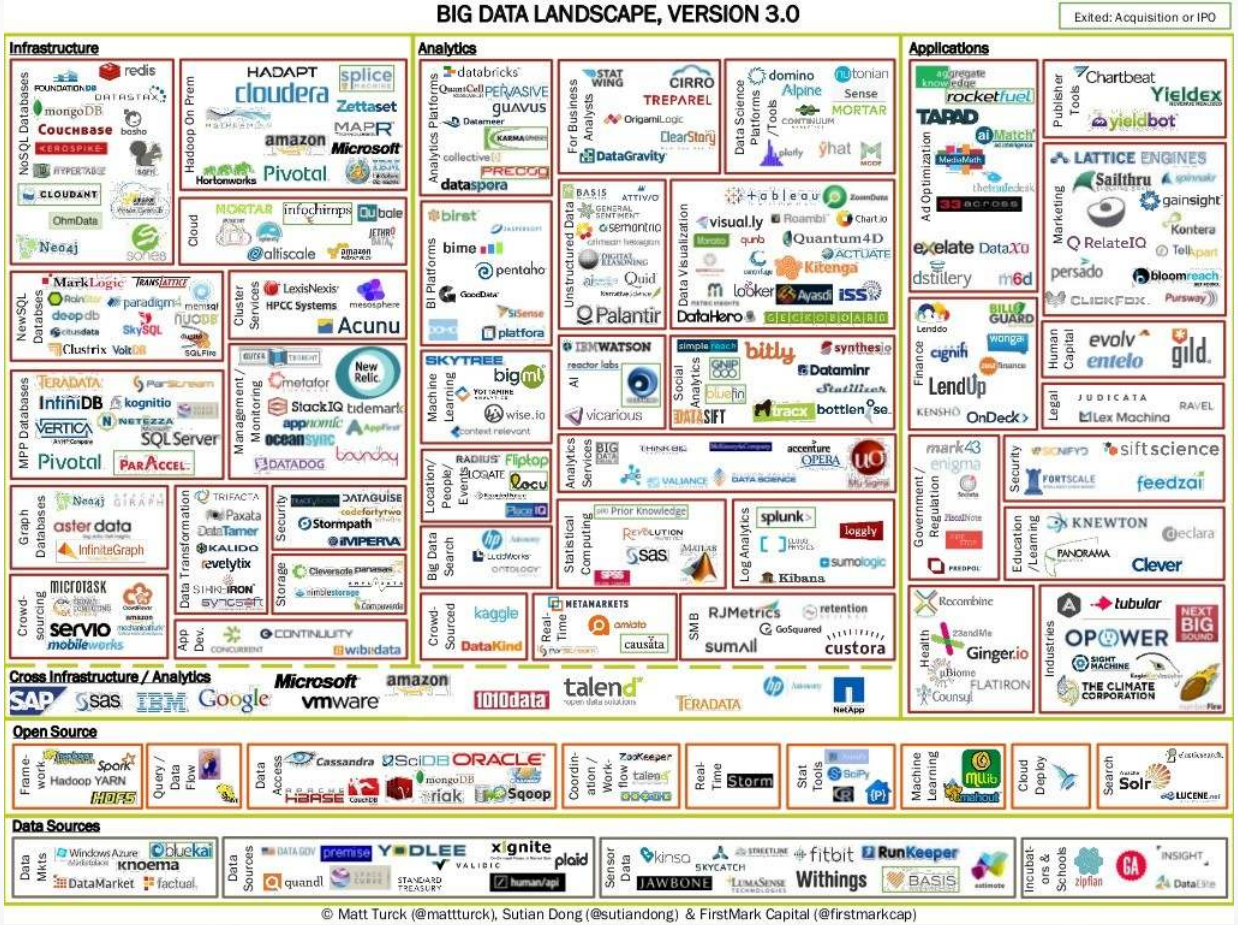
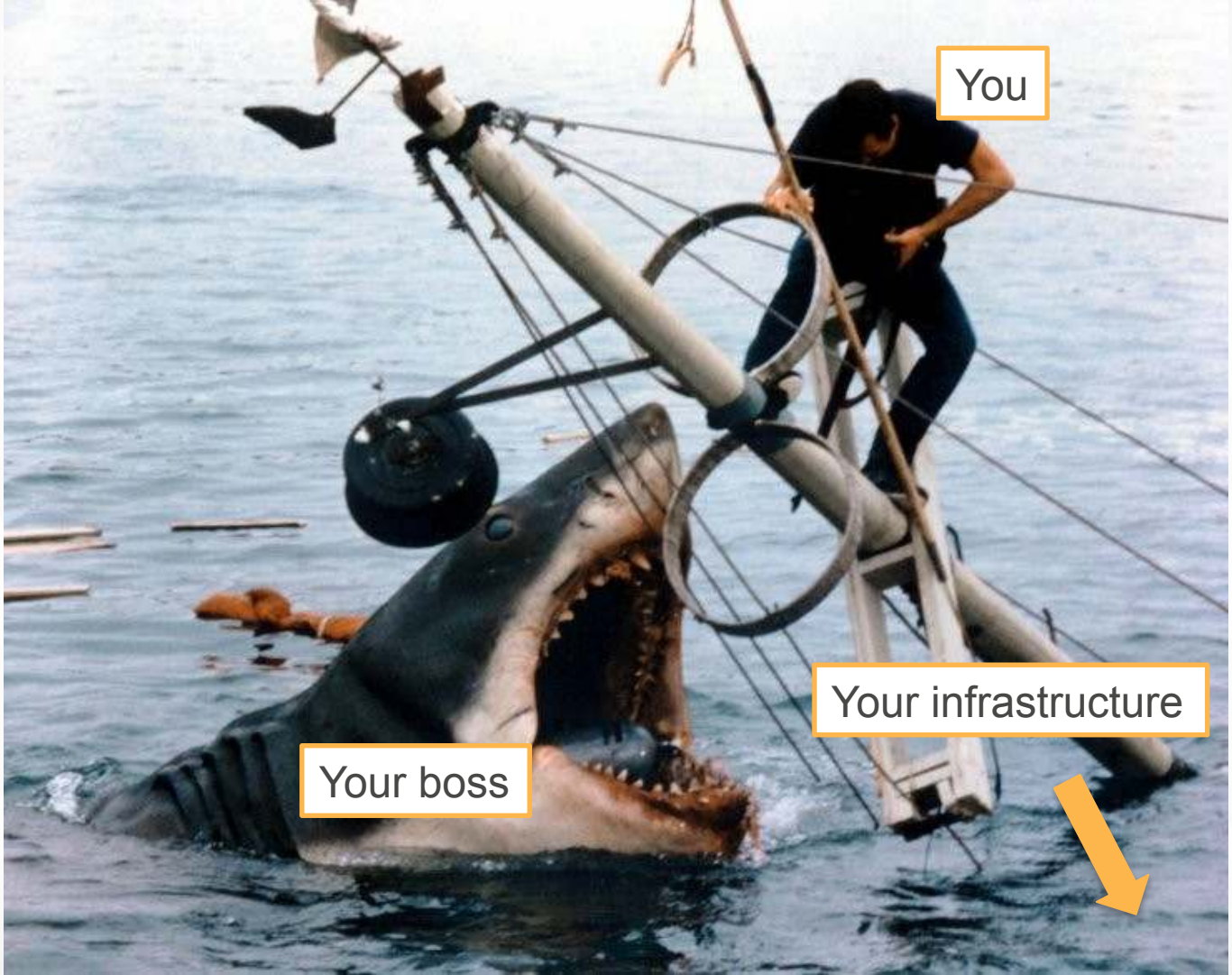
#aws #redshift #AmazonML

