

# Basics of Machine Learning

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# Lesson 12

## Unsupervised Learning



# Supervised Learning

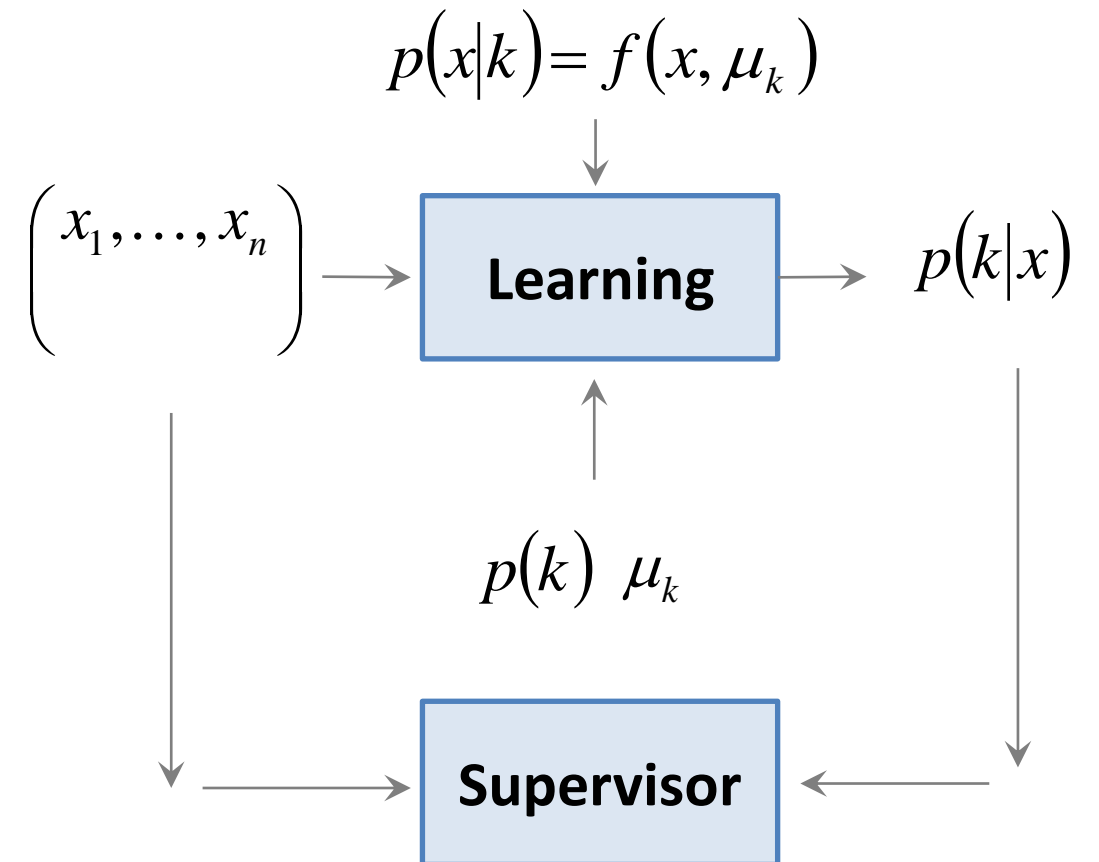
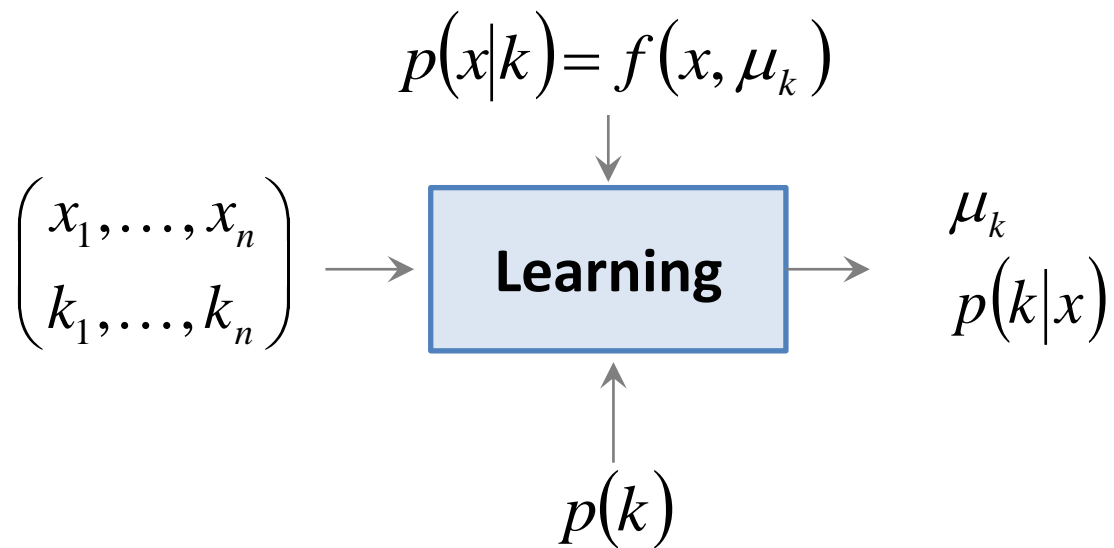
## Summary

