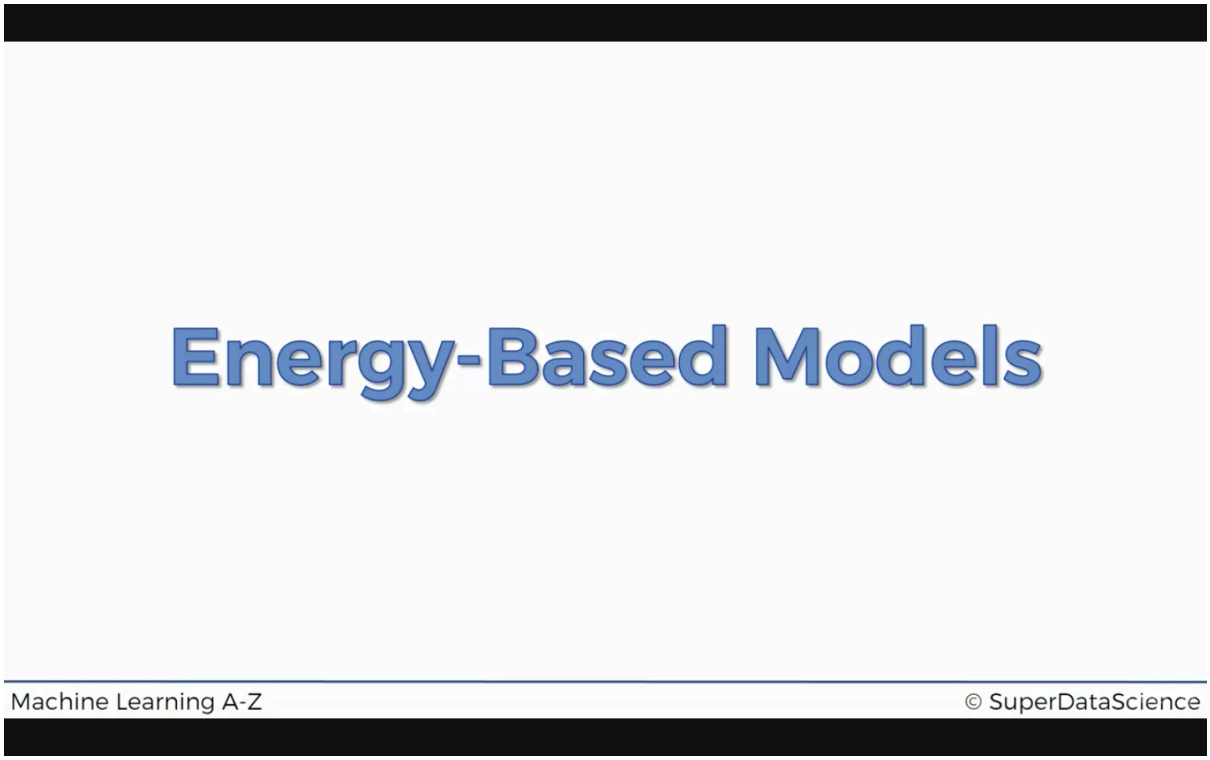
