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Advanced Data Mining with Weka

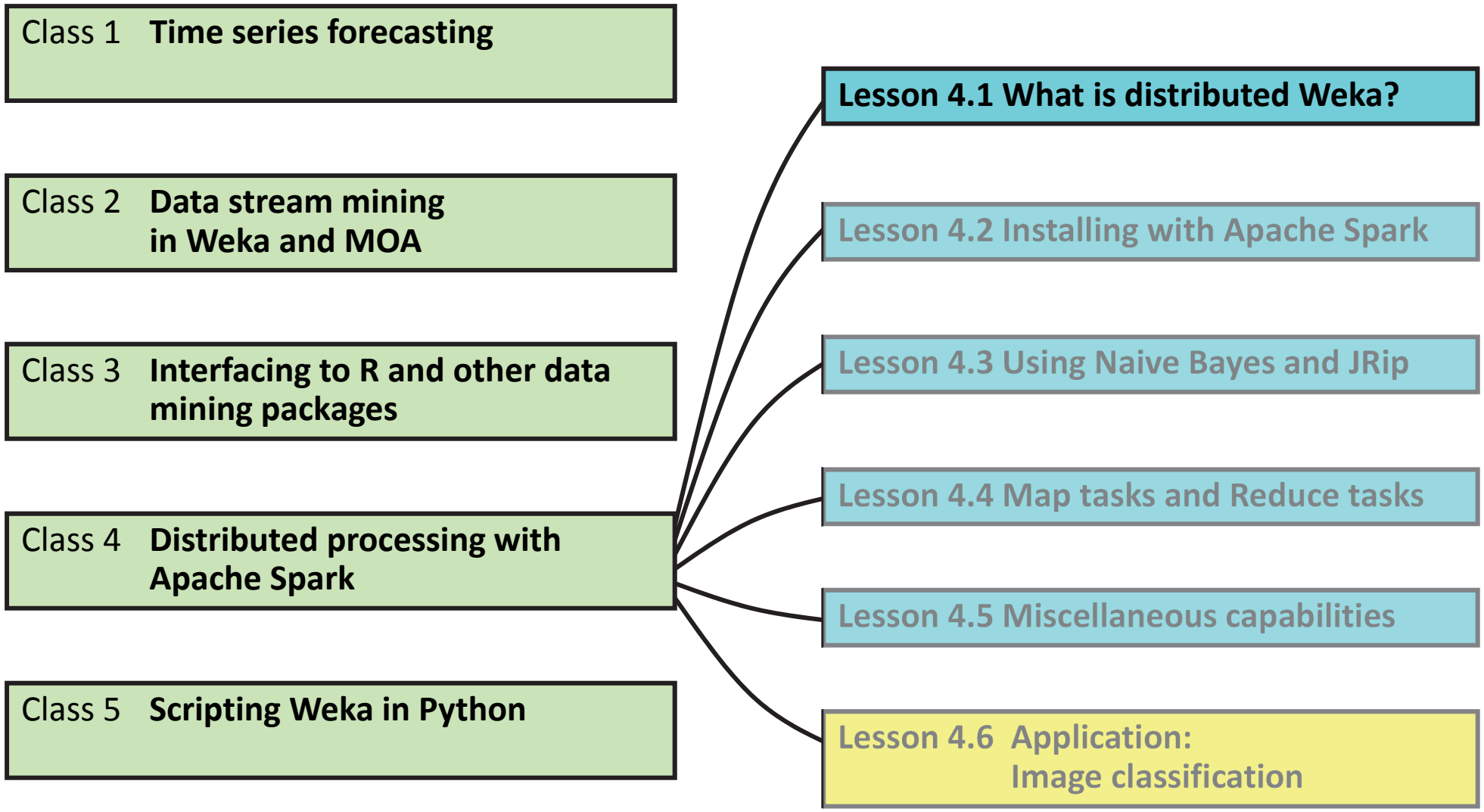
Class 4 – Lesson 1

What is distributed Weka?

Mark Hall

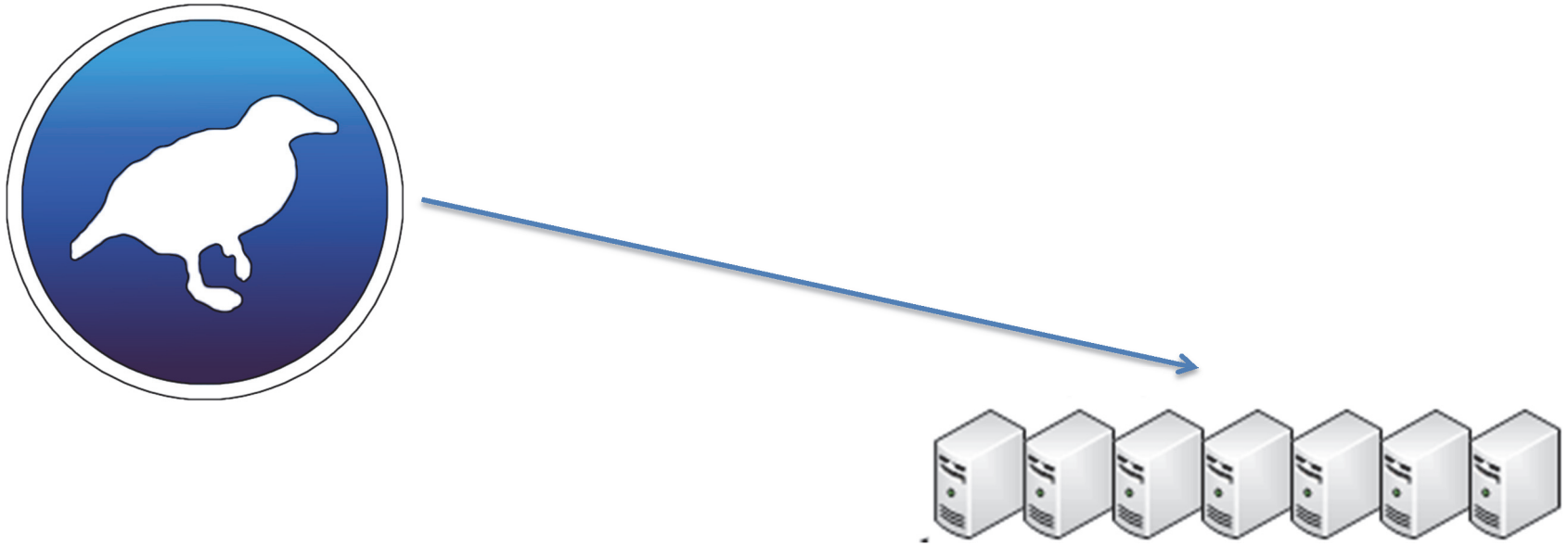
Pentaho

Lesson 4.1: What is distributed Weka?



