

CS 514 – Applied Artificial Intelligence  
Project 3  
University of Illinois at Chicago  
Fall 2017

Project Title:

Bayesian Network for Road Accident Assessment using Netica

Domain:

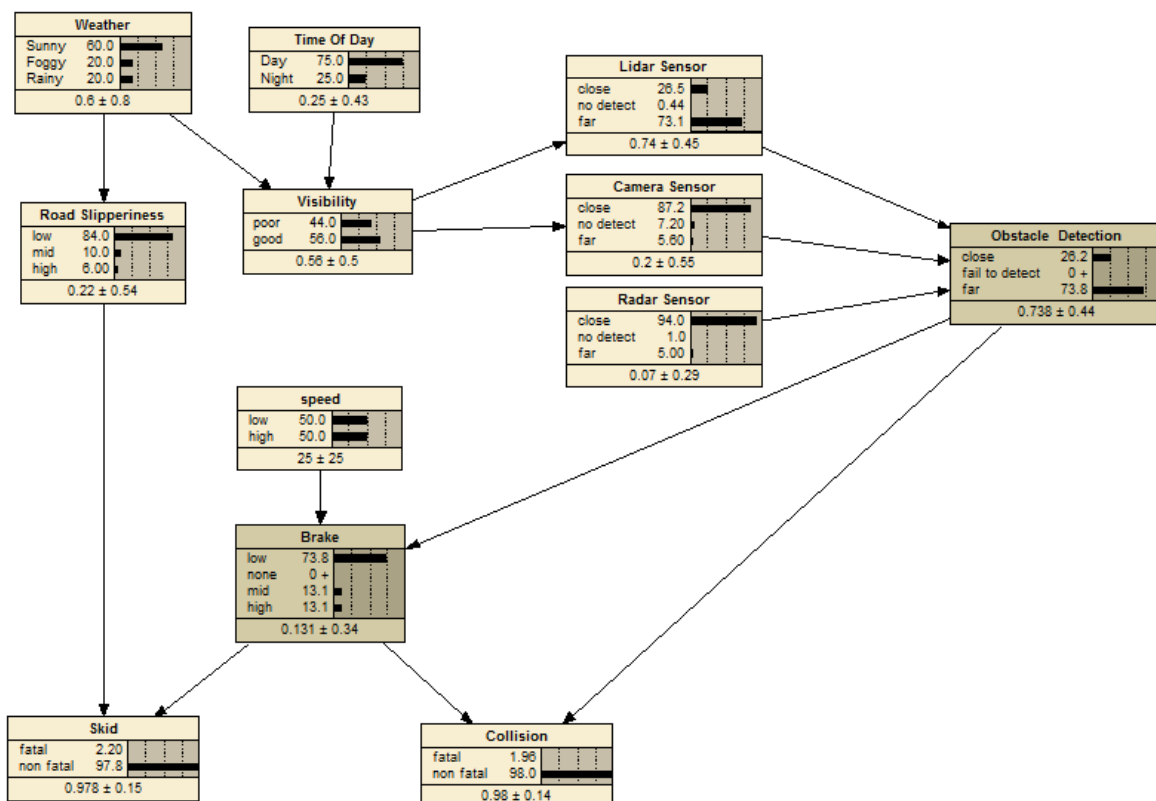
Autonomous Driving

Nickname:

Skynet

Network Structure

The network consists of 12 nodes explaining the cause and effect in vehicle accident scenarios. Here's how the Bayesian network looks like.



### Network/ Nodes Description

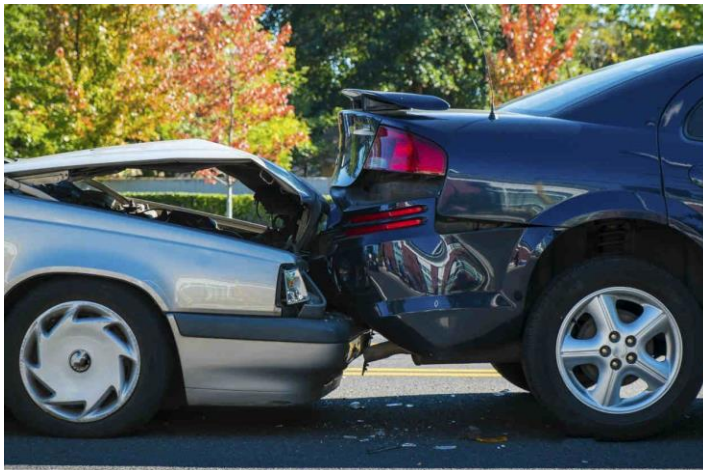
The Bayes net does the impact assessment of 2 possible types of accidents

1. Skidding
2. Collision

Skidding is the locking of wheel while braking too hard on a slippery road.



