MonoGame

Knox Game Design

September 2020

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Background

- Open source version of XNA 4 Framework
- C#
- https://www.monogame.net
- Started in 2009 as XNA Touch

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Pros

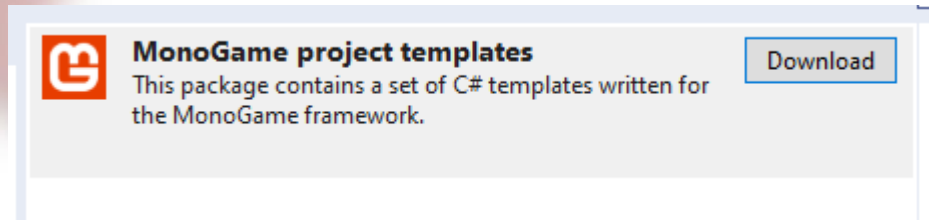
- Handles gamepad input "out of the box"
- Can publish to many platforms (Windows, Linux, Playstation 4, Android)
- Can be used to port XNA games that will no longer build on current Windows
- Can use the .NET libraries and components
- Still actively developed by the MonoGame community
- No costs; No forced splash screen

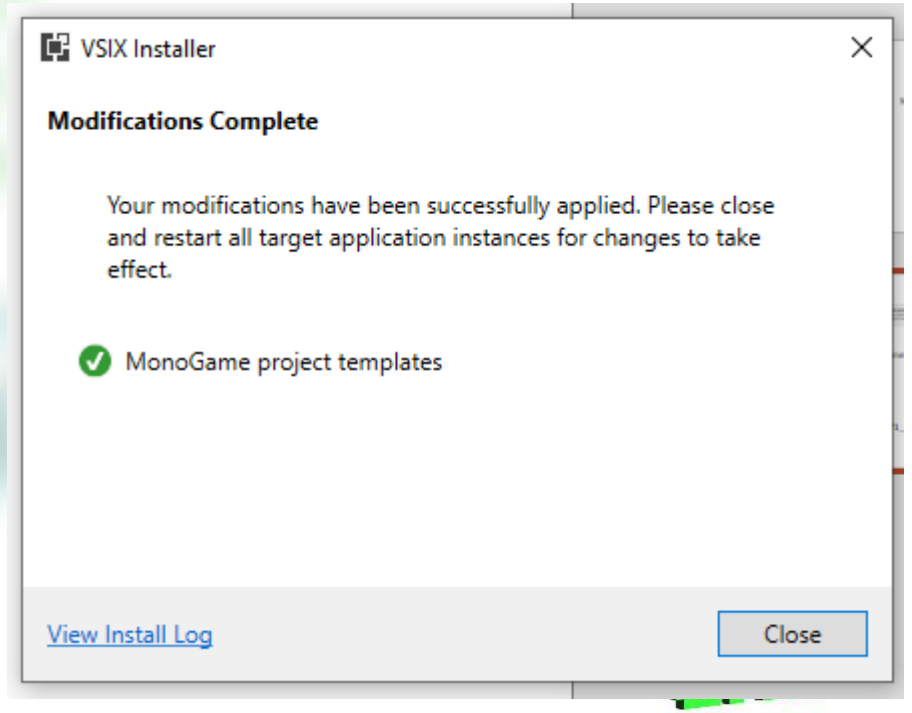
Cons

- No concept of a "scene" or "room"
- Not made for 3D games in mind
- No built in GUI components like buttons, text boxes, checkboxes, sliders, etc
- No key press/button press event; Must track the previous keyboard/gamepad state yourself
- Many things that should be simple take a lot of setup and code (asset loading)

Installing MonoGame (Windows)

