Loxodon Framework Fody

(English)

Developed by Clark

Requires Unity 2018.4 or higher.

这是一个静态织入代码的工具，已将Fody整合到Unity项目中，可以利用Fody丰富的插件来简化代码，提高开发效率。目前我已经将PropertyChanged.Fody和ToString.Fody插件也发布为Unity的package.

PropertyChanged.Fody是一个注入INotifyPropertyChanged相关代码的插件，通过为ViewModel类Model类添加注解，自动生成"INotifyPropertyChanged"接口和相关的代码。关于PropertyChanged.Fody注解的使用请查看官方文档。

ToString.Fody能够为类自动生成ToString函数。只要类添加了[ToString]注解，就会重载类的ToString函数。

BindingProxy.Fody 为ViewModel静态织入字段、属性、方法的代理类，数据绑定时使用静态注入的代理类访问对象的属性和方法，优化调用的性能。

安装

从OpenUPM安装

OpenUPM 中提供了很多的Unity插件，自动管理依赖，推荐从OpenUPM仓库安装本插件.

命令行方式安装，要求 nodejs's npm and openupm-cli, 如果没有安装nodejs命令行环境请先安装nodejs。

```
# Install openupm-cli,please ignore if it is already installed.
npm install -g openupm-cli

#Go to the root directory of your project
cd F:/workspace/New Unity Project

#Install loxodon-framework-fody-propertychanged
openupm add com.vovgou.loxodon-framework-fody-propertychanged

#Install loxodon-framework-fody-tostring
openupm add com.vovgou.loxodon-framework-fody-tostring

#Install loxodon-framework-fody-bindingproxy
openupm add com.vovgou.loxodon-framework-fody-bindingproxy
```

通过修改 Packages/manifest.json 文件安装插件(推荐)

在Unity项目的Packages目录中找到manifest.json 文件，增加第三方仓库"https://package.openupm.com"或者"https://registry.npmjs.org"到配置文件中，然后增加"com.vovgou.loxodon-framework-fody" 到dependencies节点下，Unity会自动下载插件，使用这种方式安装也相当方便，且省去了安装nodejs和openm-cli客户端的麻烦。

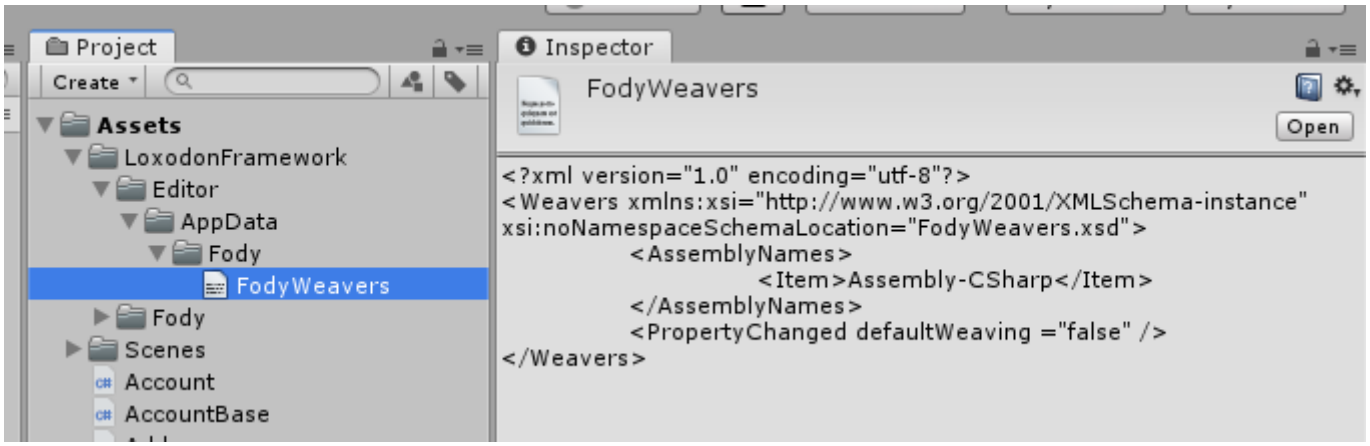
```
{
  "dependencies": {
    ...
    "com.unity.modules.xr": "1.0.0",
    "com.vovgou.loxodon-framework-fody": "2.4.9",
    "com.vovgou.loxodon-framework-fody-propertychanged": "2.6.0",
    "com.vovgou.loxodon-framework-fody-tostring": "2.6.0",
    "com.vovgou.loxodon-framework-fody-bindingproxy": "2.6.0"
  },
  "scopedRegistries": [
    {
      "name": "package.openupm.com",
      "url": "https://package.openupm.com",
      "scopes": [
        "com.vovgou",
        "com.openupm"
      ]
    }
  ]
}
```

