Mobile Programming and Multimedia

The Xamarin Framework

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Introduction

Xamarin is a cross-platform framework based on different approaches:

- Interpreted approach for Android and Windows
- Compiled approach for iOS

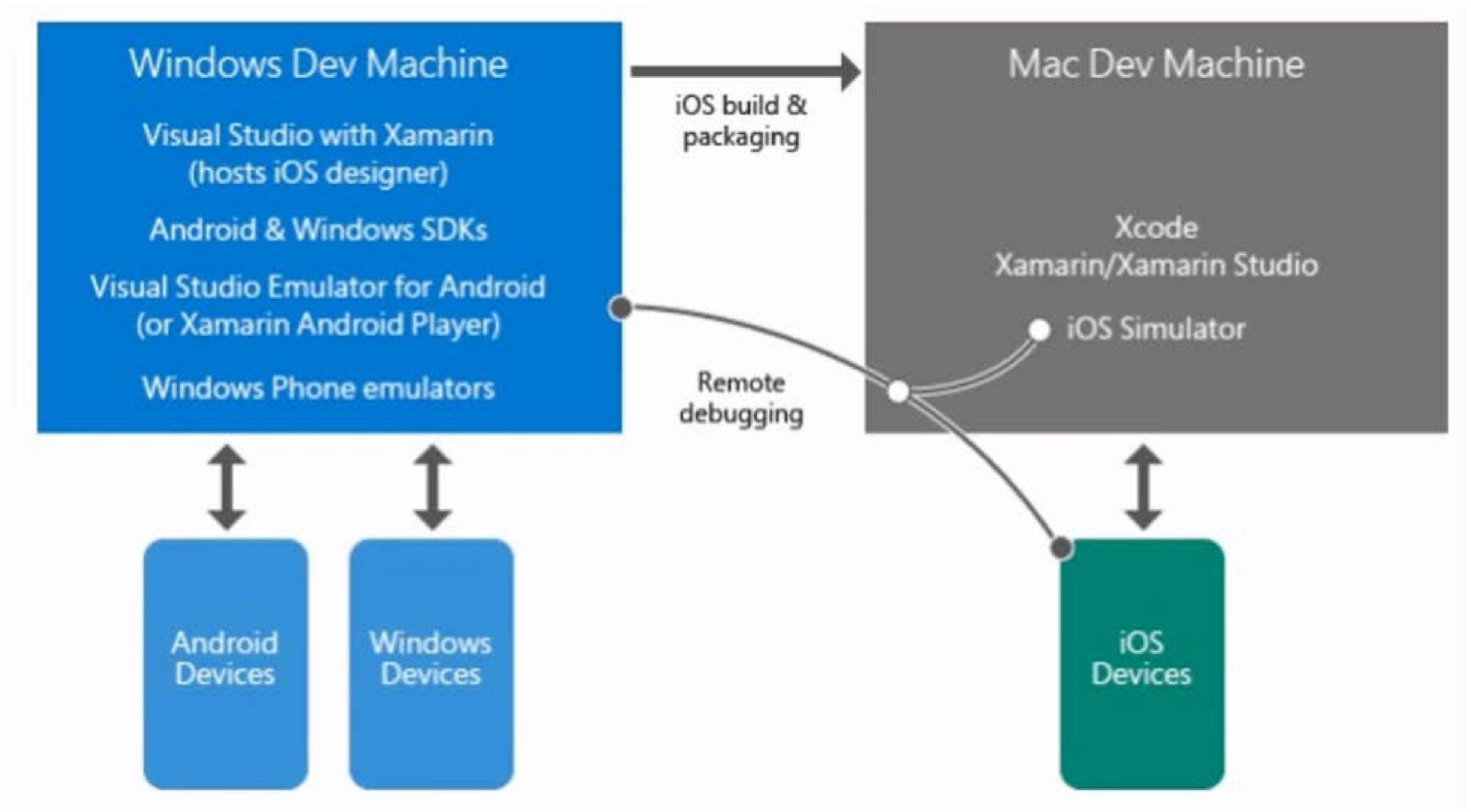
It is a project started in 2014 from Xamarin, a company based in California acquired by Microsoft in 2016

