INTRODUCTION

In this course we try to imitate Space Invaders video game that is released in 1978. In this design document I will explain how ı implement each system of the game,like sprite system, collsion system and shield system.Which data structures that i use on hierarchy and UmL of each system.I will also mention some of methods in my code.

There are there main system in this game.Core systems are Collision system,Sprite System, and GameObject class and derived class from it.There are also some helper Systems like pull ot desired image or texture manager controls textures etc.

Features of the game

1.Alliens Move accordingly
2.Alliens Animate Accordingly
3.Bombs are working   (minor bug)
4.Missile work accordingly
5.All of the Collisions work properly
6.Ship moves
7.Level system is up to 3
8.Score System works   (minor bug)
9.Sound System works   (has bugs)
10Shield System works
11.Missing Feature
12.2 player is missing
You tube Link :http://http://www.youtube.com/watch?v=HVXoAKbqBTc&feature=youtu.be

Controls
   LEFT and RIGHT arrow for left and right UP for shoot missle , DOWN for debug mode A for select in menu

BUGS
1.Sometimes bombs are dissapeared when they didnt even go to top
2.Sound of Allien when die some tims not playing(fastes one)
3.Sometimes when u hit allien with missle it does not die but contiune to live as Explosion Image
4.When Super collide with Shield it deletes collison object but no remove from draw list.
5.UFO stacks at the wall and prevent you go to next level
6.Number of Alliens reduced their speed increase but framerate of their animation is not

Overwiev

Sprite System

After assigment two ı studied singleton and flyweight desing pattern. In this final version of the game i implemented Singleton to SpriteManager Class also FlyWeight to Sprite class.Another change is SpriteManager is not derived from Game class.After adding collision and other systems to the game SpriteManager Class become main draw class.Sprite Manager access each sprite Class

draw method in the linked list .All of Sprites and Collision Object Draw in SpriteManagers Draw function.Sprite Manger class also used for changing directions of the alliens from sprite list.This class use link list as data structures to store each sprites of gameobjects to draw.Also Collision list for all collisionObjects in the GameObject. So Sprites and Collision Objects associated with SpriteManager .

     In this diagram we see that Sprites and Collison is listed in LinkList and methods that
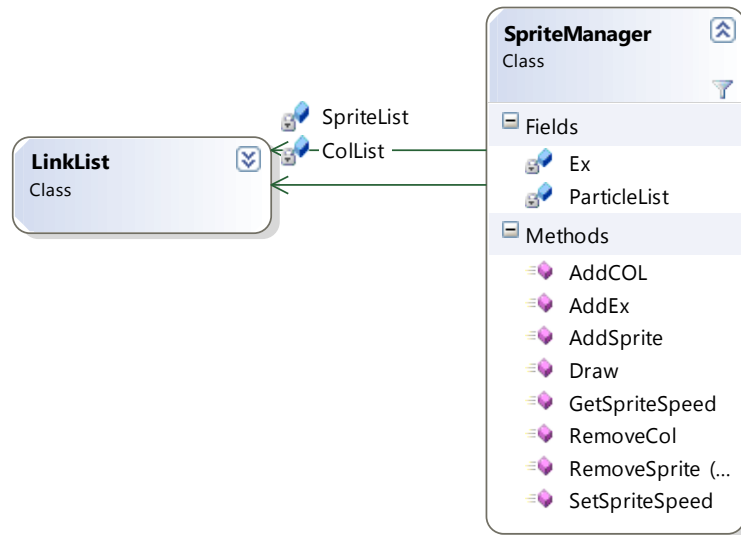
needed for functionlay of manager like adding or removing Sprites or Collision Object for Draw.

     Sprite Class is Main Class that draw images.It contains texture data,ımage data and other properties for drawing Images.After I implement flyweight patter to it.There are three main class for sprite.One is Main Sprite Class it contains all othe methods for setting and getting neccessary data.Also In constucter according to sprite type it call appropriate base class for datas that are share similar property.My implementation of Flyweight maybe wrong because what i learn from internet and also book whenever you chance any of base data all of objects share that base data should be chance , At first i thought this property of flyweight is usefull for chancing speed of alliens but it doesnt show up in my code.When ı chance to base class data wia method or function not directly it doesnt have any affect on other objects.FlySprite is Class for Flyweight pattern. One class is Flyweight factory which selects proper class(objects set) and other is base class that most of gameobjets shares.

