Homework 02

ECE 587, Spring 2026

Due Date: 03/08 (Sun.) by the end of the day (Chicago time)

1. *(1 point)*

   A hardware device is required to read a sensor every 500ns and to report the readings immediately over a network to a server. Show that the Gigabit Ethernet is actually too slow for such purpose. (Hint: check `https://en.wikipedia.org/wiki/Ethernet_frame` for minimum Ethernet frame size.)

2. *(2 points)*

   Consider the application modeled by the dataflow graph below where the output is obtained by executing each of the actors once (P, Q, R, S, T, and U) following the data dependency. Assume each activity can be either implemented as a program running on a software processor (SW) or as a hardware component (HW).
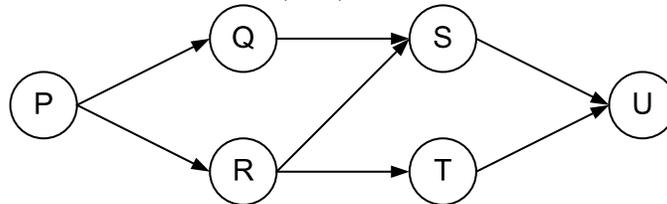
   The time to finish each actor (in clock cycles) by HW or SW and the HW cost are listed below:

Actor	SW Time	HW Time	HW Cost
P	10	5	10
Q	100	5	100
R	20	10	10
S	20	10	10
T	100	5	100
U	10	5	10

   We further use the following assumptions.

   - There should be exactly one SW processor in the system platform so that the costs of SW implementations could be ignored. The SW processor executes one actor at a time and the scheduling overhead is ignored.

- HW components do NOT share resources so that their costs add up directly.

- Performance and cost overheads of communications are ignored.

1) If all the actors are mapped to the SW processor, how many cycles are required to complete the computation?

2) If all the activities are mapped to HW components, how many cycles are required to complete the computation? What is the cost of the system?

3. *(2 points)*

Once upon a time a farmer went to a market and purchased a fox, a goose, and a bag of beans. On his way home, the farmer came to the bank of a river and rented a boat. But crossing the river by boat, the farmer could carry only himself and a single one of his purchases: the fox, the goose, or the bag of beans.

If left unattended together, the fox would eat the goose, or the goose would eat the beans. Will the farmer be able to carry himself and his purchases to the far bank of the river, leaving each purchase intact?

While you may easily find the answer to this problem online, we are interested in a method that solves this and similar river crossing puzzles. Show that you can model the problem with a FSM and then apply model checking concepts to solve it.