It is a general-purpose framework based on different parts

- Xamarin.Forms
- Xamarin Native
- XAML: XML language for interface building

Based on C#

System architecture



Widely used

BOSCH
Cognizant
3M
OUTBACK STEAKHOUSE®
DU PONT®
Alaska AIRLINES
CINEMARK.
McKESSON
avanade®
Honeywell
slack
NATIONAL INSTRUMENTS™
jetBlue
Kellogg's
Kimberly-Clark

How to build an app

Two possibilities available:

- Xamarin Native: allows writing code for a single platform (especially for the interface). Allows to use native APIs
- Xamarin.Forms: provides a set of APIs that can be used for each platform but with a native *look&feel*

To develop applications using Xamarin, it is necessary to install Microsoft Visual Studio

Which one is the best approach? - 1

Xamarin allows several choices:

- C# or XAML
- Native vs. general purpose

Which one is the best approach?

Xamarin.Form is more appropriate for:

- Apps that do not require functionalities specific to the platform
- When it is more important to reuse code instead of interface personalization
- If XAML is already known

Which one is the best approach? - 2

Xamarin.iOS & Xamarin.Android are more appropriate for:

- Apps that require native interactions (native *look&feel* is essential)
- Apps that make abundant use of native APIs
- When personalization of the interface is more important than code reuse with all the platforms

Xamarin.Forms

Projects

It is the combination of two projects, Xamarin.iOS e Xamarin.Android

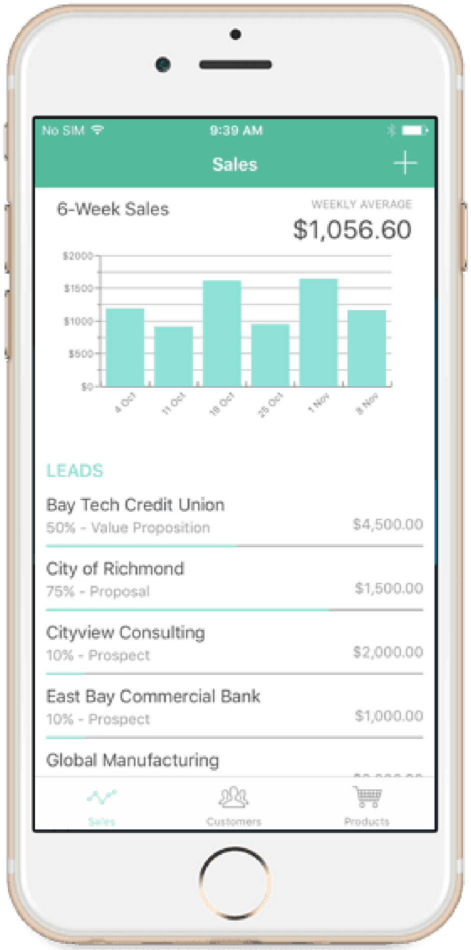
Xamarin.Forms is strongly focused on interfaces, than can be visualized equally everywhere

Uses the MVVM model

Allows a fast prototypization

An interface can be developed using C# or XAML (eXstensible Application Markup Language)

