Guided Tour of Machine Learning in Finance

Week 3: Unsupervised Learning

K-means neural algorithm

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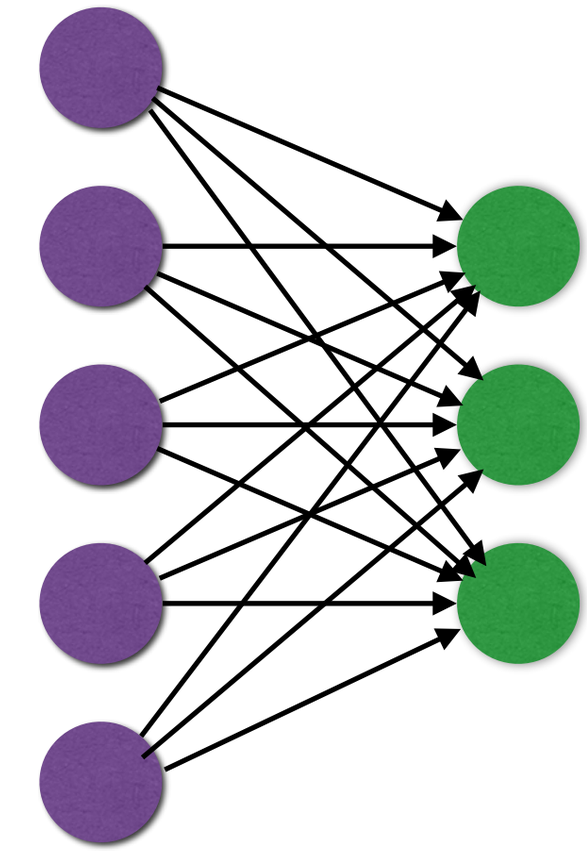
The K-means neural network

How to implement the K-means as a neural network:



Inputs Hidden nodes

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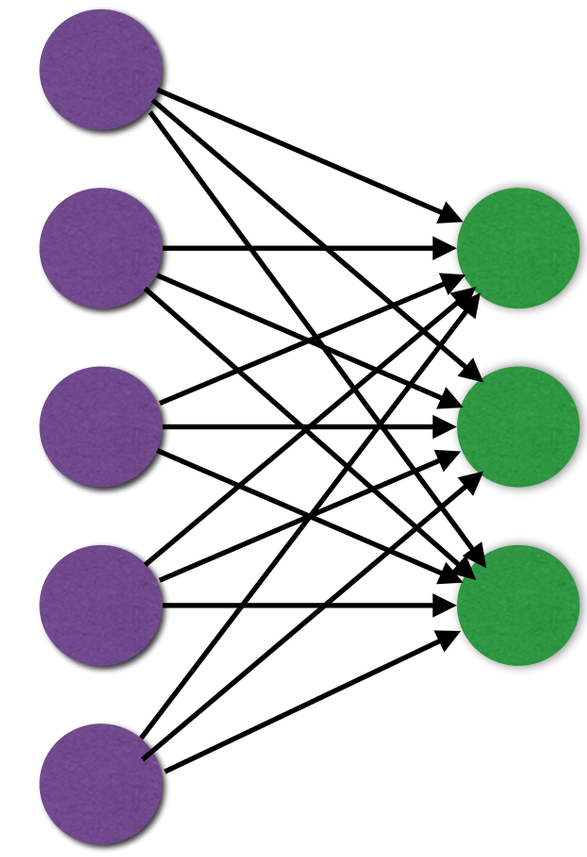
Given an input vector $\mathbf{x}^{(i)} = (x_1^{(i)},\ldots,x_N^{(i)})$, describe coordinates of K centroids relative to all component of $\mathbf{x}^{(i)}$via a matrix $\mathbf{W}$ of "weights" of size $K \times N$ with elements w_{kn}



