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Laboratory #3
October 16th, 2018
Intelligent Systems Group #1 Tuesday and Friday 5:30pm
Rubén Stranders

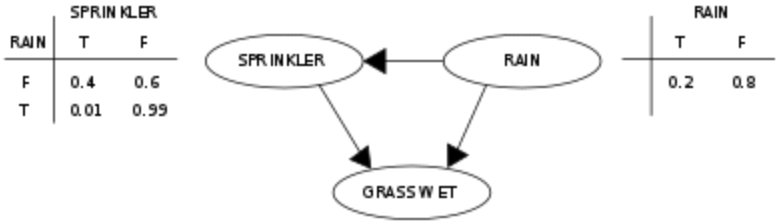
12. Lab: Implementing Bayesian Networks

Goal: understand how to use and make a simple Bayesian network **(7 hours)**

Compare with Hugin Lite

When you've finished your program, you can compare your implementation to Hugin Lite. Hugin lite is a software kit for developing graphical Bayes networks. Download it here.

Create your own example network based on a real example. Make it between 3 and 4 nodes. Wikipedia has a good example. You'll have to come up with your own though!

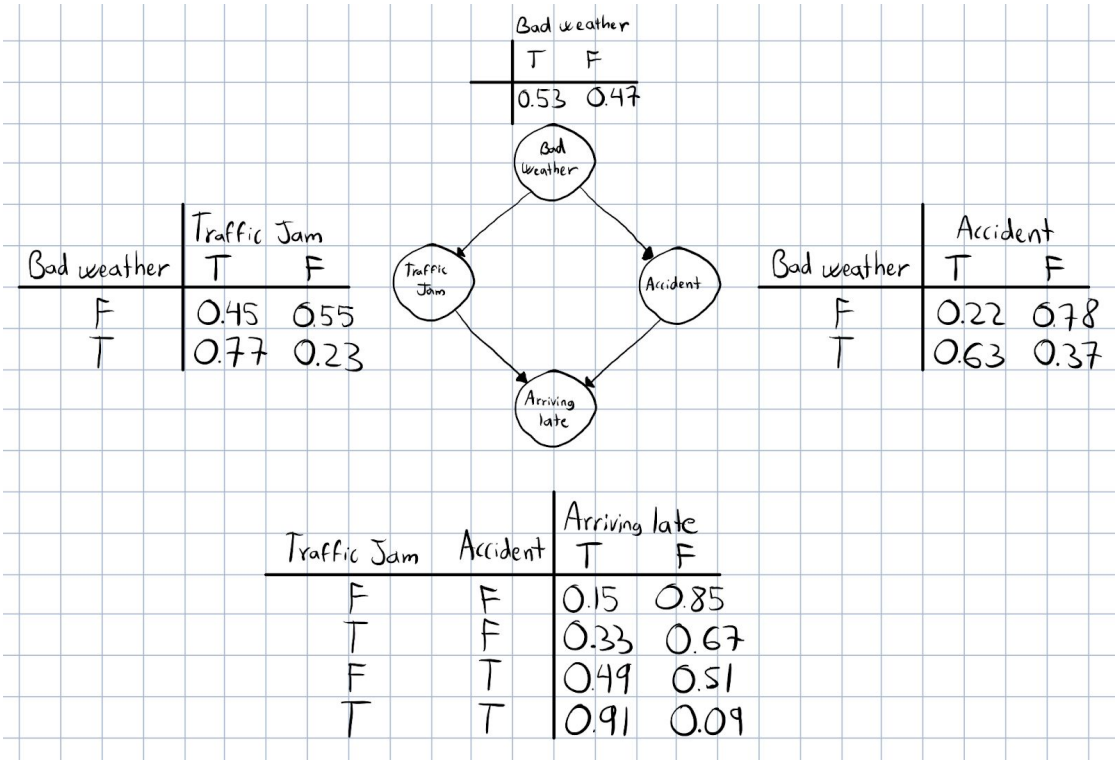


RAIN	SPRINKLER T	SPRINKLER F
F	0.4	0.6
T	0.01	0.99

RAIN T	RAIN F
0.2	0.8

SPRINKLER	RAIN	GRASS WET T	GRASS WET F
F	F	0.0	1.0
F	T	0.8	0.2
T	F	0.9	0.1
T	T	0.99	0.01

Our example:



