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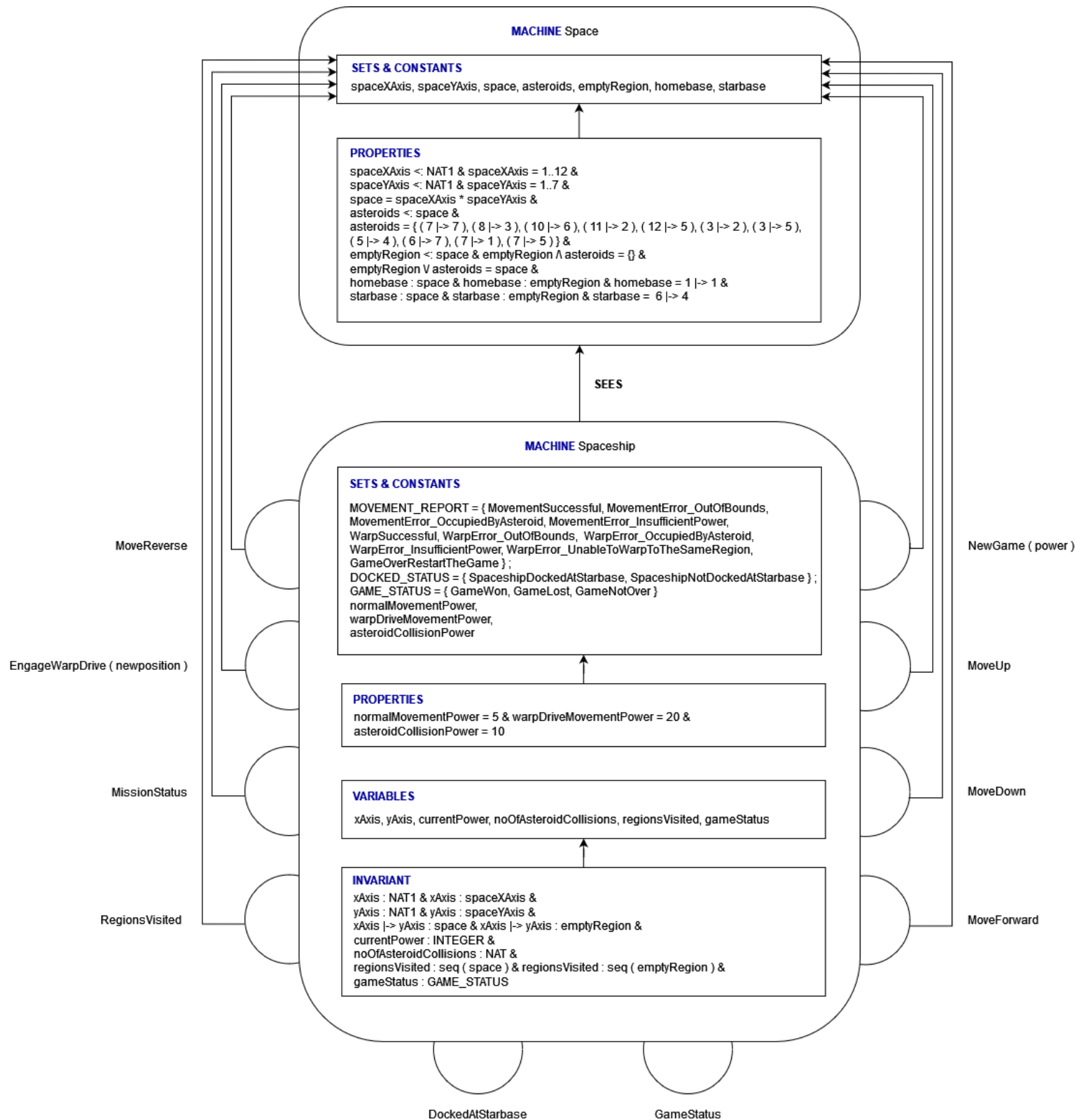
UNIVERSITY OF WESTMINSTER

