Machine Learning & Spark

MACHINE LEARNING WITH PYSPARK



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Building the perfect waffle (an analogy)



Archetype Waffle











Find waffle recipe. Give explicit instructions:

- 125 g flour
- 1 t baking powder
- 1 egg
- 225 ml milk
- 1 T melted butter

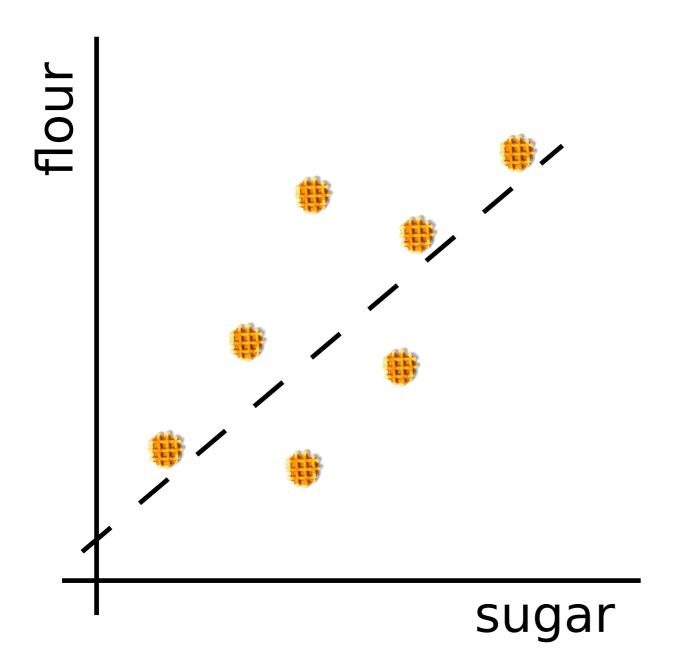
Find many waffle recipes.

Learn the perfect recipe:

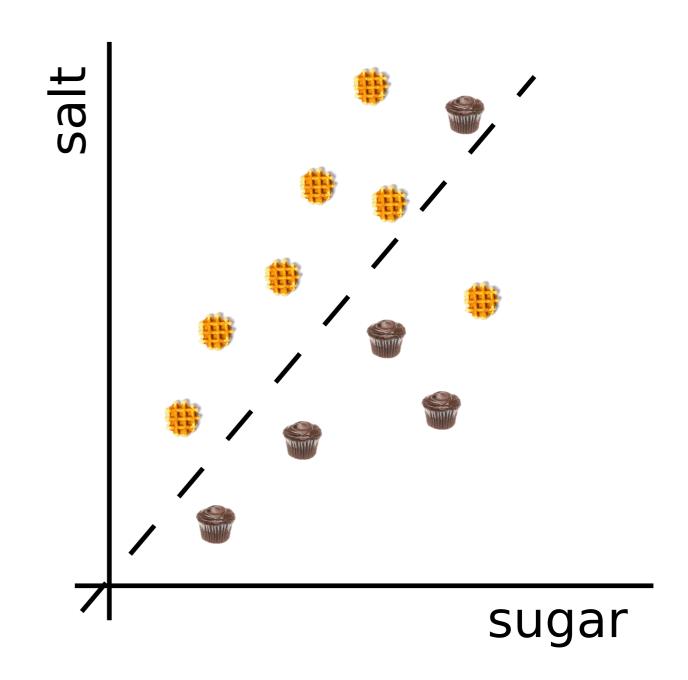
- 1. Look at lots of recipes.
- 2. What ingredients?
- 3. What proportions?

Computer generates its own instructions.