Lesson 4.1: What is distributed Weka?

- A plugin that allows Weka algorithms to run on a cluster of machines
- Use when a dataset is too large to load into RAM on your desktop, OR
- Processing would take too long on a single machine



Lesson 4.1: What is distributed Weka?

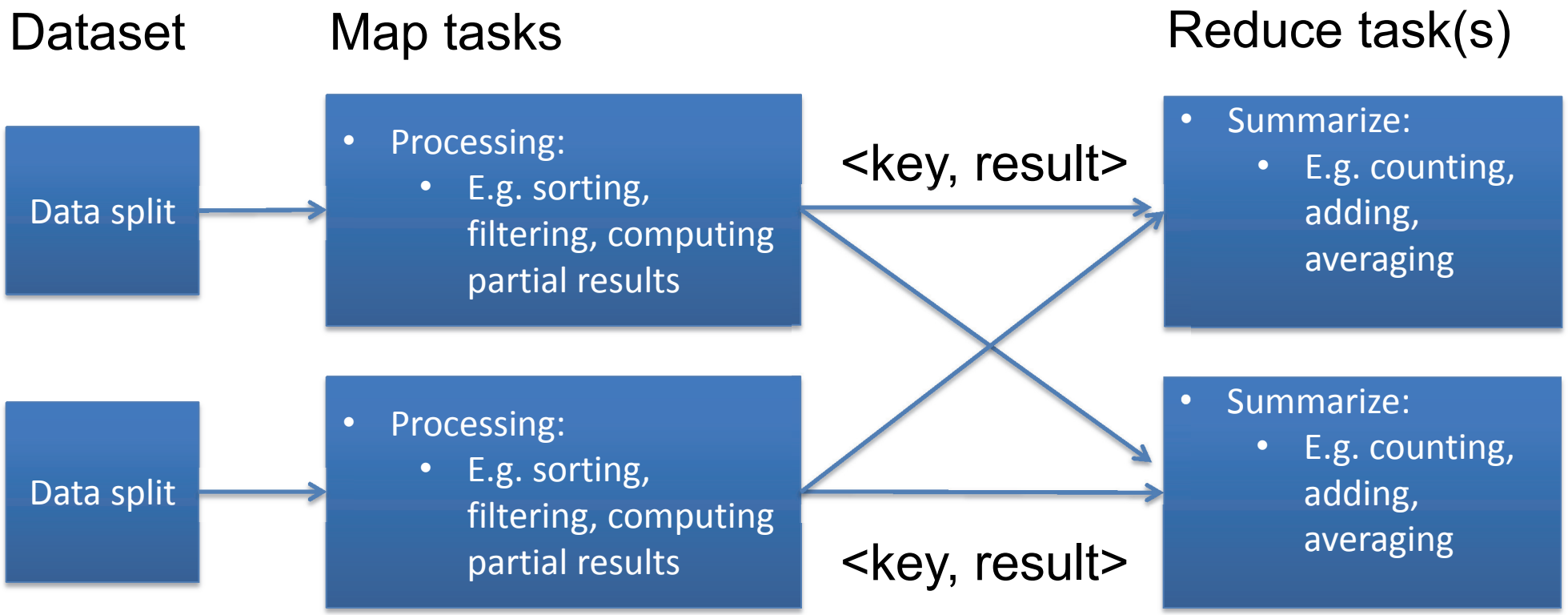
- Class 2 covered data stream mining
  - sequential online algorithms for handling large datasets
- Distributed Weka works with distributed processing frameworks that use *map-reduce*
  - Suited to large offline batch-based processing
- Divide (the data) and conquer over multiple processing machines
- More on map-reduce shortly…

Lesson 4.1: What is distributed Weka?

- Two packages are needed:
- **distributedWekaBase**
  - General map-reduce tasks for machine learning that are not tied to any particular map-reduce framework implementation
  - Tasks for training classifiers and clusterers, and computing summary statistics and correlations
- **distributedWekaSpark**
  - A wrapper for the base tasks that works on the Spark platform
  - There is also a package (several actually) that works with **Hadoop**

Lesson 4.1: What is distributed Weka?

Map-reduce programs involve a “map” and “reduce” phase



Map-reduce frameworks provide orchestration, redundancy and fault-tolerance

Lesson 4.1: What is distributed Weka?

- Goals of distributed Weka
  - Provide a similar experience to that of using desktop Weka
  - Use any classification or regression learner
  - Generate output (including evaluation) that looks just like that produced by desktop Weka
  - Produce models that are normal Weka models (some caveats apply)
- Not a goal (initially at least)
  - Providing distributed implementations of every learning algorithm in Weka
    - One exception: k-means clustering
  - We'll see how distributed Weka handles building models later…

Lesson 4.1: What is distributed Weka?

- What distributed Weka is
- When you would want to use it
- What map-reduce is
- Basic goals in the design of distributed Weka

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Advanced Data Mining with Weka

