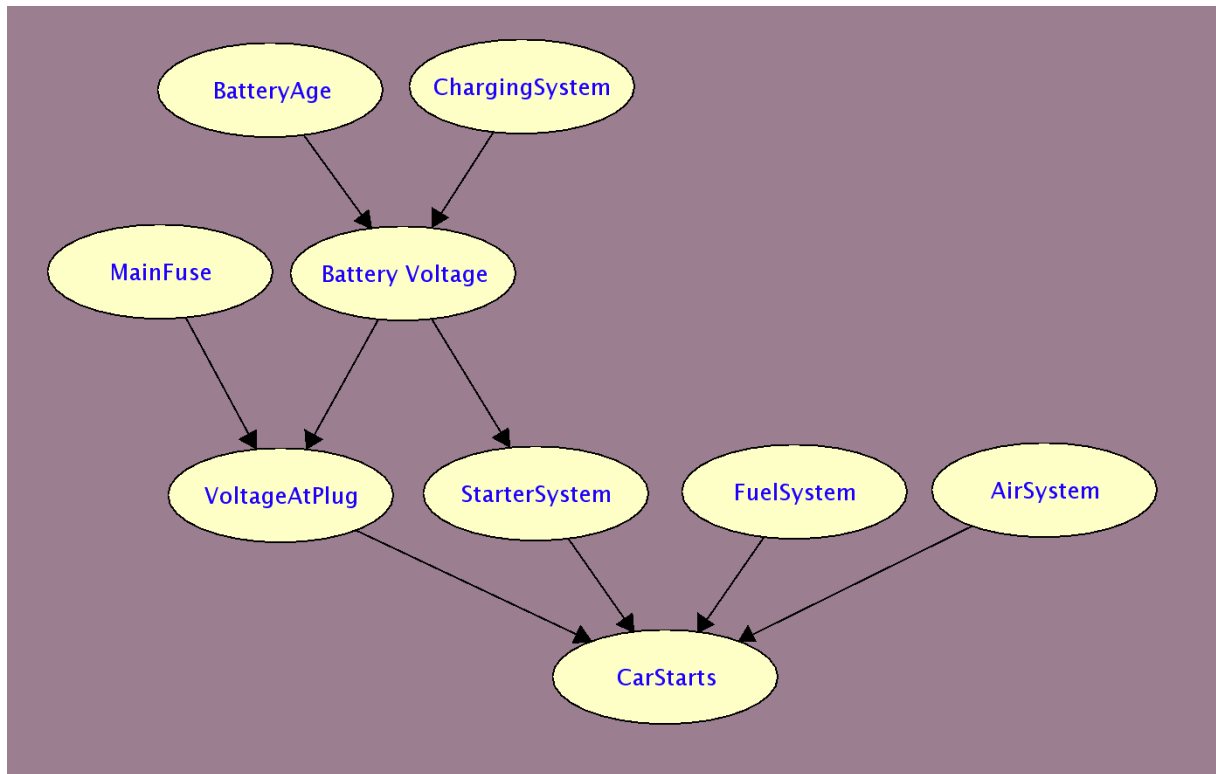# Assignment 4: Bayesian Networks

Description of the domain: The Bayesian Network that I have created models the functioning of the car. It models the different systems inside of the car that contributes to the start of the engine. Every layer of the model affects the next layer's node probability that it is connected to.

In the first layer, we have battery age that is connected to battery voltage since battery age affects the quality of the voltage that battery will give. We also have charging system and it is connected to battery voltage since how much we charge will also affect the battery voltage.

In the second layer, I used variables such as main fuse (affects voltage at plug) and battery voltage (affects voltage at plug and starter system). In the third layer voltage at plug, starter system, fuel system and air system are used as evidence to see whether car will start or not.

