## CS4710: Model-Driven Software Development, Spring 2020
## Computer Science Department
## Michigan Technological University
## Group Project #2: Play By Your Own Rules
## Due Date: March 6, 2020 at 9:30pm

**Problem description**:
A casino has invented a new game called Play By Your Own Rules (PBYOR). This game is different from any other game in that there is no single winner; instead, everybody has to win, or else everybody loses. At least 4 people should participate in this game. Let K be the number of participants, where K > 3. Here are more details about the game:

- The participants sit around a round table.
- Each person is handed a deck of 4 cards, where each card has a unique number from 0 to 3 written on it. That is, there are no duplicate values in each hand.
- This table has been designed in such a way that each person can only see the top cards in the hands of its left and right neighbors. In other words, each participant is allowed to show its top value to its left and right neighbors and can see their values as well.
- Initially, the casino owner randomly determines what the values of the top cards could be. The owner may even interrupt the game for a *finite* number of times and shuffle all cards. When he stops shuffling, the players can continue making moves in the game.
- Each participant reads the values of its immediate left and right neighbors and decides as to whether or not it should show a new top value between 0 and 3. If a participant decides to change its value, it does so *atomically*. That is, a participant can atomically read the left and right values and pick a new value as its top card.
- Note that everybody must use the same rules of decision making for selecting a new top value.

The constraints imposed by the casino owner are as follows:

- **Termination**: The rules of the game should be designed in such a way that the game will eventually reach a state where no one can make a move; i.e., *termination*. That is, the rule(s) each participant uses is(are) disabled.
- **Symmetry**: Everyone should follow the same rule(s) for determining what his/her next top value should be. Two players have *symmetric* rules/actions if the actions of one can be obtained from the other by a simple variable re-naming.
- **Winning conditions**: Everybody wins if the participants can design the rules in such a way that after a finite number of rounds of decision making by participants, the game terminates and everybody has the same value on their top card; otherwise, everybody loses.
- **No collusion**: *The players cannot collude on a specific value before the game starts; nor can they collude on a value during the game. For example, they cannot design a rule where they show a specific value $c \in \{0, 1, 2, 3\}$ as their top card regardless of the top cards of their neighbors.*

**Objective**:

Before the participants start to play, they should collectively design the rule(s) that each participant should follow so the game eventually terminates and everybody wins. Please help them by designing the rule(s) of the game.

**Deliverables**:

1. Design the rule(s) that each participant should follow so the game eventually terminates and everyone wins no matter what the initial values of the cards are. Each rule should be executed atomically. (**50 points**)
2. Create a Promela model for a version of the PBYOR, where K=5 and each proctype implements the rule(s) that you designed in Step 1. The proctypes should be symmetric because they implement the same rule(s). Two proctypes are *symmetric* if the code of one can be obtained from the other by a simple variable re-naming. (**15 points**)
3. Design and implement an Owner proctype that implements the behavior of the owner. Recall that, the owner can randomly perturb the values of the top cards of all participants for a finite number of times. (**15 points**)
4. Use SPIN to verify that no matter how the casino owner shuffles the cards, the participants eventually win this game played by the rule(s) you designed in Step 1. (**20 points**)

This project is due on March 6th at 9:30pm.