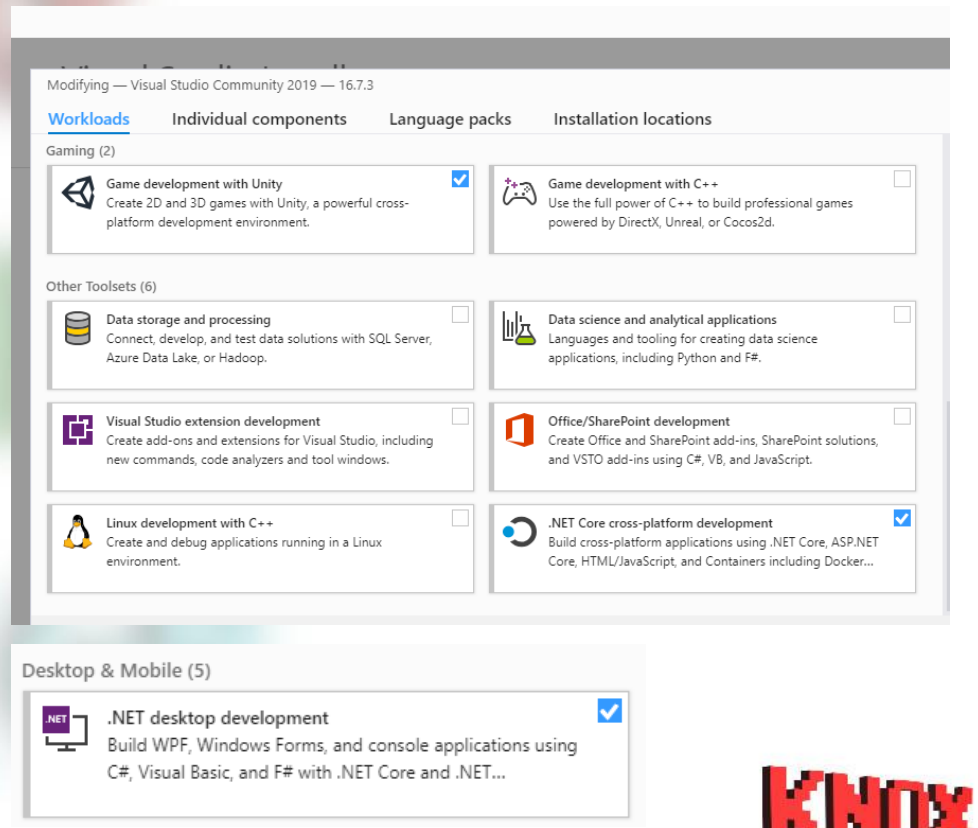
- Download and install Visual Studio Community if you don't already have it
  - https://visualstudio.microsoft.com/vs/community/
- Install the MonoGame Visual Studio extension (recommended)
  - Extensions > Manage Extensions
  - Search for "monogame"
  - Click *Download* button
  - Close Visual Studio for it to start
  - Click *Modify* button
- Alternatively, download the package from https://www.monogame.net/downloads/
- Getting started guide (Visual Studio 2019) - https://docs.monogame.net/articles/getting_started/1_setting_up_your_development_environment_windows.html





Installing MonoGame (Windows)

- Install the following components, using the Visual Studio Installer (separate application, not in Visual Studio)
  - *Modify* > *Workloads*
  - For Desktop only
    - .NET Core cross-platform development
    - .Net Desktop Development
  - Add the following for Windows 10/UWP
    - Universal Windows Platform development
- Run the following commands from the command prompt (cmd)
  - dotnet tool install --global dotnet-mgcb-editor
  - mgcb-editor --register



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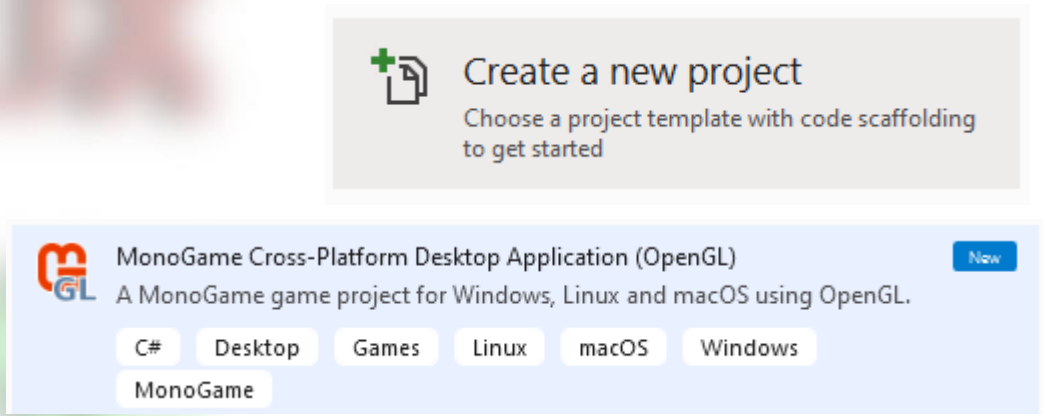
Creating a New Project

- Create new project in Visual Studio
- Choose MonoGame Cross-Platform Desktop Application
- Enter a name and select an empty folder for the project
- If you get a *component assembly* error, make sure you have the correct components installed



