

Assignment 4 – Jakub Rysiak

Excercise 1

a)

Technically all the nets could represent the probabilities if you calculate the CPT's correctly. For example you could calculate the probability of shape given wrapper, but that would be inconvenient and counterintuitive. Since the question asks for the net to fit with the story, I think that the third net represents it best, since in the story describes a causal relationship **flavor -> shape** and **flavor -> wrapping**. However all of them can represent the dependencies in the story, but one would as I mentioned have to recalculate the probabilities.

b)

As I mentioned network iii is the best representation for this problem, because it intuitively models the relationship described in the story, and the probabilities can be easily deduces from the story, such as the probability of wrapping color given flavor and shape given flavor, which is described directly in the story. In case of the others, one would have to for example calculate chance of flavor given wrapping, which is possible given the numbers we know, but unnecessary.

c)

No, it asserts that it is given flavor. If you want to know wrapping the flavor directly influences it, but if you know shape, that changes the probability distribution of flavor, which changes the probability distribution of wrapping. However if you know the flavor, shape is irrelevant in this model.

d)

To calculate the absolute probability of my candy having a red wrapping, I can do so by using the probabilities of a candy being strawberry and anchovy, and the probabilities of these being in red wrapping.

Strawberry: 0.7

Anchovy: 0.3

Red wrapping if strawberry: 0.8

Red wrapping if anchovy: 0.1

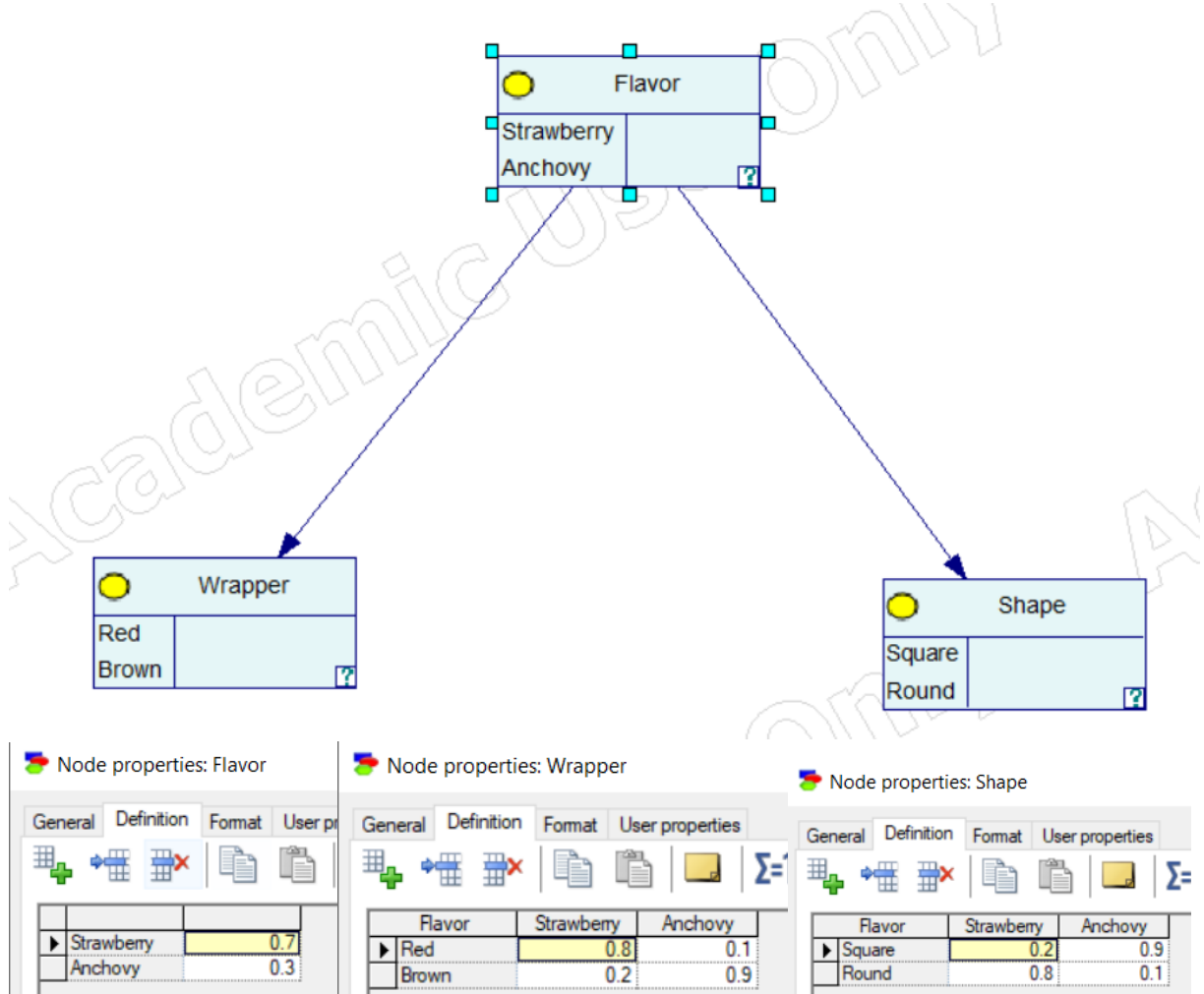
Red wrapping and strawberry: $0.7 \times 0.8 = 0.56$

