

Extract Transform Select

INTRODUCTION TO SPARK SQL WITH PYTHON



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ETS



Extract Transform Select

Extract, Transform, and Select

- Extraction
- Transformation
- Selection

Built-in functions

```
from pyspark.sql.functions import split, explode
```

The length function

```
from pyspark.sql.functions import length
```

```
df.where(length('sentence') == 0)
```

Creating a custom function

- User Defined Function
- UDF

Importing the udf function

```
from pyspark.sql.functions import udf
```


Creating a boolean UDF

```
print(df)
```

```
DataFrame[textdata: string]
```

```
from pyspark.sql.functions import udf
```

```
from pyspark.sql.types import BooleanType
```

Creating a boolean UDF

```
short_udf = udf(lambda x:
                 True if not x or len(x) < 10 else False,
                 BooleanType())
```

```
df.select(short_udf('textdata')\
          .alias("is short"))\
     .show(3)
```

```
+-----+
|is short|
+-----+
|  false|
|   true|
|  false|
+-----+
```

Important UDF return types

```
from pyspark.sql.types import StringType, IntegerType, FloatType, ArrayType
```

Creating an array UDF

```
df3.select('word array', in_udf('word array').alias('without endword'))\  
      .show(5, truncate=30)
```

```
+-----+-----+  
|      word array|      without endword|  
+-----+-----+  
|[then, how, many, are, there]| [then, how, many, are]|  
|           [how, many]|           [how]|  
|      [i, do not, know]|      [i, do not]|  
|           [quite, so]|           [quite]|  
| [you, have, not, observed]| [you, have, not]|  
+-----+-----+
```

Creating an array UDF

```
from pyspark.sql.types import StringType, ArrayType
```

```
# Removes last item in array
in_udf = udf(lambda x:
    x[0:len(x)-1] if x and len(x) > 1
    else [],
    ArrayType(StringType()))
```

Sparse vector format

1. Indices

2. Values

Example:

- Array: `[1.0, 0.0, 0.0, 3.0]`
- Sparse vector: `(4, [0, 3], [1.0, 3.0])`

Working with vector data

- `hasattr(x, "toArray")`
- `x.numNonzeros()`

Let's practice!

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Creating feature data for classification

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Transforming a dense array

```
from pyspark.sql.functions import udf
from pyspark.sql.types import IntegerType
bad_udf = udf(lambda x:
    x.indices[0]
    if (x and hasattr(x, "toArray") and x.numNonzeros())
    else 0,
    IntegerType())
```

Transforming a dense array

```
try:
    df.select(bad_udf('outvec').alias('label')).first()
except Exception as e:
    print(e.__class__)
    print(e.errmsg)
```

```
<class 'py4j.protocol.Py4JJavaError'>
An error occurred while calling o90.collectToPython.
```

UDF return type must be properly cast

```
first_udf = udf(lambda x:  
    int(x.indices[0])  
    if (x and hasattr(x, "toArray") and x.numNonzeros())  
    else 0,  
    IntegerType())
```

The UDF in action

```
+-----+-----+-----+-----+
|endword|          doc|count|          features|          outvec|
+-----+-----+-----+-----+
|      it|[please, do, not,...| 1149|(12847,[15,47,502...| (12847,[7],[1.0])|
| holmes|[start, of, the, ...|  107|(12847,[0,3,183,1...|(12847,[145],[1.0])|
|        i|[the, adventures,...|  103|(12847,[0,3,35,14...| (12847,[11],[1.0])|
+-----+-----+-----+-----+
```

```
df.withColumn('label', k_udf('outvec')).drop('outvec').show(3)
```

```
+-----+-----+-----+-----+
|endword|          doc|count|          features|label|
+-----+-----+-----+-----+
|      it|[please, do, not,...| 1149|(12847,[15,47,502...|    7|
| holmes|[start, of, the, ...|  107|(12847,[0,3,183,1...| 145|
|        i|[the, adventures,...|  103|(12847,[0,3,35,14...|  11|
+-----+-----+-----+-----+
```

CountVectorizer

- ETS : Extract Transform Select
- CountVectorizer is a Feature **Extractor**
- Its input is an array of strings
- Its output is a vector