Navigating the seven seas of Big Data





You need a better boat, not a bigger one

Let's face it, Big Data is great fun until:

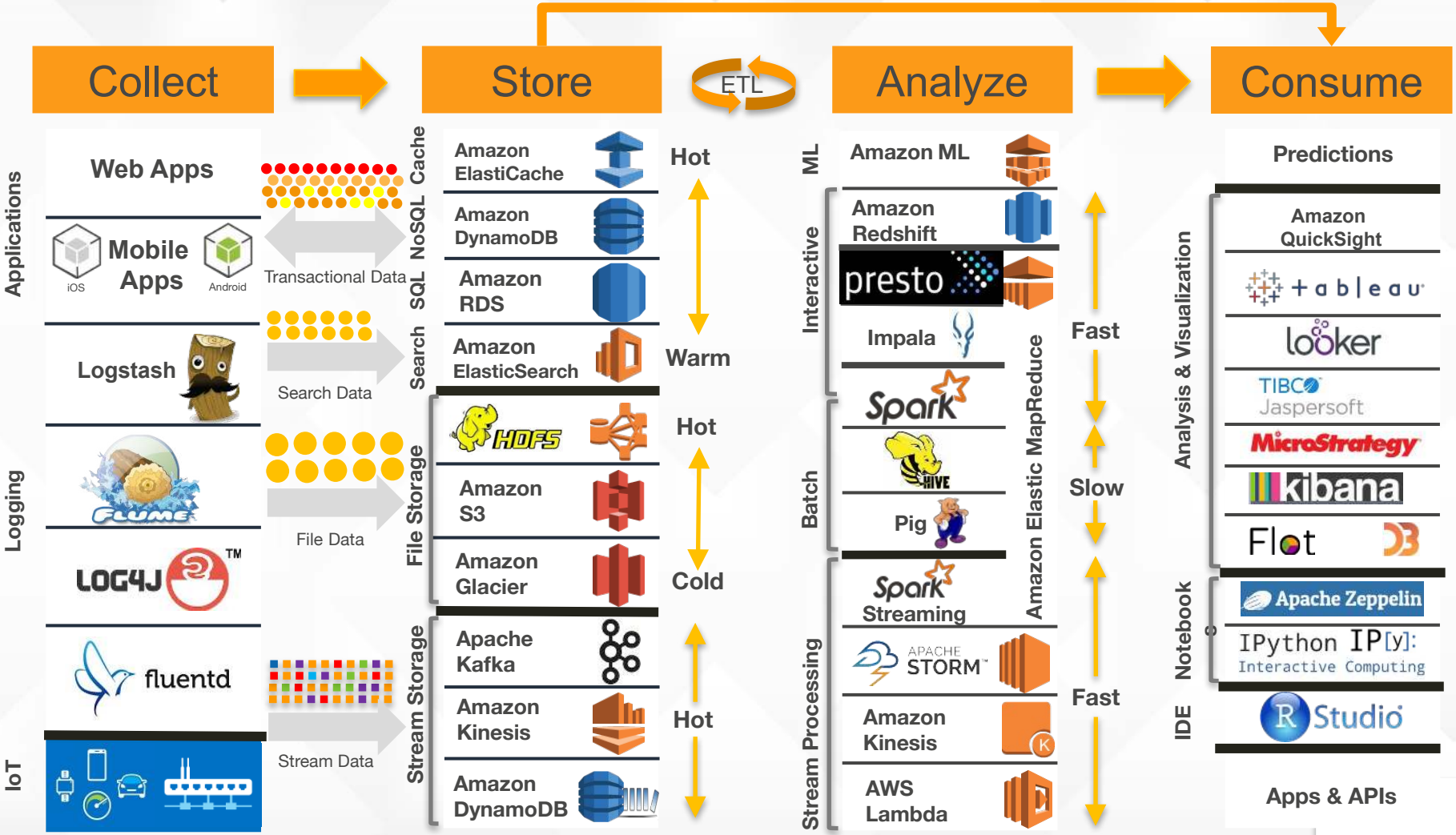
a) terabytes of data are lost forever

b) tons of money are spent on non-scalable systems

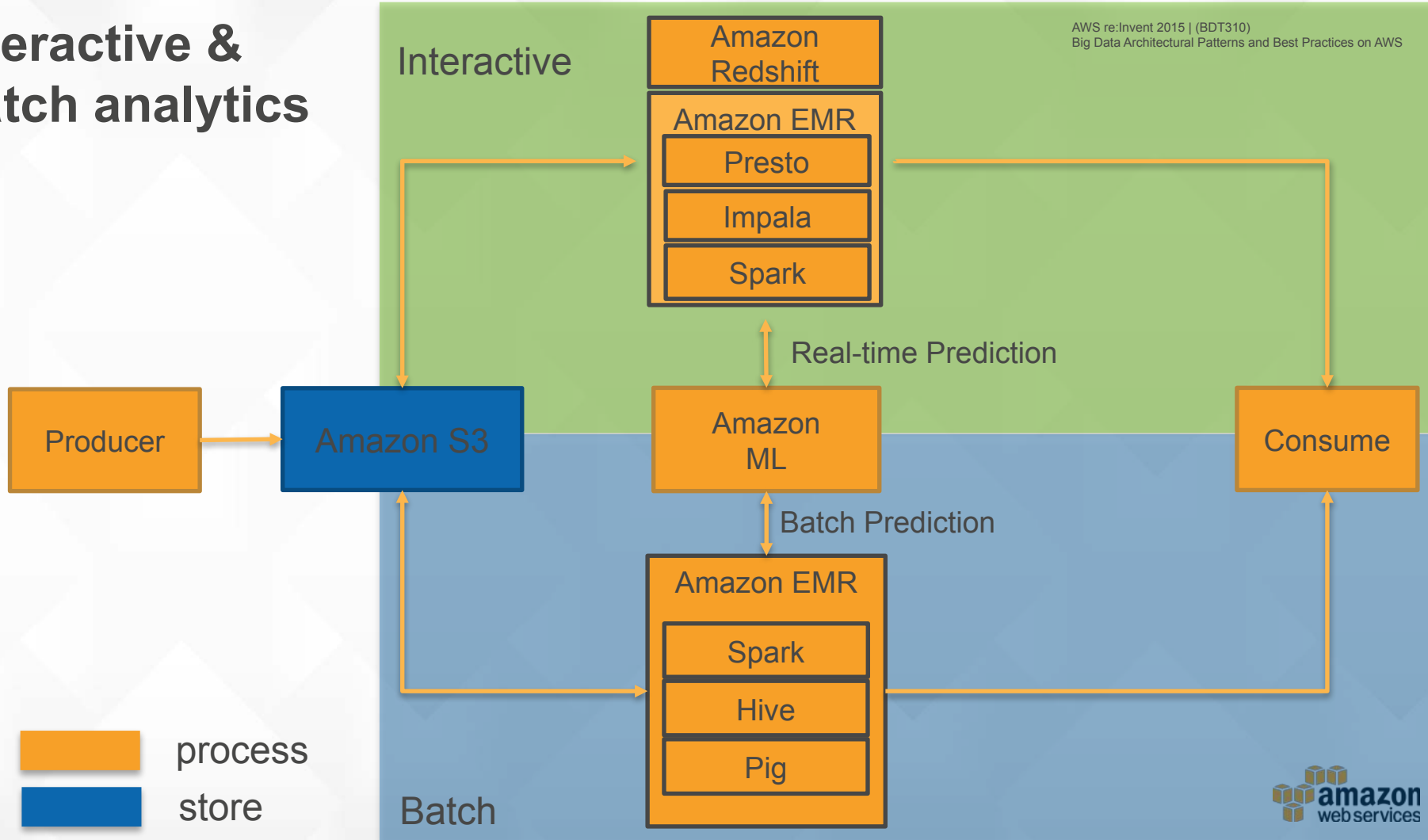
c) months are wasted on plumbing

d) all of the above…

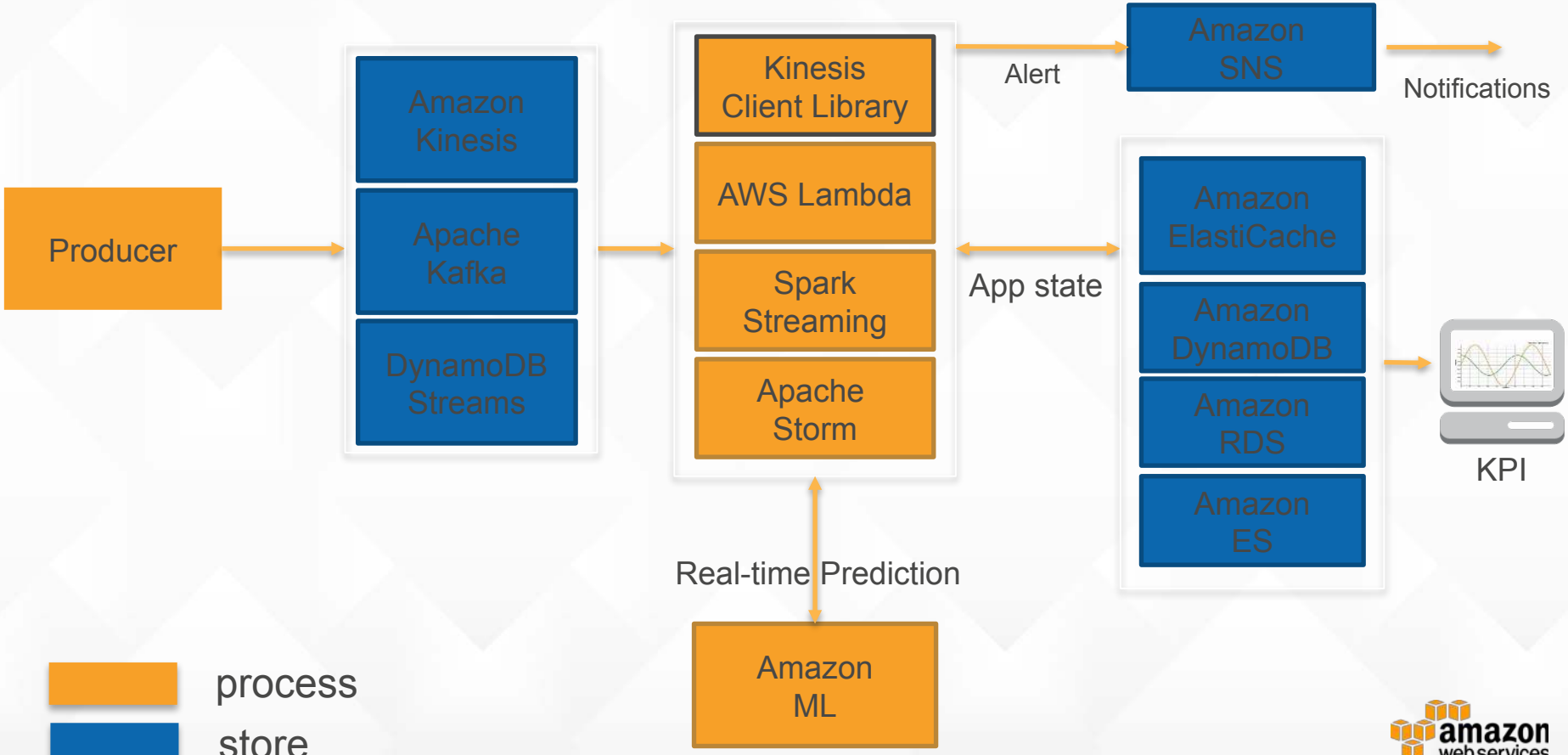
How about simple, cost-efficient, managed services that non-experts could use to build Big Data apps?


Collect
Store
ETL
Analyze
Consume
Applications
Web Apps
Mobile Apps
iOS
Android
Logging
Logstash
FLUME
LOG4J
fluentd
IoT
Transactional Data
Search Data
File Data
Stream Data
Cache
NoSQL
SQL
Search
File Storage
Stream Storage
Amazon ElastiCache
Amazon DynamoDB
Amazon RDS
Amazon ElasticSearch
HDFS
Amazon S3
Amazon Glacier
Apache Kafka
Amazon Kinesis
Amazon DynamoDB
Hot
Warm
Hot
Cold
Hot
ML
Interactive
Batch
Stream Processing
Amazon Elastic MapReduce
Amazon ML
Amazon Redshift
presto
Impala
Spark
HIVE
Pig
Spark Streaming
APACHE STORM
Amazon Kinesis
AWS Lambda
Fast
Slow
Fast
Predictions
Analysis & Visualization
Notebook
IDE
Amazon QuickSight
tableau
looker
TIBCO Jaspersoft
MicroStrategy
kibana
Flot
Apache Zeppelin
IPython IP[y]: Interactive Computing
RStudio
Apps & APIs

Interactive & Batch analytics



Real-time analytics



Amazon Redshift

an enterprise-level, petabyte scale, fully managed data warehousing service

Column-oriented database
Optimized for OLAP and BI workloads
Based on PostgreSQL 8.0.2

- SQL is all you need to know
- PostgreSQL ODBC and JDBC drivers are supported
- https://docs.aws.amazon.com/fr_fr/redshift/latest/dg/c_redshift-and-postgres-sql.html