Same but different interfaces


No SIM 9:39 AM

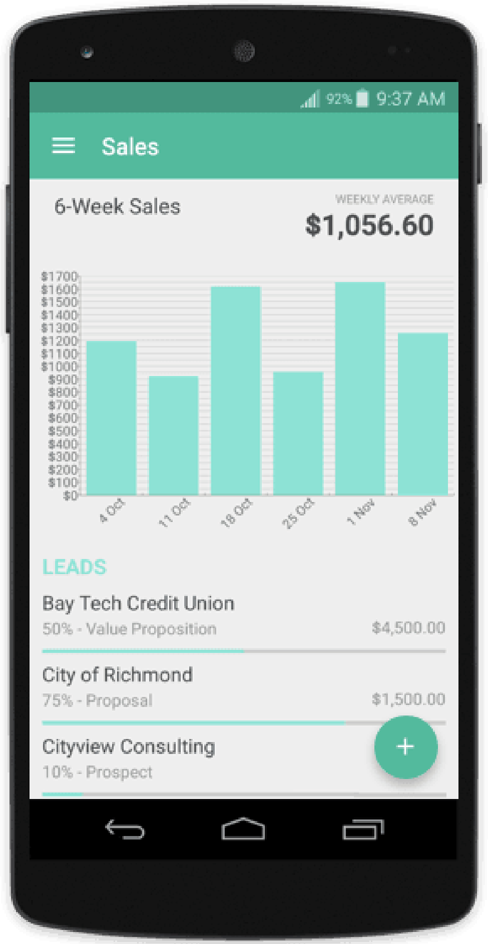
Sales

6-Week Sales

WEEKLY AVERAGE $1,056.60

LEADS

Bay Tech Credit Union 50% - Value Proposition	$4,500.00
City of Richmond 75% - Proposal	$1,500.00
Cityview Consulting 10% - Prospect	$2,000.00
East Bay Commercial Bank 10% - Prospect	$1,000.00
Global Manufacturing	


92% 9:37 AM

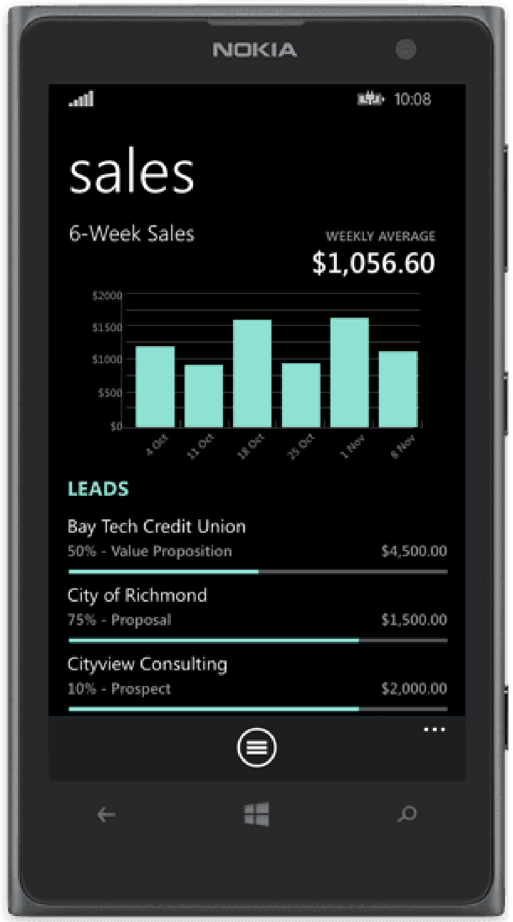
Sales

6-Week Sales

WEEKLY AVERAGE $1,056.60

LEADS

Bay Tech Credit Union 50% - Value Proposition	$4,500.00
City of Richmond 75% - Proposal	$1,500.00
Cityview Consulting 10% - Prospect	



10:08

sales

6-Week Sales

WEEKLY AVERAGE $1,056.60

LEADS

Bay Tech Credit Union 50% - Value Proposition	$4,500.00
City of Richmond 75% - Proposal	$1,500.00
Cityview Consulting 10% - Prospect	$2,000.00

Native Look&feel

Xamarin.Forms allows writing the same code for the interfaces of all platforms

Each page and each component are mapped in a specific widget specific for each platform at runtime.