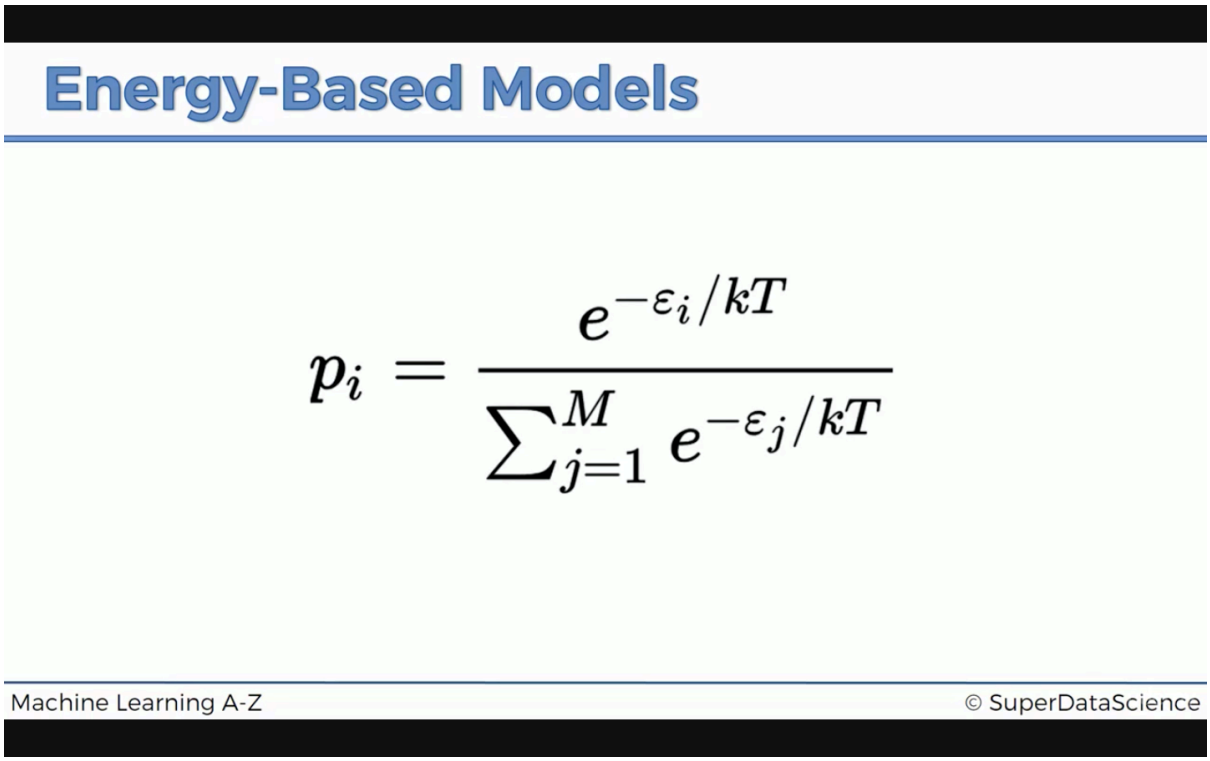
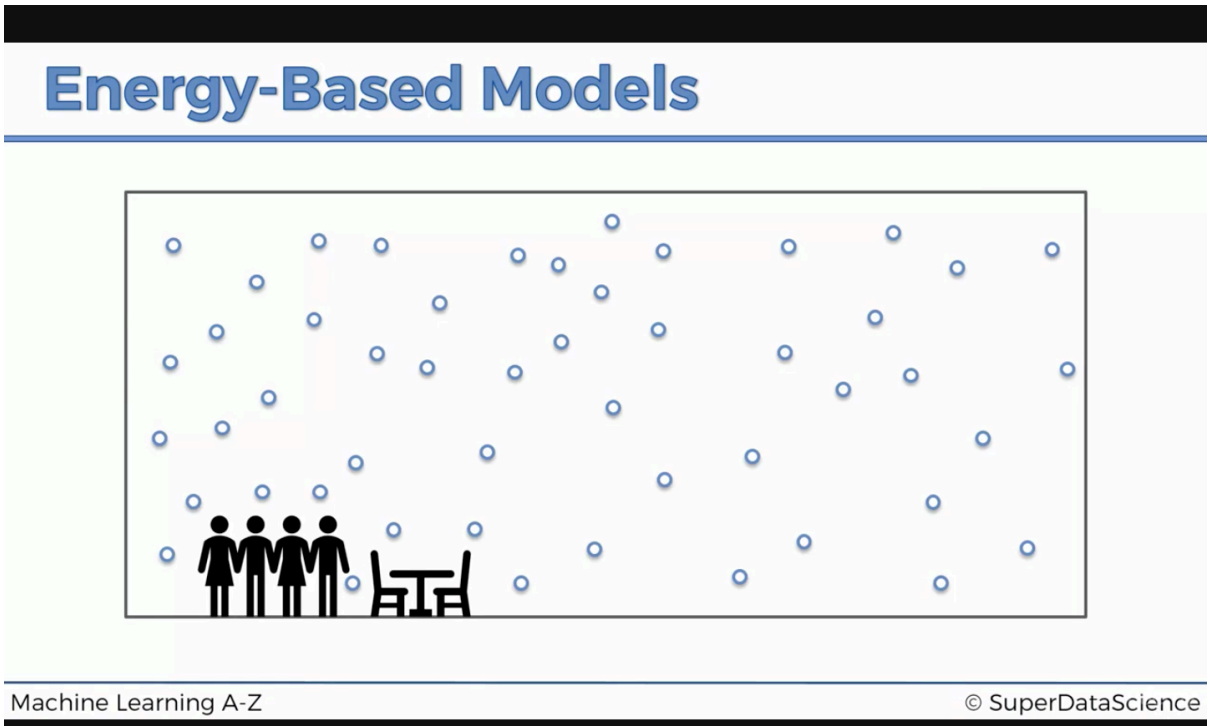