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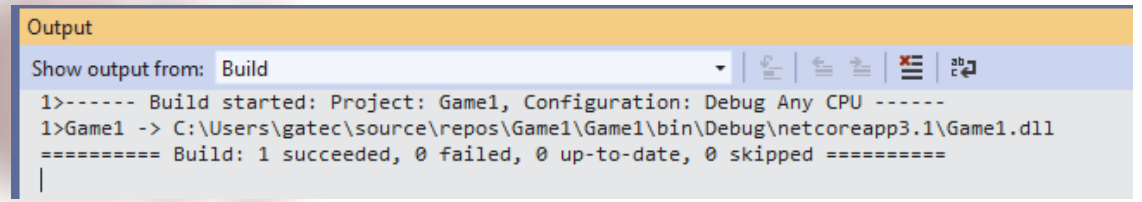
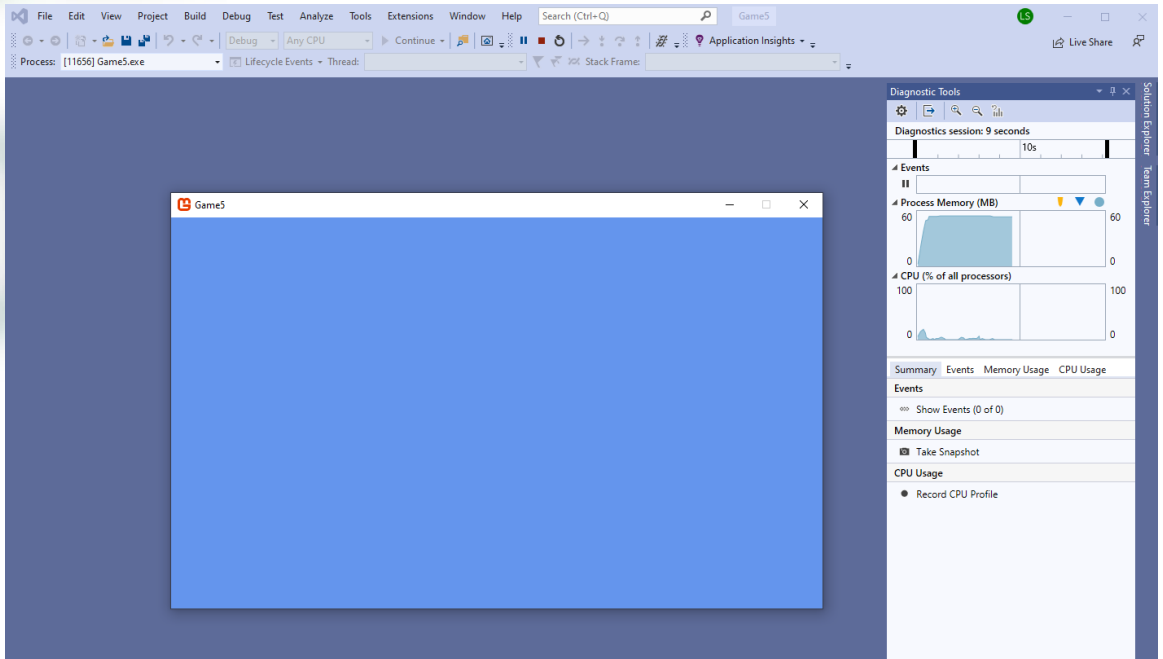
Running Your Project

- *Build > Build Solution*
  - It will probably take a while for the project to build the first time
- Press the green arrow
  - Note - if you press the green arrow before building, you may get an error
- You should get a "cornflower blue" window when the program executes

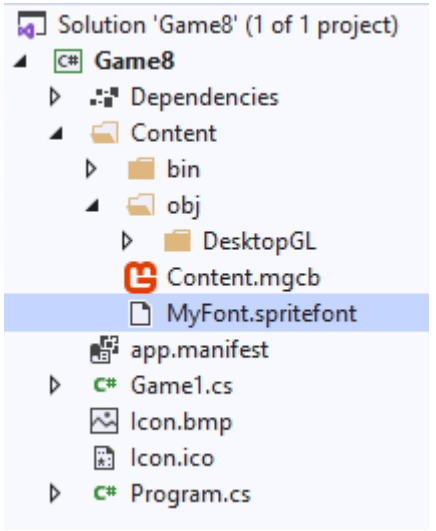




MonoGame Content Builder

- Manages assets
  - Fonts
  - Images
  - Sounds
  - Music

- https://docs.monogame.net/articles/tools/mgcb_editor.html



- Double click on Content.mgcb under Content > obj in Solution Explorer
- Note - if you don't see the MonoGame logo next to Content.mgcb, you need to run the command line steps to install and register the mgcb-editor
- Note - if it opens in a text window, select Open With and select mgcb-editor-wpf and press Set as Default then press OK
- Due to a bug, you may have to Add MGCB-Editor using the full path (C:\Users\<username>\.dotnet\tools\.store\dotnet-mgcb-editor\3.8.0.1641\dotnet-mgcb-editor\3.8.0.1641\tools\netcoreapp3.1\any\mgcb-editor-wpf.exe) and then Set as Default

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Displaying Text

- In MGCB Editor, press the *New Item* button
- Enter **MyFont** for name, Select *SpriteFont Description,* and press *Create*
- Press the *Save* button and close the window
- Double click the new MyFont.*spritefont* to change the properties of the font
- Open the *Game1.cs* file
  - Add a new instance variable