快速开始

PropertyChanged.Fody

插件导入到项目后，会在Assets\LoxodonFramework\Editor\AppData\Fody目录下自动生成FodyWeavers.xml文件。修改这个文件，添加需要织入代码的程序集名称即可。XML文件中的PropertyChanged节点是关于PropertyChanged.Fody插件的配置，具体可以查看PropertyChanged.Fody的文档。

PropertyChanged默认会织入所有继承了INotifyPropertyChanged或者添加了AddINotifyPropertyChangedInterface注解的类，如果某个类不想被织入代码，可以使用DoNotNotify注解排除。老的项目引入此插件后，会导致所有已经添加了属性通知的ViewModel类再次被织入RaisePropertyChanged函数，造成重复触发通知事件的情况，因此我重写了PropertyChanged.Fody插件的部分方法，为xml配置文件PropertyChanged节点增加了一个属性defaultWeaving。当defaultWeaving=false时，只会为添加了AddINotifyPropertyChangedInterface注解的类织入通知代码，避免老的ViewModel类被重复的织入RaisePropertyChanged函数。



FodyWeavers.xml

```
<Weavers xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="Fc
        <AssemblyNames>
                <Item>Assembly-CSharp</Item>
        </AssemblyNames>
        <PropertyChanged defaultWeaving ="true" />
</Weavers>
```

在项目中创建一个User类，添加注解"AddINotifyPropertyChangedInterface", 代码如下:

```
[AddINotifyPropertyChangedInterface]
public class User
{
    public string FirstName { get; set; }

    public string LastName { get; set; }

    public string FullName => $"{FirstName} {LastName}";
}
```

在代码被Unity编译后，PropertyChanged.Fody会自动织入INotifyPropertyChanged接口相关的代码，所有的属性都会增加RaisePropertyChanged或者OnPropertyChanged函数触发属性改变通知事件。使用ILSpy反编译工具打开Assembly-CSharp.dll程序集，User类的代码如下：

```
public class User : INotifyPropertyChanged
{
        public string FirstName
        {
                [CompilerGenerated]
                get
                {
                        return FirstName;
                }
                [CompilerGenerated]
                set
                {
                        if (!string.Equals(FirstName, value, StringComparison.Ordinal))
                        {
                                FirstName = value;
                                <>OnPropertyChanged(<>PropertyChangedEventArgs.FullName);
                                <>OnPropertyChanged(<>PropertyChangedEventArgs.FirstName);
                        }
                }
        }

        public string LastName
        {
                [CompilerGenerated]
                get
                {
                        return LastName;
                }
                [CompilerGenerated]
                set
                {
                        if (!string.Equals(LastName, value, StringComparison.Ordinal))
                        {
                                LastName = value;
                                <>OnPropertyChanged(<>PropertyChangedEventArgs.FullName);
                                <>OnPropertyChanged(<>PropertyChangedEventArgs.LastName);
                        }
                }
        }

        public string FullName => FirstName + " " + LastName;

        [field: NonSerialized]
        public event PropertyChangedEventHandler PropertyChanged;

        [GeneratedCode("PropertyChanged.Fody", "3.4.1.0")]
        [DebuggerNonUserCode]
        protected void <>OnPropertyChanged(PropertyChangedEventArgs eventArgs)
        {
                this.PropertyChanged?.Invoke(this, eventArgs);
```

```
        }
}
```