This is the diagram stat show realtion between Sprite and FlayspriteClass.
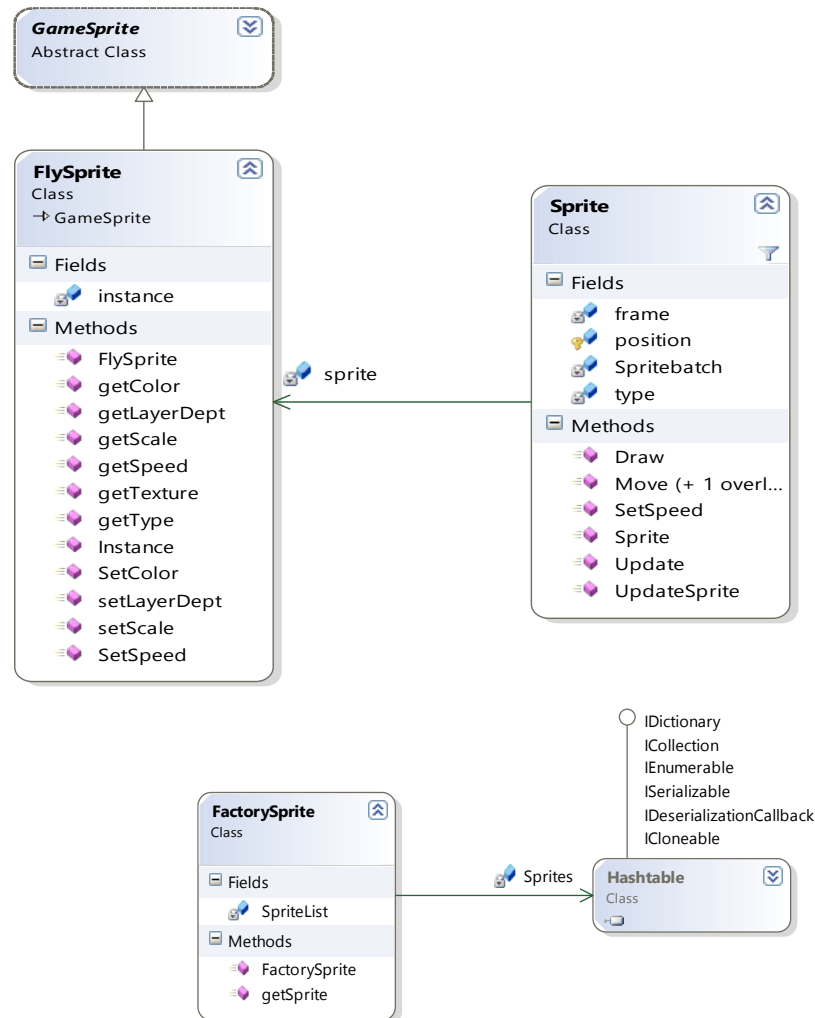
Factory sprites is list that contains FlySprite or another in this case there is only one

CollisionObject

Collision Object is the one of the main objects for GameObjects along with sprite. It is needed for bounding box collision.So its basicly rectangle cover SpriteObjects.But not all objects have images,Some of them only have collsion rectangle like walls colums,super.Collision object has draw function to draw on screen and SpriteManager class iterate this method for each Colliso object in the list.Collision Object has association with sprite class for GameObhects that have image.Collision object doesnot move itselves it get neccessary coordinates from sprites or another collision object association with sprites.For example Colums, GameObject without sprite are Union

of Collision Objects in Group related with Allien game object.
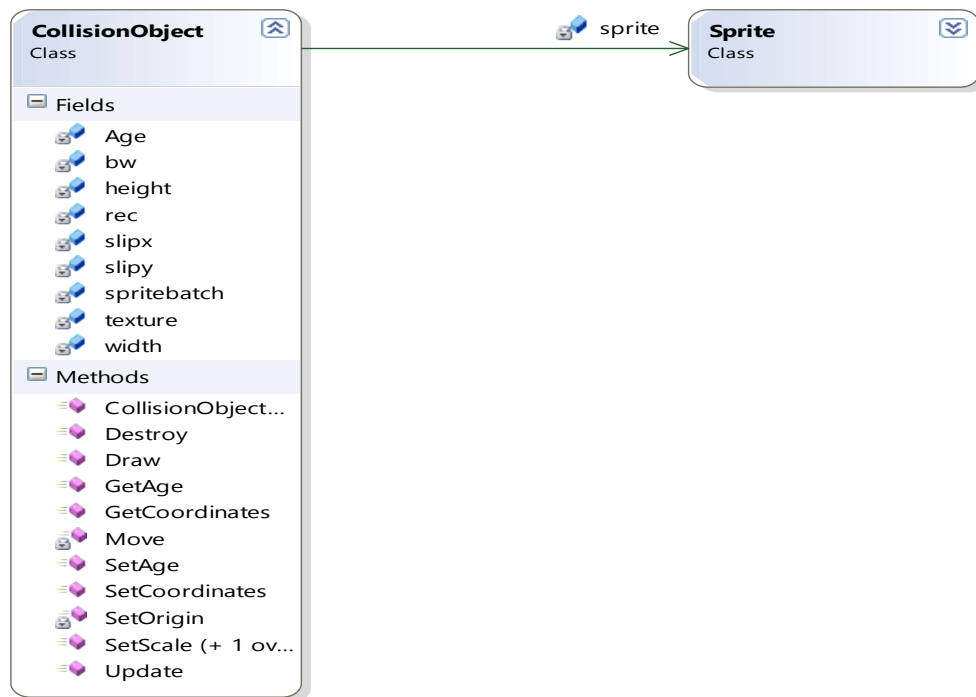
GameObject Class

GameObject class is abstact class for all other derived class ,These are Ship,Allien,Bomb,UFO,Wall,Colums,Super.Each of this object some role in the game.Main property of these object are they are all share visitor pattern for collision.I will mention this Class later in -depth

GameObject
Abstract Class

Fields
- 🔑 colObj
- 🔑 name
- 🔑 sprite
- 🔑 type

Methods
- GameObject (+...
- GetCol
- GetSprite
- Update (+ 1 ov...
- VisitAlien
- VisitBomb
- VisitMissle
- VisitShield
- VisitShip
- VisitSuper
- VisitWall