Class 4 – Lesson 2

Installing with Apache Spark

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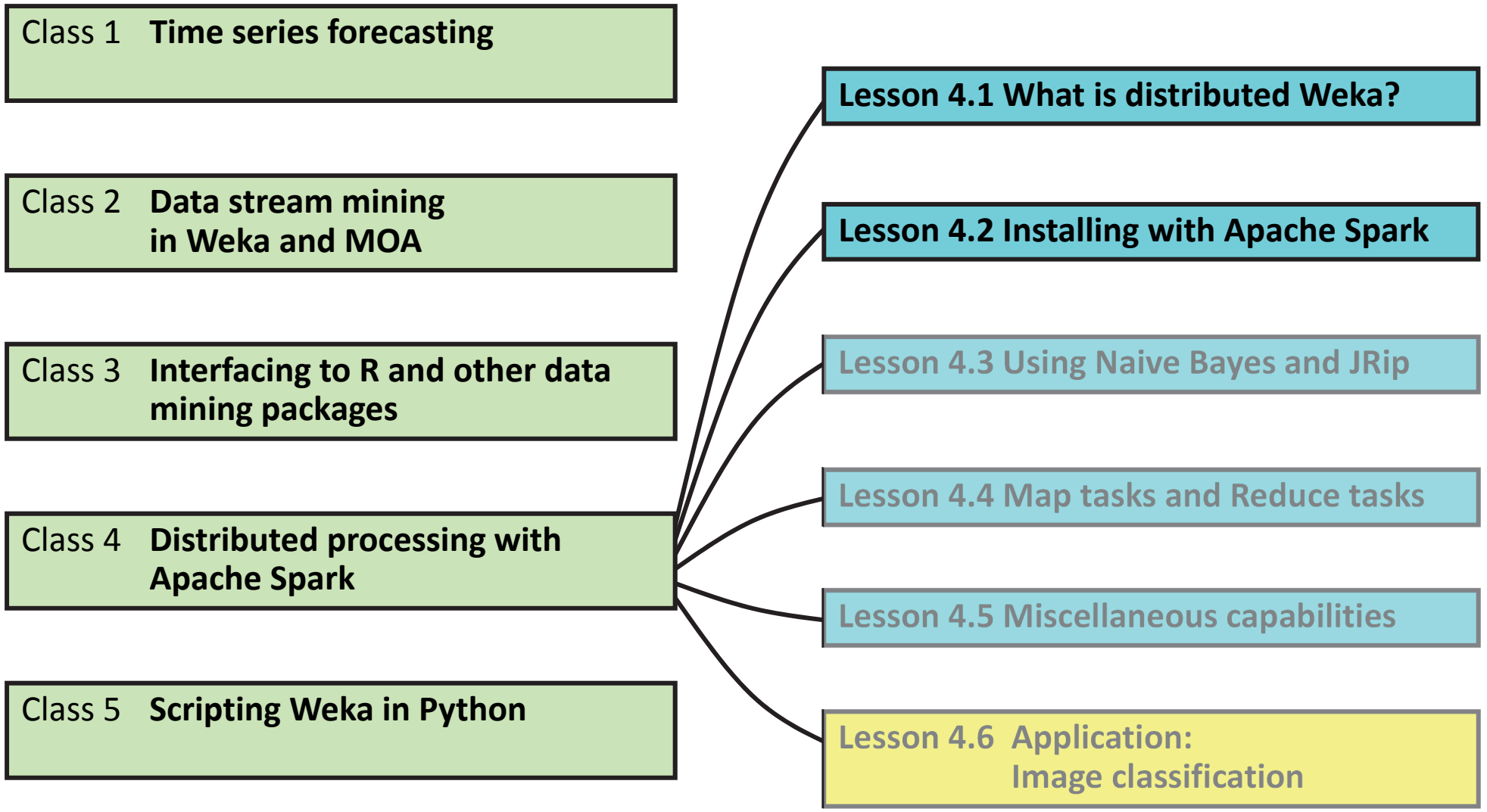
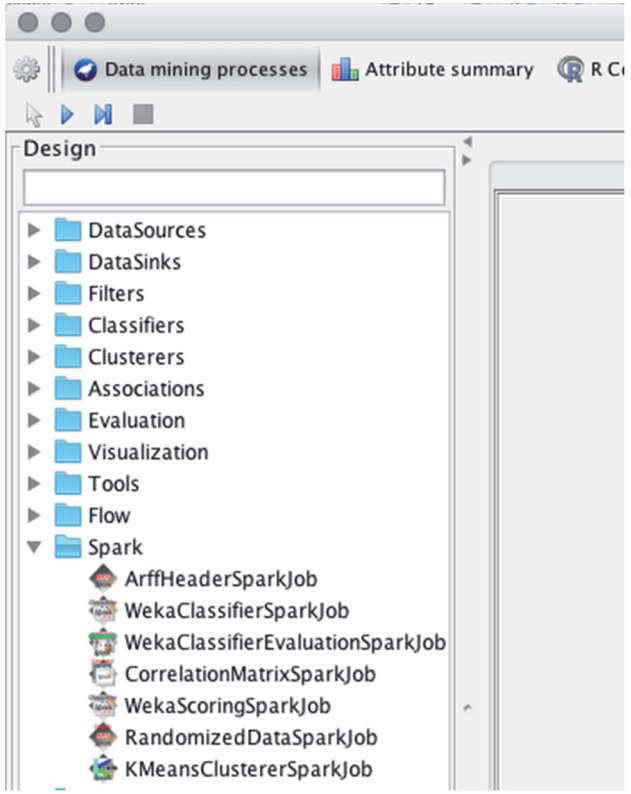
Lesson 4.2: Installing with Apache Spark



Lesson 4.2: Installing with Apache Spark

- Install **distributedWekaSpark** via the package manager
  - This automatically installs the general framework-independent **distributedWekaBase** package as well
- Restart Weka
- Check that the package has installed and loaded properly by starting the Knowledge Flow UI



Lesson 4.2: Installing with Apache Spark

The hypothyroid data

- A benchmark dataset from the UCI machine learning repository
- Predict the type of thyroid disease a patient has
  - Input attributes: demographic and medical information
- 3772 instances with 30 attributes
- A version of this data, in CSV format without a header row, can be found in ${user.home}\wekafiles\packages\distributedWekaSpark\sample_data

Lesson 4.2: Installing with Apache Spark

Why CSV without a header rather than ARFF?

- Hadoop and Spark split data files up into blocks
  - Distributed storage
  - Data local processing
- There are “readers” for text files and various structured binary files
  - Maintain the integrity of individual records
- ARFF would require a special reader, due to the ARFF header only being present in one block of the data

Lesson 4.2: Installing with Apache Spark

- Getting distributed Weka installed
- Our test dataset: the hypothyroid data
- Data format processed by distributed Weka
- Distributed Weka job to generate summary statistics

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Advanced Data Mining with Weka