ToString.Fody

FodyWeavers.xml

```
<Weavers xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="Fc
        <AssemblyNames>
                <Item>Assembly-CSharp</Item>
        </AssemblyNames>
        <ToString />
</Weavers>
```

User类代码如下，为User类添加[ToString]注解。

```
[AddINotifyPropertyChangedInterface]
[ToString]
public class User
{
    public string FirstName { get; set; }

    public string LastName { get; set; }

    public string FullName => $"{FirstName} {LastName}";
}
```

织入后的代码如下，自动生成了ToString函数。

```
public string FirstName
{
        [CompilerGenerated]
        get
        {
                return FirstName;
        }
        [CompilerGenerated]
        set
        {
                if (!string.Equals(FirstName, value, StringComparison.Ordinal))
                {
                        FirstName = value;
                        <>OnPropertyChanged(<>PropertyChangedEventArgs.FullName);
                        <>OnPropertyChanged(<>PropertyChangedEventArgs.FirstName);
                }
        }
}

public string LastName
{
        [CompilerGenerated]
        get
        {
                return LastName;
        }
        [CompilerGenerated]
        set
        {
                if (!string.Equals(LastName, value, StringComparison.Ordinal))
                {
                        LastName = value;
                        <>OnPropertyChanged(<>PropertyChangedEventArgs.FullName);
                        <>OnPropertyChanged(<>PropertyChangedEventArgs.LastName);
                }
        }
}

public string FullName => FirstName + " " + LastName;

[field: NonSerialized]
public event PropertyChangedEventHandler PropertyChanged;

[GeneratedCode("PropertyChanged.Fody", "4.0.2.0")]
[DebuggerNonUserCode]
protected void <>OnPropertyChanged(PropertyChangedEventArgs eventArgs)
{
        this.PropertyChanged?.Invoke(this, eventArgs);
}
```

```
[GeneratedCode("Fody.ToString", "1.11.1.0")]
[DebuggerNonUserCode]
public override string ToString()
{
        return string.Format(CultureInfo.InvariantCulture, "{{T: \"User\", FirstName: \"{0}\", L
        {
                FirstName ?? "null",
                LastName ?? "null",
                FullName ?? "null"
        });
}
```

BindingProxy.Fody

BindingProxy.Fody是一个性能优化组件，它可以为一个类的Property、Field和Method静态织入绑定代理类，在一些不允许JIT的平台上，可以绕过动态委托调用或者反射调用，达到直接调用Property、Field、Method的效果。 本插件仅会扫描所有继承了INotifyPropertyChanged接口的类，默认不会为类的Property和Field生成绑定代理对象（PropertyNodeProxy、FieldNodeProxy），但是可以通过修改FodyWeavers.xml配置文件中的defaultWeaveProperty ="true" 和defaultWeaveField="true"来改变默认值。但是对于Method，必须显示的为方法添加[GenerateMethodProxy]注解，才会织入方法代理类（MethodNodeProxy）。

执行效率

在魅族18s pro真机测试结果：

- 直接调用100万次取值函数，耗时:0ms
- 静态注入方式调用100万次取值函数，耗时:2ms
- 动态委托方式调用100万次取值函数，耗时:11ms
- 反射方式调用100万次取值函数，耗时:545ms
- 直接调用100万次赋值函数，耗时:103ms
- 静态注入方式调用100万次赋值函数，耗时:114ms
- 动态委托方式调用100万次赋值函数，耗时:140ms
- 反射方式调用100万次赋值函数，耗时:934ms