Then:

1. Encode your example into the input format for your program (see above)

BadWeather, TrafficJam, Accident, ArrivingLate

-BadWeather=0.47

-TrafficJam|+BadWeather=0.23

+TrafficJam|-BadWeather=0.45

+Accident|-BadWeather=0.22

+Accident|+BadWeather=0.63

+ArrivingLate|-Accident,+TrafficJam=0.33

-ArrivingLate|-Accident,-TrafficJam=0.85

+ArrivingLate|+Accident,+TrafficJam=0.91

-ArrivingLate|+Accident,-TrafficJam=0.51

2. Create a couple of queries

+BadWeather

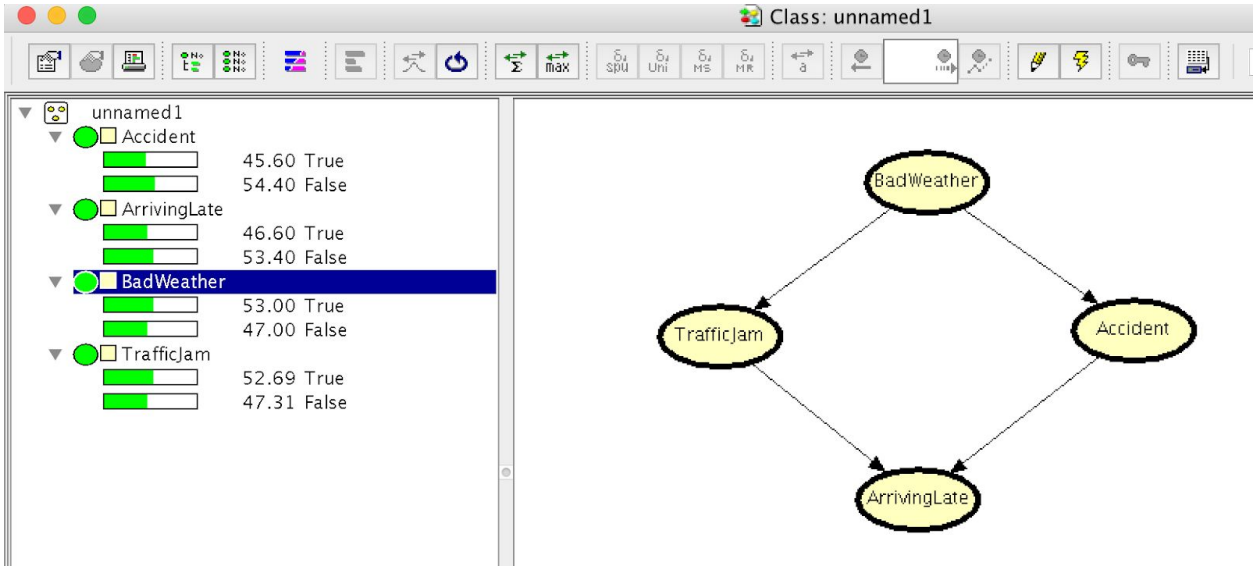
+BadWeather|-TrafficJam

+TrafficJam|-Accident,+ArrivingLate

3. Run your program

```
BadWeather, TrafficJam, Accident, ArrivingLate
9
-BadWeather=0.47
-TrafficJam|+BadWeather=0.23
+TrafficJam|-BadWeather=0.45
+Accident|-BadWeather=0.22
+Accident|+BadWeather=0.63
+ArrivingLate |-Accident,+TrafficJam=0.33
-ArrivingLate |-Accident,-TrafficJam=0.85
+ArrivingLate |+Accident,+TrafficJam=0.91
-ArrivingLate |+Accident,-TrafficJam=0.51
 3
+BadWeather
+BadWeather|-TrafficJam
+TrafficJam|-Accident,+ArrivingLate
0.53
0.3204522
0.7039899
```

4. Compare the output to Hugin Lite to see that the values between both match.



Writing your report

Write a reflection or make a table where you compare Hugin Lite to your implementation. Within this you must answer the following questions: What are the differences between what they generate? Do they use the same algorithms? What are their common bases? Which tool would you use for what cases in real life applications? (400 to 500 words)

Include the diagrams of the developed networks.