- EM Algorithm
- K-means

# EM algorithm

# Unsupervised learning

## EM algorithm



# Unsupervised learning

## EM algorithm



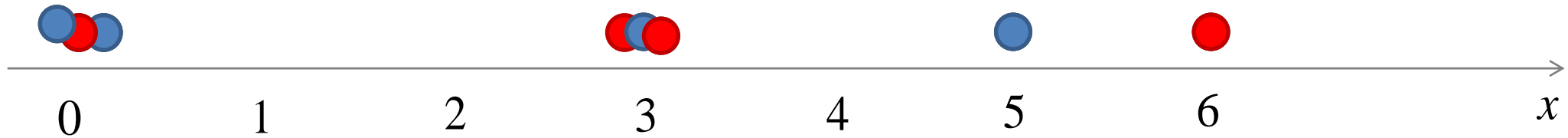
# Unsupervised learning

## EM algorithm



# Unsupervised learning

## EM algorithm



$$\mu_{\bullet} = \frac{1}{4} (0 + 0 + 3 + 5) = 2$$

$$\sigma_{\bullet} = \frac{1}{4} (2^2 + 2^2 + 1^2 + 3^2) = 4.5$$

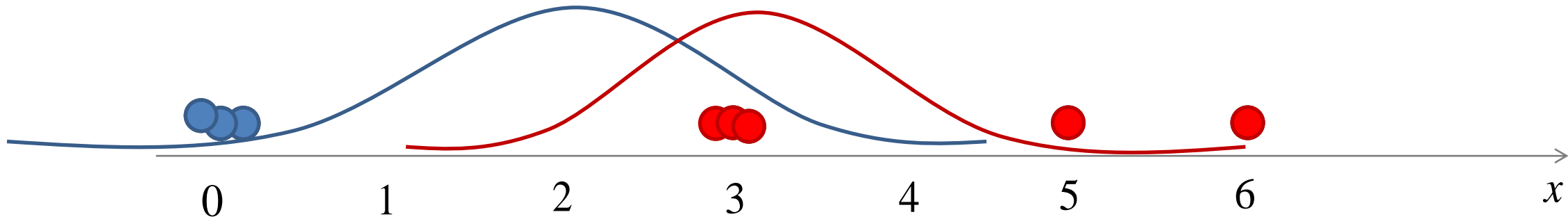
$$\mu_{\bullet} = \frac{1}{4} (0 + 3 + 3 + 6) = 3$$

$$\sigma_{\bullet} = \frac{1}{4} (3^2 + 0^2 + 0^2 + 3^2) = 4.5$$



# Unsupervised learning

## EM algorithm



$$\mu_{\bullet} = \frac{1}{4} (0 + 0 + 3 + 5) = 2$$

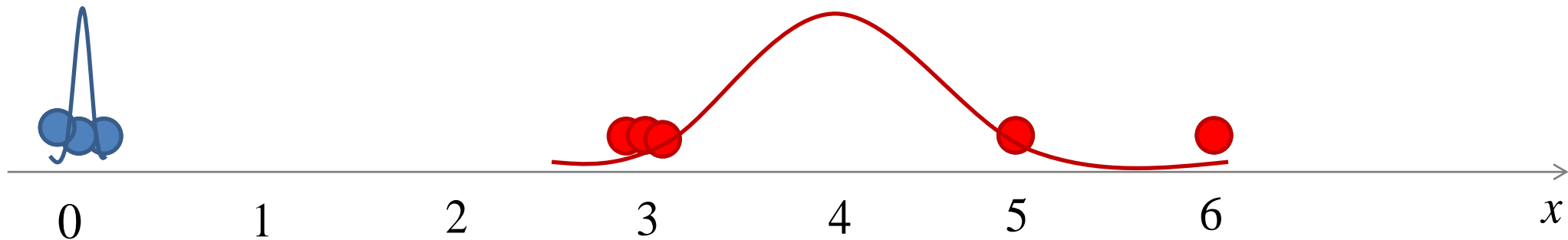
$$\sigma_{\bullet} = \frac{1}{4} (2^2 + 2^2 + 1^2 + 3^2) = 4.5$$