Regression

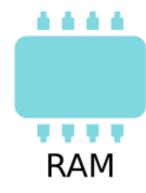


Classification



Data in RAM

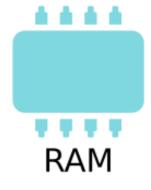
Data Size

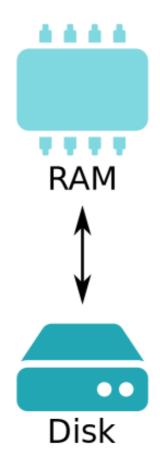




Data exceeds RAM

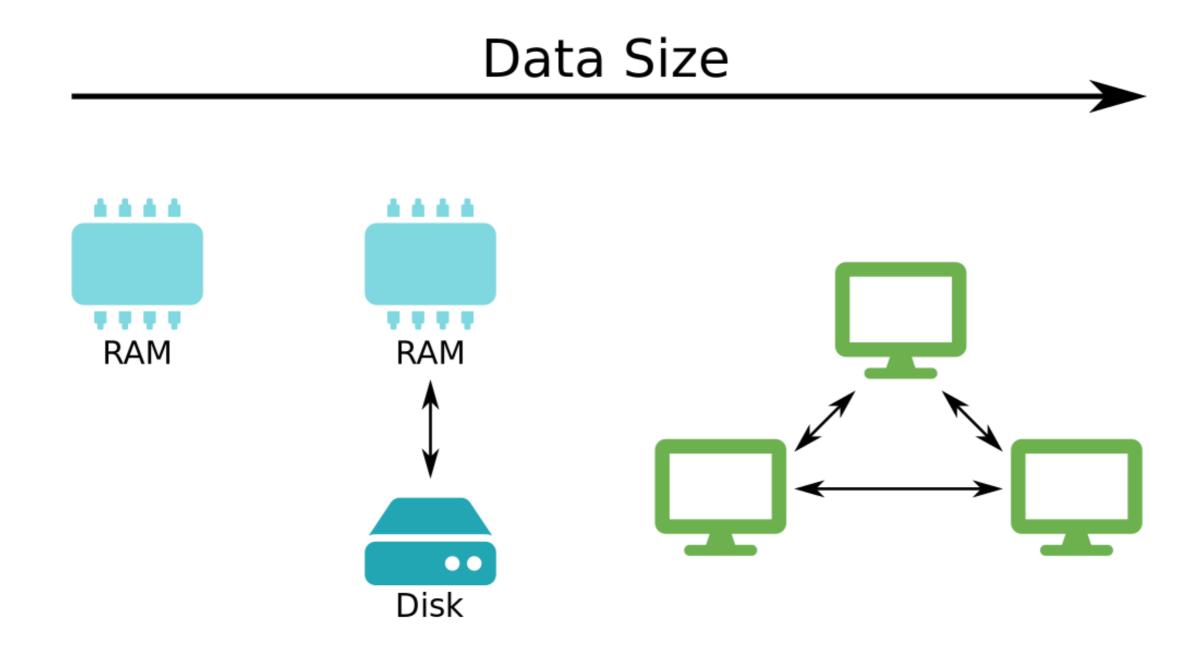
Data Size







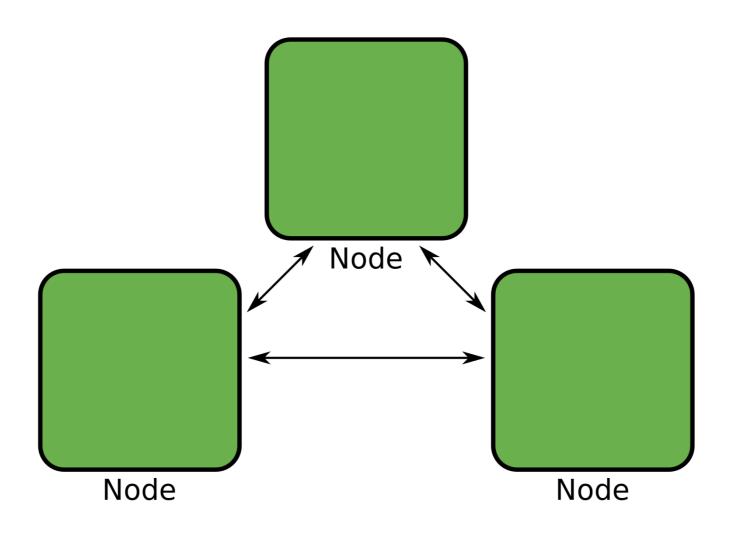
Data distributed across a cluster



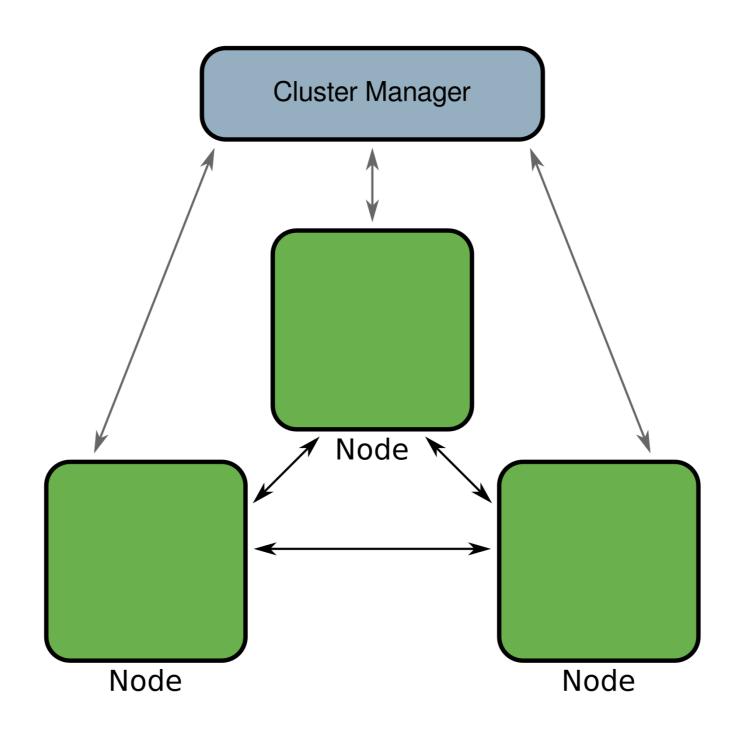
What is Spark?

