TDT4171 AI2 Exercise 1

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1. 5-card poker hands

a) How many atomic events are there in the joint probability distribution (i.e.,how many 5-card hands are there)?

There are $52 * 51 * 50 * 49 * 48 = 311875200$ different hands.

b) What is the probability of each atomic event?

$$\frac{1}{311875200}$$

c) What is the probability of being dealt a royal straight flush? Four of a kind?

Royal straight flush:

Four possibilities, one per suit.

$$\frac{4}{52 * 51 * 50 * 49 * 48} = \frac{1}{52 * 51 * 50 * 49 * 12} = \frac{1}{77968800}$$

Four of a kind:

The four of a kind can take on 13 different values. The wildcard for each value then has $52 - 4 = 48$ different possibilities:

$$\frac{13 * 48}{52 * 51 * 50 * 49 * 48} = \frac{1}{4 * 51 * 50 * 49} = \frac{1}{499800}$$

2. Bayesian Network

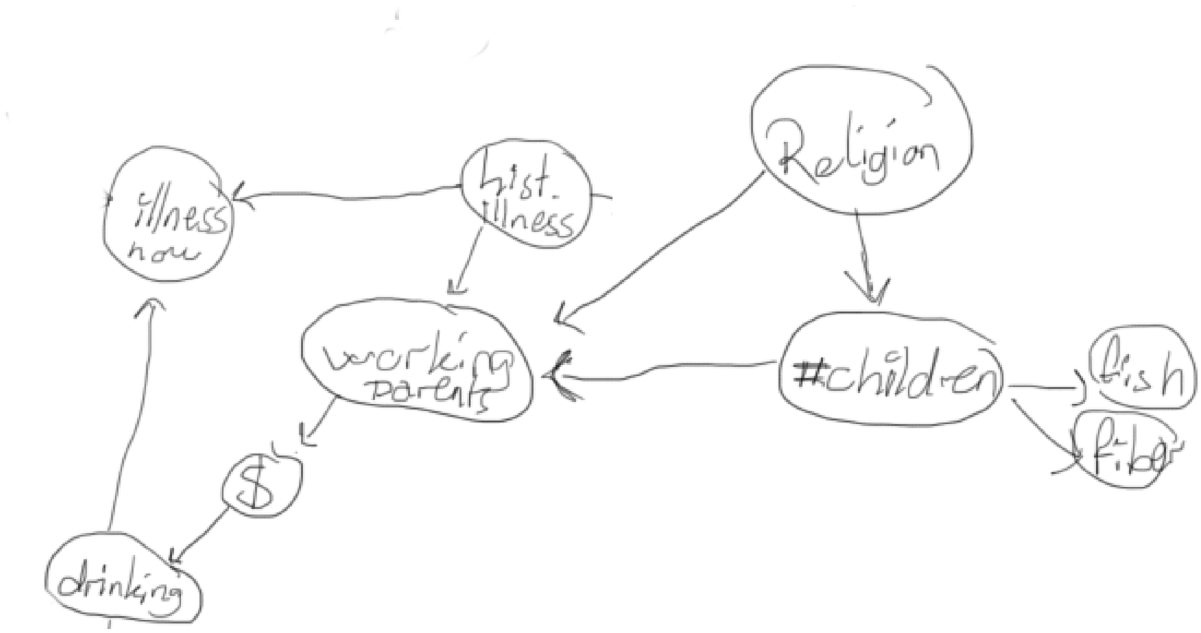

Figure 1: Bayesian network

Conditional independence properties of the network

The following variables are conditionally independent given my network:

- Fish eaten / Fiber eaten, given number of children
- Illness now / Working parents, given history of illness.

I think these are reasonable.

3. Monty Hall

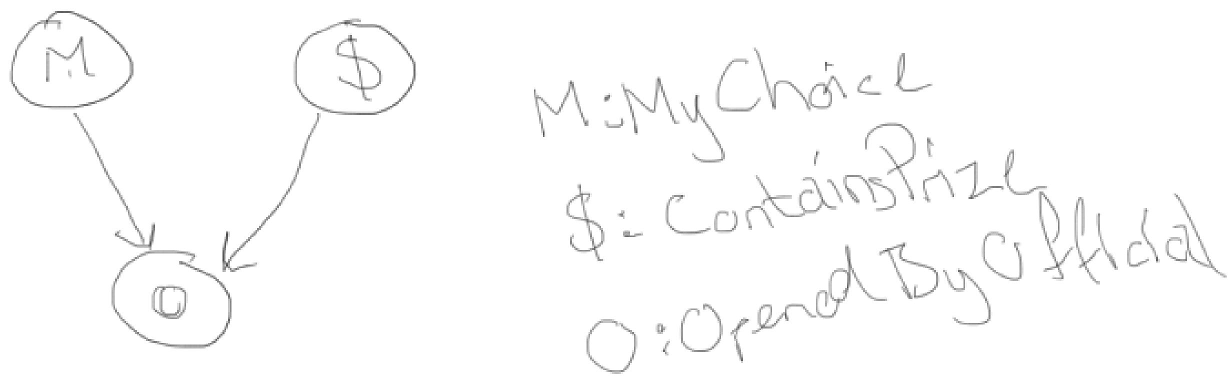

Figure 2: Bayesian network describing the Monty Hall game

m	P(m)	,	$	P($)
1	1/3	,	1	1/3
2	1/3	,	2	1/3
3	1/3	,	3	1/3

Table 1: Base probabilities for MyChoice and ContainsPrice.

Row	$	M	P(o=1)	P(o=2)	P(o=3)
1.	1	1	0	0.5	0.5
2.	1	2	0	0	1
3.	1	3	0	1	0
4.	2	1	0	0	1
5.	2	2	0.5	0	0.5
6.	2	3	1	0	0
7.	3	1	0	1	0
8.	3	2	1	0	0
9.	3	3	0.5	0.5	0

Table 2: Probabilities for OpenedByOfficial, given MyChoice and ContainsPrice

Argument and Conclusion

There are two "start situations"; MyChoice = ContainsPrice (with a probability of $\frac{1}{3}$), and MyChoice != ContainsPrice (with a probability of $\frac{2}{3}$). For each of these, there are two choices to make after the Official has opened his door: Keep MyChoice, or change MyChoice to the last door. Let's investigate each of these situations.

1) `M = $`, *don't switch door*

Rows 1, 5 and 9 satisfies `M = $`. Out of these, we see that this strategy wins every time.

2) `M != $`, *don't switch door*

Rows 2, 3, 4, 6, 7, 8 satisfies `M != $`. If we don't switch doors in this situation, we lose.

Note that under the *Don't switch* strategy, we win $\frac{3}{9} = \frac{1}{3}$ of the time.

3) `M = $`, *switch door.*

Rows 1, 5, 9 again. We lose in all of these 3 situations.

4) `M != $`, *switch door*

Rows 2, 3, 4, 6, 7, 8. We see from the table that Monty has opened the empty door (P=1), so switching wins us the price in all of these cases.

By playing the *switch door* strategy, we obtain a $\frac{2}{3}$ chance of winning! Thus, **We should always switch doors**.