

# A

## 1.0 Introduction

### 1.1 Purpose

The purpose of this document is to show a detailed description of the videogame “Asteroids”. The document will contain details regarding product features, user interaction sequences, and required features and functionality.

The document will be used by both developers and the client during the development phase, as a reference for product specifications.

### 1.2 Scope

The piece of software to be written will be a game called “AMBrosIA”, modeled after the arcade-style game “Asteroids”. The game can be played by one or two people, and will feature a 2D graphical user interface in which the player will be able to control a spaceship and destroy approaching asteroids. As a game, the software will have an entertainment value to those who play it, with the development team’s goal being to maximize the entertainment value possible.

### 1.3 Definitions,acronyms,abbreviations

*Graphical User Interface (GUI)* : A method of interacting with software using images, rather than text.

***Company name:* Ambrosia Games, Ltd.**

## 2. Overall Description

### 2.1 Product Perspective

There are many different versions of the game Asteroids available today, ranging from web application versions (usually Flash) to the old arcade version of Asteroids programmed in Assembly.

After careful consideration, this version of Asteroids will be written as a Java desktop application. One notable feature that will set it apart from the competition will be a two player mode, allowing two different players to compete against each other, one after the other, and

compare high scores.

## 2.2 Product Functions and Use Cases

### 2.2.1 System Features

Our system needs to follow and implement the basic rules of the game Asteroids. The following is a lists of features that our game needs to have:

- User interface consisting of players statics and high scores
- Gameplay graphical components:
  - Multi-sized asteroids
  - Aliens
  - Bonus drops
  - Weapon drops
  - Spaceship animations
  - Environment wraparounds
- Gameplay system mechanics
- Implementation of
  - Shooting
  - Firing rate control
  - Impact detection
  - Game physics for asteroids and spaceships
  - Bonus life drops
  - Sound systems
  - AI implementation for alien ships
  - 2 player mode, alternating turns
  - Different levels of difficulty

An extensive list, including details regarding the above, can be found in section 3.

### 2.2.2 Use Cases

#### 2.2.2.1 Use Case - Play Asteroids

Use Case Name	Play the game Asteroids
Participating Actors	1 player or 2 players in alternating turns
Entry Conditions	The user either chooses 1 player mode or 2-player mode on the menu screen to play.
Basic Flow of Events	1. Play background music, load the game itself (ship, asteroids, physics, and so on)

	<ol style="list-style-type: none"> <li>2. Asteroids moves in and out of the window area</li> <li>3. Player (actor) is able to accelerate and change directions</li> <li>4. Player is able to shoot projectiles. If a projectile collides with asteroid, it explodes</li> <li>5. Player can collide with the asteroids, which will cause him to lose life</li> <li>6. Alien spaceship may arrive occasionally, and shoots bullets at Player</li> <li>7. If no asteroids remain, player moves to the next level</li> <li>8. If in 2-player mode, when first player loses life the second player gets to play</li> <li>9. If player has lives left, player can continue playing</li> </ol>
Exception Conditions	<p>Step 5. Player closes the game operation when near hit.</p> <p>When game is reloaded, display menu to:</p> <ol style="list-style-type: none"> <li>1) Load last X,Y coordinates</li> <li>2) Restart to level 1</li> </ol>
Exit Conditions	<p>The game ends when the player uses all of their lives.</p> <p>When there are no lives left, the game interface will display the score and prompt the user to enter their name.</p>
Quality Requirement	<p>The player must have java installed in order to play the game.</p>

#### 2.2.2.2 Use Case - Check Leaderboard

Use Case Name	Check leaderboard to see top 10 scores
Participating Actors	Player
Entry Condition	The player clicks on leaderboard from the menu screen.
Exit Conditions	The player clicks 'Back' and the game screen goes back to main menu.

