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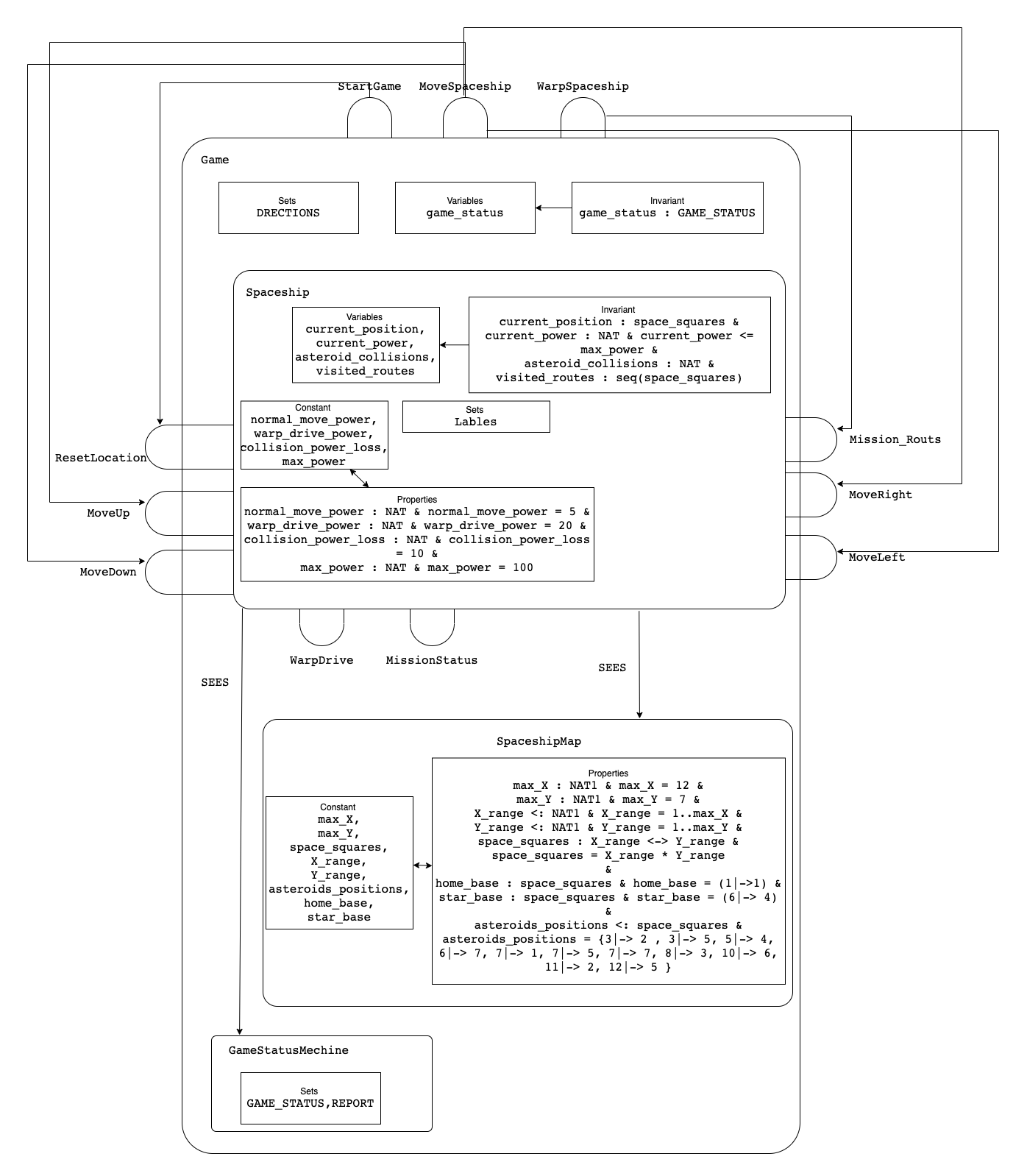
UNIVERSITY OF WESTMINSTER

**Formal Methods – Coursework (2023/24)**

**Module leader Klaus Draeger**

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| Name | : | Janindu Chamodya Vitharana Pathirana |
| IIT ID | : | 2019592 |
| UOW ID | : | w1809774 |
| Date | : | 2023/12/25 |

# Structure Diagram of your Spaceship & Asteroids System B machine.



# State invariants description.

## Game Machine

* 1. **game\_status : GAME\_STATUS**: The variable **game\_status** must always have a value from the set **GAME\_STATUS**, which includes {WON, LOST, NOT\_OVER}.

## Spaceship Machine

* 1. **current\_position : space\_squares**: The current position of the spaceship must always be within the set of **space\_squares**.
  2. **current\_power : NAT & current\_power <= max\_power**: The current power level of the spaceship must be a natural number (non-negative integer) and should not exceed the maximum power defined by **max\_power**.
  3. **asteroid\_collisions : NAT**: The number of asteroid collisions must be a natural number.
  4. **visited\_routes : seq(space\_squares)**: The sequence of visited routes must consist of elements from the set **space\_squares**.

## SpaceshipMap Machine

* 1. **max\_X : NAT1 & max\_X = 12**: The maximum value for the X-coordinate must be a natural number greater than zero and equal to 12.
  2. **max\_Y : NAT1 & max\_Y = 7**: The maximum value for the Y-coordinate must be a natural number greater than zero and equal to 7.
  3. **X\_range <: NAT1 & X\_range = 1..max\_X**: The X-coordinate range must be a subset of natural numbers up to **max\_X** and is defined as 1 through **max\_X**.
  4. **Y\_range <: NAT1 & Y\_range = 1..max\_Y**: The Y-coordinate range must be a subset of natural numbers up to **max\_Y** and is defined as 1 through **max\_Y**.
  5. **space\_squares : X\_range <-> Y\_range**: The set of **space\_squares** must be a bijective relation between the X and Y coordinates within their respective ranges.
  6. **home\_base : space\_squares & home\_base = (1|->1)**: The home base must be a valid element of **space\_squares** and is specifically located at coordinates (1, 1).
  7. **star\_base : space\_squares & star\_base = (6|-> 4)**: The star base must be a valid element of **space\_squares** and is specifically located at coordinates (6, 4).
  8. **asteroids\_positions <: space\_squares**: The set of asteroid positions must be a subset of **space\_squares**.