**Formal verification final assignment**

**Part 1**

**Question 1**

Describing an FDS for a general Sokoban board

Variables (V):  
keeper\_position: a tuple representing the warehouse keeper's coordinates on the grid.  
box\_positions: a set of tuples representing the coordinates of each box on the grid.  
wall\_positions: a set of tuples representing the coordinates of all walls.  
goal\_positions: a set of tuples representing the coordinates of all goal positions.

Initial State (Θ): Derived from the XSB format, where the coordinates for the keeper, boxes, walls, and goals are initialized.

Transition Relation (ρ): A set of rules that define valid state transitions, which include the movement of the keeper and any box that is pushed. These transitions account for the rules of the game, such as the keeper only pushing boxes and not pulling them, and not moving into walls or outside the grid.

Justice (J): The justice conditions ensure that each box is eventually pushed onto a goal position.

Compassion (C): Not explicitly defined in the context of Sokoban, but if applicable, it would ensure that certain moves are taken infinitely often to avoid deadlocks.

Example for a 5x5 board :

#####

#@$.#

#.$-#

#...#

#####

**Question 2**

CTL Specification for Sokoban Win:



LTL Specification for Sokoban Win:



**Part 2**

**Question 1 – Python script which transform XSB board to SMV model**

File in repo - formal\_verification.py

**Question 2 –**

Board 1 :

    xsb\_input = """

    #####

    #@$.#

    #.$-#

    #...#

    #####

    """

File in repo , SMV file produced – Board1. smv

Board 2 :

    xsb\_input = """

    ----#####----------

    ----#---#----------

    ----#$--#----------

    --###--$##---------

    --#--$-$-#---------

    ###-#-##-#---######

    #---#-##-#####--..#

    #-$--$----------..#

    #####-###-#@##--..#

    ----#-----#########

    ----#######--------

    """

File in repo , SMV file produced – Board2.smv

**Question 3 –**

Board 1 : winnable, solution is R->D

Board 2 : winnable, solution is ?

**Part 3**

**Question 1 –**