#### 2.2.2.3 Use Case Diagrams

## Game Menu

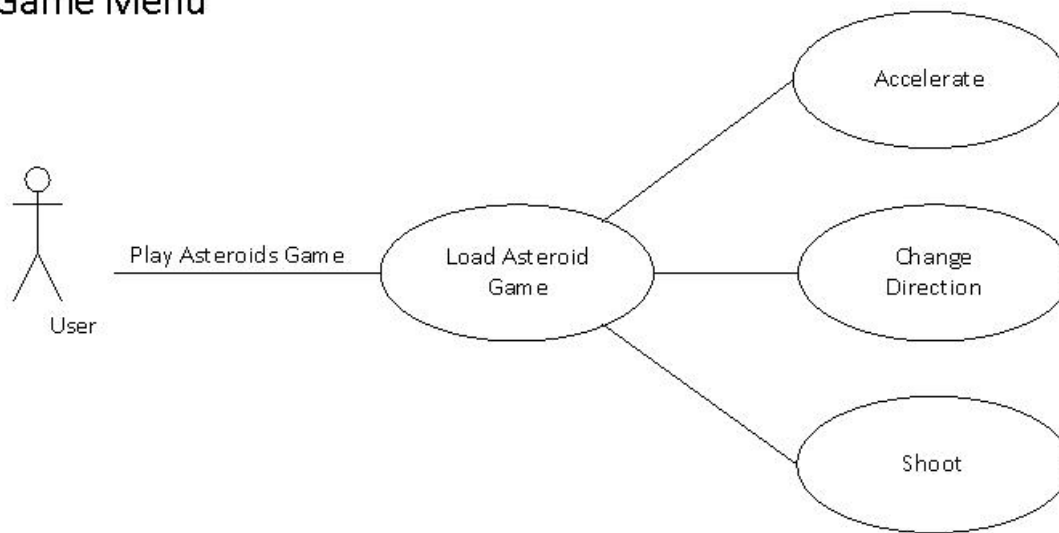


Diagram 1 Game Menu Use Case Diagram

## Display Screen

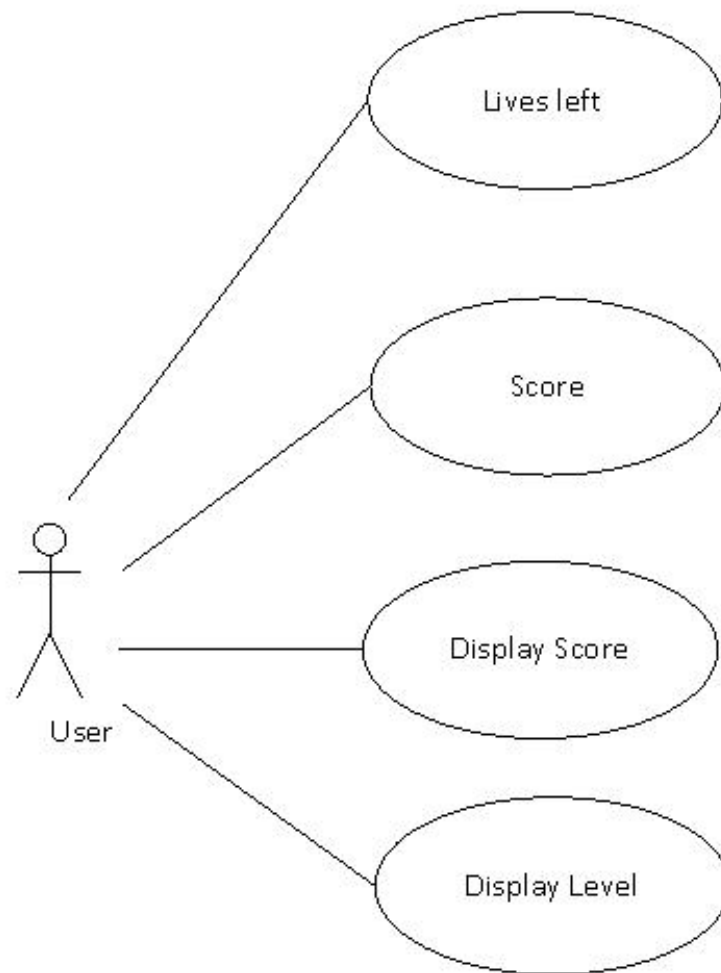


Diagram 2 Display Screen Use Case Diagram

## Game Object Interaction

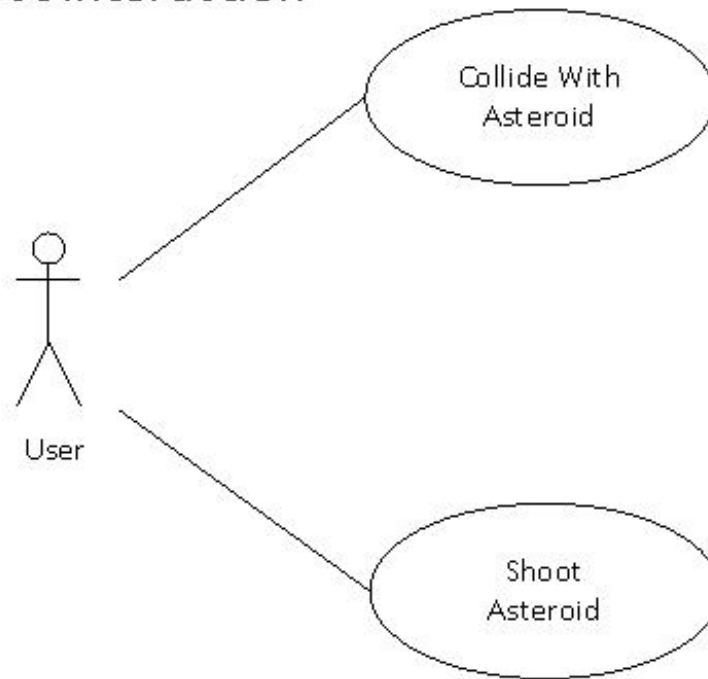


Diagram 3 Game Object Interaction Use Case Diagram

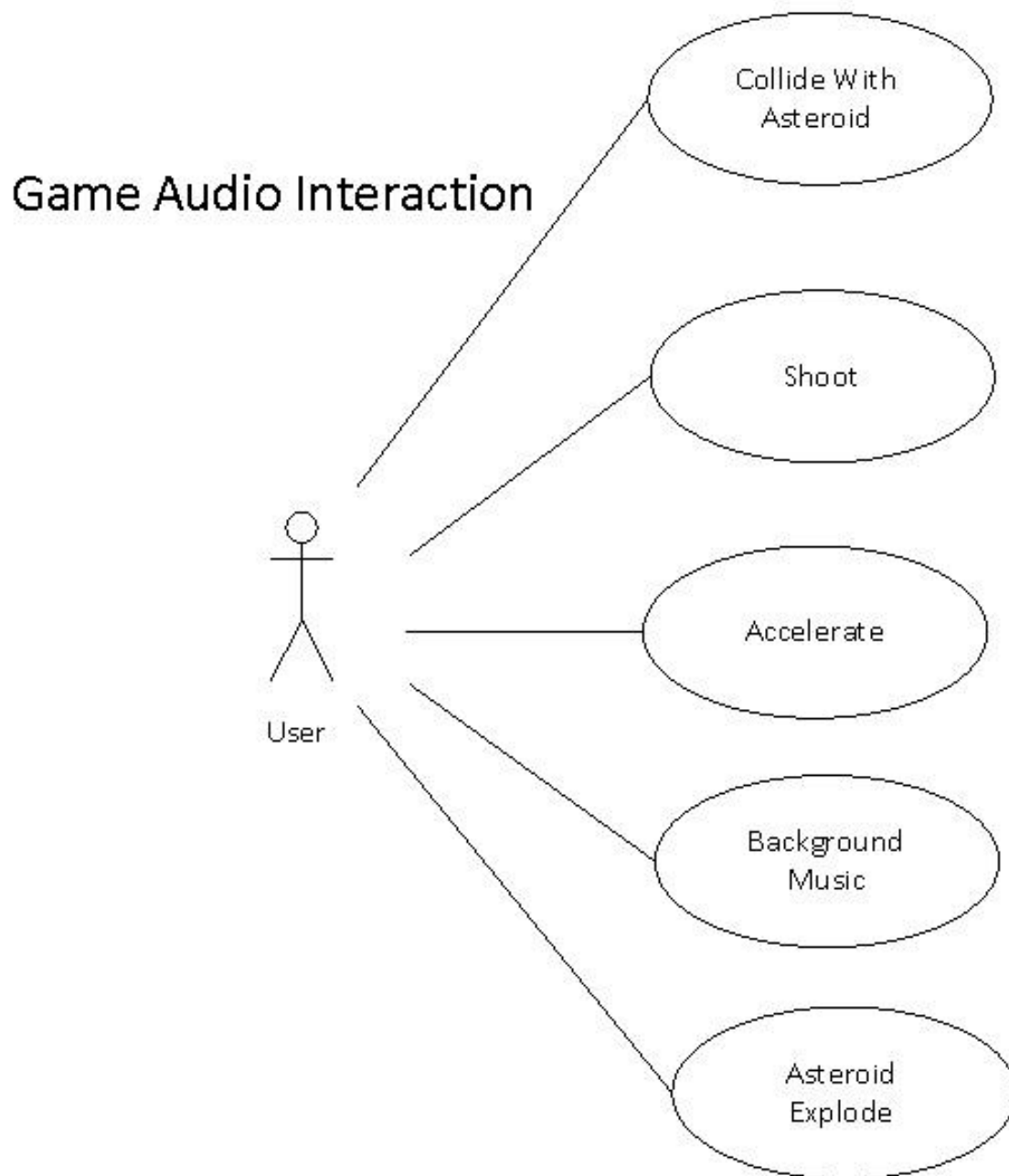


Diagram 4 Game Audio Interaction Use Case Diagram

## 2.3 User Characteristics

This project should be implemented such that even users with little or no experience with the game will have no difficulty playing. Users who have basic computer skills should have no problem playing.

## **2.4 Constraints**

This software should appeal to users of all ages. It should be implemented in a way that is simple so that players with very little computer experience or knowledge can play and enjoy. The game interface should engage people who are familiar with the game, but it should be clear enough so that the players do not need additional knowledge to use the interface.

## **2.5 Assumptions and Dependencies**

The primary assumption is that all the players of this game have computers that have java installed. This is highly likely, as java usage is quite widespread. A secondary assumption is that all computers have keyboards, sound systems, etc. Once again, this is a reasonable assumption, given that keyboards are required to even install an operating system, and most computers have sound systems - and even if they don't, the game will still be playable.

# **3. System Features**

## **3.1 Functional Requirements**

### **3.1.1 Menu Screen**

#### **3.1.1.1 Brief Description of feature**

When the game application is first opened, the Menu screen is displayed. From here, the player has 5 options: Single – Player Mode, Two – Player Mode, LeaderBoard, Tutorial and Quit.