Free tier: https://aws.amazon.com/fr/redshift/free-trial/
Available on-demand from $0.25 / hour / node (us-east-1)
As low as $0.094 / hour / node (us-east-1, 3-year RI)

https://aws.amazon.com/redshift

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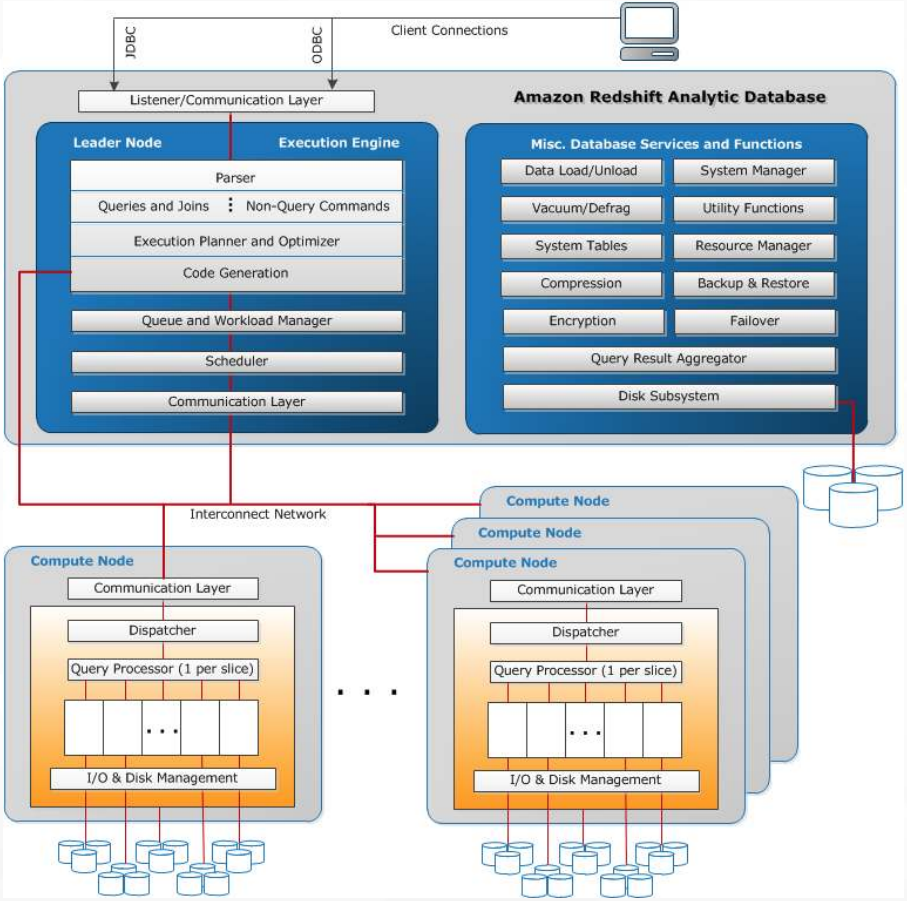
Amazon Redshift architecture

- Parallel processing
- Columnar data storage
- Data compression
- Query optimization
- Compiled code
- Workload management



https://docs.aws.amazon.com/fr_fr/redshift/latest/dg/c_high_level_system_architecture.html

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Instance types

Dense Storage Node Types

Node Size	vCPU	ECU	RAM (GiB)	Slices Per Node	Storage Per Node	Node Range	Total Capacity
ds1.xlarge	2	4.4	15	2	2 TB HDD	1–32	64 TB
ds1.8xlarge	16	35	120	16	16 TB HDD	2–128	2 PB
ds2.xlarge	4	13	31	2	2 TB HDD	1–32	64 TB
ds2.8xlarge	36	119	244	16	16 TB HDD	2–128	2 PB

Dense Compute Node Types

Node Size	vCPU	ECU	RAM (GiB)	Slices Per Node	Storage Per Node	Node Range	Total Capacity
dc1.large	2	7	15	2	160 GB SSD	1–32	5.12 TB
dc1.8xlarge	32	104	244	32	2.56 TB SSD	2–128	326 TB

https://docs.aws.amazon.com/fr_fr/redshift/latest/mgmt/working-with-clusters.html#rs-about-clusters-and-nodes

Case study: Photobox

http://www.lemagit.fr/etude/Photobox-consolide-et-analyse-ses-donnees-avec-AWS-RedShift

Maxime Mezin, Data & Photo Science Director:

"*L'entrepôt de données ne comportait que les données du site e-commerce liées aux ventes. Alors que nous avions la volonté d'intégrer des données du service clients et des données d'analyse (…) Nous avions atteint la limite du stockage de la base Oracle, et cela ne marchait pas très bien en termes de performances*"

"*Avec Redshift, la rapidité d'exécution des traitements a été multipliée par 10. Sans parler de la vitesse de chargement des données*"

"*On paie en fonction de la quantité de données que l'on va stocker. Chez Google, cela était plus compliqué*"

- 2 Redshift clusters : 1 for historical data, 1 for real-time processing (SSD)
- TCO divided by 7 (90K€→13K€)

Case study: Financial Times

https://aws.amazon.com/solutions/case-studies/financial-times/

- BI analysis of customer usage, to decide which stories to cover
- Conventional data warehouse built using Microsoft technologies
- Scalability issues, impossible to perform real-time analytics → Amazon Redshift PoC
- Amazon Redshift performed so quickly that some analysts thought it was malfunctioning ☺

John O'Donovan, CTO:

"*Some of the queries we're running are 98 percent faster, and most things are running 90 percent faster (…) and the ability to try Redshift out before having to invest a significant amount of capital was a huge bonus*."