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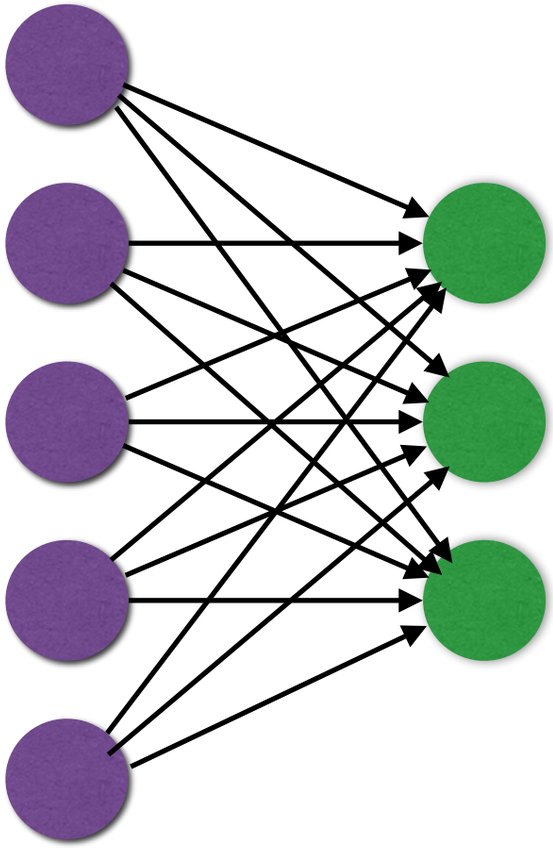

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Linear activation

Scalar product as a measure of similarity

$$h_k = \sum_n w_{kn} x_n = \mathbf{W}_\mathbf{k}^\mathbf{T} \cdot \mathbf{x}, \;\; k = 1,\ldots,K$$

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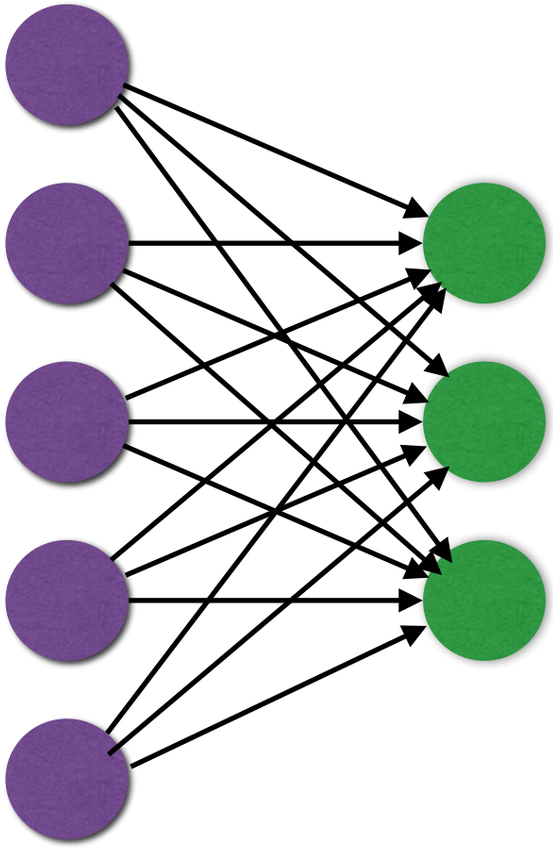

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- repeat for a number of epochs:
  - for each datapoint:
    - compute all activations
    - choose the winning neuron with a maximal activation h_k
    - update the weights only for the winner neuron $\Delta w_{kn} = \eta\left(x_n - w_{kn}\right)$

Control question

Select all correct answers

1. The K-means algorithm can be implemented either in a batch mode (in one pass for the whole data), or in a mini-batch or online mode.
2. The mini-batch or online version of the K-means algorithm can be implemented using a single-layer Neural Network with competing neurons.
3. The online version of ANY Machine Learning algorithm, including yet unknown algorithms, can be implemented using a Neural Network with neurons that both compete and cooperate.

Correct answer: 1, 2