

## Introduction

The network built for comparison is a very simple representation of the events that can occur in a relationship. We focus mainly on the probabilities of a man apologizing given the following events.

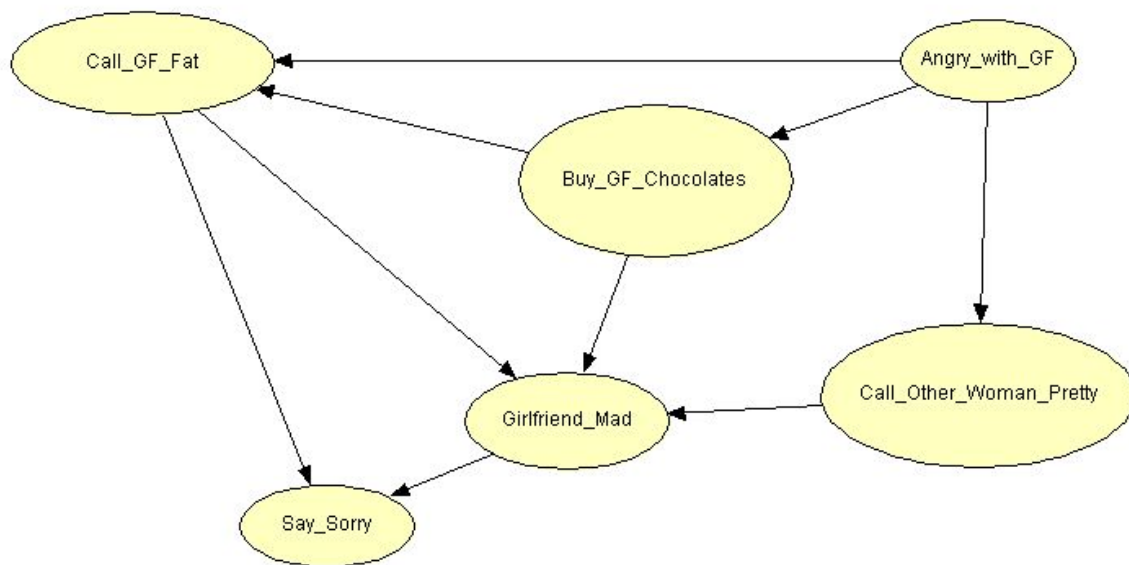


Image 1. Bayesian Network

The number of parameters required to define the network presented above is 29. These were established as follows:

- **+AngryWithGF = 0.4**
- **+BuyGFChocolates|+AngryWithGF = 0.1**
- **+BuyGFChocolates|-AngryWithGF = 0.35**
- **+CallOtherWomanPretty|+AngryWithGF=0.75**
- **+CallOtherWomanPretty|-AngryWithGF=0.45**
- **+CallGFFat|+BuyGFChocolates,+AngryWithGF=0.6**
- **+CallGFFat|+BuyGFChocolates,-AngryWithGF=0.2**
- **+CallGFFat|-BuyGFChocolates,+AngryWithGF=0.3**
- **+CallGFFat|-BuyGFChocolates,-AngryWithGF=0**
- **+GirlFriendMad|+BuyGFChocolates,+CallGFFat,+CallOtherWomanPretty,+AngryWithGF=0.97**
- **+GirlFriendMad|+BuyGFChocolates,+CallGFFat,+CallOtherWomanPretty,-AngryWithGF=0.9**
- **+GirlFriendMad|+BuyGFChocolates,+CallGFFat,-CallOtherWomanPretty,+AngryWithGF=0.85**