For example, a Xamarin.Forms entry becomes:

- A UITextView on iOS
- A EditText on Android
- A TextBox on Windows

C#

Basic types

Type	Description
bool	true/false
byte	Positive integer, 8 bits
char	characters, 8 bits
int	4 bytes
short	2 bytes
float	4 bytes
double	8 bytes
object	Basic type
string	Sequence of characters

Variables

Variables names must have at least one character, cannot start with a number, and cannot have spaces

```
string text = "Hello" + "world!"
```

Array

In C# arrays are defined with [] and can contain only data of the same type

Arrays can contain other arrays

```
int [] grades;
grades = new int[5];
grades[0] = 18;
int numbers [];
numbers = new int[5] {1, 2, 3, 4, 5}
Console.WriteLine(numbers.Lenght);
Console.ReadLine();
```

List

Lists are objects.

Constructor:

– List<type> name = new List<type>();

```
List<string> vegetables = new List<string>();
vegetables.Add(”carrots");
vegetables.Add("zucchini");
vegetables.Remove("zucchini");
```

vegetables.AddRange(otherList) $\rightarrow$ concatenation

Dictionaries

Dictionaries in C# are associative arrays. Each value has an associated key

```
Dictionary<string, long> numbers = new
                                   Dictionary<string, long>();
numbers.Add("Giorgio", 3481111);
numbers["Giovanni"] = 3482222;
numbers.Remove("Giorgio");
numbers.Count;
```

If … then … else

```
if (condition) {
    then instructions
} else {
    else instructions
}
```

Loops

```
while (condition){
      instructions
}

do{
       instructions
} while (condition)
```

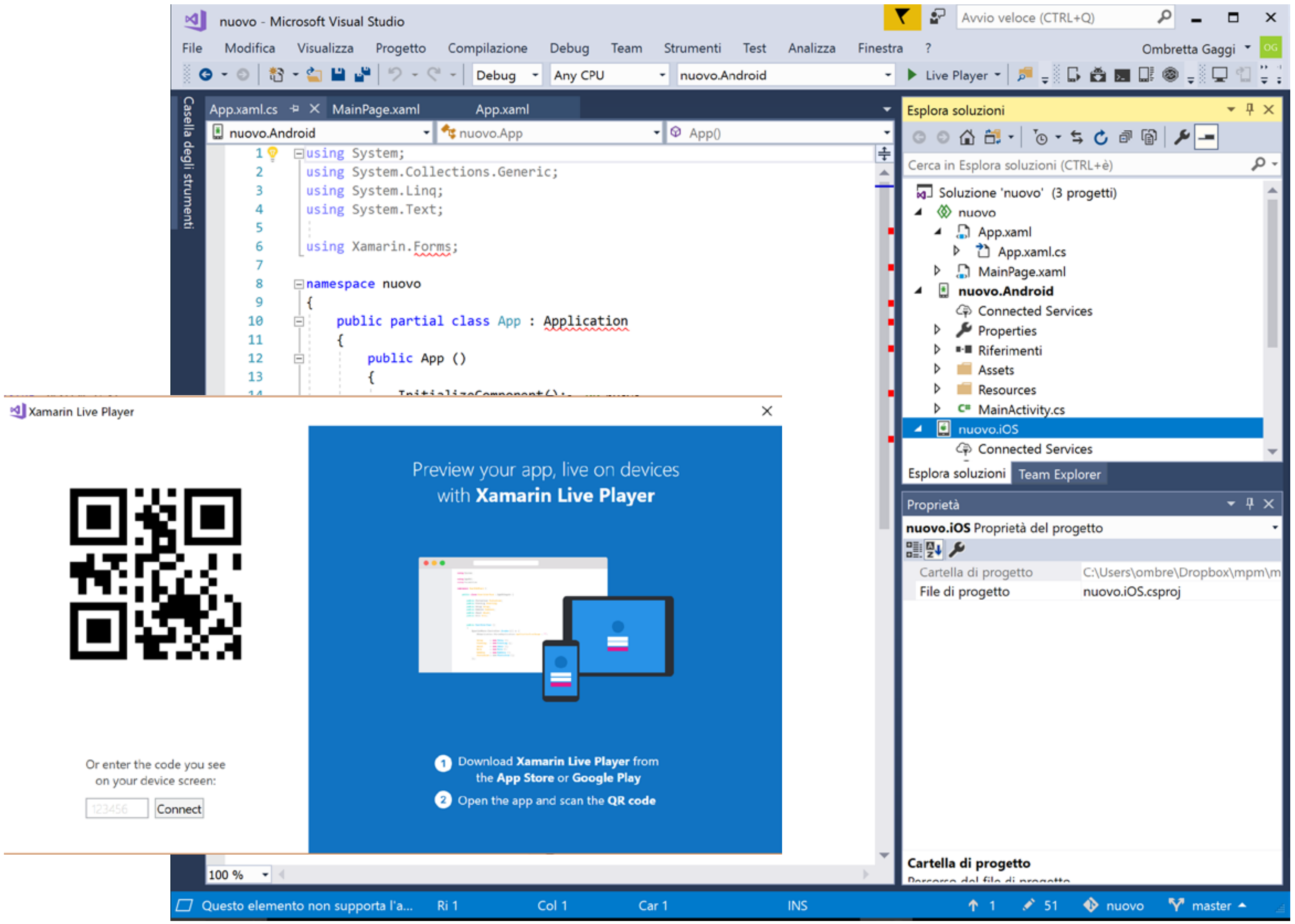
```
for(init; condition; increment){
       instructions
}

foreach (string day in days) {
      MessageBox.Show(day)
}
```

