



FALMOUTH
UNIVERSITY

COMP120: Creative Computing
2: Tinkering Graphics I



Learning Outcomes

By the end of this workshop, you should be able to:

- ▶ **Apply** knowledge of colour models to **write** code that manipulates pixels in a Visual Studio Form App
- ▶ **Use** functions, arguments, and basic data structures such as arrays

Painting with Pixels



Activity #1a – Setup

In pairs:

- ▶ Open Visual Basic
- ▶ Create a ‘Windows Forms Application’
- ▶ Refer to the following documentation for details:

[https://docs.microsoft.com/en-us/visualstudio/ide/
create-csharp-winform-visual-studio](https://docs.microsoft.com/en-us/visualstudio/ide/create-csharp-winform-visual-studio)

Activity #1a – Setup

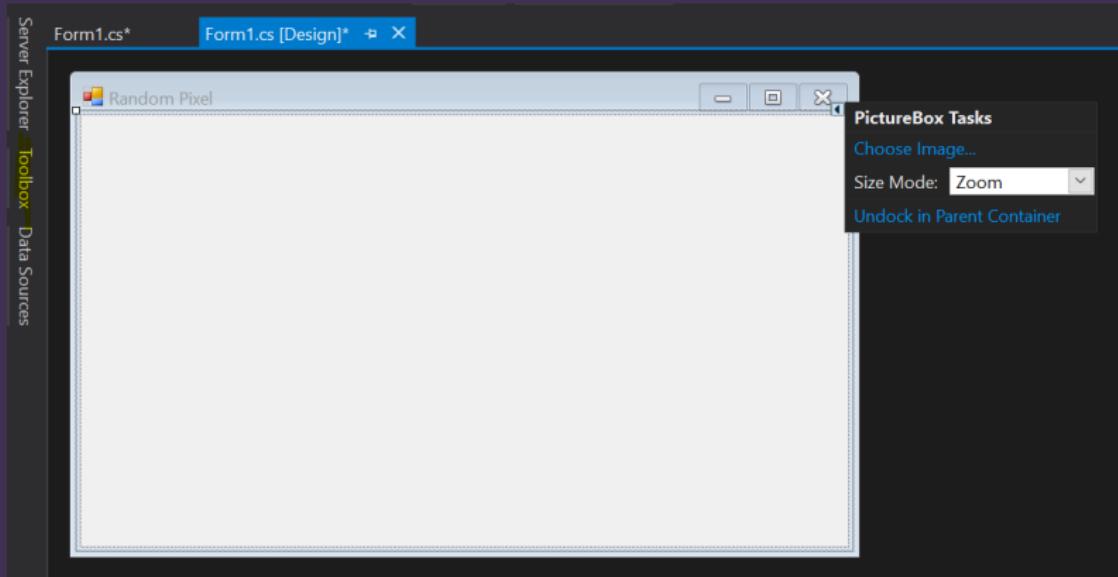
```
int width = 640, height = 320;
Bitmap bmp = new Bitmap(width, height);

for (int y = 0; y < height; y++)
{
    for (int x = 0; x < width; x++)
    {
        bmp.SetPixel(x, y, Color.FromArgb(255, 0, 0, 0));
    }
}
pictureBox1.Image = bmp;
bmp.Save("D:\\images\\blackImage.png");
```

Note: This is an example that is contained in the 'Form' class

Activity #1a – Setup

Add a **Picturebox** from the **Toolbox** panel. Set the **Picturebox** to **Zoom**.