测试代码

```
using BindingProxy;
using Loxodon.Framework.Binding.Proxy;
using Loxodon.Framework.Binding.Proxy.Sources.Weaving;
using Loxodon.Framework.Binding.Reflection;
using Loxodon.Framework.Observables;
using PropertyChanged;
using System;
using UnityEngine;

public class PerformanceTest : MonoBehaviour
{
    [AddINotifyPropertyChangedInterface]
    [GeneratePropertyProxy]
    public class AccountViewModel : ObservableObject
    {
        public string FirstName { get; set; }

        public string LastName { get; set; }

        public string FullName => $"{FirstName} {LastName}";

    }

    void Start()
    {
        AccountViewModel account = new AccountViewModel();
        account.FirstName = "Clark";

        Type accountType = typeof(AccountViewModel);
        IWovenNodeProxyFinder finder = account as IWovenNodeProxyFinder;
        var sourceProxy = finder.GetSourceProxy("FirstName");
        IObtainable<string> obtainable = (IObtainable<string>)sourceProxy;
        IModifiable<string> modifiable = (IModifiable<string>)sourceProxy;

        var proxyPropertyInfo = accountType.AsProxy().GetProperty("FirstName");
        var propertyInfo = accountType.GetProperty("FirstName");

        int n = 1000000;
        System.Diagnostics.Stopwatch w = new System.Diagnostics.Stopwatch();
        w.Start();
        for (int i = 0; i < n; i++)
        {
            var v = account.FirstName;
        }
        w.Stop();
        Debug.LogFormat("直接调用100万次取值函数，耗时:{0}ms", w.ElapsedMilliseconds);
        w.Reset();
        w.Start();
        for (int i = 0; i < n; i++)
        {
```

```
    var v = obtainable.GetValue();
}
w.Stop();
Debug.LogFormat("静态注入方式调用100万次取值函数，耗时:{0}ms", w.ElapsedMilliseconds);

w.Reset();
w.Start();
for (int i = 0; i < n; i++)
{
    var v = proxyPropertyInfo.GetValue(account);
}
w.Stop();
Debug.LogFormat("动态委托方式调用100万次取值函数，耗时:{0}ms", w.ElapsedMilliseconds);

w.Reset();
w.Start();
for (int i = 0; i < n; i++)
{
    var v = propertyInfo.GetValue(account);
}
w.Stop();
Debug.LogFormat("反射方式调用100万次取值函数，耗时:{0}ms", w.ElapsedMilliseconds);

string value1 = "Clark1";
string value2 = "Clark2";
w.Reset();
w.Start();
for (int i = 0; i < n; i++)
{
    account.FirstName = ((i & 0x1) == 0x1 ? value1 : value2);
}
w.Stop();
Debug.LogFormat("直接调用100万次赋值函数，耗时:{0}ms", w.ElapsedMilliseconds);

w.Reset();
w.Start();
for (int i = 0; i < n; i++)
{
    modifiable.SetValue((i & 0x1) == 0x1 ? value1 : value2);
}
w.Stop();
Debug.LogFormat("静态注入方式调用100万次赋值函数，耗时:{0}ms", w.ElapsedMilliseconds);

w.Reset();
w.Start();
for (int i = 0; i < n; i++)
{
    proxyPropertyInfo.SetValue(account, (i & 0x1) == 0x1 ? value1 : value2);
}
w.Stop();
Debug.LogFormat("动态委托方式调用100万次赋值函数，耗时:{0}ms", w.ElapsedMilliseconds);
```

```
        w.Reset();
        w.Start();
        for (int i = 0; i < n; i++)
        {
            propertyInfo.SetValue(account, (i & 0x1) == 0x1 ? value1 : value2);
        }
        w.Stop();
        Debug.LogFormat("反射方式调用100万次赋值函数，耗时:{0}ms", w.ElapsedMilliseconds);
    }
}
```

配置文件

FodyWeavers.xml

```
<Weavers xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="Fo
        <AssemblyNames>
                <Item>Assembly-CSharp</Item>
        </AssemblyNames>
        <BindingProxy defaultWeaveProperty ="false"  defaultWeaveField="false" Debug="true"/>
</Weavers>
```