**Informatics Institute of Technology
Department of Computing**
(B.Eng.) in Software Engineering

Module: 6SENG003C Reasoning About Programs
Module Leader: Dr. Thilini Piyatilake

Coursework – Structure Diagram

Date of Submission   : 03/12/2021

Tutorial Group   : SE/CS Group E

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MACHINE Space

SETS & CONSTANTS
spaceXAxis, spaceYAxis, space, asteroids, emptyRegion, homebase, starbase

PROPERTIES
spaceXAxis <: NAT1 & spaceXAxis = 1..12 &
spaceYAxis <: NAT1 & spaceYAxis = 1..7 &
space = spaceXAxis * spaceYAxis &
asteroids <: space &
asteroids = { (7 |-> 7), (8 |-> 3), (10 |-> 6), (11 |-> 2), (12 |-> 5), (3 |-> 2), (3 |-> 5),
(5 |-> 4), (6 |-> 7), (7 |-> 1), (7 |-> 5) } &
emptyRegion <: space & emptyRegion ∧ asteroids = {} &
emptyRegion ∨ asteroids = space &
homebase : space & homebase : emptyRegion & homebase = 1 |-> 1 &
starbase : space & starbase : emptyRegion & starbase = 6 |-> 4

SEES

MACHINE Spaceship

SETS & CONSTANTS
MOVEMENT_REPORT = { MovementSuccessful, MovementError_OutOfBounds,
MovementError_OccupiedByAsteroid, MovementError_InsufficientPower,
WarpSuccessful, WarpError_OutOfBounds, WarpError_OccupiedByAsteroid,
WarpError_InsufficientPower, WarpError_UnableToWarpToTheSameRegion,
GameOverRestartTheGame } ;
DOCKED_STATUS = { SpaceshipDockedAtStarbase, SpaceshipNotDockedAtStarbase } ;
GAME_STATUS = { GameWon, GameLost, GameNotOver }
normalMovementPower,
warpDriveMovementPower,
asteroidCollisionPower

PROPERTIES
normalMovementPower = 5 & warpDriveMovementPower = 20 &
asteroidCollisionPower = 10

VARIABLES
xAxis, yAxis, currentPower, noOfAsteroidCollisions, regionsVisited, gameStatus

INVARIANT
xAxis : NAT1 & xAxis : spaceXAxis &
yAxis : NAT1 & yAxis : spaceYAxis &
xAxis |-> yAxis : space & xAxis |-> yAxis : emptyRegion &
currentPower : INTEGER &
noOfAsteroidCollisions : NAT &
regionsVisited : seq (space) & regionsVisited : seq (emptyRegion) &
gameStatus : GAME_STATUS

MoveReverse

EngageWarpDrive (newposition)

MissionStatus

RegionsVisited

NewGame (power)

MoveUp

MoveDown

MoveForward

DockedAtStarbase

GameStatus

Explanation of State Variants

1. xAxis : NAT1

   The x axis (x co-ordinate) should be an element of natural numbers starting from 1.

2. xAxis : spaceXAxis

   The x axis (x co-ordinate) of the spaceship should be within the x axis boundary of the space (spaceXAxis).

3. yAxis : NAT1

   The y axis (y co-ordinate) should be an element of natural numbers starting from 1.

4. yAxis : spaceYAxis

   The y axis (y co-ordinate) of the spaceship should be within the y axis boundary of the space (spaceYAxis).

5. xAxis |-> yAxis : space

   The current co-ordinate of the spaceship (xAxis, yAxis) should be located within the space.

6. xAxis |-> yAxis : emptyRegion

   The current co-ordinate of the spaceship (xAxis, yAxis) should be located within the empty region (unoccupied by the asteroids) of the space.

7. currentPower : INTEGER

   The current value of the power should be an element of the integer numbers.

8. noOfAsteroidCollisions : NAT

   The number of asteroid collisions of the spaceship should be an element of the natural numbers starting from zero.

9. regionsVisited : seq (space)

   The regions visited by the spaceship should be a sequence of the space.

10. regionsVisited : seq (emptyRegion)

    The regions visited by the spaceship should be a sequence of the empty region (unoccupied by the asteroids) of the space.

11. missionStatus : GAME_STATUS

    The gameStatus variable should be an element of the SET 'GAME_STATUS'.