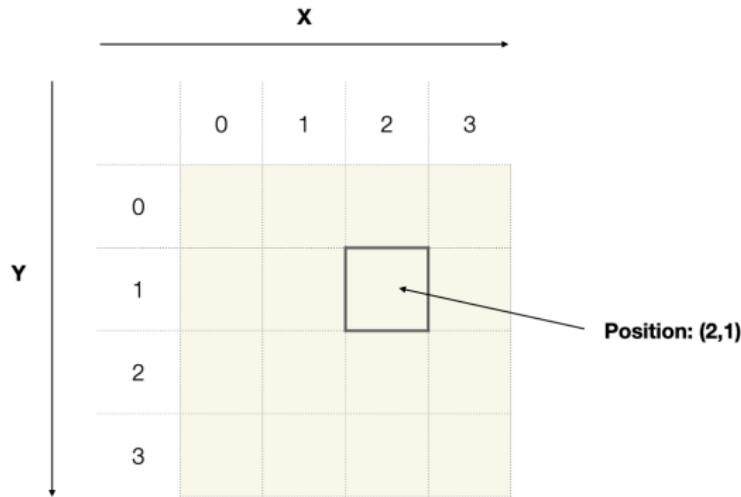
Key C# Methods Used

- ▶ `Bitmap` - consists of the pixel data for a graphics image and its attributes.
 - ▶ `New` - Initializes a new instance of the `Bitmap` class with the specified size or from an existing file.
 - ▶ `Save` - Saves the Image to the specified file or stream.
- ▶ `SetPixel` - Sets the color of the specified pixel in a `Bitmap`.
- ▶ `GetPixel` - Gets the color of the specified pixel in a `Bitmap`.
- ▶ `Color.FromArgb` - Creates a colour structure from the four 8-bit ARGB components (alpha, red, green, and blue) values.

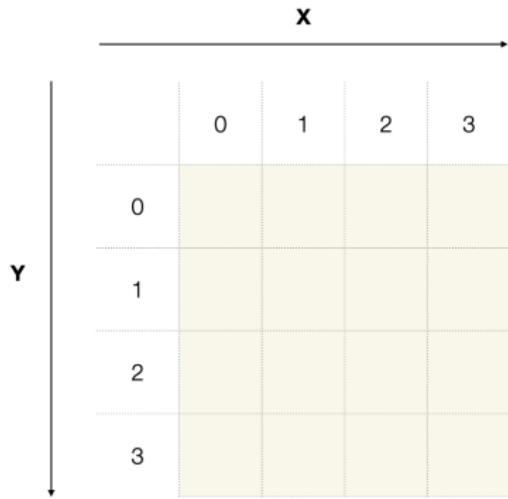
Key Concepts

```
for (int hours = 0; hours < 24; hours++)
{
    for (int minutes = 0; minutes < 60; minutes++)
    {
        //do something for every minute in the day
    }
}
```

Nested for Loops - to iterate through all the positions in a two dimensional array. For example: all the pixels in an image which are arranged in rows and columns.

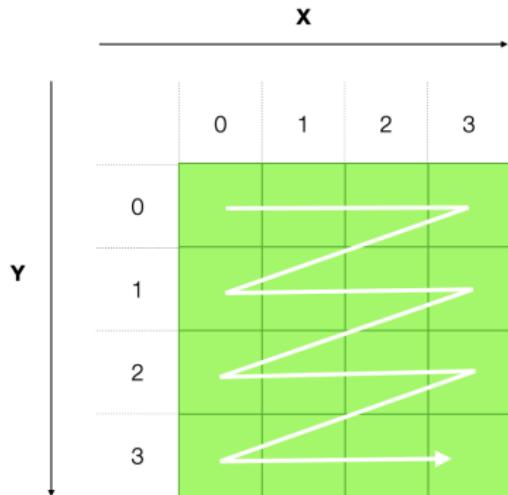


Pixel Painting - Two Dimensional Arrays (X and Y)



```
for (x = 0; x < width; x++)
{
    for (y = 0; y < height; y++)
    {
        Console.WriteLine("x: "+x+" y: "+y);
    }
}
```