"*Amazon Redshift is the single source of truth for our user data."*

"*Being able to explore near-real-time data improves our decision making massively. We can make decisions based on what's happening now rather than what happened three or four days ago."*

Amazon Redshift performance

No indexes, no partitioning, etc.

Distribution key

- How data is spread across nodes
- EVEN (default), ALL, KEY

Sort key

- How data is sorted inside of disk blocks
- Compound and interleaved keys are possible

Both are crucial to query performance!

Universal Pictures

DEMO #1

Demo gods, I'm your humble servant,
please be good to me

Create tables:
no key (1), sort key (2),
sort key + distribution key (3)

Load 1 billion lines (~45GB) from Amazon S3

Run queries (A, B, C) on a 4-node cluster

Resize the cluster

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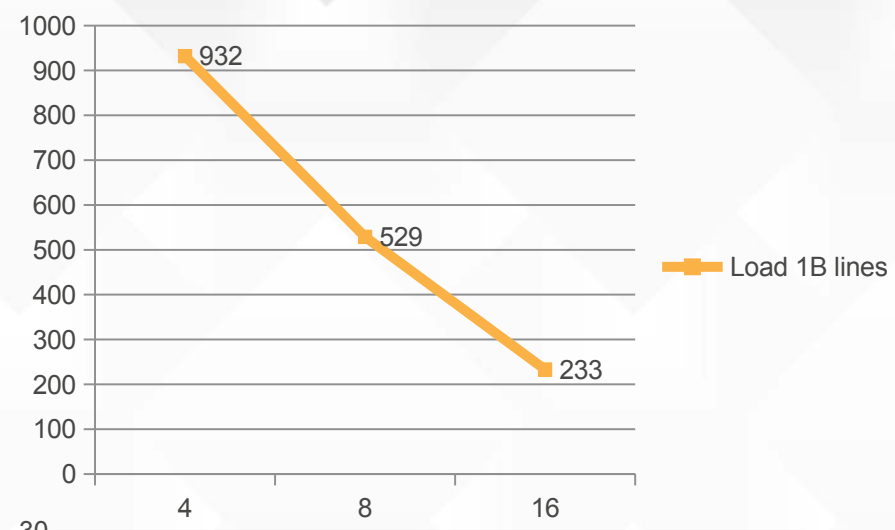