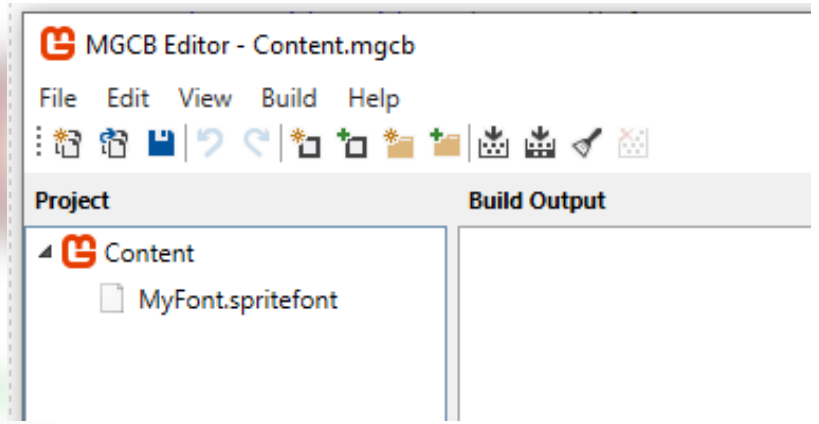
```
SpriteFont myfont;
```

  - In the *LoadContent()* method, add the following

```
myfont = Content.Load<SpriteFont>("MyFont");
```

  - In the *Draw()* method, add the following

```
_spriteBatch.Begin();
_spriteBatch.DrawString(myfont, "Hello World", new Vector2(100, 100), Color.White);
_spriteBatch.End();
```



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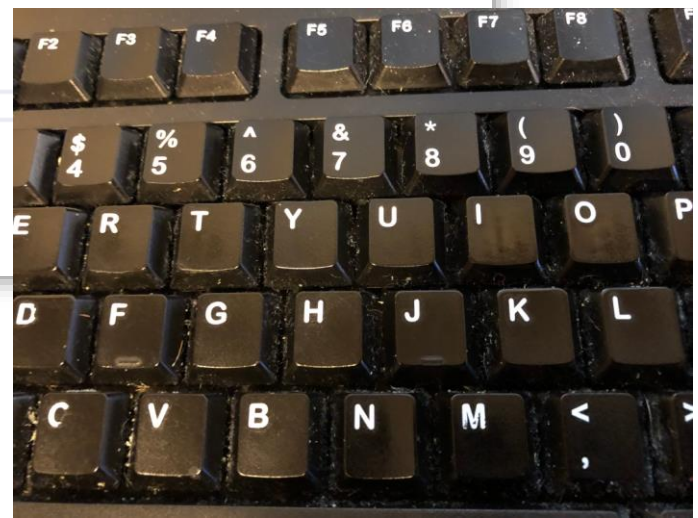
Game Layout

- Constructor (method name same as class) - Called when object is instantiated
- Initialize - Called on start
- LoadContent - Call on start, used for loading assets/resources
- Update - Called on each frame
  - Used to handle input and update game logic
  - Don't have to handle sleeping until next update
  - Use gameTime to smooth movements (similar to Unity's Time.deltaTime)
- Draw - Called on each frame, Used for drawing to the screen

Input (Keyboard)

- Must track when each key goes from up to down
- When inputting a string of characters, must handle adding each key to string
- Use Keyboard.GetState() to get the current state of the keyboard
- Use state.IsKeyDown(key) to determine if a key is pressed

```
KeyboardState state = Keyboard.GetState();

Keys key;

int i;
for (i = 0; i <= 9; i++) {
    key = Keys.D0 + i;
    if (state.IsKeyDown(key) && !previousState.IsKeyDown(key)) {
        if (strGuess.Length < 2) {
            strGuess += i.ToString();
        }
    }
}

key = Keys.Back;
if (state.IsKeyDown(key) && !previousState.IsKeyDown(key)) {
    if (strGuess.Length > 0) {
        strGuess = strGuess.Substring(0, strGuess.Length - 1);
    }
}

key = Keys.Enter;
if (state.IsKeyDown(key) && !previousState.IsKeyDown(key)) {
    if (strGuess.Length > 0) {
        checkGuess(int.Parse(strGuess));
    }
}


base.Update(gameTime);

previousState = state;
```



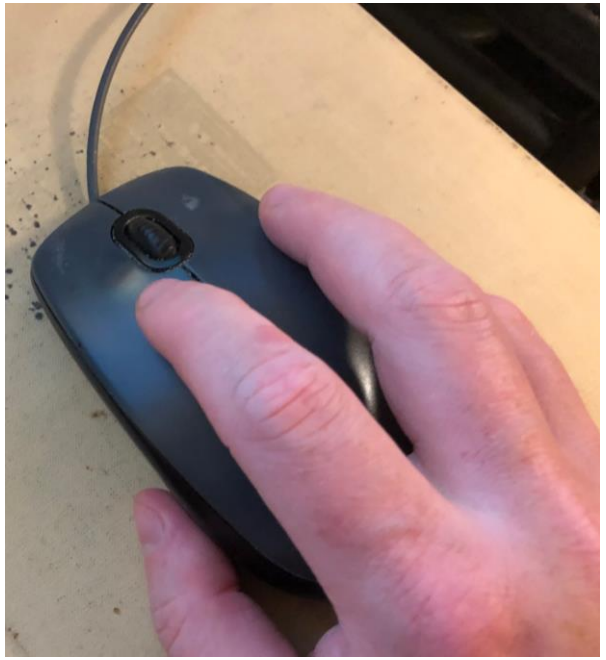
Input (Gamepad)