Allien
Class
→ GameObject

Bomb
Class
→ GameObject

Column
Class
→ GameObject

Missle
Class
→ GameObject

Shield
Class
→ GameObject

Ship
Class
→ GameObject

Super
Class
→ GameObject

UfO
Class
→ GameObject

Wall
Class
→ GameObject

GameObject manager is like as Spritemanager but it responsible for update all of the objects.Like moving alliens,or droping bombs,ship movements.It contains Link list of these objects(Alliens,Bombs). Except singleton ones.(Super,wall,Missle,Ship,) that is not need for list.
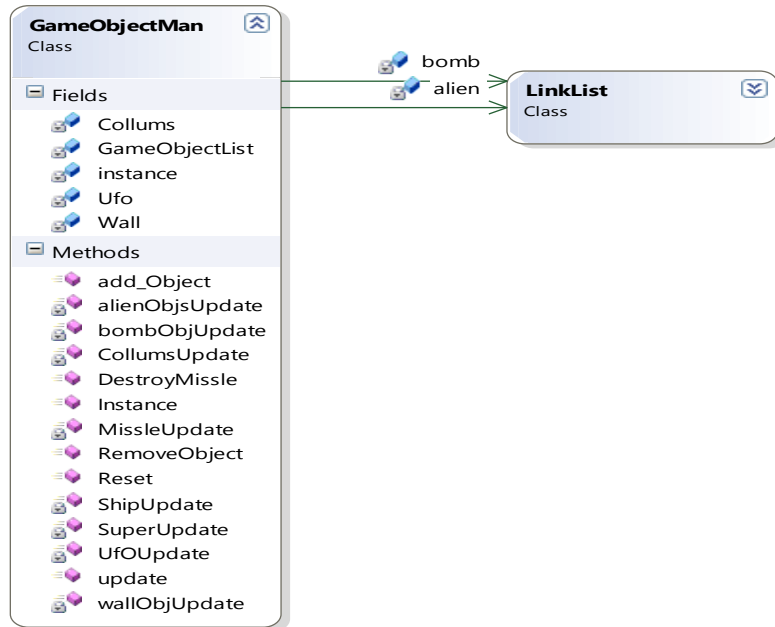
Collision System

As I mentoined above collsion in this game using bounding box,And for decreasing number of comparison we use group of objects that can collide each other.And look for collision according to their collison objects.For example ship and bomb is one group,Allien vs missle is another group.I do not use group manager in this case.Grop manager is only used ofr computing supers border not for collison and collision pair.

CollisionPair
Class

Fields
- type

Methods
- check_Super_vs_ShieldSu...
- checkAlienVsWall
- checkBombsvsMissle
- checkBombsvsShield
- checkBombsvsSuperShield
- checkBombvsShip
- checkMissleVsAllien
- checkMissleVsAllien2
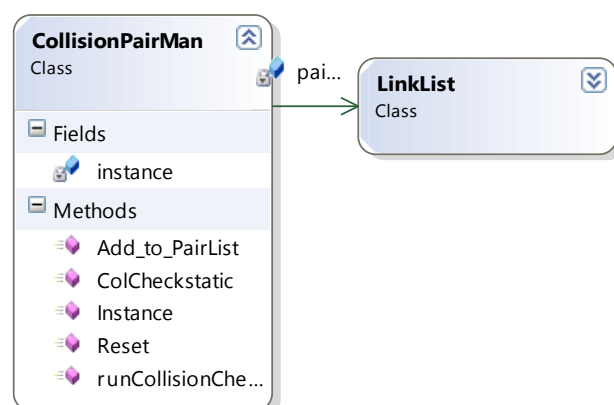- checkMissleVsShield
- checkMissleVsSuper
- checkMissleVsWall
- checkShipvsSuper
- checkSupervsShield
- checkUFOvsMissle
- checkUFOvsWall
- collision
- CollisionPair (+ 2 overloa...
- ColumShieldvsMissle
- ColumShieldvsSuper
- getType
- Run
- SuperShieldvsMissle
- wallcollision

ColB →

ColA →

Group
Class

Fields
- Age
- Border
- group
- type

Methods
- AddToGroup (+...
- CalculateBorders
- Clear
- GetColType
- GetCoordinates
- GetList
- Group
- RemoveFromGr...
- Search

As we see in the digram collsion Pair is the class that make comparison and its assosiated with two group.Of course as Singleton ones group is not needed,Or one group is sufficent. (Ship,Super,as two singleton there is no need to assosiation they are only one) (Bomb vs Ship only one group is needed for comparison)

Some of Comparisons need two or threefunctions,Becasue of hiearcrcy.First missle vs Super, than Column vs Missle(checkmisslevsAllien) and las allien vs missle(checkmisslevsAllien2).Collision Pair is Listed in its manager for iterate all this collisions in one loop.

Collision Pair Manager

CollisionPairMan
Class

pai...

LinkList
Class

Fields
- instance

Methods
- Add_to_PairList
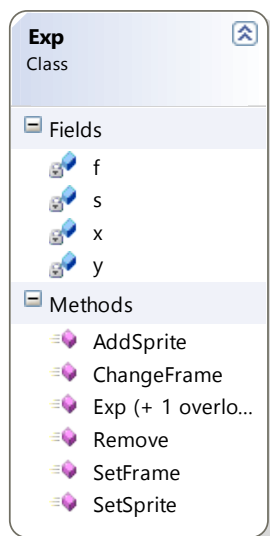- ColCheckstatic
- Instance
- Reset
- runCollisionChe...

Collison Pair manager is simply list of CollisionPair Objects it check and runs all this collisionPairs in the list.It is Singleton like all of the managers.