#### **3.1.1.2 Stimulus/Response sequence**

No stimulus is required to get to the Menu screen other than opening the game application. At this stage, the player can choose between 3 options (listed above) by either:

- Select the wanted option using up/down arrow keys, and press “Enter” key.
- Highlight (hover mouse over) wanted option , and select using left mouse button or the “Enter” key.

#### **3.1.1.3 Associated functional requirements**

**[R3.1.1.3.1]** When the player selects Single – Player Mode, the Menu screen shall transition to the Single – Player Mode screen. [Essential, Easy]



**[R3.1.1.3.2]** When the player selects Leaderboard, the Menu screen shall transition to the Leaderboard screen. [Essential, Easy]

**[R3.1.1.3.3]** When the player selects Two – Player Mode, the Menu screen shall transition to the 2 – Player Mode screen. [Essential, Easy]

**[R3.1.1.3.4]** When the player selects Tutorial Mode, the Menu screen shall transition to the Tutorial

**[R3.1.1.3.5]** When the player selects Quit, the game application closes. [Optional, Easy]

## **3.1.2 Single – Player Mode**

### **3.1.2.1 Brief Description of feature**

When the player has transitioned from the Menu screen to Single – Player mode screen, the player will control a single ship capable of moving on a 2D plane and shoot projectiles at Asteroids and Alien crafts.

### **3.1.2.2 Stimulus/Response sequence**

As mentioned above, the ship can move on a 2D surface and shoot projectiles straight ahead. When the player's ship destroys an Alien craft or Asteroids, the Current Score is incremented by 10 points. If the player's ship touches an Asteroid, an Alien craft or an Alien craft projectile, then the player's ship is destroyed, and the player loses a life until none are left. When there are none left, the game exits - at which point the player is given the option to record their score. Exiting from the game returns the player to the main menu. Moreover, in Single – Player Mode, there will be 3 inner panels on the top right corner of the screen: Current Score, Lives and Level.