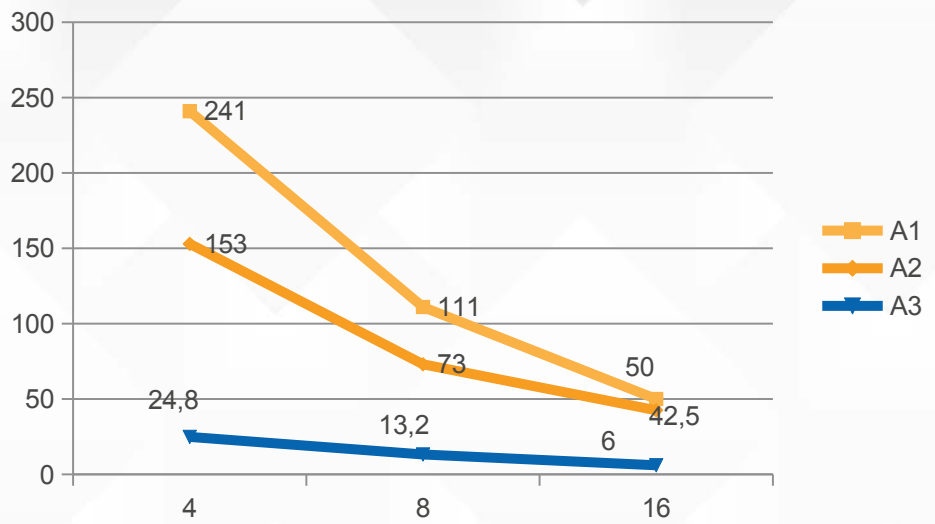

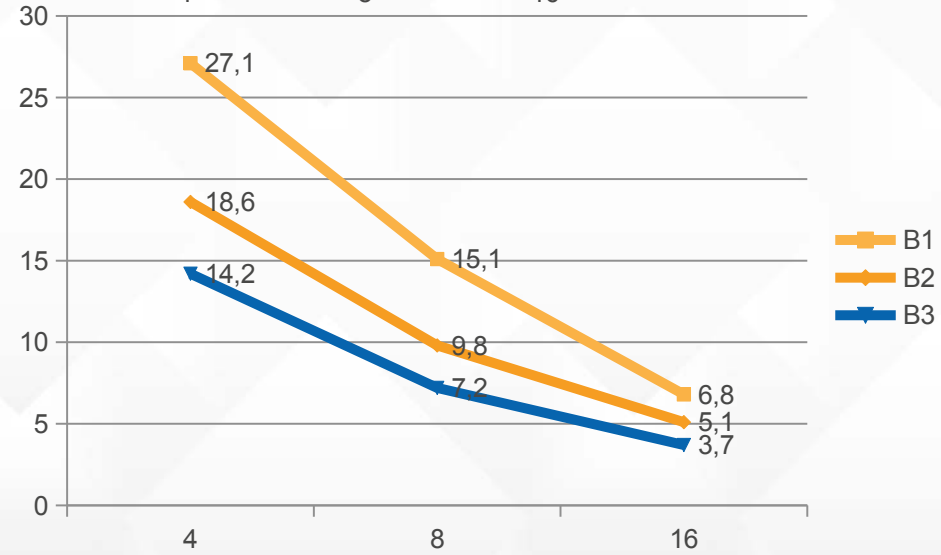

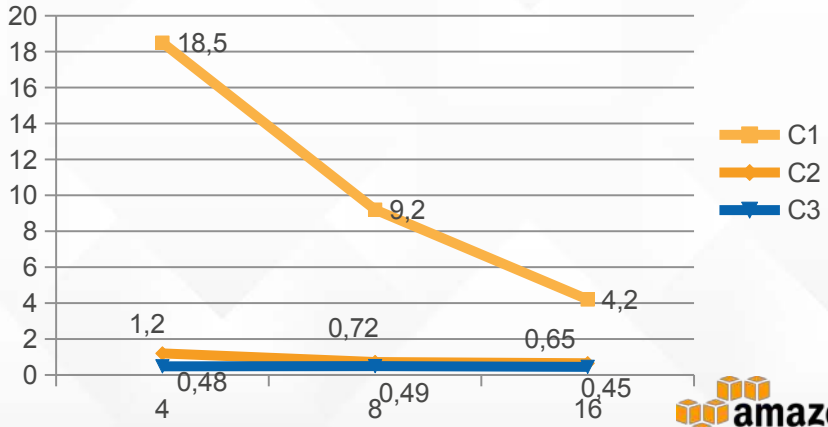

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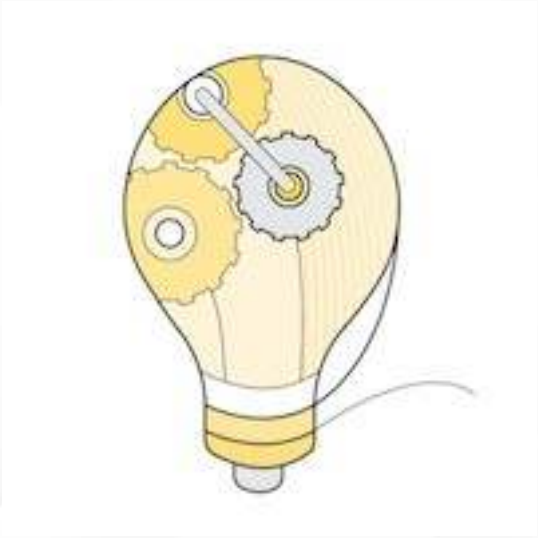
Amazon Machine Learning

A managed service for building ML models and generating predictions



Integration with Amazon S3, Redshift and RDS
Data transformation, visualization and exploration
Model evaluation and interpretation tools
API for inspection and automation
API for batch and real-time predictions

$0.42 / hour for analysis and model building (eu-west-1)
$0.10 per 1000 batch predictions
$0.0001 per real-time prediction

https://aws.amazon.com/machine-learning

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Amazon ML prediction algorithms

- Binary attributes → binary classification