Helper Classes.

Explosion

Exp class is just add black rectangle for trick player part of Shield looks like destroyed.It has its own draw method and whenever visitor of shield called it will create data given from collison object of shield column.Itis added to Spritemanager to manage all created rectangles to draw.
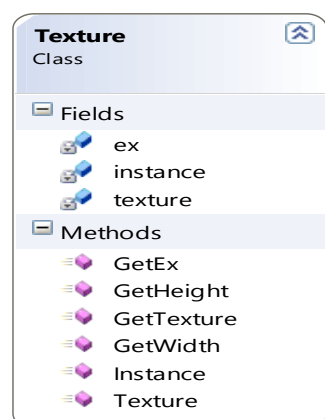
Exp
Class

Fields
- f
- s
- x
- y

Methods
- AddSprite
- ChangeFrame
- Exp (+ 1 overlo...
- Remove
- SetFrame
- SetSprite

Image Class

Image Class is helper class for getting desired image easly.It has calculation mehod for calculate source rectangle that is goint to draw for sprites.I justgive interger value to which image tat ı want to use and it handle itselves ı dont deal anything.

Texture Class

This class created for handle textures bur for now it just load the texture and also get properties of texture because there is one texture file for this game ı didnt go deep on texture managing

Image
Class

Fields
- Frame
- instance

Methods
- drawframe
- Instance

Texture
Class

Fields
- ex
- instance
- texture

Methods
- GetEx
- GetHeight
- GetTexture
- GetWidth
- Instance
- Texture
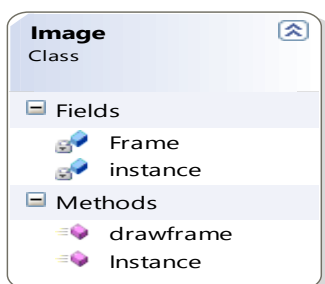
Score System

Score system has three class.Score manager is calculate score for alliens dead.Score screen is printing score and high score on screen.File Manager is getting an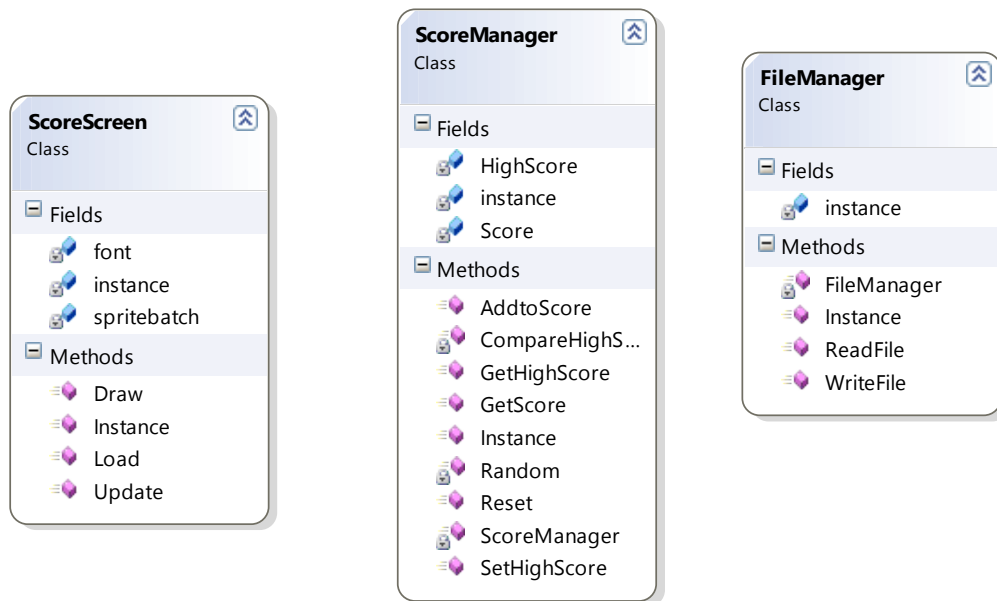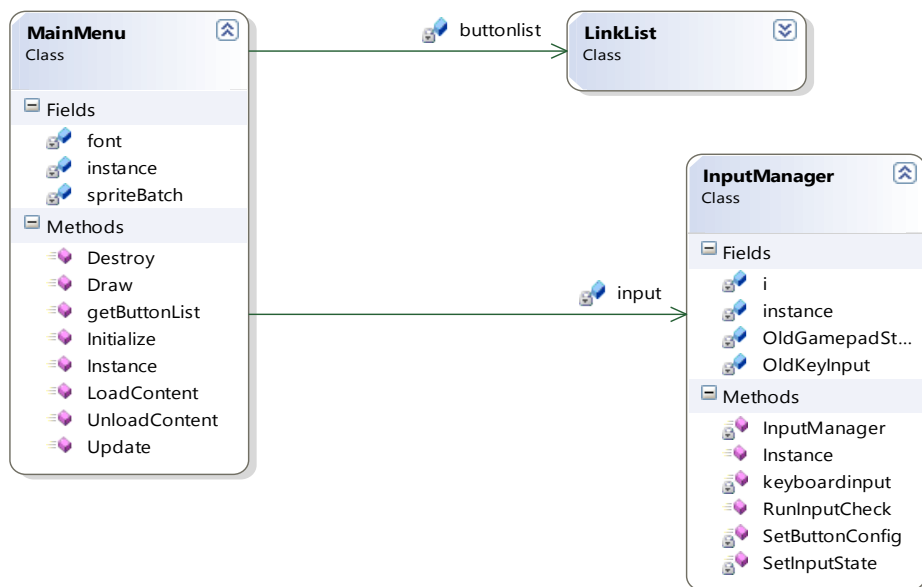d writnig highscore to file. Score manager its own draw method and while all other is singleten it just intance and get needed data from them