### **3.1.2.3 Associated functional requirements**

**[R3.1.2.3.1]** Three panels will be positioned on the top right corner of the screen: current score, lives, bombs, shield points and level. The panels will be constantly updated, and keep track of the player's high score, lives remaining, current shield level, number of bombs and current level. [Essential, Medium]

**[R3.1.2.3.2]** When entering Single – Player mode, the player's ship is initiated at the center of the map. [Essential, Medium]

**[R3.1.2.3.3]** When entering Single – Player mode, the player's ship starts at with Current Score of 0, life stock of 3, a bomb stock of 1, zero shield points and at level 1. [Essential, Easy]

**[R3.1.2.3.4]** When Player 1 or Player 2's ship is destroyed, an Alien craft or an Alien craft projectile, the respective player's life stock is decremented by 1.[Essential ,Easy]

**[R3.1.2.3.5]** If the player's life stock hits 0, a message box with “Game Over” shall appear in the center of the game screen. It should also have a text field for the player to enter their name to save their high score. Once the name has been entered the screen will transition back to the Menu screen. [Essential, Medium]

**[R3.1.2.3.6]** When the final level is finished, a message box with “Victory” shall appear in the center of the game screen. A message box will prompt the player to enter their name so that their high score is saved. After entering the name the screen returns to the Menu screen. [Essential, Easy]

**[R3.1.2.3.7]** When a player finishes a current level, the current level shall be incremented by 1. [Essential, Easy]

**[R3.1.2.3.8]** Definition of a level: see section 3.1.15

### **3.1.3 Leaderboard**

#### **3.1.3.1 Brief Description of feature**

The leaderboard will display the top 10 entries with the highest scores along with the name of the scoring player.

#### **3.1.3.2 Stimulus/Response sequence**

No stimuli is required once on this screen. However, if the player wants to go back to the Menu screen, the “Back” button on the leaderboard screen must be pressed. Accessing the screen done through the use of a menu option; see section 3.1.1.2 for details of button usage.

#### **3.1.3.3 Associated functional requirements**

**[R3.1.3.3.1]** The leaderboard will only display the top 10 entries of the players with the highest scores. [Essential, Medium]

**[R3.1.3.3.2]** The leaderboard will read the information from a text file “highscores.txt” in the game’s root directory. [Essential, Easy]

**[R3.1.3.3.3]** Each entry will display the player's name, the high score, the level reached, the number of asteroids destroyed, the number of aliens destroyed, the number of player deaths. [Essential, Medium]

**[R3.1.3.3.4]** Entries will be displayed from top to bottom in descending order based on the high scores. [Essential, Easy]

**[R3.1.3.3.5]** If the player presses the "Back" button, then it shall return the player to the Menu screen. [Essential, Easy]

### **3.1.4 Two-Player Mode**

#### **3.1.4.1 Brief Description of feature**

When the player has transitioned from the Menu screen to Two – Player mode screen, a second player can play. However, they will not play simultaneously. The 1st player will play until his life stock reaches 0. Then the second player can play until his/her life stock reaches 0.

#### **3.1.4.2 Stimulus/Response sequence**

Refer to Single – player mode [3.1.2.2]. The only difference is that there are 2 players: Player 1 and Player 2. Consequently, there are going to be 2 inner labels, Current Score and Lives for each players. There is going to be 1 label for current level.

#### **3.1.4.3 Associated functional requirements**

**[R3.1.4.3.1]** Three panels will be positioned on the top right corner of the screen: current score, lives, bombs, shield points and level. The panels will be constantly updated, and keep track of the player's high score, lives remaining, current shield level, number of bombs and current level. [Essential, Medium]

**[R3.1.4.3.2]** When entering Two – Player mode, Player 1's ship is initiated at the center of the map.[Essential, Medium]

**[R3.1.4.3.3]** When entering Two – Player mode, both players start at with Current Score of 0, life stock of 3, a bomb stock of 1, zero shield points and at level 1.[Essential, Easy]

**[R3.1.4.3.4]** When Player 1 or Player 2's ship is destroyed, an Alien craft or an Alien craft projectile, the respective player's life stock is decremented by 1.[Essential ,Easy]

**[R3.1.4.3.5]** If Player 1's life stock hits 0 or beats the final level, then a message box will appear. The message box will state "End of Player 1". It will also allow Player 1 to enter their name so that their high score is submitted to the leaderboard. Once name has been entered, Player 1's turn comes to an end.

**[R3.1.4.3.6]** At the end of Player 1 turn, a message appears in the center of the game screen stating "Player 2 Turn" with a countdown of 5 seconds after that game resets to level 1 and Player 2 is loaded in. [Desirable, Medium]

**[R3.1.4.3.7]** If Player 2's life stock hits 0 or beats the final level, then a message box will appear. The message box will state "End of Player 2". It will also allow Player 2 to enter their name so that their high score is submitted to the leaderboard. Once name has been entered, Player 2's turn comes to an end. [Desirable, Medium]

**[R3.1.4.3.8]** At the end of Player 2's turn, the game displays both Player 1 and Player 2's high score in the center of the game screen and displays "Player 1 Wins" or "Player 2 Wins" depending who has the higher score. If both have an equal score, then the game displays "It's a tie!" in the center of the game screen. [Desirable, Medium]

**[R3.1.4.3.9]** When a player finishes a current level, the current level shall be incremented by 1. And the player continues on to the next level. [Essential, Easy]

## **3.1.5 Tutorial Mode**

### **3.1.5.1 Brief Description of feature**

When accessed, a page will appear giving a brief overview of the controls and any special items of interest, such as more complex special features.