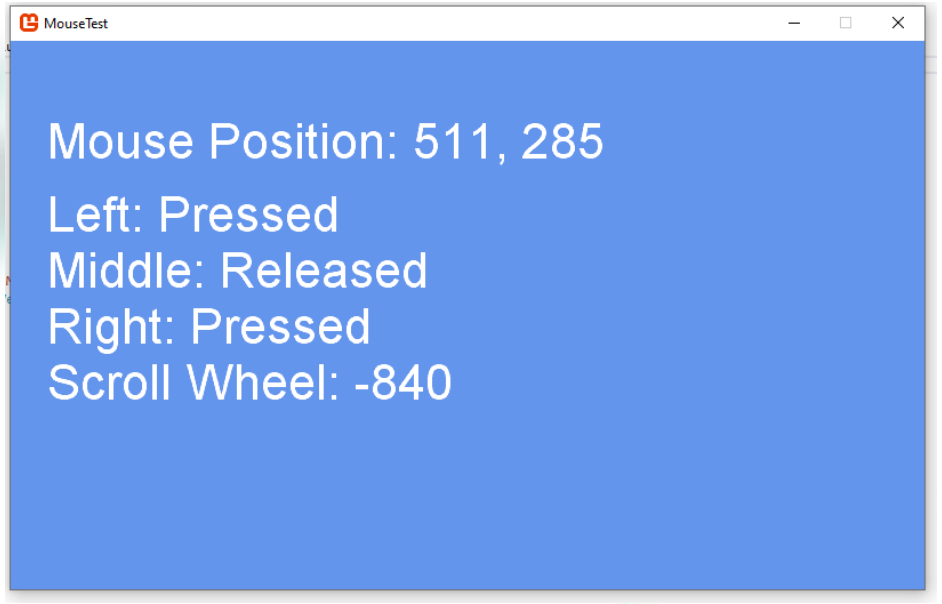
- Get status of Gamepad button
  - *GamePad.GetState(PlayerIndex.One).Buttons.<A,B,X,Y,Start,LeftStick,RightStick>*
  - Button down equals *ButtonState.Pressed*
  - Button up equals *ButtonState.Released*
- GetTrigger value
  - *GamePad.GetState(PlayerIndex.One).Triggers.<LeftStick,RightStick>*
- Get thumbstick position
  - GamePad.GetState(PlayerIndex.One).Thumbsticks.<Left,Right>.<X,Y>

```
Pressed:  A XY
Released:  B  L1R1StL3R3
L2: 0.00 R2: 0.00
LS x:0.13 y:0.95 deg:82.19
RS x:0.00 y:0.57 deg:90.00
DPad: Up
```

Input (Mouse)

- Get mouse position
  - *Mouse.GetState().<X,Y>*
- Get button pressed/released
  - *Mouse.GetState().<Left,Middle,Right>Button == ButtonState.Pressed*
- Get mouse wheel position
  - *Mouse.GetState().ScrollWheelValue* (integer)
- Note - need to track previous mouse state if you need to perform an action on the frame a button was clicked





Number Guessing Game

- Store secret number and guess count as integers
- Make new *Random* object, then call *Next()* with the range of the secret number
- Store the guess input and result as a string
- Track game over state as a bool
- Create *restart* method to reset variables
- Increment guess count on each guess
- Set result to "Higher" or "Lower" based on the guess value

```
private void restart() {
    isGameOver = false;
    Random r = new Random();
    iSecretNumber = r.Next(1, 100);

    iGuessCount = 0;

    strGuess = "";
    strResult = "";
}
```

```
protected override void Update(GameTime gameTime) {

  key = Keys.Enter;
  if (state.IsKeyDown(key) && !previousState.IsKeyDown(key)) {
      if (strGuess.Length > 0) {
          checkGuess(int.Parse(strGuess));
      }
  }
```

```
protected override void Draw(GameTime gameTime) {
    GraphicsDevice.Clear(Color.Black);

    // TODO: Add your drawing code here
    _spriteBatch.Begin();
    _spriteBatch.DrawString(myFont, "Guess the number\nbetween 1 and 100", new Vector2(100, 100),
      Color.White);
    _spriteBatch.DrawString(myFont, strGuess, new Vector2(100, 200), Color.Yellow);
    _spriteBatch.DrawString(myFont, strResult, new Vector2(100, 300), Color.Red);
    _spriteBatch.End();

    base.Draw(gameTime);
}
```

```
private void checkGuess(int iGuess) {
    iGuessCount++;
    strGuess = "";

    if (iGuess < iSecretNumber) {
        strResult = iGuess + ": Higher";
    } else if (iGuess > iSecretNumber) {
        strResult = iGuess + ": Lower";
    } else if (iGuess == iSecretNumber) {
        strResult = iGuess + ": Correct!\n" + iGuessCount + " to
        isGameOver = true;
    }
}
```

