INFORMATICS INSTITUTE OF TECHNOLOGY

In Collaboration with

UNIVERSITY OF WESTMINSTER

6SENG005C.1 Formal Methods

Coursework - Developing a B Specification of the Spaceship and Asteroids System using Atelier B & Pro B.

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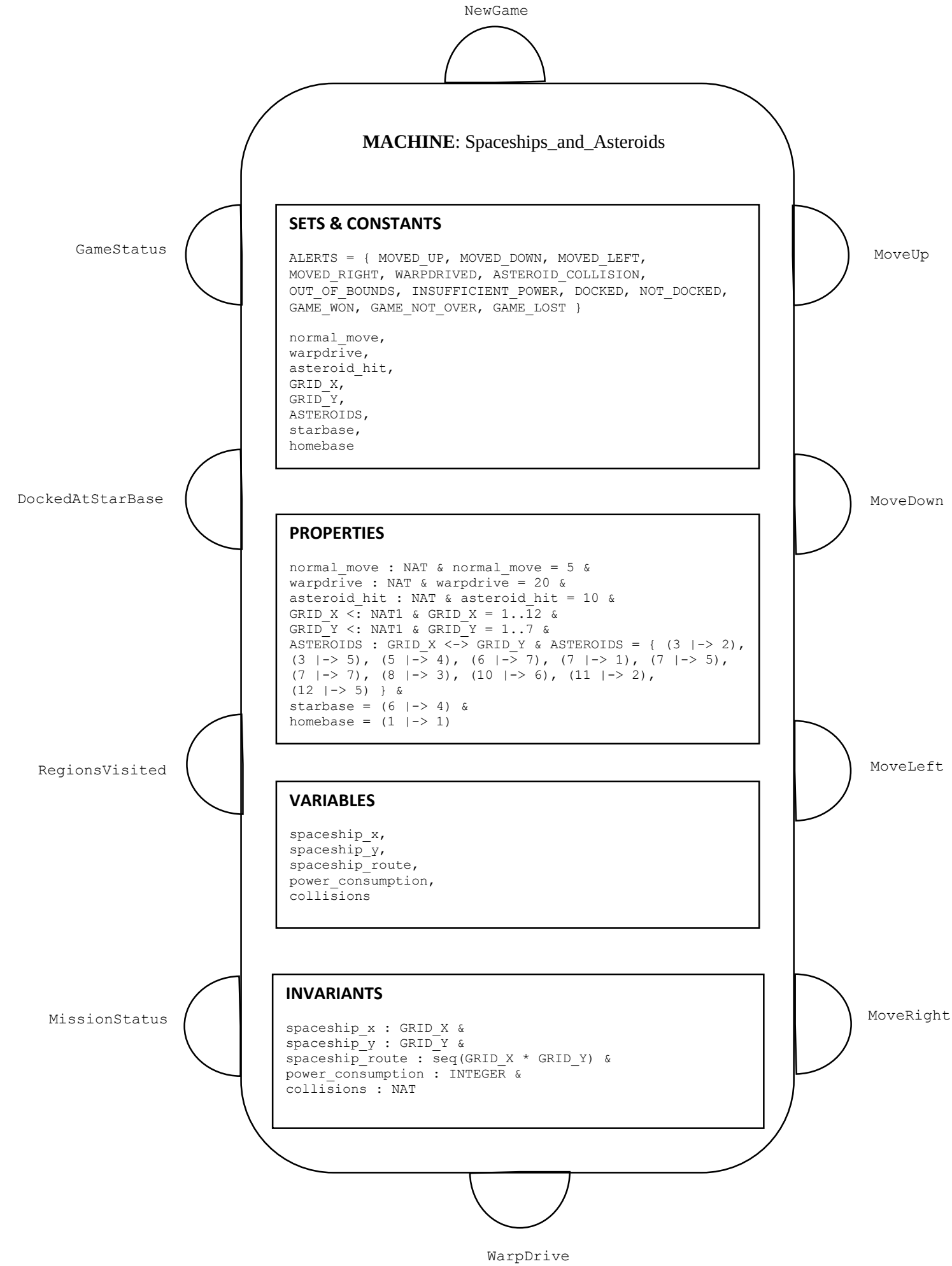
NewGame
MACHINE: Spaceships_and_Asteroids
SETS & CONSTANTS
ALERTS = { MOVED_UP, MOVED_DOWN, MOVED_LEFT,
MOVED_RIGHT, WARPDRIVED, ASTEROID_COLLISION,
OUT_OF_BOUNDS, INSUFFICIENT_POWER, DOCKED, NOT_DOCKED,
GAME_WON, GAME_NOT_OVER, GAME_LOST }
normal_move,
warpdrive,
asteroid_hit,
GRID_X,
GRID_Y,
ASTEROIDS,
starbase,
homebase
PROPERTIES
normal_move : NAT & normal_move = 5 &
warpdrive : NAT & warpdrive = 20 &
asteroid_hit : NAT & asteroid_hit = 10 &
GRID_X <: NAT1 & GRID_X = 1..12 &
GRID_Y <: NAT1 & GRID_Y = 1..7 &
ASTEROIDS : GRID_X <-> GRID_Y & ASTEROIDS = { (3 |-> 2),
(3 |-> 5), (5 |-> 4), (6 |-> 7), (7 |-> 1), (7 |-> 5),
(7 |-> 7), (8 |-> 3), (10 |-> 6), (11 |-> 2),
(12 |-> 5) } &
starbase = (6 |-> 4) &
homebase = (1 |-> 1)
VARIABLES
spaceship_x,
spaceship_y,
spaceship_route,
power_consumption,
collisions
INVARIANTS
spaceship_x : GRID_X &
spaceship_y : GRID_Y &
spaceship_route : seq(GRID_X * GRID_Y) &
power_consumption : INTEGER &
collisions : NAT
GameStatus
DockedAtStarBase
RegionsVisited
MissionStatus
MoveUp
MoveDown
MoveLeft
MoveRight
WarpDrive

