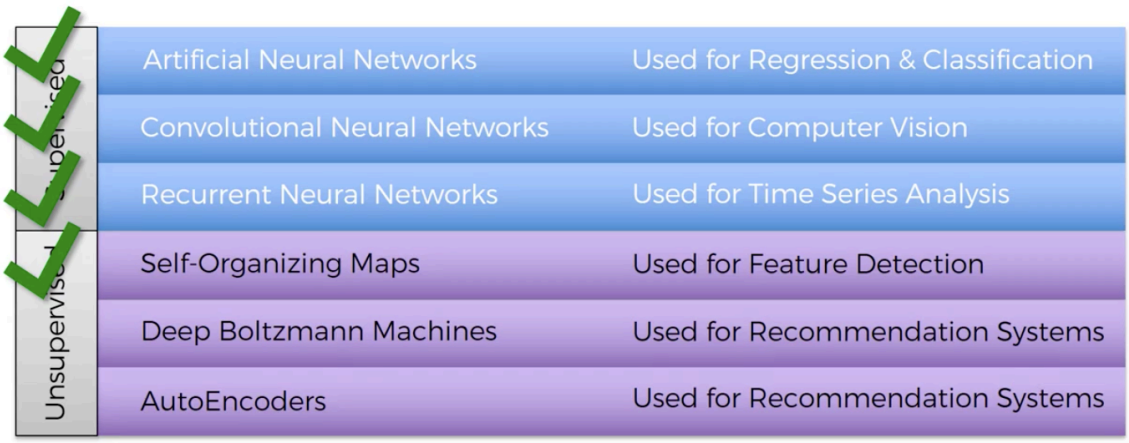
# Boltzmann Machines



## Boltzmann Machines



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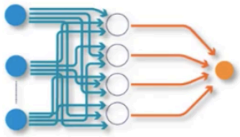



ANN

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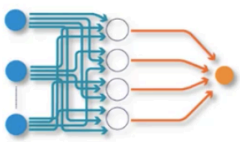

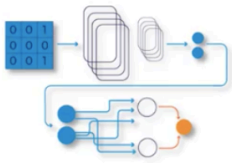



CNN

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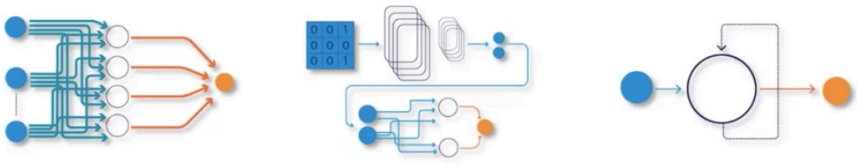



RNN

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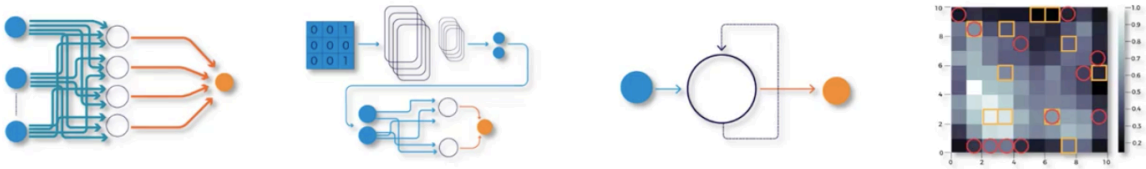



SOM

If you notice all of these four are directed model (even SOM) which there is direction that model operate. Like the arrows or the data that goes to a node in map

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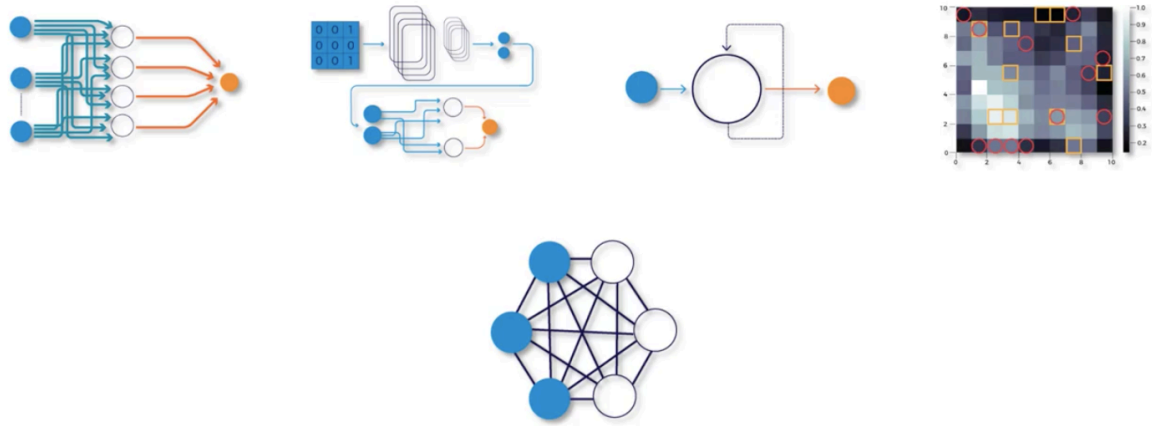



Boltzmann machines are undirected models, So they are both ways.