$$\mu_{\bullet} = \frac{1}{4} (0 + 3 + 3 + 6) = 3$$

$$\sigma_{\bullet} = \frac{1}{4} (3^2 + 0^2 + 0^2 + 3^2) = 4.5$$

# Unsupervised learning

## EM algorithm



$$\mu_{\bullet} = \frac{1}{3} (0 + 0 + 0) = 0$$

$$\sigma_{\bullet} = \frac{1}{3} (0^2 + 0^2 + 0^2) = 0$$

$$\mu_{\bullet} = \frac{1}{5} (3 + 3 + 3 + 5 + 6) = 4$$

$$\sigma_{\bullet} = \frac{1}{5} (1^2 + 1^2 + 1^2 + 1^2 + 2^2) = 1.6$$

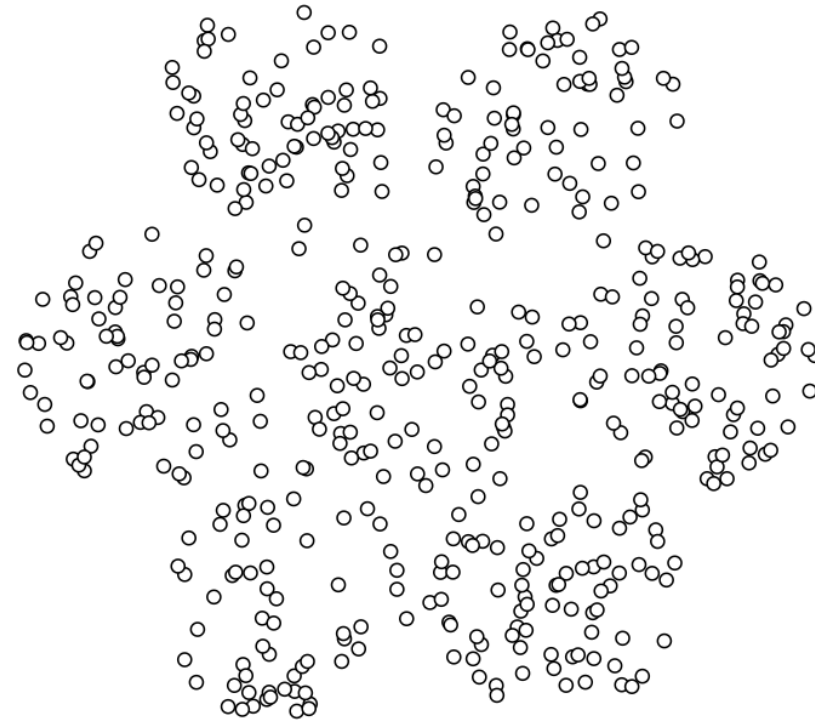
# K-Means

# Unsupervised learning

## K-means

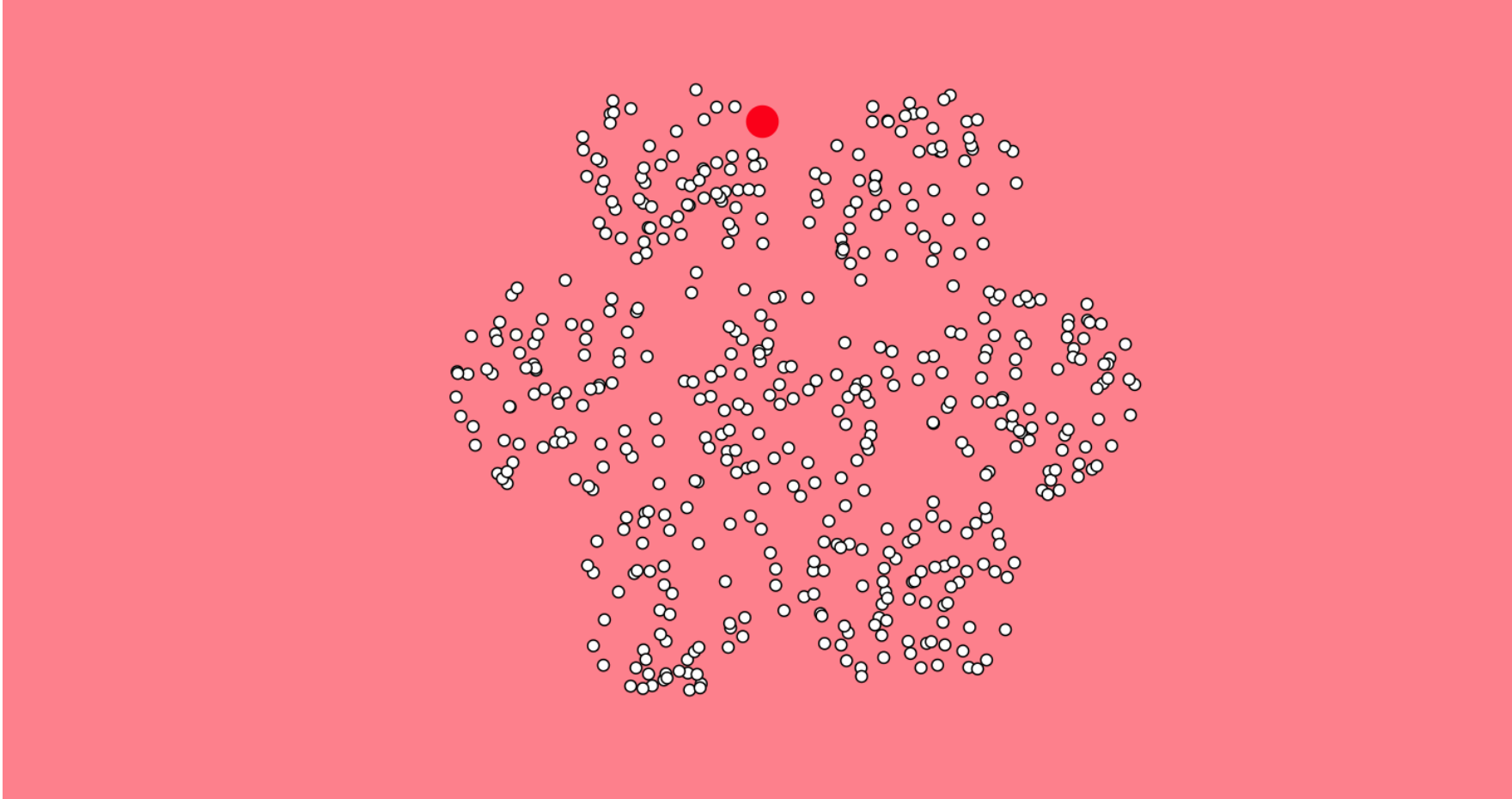
**K-means** is an unsupervised clustering algorithm

Do not confuse with KNN **classification** (or regression) algorithm which classifies an unlabeled observation based on its  $k$  surrounding neighbors.



