IKVM.NET
Building a Java VM on the .NET Framework

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Who am I

- Jeroen Frijters /Yeroon Frighters/
- Co-founder of a small ISV in The Netherlands
- Lead developer of IKVM.NET an Open Source JVM for .NET

What is IKVM.NET?

- Java VM on top of .NET & Mono
  - JIT compiler to translate Java bytecode into MSIL
  - Reflection
  - Etc.
- Static compiler that translates Java classes/jars into .NET assemblies
  - Basically ahead of time compiler for above mentioned JIT
- .NET port of OpenJDK class library
  - Some gaps, but most APIs part of “Java” are available

Why is IKVM.NET?

- Started in the spring of 2002 as an experiment
- My blog on June 19th, 2002:

  "I have a large Java application that I would like to slowly migrate to .NET, in order to be able to do that, I need a way to interoperate with Java code, the existing solutions I have looked at are inadequate. Besides, It's lots of fun to build something like this :-)"

Compatibility

- Java 7
  - Based OpenJDK class library without the native code.
  - Swing/AWT/Fonts/Graphics/Printing not supported.
- There are some minor VM level incompatibilities, but so far these are just theoretical.
- Practical sources of incompatibilities:
  - sun.* packages
  - “The class loader problem”

[System|IKVM].Reflection

- Thanks to AppDomain.TypeResolve event it is possible to build a managed “JIT”.
- But, System.Reflection has some serious limitations for compilers.
- IKVM.Reflection is now used by ikvmc, Mono C# compiler, Scala .NET and others.

Type System

- cli.System.Object extends java.lang.Object
- java.lang.Object : System.Object
- java.lang.String is only a container for static methods. Instances are always System.String.
- cli.System.Exceptions extends java.lang.Throwable
- java.lang.Throwable : System.Exception
- (checked exceptions)

Type System cont.

- java.lang.Comparable : System.IComparable
- java.lang.Cloneable, java.io.Serializable & java.lang.CharSequence need to be special cased (strings and arrays)

Exposing .NET features to Java

- Delegates
- ByRef method arguments
- Custom attributes
- Value Types
- Enums
- Properties & Events

Delegates in Java

```
public final class RunnableDelegate
    extends cli.System.MulticastDelegate
    implements Runnable
{
    public RunnableDelegate(Method m) { }
    public native void Invoke();
    public interface Method
    {
        void Invoke();
    }
    public void run()
    {
        Invoke();
    }
}
```

Delegates in Java

```
package ikvm.runtime;

public final class Delegates
{
    public static Runnable toRunnable(RunnableDelegate delegate)
    {
        return delegate;
    }
}
```

```
java.lang.Thread thread = new java.lang.Thread(
    ikvm.runtime.Delegates.toRunnable(delegate {
        Console.WriteLine("Hello World");
    }));
thread.start();
```

ByRef Method Arguments

- Same as in Java, hack it with an array
- Would like to use generics, but erasure makes this hard (due to inability to do method overloading)

Custom Attributes

- Exposing them as annotations works (most of the time)

```
package sun.misc;

class Unsafe
{
   @SecurityPermissionAttribute.Annotation(
            value = SecurityAction.__Enum.LinkDemand,
            UnmanagedCode = true)
   @cli.System.Security.SecurityCriticalAttribute.Annotation
   public void freeMemory(long address)
   {
      Marshal.FreeHGlobal(IntPtr.op_Explicit(address));
   }
}
```

Value Types

- Weak support:
  - You can only use them from Java, not define them.
  - Will usually be boxed.

Enums

- Would like the ability to do method overloading based on enum type
- Need ability to “bit twiddle”
- Usable in custom attribute annotations

```
package cli.System;

public final class DayOfWeek extends cli.System.Enum
{
    public static final int Sunday = 0;
    public static final int Monday = 1;
    …
    public final int Value;
    public static native DayOfWeek wrap( int i);
}
```

Properties & Events

- No special support
- Directly use the underlying methods

```
import cli.System.Windows.Forms.*;

class Demo
{
   public static void main(String[] args)
   {
      Form form = new Form();
      form.set_Width(400);
      form.set_Height(400);
      form.add_FormClosing(new FormClosingEventHandler(
                                 new FormClosingEventHandler.Method() {
        public void Invoke(Object sender, FormClosingEventArgs args) {
          System.out.println("Closing...");
        }
      }));
      Application.Run(form);
  }
}
```

