IA169 – Homework 5
Timed wolf-goat-cabbage problem

A farmer walks the land with Wolf, Goat, and 2kg of Cabbage and comes to a river. There is a raft at the bank that can be used to cross the river, however, only the farmer and one piece of cargo fit the raft. The wolf is not well trained and if it is hungry, it kills the goat and eats it at the moment when the farmer leave them unattended. The wolf gets hungry after 40 minutes after the last feeding and the farmer fed him when they came to the river. If the goat and the cabbage are left unattended the Goat eats the Cabbage. However, the goat is a slow-eater and it eats only 100g of cabbage per minute (it starts eating immediately when the goat and cabbage are left unattended). Crossing the river alone or with the cabbage takes the farmer 7-11 minutes as the cabbage does not weigh much. Crossing the river with the wolf takes 13-17 minutes and with the goat 21-27 minutes as the goat cannot stand calmly.

Model the problem in UPPAAL and use the model(s) to answer these questions:

- [Q1] Is there a strategy for the farmer to cross the river with all of the cabbage and animals alive?
- [Q2] Is there a possibility that the farmer crosses the river with both animals alive but only with a part of the cabbage (i.e., less than 2kg but more than 0 kg of cabbage).
- [Q3] How fast can the farmer cross the river with all of the cabbage and animals alive? How many crossings with the raft does the fastest strategy take?
- [Q4] Is there a way to cross the river with the whole cabbage and both animals alive if you use the raft 7 times? And 12 times?
- [Q5] Is it possible that the farmer leaves the wolf and the goat unattended (at least once) and still is able to cross with the whole cabbage and both animals alive?
- [Q6] Is it possible that the farmer repeatedly (i.e., more than once) leaves the wolf and the goat unattended and still is able to cross the river with the whole cabbage and both animals alive?

Now assume that the wolf has a tapeworm and the farmer feeds it anytime when he leaves it on a bank (i.e., if wolf and farmer are on the same bank and the farmer is leaving, she carefully feeds it). The wolf with tapeworm gets hungry always 40 minutes after eating. Adjust the model (or create a new one) for this situation and answer questions Q5 and Q6. What are the answers to questions Q5-Q6 if the wolf gets hungry after 25 minutes?

Comment:

Assigment was edited: Woman->Farmer & Dog->Wolf.

<modelfilename>.xml file consider that farmer is not lazy, so he is not waiting on the banks random amout of time.

<modelfilename>_lazyfarmer.xml file consider that farmer is lazy, so he is waiting on the banks random amout of time.

[A1] - Yes, as the property for query "E<> ModelProcess._FWGC and cabbage==20" is satisfied. Check on model1.xml and model1_lazyfarmer.xml

[A2] - Yes, as the property for query "E<> ModelProcess._FWGC and cabbage<20 and cabbage>0" is satisfied. Check on model1.xml and model1_lazyfarmer.xml

[A3] - With use of the query from A1 and setting Options->Diagnostic Trace->Fastest we can get a path by which it takes 55minutes to cross with all of the belongings and the number of crossings is 5 (counted manually in Simulation Trace). Check on model1.xml and model1_lazyfarmer.xml

[A4] - Yes for 7 crossings. Property was satisfied with query "E<> ModelProcess._FWGC and cabbage==20 and usedRaftCounter==7".

No for 12 crossings, as the number of crossings has to be even to satisfy the property.
Both checked on model1.xml and model1_lazyfarmer.xml

[A5] – It is possible. Checked with query "E<> ModelProcess._FWGC and cabbage==20 and goatWolfTogetherCounter>=1"
and also manually: Firstly there are all on one bank. You'll take cabbage and farmer on second bank so the wolf and goat are alone on bank1. Then Farmer returns alone on bank1. You'll take the wolf and farmer on second bank, where you leave wolf and cabbage alone. Lastly farmer return alone for the goat which he'll take with himself to the second bank so all are together on second bank with 2kg of cabbage. Checked on model1_adjusted.xml and model1_adjusted_lazyfarmer.xml

[A6] - It is possible. Checked with query "E<> ModelProcess._FWGC and cabbage==20 and goatWolfTogetherCounter>=2"
and also manually:
You'll take cabbage and farmer on second bank so the wolf and goat are alone on bank1. Then Farmer returns with cabbage on bank1. This repeats once again. You'll take the wolf and farmer on second bank, where you leave wolf and cabbage alone. Lastly farmer return alone for the goat which he'll take with himself to the second bank so all are together on second bank with 2kg of cabbage. In this situation we consider that the two cruises with cabbage do not exceed 40 minutes. Checked on model1_adjusted.xml and model1_adjusted_lazyfarmer.xml

[Adjusted model A5] - It is possible. Property was satisfied with A5 query. Check with A5 query on model1_adjusted.xml and model1_adjusted_lazyfarmer.xml
[Adjusted model A6] - It is possible. Property was satisfied with A6 query. Check with A6 query on model1_adjusted.xml and model1_adjusted_lazyfarmer.xml
[Adjusted model 25min A5] - It is possible. Property was satisfied with A5 query. Check with A5 query on model1_adjusted_25min.xml and model1_adjusted_25min_lazyfarmer.xml

[Adjusted model 25min A6] - It is possible. Property was satisfied with A6 query. Check with A6 query on model1_adjusted_25min.xml and model1_adjusted_25min_lazyfarmer.xml