Guess the number
between 1 and 100
25

50: Lower

Guess the number
between 1 and 100

18: Correct!
4 total guesses

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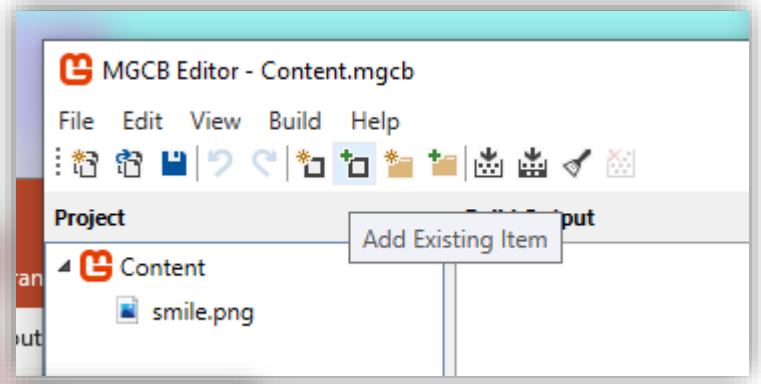
Displaying Images

- Start the MGCB Editor by double clicking *Content.mgcb* in the Solution Explorer
  - Press the *Add Existing Item* button
  - Navigate and select your image file (such as .PNG)
  - Press *Add* to copy the file to the directory
  - Press the *Save* button
- In source code (*Game1.cs*)
  - Add a new instance variable

    ```
    Texture2D sprSmile;
    ```
  - In the *LoadContent()* method, add the following

    ```
    sprSmile = Content.Load<Texture2D>("smile");
    ```
  - In the *Draw()* method, add the following

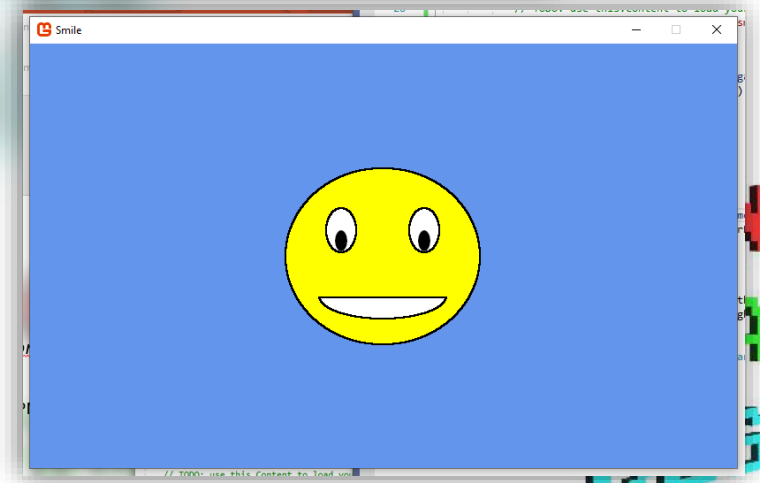
    ```
    _spriteBatch.Begin();
    _spriteBatch.Draw(sprSmile,new Rectangle(x, y, w, h), Color.White);
    _spriteBatch.End();
    ```




```
Texture2D sprSmile;
```

```
protected override void LoadContent() {
    _spriteBatch = new SpriteBatch(GraphicsDevice);

    // TODO: use this.Content to load your game content here
    sprSmile = Content.Load<Texture2D>("smile");
}
```

```
protected override void Draw(GameTime gameTime) {
    GraphicsDevice.Clear(Color.CornflowerBlue);

    // TODO: Add your drawing code here
    int w = sprSmile.Width;
    int h = sprSmile.Height;
    int x = (GraphicsDevice.Viewport.Width - w) / 2;
    int y = (GraphicsDevice.Viewport.Height - h) / 2;

    _spriteBatch.Begin();
    _spriteBatch.Draw(sprSmile, new Rectangle(x, y, w, h), Color.White);
    _spriteBatch.End();

    base.Draw(gameTime);
}
```



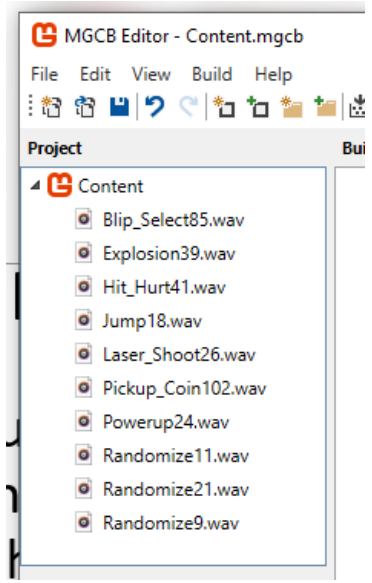
Playing Sound

- Start the MGCB Editor by double clicking *Content.mgcb* in the Solution Explorer
  - Press the *Add Existing Item* button
  - Navigate and select your sound files (such as .WAV)
  - Press *Add* to copy the file to the directory (can shift + click to add multiple files at the same time)
  - Press the *Save* button
- In source code (*Game1.cs*)
  - Create and load a new SoundEffect object

```
SoundEffect sound = Content.Load<SoundEffect>("Blip_Select85");
```