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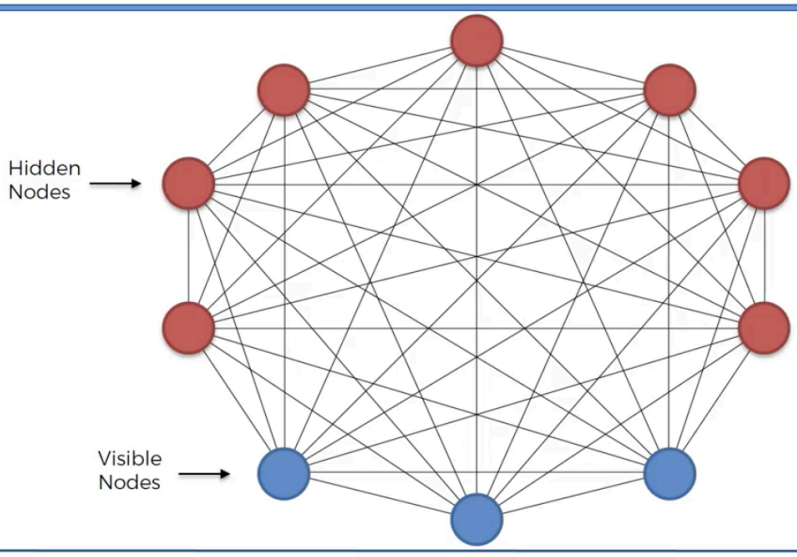
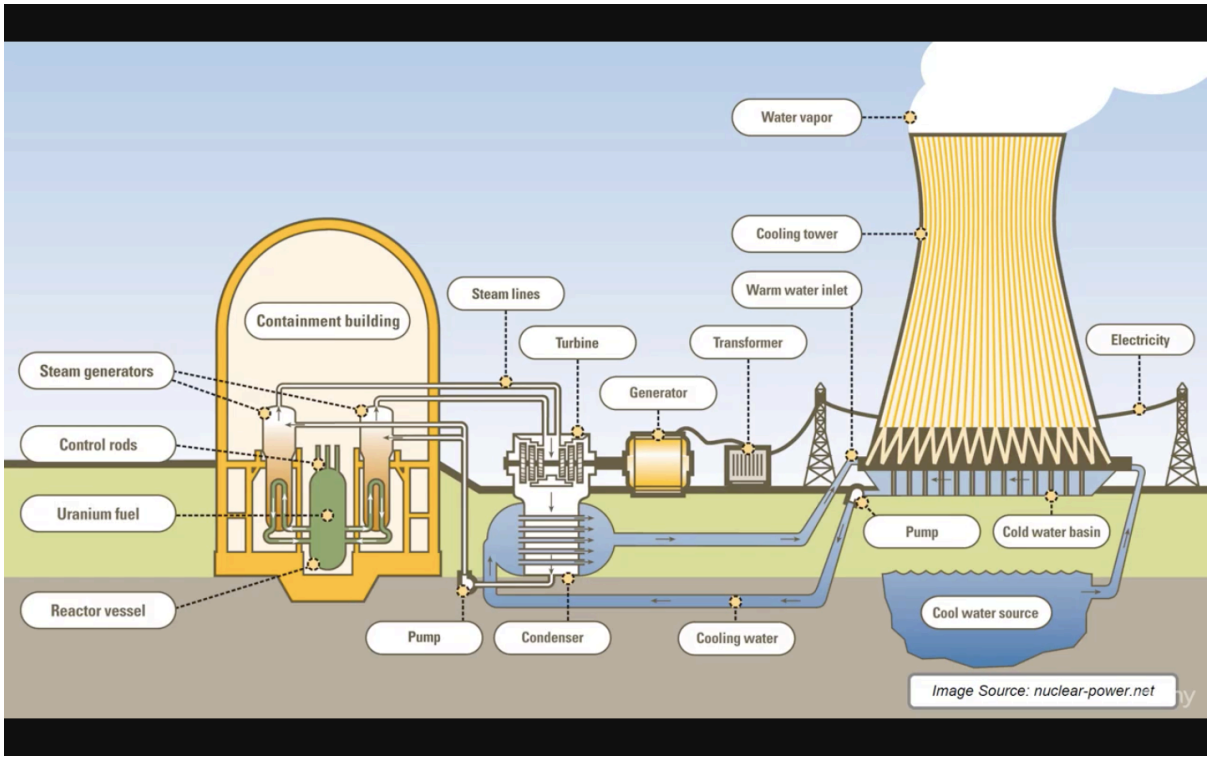