### **3.1.5.2 Stimulus/Response sequence**

See section 3.1.3.2.

### **3.1.5.3 Associated functional requirements**

**[R3.1.5.3.1]** An information page displaying control information (i.e. use up arrow to move forward) and special feature information (i.e. usage of special gun [optional feature]). [Optional, Medium]

**[R3.1.5.3.2]** If the player presses the “Back” button, then it shall return the player to the Menu screen.  
[Essential, Easy]

## **3.1.6 Game Controls**

### **3.1.6.1 Brief Description of feature**

The basic controls are Up Arrow, Down Arrow, Left Arrow, Right Arrow, Space Bar, and P.

### **3.1.6.2 Stimulus/Response sequence**

The only stimuli required for this feature are listed above.

### **3.1.6.3 Associated functional requirements**

**[R3.1.6.3.1]** The Up Arrow key shall accelerate the Player ship. [Essential, Medium]

**[R3.1.6.3.2]** The Down Arrow key shall activate Player’ bomb. [Essential, Medium]

**[R3.1.6.3.3]** The Left Arrow key shall rotate the Player ship counter-clockwise at constant angular velocity with the ship center as the center of rotation. [Essential, Medium]

**[R3.1.6.3.4]** The Right Arrow key shall rotate the Player ship -clockwise at constant angular velocity with the ship center as the center of rotation. [Essential, Medium]

**[R3.1.6.3.5]** The Space Bar key shall shoot projectiles from the front of the Player ship. [Essential, Medium]

**[R3.1.6.3.6]** The P key shall pause the game at the frame when the key was pressed. It shall be unpaused when P is pressed again. [Optional, Medium]

**[R3.1.6.3.7]** The Backspace key activates the shields. [Optional, Medium]

## **3.1.7 Player Ship**

### **3.1.7.1 Brief Description of feature**

The player's ship will be controllable by the player, and will be of simple triangular shape with some key animations, such as destruction and acceleration. It will be used to launch projectiles which destroy asteroids or aliens.

#### **3.1.7.2 Stimulus/Response sequence**

If the ship touches an Asteroid or gets hit by an enemy projectile, the player's ship shall be destroyed and one life shall be subtracted from the player's current life stock.

As described in section 3.1.6.3, the player shall have control of the ship.

As described in section 3.1.8, the ship shall be subject to Newtonian physics.

#### **3.1.7.3 Associated functional requirements**

**[R3.1.7.3.1]** The player shall be able to control the ship as described in section 3.1.6.3. [Essential, Medium]

**[R3.1.7.3.2]** The player ship shall be of triangular shape, and will not change even if a new ship is created or the game restarted. The ship's triangle representation may or may not be of a solid color, depending on implementation difficulty as determined during code development. [Essential, Medium]

**[R3.1.7.3.3]** Every time the player ship spawns, it has a 3 seconds of invulnerability, which means it cannot lose any points from its shields or life stock. [Optional, Hard]

### **3.1.8 Physics Engine / Environment**

#### **3.1.8.1 Brief Description of feature**

The motion of the player's ship shall be subjected to Newtonian mechanics. Asteroids and aliens will not follow said mechanics, but will instead travel along set paths or directions at fixed speeds.

#### **3.1.8.2 Stimulus/Response sequence**

There are no required stimuli, because the physics of the game are active during the whole game from start to end.

#### **3.1.8.3 Associated functional requirements**

**[R3.1.8.3.1]** When the player's ship gets touched by an Asteroid, an Alien craft or an Alien craft projectile, the ship is destroyed, and the player's life stock is decremented by 1.[Essential, Hard]

**[R3.1.8.3.2]** When the player's ship collides with an asteroid or alien craft while the player ship's shields are active, the rebound motion will be modelled using momentum. The player ship will bounce off but the asteroid or alien craft will continue unaffected [Optional, Hard]

**[R3.1.8.3.3]** Asteroids will have the following physical properties: position, direction, velocity, size and momentum.[Essential, Easy]

**[R3.1.8.3.4]** Alien crafts will have the following physical properties: position, direction and velocity. [Essential, Easy]

**[R3.1.8.3.5]** Player's ship will have the following physical properties: position, velocity, angular velocity, acceleration and momentum. [Essential, Hard]

**[R3.1.8.3.6]** The map shall have environment wraparounds. Going through the top edge shall result into coming from the bottom edge and vice-versa. Going through the left edge shall result into coming from the right edge and vice-versa. [Essential, Hard]

### **3.1.9 Weapon Mechanics**

#### **3.1.9.1 Brief Description of feature**

Player and alien ships have weapon systems that can fire projectiles and destroy asteroids and each other.

#### **3.1.9.2 Stimulus/Response sequence**

When the player fires a projectile, a new projectile is created at the location of the player's ship travelling at fixed velocity in the same direction as the player's ship. The same applies to an alien ship.

When a projectile overlaps with an object, the object is "hit" and destroyed if it is not the object from which the projectile was created (player or alien ship).