Switch

```
switch(expression){
    case A:
        instructions
        break;
    case B:
         instructions
        break;
    default:
         instructions
}
```

Tools and file management



```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

using Xamarin.Forms;

namespace nuovo
{
    public partial class App : Application
    {
        public App ()
        {
```

nuovo.iOS Proprietà del progetto

Cartella di progetto	C:\Users\ombre\Dropbox\mpm\m
File di progetto	nuovo.iOS.csproj

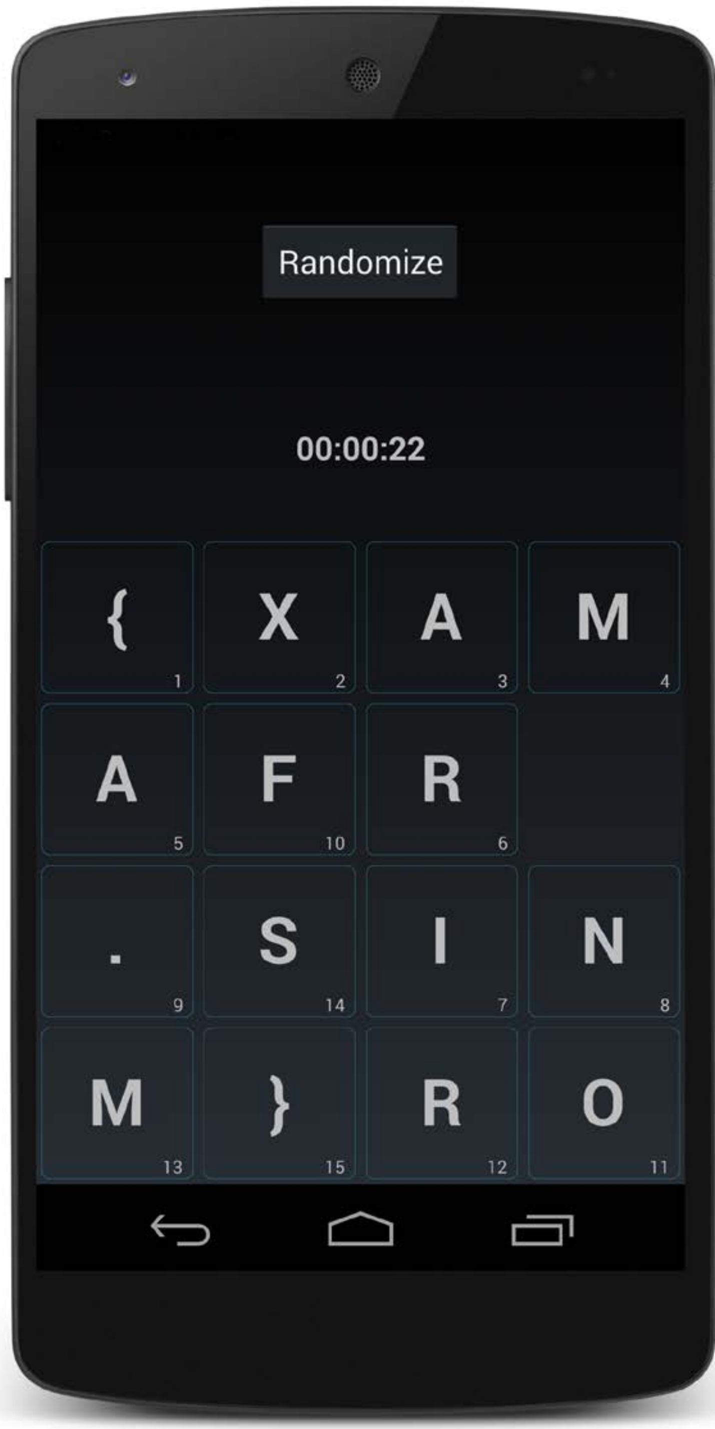
Cartella di progetto

Preview your app, live on devices with **Xamarin Live Player**

1. Download **Xamarin Live Player** from the **App Store** or **Google Play**
2. Open the app and scan the **QR code**

Or enter the code you see on your device screen:

A simple example



App.cs

```
using System;
using Xamarin.Forms;

namespace Xuzzle{
    public class App : Application{
        public App (){
         MainPage = new XuzzlePage();
      }
   }
}
```

Classe XuzzlePage – main page

```
using System; using System.Threading.Tasks; using Xamarin.Forms;
namespace Xuzzle{
	class XuzzlePage : ContentPage{ //variables definition
		static readonly int NUM = 4;
		XuzzleSquare[,] squares = new XuzzleSquare[NUM, NUM];
		int emptyRow = NUM - 1;  int emptyCol = NUM - 1;
		StackLayout stackLayout;
		AbsoluteLayout absoluteLayout;
		Button randomizeButton;
		Label timeLabel;
		double squareSize;
		bool isBusy;
		bool isPlaying;
		//functions definition
}
```

Constructor

```
public XuzzlePage (){
    // AbsoluteLayout to draw the puzzle
    absoluteLayout = new AbsoluteLayout () {
