# SE 3XA3: Module Interface Specification
# Genetic Cars

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Table 1: **Revision History**

| **Date** | **Version** | **Notes** |
|---|---|---|
| Nov 10 | 1.0 | Created MIS Document |
| Nov 12 | 1.1 | Updated MIS to reflect new modules |
| Nov 13 | 1.2 | Added the car module to MIS |
| Nov 13 | 1.3 | Added title page and revision history |

# Module Interface Specification

## Members

### b2Vec2

b2Vec2 This imports the Box2D Vector and any associated methods.

Source: gratebox_documentation.js, line 6

### camera_x

camera_x This variable keeps track of the horizontal velocity of the camera.

Source: gratebox_documentation.js, line 40

### camera_y

camera_y This variable keeps track of the vertical velocity of the camera.

Source: gratebox_documentation.js, line 48

### car

car This variable holds the car model

Source: gratebox_documentation.js, line 32

### carsArray

carsArray This variable array contains the cars in the population cars.

Source: gratebox_documentation.js, line 112

### currentMember

currentMember This variable integer indicates the current member of the group of cars.

Source: gratebox_documentation.js, line 126

### diff_x

diff_x This variable keeps track of the change in the horizontal displacement of the camera.

Source: gratebox_documentation.js, line 55

### diff_y

diff_y This variable keeps track of the change in the vertical displacement of the camera.

## Contents

Source: gratebox_documentation.js, line 62

### MUTATION_RATE

MUTATION_RATE This constant indicates the rate at which mutations occur.

Source: gratebox_documentation.js, line 103

### PARENT_POOL

PARENT_POOL This constant indicates the size of the pool from which parents creat offspring.

Source: gratebox_documentation.js, line 96

### points

points This variable keeps track of points on a car

Source: gratebox_documentation.js, line 25

### POPULATION_SIZE

POPULATION_SIZE This constant indicates the size of the initial population of cars.

Source: gratebox_documentation.js, line 89

### proc1

proc1 This variable keeps track of the game loop thread.

Source: gratebox_documentation.js, line 69

### proc2

proc2 This variable keeps track of updateCar thread.

Source: gratebox_documentation.js, line 76

### topCars

topCars This variable array contains the highest performing cars for the purpose of creating the next generation.

Source: gratebox_documentation.js, line 119

## Functions

### cameraPos()

This method sets the camera position to the position of the car.

Source: gratebox_documentation.js, line 645

## Car()

This method establishes the initial values shared by all cares. All cars start with 10 health and have a fitness and carDef of 0.

Source: gratebox_documentation.js, line 818

## ConnectTile()

This method connects the tiles to each other in a sequential fashion starting from the first tile at the origin.

Source: gratebox_documentation.js, line 574

## createtile(world, x, y, width, height, angle) → {Body}

This method creates a box with a specified width and height rotated at a specified angle on the screen.

### Parameters:

| Name | Type | Description |
|---|---|---|
| world | b2World | The Box2D world that the box is created in |
| x | Integer | The x-coordinate of the upper left corner |
| y | Integer | The y-coordinate of the upper left corner |
| width | Integer | The width of the box |
| height | Integer | The height of the box |
| angle | Float | The rotation of the box, counterclockwise from the horizontal, in radians |

Source: gratebox_documentation.js, line 542

### Returns:

The box

Type
Body

## crossOverOffsprings(cars, topCars) → {Array.<Cars>}

This method crosses over the chromosomes of the offspring cars.

### Parameters:

| Name | Type | Description |
|---|---|---|
| cars | Array.<Cars> | The array of cars to crossover |
| topCars | Integer | The number of cars in the surviving parent generation |

Source: gratebox_documentation.js, line 690

### Returns:

An array of the crossed-over cars

Type
Array.<Cars>

### draw_world(world, context)

This method draws the world on the screen, before it is updated.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| world | b2World | The world to draw on |
| context | Canvas | The canvas to draw the world on |

Source: gratebox_documentation.js, line 632

### drawCar(world, worldScale, vertex1X, vertex1Y, vertex2X, vertex2Y, vertex3X, vertex3Y, vertex4X, vertex4Y, vertex5X, vertex5Y, vertex6X, vertex6Y, vertex7X, vertex7Y, vertex8X, vertex8Y, frontwheelPos, rearWheelPos) → {b2BodyDef}