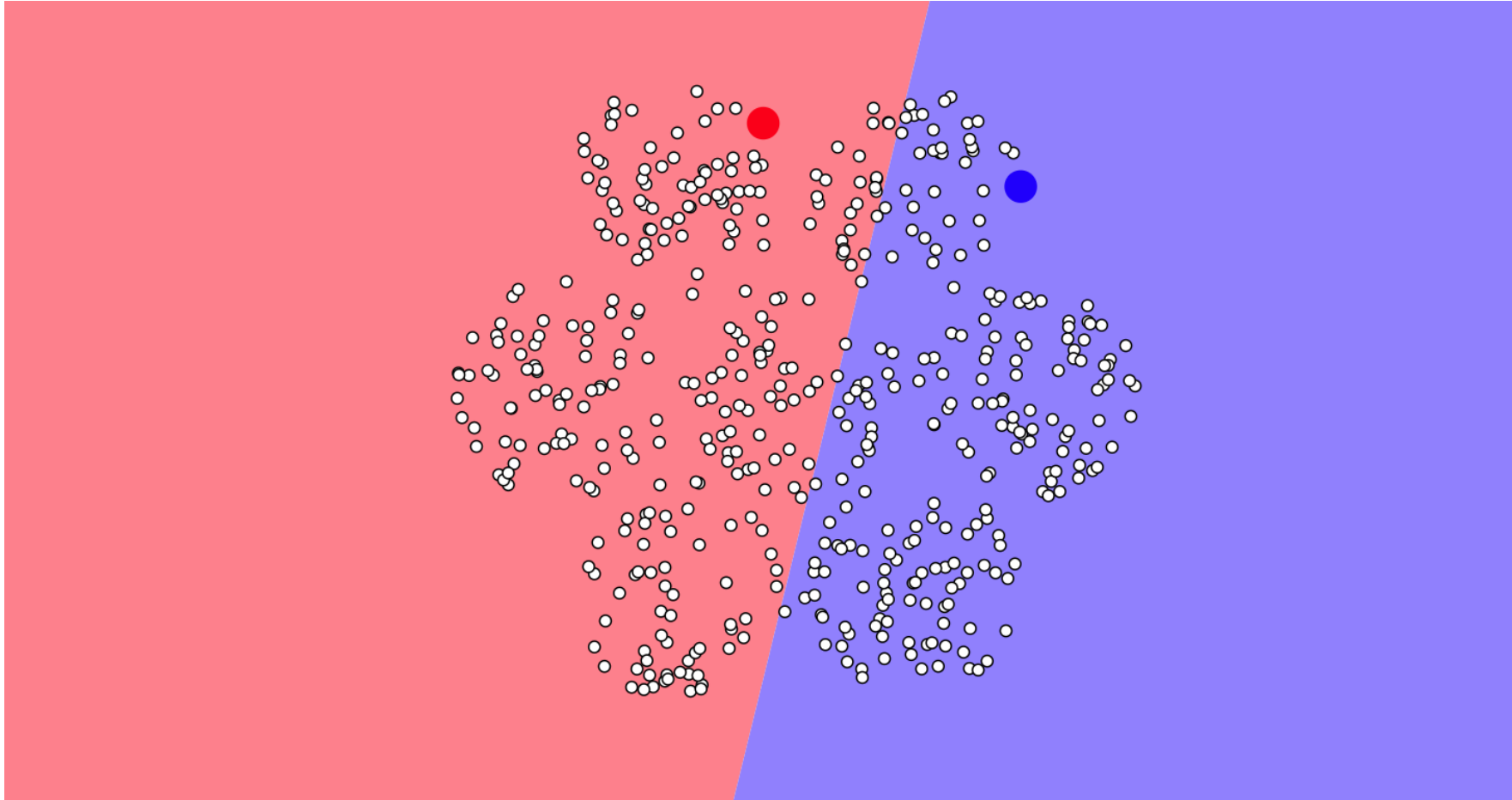
# Unsupervised learning

## K-means



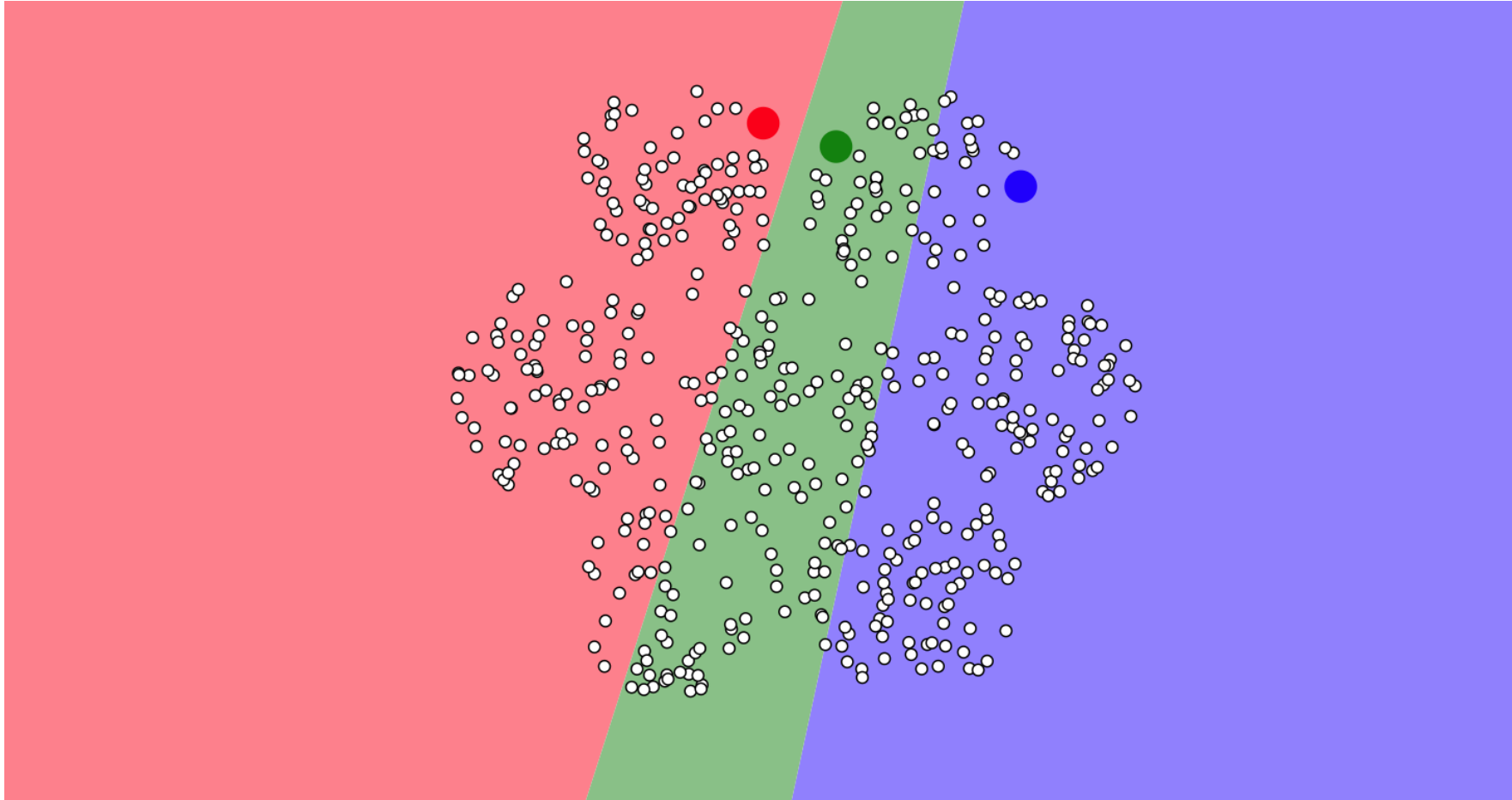