        HorizontalOptions = LayoutOptions.Center,
        VerticalOptions = LayoutOptions.Center
    };
    // strings
    string text = "{XAMARIN.FORMS}";
    string winText = "CONGRATULATIONS";
    int index = 0;
    …
}
```

Drawing the interface - 1

```
for (int row = 0; row < NUM; row++) {
    for (int col = 0; col < NUM; col++) {
        if (row == NUM - 1 && col == NUM - 1) break; //do not fill the last square
        XuzzleSquare square = new XuzzleSquare (text [index], winText [index], index) {
            Row = row, //initialization and draw of each  card
            Col = col
        }; // Add tap recognition
        TapGestureRecognizer tapGestureRecognizer = new TapGestureRecognizer {
            Command = new Command (OnSquareTapped),
            CommandParameter = square
        };
        square.GestureRecognizers.Add (tapGestureRecognizer);
        // adding to tile array and  to absoluteLayout for visualization
        squares [row, col] = square;
        absoluteLayout.Children.Add (square);
        index++;
}}
```

Botton for repositioning

```
randomizeButton = new Button {
    Text = "Randomize",
    HorizontalOptions = LayoutOptions.Center,
    VerticalOptions = LayoutOptions.CenterAndExpand
};
randomizeButton.Clicked += OnRandomizeButtonClicked;
```

Text for timer

```
timeLabel = new Label {
        FontSize = Device.GetNamedSize (NamedSize.Large,
                                                  typeof(Label)),
        FontAttributes = FontAttributes.Bold,
        HorizontalOptions = LayoutOptions.Center,
        VerticalOptions = LayoutOptions.CenterAndExpand
};
```