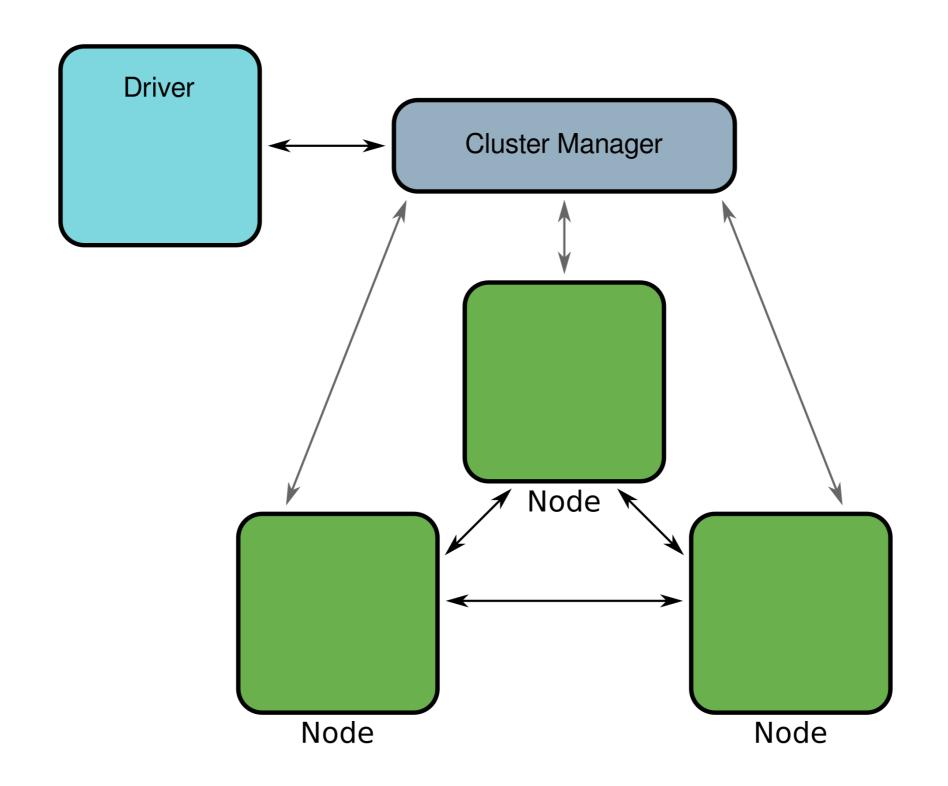


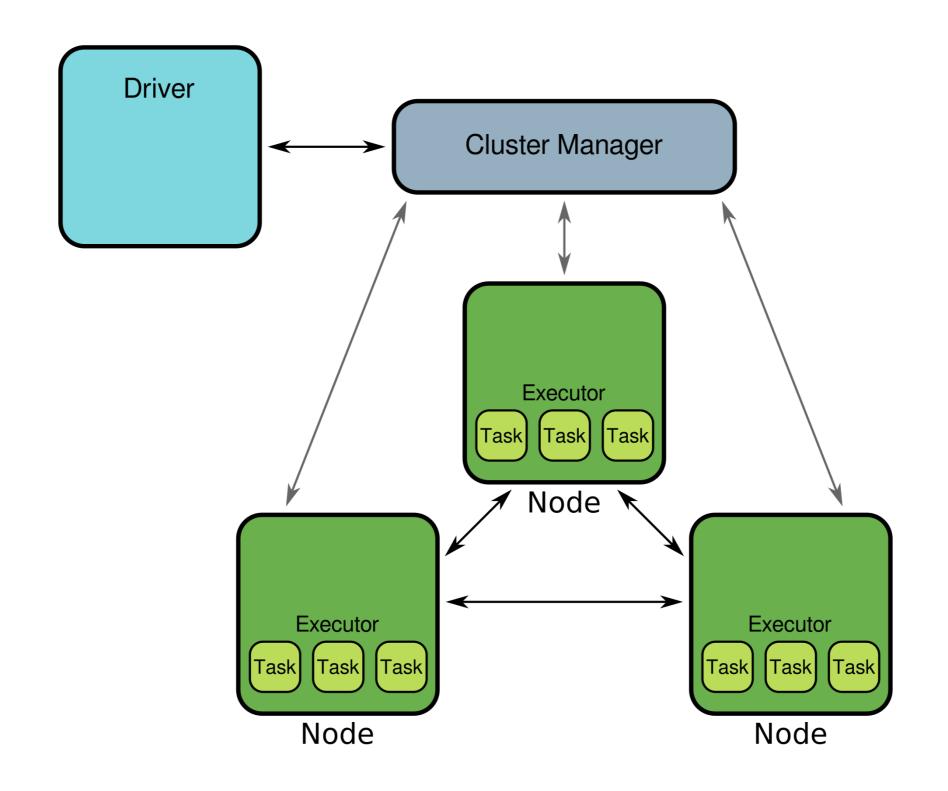
- Compute across a distributed cluster.
- Data processed in memory.
- Well documented high-level API.











Onward!