# Unsupervised learning

## K-means



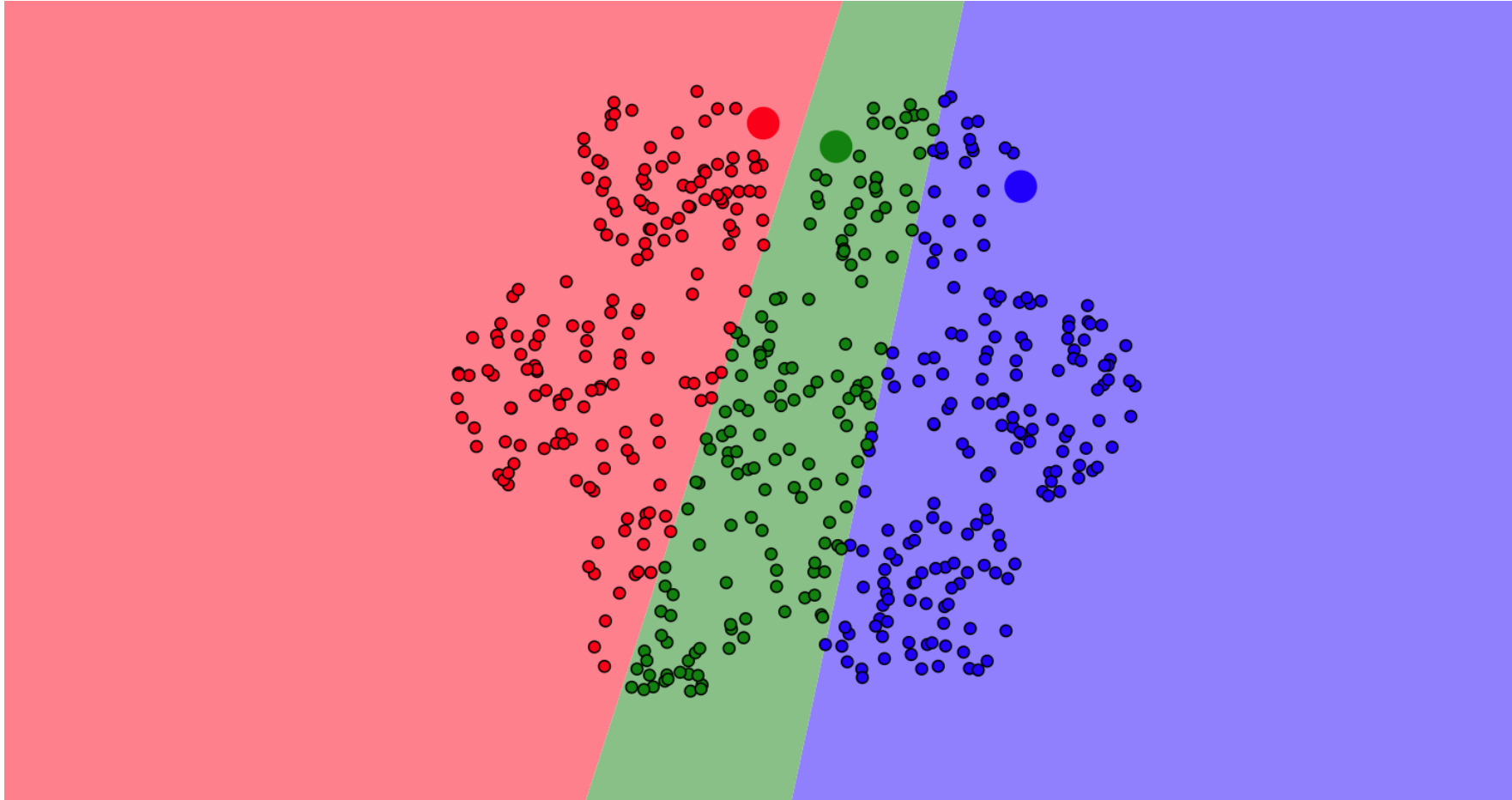
# Unsupervised learning

## K-means



# Unsupervised