State Invariants

Total of five state invariants has been identified and used in the specification of the system. They are as follows,

1. spaceship_x
2. spaceship_y
3. spaceship_route
4. power_consumption
5. collisions

Description of State Invariants

- **spaceship_x** – This variable is used to store the x co-ordinate of the current square position of the spaceship. As an invariant this variable is declared as an element of the GRID_X set, where this set consists of the numbers from 1 to 12. Therefore, the variable spaceship_x can also only hold a value between 1 and 12 at a point of time.
- **spaceship_y** – This variable is used to store the y co-ordinate of the current square position of the spaceship. As an invariant this variable is declared as an element of the GRID_Y set, where this set consists of the numbers from 1 to 7. Therefore, the variable spaceship_y can also only hold a value between 1 to 7 at a point of time.
- **spaceship_route** – This variable is mainly used to store the route in which the spaceship travels inorder to reach the star base location. As an invariant this variable is declared as a sequence of maplets of relation set of GRID_X and GRID_Y as "x |-> y" format where x is an element of GRID_X and y is an element of GRID_Y. Sequence was used here because the elements of the route will change dynamically when the program runs.
- **power_consumption** – This variable stores the power of the spaceship which is needed to make a move inorder to reach the target destination of starbase location. As an invariant type it is declared as an INTEGER since the power_consumption

variable can hold any positive as well negative value as well. Whenever there are multiple collisions the value can go below 0 as well. (power_consumption < 0)

eg: - power_consumption = power_consumption – asteroid_hit
= 8 - 10
= -2

- **collisions** – This variable holds the count in which the spaceship hits the asteroid and collides. Since there can be no collisions as well as there can be multiple collisions can happen (0 to n), as an invariant it has been declared as NAT (natural numbers start from 0) instead of NAT1.