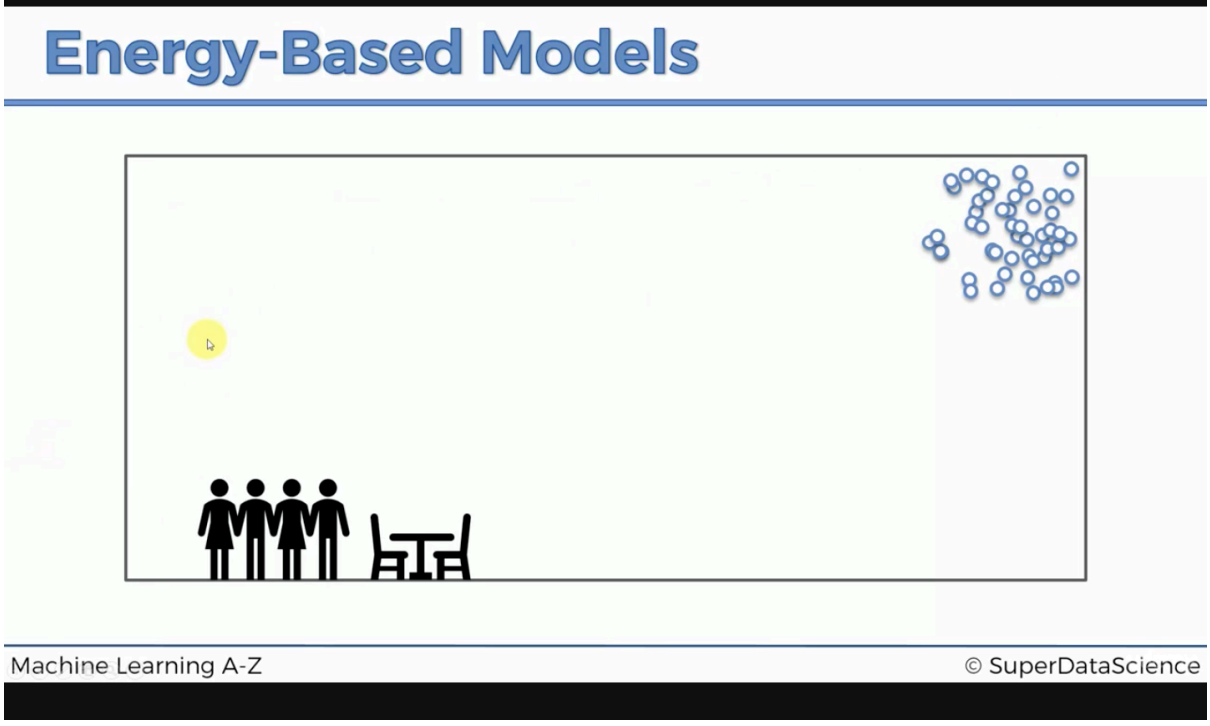