Flow of Nested Loops



OUTPUT

```
x: 0 y: 0
x: 1 y: 0
x: 2 y: 0
x: 3 y: 0
x: 0 y: 1
x: 1 y: 1
x: 2 y: 1
x: 3 y: 1
x: 0 y: 2
x: 1 y: 2
x: 2 y: 2
x: 3 y: 2
x: 0 y: 3
x: 1 y: 3
x: 2 y: 3
x: 3 y: 3
```

Flow of Nested Loops

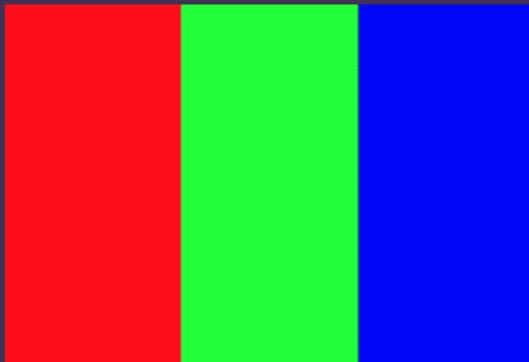
Activity #1b – Setup

In pairs:

- ▶ Render a green Bitmap image
- ▶ Refer to the following documentation:
 - ▶ <https://docs.microsoft.com/en-us/dotnet/api/system.drawing.color.fromargb>
 - ▶ <https://docs.microsoft.com/en-us/dotnet/api/system.drawing.bitmap.setpixel>

Activity #3 - Test Card

- ▶ Create a `Bitmap` image that displays 3 equal vertical bars of red, green and blue
- ▶ The image must be **640 x 480** in size.
- ▶ Consider how you will allocate the painting of pixels to the different areas of the screen.



Activity #3 - Random Pixels

- ▶ Create a `Bitmap` image that displays random pixel for every pixel in the image. Like snow on an old TV.
- ▶ Consider how you will generate random values for ARGB
- ▶ You will need to explore these methods associated with the `Random` class:

```
new Random();
```

Initializes a new instance of the `Random` class.

```
Next();
```

Returns a non-negative random integer.

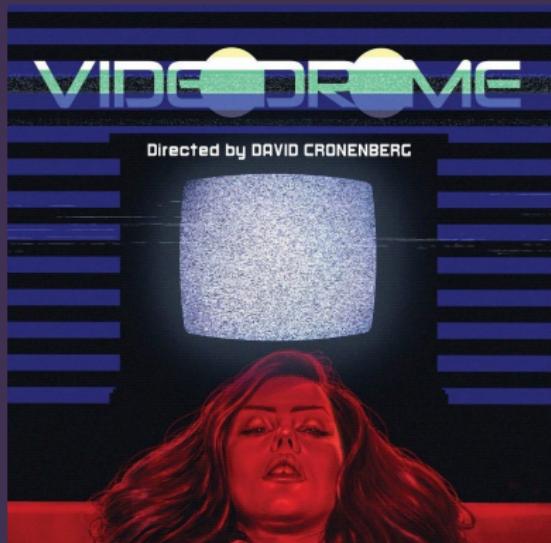
Activity #3 - Random Pixels

```
Random rand = new Random();
```

Create a variable to contain the Random class.

```
int a = rand.Next(256);
```

Assign a variable for each colour channel and use Next with the new random variable to randomly choose a value.



Manipulating Bitmaps



Activity #4 – Less Red

In pairs:

- ▶ Define a function to load an image file to the Windows Form UI
- ▶ Then, define a function to reduce it's **redness**
- ▶ Refer to the following documentation:
 - ▶ <https://docs.microsoft.com/en-us/dotnet/api/system.drawing.bitmap>

Activity #4– Less Red

```
string img = "C:\\\\Images\\\\myPic.jpg";
Bitmap bmp = new Bitmap(img);
int width = bmp.Width;
int height = bmp.Height;
Bitmap rbmp = new Bitmap(bmp);

for (int y = 0; y < height; y++)
{
    for (int x = 0; x < width; x++)
    {
        Color p = bmp.GetPixel(x, y);
        int a = p.A;
        int r = p.R;
        int g = p.G;
        int b = p.B;
        int rI = Convert.ToInt32(r*.5);
        rbmp.SetPixel(x, y, Color.FromArgb(a, rI, g, b));
    }
}
```