learning

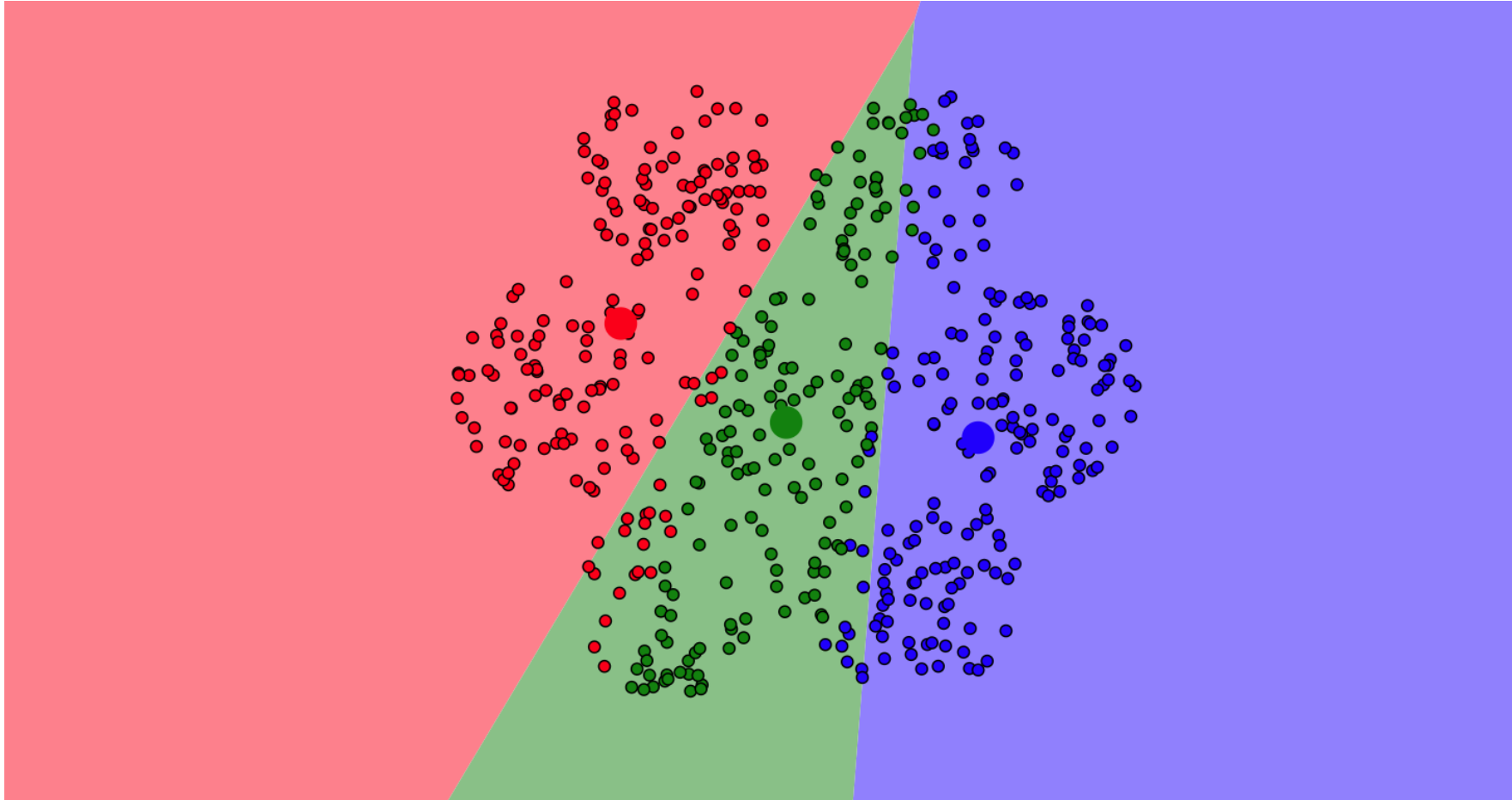
## K-means





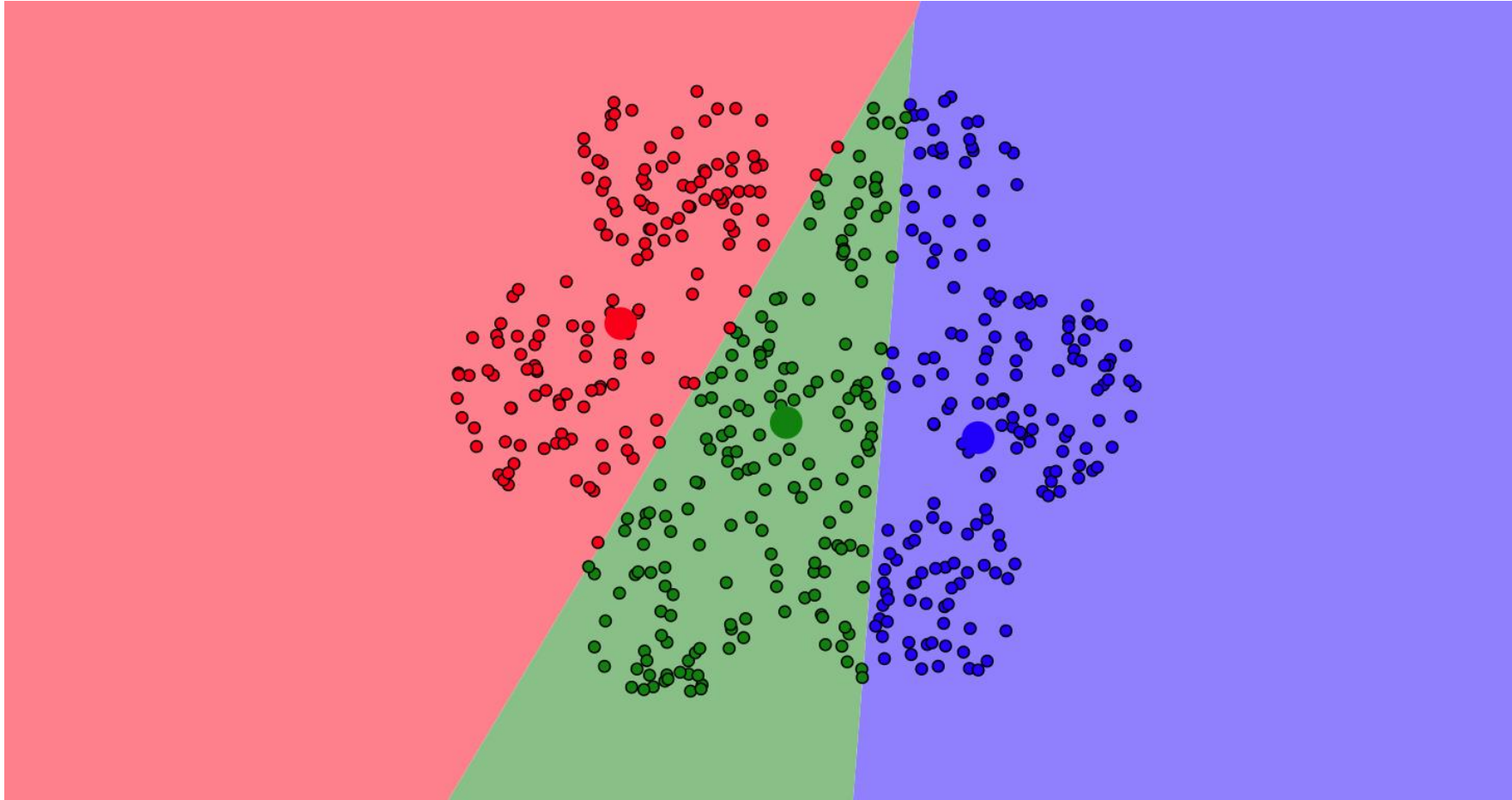
# Unsupervised