Class 4 – Lesson 3

Using Naive Bayes and JRip

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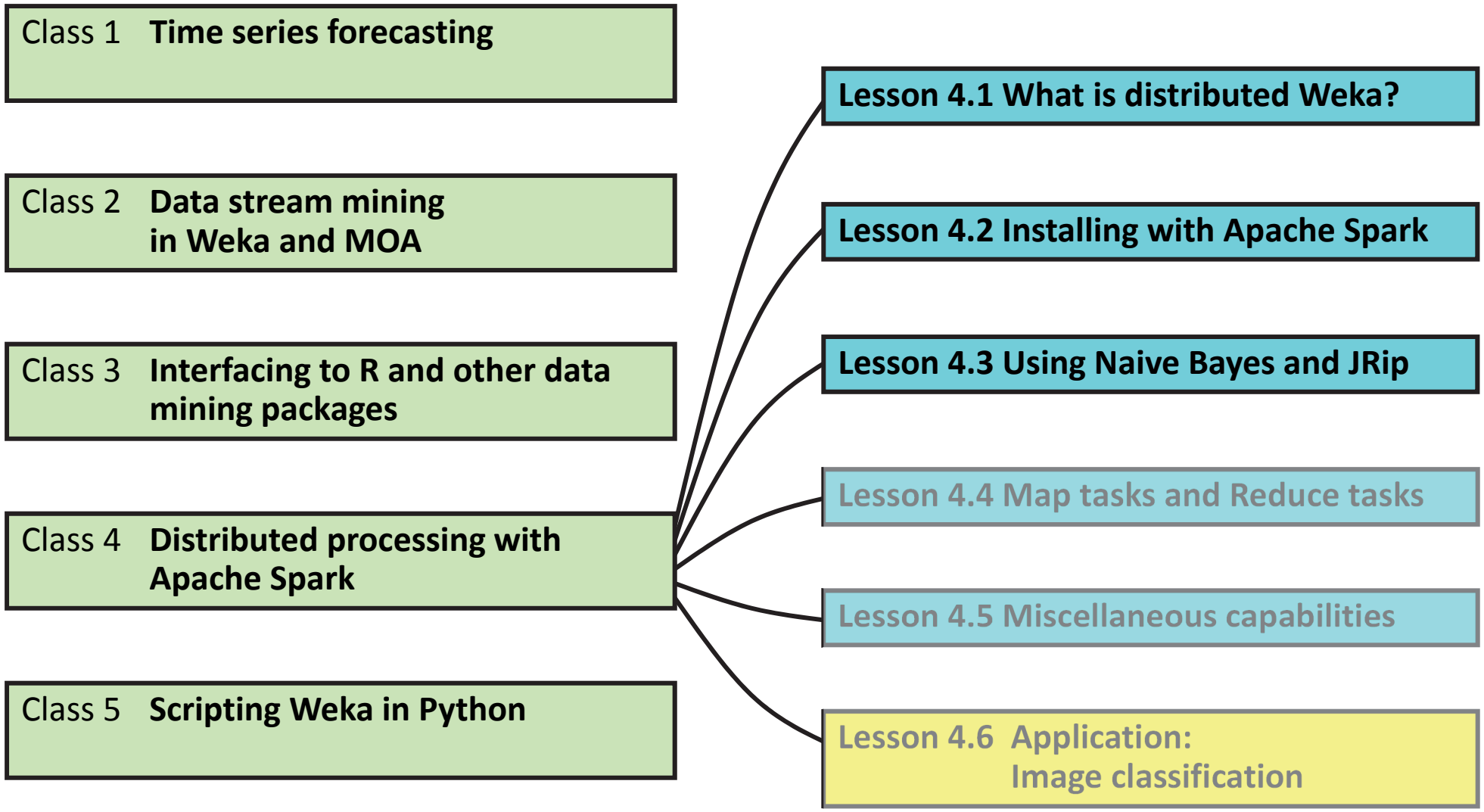
Lesson 4.3: Using Naive Bayes and JRip