Exposing Java to .NET

- Keeping IntelliSense™ clean
- Static fields in interfaces
- Annotations
- Generics
- Workarounds

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__WorkaroundBaseClass__

```
public abstract class Base
{
    protected abstract void M();
}

public abstract class Derived : Base
{
    public override void M()
    {
    }
}
```

```
class Program : Derived
{
}
```

error CS0534: 'Program' does not implement inherited abstract member 'Base.M()'

__WorkaroundBaseClass__

```
public abstract class Base
{
    protected abstract void M();
}

[HideFromJava] [EditorBrowsable(EditorBrowsableState.Never)]
public abstract __WorkaroundBaseClass__Derived : Base
{
    protected override void M() { throw new AbstractMethodError(); }
}

public abstract class Derived : __WorkaroundBaseClass__Derived
{
    public override void M()
    {
    }
}
```

```
class Program : Derived
{
}
```

Interop “Magic”

- Limited support for automagic .NET serialization support for Java serializable classes
- .NET exceptions are serialized as com.sun.xml.internal.ws.developer. ServerSideException
- java.io.Closeable => System.IDisposable
- java.lang.Iterable => System.IEnumerable
- java.lang.AutoCloseable ⇔ System.IDisposable

“Jar Hell”

- Hard to determine jar dependencies
- Circular depencies occur more often than you’d think

```
ikvmc { foo.jar -out:Foo.dll } { bar.jar -out:Bar.dll }
```

Performance

- Typically pretty good
- .NET often wins on string processing
- Exception heavy code suffers
- Don’t “benchmark” under the debugger!

Users

Several commercial and open source applications use IKVM.NET

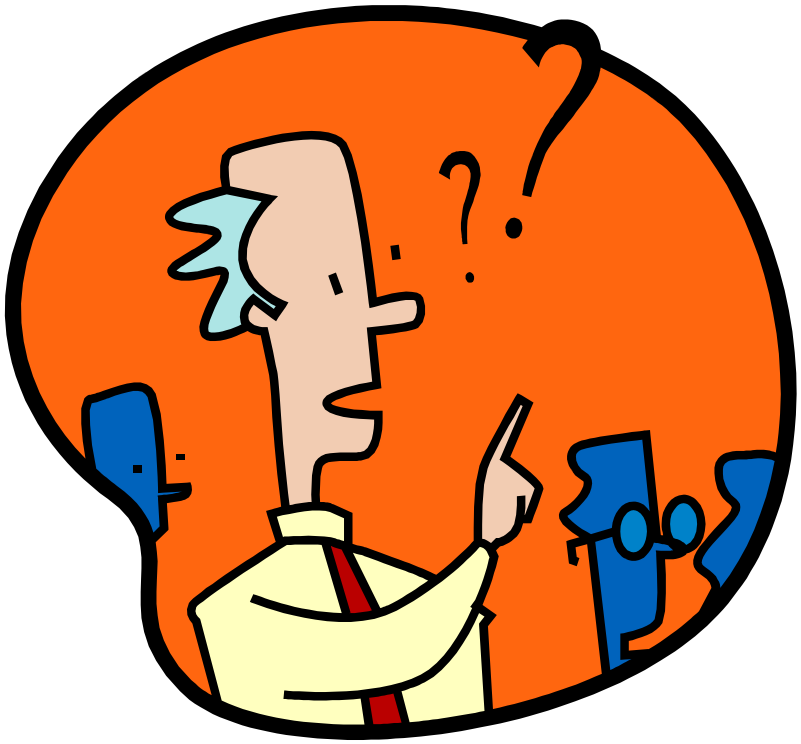
> *"At my company we are still amazed to see large part of our Java system successfully running on .NET platform thanks to IKVM."*
>
> Andy Malakov, Deltix Lab, Inc.

> *"We are very happy with IKVM. It enables us to develop our core libraries in Java and compile for use in .NET. The IKVM team is very responsive and knowledgeable about the issues we were facing."*
>
> Shamus Neville, eTrading and Analytics Group at HSBC

> *"Having used IKVM for over a year, we have found IKVM to work reliably and offer production quality operation. The one time where we did run into some specific problem, the open source nature of IKVM allowed us to quickly track down the bug and verify the cause of the problem. We had a fix for the problem the very same day."*
>
> Otto Perdeck, Chordiant Software

More at http://www.ikvm.net/stories.html

Questions



More Information

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