支持的注解类型

- GenerateFieldProxyAttribute
  在类上标注，则为整个类的所有public的field生成FieldNodeProxy对象。在Field上标注，则仅表示此字段需要生成FieldNodeProxy对象。
- GeneratePropertyProxyAttribute
  在类上标注，则为整个类的所有public的Property生成PropertyNodeProxy对象。在Property上标注，则仅表示此属性需要生成PropertyNodeProxy对象。
- GenerateMethodProxyAttribute
  只能在方法上标注，表示此方法需要生成MethodNodeProxy对象。
- IgnoreAttribute
  可以在类，属性、字段、方法上标注，表示忽略生成绑定代理对象。

注册绑定代理工厂

在绑定服务BindingServiceBundle启动时，将WovenNodeProxyFactory工厂注册到INodeProxyFactoryRegister中，WovenNodeProxyFactory的优先级要高于默认的UniversalNodeProxyFactory优先级（优先级0），可以设置为100。在创建绑定代理时即可使用WovenNodeProxyFactory创建本插件静态织入的代理对象，已达到优化性能的目的。

```
ApplicationContext context = Context.GetApplicationContext();
IServiceContainer container = context.GetContainer();

/* Initialize the data binding service */
BindingServiceBundle bundle = new BindingServiceBundle(context.GetContainer());
bundle.Start();

INodeProxyFactoryRegister nodeFactoryRegister = container.Resolve<INodeProxyFactoryRegister>();
nodeFactoryRegister.Register(new WovenNodeProxyFactory(),100);//优先级设置为100即可
```

示例代码如下：

```
//当defaultWeaveField ="true" 或者类添加GenerateFieldProxy注解，则会为类中所有public的Field生成Fiel
[GenerateFieldProxy]
//当defaultWeaveProperty ="true" 或者类添加GeneratePropertyProxy注解，则会为类中所有public的Propert
[GeneratePropertyProxy]
[AddINotifyPropertyChangedInterface]
public class AccountViewModel : INotifyPropertyChanged
{

    public event PropertyChangedEventHandler PropertyChanged;

    public string Mobile;

    public string FirstName { get; set; }

    public string LastName { get; protected set; }

    public string FullName => $"{FirstName} {LastName}";

    //忽略此属性，不生成属性绑定代理
    [Ignore]
    public int Age { get; set; }

    [GenerateMethodProxy]
    public void OnValueChanged()
    {
    }

    [GenerateMethodProxy]
    public void OnValueChanged(int value)
    {
    }
}
```

插件会在Unity编译后为公共的字段、属性和标注了[GenerateMethodProxy]注解的方法自动织入代理类，比如FirstName属性，会自动生成一个FirstNamePropertyNodeProxy的类。除了代理类，还会为

AccountViewModel类织入IWovenNodeProxyFinder的接口和实现，通过IWovenNodeProxyFinder接口的GetSourceProxy(name)函数，即可获得属性的代理实例。前文中的WovenNodeProxyFactory便是通过此函数来获得属性的代理。