  - Play by calling *Play()* on the SoundEffect object

```
sound.Play();
```




```
List<SoundEffect> sounds;

sounds = new List<SoundEffect>();

SoundEffect sound;

sound = Content.Load<SoundEffect>("Blip_Select85");
sounds.Add(sound);
sound = Content.Load<SoundEffect>("Explosion39");
sounds.Add(sound);
sound = Content.Load<SoundEffect>("Hit_Hurt41");
sounds.Add(sound);
sound = Content.Load<SoundEffect>("Jump18");
sounds.Add(sound);
sound = Content.Load<SoundEffect>("Laser_Shoot26");
sounds.Add(sound);
sound = Content.Load<SoundEffect>("Pickup_Coin102");
sounds.Add(sound);
sound = Content.Load<SoundEffect>("Powerup24");
sounds.Add(sound);
sound = Content.Load<SoundEffect>("Randomize11");
sounds.Add(sound);
sound = Content.Load<SoundEffect>("Randomize21");
sounds.Add(sound);
sound = Content.Load<SoundEffect>("Randomize9");
sounds.Add(sound);
```

Press a number to play a sound

```
KeyboardState state = Keyboard.GetState();
Keys key;
int i;
for (i = 0; i <= 9; i++) {
    key = Keys.D0 + i;
    if (state.IsKeyDown(key) && !previousState.IsKeyDown(key)) {
        sounds[i].Play();
    }
}
```

Playing Music

- Add music file (MP3, OGG, etc) using MGCB Editor
- Create a Song object

```
Song mysong;
```

- Load using Content

```
mysong = Content.Load<Song>("mus_overworld");
```

  - Note - If using a .wav file, make sure to change Processor to Song

```
mysong = Content.Load<Song>("mus_battle");
MediaPlayer.Play(mysong);
MediaPlayer.Volume = 0.5f;
```

- Play using MediaPlayer

```
MediaPlayer.Play(mysong);
```

- Use *MediaPlayer.Volume* property to set the volume
- Stop playing with *MediaPlayer.Stop()*

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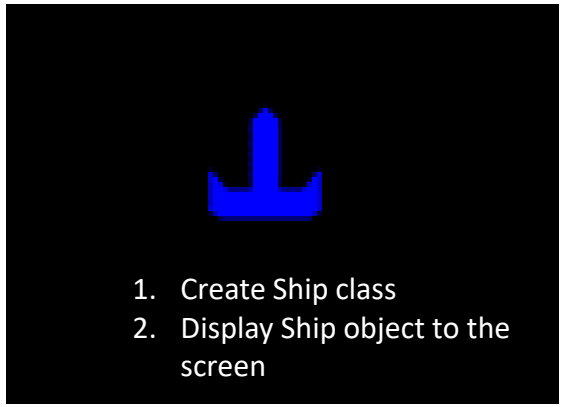
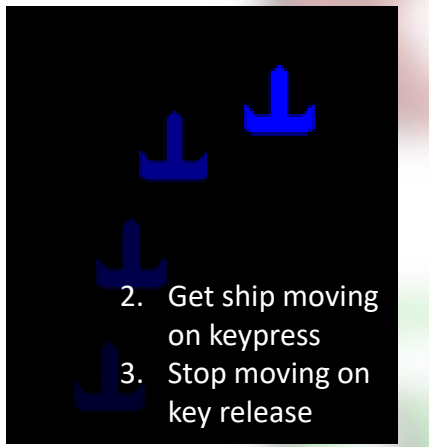
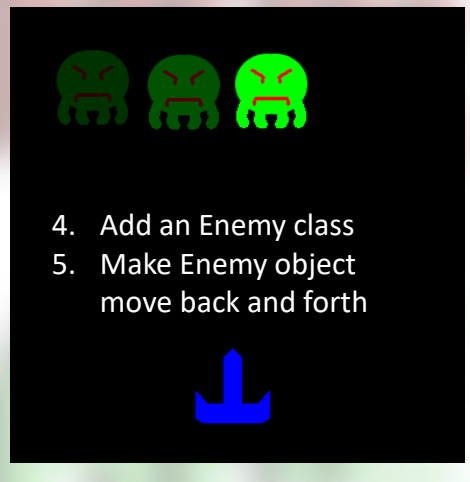
Simple Space Shooter