- Categorical attributes → multi-class classification
- Numeric attributes → linear regression
- Code samples on https://github.com/awslabs/machine-learning-samples

Case study: BuildFax

https://aws.amazon.com/solutions/case-studies/buildfax/

BuildFax:
On-Demand Property Condition.

More than 8,000 Cities & Counties

90+ MILLION Properties

185+ MILLION Building Permits

10+ BILLION Data Points

"Amazon Machine Learning democratizes the process of building predictive models. It's easy and fast to use, and has machine-learning best practices encapsulated in the product, which lets us deliver results significantly faster than in the past"

Joe Emison, Founder & Chief Technology Officer

BUILDFAX

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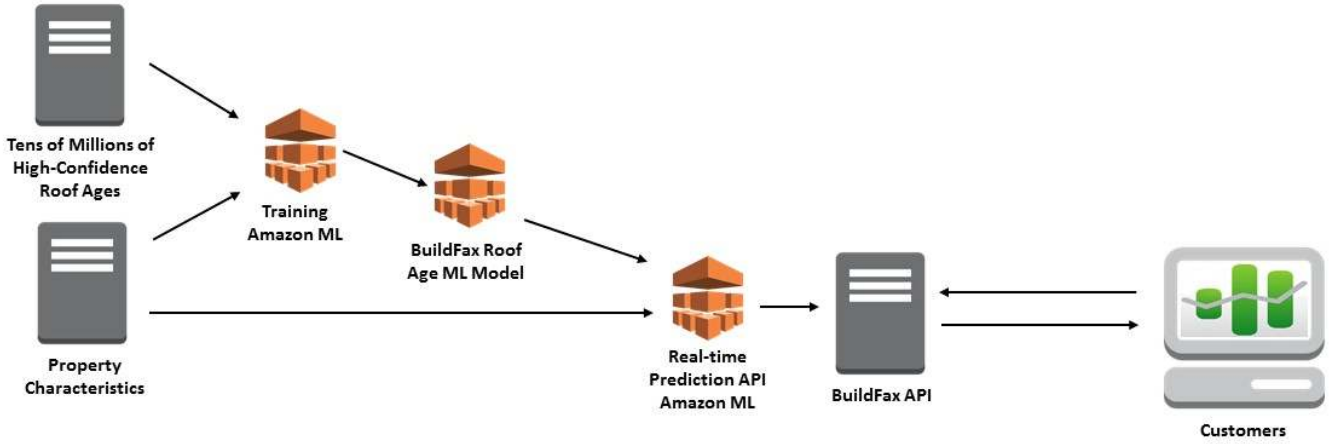