No slides for Lesson 4.3

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Class 4 – Lesson 4

Map tasks and Reduce tasks

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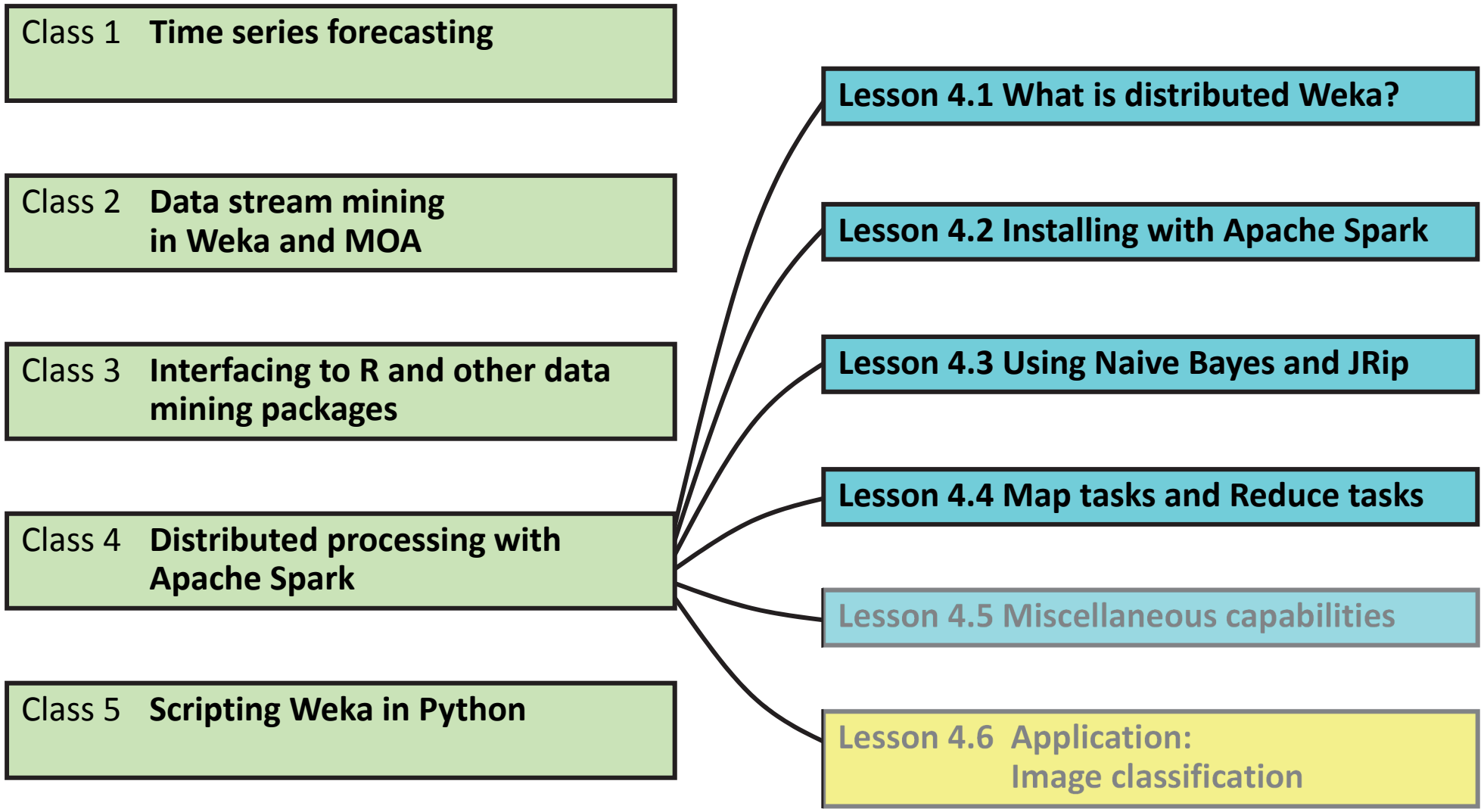
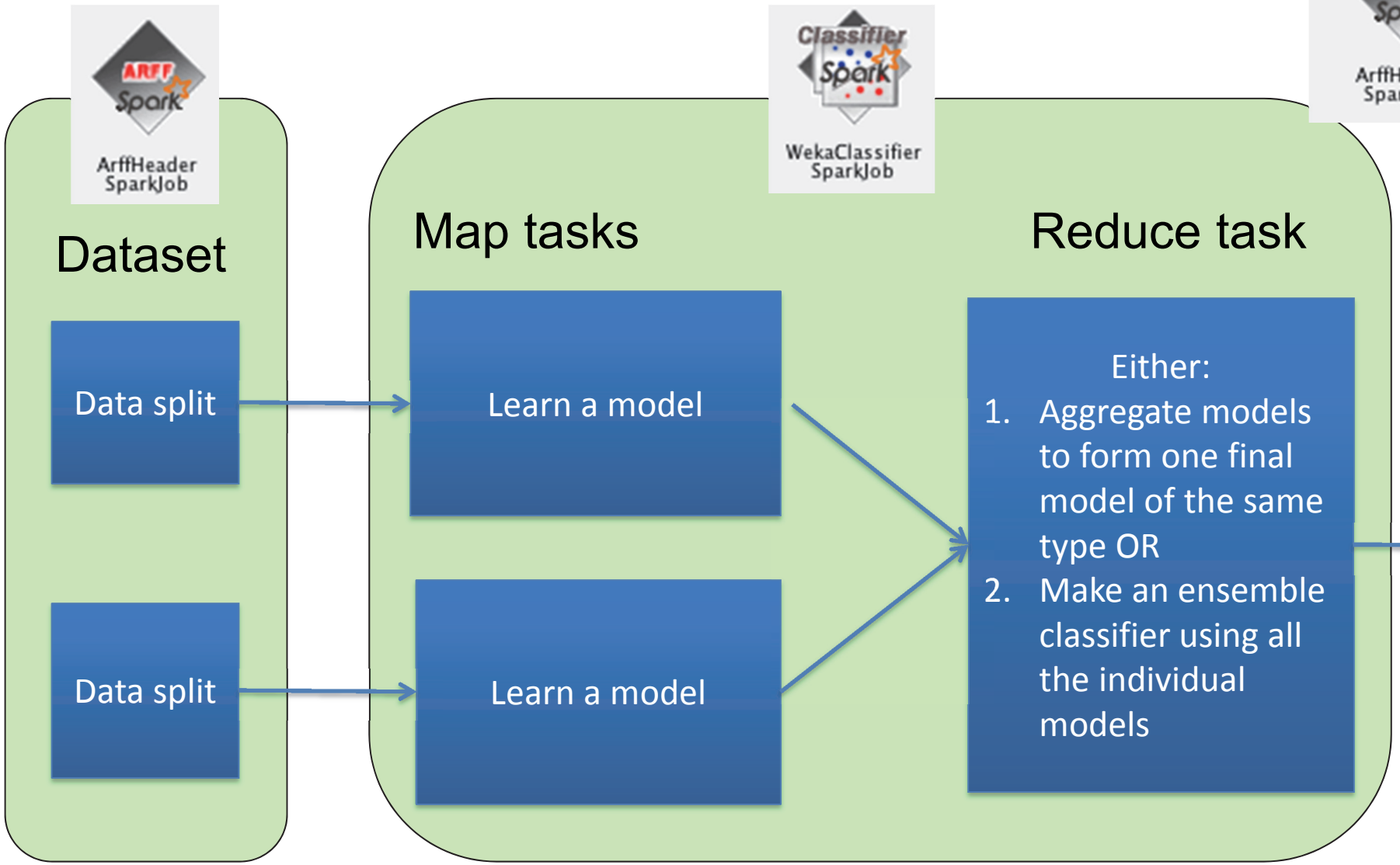
Lesson 4.4: Map tasks and Reduce tasks



Lesson 4.4: Map tasks and Reduce tasks

How is a classifier learned in Spark?



