**Bayesian Network**

In a Bayesian network, the graph represents the conditional dependencies of different variables in the model. Each node represents a variable, and each directed edge represents a conditional relationship. Essentially, the graphical model is a visualization of the chain rule.

**Neural Network**

In a neural network, each node is a simulated "neuron". The neuron is essentially on or off, and its activation is determined by a linear combination of the values of each output in the preceding "layer" of the network.

**Decision Tree**

Let's say we are using a decision tree for classification. The tree essentially provides us with a flowchart describing how we should classify an observation. We start at the root of the tree, and the leaf where we end up determines the classification we predict.

On the outset, Bayesian networks and artificial neural networks look similar - and they are. Both are directional graphs, and take in a set of inputs, "do math", and allow us to predict outputs.  
  
However, the primary difference is that Bayesian networks have intrinsic meaning behind the structure, whereas artificial neural networks do not.  
  
**Bayesian networks** map the relationship between events in terms of probability. It shows how the occurrence of certain events influence the probability of other events occurring. Here is a simple Bayesian network from Wikipedia:

Each event has a probability of occurring/not occurring, and also the probability of it occurring *given* other events occurring/not occurring. This kind of diagram is very useful when we have inter-dependent events, and want to model outcomes and make decisions. For instance, medical diagnoses and spam filters utilize Bayesian networks.   
  
Whereas in a Bayesian model, each node represents an event, and edges infer probabilities, nodes and edges in **artificial neural networks** don't really mean anything individually. Rather, it simply takes in inputs and runs it through a series of sums and functions to determine an output. If you were to look at the individual nodes and weights, you couldn't discern much from them. Interestingly, though, when you create a network of "meaningless" nodes, you can solve some pretty amazing problems.  
  
Also, Bayesian networks are used from inference to prediction to modeling, whereas neural networks are used exclusively to predict.  
There are also clear implementation differences between the two. You might find this website very useful in explaining how a neural network works more in detail:  
[Neural networks and deep learning](http://neuralnetworksanddeeplearning.com/chap1.html)

[**https://www.quora.com/What-is-the-difference-between-a-Bayesian-network-and-an-artificial-neural-network**](https://www.quora.com/What-is-the-difference-between-a-Bayesian-network-and-an-artificial-neural-network)

[**http://fabj.tistory.com/18**](http://fabj.tistory.com/18)

**Classification** is the process of categorizing a group of basic objects on the basis of some data features that describe them. There are lots of classifiers at present :

* Bayesian networks
* Logistic Regression
* Support Vector Machines
* Neural Networks and so on...

**Neural Networks** are a computational approach which is based on a large collection of neural units loosely modeling the way a biological brain solves problems with large clusters of biological neurons connected by axons. Neural nets are highly structured networks bases, and have three kinds of layers - an input, an output, and so called hidden layers, which refer to any layers between the input and the output layers. Each node (also called a neuron) in the hidden and output layers has a classifier.

**Bayesian networks**, is a probabilistic directed acyclic graphical model, a probabilistic graphical model (a type of statistical model) that represents a set of random variables and their conditional dependencies via a directed acyclic graph. For example, a Bayesian network could represent the probabilistic relationships between diseases and symptoms. Given symptoms, the network can be used to compute the probabilities of the presence of various diseases.

**Similarities**

* Both use directed graphs.
* Both are used as classifier algorithms.

**Differences**

* In Bayesian networks the visual representation of graph that is vertices and edges have meaning- The network structure itself gives you valuable information about conditional dependence between the variables. With Neural Networks the network structure does not tell you anything.
* Bayesian networks represent independence (and dependence) relationships between variables. Thus, the links represent conditional relationships in the probabilistic sense. Neural networks, generally speaking, have no such direct interpretation, and in fact the intermediate nodes of most neural networks are discovered features, instead of having any predicate associated with them in their own right.
* Bayesian networks are generally simpler in comparison to Neural networks, with many decisions about hidden layers, and topology and variants.

A potential reason to pick artificial neural networks (ANN) over Bayesian networks is the possibility you mentioned: correlations between input variables. Bayesian networks like Naive bayes assumes that all input variables are independent. If that assumption is not correct, then it can impact the accuracy of the Naive Bayes classifier. An ANN with appropriate network structure can handle the correlation/dependence between input variables.