Last of all, in the fourth layer we have the last variable "car starts" to see the final result depending on the other evidences in the earlier layers.
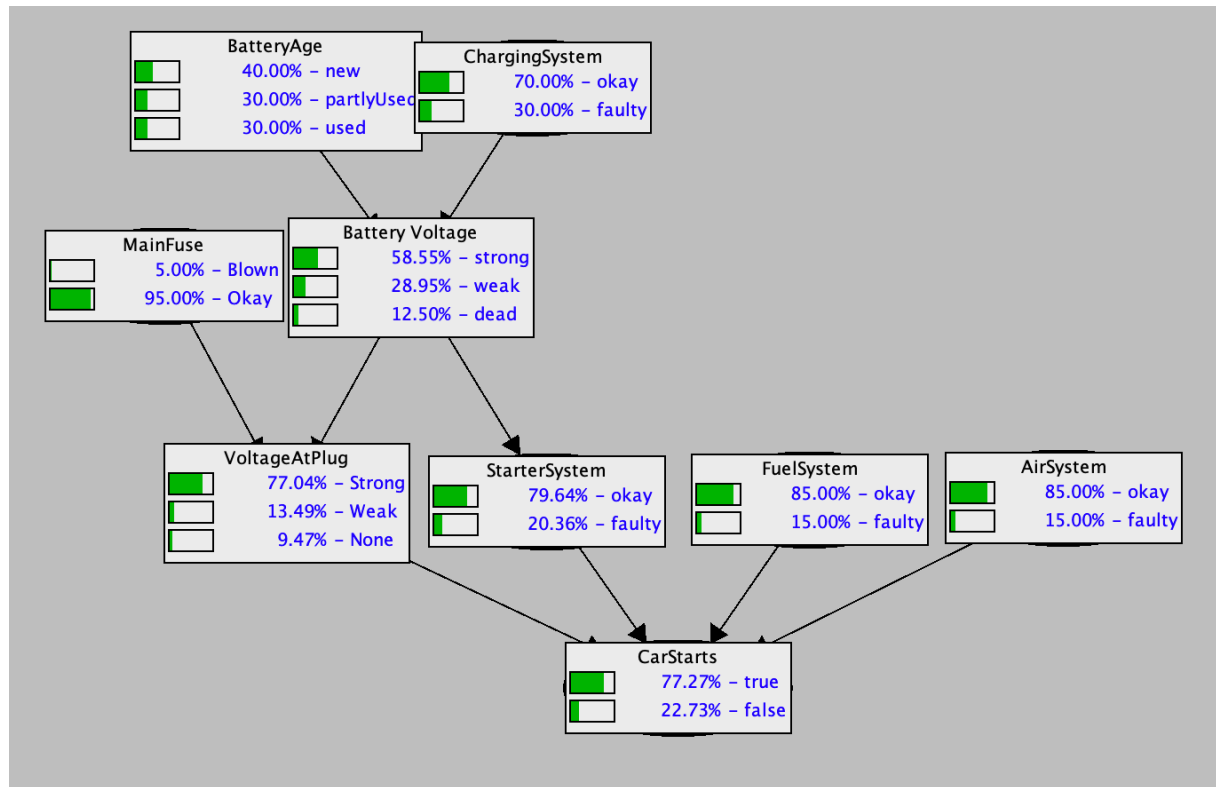
Variables and their types are given like this in the model that I have created:
- Battery Age (new, partly used, used)
- Charging System (okay, faulty)
- Main Fuse (blown, okay)
- Battery Voltage (strong, weak, dead)
- Voltage at Plug (strong, weak, none)
- Starter System (okay, faulty)
- Fuel System (okay, faulty)
- Air System (okay, faulty)
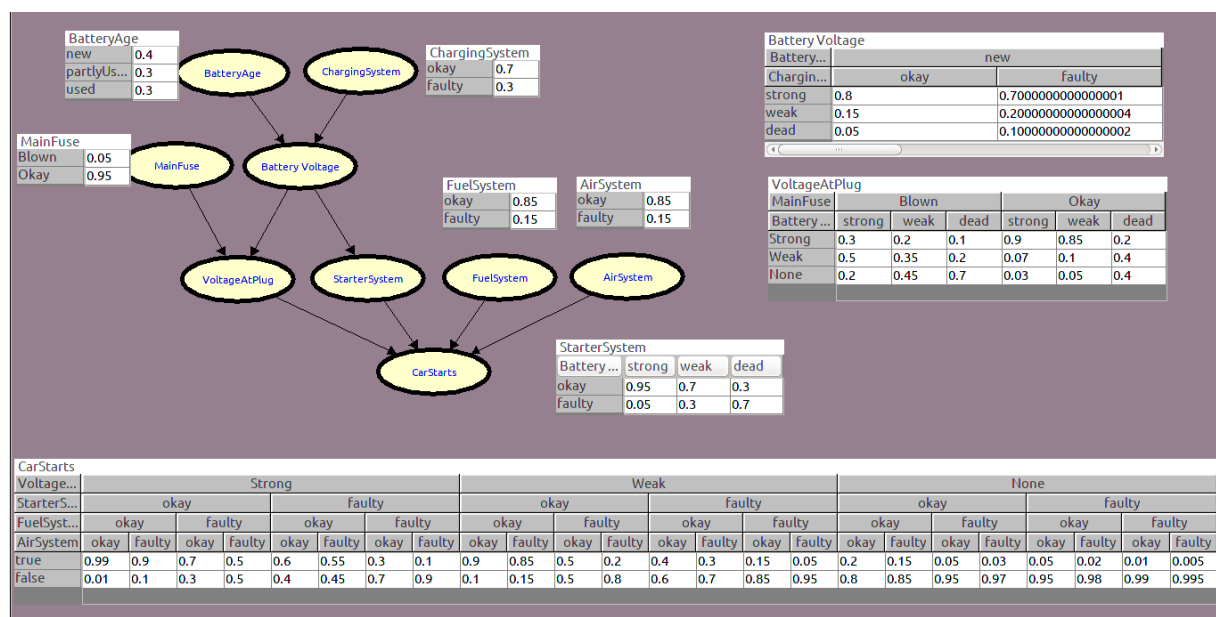- Car Starts (true, false)