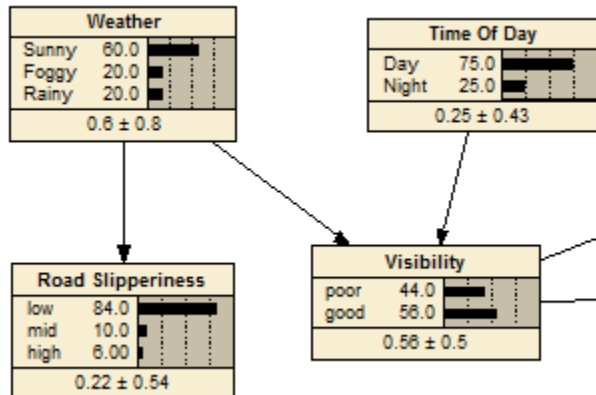
Collision is the violent crash between two moving vehicles due to speeding and not maintaining a gap between vehicles in a lane.



Collision is dependent on brake amount and distance between vehicles while skid depends on brake and slipperiness.

The network models the causes of a vehicle accident. The dependency graph starts from weather and time of the day which impact the visibility. Also, road slipperiness is dependent on weather condition. (high when rainy).

Following fragment of Bayes net shows this dependency

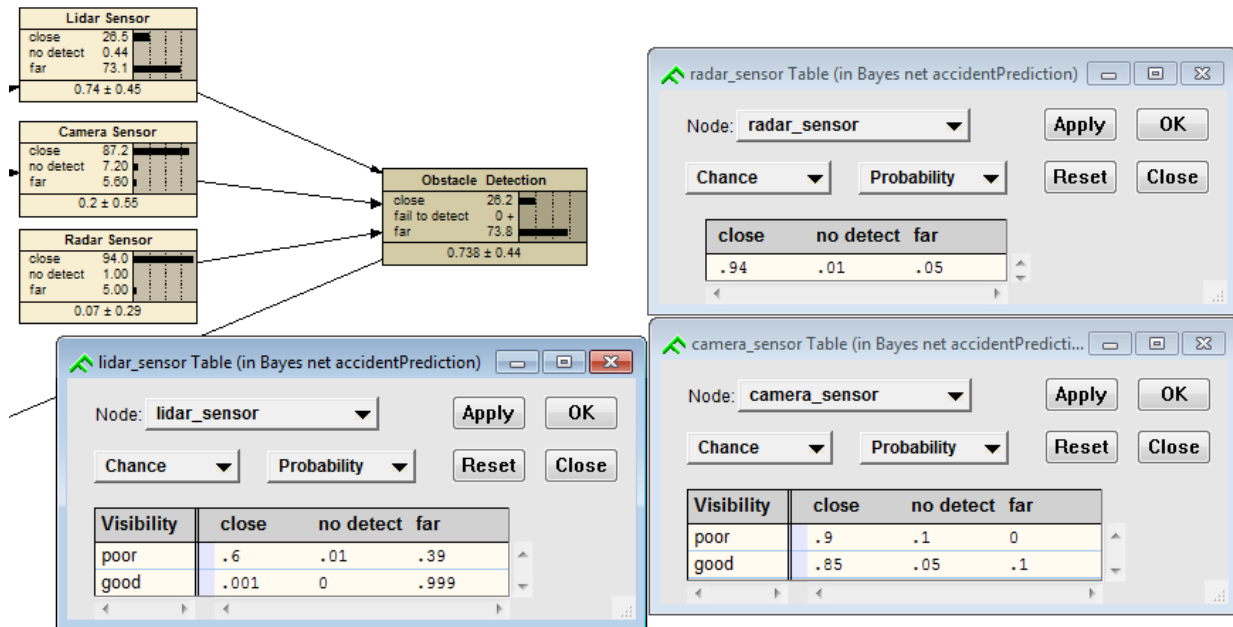


The detection of obstacle is done with 3 types of sensors as described below.

### Sensor Types

1. LIDAR: It is a surveying technology that measures distance by illuminating a target with a laser light. It's performance is seen to degrade in poor visibility conditions. It has high range among all the sensors, hence can detect obstacle while it's still far.
2. Camera Sensor: It is passive visual system which uses sophisticated object detection algorithms to detect obstacles. It is good in detecting closer obstacles. It's performance also degrades with visibility conditions.
3. RADAR: It uses radio waves to determine the presence of obstacle, hence, are independent of visibility condition. It is the only sensor which performs equally in all weather conditions.

