Quiz 2 (*22 Aug, Marks: 6, Duration: 45 mins*) **COL750, Jul-Dec 2024**

Name: **Entry No.:**

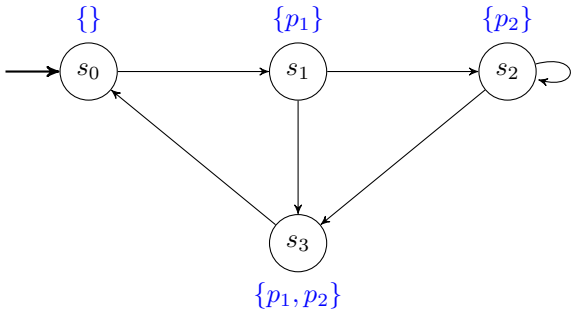
1. Suppose p, q, r are three propositional atoms.
   (a) **[0.5 marks]** Are the two formulas $((p \text{ U } q) \text{ U } r)$ and $(p \text{ U } (q \text{ U } r))$ equivalent? That is, whichever (infinite) path satisfies the first formula would satisfy the second and vice-versa? Explain your answer.
   (b) **[0.5 marks]** Is $(p \text{ U } (q \vee r))$ equivalent to $((p \text{ U } q) \vee (p \text{ U } r))$? Explain.
   (c) **[0.5 marks]** Is $((q \vee r) \text{ U } p)$ equivalent to $((q \text{ U } p) \vee (r \text{ U } p))$? Explain.

2. Consider the transition system described by the following NuSMV code:

```
MODULE main
VAR
  z: boolean;
  y: boolean;
ASSIGN
  init(z) := FALSE;
  init(y) := TRUE;
  next(z) := case
               y : z;
               !y & z : !z;
               TRUE : z;
             esac;
```

   (a) **[1 marks]** Draw the transition system corresponding to the above NuSMV code.
   (b) **[0.5 marks]** Argue whether or not the above transition system satisfies the property $(\text{F } \neg y) \rightarrow (\text{F } \neg z)$.

3. **[1.5 marks]** Does the transition system shown in the figure satisfy the following formulas? Briefly explain why.



   (a) $G\ (p_1 \rightarrow X\ p_2)$
   (b) $F\ G\ p_2$

4. **[1.5 marks]** Prove or disprove the following statement: there exists an LTL formula ψ and a transition system T such that T satisfies neither ψ nor $\neg\psi$ (i.e., T does not satisfy ψ, and T does not satisfy $\neg\psi$).