learning

## K-means



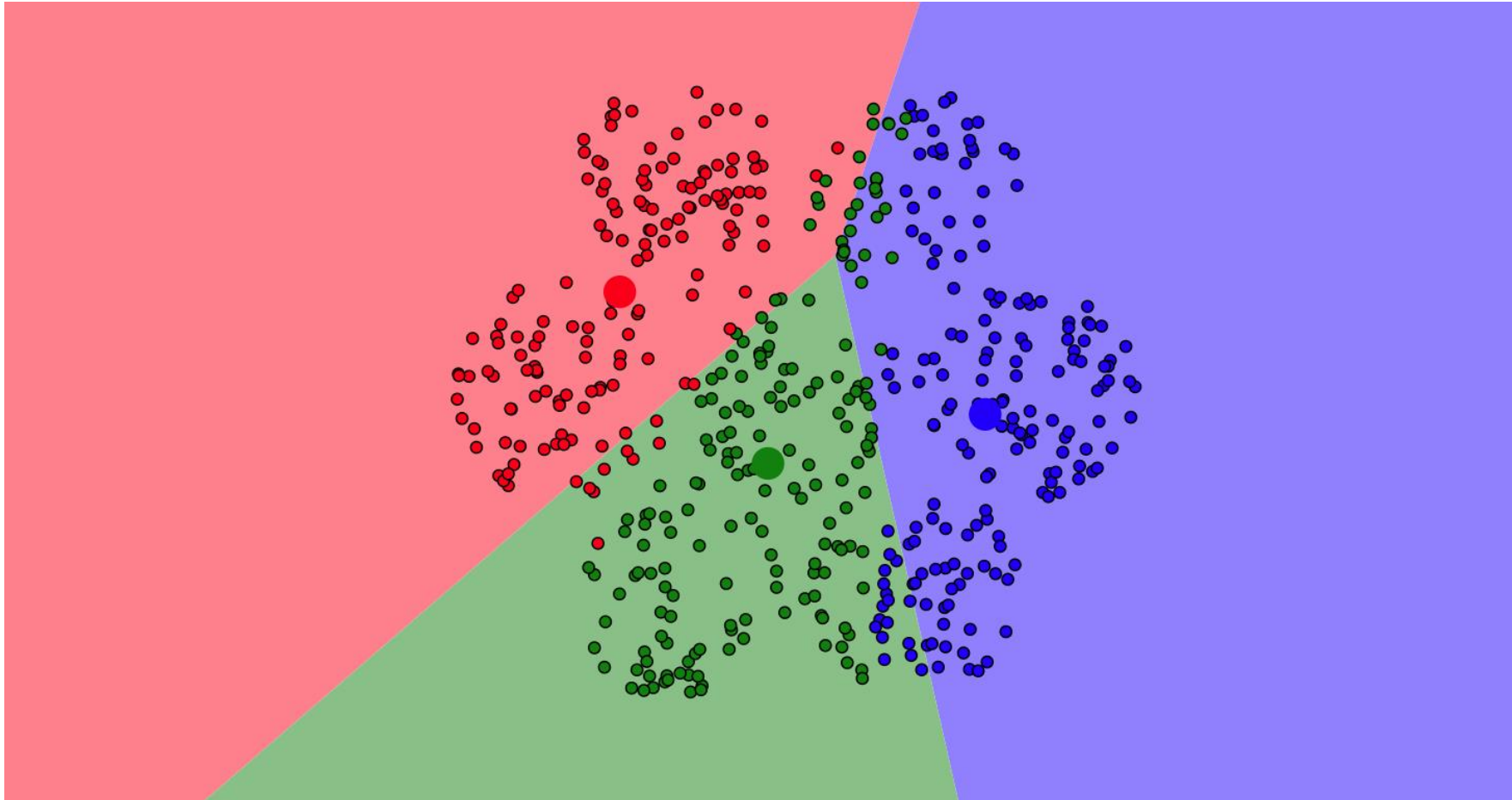
# Unsupervised learning

## K-means



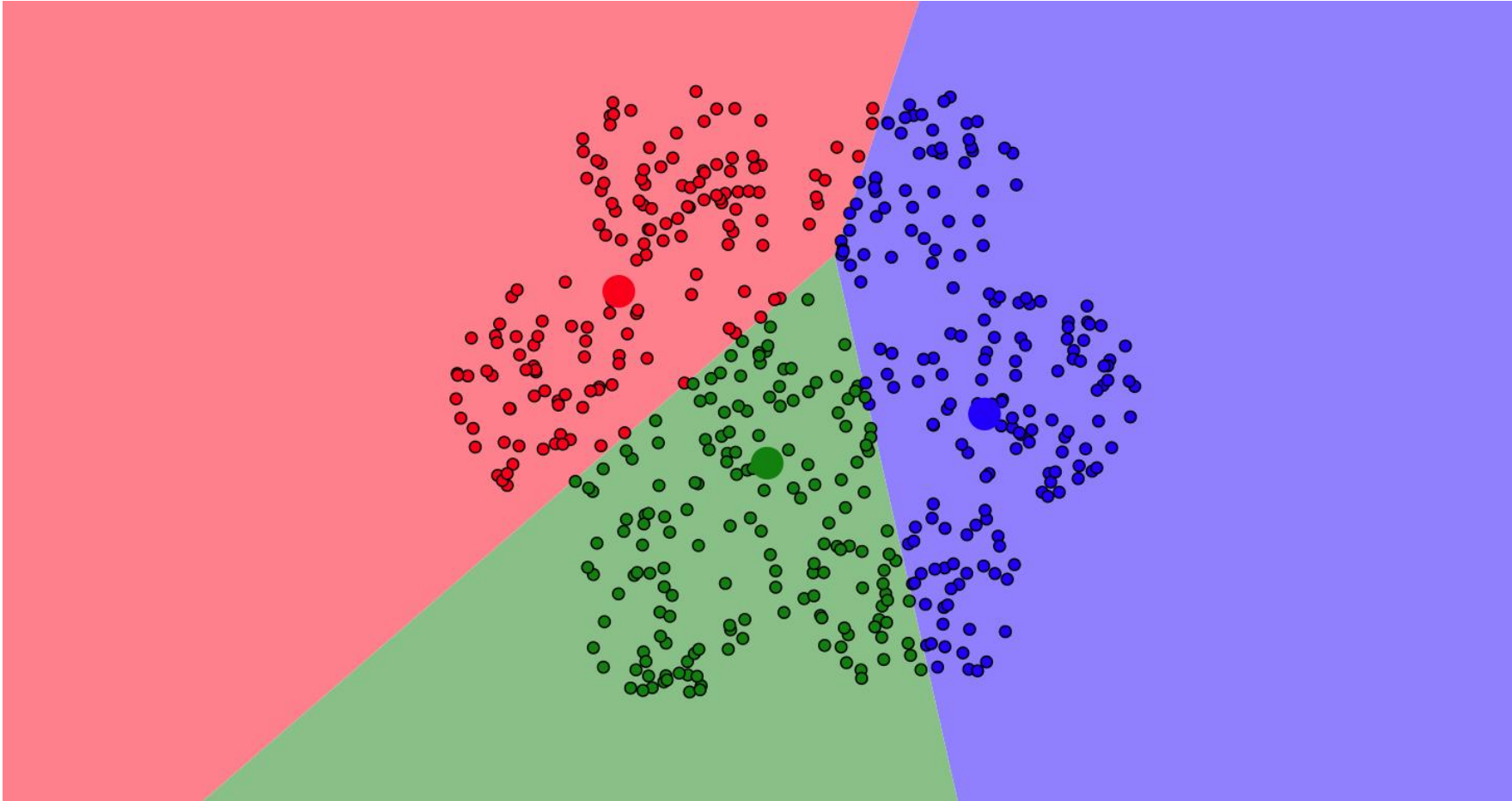
# Unsupervised learning

## K-means



# Unsupervised learning

## K-means



# Unsupervised learning

## K-means