Here's how the probabilities are defined for these sensors. Note that radar sensors are not conditioned on visibility while Lidar and camera sensors are.



## Obstacle Detection

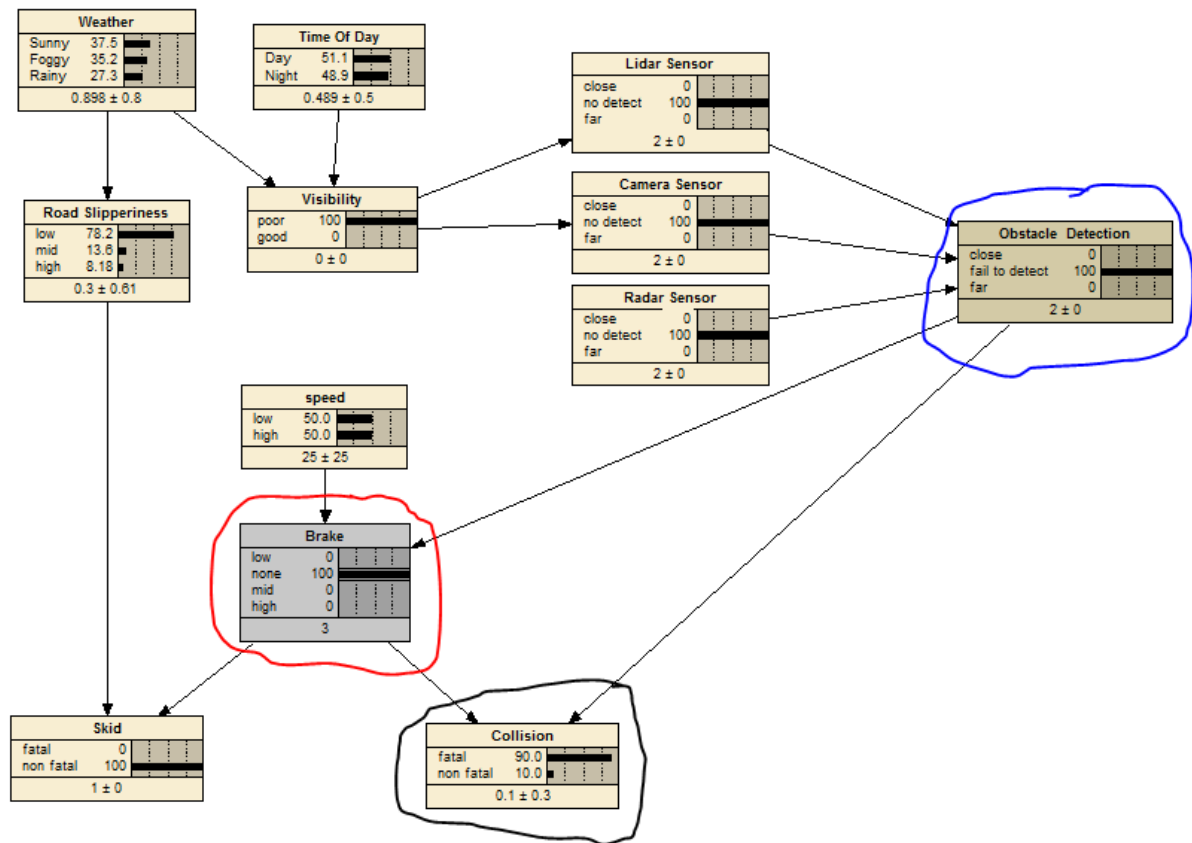
This node aggregates the reading of three different sensors of different capacity. The sensor output is the distance(discrete) between vehicle and obstacle. As soon as any of the sensor detects the far vehicle, this node provides this information to 'brake' node. If every sensor fails to detect the obstacle, then only, 'fail to detect' is passed to 'brake' node.

## Brake

Obstacle Detection	speed	Brake
close	low	mid
close	high	high
fail to detect	low	none
fail to detect	high	none
far	low	low
far	high	low

Brake depends on obstacle detection and current speed. Amount of brake applied influences the probability of collision and skidding. If high brake is applied on wet surface, then the skid is more likely to be fatal. Similarly, if low brake is applied, the collision is more likely to happen.