Boltzmann distribution. P is probability of a certain state of the system. i is the state. e is exponent. Epsilon is energy of that system. K is a constant. T is temperature of the system. Sum of all values of possible states in system. This is for a thermodynamic system (can be gas, molecule, etc.)

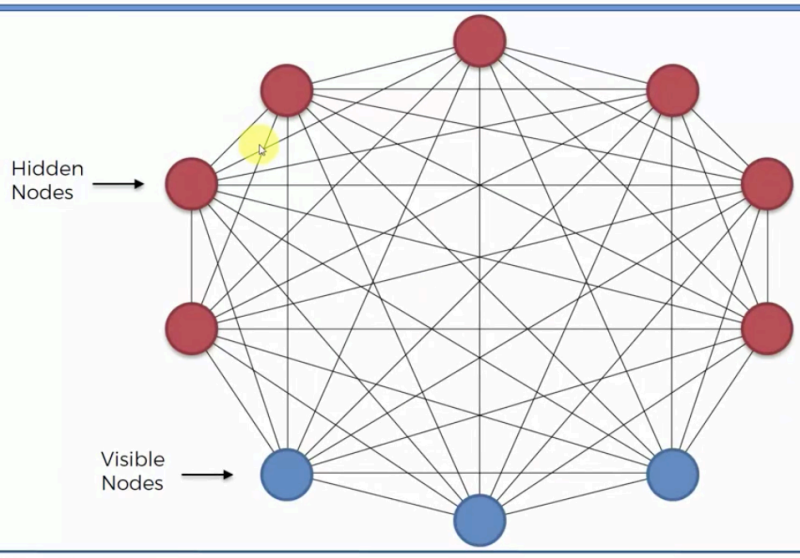




As we know, statistically it's possible that all of the gas go on a corner but based on the formula, because it has a high energy then the probability is tiny. The picture above this is the lowest energy possible so the probability is high.

Another example is when you drop an ink inside a water and it spread to whole water. Because that's the lowest energy for this system.
If you drop an oil in water, its shape will remain because it's the lowest energy for that system.

Boltzmann Machines



In Boltzmann machine, energy defines through the weights of the synapses. Once the weights are set, based on those weights, we try to find the lowest energy state for itself

Energy-Based Models

$$E(v,h) = -\sum_i a_i v_i - \sum_j b_j h_j - \sum_i \sum_j v_i w_{i,j} h_j$$

Energy function for a restricted Boltzmann machine. a and b are biases in the system. v is constant which is a visible node that we are calculating. h is the hidden node that we are calculating. w is the weight between visible node and hidden node.

Energy-Based Models

$$E(v,h) = -\sum_i a_i v_i - \sum_j b_j h_j - \sum_i \sum_j v_i w_{i,j} h_j$$

$$P(v,h) = \frac{1}{Z} e^{-E(v,h)}$$

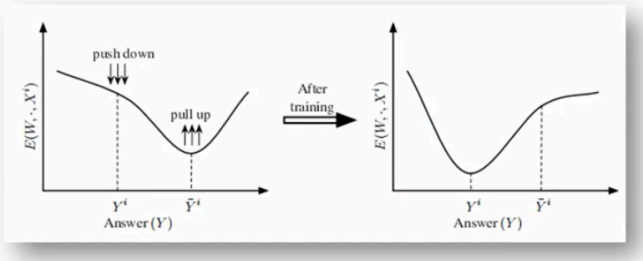
The probability of being in a certain state. E is energy. Z is the sum of all values (next to it) for all possible states.

Energy-Based Models

Additional Reading:

A Tutorial on Energy-Based Learning

By Yann LeCun et al. (2006)



Link:

http://yann.lecun.com/exdb/publis/pdf/lecun-06.pdf

Energy-Based Models

Additional Reading:

Mr. Nobody (film)

By Jaco Van Dormael (2009)

Link:

http://www.imdb.com/title/tt0485947/