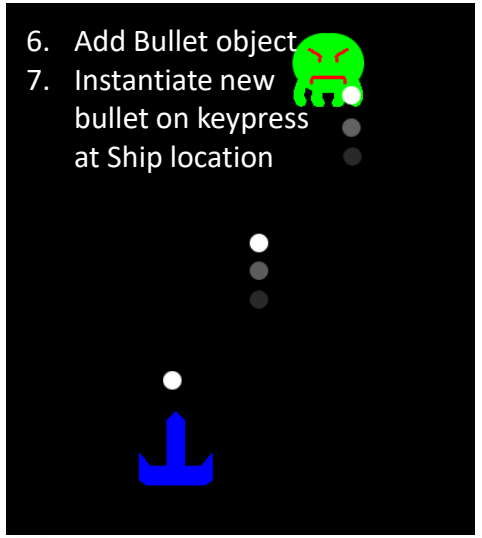
1. Create Ship class
2. Display Ship object to the screen



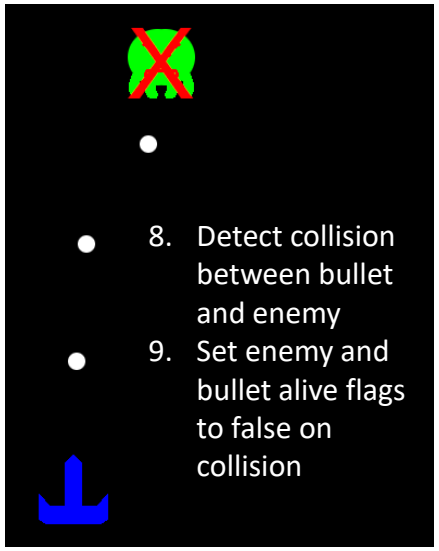
2. Get ship moving on keypress
3. Stop moving on key release



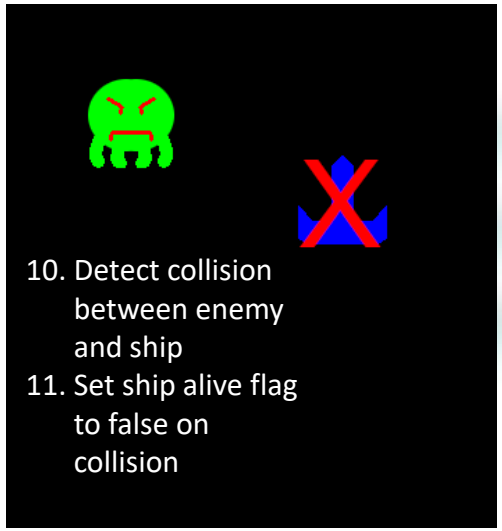
4. Add an Enemy class
5. Make Enemy object move back and forth



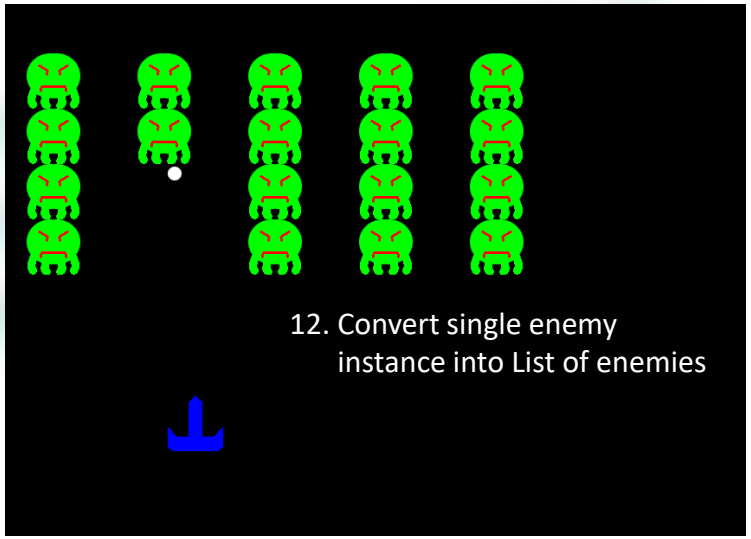
6. Add Bullet object
7. Instantiate new bullet on keypress at Ship location



8. Detect collision between bullet and enemy
9. Set enemy and bullet alive flags to false on collision



10. Detect collision between enemy and ship
11. Set ship alive flag to false on collision



12. Convert single enemy instance into List of enemies

13. Add Game Over state
14. Add points system
15. Add sound effects and music
16. Add effect when enemy or ship is killed

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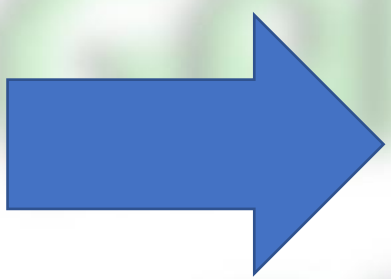
From XNA to MonoGame



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Resources

- Beginning MonoGame
  - http://www.geekswithblogs.net/cwilliams/archive/2017/02/06/232974.aspx
- MonoGame Tutorial
  - https://gamefromscratch.com/monogame-tutorial-series/

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