Lesson 4.4: Map tasks and Reduce tasks

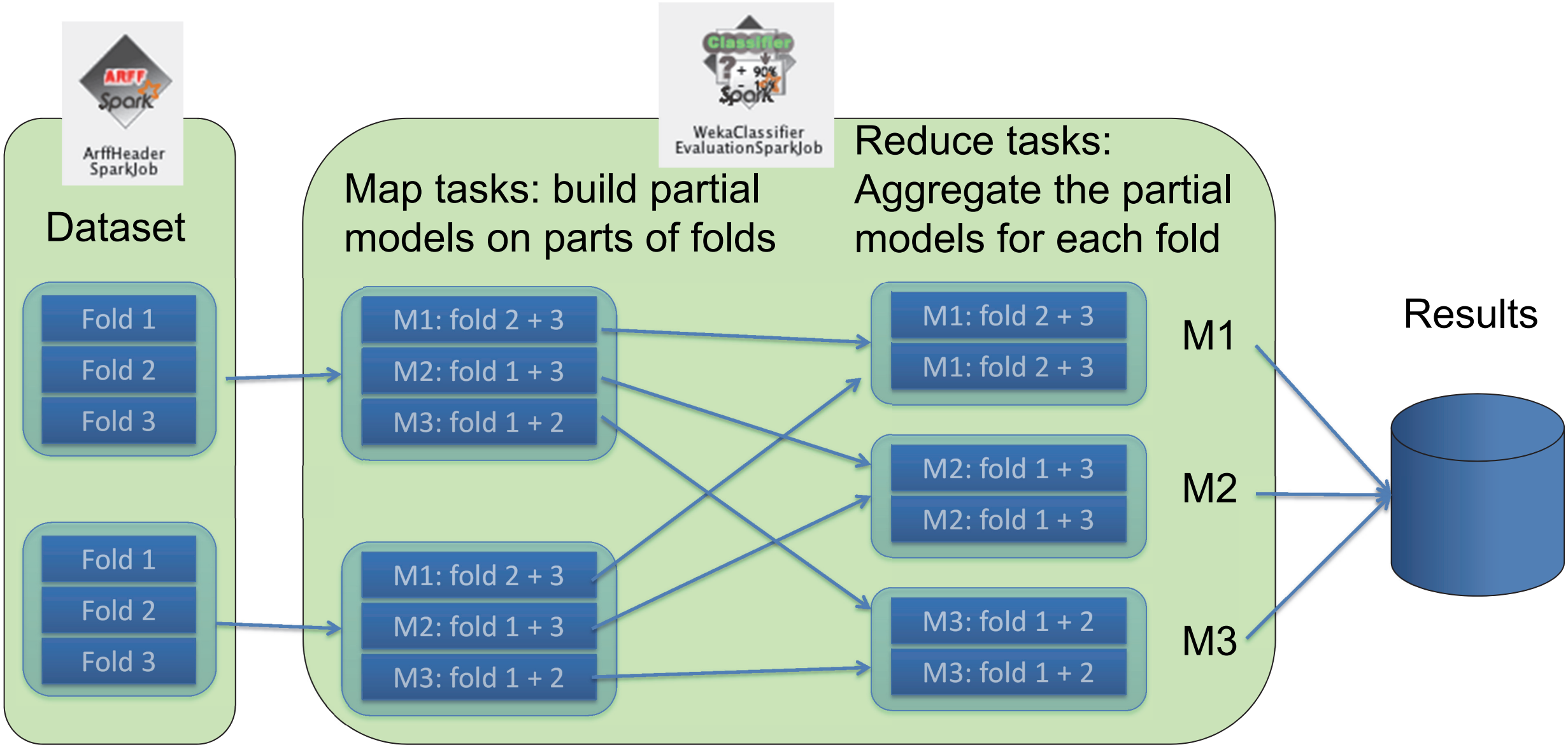
Cross validation in Spark

- Implemented with two phases (passes over the data):

1. Phase one: model construction
2. Phase two: model evaluation

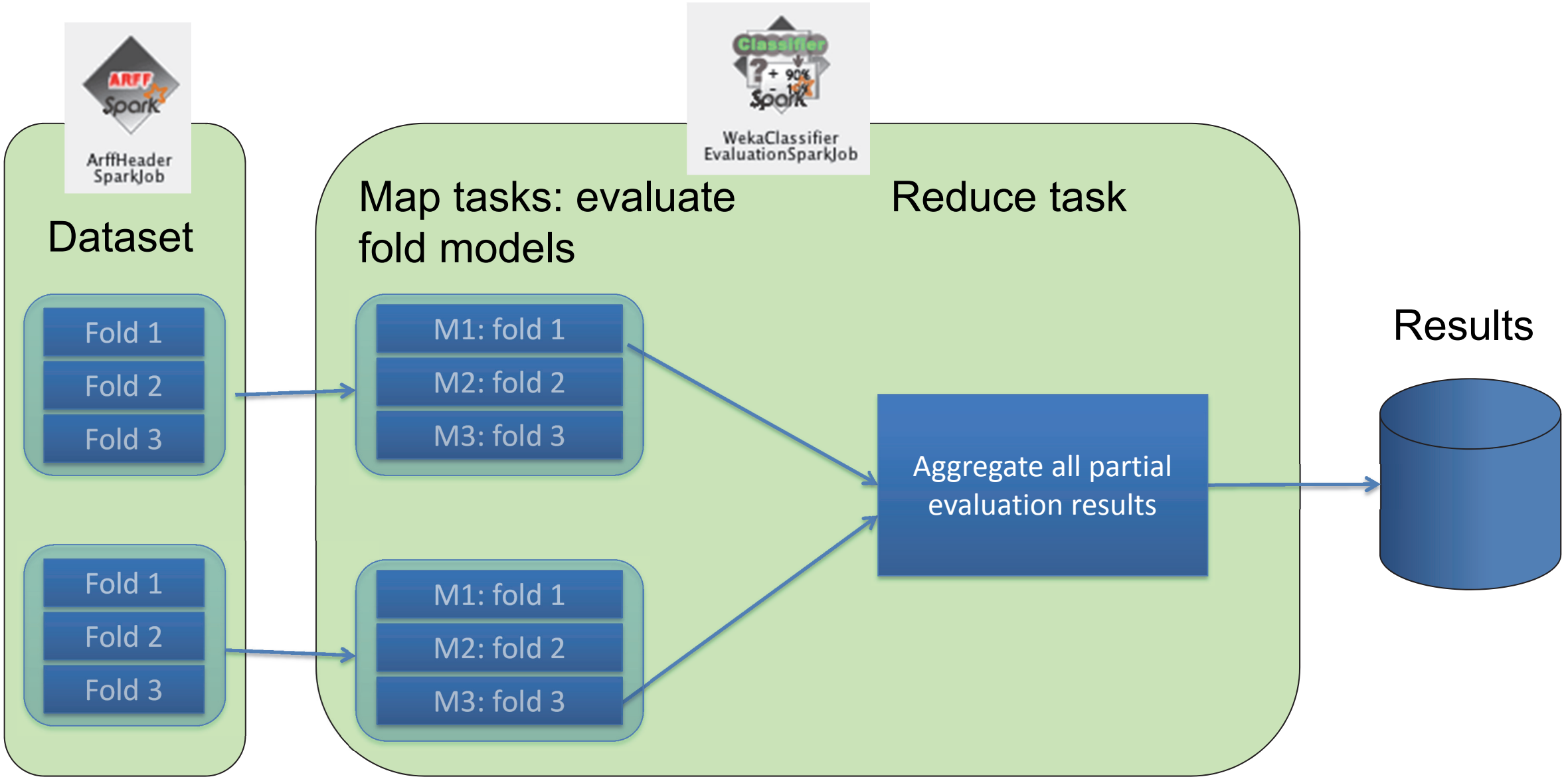
Lesson 4.4: Map tasks and Reduce tasks

Cross-validation in Spark phase 1: model construction



Lesson 4.4: Map tasks and Reduce tasks

Cross-validation in Spark phase 2: model evaluation



Lesson 4.3 & 4.4: Exploring the Knowledge Flow templates

- Creating ARFF metadata and summary statistics for a dataset
- How distributed Weka builds models
- Distributed cross-validation

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Advanced Data Mining with Weka