Variable Types:

- Evidence variables (fuel system, air system, charging system, battery age, main fuse)
- Query variable (car starts)
- Intermediary variables/neither (battery voltage, voltage at plug, starter system)
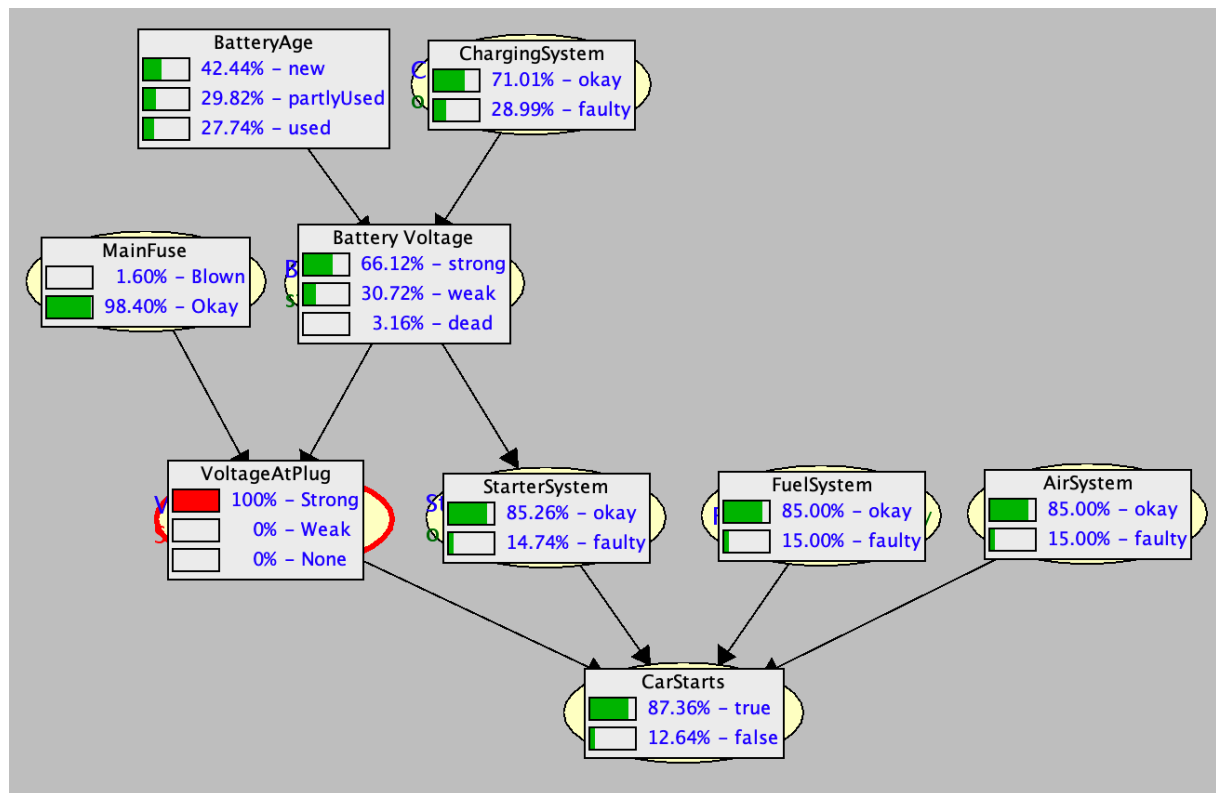
Probabilities for each Variable:

BatteryAge
40.00% – new
30.00% – partlyUsed
30.00% – used

ChargingSystem
70.00% – okay
30.00% – faulty

MainFuse
5.00% – Blown
95.00% – Okay

Battery Voltage
58.55% – strong
28.95% – weak
12.50% – dead

VoltageAtPlug
77.04% – Strong
13.49% – Weak
9.47% – None

StarterSystem
79.64% – okay
20.36% – faulty

FuelSystem
85.00% – okay
15.00% – faulty

AirSystem
85.00% – okay
15.00% – faulty

CarStarts
77.27% – true
22.73% – false

CPT Tables:

BatteryAge

new	0.4
partlyUs...	0.3
used	0.3

ChargingSystem

okay	0.7
faulty	0.3

MainFuse

Blown	0.05
Okay	0.95

FuelSystem

okay	0.85
faulty	0.15

AirSystem

okay	0.85
faulty	0.15

Battery Voltage

Battery...	new	
Chargin...	okay	faulty
strong	0.8	0.7000000000000001
weak	0.15	0.20000000000000004
dead	0.05	0.10000000000000002

VoltageAtPlug

MainFuse	Blown			Okay		
Battery...	strong	weak	dead	strong	weak	dead
Strong	0.3	0.2	0.1	0.9	0.85	0.2
Weak	0.5	0.35	0.2	0.07	0.1	0.4
None	0.2	0.45	0.7	0.03	0.05	0.4

StarterSystem

Battery...	strong	weak	dead
okay	0.95	0.7	0.3
faulty	0.05	0.3	0.7

CarStarts

| Voltage...	Strong								Weak								None							
StarterS...	okay				faulty				okay				faulty				okay				faulty			
FuelSyst...	okay		faulty		okay		faulty		okay		faulty		okay		faulty		okay		faulty		okay		faulty	
AirSystem	okay	faulty	okay	faulty	okay	faulty	okay	faulty	okay	faulty	okay	faulty	okay	faulty	okay	faulty	okay	faulty	okay	faulty	okay	faulty	okay	faulty
true	0.99	0.9	0.7	0.5	0.6	0.55	0.3	0.1	0.9	0.85	0.5	0.2	0.4	0.3	0.15	0.05	0.2	0.15	0.05	0.03	0.05	0.02	0.01	0.005
false	0.01	0.1	0.3	0.5	0.4	0.45	0.7	0.9	0.1	0.15	0.5	0.8	0.6	0.7	0.85	0.95	0.8	0.85	0.95	0.97	0.95	0.98	0.99	0.995

Test Cases:

Case 1:

If we know that voltage at plug is strong, then we also need to check it's evidences in order to show the 'explaining away' phenomenon. After knowing that voltage at plug is strong, lets say that we checked if main fuse is blown or okay.
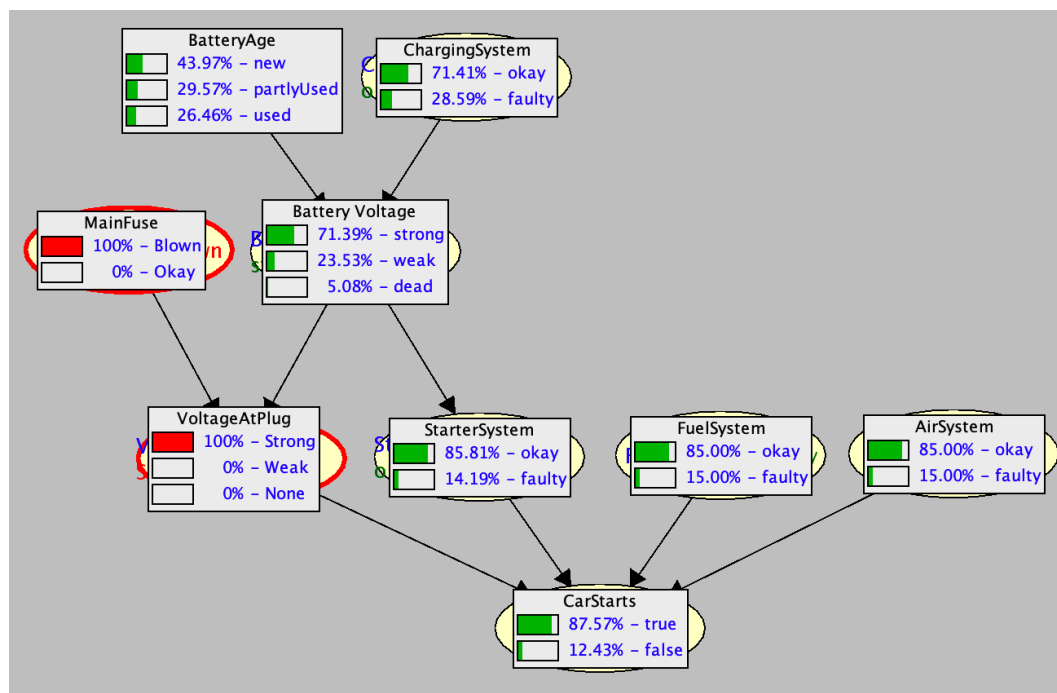
Then we saw that main fuse is blown. This event would increase our belief about battery voltage being strong since we can't really explain strong voltage at plug by main fuse being okay. We can explain this event with 'explaining away' phenomena since probability explained away in this situation. In this example, battery voltage is increased from 66.12% to 71.39% after learning that main fuse is blown.