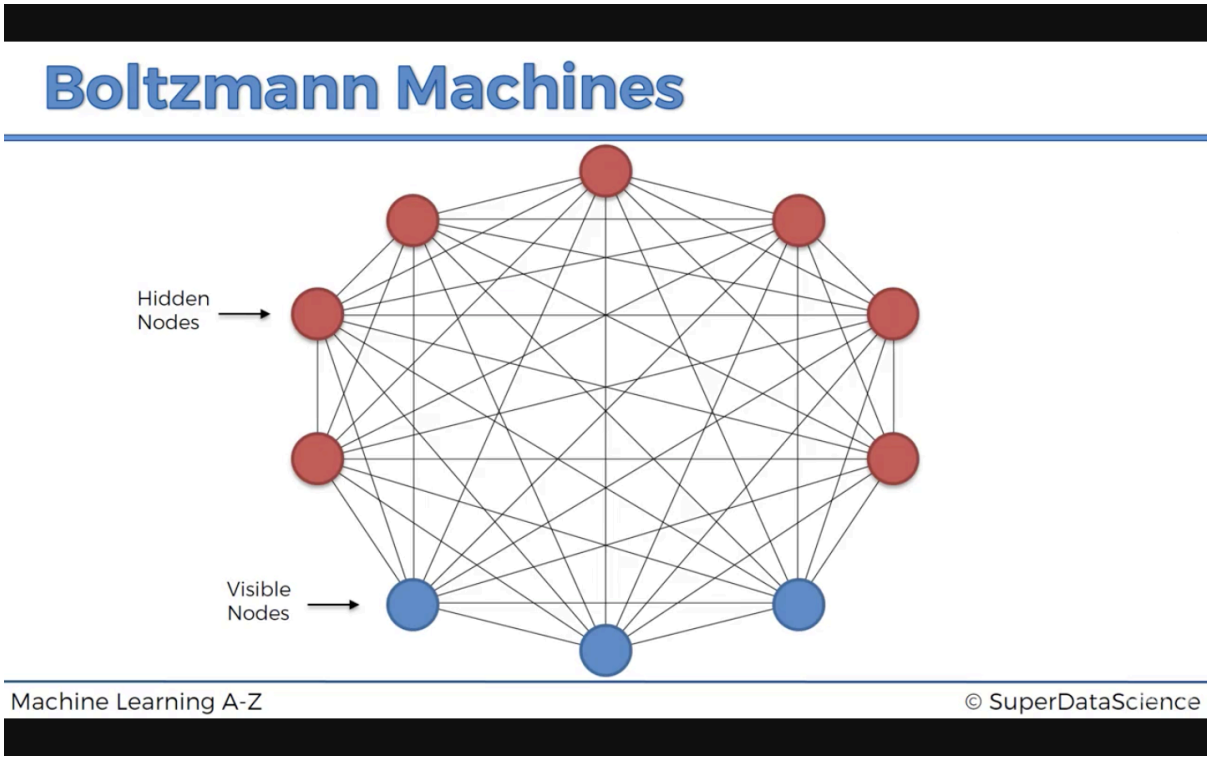

If you notice: 1. there is no output layer in this model 2. everything is connected to each other 3. There is no direction or in other word they are bi-directional

Question: Where do we start in Boltzmann machines?

Look at the visible nodes, all of them are connected to each other. You might say why is that, don't the inputs are fixed. Well Boltzmann machines are fundamentally different to all algorithms and for them, they don't just expect input data. What they do is they generate data and information regardless of whether it's input node or a hidden node. For Boltzmann machine all of these nodes are the same.




For better understanding imagine a nuclear power. In here most of engineers consider things like pressure in container building, Turbines function, pumps pressure but they usually don't consider everything, they only consider things that are more important. For example, they don't consider the dryness of ground in different areas of nuclear power, different temperature in different high of nuclear towel, and so on. The important thing to notice is that all of these features are contain to the system and have some effect. That's what Boltzmann machine does. It considers the whole system. So:
Visible nodes are thing we can and do measure, hidden nodes are things we can't or don't measure.




The Boltzmann machine is capable of generating all the values or nodes on its own, it doesn't need any input. In the case of nuclear power, it generates different state of system. For example, imagine the blue node (features engineers consider) and red nodes (features engineers don't consider). And it looks at the state where temperature is a certain temperature, the speed of wind is a certain speed of wind, etc. and then it looks at different state, it says what if the temperature is a little higher, wind is a little faster and so. And it keeps generating different states.

Note: this is not a deterministic deep learning model, it's stochastic learning model or generative deep learning model.

In our case, we feed our training into Boltzmann machine as inputs to help it adjust the weights of this system accordingly so it resembles our system. it looks at possible connection between all these parameters and how do they influence each other.  in case of our nuclear power it will reveal all of the abnormal models that led to nuclear power meltdown and gives the best system.

The reason, we don't have an output is because we aren't outputting any value in here. We are creating a model that describes our system

Note: we both visible and hidden nodes are the same for the Boltzmann machine, it' sonly different for humans.