Red wrapping and anchovy: $0.3 \times 0.1 = 0.03$

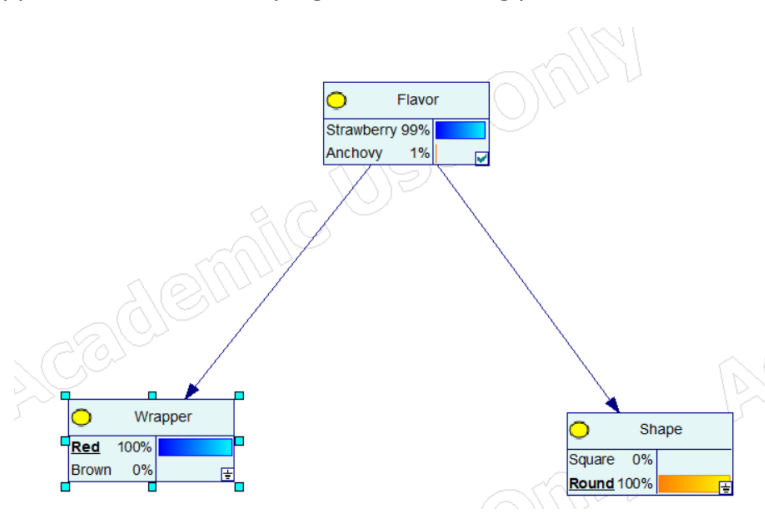
Since the only two flavors are strawberry and anchovy, to get the probability of red wrapping we can just add the two numbers, giving us $0.56 + 0.03 = 0.59$

e)

To calculate this I created a model in geNIe, where I used the net iii from the previous tasks. I the nodes flavor, wrapper and shape, and used the probabilities from the story.



And given red wrapper and a round candy, I get the following probabilities:



More precisely:

marginal probability distribution:

►	Strawberry	0.99334812
	Anchovy	0.0066518847

f)

To calculate the expected value of an unopened candy, I need to sum the products of all the outcome utilities and their probabilities. In this case I have two outcomes, with utilities s and a , with probabilities 0.7 and 0.3. From that we get the expected value of any candy:

$$0.7s + 0.3a$$

Exercise 2

a)

To solve this problem I need to use the utility function for winning 500\$, winning 5000\$ and winning nothing multiplied by the probability. Using the function with $R = 500\$$ the utility of 500\$ is approximately -0.36, and the utility of 5000\$ is 4.5×10^{-5} . The utility of 0\$ is -1.

Since gaining 500\$ in the first choice is the only outcome, the expected utility is the same number, but the second choice needs to be weighed by 0.6 and 0.4. Summing up those two numbers gives us -0.4, which is a lower number than -0.36, meaning Mary would choose the first option if she acted rationally.

b)

To solve this problem I can set up an equation with the utility multiplied by the probability of all the outcomes on the left, and the secure outcome with its utility on the right, and then solve for R .

$$-e^{-\frac{500}{R}} \cdot 0.5 - 0.5 = -e^{-\frac{100}{R}}$$

I later found that it's not trivial to find the solution algebraically, so I used an online numeric tool to find the solution.

I rewrote the equation such that I could use the tool to find the root, and found that for value of $R = 152.38$ the value of the function is approximately 0.