Case 2:
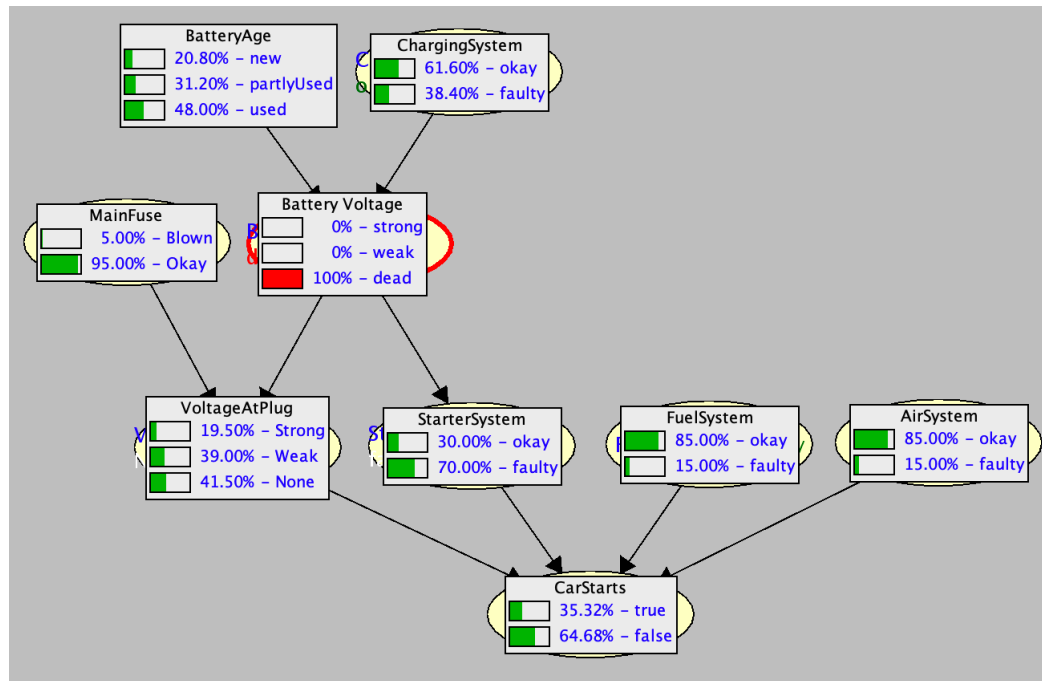
In this case we know that our battery voltage is dead. So let's say that we decided to check if there is something wrong with the charging system.
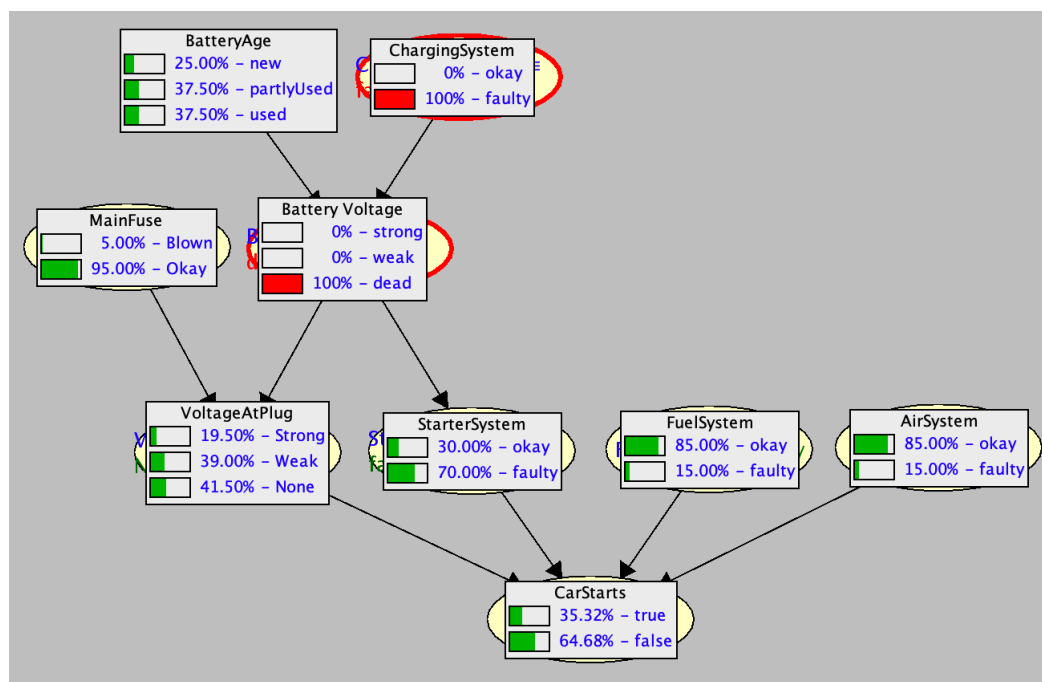
Then we saw that charging system is faulty although our initial belief about the charging system was different. After seeing that charging system is faulty, our initial belief about the battery age is changed. It increased our belief of battery age that it is new or partly used. Again our battery voltage being dead is 'explained away' by battery age being new or partly used.