#### **3.1.9.3 Associated functional requirements**

**[R3.1.9.3.1]** Both player and alien vessels have a weapon system: they can fire projectiles. [Essential, Medium]

**[R3.1.9.3.2]** The player ship has a maximum rate of fire of 4 shots per second [Essential, Medium]

**[R3.1.9.3.3]** The alien craft has a maximum rate of fire of 1 shot per second. [Essential, Easy]

**[R3.1.9.3.4]** Holding the fire button for 1.5 seconds will launch a spread of 4 projectiles in an arc. The projectile will have a trajectory of 60, 20, -20 and -60 degrees relative to the heading of the ship. [Desirable, Easy]

**[R3.1.9.3.5]** Bomb is limited ammunition. For the bomb to be activate the bomb stockpile count needs to be greater than 0. [Essential, Easy]

**[R3.1.9.3.6]** The player ship can carry a max of 3 bombs. [Essential, Easy]

**[R3.1.9.3.7]** When a bomb is activated it decrements bomb stockpile by 1. [Essential, Easy]

**[R3.1.9.3.8]** When a bomb is activated, it clears the entire screen of asteroids and alien crafts and a explosion sound effect is played immediately after the bomb activation. [Essential, Medium]

**[R3.1.9.3.9]** A projectile fired from an alien craft or the player ship will last for 5 seconds before disappearing. [Essential, Medium]

**[R3.1.9.3.10]** A projectile fired from the player ship cannot harm the player ship. [Essential, Medium]

**[R3.1.9.3.11]** Projectiles have constant velocity; speed should be greater than that of asteroids and player. Exact speed TBD during game development and testing. [Essential, Easy]

**[R3.1.9.3.12]** New projectiles are created at the same location of the ship that fires a weapon, travelling in the same direction as the associated ship. [Essential, Medium]

**[R3.1.9.3.13]** Projectiles are said to “hit” and destroy something when their position overlaps with that of an object, so long as the object is not is not the ship from which the projectile was spawned. (player/alien). [Essential, Hard]



**[R3.1.9.3.14]** The player's ship shall have a max velocity of <TBD>. From this point, the player's ship stays at constant speed. [Desirable, Medium]

## **3.1.10 Shield Mechanics**

### **3.1.10.1 Brief Description of feature**

Shields make the ship invulnerable for a fixed amount of time when active.

### **3.1.10.2 Stimulus/Response sequence**

Shields are activated via a button press [Section 3.1.6.3]. When active, any conflicting requirements in 3.1.10 take precedence over those found in other sections (i.e. 3.1.8 or 3.1.9).

### **3.1.10.3 Associated functional requirements**

**[R3.1.10.3.1]** A player's ship can have 0, 1, 2, or 3 shield points. [Optional, Easy]

**[R3.1.10.3.2]** When a player ship with active shields collides with an asteroid, alien craft, or alien projectile, the player's ship is not destroyed, thus no points are deducted from the player's life stock. Rather, the colliding object is destroyed. Points are deducted based on the object that the player collided with:

Large Asteroid: 3 shield points

Medium Asteroid: 2 shield points

Small Asteroid: 1 shield point

Alien Craft: 1 shield point

Alien Craft Projectile: 1 shield point

[Optional, Medium]

**[R3.1.10.3.3]** Shields can only be activated if the player has more than zero shield points. If the player does not, shields cannot be activated. [Optional, Easy]

**[R3.1.10.3.4]** Once activated, shields remain active for 4 seconds (regardless of shield point count after activation), after which they are deactivated. Shields cannot be reactivated until 4 seconds after deactivation. [Optional, Easy]

**[R3.1.10.3.5]** Shield points are reset to 3 at the beginning of every level.[Optional, Easy]

**[R3.1.10.3.6]** If not explicitly activated by the user via a button press, shields are not active. Shields start as deactivated at the beginning of every level. [Optional, Easy]

### **3.1.11 Score Calculation**

#### **3.1.11.1 Brief Description of feature**

The player's score is based on the number of asteroids and aliens destroyed.

#### **3.1.11.2 Stimulus/Response sequence**

Destroying an asteroid or an alien changes the score, per 3.1.11.3.

#### **3.1.11.3 Associated functional requirements**

**[R3.1.11.3.1]** When the player's ship destroys an Alien craft, the Current Score shall be incremented by 200. [Essential, Easy]

**[R3.1.11.3.1]** When the player's ship destroys a small Alien craft, the Current Score shall be incremented by 1000. [Essential, Easy]

**[R3.1.11.3.2]** When the player's ship destroys a Large Asteroid, the Current Score shall be incremented by 20. [Essential, Easy]

**[R3.1.11.3.3]** When the player's ship destroys a Medium Asteroid, the Current Score shall be incremented by 50 [Essential, Easy]

**[R3.1.11.3.4]** When the player's ship destroys a Small Asteroid, the Current Score shall be incremented by 100. [Essential, Easy]

**[R3.1.11.3.5]** Asteroids and alien crafts destroyed by bombs do not count towards the player's score. [Essential, Medium]

### **3.1.12 Asteroids**

#### **3.1.12.1 Brief Description of feature**

The asteroids are the main gameplay aspect of the game. The goal is to destroy them. Their

behaviour and requirements are described below.

### **3.1.12.2 Stimulus/Response sequence**

When an Asteroid is hit by either a player's ship projectile or Alien craft projectile, it either splits into smaller pieces or disappears, depending on the size. See 3.1.12.3 for details.

### **3.1.12.3 Associated functional requirements**

**[R3.1.12.3.1]** There are three asteroid sizes: small, medium and large. [Essential, Easy]

**[R3.1.12.3.2]** When a small asteroid is destroyed, no further asteroids are spawned. [Essential, Easy]

**[R3.1.12.3.3]** When a medium asteroid is destroyed, 2 small asteroids are spawned. [Essential, Easy]

**[R3.1.12.3.4]** When a large asteroid is destroyed, 2 medium asteroids are spawned. [Essential, Easy]

**[R3.1.12.3.5]** Asteroids may pass through each other without collision. [Essential, Hard]

**[R3.1.12.3.6]** Asteroids are spawned with a random direction, random speed, and random size. If asteroids are spawned due to the destruction of another asteroid then their initial position is the original position of the destroyed asteroid, else they have a random position. [Essential, Easy]

**[R3.1.12.3.7]** Asteroids are only spawned at the beginning of a level. The number and size will depend on the difficulty level. [Essential, Easy]

## **3.1.13 Alien Craft and AI**

### **3.1.13.1 Brief Description of feature**

The alien AI will maneuver the alien craft (also referred to as "ship") and aim and shoot projectiles.