Class 4 – Lesson 5

Miscellaneous capabilities

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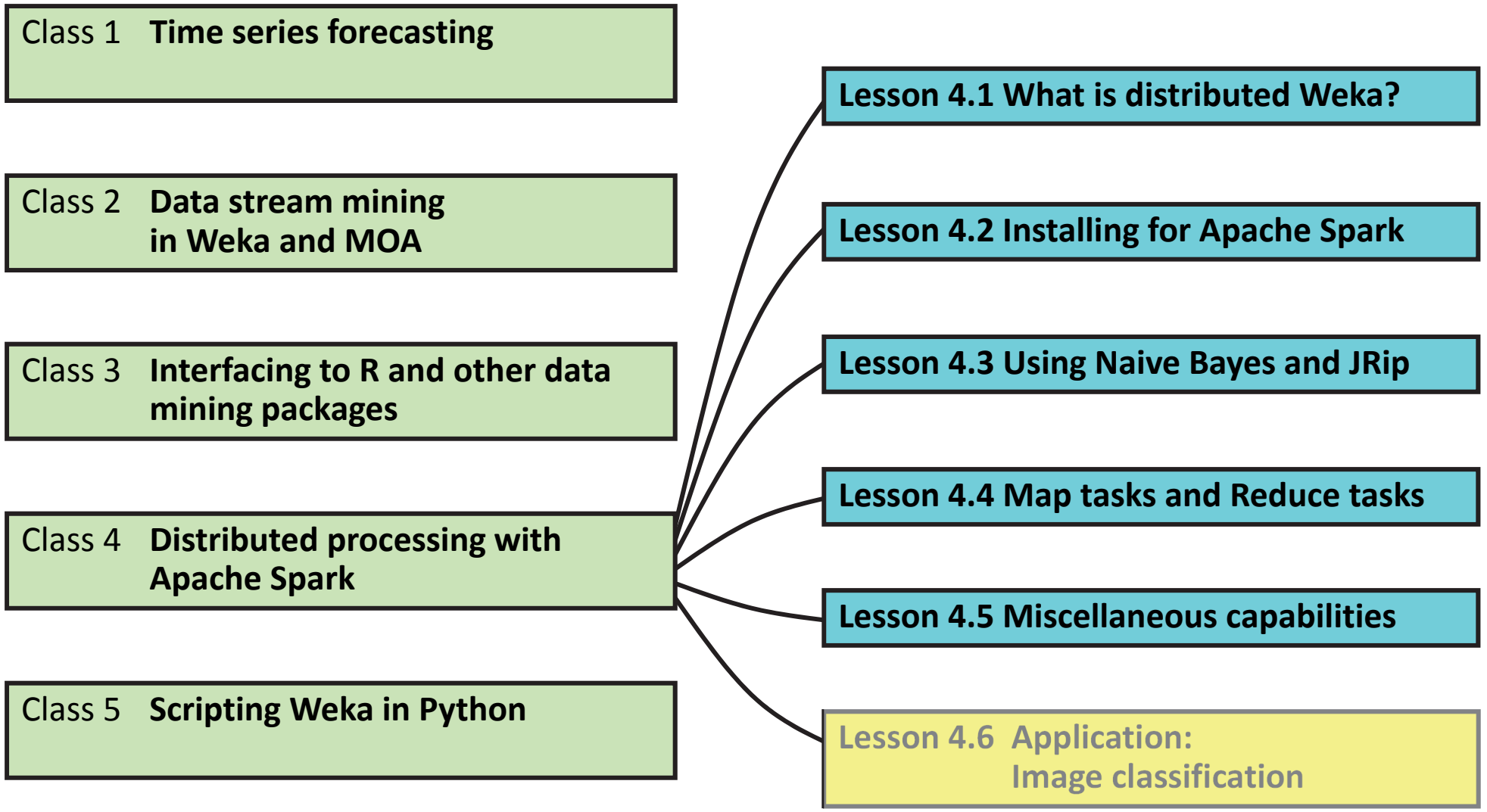
Lesson 4.5: Miscellaneous capabilities



Lesson 4.5: Miscellaneous capabilities

- Computing a correlation matrix in Spark and using it as input to PCA
- Running k-means clustering in Spark
- Where to go for information on setting up Spark clusters

Lesson 4.5: Miscellaneous capabilities

Further reading

- Distributed Weka for Spark
  - http://markahall.blogspot.co.nz/2015/03/weka-and-spark.html
- Distributed Weka for Hadoop
  - http://markahall.blogspot.co.nz/2013/10/weka-and-hadoop-part-1.html
- K-means|| clustering in distributed Weka
  - http://markahall.blogspot.co.nz/2014/09/k-means-in-distributed-weka-for-hadoop.html
- Apache Spark documentation
  - http://spark.apache.org/docs/latest/
- Setting up a simple stand-alone cluster
  - http://blog.knoldus.com/2015/04/14/setup-a-apache-spark-cluster-in-your-single-standalone-machine/

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Advanced Data Mining with Weka