ScoreManager
Class

Fields
- HighScore
- instance
- Score

Methods
- AddtoScore
- CompareHighS...
- GetHighScore
- GetScore
- Instance
- Random
- Reset
- ScoreManager
- SetHighScore

FileManager
Class

Fields
- instance

Methods
- FileManager
- Instance
- ReadFile
- WriteFile

ScoreScreen
Class

Fields
- font
- instance
- spritebatch

Methods
- Draw
- Instance
- Load
- Update

Menu System

Menu system has two main section one is Unupdateble images and other is buttons.Menu is load Unupdatable Class in its load method.But main porperty or MainMenu Class is update and draw buttons.Other images drawing hande by another Class.Menu system is assosiated with input manager for controling buttons.It updates buttong according to input from Input Manager.

MainMenu
Class

Fields
- font
- instance
- spriteBatch

Methods
- Destroy
- Draw
- getButtonList
- Initialize
- Instance
- LoadContent
- UnloadContent
- Update

buttonlist

LinkList
Class

input

InputManager
Class

Fields
- i
- instance
- OldGamepadSt...
- OldKeyInput

Methods
- InputManager
- Instance
- keyboardinput
- RunInputCheck
- SetButtonConfig
- SetInputState

UnUpdatable Class

This class handles drawing of images and textsprites in MainMenu.It loads list Sprites ofimages and also list of textobject that draw itselves.All ot the text labels created in UnUpdatable Class and TexLabel draw its string according to its created name
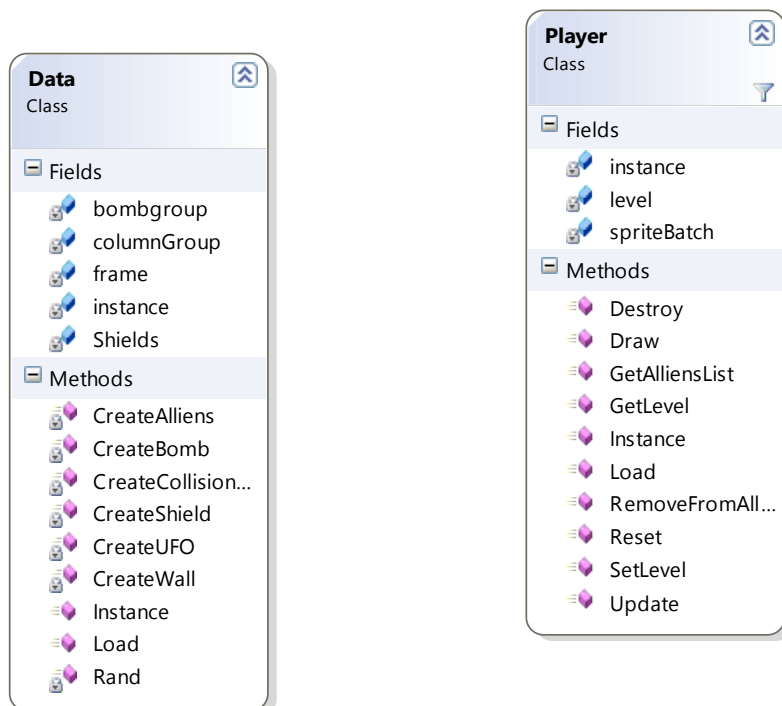
TextLabel
Class

Fields
- color
- font
- name
- position
- scale
- spriteBatch

Methods
- Draw
- LoadFont
- SetName
- SetScale
- TextLabel

LinkList
Class

SpriteLabel
TextLabels

UnUpdateable
Class

Fields
- instance

Methods
- Create
- Destroy
- Draw
- GetInstance
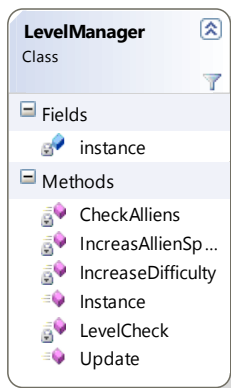- Instance
- LoadContent
- LoadSpriteLabels
- LoadTextLabels
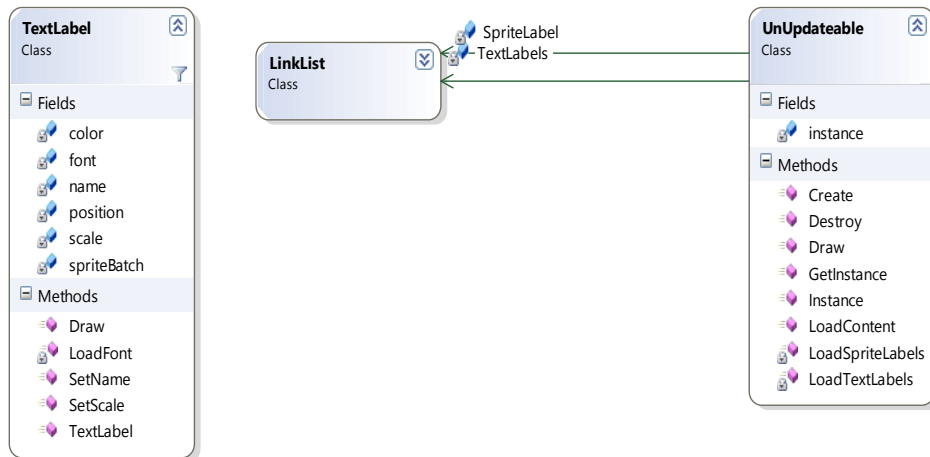
Player Class is Gamplay Class that all of GameObjects Loads, Updates,Reset and Drawed.When Player select play This class responisble for all of the game functioning. Reset is reset game back to begining when player dies or level is clear.