### **3.1.13.2 Stimulus/Response sequence**

Aliens will spawn randomly during the course of a level.

### **3.1.13.3 Associated functional requirements**

**[R3.1.13.3.1]** Alien craft can be destroyed with one projectile hit from player ship or by colliding with an asteroid. [Essential, Easy]

**[R3.1.13.3.2]** The alien craft will be no smaller than the player vessel nor bigger than a small asteroid.

**[R3.1.13.3.3]** A maximum of one alien craft may be present in a level at once. [Desirable, Easy]

**[R3.1.13.3.4]** The alien AI will actively try to predict where the player will be next and fire a shot at that position. [Optional, Hard]

**[R3.1.13.3.5]** If the requirement above is not implemented, the alien craft will shoot projectiles in random directions at a rate of 1 per second. [Essential, Medium]

**[R3.1.13.3.6]** The alien craft will be represented by an icon similar in style to the common perception of a UFO. The exact representation will be determined by the freely available icons on the internet at the time of development. [Essential, Easy]

**[R3.1.13.3.7]** The alien craft will move on a hard coded predetermined path. [Essential, Easy]

**[R3.1.13.3.8]** The alien craft should actively avoid asteroids. [Optional, Hard]

**[R3.1.13.3.9]** Alien crafts can pass through each other. [Essential, Easy]

**[R3.1.13.3.10]** Alien craft will be spawned and come from a random edge of the game window and at a random time during gameplay. [Essential, Medium]

## **3.1.14 Bonus Drops**

### **3.1.14.1 Brief Description of feature**

Bonus drops are objects placed at random locations around the map that have special effect on the player and/or his ship, if the player's ship collides with it.

### **3.1.14.2 Stimulus/Response sequence**

During single or Two – player mode gameplay, there are bonus drops that appear at random times. When a ship flies on it, the ship gains the bonus' offered enhancement.

### **3.1.14.3 Associated functional requirements**

**[R3.1.14.3.1]** A bonus drop randomly appears after an alien craft has been destroyed. [Essential, Easy]

**[R3.1.14.3.2]** Bonus drops are removed once the player passes over them and acquires the associated feature.[Essential, Easy]

**[R3.1.14.3.3]** Only the player's ship can benefit from the Bonus Drop. [Essential, Easy]

**[R3.1.14.3.4]** When the player ship touches a Bonus Drop the player shall gain at random:

- 1 additional life
- 1 additional bomb
- Shields are fully recharged (shield points reset to 3). [Essential/Essential/Optional,Easy]

**[R3.1.14.3.5]** If the Bonus Drop is not touched by the player's ship after 7 seconds it will dissappear. [Essential, Easy]

**[R3.1.14.3.6]** Asteroids and alien craft can pass through Bonus Drops, but cannot benefit from them, and will not remove the bonus drop. [Essential, Easy]

### **3.1.15 Difficulty Level**

#### **3.1.15.1 Brief Description of feature**

In order to prolong the play time of the game, a difficulty feature is integrated. When reaching a higher level, the player shall notice a higher frequency of newly spawned Asteroids and Alien crafts.

#### **3.1.15.2 Stimulus/Response sequence**

When the player “defeats” the level, in other words destroys all Asteroids and Alien crafts on the given level, then the player shall proceed to the next level until the final level is reached. The player starts by default at level 1 in both Single – Player mode and Two – Player mode.

#### **3.1.15.3 Associated functional requirements**

**[R3.1.15.3.1]** When all Asteroids and Alien crafts are destroyed, the player shall proceed to the next level. The first level is 1, the last level will be determined during the testing phase. [Essential, Medium]

**[R3.1.15.3.2]** Each time a player goes up 1 level, there will be 5 percent more Asteroids, 5 percent more Alien crafts, and the Alien crafts shall appear at a rate of 5 percent more frequently. The speed

at which the asteroids will travel will also increase by 10 percent per level. The drop rate of Bonus Drops will be decreased by 10 percent per level. [Essential/Desirable (not all need to be implemented), Medium]

### **3.1.16 Graphics / Animations**

#### **3.1.16.1 Brief Description of feature**

Graphics are a core feature of the game, as they are nearly the only output from the program that the user receives, the other one being sound. Most of the graphics implementation will be handled by Java libraries.

#### **3.1.16.2 Stimulus/Response sequence**

Stimuli (that not handled by Java libraries) are limited to the destruction of an asteroid, alien craft, or player ship, as well as player ship acceleration. Refer to the appropriate sections for more details.

#### **3.1.16.3 Associated functional requirements**

**[R3.1.16.3.1]** When an asteroid is destroyed, an asteroid explosion animation will be drawn at the position of the destroyed asteroid. [Essential, Medium]

**[R3.1.16.3.2]** Implement core graphics functionality, such as drawing windows.[Essential, Hard]

**[R3.1.16.3.3]** When the player's ship is destroyed, a ship explosion animation shall be drawn at the player's destroyed ship position. [Essential, Medium]

**[R3.1.16.3.4]** When an alien craft is destroyed, a ship explosion animation shall be drawn at the position of the alien craft. [Essential, Medium]

**[R3.1.16.3.5]** When the player ship accelerates, an animation for the thruster activating shall be displayed. [Essential, Medium]

**[R3.1.16.3.6]** When a player ship spawns, a flickering animation shall be displayed on the player ship for the duration of its invulnerability. [Essential, Medium]

### **3.1.17 Sounds**

#### **3.1.17.1 Brief Description of feature**

The game will contain a sound engine that will play various music and sound effects.