Other Amazon ML use cases

ICAO classifies and categorizes international aviation incidents daily

Plans to train ML models to predict fuel efficiency based on vehicle metadata, to push near-real-time data to customers

Securely sorts millions of mail pieces for clients every day for tremendous cost savings then brings it to the USPS for delivery

DEMO #2

Demo gods, I know I'm pushing it,
but please don't let me down now

Load data from Amazon S3 to Redshift and explore
Train and evaluate a regression model with Amazon ML
Perform batch prediction from data stored in Amazon S3

Load data from Amazon Redshift
Train and evaluate a regression model with Amazon ML
Create a real-time prediction API
Perform real-time prediction from Java app
(https://raw.githubusercontent.com/juliensimon/aws/master/ML/MLSample.java)

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Thank you! Let's keep in touch ☺

Want to start a local AWS User Group? https://aws.amazon.com/fr/usergroups/

Many events and meetups in 2016 all across France
→ Please follow us at @aws_actus @julsimon

AWS Summit Paris : 31/05/2016 (free!) https://aws.amazon.com/fr/paris16/

13/01 

14/01 

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BONUS SLIDES

Row storage vs columnar storage

SSN	Name	Age	Addr	City	St
101259797	SMITH	88	899 FIRST ST	JUNO	AL
892375862	CHIN	37	16137 MAIN ST	POMONA	CA
318370701	HANDU	12	42 JUNE ST	CHICAGO	IL

101259797|SMITH|88|899 FIRST ST|JUNO|AL|892375862|CHIN|37|16137 MAIN ST|POMONA|CA|318370701|HANDU|12|42 JUNE ST|CHICAGO|IL

Block 1 Block 2 Block 3

SSN	Name	Age	Addr	City	St
101259797	SMITH	88	899 FIRST ST	JUNO	AL
892375862	CHIN	37	16137 MAIN ST	POMONA	CA
318370701	HANDU	12	42 JUNE ST	CHICAGO	IL

101259797|892375862|318370701|468248180|378568310|231346875|317346551|770336528|277332171|455124598|735885647|387586301

Block 1

https://docs.aws.amazon.com/fr_fr/redshift/latest/dg/c_columnar_storage_disk_mem_mgmnt.html

Amazon Redshift & Machine Learning resources

Documentation

https://aws.amazon.com/documentation/redshift/ https://aws.amazon.com/documentation/machine-learning/

Big Data videos from AWS re:Invent 2015

https://blogs.aws.amazon.com/bigdata/post/Tx3D3UYOXB9XG6Z/Videos-now-available-for-AWS-re-Invent-2015-Big-Data-Analytics-sessions

If you're going to watch only one: https://www.youtube.com/watch?v=K7o5OlRLtvU

More Amazon Redshift resources

Articles by Werner Vogel, CTO, Amazon.com

http://www.allthingsdistributed.com/2012/11/amazon-redshift.html

http://www.allthingsdistributed.com/2013/02/amazon-redshift-resilience.html

http://www.allthingsdistributed.com/2013/05/amazon-redshift-designing-for-security.html

Tuning Amazon Redshift

https://docs.aws.amazon.com/fr_fr/redshift/latest/dg/t_Sorting_data.html

https://docs.aws.amazon.com/fr_fr/redshift/latest/dg/t_Distributing_data.html

http://blogs.aws.amazon.com/bigdata/post/Tx31034QG0G3ED1/Top-10-Performance-Tuning-Techniques-for-Amazon-Redshift

Creating and deleting an Amazon Redshift cluster

$ aws redshift **create-cluster** --cluster-identifier CLUSTER_NAME
--node-type dc1.large --number-of-nodes 4
--db-name DATABASE_NAME
--master-username USER_NAME
--master-user-password USER_PASSWORD
--publicly-accessible ← *probably not what you want!*

$ aws redshift **delete-cluster** --cluster-identifier CLUSTER_NAME
--skip-final-cluster-snapshot ← *data will be lost!*

Connecting to Amazon Redshift with *psql*

$ **psql** -h *xxx*.redshift.amazonaws.com -p 5439
-d DB_NAME -U USER_NAME

Force SSL:
$ **psql** -h *xxx*.redshift.amazonaws.com -p 5439
-U USER_NAME "dbname=DB_NAME sslmode=require”

Loading data from Amazon S3 to Amazon Redshift

COPY command example

$ **copy** *TABLE_NAME*
from 's3://*BUCKET_NAME/FOLDER_NAME/*'
region 'eu-west-1'
credentials 'aws_access_key_id=*MY_ACCESS_KEY*;
aws_secret_access_key=*MY_SECRET_KEY*'
delimiter ',' **bzip2** **maxerror** 1000;

View last 10 load errors

select * **from** stl_load_errors **order by** starttime **desc limit** 10;

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Resizing an Amazon Redshift cluster

$ aws redshift **modify-cluster**
--cluster-identifier mycluster
--number-of-nodes 8

Listing Amazon ML models

$ aws machinelearning **describe-ml-models**
--query "Results[*].{Name:Name, Id:MLModelId, Type:MLModelType}"