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Connecting to Spark

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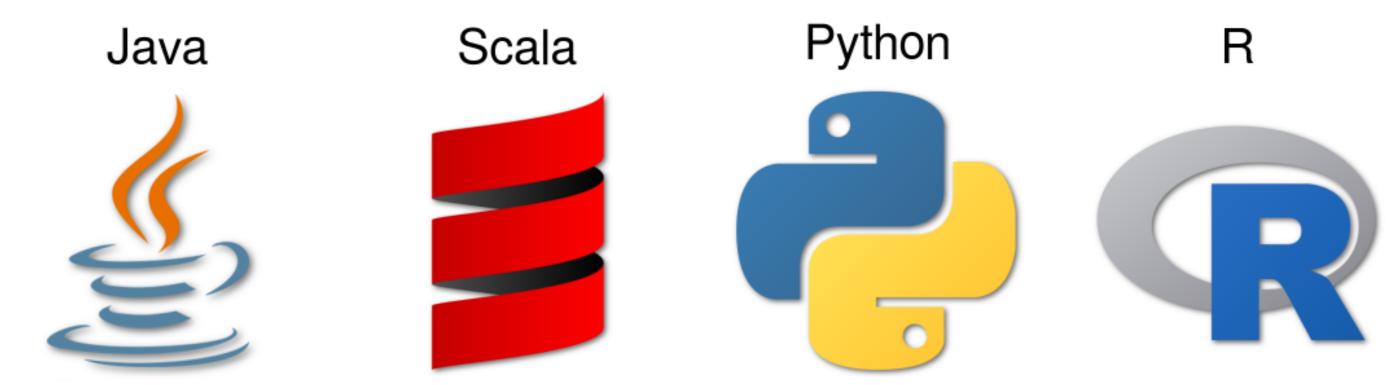


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Interacting with Spark



Languages for interacting with Spark.

- Java low-level, compiled
- Scala, Python and R high-level with interactive REPL

Importing pyspark

From Python import the pyspark module.

```
import pyspark
```

Check version of the pyspark module.

```
pyspark.__version__
```

'2.4.1'



Sub-modules

In addition to pyspark there are

- Structured Data pyspark.sql
- Streaming Data pyspark.streaming
- Machine Learning pyspark.mllib (deprecated) and pyspark.ml

Spark URL

Remote Cluster using Spark URL — spark://<IP address | DNS name>:<port>

Example:

• spark://13.59.151.161:7077

Local Cluster

Examples:

- local only 1 core;
- local[4] 4 cores; or
- local[*] all available cores.

Creating a SparkSession

```
from pyspark.sql import SparkSession
```

Create a local cluster using a SparkSession builder.

```
spark = SparkSession.builder \
    .master('local[*]') \
    .appName('first_spark_application') \
    .getOrCreate()
```

Interact with Spark...

```
# Close connection to Spark
>>> spark.stop()
```



Let's connect to Spark!

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Loading Data

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DataFrames: A refresher

DataFrame for tabular data.

123	abc	123	abc
123	abc	123	abc
123	abc	123	abc
123	abc	123	abc
123	abc	123	abc

Selected methods:

- count()
- show()
- printSchema()

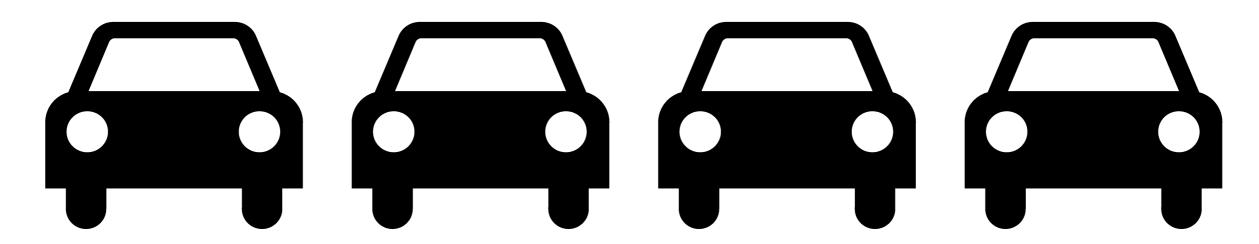
Selected attributes:

dtypes

CSV data for cars

The first few lines from the 'cars.csv' file.