### **3.1.17.2 Stimulus/Response sequence**

Music will be played depending on the interface (i.e. menu, main game) the user is currently at. Sound effects will play when events take place in the game such as collisions, movement and shooting.

### **3.1.17.3 Associated functional requirements**

**[R3.1.17.3.1]** When an asteroid is destroyed, an asteroid explosion sound will play. [Essential, Easy]

**[R3.1.17.3.2]** When the player ship is destroyed, a ship explosion sound will play. [Essential, Easy]

**[R3.1.17.3.3]** When an alien craft is destroyed, a ship explosion sound will play. [Essential, Easy]

**[R3.1.17.3.4]** When an alien craft or player ship fires a projectile, a gun shot will play. [Essential, Easy]

**[R3.1.17.3.5]** When a player ship is hit with shields active, a shield deflection sound will play.  
[Optional, Easy]

**[R3.1.17.3.6]** When a player accelerates, play the thrusters sound. [Optional, Easy]

**[R3.1.17.3.7]** In the main menu, in the leaderboard, and during single and two-player mode game, the game will play the standard theme song. [Essential, Easy]

**[R3.1.17.3.8]** Upon game over due to losing all lives, the game will play the defeat sound (TBD).  
[Optional, Easy]

**[R3.1.17.3.9]** Upon game over due to beating the last level, the game will play the victory sound (TBD). [Optional, Easy]

## **3.2 Quality Requirements**

### **3.2.1 Performance (speed, throughput, storage)**

**[R3.2.1.1]** The game will run at a speed greater than or equal to 20 frames per second. [Desirable, Medium]

**[R3.2.1.2]** The game will require less than 128 Megabytes of memory during runtime. [Desirable, Medium]

**[R3.2.1.3]** Asteroids will require less than 64 Megabytes of hard drive storage. [Desirable, Medium]

**[R3.2.1.4]** The game will take less than half a second to respond to user input. [Essential, Easy]

**[R3.2.1.5]** The game will take less than 2 seconds to transition from Menu to Single - Player mode, Menu to Two - Player mode, Menu to LeaderBoard, Menu to Tutorial screen and vice-versa through the “back” button. [Desirable, Hard]

## **3.2.2 Usability and Human factors**

### **3.2.3 Reliability and availability**

**[R3.2.3.1]** AMBroSIA must have an average uptime of at least 2 hours. [Essential, Medium]

**[R3.2.3.2]** AMBroSIA must be able to run on the latest versions, of the time of writing, of the following operating systems: Windows, Linux, and Mac OS X. [Essential, Easy]

### **3.2.4 Maintainability**

Maintainability is not a requirement for the development of AMBroSIA. The final version of the application will be shipped as is to the client without future support or maintenance.

### **3.2.5 Cost**

**[R3.2.5.1]** Development of AMBroSIA must remain within budget, approximately 330 hours. [Essential, Difficult]

## **3.3 Design Constraints**

### **3.3.1 Constraints on the application or its development**

**[R3.3.1.1]** Development of AMBroSIA will be done in the Java programming language using the Java SDK version 1.7.x [Essential, Easy]



**[R3.3.1.2]** Development of AMBroSIA will be done in the Netbeans IDE environment. [Essential, Easy]

**[R3.3.1.3]** Development of AMBroSIA will be done on Windows and Mac OS X platforms. [Essential, Easy]

**[R3.3.1.4]** AMBroSIA will run on hardware that can be found in modern desktop and notebook PCs. [Essential, Easy]

**[R3.3.1.5]** AMBroSIA will run on Windows, Linux or Mac OS X. [Essential, Easy]

### **3.3.2 External interfaces**

**[R3.3.2.1]** Input may only come from a mouse or keyboard. [Essential, Easy]

**[R3.3.2.2]** Output must only go 1 monitor connected to the system running the application. [Essential, Medium]

### **3.3.3 User Interfaces**

**[R3.3.3.1]** The game will be used by the clients.

**[R3.3.3.2]** There will be only one type of user and they will have a background in software engineering.

**[R3.3.3.3]** The users will have played games before (specifically, other variants of the game “Asteroids”).

### **3.3.4 Error handling**

**[R3.3.4.1]** In the case of an unrecoverable and unhandled error, the application must display a message box with an error number, error name, and a description of the error. Once the user closes the message box the application must end. [Essential, Easy]

## **3.4 Process Constraints**

### **3.4.1 Resources**

### **3.4.1.1 Game Materials**

For the development of AMBroSIA the following materials are required:

- Graphics and art assets
- Music and sound effects

### **3.4.1.2 Human Resources**

The development of AMBroSIA will require programmers with the following skillsets:

- Strong implementation skills in OOP languages. Java is preferred.
- Good knowledge of algorithms and data structures
- Good knowledge of mechanics for the implementation of the physics engine.
- Gaming experience to allow good game design that will satisfy most users of AMBroSIA.

No other human resources will be used, requiring some programmers to dedicate time to the following tasks (beyond programming) as required:

- Project documentation
- Testing
- Project management (team coordination, code base management)

### **3.4.2 Standards**

[R3.4.3.1] Only standard Java libraries as well as those for which Prof. Zeng gives permission will be used for the development of AMBroSIA. [Essential, Easy]