Fitting the CountVectorizer

```
from pyspark.ml.feature import CountVectorizer

cv = CountVectorizer(inputCol='words',
                    outputCol="features")

model = cv.fit(df)
result = model.transform(df)
print(result)
```

```
DataFrame[words: array<string>, features: vector]

# Dense string array on left, dense integer vector on right
+-----+-----+
|words          |features          |
+-----+-----+
|[Hello, world]  |(10,[7,9],[1.0,1.0])|
|[How, are, you?]|(10,[1,3,4],[1.0,1.0,1.0])|
|[I, am, fine, thank, you]|(10,[0,2,5,6,8],[1.0,1.0,1.0,1.0,1.0])|
+-----+-----+
```

Let's practice!

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Text Classification

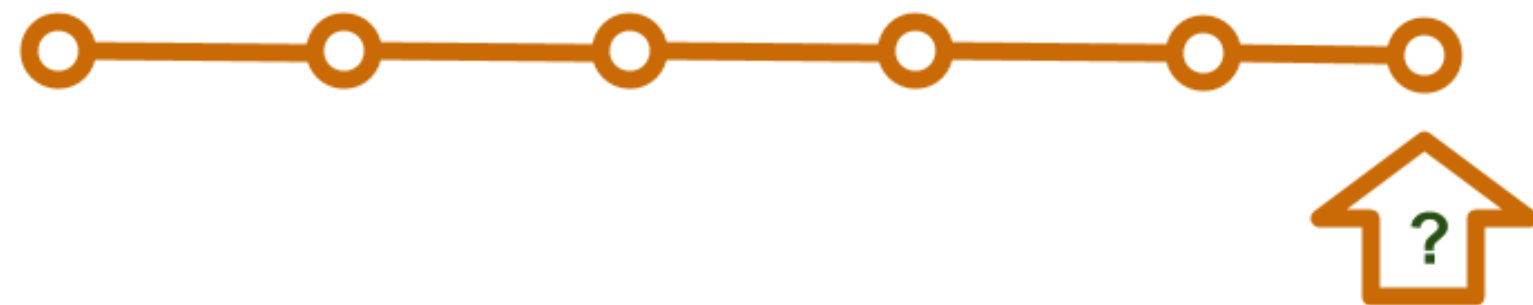
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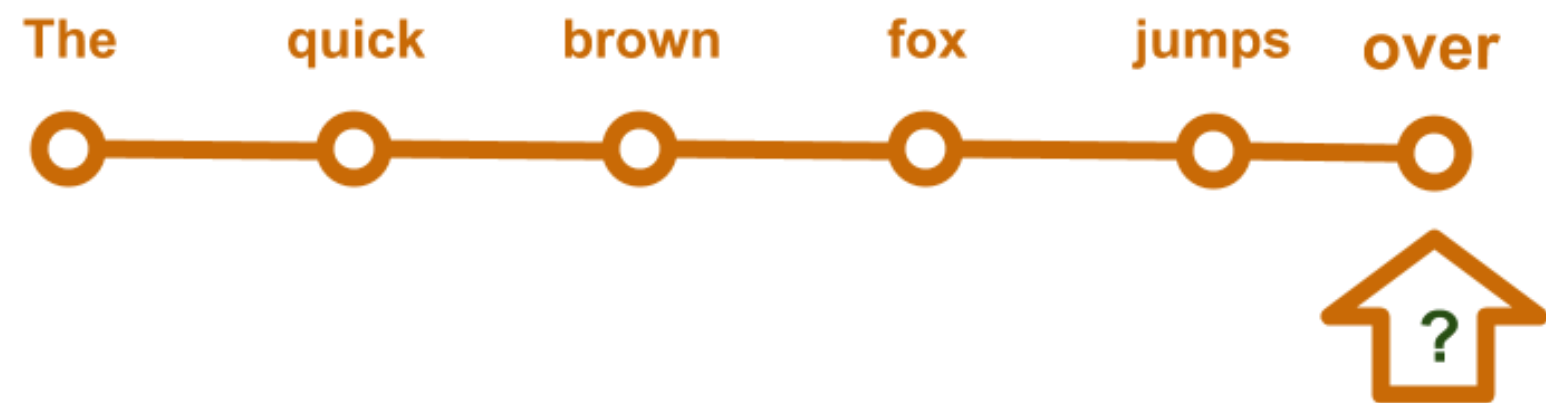