This method creates a car to the screen.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| world | b2World | The Box2D world where the car will be placed in |
| worldScale | Integer | The scaling factor for the Box2D world |
| vertex1X | Integer | The x-coordinate of the first vertex |
| vertex1Y | Integer | The y-coordinate of the first vertex |
| vertex2X | Integer | The x-coordinate of the second vertex |
| vertex2Y | Integer | The y-coordinate of the second vertex |
| vertex3X | Integer | The x-coordinate of the third vertex |
| vertex3Y | Integer | The y-coordinate of the third vertex |
| vertex4X | Integer | The x-coordinate of the fourth vertex |
| vertex4Y | Integer | The y-coordinate of the fourth vertex |
| vertex5X | Integer | The x-coordinate of the fifth vertex |
| vertex5Y | Integer | The y-coordinate of the fifth vertex |
| vertex6X | Integer | The x-coordinate of the sixth vertex |
| vertex6Y | Integer | The y-coordinate of the sixth vertex |
| vertex7X | Integer | The x-coordinate of the seventh vertex |
| vertex7Y | Integer | The y-coordinate of the seventh vertex |
| vertex8X | Integer | The x-coordinate of the eighth vertex |
| vertex8Y | Integer | The y-coordinate of the eighth vertex |
| frontwheelPos | Integer | The vertex that the front wheel is attached to |
| rearWheelPos | Integer | The vertex that the back wheel is attached to |

Source: gratebox_documentation.js, line 464

#### Returns:

The completed car

Type
b2BodyDef

### generateNewCar()

Method that generates new car randomly.

Source: gratebox_documentation.js, line 832

### getCarDef()

Method that retrieves the definition of a car.

Source: gratebox_documentation.js, line 994

### getChromosome()

Method that retrieves the specific chromosome of a car.

Source: gratebox_documentation.js, line 980

### getFitness()

Method that retrieves the fitness of a car.

Source: gratebox_documentation.js, line 1001

### getHealth()

Method that retrieves the health of a car.

Source: gratebox_documentation.js, line 987

### getRandomArbitrary(min, max) → {Float}

This method generates a random floating point number between min and max, exclusive.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| min | Integer | The lower bound |
| max | Integer | The upper bound |

Source: gratebox_documentation.js, line 1028

#### Returns:

A floating point number between min and max.

Type
Float

### getRandomArbitraryInteger(min, max) → {Integer}

This method generates a random integer between min and max, exclusive.

#### Parameters:

| Name | Type | Description |
|---|---|---|

| Name | Type | Description |
| --- | --- | --- |
| min | Integer | The lower bound |
| max | Integer | The upper bound |

Source: gratebox_documentation.js, line 1015

### Returns:

A random number between min and max

Type
Integer

## getVertexXArray()

Method that retrieves the array of horizontal vertices of a car.

Source: gratebox_documentation.js, line 952

## getVertexYArray()

Method that retrieves the array of vertical vertices of a car.

Source: gratebox_documentation.js, line 959

## getWheelPosArray()

Method that retrieves the array of wheel positions of a car.

Source: gratebox_documentation.js, line 966

## getWheelRadiusArray()

Method that retrieves the array of wheel radiuses of a car.

Source: gratebox_documentation.js, line 973

## increaseFitness()

Method that increases the fitness value of a car by 1.

Source: gratebox_documentation.js, line 859

## init()

This method initializes the Box2D environment, and any objects within the Box2D world.

Source: gratebox_documentation.js, line 137

### Returns:

The created Box2D world

## makeCarJoints(world, bodyA, bodyB, wheelPosX, wheelPosY) → {b2RevoluteJointDef}

This method creates joints used to connect the wheels to the car chassis.

### Parameters:

| Name | Type | Description |
|---|---|---|
| world | b2World | The Box2D world where the joint will be placed in |
| bodyA | b2BodyDef | The first object to connect the joint to |
| bodyB | b2BodyDef | The second object to connect the joint to |
| wheelPosX | Integer | The x-coordinate of the wheel |
| wheelPosY | Integer | The y-coordinate of the wheel |

Source: gratebox_documentation.js, line 411

### Returns:

The joint connecting bodyA to bodyB

Type
b2RevoluteJointDef

## makePolygon(num, vertex1X, vertex1Y, vertex2X, vertex2Y) → {b2FixtureDef}

This method creates a polygon for the car given 4 points on the Cartesian plane. It assumes that one of the points of the polygon will be at the origin.

### Parameters:

| Name | Type | Description |
|---|---|---|
| num | Integer | The index of the polygon of the car |
| vertex1X | Integer | The x-coordinate of the first vertex |
| vertex1Y | Integer | The y-coordinate of the first vertex |
| vertex2X | Integer | The x-coordinate of the second vertex |
| vertex2Y | Integer | The y-coordinate of the second vertex |

Source: gratebox_documentation.js, line 237

### Returns:

The polygon created

Type
b2FixtureDef

## makeWheelFixture(world, car, wheelbodyDef, wheelFixture) → {Body}

This method connects the wheel to the car chassis.

### Parameters:

| Name | Type | Description |
|---|---|---|
| world | b2World | The Box2D world where the wheel will be placed in |
| car | b2BodyDef | The car to connect the wheels to |
| wheelbodyDef | b2BodyDef | The body (physics) definition of the wheel |
| wheelFixture | b2FixtureDef | The shape definition of the wheel |

Source: gratebox_documentation.js, line 432

### Returns:

The wheel

Type
Body

## makeWheelShape(world, worldScale, radius) → {b2FixtureDef}

This method creates the shape of a wheel for the car given its radius.