织入后的代码如下：

```
public class AccountViewModel : INotifyPropertyChanged, IWovenNodeProxyFinder
{
        [GeneratedCode("BindingProxy.Fody", "1.0.0.0")]
        [DebuggerNonUserCode]
        [Preserve]
        private class MobileFieldNodeProxy : WovenFieldNodeProxy<AccountViewModel, string>
        {
                public MobileFieldNodeProxy(AccountViewModel source)
                        : base(source)
                {
                }

                public override string GetValue()
                {
                        return source.Mobile;
                }

                public override void SetValue(string value)
                {
                        source.Mobile = value;
                }
        }

        [GeneratedCode("BindingProxy.Fody", "1.0.0.0")]
        [DebuggerNonUserCode]
        [Preserve]
        private class FirstNamePropertyNodeProxy : WovenPropertyNodeProxy<AccountViewModel, stri
        {
                public FirstNamePropertyNodeProxy(AccountViewModel source)
                        : base(source)
                {
                }

                public override string GetValue()
                {
                        return source.FirstName;
                }

                public override void SetValue(string value)
                {
                        source.FirstName = value;
                }
        }

        [GeneratedCode("BindingProxy.Fody", "1.0.0.0")]
        [DebuggerNonUserCode]
        [Preserve]
        private class LastNamePropertyNodeProxy : WovenPropertyNodeProxy<AccountViewModel, strir
        {
                public LastNamePropertyNodeProxy(AccountViewModel source)
```

```
                : base(source)
        {
        }

        public override string GetValue()
        {
                return source.LastName;
        }

        public override void SetValue(string value)
        {
                throw new MemberAccessException("AccountViewModel.LastName is read-only
        }
}

[GeneratedCode("BindingProxy.Fody", "1.0.0.0")]
[DebuggerNonUserCode]
[Preserve]
private class FullNamePropertyNodeProxy : WovenPropertyNodeProxy<AccountViewModel, strir
{
        public FullNamePropertyNodeProxy(AccountViewModel source)
                : base(source)
        {
        }

        public override string GetValue()
        {
                return source.FullName;
        }

        public override void SetValue(string value)
        {
                throw new MemberAccessException("AccountViewModel.FullName is read-only
        }
}

[GeneratedCode("BindingProxy.Fody", "1.0.0.0")]
[DebuggerNonUserCode]
[Preserve]
private class OnValueChangedMethodNodeProxy : WovenMethodNodeProxy<AccountViewModel>, II
{
        public OnValueChangedMethodNodeProxy(AccountViewModel source)
                : base(source)
        {
        }

        public object Invoke()
        {
                source.OnValueChanged();
                return null;
        }
```

```
        public object Invoke(int value)
        {
                source.OnValueChanged(value);
                return null;
        }

        public override object Invoke(params object[] args)
        {
                switch ((args != null) ? args.Length : 0)
                {
                case 0:
                        return Invoke();
                case 1:
                        return Invoke((int)args[0]);
                default:
                        return null;
                }
        }
}

public string Mobile;

[GeneratedCode("BindingProxy.Fody", "1.0.0.0")]
private WovenNodeProxyFinder _finder;

public string FirstName
{
        [CompilerGenerated]
        get
        {
                return FirstName;
        }
        [CompilerGenerated]
        set
        {
                if (!string.Equals(FirstName, value, StringComparison.Ordinal))
                {
                        FirstName = value;
                        <>OnPropertyChanged(<>PropertyChangedEventArgs.FullName);
                        <>OnPropertyChanged(<>PropertyChangedEventArgs.FirstName);
                }
        }
}

public string LastName
{
        [CompilerGenerated]
        get
        {
                return LastName;
```

```
        }
        [CompilerGenerated]
        protected set
        {
                if (!string.Equals(LastName, value, StringComparison.Ordinal))
                {
                        LastName = value;
                        <>OnPropertyChanged(<>PropertyChangedEventArgs.FullName);
                        <>OnPropertyChanged(<>PropertyChangedEventArgs.LastName);
                }
        }
}

public string FullName => FirstName + " " + LastName;

public int Age
{
        [CompilerGenerated]
        get
        {
                return Age;
        }
        [CompilerGenerated]
        set
        {
                if (Age != value)
                {
                        Age = value;
                        <>OnPropertyChanged(<>PropertyChangedEventArgs.Age);
                }
        }
}

public event PropertyChangedEventHandler PropertyChanged;

public void OnValueChanged()
{
}

public void OnValueChanged(int value)
{
}

[GeneratedCode("PropertyChanged.Fody", "3.4.1.0")]
[DebuggerNonUserCode]
protected void <>OnPropertyChanged(PropertyChangedEventArgs eventArgs)
{
        this.PropertyChanged?.Invoke(this, eventArgs);
}

[GeneratedCode("BindingProxy.Fody", "1.0.0.0")]
```

```
        [DebuggerNonUserCode]
        ISourceProxy IWovenNodeProxyFinder.GetSourceProxy(string name)
        {
                if (_finder == null)
                {
                        _finder = new WovenNodeProxyFinder(this);
                }
                return _finder.GetSourceProxy(name);
        }
}
```

Contact Us

Email: yangpc.china@gmail.com

Website: https://vovgou.github.io/loxodon-framework/

QQ Group: 622321589