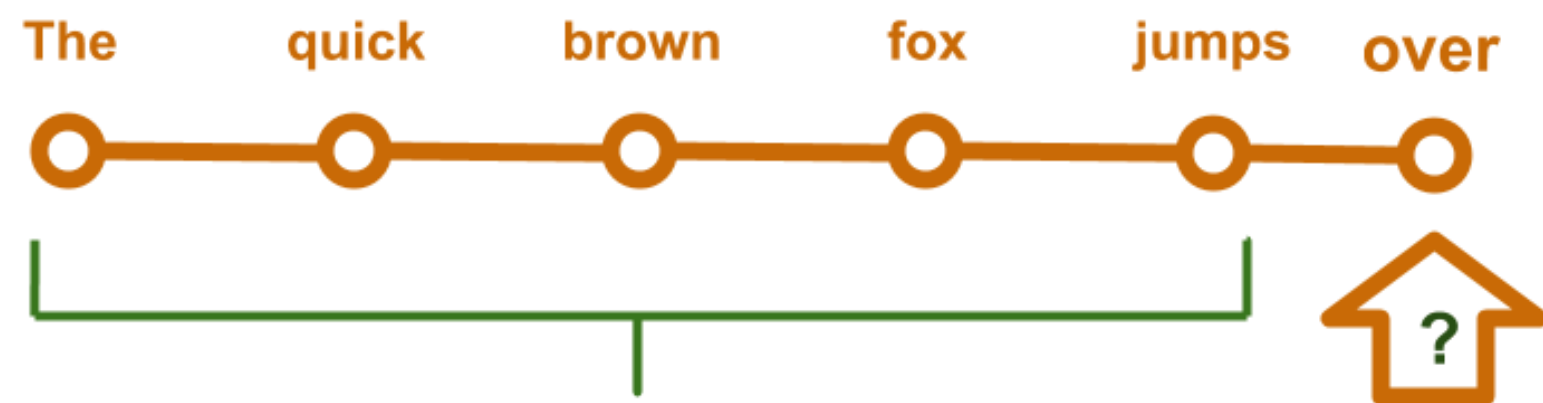
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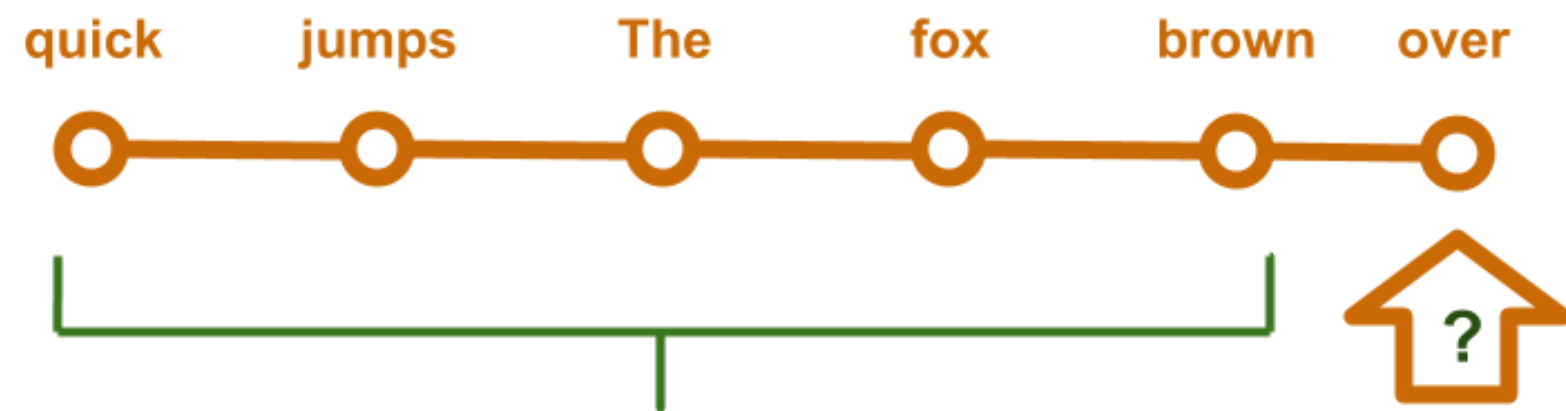