### Parameters:

| Name | Type | Description |
|---|---|---|
| world | b2World | The Box2D world where the wheel will be placed in |
| worldScale | Integer | The scaling factor |
| radius | Float | The radius of the wheel |

Source: gratebox_documentation.js, line 390

### Returns:

The shape of the wheel created

Type
b2FixtureDef

## mutateOffsprings(cars, numberOfParents, mutationFactor) → {Array.<Cars>}

This method mutates the genes in the offspring's chromosomes.

### Parameters:

| Name | Type | Description |
|---|---|---|
| cars | Array.<Cars> | The array of cars to crossover |
| numberOfParents | Integer | The number of parents in the cars array |
| mutationFactor | Float | The likelihood of mutation |

Source: gratebox_documentation.js, line 731

### Returns:

An array of the mutated cars

Type
Array.<Cars>

## nextCar()

This method selects the next car to be simulated.

Source: gratebox_documentation.js, line 206

### removeHealth()

Method that reduces the health value of a car by 1.

Source: gratebox_documentation.js, line 866

### resetCamera(world, context)

This method resets the camera for the next simulation.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| world | b2World | The world on which the camera is reset. |
| context | Canvas | The canvas to draw the world on |

Source: gratebox_documentation.js, line 617

### resetWorld(world)

This method resets the world for the next simulation.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| world | b2World | The world to be reset. |

Source: gratebox_documentation.js, line 605

### selectNextGeneration(cars, n) → {Array.<Cars>}

This method selects for the next generation of cars.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| cars | Array.<Cars> | The array of cars to choose from. |
| n | Integer | The number of cars to select for. |

Source: gratebox_documentation.js, line 664

#### Returns:

An array of the top n cars.

Type
Array.<Cars>

### setCarDef(carDef)

Method that sets the definition of a car.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| carDef | Float | The set value of the ar's definition. |

Source: gratebox_documentation.js, line 934

### setChromosome(chromosome)

Method that sets the chromosome of a car

#### Parameters:

| Name | Type | Description |
|---|---|---|
| chromosome | Array.<Chromosome> | The chromosome to be altered. |

Source: gratebox_documentation.js, line 942

### setVertexX(vertexXArray, i)

Method that sets a specific vertex in an array of the horizontal vertices to a specific value.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| vertexXArray | Array. <vertexXArray> | The array of vertices where the vertex is present. |
| i | Integer | The identify of the specific vertex in the array that is to be altered. |

Source: gratebox_documentation.js, line 883

### setVertexXArray(vertexXArray)

Method that sets the array of vertices in the horizontal.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| vertexXArray | Array.<vertexXArray> | The array of vertices to be set. |

Source: gratebox_documentation.js, line 874

### setVertexY(vertexYArray, i)

Method that sets a specific vertex in an array of the vertical vertices to a specific value.

#### Parameters:

| Name | Type | Description |
|---|---|---|
| vertexYArray | Array. <vertexXArray> | The array of vertices where the vertex is present. |
| i | Integer | The identify of the specific vertex in the array that is to be altered. |

Source: gratebox_documentation.js, line 900

### setVertexYArray(vertexYArray)

Method that sets the array of vertices in the vertical.

#### Parameters:

| Name | Type | Description |
|---|---|---|

| Name | Type | Description |
| --- | --- | --- |
| vertexYArray | Array.<vertexXArray> | The array of vertices to be set. |

Source: gratebox_documentation.js, line 891

### setWheelPos(wheelPos, i)

Method that sets the position of a specific wheel to a specific location.

#### Parameters:

| Name | Type | Description |
| --- | --- | --- |
| wheelPos | Array.<wheelPosArray> | The array that conatins the locations of the wheels. |
| i | Integer | The identify of the specific wheel position to be set in the array. |

Source: gratebox_documentation.js, line 909

### setWheelRadius(wheelRadius, i)

Method that sets the radius of a specific wheel.

#### Parameters:

| Name | Type | Description |
| --- | --- | --- |
| wheelRadius | Array.<wheelRadius> | The array that conatins the radiuses of the wheels. |
| i | Integer | The identify of the specific wheel radius to be set in the array. |

Source: gratebox_documentation.js, line 918

### setWheelRadiusArray(wheelRadiusArray)

Method that sets array of wheel radiuses to a specific array.

#### Parameters:

| Name | Type | Description |
| --- | --- | --- |
| wheelRadiusArray | Array.<wheelRadius> | The array that conatins the locations of the wheels. |

Source: gratebox_documentation.js, line 926

### update()

This method updates the screen.

Source: gratebox_documentation.js, line 187