Data
Class

Fields
- bombgroup
- columnGroup
- frame
- instance
- Shields

Methods
- CreateAlliens
- CreateBomb
- CreateCollision...
- CreateShield
- CreateUFO
- CreateWall
- Instance
- Load
- Rand

Player
Class

Fields
- instance
- level
- spriteBatch

Methods
- Destroy
- Draw
- GetAlliensList
- GetLevel
- Instance
- Load
- RemoveFromAll...
- Reset
- SetLevel
- Update

Data class is helper for Player class to create allien grid , create shields,bombs and other game objects also it create collision group and pairs for collison Objets.
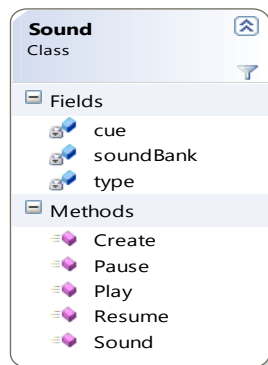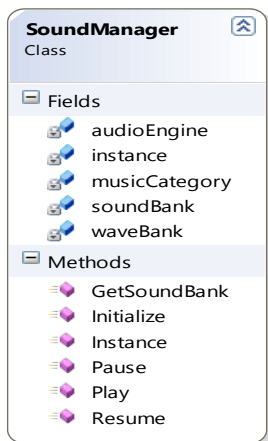
Level System

Level Manger is handles to level .Like fasten up alliens when dies or chance sound, Set up

LevelManager
Class

Fields
- instance

Methods
- CheckAlliens
- IncreasAllienSp...
- IncreaseDifficulty
- Instance
- LevelCheck
- Update

new alliens high speed when player clear current level.
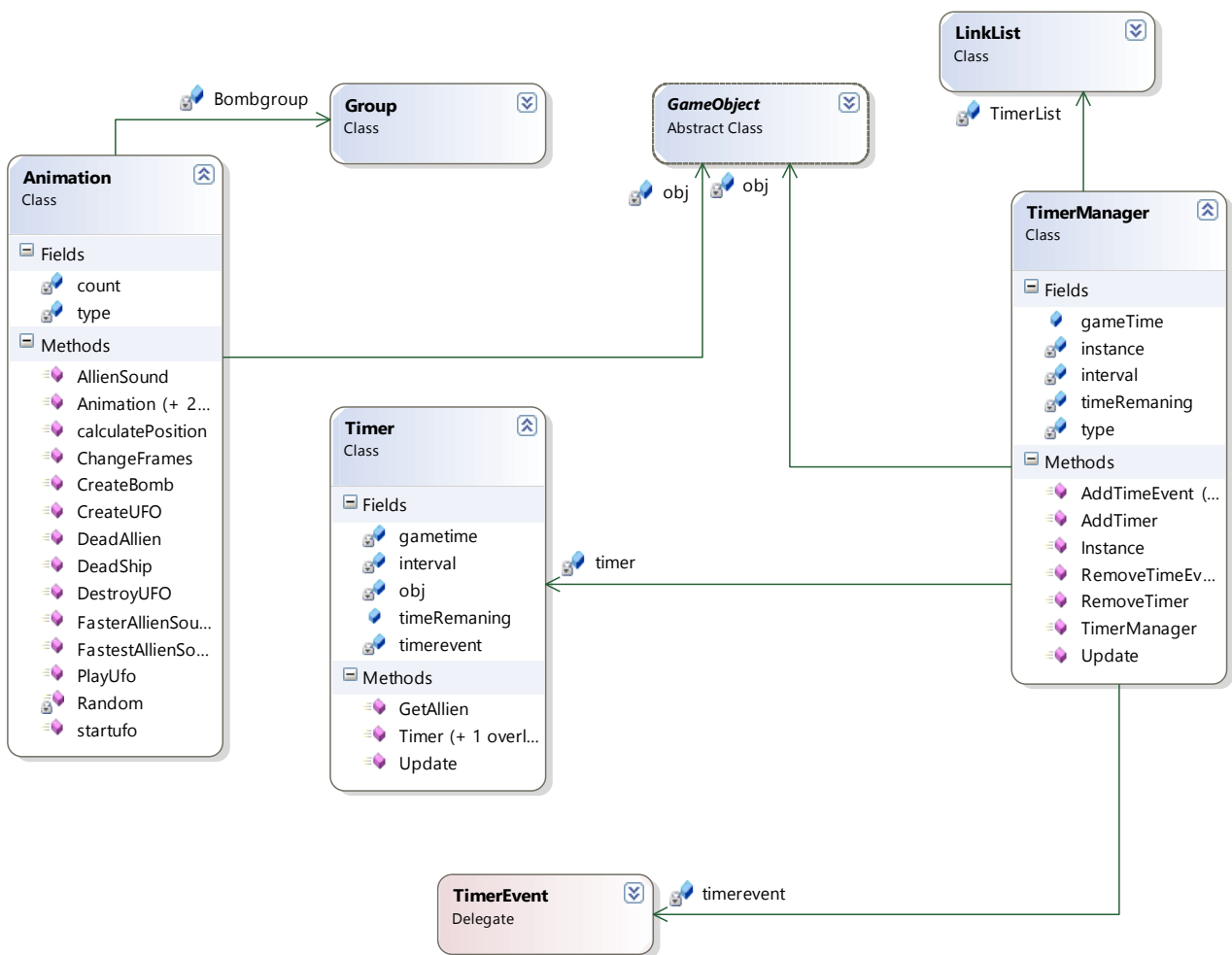
SoundSystem