Drawing the interface - 2

```
stackLayout = new StackLayout {
                Children = {
                        new StackLayout {
                                VerticalOptions = LayoutOptions.FillAndExpand,
                                HorizontalOptions = LayoutOptions.FillAndExpand,
                                Children = {
                                        randomizeButton,
                                        timeLabel
                                }
                        },
                        absoluteLayout
                }
};
stackLayout.SizeChanged += OnStackSizeChanged; //insert into the page
this.Padding = new Thickness(0, Device.RuntimePlatform == Device.iOS ? 20 : 0, 0, 0);
this.Content = stackLayout;
//end of XuzzlePage() constructor
```

OnStackSizeChanged

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```
void OnStackSizeChanged (object sender, EventArgs args){
        double width = stackLayout.Width;
        double height = stackLayout.Height;
        if (width <= 0 || height <= 0) return;
        // check landscape or portrait
        stackLayout.Orientation = (width < height) ?
                                        StackOrientation.Vertical:StackOrientation.Horizontal;
        // calculating position and size of each card based on screen size
        squareSize = Math.Min (width, height) / NUM;
        absoluteLayout.WidthRequest = NUM * squareSize;
        absoluteLayout.HeightRequest = NUM * squareSize;
        foreach (View view in absoluteLayout.Children) {
                XuzzleSquare square = (XuzzleSquare)view;
                square.SetLabelFont (0.4 * squareSize, FontAttributes.Bold);
                AbsoluteLayout.SetLayoutBounds (square,
                        new Rectangle (square.Col * squareSize,
                                        square.Row * squareSize,  squareSize, squareSize));
        }
}
```

OnSquareTapped

```
async void OnSquareTapped (object parameter){
	if (isBusy) return;
	isBusy = true;
	XuzzleSquare tappedSquare = (XuzzleSquare)parameter;
	await ShiftIntoEmpty (tappedSquare.Row, tappedSquare.Col);
	isBusy = false; //check if player wins
	if (isPlaying) {
		int index;
		for (index = 0; index < NUM * NUM - 1; index++) {
			int row = index / NUM; int col = index % NUM;
			XuzzleSquare square = squares [row, col];
			if (square == null || square.Index != index) break;
		} // win
		if (index == NUM * NUM - 1) {
			isPlaying = false;
			await DoWinAnimation ();
		}
}}
```

ShiftIntoEmpty

```
async Task ShiftIntoEmpty (int tappedRow, int tappedCol, int length = 100)
    if (tappedRow == emptyRow && tappedCol != emptyCol) {// Shift columns
        int inc = Math.Sign (tappedCol - emptyCol);
        int begCol = emptyCol + inc;
        int endCol = tappedCol + inc;
        for (int col = begCol; col != endCol; col += inc) {
            await AnimateSquare (emptyRow, col, emptyRow, emptyCol, length);
        }       // Shift rows
    } else if (tappedCol == emptyCol && tappedRow != emptyRow) {
        int inc = Math.Sign (tappedRow - emptyRow);
        int begRow = emptyRow + inc;
        int endRow = tappedRow + inc;
        for (int row = begRow; row != endRow; row += inc) {
            await AnimateSquare (row, emptyCol, emptyRow, emptyCol, length);
        }
    }
}
```

AnimateSquare

```
async Task AnimateSquare (int row, int col, int newRow, int newCol, int length){
      XuzzleSquare animaSquare = squares [row, col]; // card to animate
      //destination rectangle
      Rectangle rect = new Rectangle (squareSize * emptyCol,
                                      squareSize * emptyRow,  squareSize,  squareSize);
      await animaSquare.LayoutTo (rect, length);
      //variables for the new  layout
      squares [newRow, newCol] = animaSquare;
      animaSquare.Row = newRow;
      animaSquare.Col = newCol;
      squares [row, col] = null;
      emptyRow = row;
      emptyCol = col;
}
```

OnRandomizeButtonClicked - 1