## Example Scenario #1



### Observation

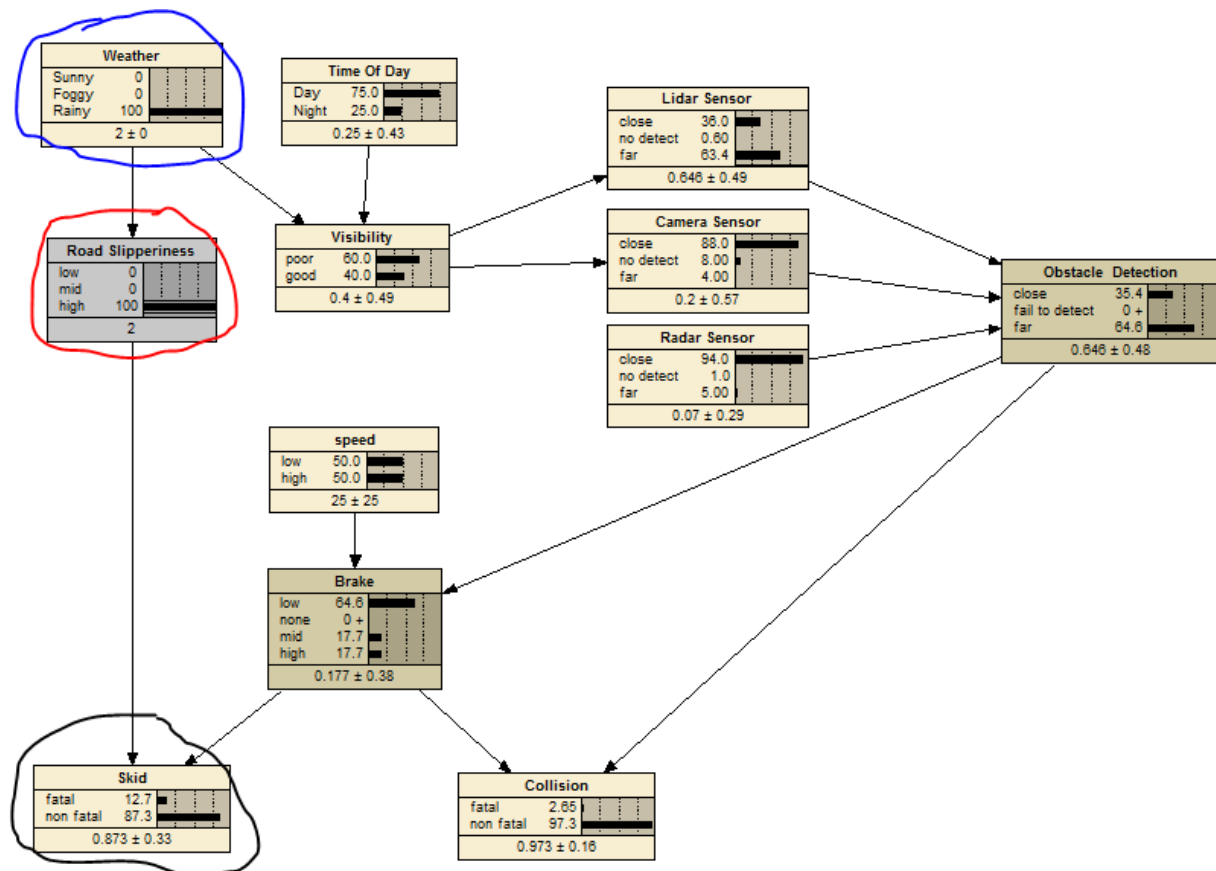
no brake is applied (red circle)

### Changes

Explanation Node: It means the sensors have failed to detect the obstacle (blue circle)

Consequence Node: It raises the probability of collision being fatal (black circle)

## Example Scenario #2



## Observation

The slipperiness of road is high

## Changes

This observation increases the probability of skid being fatal. It's interesting to note that this also changed the probability of collision. Slippery road means it is a rainy day, so visibility is weaker hence there is more chances of collision.

### Extension

It is possible to add more nodes for diverse types of sensors like the one which detects speed of obstacle, curvature of road etc. This network can be extended to 20-30 nodes to include more factors.

### Case File

The generated case file is included along with the project. It consists of 10000 possible observations with 5% missing data. We can train the network to learn CPT from the similar case file.

### Testing the project

I used Netica 6.04 64 bit version for development. It should work with version 5 too. I haven't tested on other versions.

You can test by opening the "accidentPredictionFinal.neta" file. You can test for different cases by clicking on corresponding values of nodes.