Case 3:
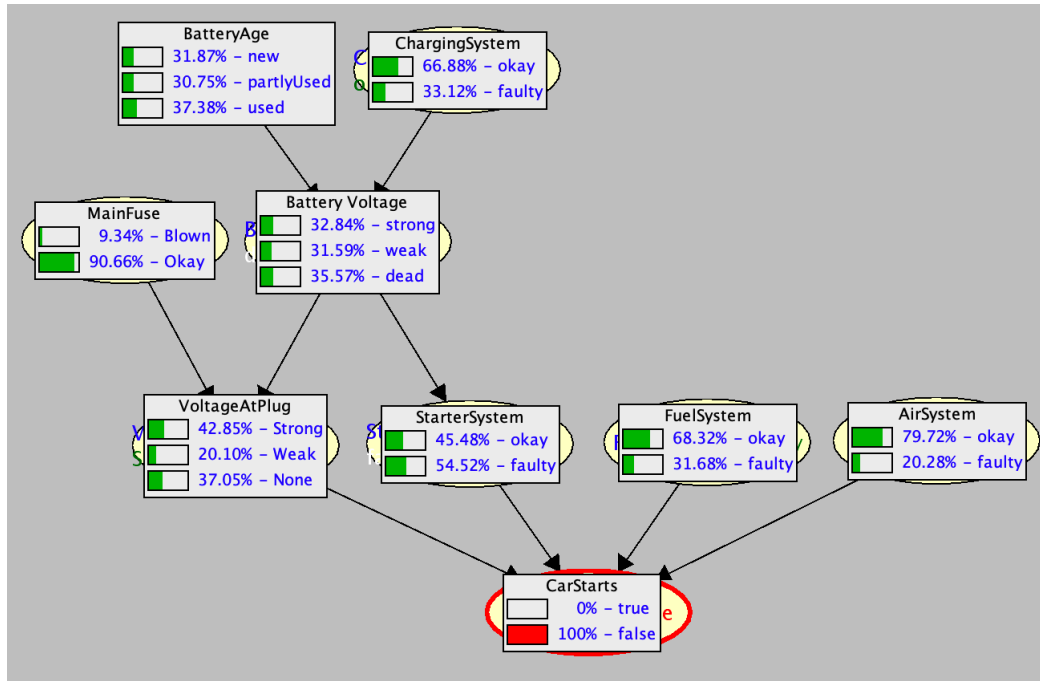
In the last case we know that car does not start.
Also checked the air system and voltage at plug and saw that both of them is fine and working properly.
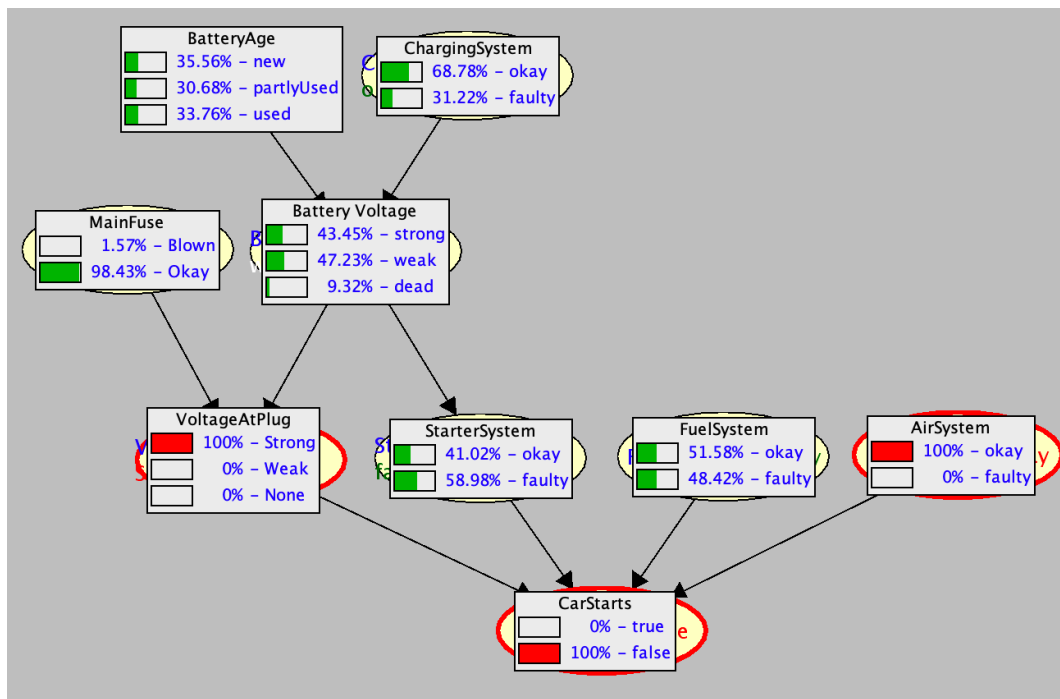
So our belief about the system having fault 'explained away' to starter system and fuel system.