Class 4 – Lesson 6

Application: Image classification

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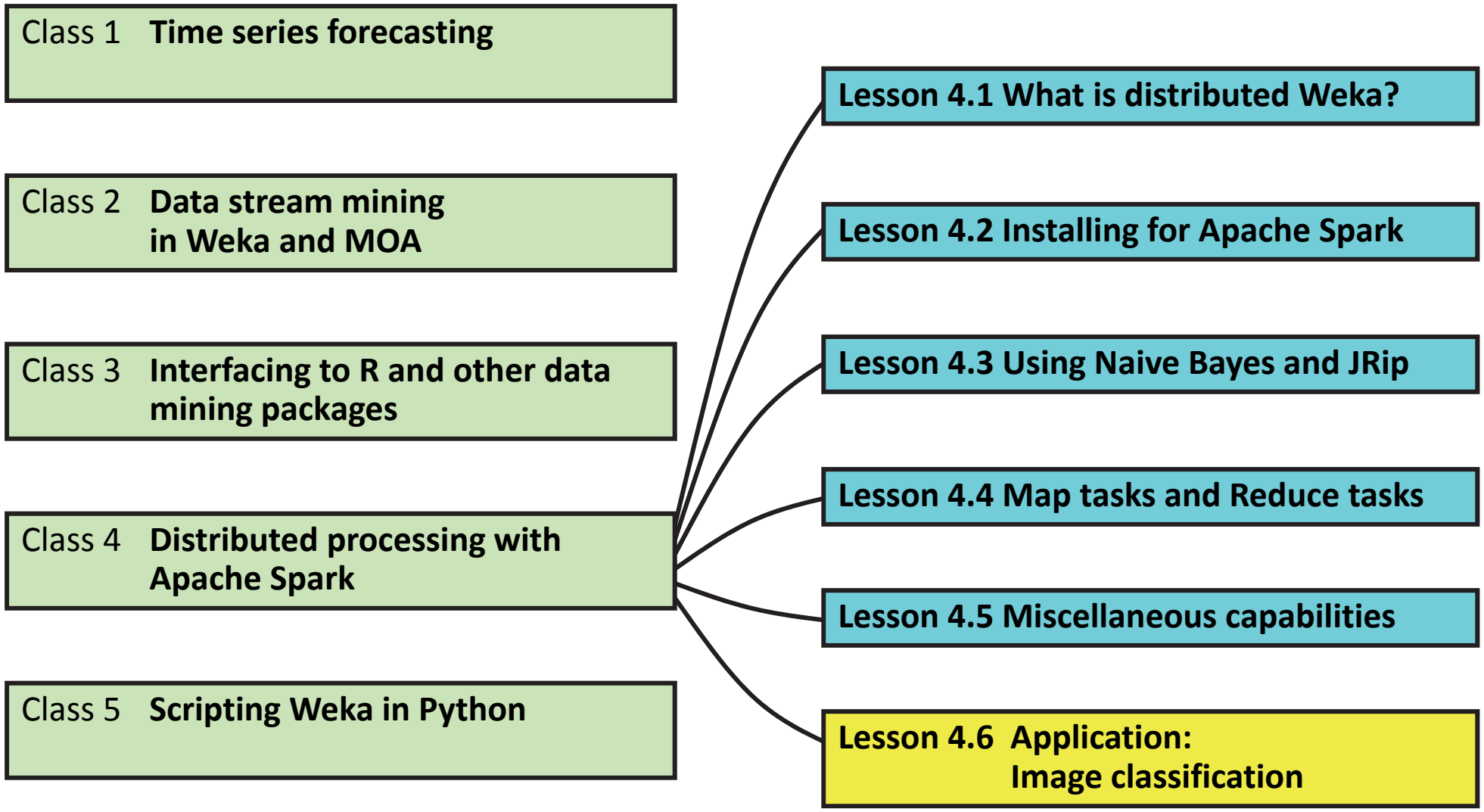
Lesson 4.6: Application: Image classification



Lesson 4.6: Application: Image classification

- **Image features** are a way of describing an image using numbers
- For example:
  - How bright is the image (f_1)?
  - How much yellow is in the image (f_2)?
  - How much green is in the image (f_3)?
  - How symmetrical is the image (f_4)?

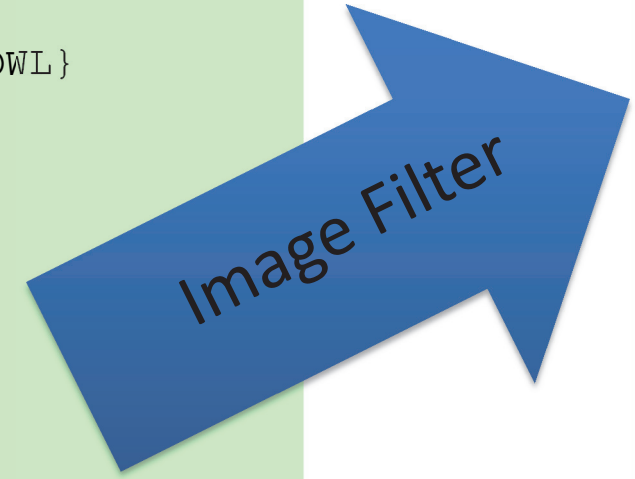
f_1	50%
f_2	50%
f_3	10%
f_4	100%

f_1	50%
f_2	2%
f_3	65%
f_4	50%

Lesson 4.6: Application: Image classification

- **Image filters** extract the same features for a set of images

```
@relation butterfly_vs_owl
@attribute filename string
@attribute class {BUTTERFLY,OWL}
@data
mno001.jpg,BUTTERFLY
mno002.jpg,BUTTERFLY
mno003.jpg,BUTTERFLY
mno004.jpg,BUTTERFLY
owl001.jpg,OWL
owl002.jpg,OWL
owl003.jpg,OWL
owl004.jpg,OWL
```




```
@relation butterfly_vs_owl
@attribute filename string
@attribute f1 numeric
@attribute f2 numeric
@attribute f3 numeric
@attribute class {BUTTERFLY,OWL}

@data
mno001.jpg,3,7,0,BUTTERFLY
mno002.jpg,1,2,0,BUTTERFLY
mno003.jpg,3,4,0,BUTTERFLY
mno004.jpg,6,3,0,BUTTERFLY
owl001.jpg,3,5,0,OWL
owl002.jpg,7,3,0,OWL
owl003.jpg,3,5,0,OWL
owl004.jpg,7,5,1,OWL
```

Lesson 4.6: Application: Image classification

1. Install **`imageFilters`** package using the Package Manager
2. Create your own ARFF file or use the example at **`%HOMEPATH%/wekafiles/packages/imageFilters/data`**
3. Open the ARFF file in the WEKA Explorer
4. Select an image filter from **`filters/unsupervised/instance/imagefilter`**
5. Set the filter's **`imageDirectory`** option to the correct directory
6. Click the Apply button
7. Repeat 5-7 if you wish to apply more than one filter
8. (Optional) Remove the first filename attribute
9. Select a classifier and perform some experiments

Lesson 4.6: Application: Image classification

- Summary
  - Image features are mathematical properties of images
  - Image filters can be applied to calculate image features for an entire dataset of images
  - Different features measure different properties of the image
  - Experimenting with WEKA can help you identify the best combination of image feature and classifier for your data

Lesson 4.6: Application: Image classification

❖ References

- **LIRE**: Mathias L. & Chatzichristofis S.A. (2008) Lire: Lucene Image Retrieval – An Extensible Java CBIR Library. *Proceedings of the 16th ACM International Conference on Multimedia*, 1085-1088.
- **MPEG7 Features**: Manjunath B., Ohm J.R., Vasudevan V.V. & Yamada A. (2001) Color and texture descriptors. *IEEE Trans. on Circuits and Systems for Video Technology*, 11, 703–715.
- **Bird images**: Lazebnik S., Schmid C. & Ponce J. (2005) Maximum Entropy Framework for Part-Based Texture and Object Recognition. *Proceedings of the IEEE International Conference on Computer Vision*, vol. 1, 832-838.
- **Butterfly images**: Lazebnik S., Schmid C. & Ponce J. (2004) Semi-Local Affine Parts for Object Recognition. *Proceedings of the British Machine Vision Conference*, vol. 2, 959-968.

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