Activity #5 – Swap Channel

In pairs:

- ▶ Define a function that turns all of the red values of pixels into blue values...
- ▶ ...and all of the blue values into red values

Activity #5 – Swap Channel

```
//get pixel value
Color p = bmp.GetPixel(x, y);

//extract ARGB value from p
int a = p.A;
int r = p.R;
int g = p.G;
int b = p.B;

//swap red for blue
RtoBbmp.SetPixel(x, y, Color.FromArgb(a, r, g, r));

//swap blue for red
BtoRbmp.SetPixel(x, y, Color.FromArgb(a, b, g, b));
```

Note: This code occurs inside the nested for loop and presumes you have setup 2 bitmap variables - RtoBbmp and BtoRbmp.

Activity #6 – Greyscale

In pairs:

- ▶ Define a function that loads an image and turns it to greyscale
- ▶ Consider the following calculation:
 - ▶ $NewPixelValue = \frac{\sum CurrentChannelValue}{NumberOfChannels}$

Activity #6 – Greyscale

```
//get pixel value
p = bmp.GetPixel(x, y);

//extract pixel component ARGB
int a = p.A;
int r = p.R;
int g = p.G;
int b = p.B;

//find average
int avg = (r + g + b) / 3;

//set new pixel value
bmp.SetPixel(x, y, Color.FromArgb(a, avg, avg, avg));
```

Note: This code occurs inside the nested for loop and presumes you have setup a bitmap variable - bmp.

Activity #7 – Negative

In pairs:

- ▶ Define a function that loads an image and turns it to its negative
- ▶ Consider the following calculation:
 - ▶ $NewChannelValue = 255 - CurrentChannelValue$

Activity #7 – Negative

```
//get pixel value
Color p = bmp.GetPixel(x, y);

//extract ARGB value from p
int a = p.A;
int r = p.R;
int g = p.G;
int b = p.B;

//find negative value
r = 255 - r;
g = 255 - g;
b = 255 - b;

//set new ARGB value in pixel
bmp.SetPixel(x, y, Color.FromArgb(a, r, g, b));
```

Note: This code occurs inside the nested for loop and presumes you have setup a bitmap variable - bmp.

Activity #7 – Top-Copy

In pairs:

- ▶ Define a function that copies the top half of a picture to its bottom half
- ▶ Refer to the following documentation:
 - ▶ Consider this example of multiple conditions in a for loop as a possible solution:
 - ▶ http://www.java2s.com/Tutorial/Cpp/0060_Operators-statements/Usenotmultiplestatementsinforloops.htm

Activity #7 – Top-Copy

```
int width = oldImg.Width;
int height = oldImg.Height;

Bitmap newImg = new Bitmap(width, height);

for (int y = 0, ry = height/2; y < height/2; y++, ry++)
{
    for (int x = 0; x < width; x++ )
    {
        Color p = oldImg.GetPixel(x, y);
        newImg.SetPixel(x, y, p);
        newImg.SetPixel(x, ry, p);
    }
}
```

Note: You still need to consider load and saving element of this code block.

Challenge for next week – Sunset

In pairs:

- ▶ Define a function that loads an image and produces several images as output, decreasing luminance
- ▶ You will need to think about how to reduce the luminance of the image iteratively producing a number of images and displaying them.

Challenge for next week – Sunset

```
def decreaseRed(picture, amount):
    for p in getPixels(picture):
        value=getRed(p)
        setRed(p,value*amount)

amount = 0.1 #tinker with this value
wait_time = 50 #tinker with this value

for i in range(10):
    decreaseRed(picture, amount)
    decreaseGreen(picture, amount)
    decreaseBlue(picture, amount)
    wait(50)
```

Note: This is Python code can you adapt it for C#