From this lab we understood the bases of Bayesian networks and the way the Bayes algorithm should be used for updating the belief given different events or probabilities. We saw how the initial probabilities were needed in order to be able to compute a solution for a specific query and how numeration algorithm worked in order to make this process computable.

Moreover, with the interaction with hugin lite we encountered a more friendly interface to simulate Bayesian networks, this given the GUI that the software offers and the ease of usage in terms of constructing the network and giving the different initial parameters. In addition, hugin shows the different probabilities graphically in a sidebar, which made some of the information easier to understand.

Furthermore, in terms of the used algorithms we learnt that hugin and our program used different algorithms to find a solution, while we tried to implement numeration algorithm in the code, hugin used an algorithm published in the Journal of the Royal Statistical Association. Even so, both algorithms were suited to work for Bayesian networks.

On the other hand, speaking about the possible applications of this programs, we would both in different real life applications, Hugin while interacting with humans especially, this because of the ease of understand it for people and because of the simple interaction, while our lab in cases where just the computer would need a response to a certain probability as a library or a part of a program.

We might say that both share common bases in the meaning that they need a certain number of initial parameters in order to compute all the portability tables and given a query they use algorithms in order to compute an answer for the user.

Fortunately, our lab worked properly at the end thanks to the effort made by Juan Manuel, before it wasn´t working because of the following factors: We used ruby for the first time and so we struggled with the syntax, we tried first different implementatiation of the enumeration algorithm and we believed it was going to work, but after a while that wasn't happening, so we took more time than the one we had in trying to make the adaptations to the code. However, we were able to understand ruby and the logic needed to do the algorithm and we successfully implemented the lab with great results.

References:

Britt, J. (2015). *Array*. Retrieved from http://ruby-doc.org/core-1.9.3/Array.html

Fandom. (n.d.). *Ruby - Remove Elements From An Array*. Retrieved from http://programmingresources.wikia.com/wiki/Ruby-_Remove_Elements_From_An_Array

Hogan, B. (2017). *How to work with arrays in Ruby.* Retrieved from https://www.digitalocean.com/community/tutorials/how-to-work-with-arrays-in-ruby

Ruby Tutorial. (2013). *Clases y objetos.* Retrieved from http://rubytutorial.wikidot.com/clases-objetos

StackOverflow. (2015). *Cloning an array with its content.* Retrieved from https://stackoverflow.com/questions/31455309/cloning-an-array-with-its-content

StackOverflow. (2012). *How do I automatically cast a class instance to Float in Ruby?* Retrieved from https://stackoverflow.com/questions/8459056/how-do-i-automatically-cast-a-class-instance-to-float-in-ruby

StackOverflow. (2011). *How to declare an empty 2-dimensional array in ruby?* Retrieved from https://stackoverflow.com/questions/5372701/how-to-declare-an-empty-2-dimensional-array-in-ruby

StackOverflow. (2012). *Set Attribute Dynamically of Ruby Object.* Retrieved from https://stackoverflow.com/questions/7849521/set-attribute-dynamically-of-ruby-object

StackOverflow. (2015). *Why does my Ruby string show the escape character backslash ('\') twice?* Retrieved from https://stackoverflow.com/questions/34192445/why-does-my-ruby-string-show-the-escape-character-backslash-twice

Zaiste. (2017). *Rails ActiveRecord: Updating attributes (object fields)*. Retrieved from https://zaiste.net/rails_activerecord_updating_attributes_object_fields/