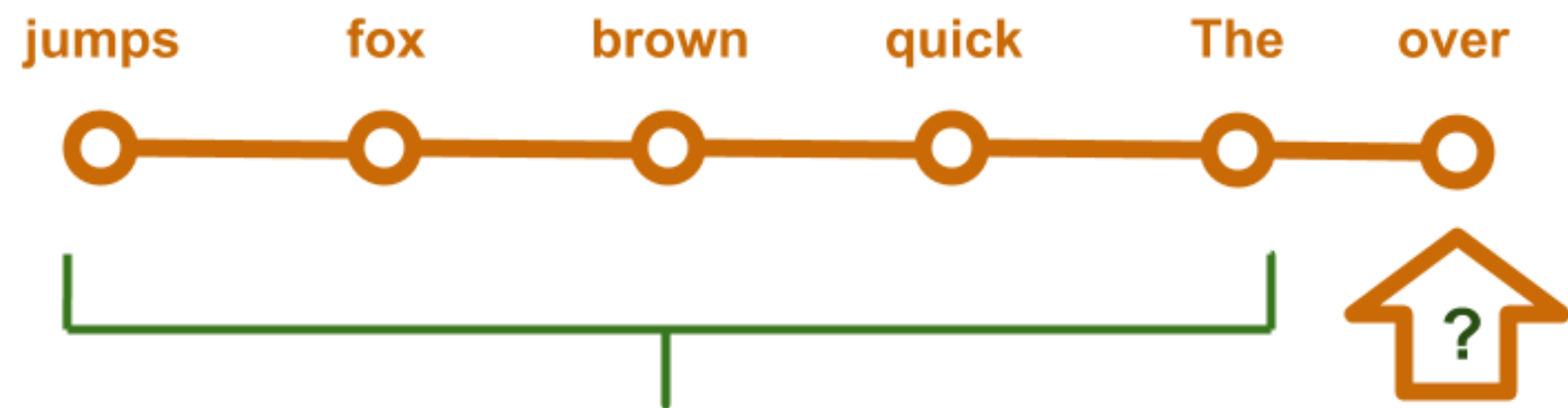
Endword Prediction

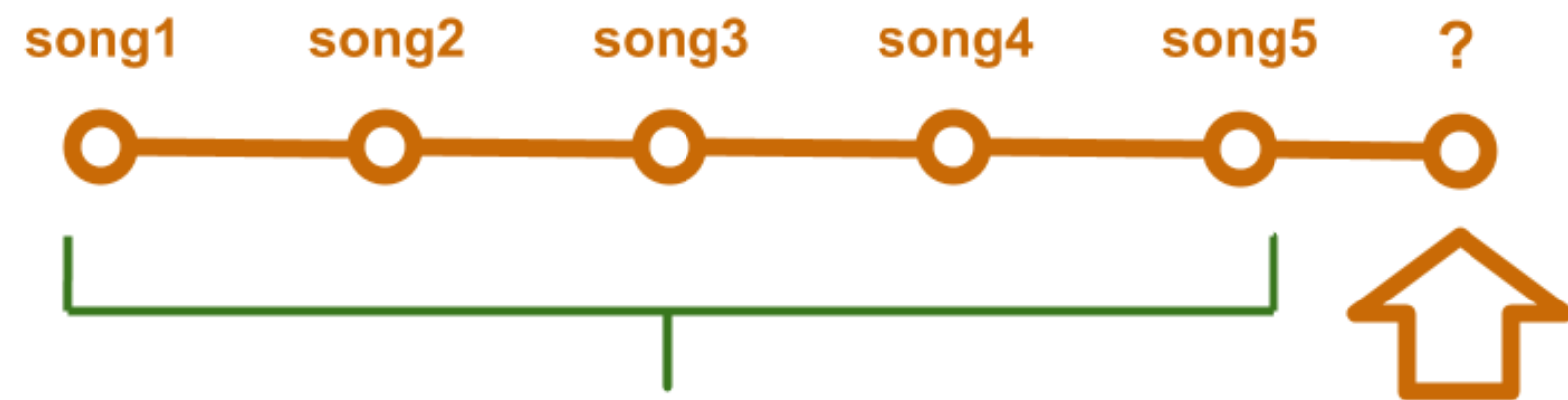


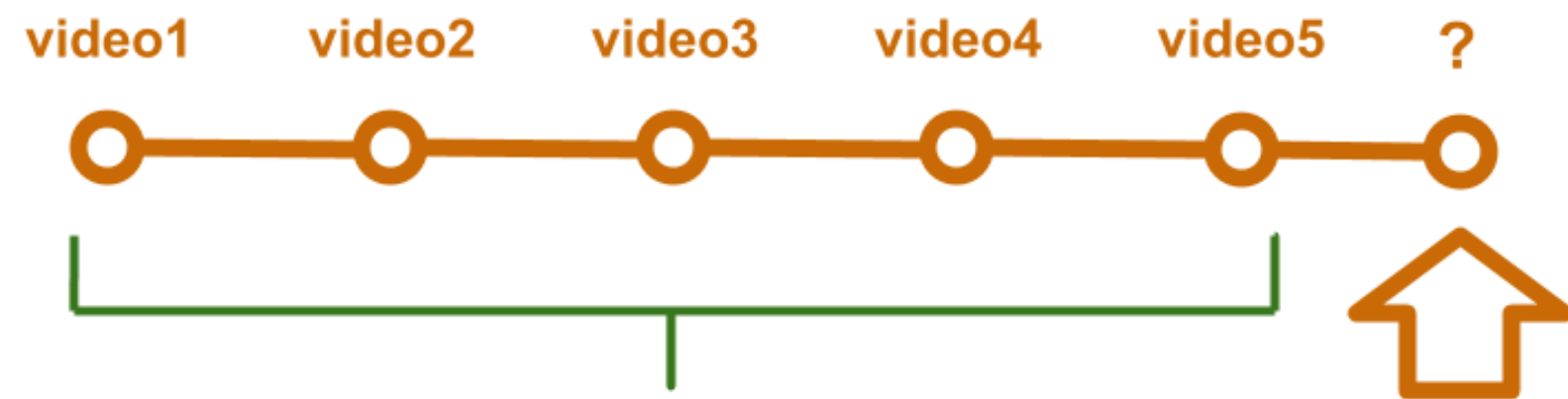












Selecting the data

```
df_true = df.where("endword in ('she', 'he', 'hers', 'his', 'her', 'him')")\
               .withColumn('label', lit(1))
```

```
df_false = df.where("endword not in ('she', 'he', 'hers', 'his', 'her', 'him')")\
                .withColumn('label', lit(0))
```

Combining the positive and negative data

```
df_examples = df_true.union(df_false)
```

Splitting the data into training and evaluation sets

```
df_train, df_eval = df_examples.randomSplit((0.60, 0.40), 42)
```

Training

```
from pyspark.ml.classification import LogisticRegression

logistic = LogisticRegression(maxIter=50, regParam=0.6, elasticNetParam=0.3)

model = logistic.fit(df_train)

print("Training iterations: ", model.summary.totalIterations)
```

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Predicting and evaluating

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Applying a model to evaluation data

```
predicted = df_trained.transform(df_test)
```

- prediction column: double
- probability column: vector of length two

```
x = predicted.first  
print("Right!" if x.label == int(x.prediction) else "Wrong")
```


Evaluating classification accuracy

```
model_stats = model.evaluate(df_eval)
```

```
type(model_stats)
```

```
pyspark.ml.classification.BinaryLogisticRegressionSummary)
```

```
print("\nAccuracy: %.2f" % model_stats.areaUnderROC)
```

Example of classifying text

- Positive labels:
 - ['her', 'him', 'he', 'she', 'them', 'us', 'they', 'himself', 'herself', 'we']
- Number of examples: **5746**
- Number of examples: **2873 positive, 2873 negative**
- Number of training examples: **4607**
- Number of test examples: **1139**
- training iterations: **21**
- Test AUC: **0.87**

Predicting the endword

- Positive label: 'it'
- Number of examples: 438
- Number of examples: **219 positive, 219 negative**
- Number of training examples: **340**
- Number of test examples: **98**
- Test AUC: **0.85**

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Recap

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Recap

- Window function SQL
- Extract
- Transform
- Select
- Train
- Predict
- Evaluate

Congratulations!

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