Sound Manager is responisble for play sounds according to given type.It creates sound object and Sound object select ist type and creteaccordin to it.I had a problem for implementing this .First i thought link list of sound objects but this object become null after some time goes on. So choose create a new sound every time tis called.Resume method is for playin repeatedly but ı count do it with timer to catch proper frequence.So ı create a another sound using Xact for allien sound

SoundManager
Class

Fields
- audioEngine
- instance
- musicCategory
- soundBank
- waveBank

Methods
- GetSoundBank
- Initialize
- Instance
- Pause
- Play
- Resume

Sound
Class

Fields
- cue
- soundBank
- type

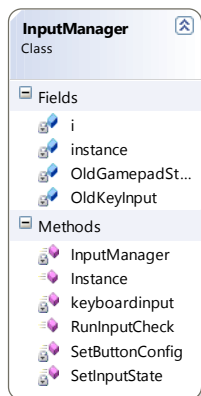Methods
- Create
- Pause
- Play
- Resume
- Sound

so when alliens die it just change sound.

Timer System

This system responsble for all animation of the game also sound,Timer manager manages all of the timers when time is up in one timer it calback its method and it invoke animation or sound.For sound and animation its most important Class because animation and sound repeat is going with time
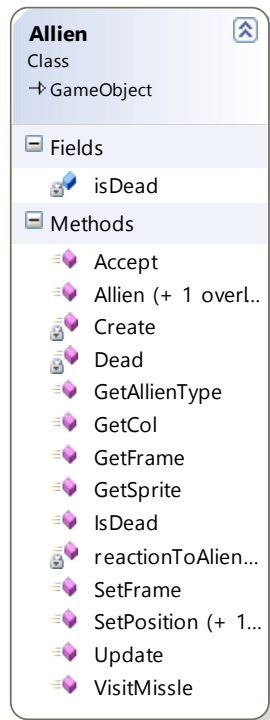
Class Diagram

LinkList
Class

Group
Class

Bombgroup

GameObject
Abstract Class

TimerList

obj   obj

Animation
Class

Fields
- count
- type

Methods
- AllienSound
- Animation (+ 2...
- calculatePosition
- ChangeFrames
- CreateBomb
- CreateUFO
- DeadAllien
- DeadShip
- DestroyUFO
- FasterAllienSou...
- FastestAllienSo...
- PlayUfo
- Random
- startufo

TimerManager
Class

Fields
- gameTime
- instance
- interval
- timeRemaning
- type

Methods
- AddTimeEvent (...
- AddTimer
- Instance
- RemoveTimeEv...
- RemoveTimer
- TimerManager
- Update

Timer
Class

Fields
- gametime
- interval
- obj
- timeRemaning
- timerevent

Methods
- GetAllien
- Timer (+ 1 overl...
- Update

timer

TimerEvent
Delegate

timerevent

Input Manger is just handle keyboard and gamepad Inputs

InputManager
Class

Fields
- i
- instance
- OldGamepadSt...
- OldKeyInput

Methods
- InputManager
- Instance
- keyboardinput
- RunInputCheck
- SetButtonConfig
- SetInputState

Game Objects

Allien

Allien
Class
→ GameObject

Fields
- 🔧 isDead

Methods
- 🟣 Accept
- 🟣 Allien (+ 1 overl..
- 🔒 Create
- 🔒 Dead
- 🟣 GetAllienType
- 🟣 GetCol
- 🟣 GetFrame
- 🟣 GetSprite
- 🟣 IsDead
- 🔒 reactionToAlien...
- 🟣 SetFrame
- 🟣 SetPosition (+ 1...
- 🟣 Update
- 🟣 VisitMissle

```
private void reactionToAlien(Allien a, Missle m)
    {
       if(Missle.IsAlive()){
         Missle.Instance().Destroy();

         Dead(a);}
       this.sprite.SetFrame(23);

    }
    private void Dead(Allien a)
    {

        this.sprite.SetFrame(23);

        this.isDead = true;

        Animation ani = new Animation(a);


        TimerManager.Instance().AddTimeEvent(this,2, ani.DeadAllien);

        SoundManager.Instance().Play(CueType.AllienKillQue);

        ScoreManager.Instance().AddtoScore(a);
        Player.Instance().RemoveFromAllienList(a);


    }
```
This is vistor method reaction to missle vs Allien