```
async void OnRandomizeButtonClicked (object sender, EventArgs args) {
        Button button = (Button)sender;
        button.IsEnabled = false;
        Random rand = new Random ();
        isBusy = true;
        // Simulate some fast crazy taps
        for (int i = 0; i < 100; i++) {
                await ShiftIntoEmpty (rand.Next (NUM), emptyCol, 25);
                await ShiftIntoEmpty (emptyRow, rand.Next (NUM), 25);
        }
        button.IsEnabled = true;
        isBusy = false;
        …
}
```

OnRandomizeButtonClicked - 2

```
async void OnRandomizeButtonClicked (object sender, EventArgs args) {
        … // preparation of the game
        DateTime startTime = DateTime.Now;
        Device.StartTimer (TimeSpan.FromSeconds (1), () => {
                // Round duration and get rid of milliseconds.
                TimeSpan timeSpan = (DateTime.Now - startTime) + TimeSpan
                                                        .FromSeconds(0.5);
                timeSpan = new TimeSpan (timeSpan.Hours, timeSpan.Minutes,
                                                        timeSpan.Seconds);
                if (isPlaying) // shows the duration
                        timeLabel.Text = timeSpan.ToString ("t");
                return isPlaying;
        });
        this.isPlaying = true;
}
```

DoWinAnimation

```
async Task DoWinAnimation (){
    //blocking input
    randomizeButton.IsEnabled = false;
    isBusy = true;
    for (int cycle = 0; cycle < 2; cycle++) {
        foreach (XuzzleSquare square in squares)
                if (square != null)
                    await square.AnimateWinAsync (cycle == 1);
                if (cycle == 0)
                    await Task.Delay (1500);
    }
    //restarting input
    randomizeButton.IsEnabled = true;
    isBusy = false;
}
```

XuzzleSquare

```
using System;
using System.Threading.Tasks;
using Xamarin.Forms;

namespace Xuzzle{
        class XuzzleSquare : ContentView{
                Label label;
                string normText, winText;
                //constructor and functions
                // current position
                public int Index { private set; get; }
                public int Row { set; get; }
                public int Col { set; get; }
        }
}
```

Constructor - 1

```
public XuzzleSquare (char normChar, char winChar, int index){
        this.Index = index;
        this.normText = normChar.ToString ();
        this.winText = winChar.ToString ();
        // each card is a frame with two labels
        label = new Label {
                Text = this.normText,
                HorizontalOptions = LayoutOptions.Center,
                VerticalOptions = LayoutOptions.CenterAndExpand
        };
        Label tinyLabel = new Label {
                Text = (index + 1).ToString (),
                FontSize = Device.GetNamedSize (NamedSize.Micro, typeof(Label)),
                HorizontalOptions = LayoutOptions.End
        };
        …
}
```

Constructor - 2

```
public XuzzleSquare (char normChar, char winChar, int index){
        …
        this.Padding = new Thickness (3);
        this.Content = new Frame {
        OutlineColor = Color.Accent,
        Padding = new Thickness (5, 10, 5, 0),
                Content = new StackLayout {
                        Spacing = 0,
                        Children = {
                                label,
                                tinyLabel,
                        }
                }
        };
        // blocks touch event that is managed by this object and not by the ones below
        this.BackgroundColor = Color.Transparent;
}
```

AnimateWinAsync

```
public async Task AnimateWinAsync (bool isReverse) {
    uint length = 150;
    await Task.WhenAll (this.ScaleTo (3, length),
                        this.RotateTo (180, length));
    label.Text = isReverse ? normText : winText;
    await Task.WhenAll (this.ScaleTo (1, length),
    this.RotateTo (360, length));
    this.Rotation = 0;
}
```

SetLabelFont

```
public void SetLabelFont(double fontSize,
                         FontAttributes attributes){
    label.FontSize = fontSize;
    label.FontAttributes = attributes;
}
```

References

Official site

- https://www.xamarin.com/

Documentation

- https://developer.xamarin.com/guides/

Puzzle example

- https://developer.xamarin.com/samples/xamarin-forms/Xuzzle/