mfr, mod, org, type, cyl, size, weight, len, rpm, cons
Mazda, RX-7, non-USA, Sporty, NA, 1.3, 2895, 169, 6500, 9.41
Nissan, Maxima, non-USA, Midsize, 6, 3, 3200, 188, 5200, 9.05
Chevrolet, Cavalier, USA, Compact, 4, 2.2, 2490, 182, 5200, 6.53
Subaru, Legacy, non-USA, Compact, 4, 2.2, 3085, 179, 5600, 7.84
Ford, Escort, USA, Small, 4, 1.8, 2530, 171, 6500, 7.84



Reading data from CSV

The .csv() method reads a CSV file and returns a DataFrame.

```
cars = spark.read.csv('cars.csv', header=True)
```

Optional arguments:

- header is first row a header? (default: False)
- sep field separator (default: a comma ',')
- schema explicit column data types
- inferSchema deduce column data types from data?
- nullValue placeholder for missing data

Peek at the data

The first five records from the DataFrame.

```
cars.show(5)
```

```
+-----+
| mfr| mod| org| type|cyl|size|weight|len| rpm|cons|
+-----+
| Mazda| RX-7|non-USA| Sporty| NA| 1.3| 2895|169|6500|9.41|
| Nissan| Maxima|non-USA|Midsize| 6| 3| 3200|188|5200|9.05|
|Chevrolet|Cavalier| USA|Compact| 4| 2.2| 2490|182|5200|6.53|
| Subaru| Legacy|non-USA|Compact| 4| 2.2| 3085|179|5600|7.84|
| Ford| Escort| USA| Small| 4| 1.8| 2530|171|6500|7.84|
```

Check column types

cars.printSchema()

```
root
|-- mfr: string (nullable = true)
|-- mod: string (nullable = true)
|-- org: string (nullable = true)
|-- type: string (nullable = true)
|-- cyl: string (nullable = true)
|-- size: string (nullable = true)
|-- weight: string (nullable = true)
|-- len: string (nullable = true)
|-- rpm: string (nullable = true)
|-- cons: string (nullable = true)
```

Inferring column types from data

```
cars = spark.read.csv("cars.csv", header=True, inferSchema=True)
cars.dtypes
```

```
[('mfr', 'string'),
('mod', 'string'),
('org', 'string'),
('type', 'string'),
('cyl', 'string'),
('size', 'double'),
('weight', 'int'),
('len', 'int'),
('rpm', 'int'),
('cons', 'double')]
```

Dealing with missing data

Handle missing data using the nullValue argument.

```
cars = spark.read.csv("cars.csv", header=True, inferSchema=True, nullValue='NA')
```

The nullValue argument is case sensitive.

Specify column types

```
schema = StructType([
    StructField("maker", StringType()),
    StructField("model", StringType()),
    StructField("origin", StringType()),
    StructField("type", StringType()),
    StructField("cyl", IntegerType()),
    StructField("size", DoubleType()),
    StructField("weight", IntegerType()),
    StructField("length", DoubleType()),
    StructField("rpm", IntegerType()),
    StructField("consumption", DoubleType())
])
cars = spark.read.csv("cars.csv", header=True, schema=schema, nullValue='NA')
```

Final cars data

```
model
               |origin |type |cyl |size|weight|length|rpm |consumption|
lmaker
     Mazda
Nissan
     |Maxima | non-USA|Midsize|6 |3.0 |3200 |188.0 |5200|9.05
                    |Compact|4 |2.2 |2490 |182.0 |5200|6.53
|Chevrolet |Cavalier
             USA
      Legacy | non-USA|Compact|4 | 2.2 | 3085 | 179.0 | 5600 | 7.84
Subaru
    |Escort | USA | Small | 4 | 1.8 | 2530 | 171.0 | 6500 | 7.84
Ford
Mercury
     |900 | |non-USA|Compact|4 |2.1 |2775 |184.0 |6000|9.05
Saab
    |Caravan | USA | Van | 6 | 3.0 | 3705 | 175.0 | 5000 | 11.2
Dodge
```

Let's load some data!

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