- **+GirlFriendMad**|+BuyGFChocolates,+CallGFFat,-CallOtherWomanPretty,-AngryWithGF=0.7
  - **+GirlFriendMad**|+BuyGFChocolates,-CallGFFat,+CallOtherWomanPretty,+AngryWithGF=0.7
  - **+GirlFriendMad**|+BuyGFChocolates,-CallGFFat,+CallOtherWomanPretty,-AngryWithGF=0.65
  - **+GirlFriendMad**|+BuyGFChocolates,-CallGFFat,-CallOtherWomanPretty,+AngryWithGF=0.2
  - **+GirlFriendMad**|+BuyGFChocolates,-CallGFFat,-CallOtherWomanPretty,-AngryWithGF=0.05
  - **+GirlFriendMad**|-BuyGFChocolates,+CallGFFat,+CallOtherWomanPretty,+AngryWithGF=1
  - **+GirlFriendMad**|-BuyGFChocolates,+CallGFFat,+CallOtherWomanPretty,-AngryWithGF=0.99
  - **+GirlFriendMad**|-BuyGFChocolates,+CallGFFat,-CallOtherWomanPretty,+AngryWithGF=0.85
  - **+GirlFriendMad**|-BuyGFChocolates,+CallGFFat,-CallOtherWomanPretty,-AngryWithGF=0.8
  - **+GirlFriendMad**|-BuyGFChocolates,-CallGFFat,+CallOtherWomanPretty,+AngryWithGF=0.8
  - **+GirlFriendMad**|-BuyGFChocolates,-CallGFFat,+CallOtherWomanPretty,-AngryWithGF=0.75
  - **+GirlFriendMad**|-BuyGFChocolates,-CallGFFat,-CallOtherWomanPretty,+AngryWithGF=0.45
  - **+GirlFriendMad**|-BuyGFChocolates,-CallGFFat,-CallOtherWomanPretty,-AngryWithGF=0.2
- 
- **+SaySorry**|+CallGFFat,+GirlFriendMad=1
  - **+SaySorry**|+CallGFFat,-GirlFriendMad=0.35
  - **+SaySorry**|-CallGFFat,+GirlFriendMad=0.8
  - **+SaySorry**|-CallGFFat,-GirlFriendMad=0

## Results

These values were implemented in Hugin and in the script:

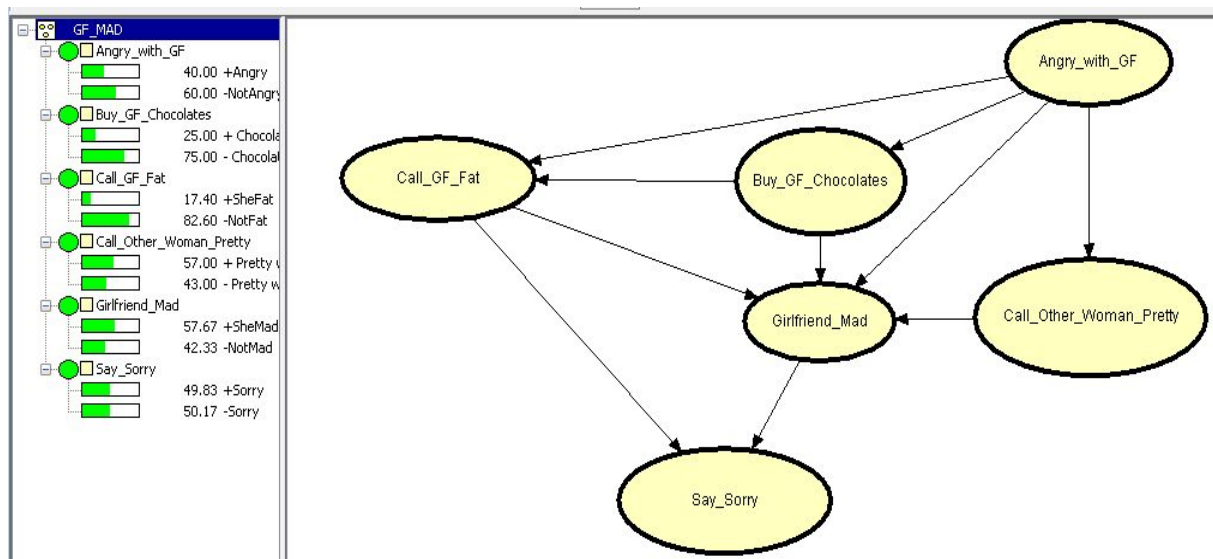


Image 2. Hugin Implementation

```

AngryWithGF,BuyGFChocolates,CallGFFat,CallOtherWomanPretty,GirlFriendMad,SaySorry
29
+AngryWithGF=0.4
+BuyGFChocolates|+AngryWithGF=0.1
+BuyGFChocolates|-AngryWithGF=0.35
+CallOtherWomanPretty|+AngryWithGF=0.75
+CallOtherWomanPretty|-AngryWithGF=0.45
+CallGFFat|+BuyGFChocolates,+AngryWithGF=0.6
+CallGFFat|+BuyGFChocolates,-AngryWithGF=0.2
+CallGFFat|-BuyGFChocolates,+AngryWithGF=0.3
+CallGFFat|-BuyGFChocolates,-AngryWithGF=0
+GirlFriendMad|+BuyGFChocolates,+CallGFFat,+CallOtherWomanPretty,+AngryWithGF=0.97
+GirlFriendMad|+BuyGFChocolates,+CallGFFat,+CallOtherWomanPretty,-AngryWithGF=0.9
+GirlFriendMad|+BuyGFChocolates,+CallGFFat,-CallOtherWomanPretty,+AngryWithGF=0.85
+GirlFriendMad|+BuyGFChocolates,+CallGFFat,-CallOtherWomanPretty,-AngryWithGF=0.7
+GirlFriendMad|+BuyGFChocolates,-CallGFFat,+CallOtherWomanPretty,+AngryWithGF=0.7
+GirlFriendMad|+BuyGFChocolates,-CallGFFat,+CallOtherWomanPretty,-AngryWithGF=0.65
+GirlFriendMad|+BuyGFChocolates,-CallGFFat,-CallOtherWomanPretty,+AngryWithGF=0.2
+GirlFriendMad|+BuyGFChocolates,-CallGFFat,-CallOtherWomanPretty,-AngryWithGF=0.05
+GirlFriendMad|-BuyGFChocolates,+CallGFFat,+CallOtherWomanPretty,+AngryWithGF=1
+GirlFriendMad|-BuyGFChocolates,+CallGFFat,+CallOtherWomanPretty,-AngryWithGF=0.99
+GirlFriendMad|-BuyGFChocolates,+CallGFFat,-CallOtherWomanPretty,+AngryWithGF=0.85
+GirlFriendMad|-BuyGFChocolates,+CallGFFat,-CallOtherWomanPretty,-AngryWithGF=0.8
+GirlFriendMad|-BuyGFChocolates,-CallGFFat,+CallOtherWomanPretty,+AngryWithGF=0.75
+GirlFriendMad|-BuyGFChocolates,-CallGFFat,-CallOtherWomanPretty,+AngryWithGF=0.45
+GirlFriendMad|-BuyGFChocolates,-CallGFFat,-CallOtherWomanPretty,-AngryWithGF=0.2
+SaySorry|+CallGFFat,+GirlFriendMad=1
+SaySorry|+CallGFFat,-GirlFriendMad=0.35
+SaySorry|-CallGFFat,+GirlFriendMad=0.8
+SaySorry|-CallGFFat,-GirlFriendMad=0
5
+SaySorry
+SaySorry|+AngryWithGF
+GirlFriendMad|+AngryWithGF
+SaySorry|+GirlFriendMad
+SaySorry|+CallOtherWomanPretty,-BuyGFChocolates
0.498327
0.698579
0.78815
0.855378
0.689697

```

Image 3. Script Implementation

Then, the following queries were asked to each program:

Query	Hugin	Script
+SaySorry	49.83	49.8327
+SaySorry +AngryWithGF	69.86	69.8579
+GirlFriendMad +AngryWithGF	78.82	78.815
+SaySorry +GirlFriendMad	85.54	85.5378
+SaySorry +CallOtherWomanPretty,-BuyGFChocolates	68.97	68.9697

## Conclusions

- ❖ What are the differences between what they generate?

Both of them generate the same outputs, only varying in decimal precision. Also, Hugin allows to ask for any Query at running time, changing the known values at any time. Meanwhile, our script ask for the queries before calculation and after that the execution stop, this due to the requirements for this assignment.

- ❖ Do they use the same algorithms?

While our program uses the enumeration algorithm, it is stated in the software documentation that the algorithm for Hugin Expert is based on the algorithm published by Steffen L. Lauritzen of Aalborg and David Spiegelhalter of Cambridge in the Journal of the Royal Statistical Association. We could not find more information on the used algorithm, but the previous claim leads us to believe that it is not the same algorithm that we used.

❖ What are their common bases?

They are based on Bayes theorem, both relying on CP tables as initial parameters (are the same for both implementations), however, Hugin requires for the user to fill every table correctly, while our script calculates the complementary probability based on the inputs.

On both cases, the user can ask for any possible query, however we could only see a set of probabilities at a time using Hugin, while our script will display as many queries as requested at the same time.

❖ Which tool would you use for what cases in real life applications?

The main difference between the two implementations is that Hugin has a very simple GUI, where the user creates every node and arc just placing the elements in the sheet, and after that Hugin generates and updates the tables for every node to write the parameters. Also, the visualization of data after running the program is easy to handle. This leads to an easier implementation of a Bayesian network, visualizing the entire network when creating it.

On the other hand, an advantage of the script that we created is that you can write as many queries as needed, and they will be displayed at the same time. In the case that you have a large network, it could be easier to generate a list of the needed probabilities using the script, instead of reading them one at a time from Hugin by selecting or deselecting which variables are given.

This leads to the conclusion that Hugin could be a good alternative for smaller networks in which you can see all the different probabilities in a small amount of time, however, if a bigger network is implemented, it could be complicated to build or to get information from the network, also connections could get messy due to the size of the network. In such cases, we think it could be better to use our program as the format in which the information is presented could make it easier to extract large amounts of information at the same time.