Image of the sprite is changed and new timer for deleting colObj and sprites of Alliens called.I use timer because if ı dont use it effect of explosion(sprite) is not showing up
there is a bug in here sometimes allien does not killed(removed from spritebatch list) contiune to living just chanced its image to explosin image

```
This is the calback funtion regarding allien dead.
 public void DeadAllien()
    {
        GameObjectMan.Instance().RemoveObject((Allien)obj);
```

```
                SpriteManager.Instance().RemoveSprite(((Allien)obj));
                TimerManager.Instance().RemoveTimeEvent((Allien)obj);

          }

        public void AllienSound()
        {
            SoundManager.Instance().Play(CueType.AllienQue);


        }
```
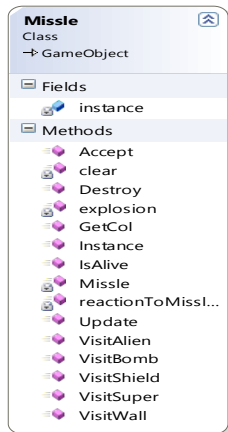This is another calback function for kill sound of Allien

Missle

Missle is a singleton game object that destory alliens ,shields.it inherid all of game object methods,And its created by ship in position of ship

```
 private void reactionToMissle(Shield s,CollisionObject col, Missle m,Group g)
        {
            int x = col.GetCoordinates().X;
            int y = col.GetCoordinates().Y;
            int width = col.GetCoordinates().Width;
            int height = col.GetCoordinates().Height;
             m.Destroy();
             if (g.GetList().Count == 2)
             {
                 col.Destroy(col);

                 g.RemoveFromGroup(col);
             }

            Exp ex = new Exp(x,y,26);
            ex.SetFrame(26);
            ex.AddSprite();
            g.Age -= 1;

            if (g.Age == 0)
            {
                Rec rec = new Rec(g.GetCoordinates().X, g.GetCoordinates().Y,
g.GetCoordinates().Width+3, g.GetCoordinates().Height+2);
                col.Destroy(col);
                g.RemoveFromGroup(col);
                s.RemoveGroup(g);

            }
            if (s.GetColGroup().GetList().Count == 0)
            {
                SpriteManager.Instance().RemoveSprite(s.GetSprite());
                s.RemoveSuper();

            }
```

in this method for reaction t o shiled it destroy itselves and remove shield colum if life of shield colum is not 0 and if its zero create Exploson object to cover that part of shield.

Ship

Ship is main object that player uses it shoot missles and move according to user input.Its also game object. In here reaction to bomb if its life 0 it ides and reset the game if tis not change Image of itselves to explosin image and ad timer to create itselves again

```
private void reactionToShip(Bomb b)
    {
        SoundManager.Instance().Play(CueType.ExplosionQue);

        if (life == 0)
        {
            Ship.Instance().Destroy();
            b.Dead(b);
            Gamereset();




        }
        else
            DecreaseLife();

            sprite.SetFrame(22);
            this.isAlive = false;
            Animation ani = new Animation(this);
            TimerManager.Instance().AddTimeEvent(this, 3, ani.DeadShip);


        b.Dead(b);

    }
Callback funtion to Dead of ship
    public void DeadShip()
    {
        Ship.Instance().reset();
        TimerManager.Instance().RemoveTimeEvent(obj);


    }
```

Bombs

Bombs Does not created by anybody it create itselves according to collums.I used **reservoir sampling**. Algorithim to create bombs at random linklist.Boms are created by timer event

```csharp
    public void CreateBomb()
    {
        int k = 0;
        Group[] group = calculatePosition();
        for (Node i = Bombgroup.GetList().head; i != null; i = i.next)
        {

            if (Super.IsAlive())
            {

                ((Bomb)i.data).SetBomb();
                if (group[k] != null)
                {
                    ((Bomb)i.data).SetPosition(new
Vector2(group[k].GetCoordinates().X, group[k].GetCoordinates().Bottom));
                }
            }
            k++;

        }


    }
    public Group[] calculatePosition()
    {
        LinkList list = GroupManager.Instance().GetLinkList(ColType.Column);

        int samplecount = 3;
        Random rand = new Random();
        int k = 0;
        Group[] samples = new Group[samplecount];

        if (samplecount <= 0)
            throw new ArgumentOutOfRangeException("sampleCount");
        for (Node i = list.head; i != null; i = i.next)
        {
            if (k < samplecount)
            {
                samples[k] = ((Group)i.data);

            }
            else
            {
                int j = rand.Next() % k;
                if (j < samplecount)
                    samples[j] = (Group)i.data;
            }
            k++;


        }
```

Switching Menu to Gameplay

I just create gamestate as enum to change state of the game for example,

```csharp
        if (gamestate == GameState.MainMenu)
        {
            MainMenu.Instance().Update(gameTime);
        }
        else if (gamestate == GameState.Player1)
        {
            Player.Instance().Update(gameTime);
        }
```

as we clearly see it updates according to GameState eunm in button class when palyer elect one of the butttons and press it chances gamestate.I look up more advanced object orianted solution for menu change but there is not enough time to understand and implment it

```
public void Update()
        {

            if (isSelected == true)
            {
                if (type == ButtonType.SinglePlayer)
                {
                  //  MainMenu.Destroy();
                    Game1.GameInstance.gamestate = GameState.Player1;

                }

                else if (type == ButtonType.MultiPlayer)
                {
                    DeSelect();
                    Game1.GameInstance.gamestate = GameState.Player2;

                }

                DeSelect();
            }
```

Conculusion

This course most fun ,teaching but also hard for me.I am getting to how to design or how to approach a problem diffrently after this class.I had never desing this much code by myselves in my life.