Jython and Java™ Technology: Plug-and-Play

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Goal of This Talk

What you will gain

Learn how to seamlessly integrate Jython with your Java™ applications.

Agenda

Why Jython?

Getting Familiar With Jython

Using Jython Objects in Java Technology

Using Java Objects in Jython

Script Deployment

What's Next?

Q&A

We Do Not Need Scripting—Reflection Already Has All the Dynamics!

```
import st.extreme.jython.Clock;

try {
  Class cCls = Class.forName("st.extreme.jython.Clock");
  Class <?> fCls =
    Class.forName("st.extreme.jython.ClockFrame");
  Object frame = fCls.newInstance();
  Object clock = cCls.newInstance();
  Method clockMethod = fCls.getMethod("setClock",
    new Class[] { Clock.class });
  clockMethod.invoke(frame, new Object[] { clock });
  Method visibleMethod = fCls.getMethod("setVisible",
    new Class[] { boolean.class });
  visibleMethod.invoke(frame, new Object[] { true });
} catch (Exception e) {
  e.printStackTrace();
}
```

Jython

- Gives you a dynamic scripting environment
- Lets you access in one environment:
  - All of your Java libraries
  - Most of the Python libraries
- Is a good choice for your toolbox
  - Stable
  - Fast
  - Easy to integrate

Python

- Easy to learn
- Freely usable and distributable
- Extensive standard libraries and third-party modules for virtually every task
- Well documented
- You can do amazing things in very few lines of code

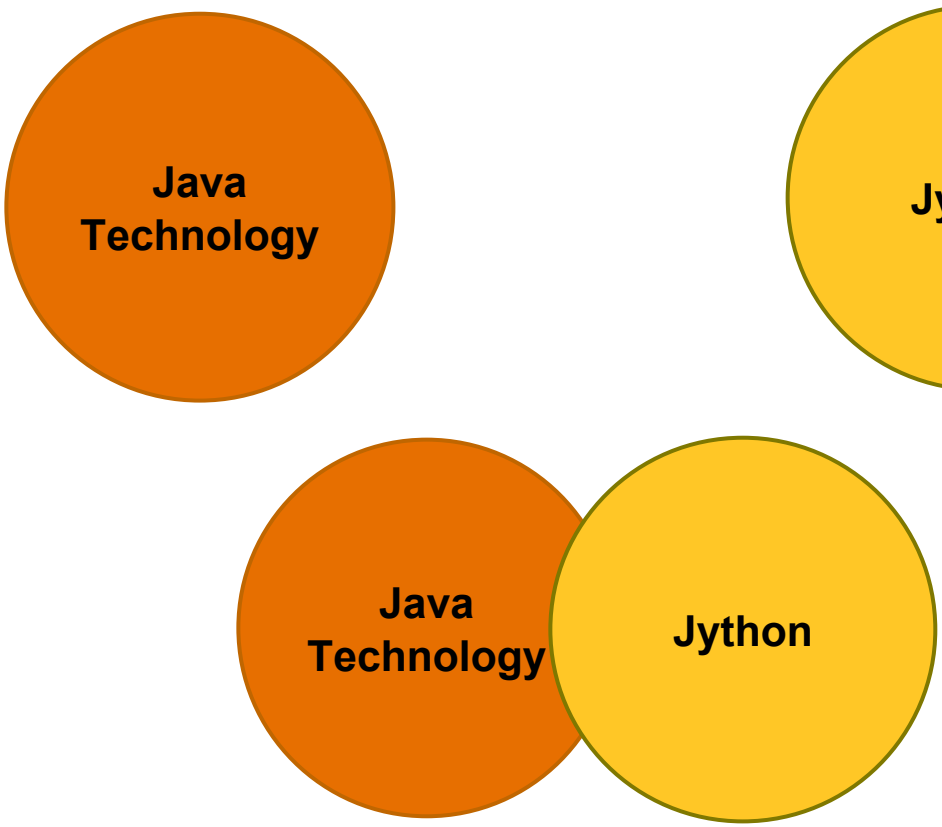
Python

A working SMTP server, printing messages to stdout

```
from smtpd import *
import asyncore

try:
  DebuggingServer(('localhost', 25), ('localhost', 25))
  asyncore.loop(timeout=2)
except KeyboardInterrupt:
  print "Crtl+C pressed. Shutting down."
```

Is This Your Picture of Java Technology/Jython Integration?



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Getting Familiar With Jython

How to get started

- Download the installation .jar from http://www.jython.org
- Execute the .jar file
  - Select ‘standalone’ as installation type
- Result: a file named **`jython.jar`**
- **`java -jar jython.jar`**
- **`jython.jar`** can be added to your classpath

DEMO

Play around with the interpreter
Play around with your own Java objects

What We Have Learned So Far

- Simply add **`jython.jar`** to your classpath
- Start the interactive interpreter as follows:
  - **`org.python.util.jython`**
- Use the interpreter to:
  - Play with your Java objects
  - Become acquainted with the Python language
- Java objects behave as expected

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Using Jython Objects in Java Technology

- Interpreted Mode
- Compiled Mode
- Optimized Mode

Interpreted Mode: The Clock Example

- A provider class returns Java 2D™ API shapes:
  - Hands
  - Ticks
- These shapes rotate around the centre point
- Implement the second hand in Jython
- Make our implementation look like a “normal” Java object to the application
- Change the behavior of the application at runtime

Original example from: http://www.chinaitpower.com/2005September/2005-09-13/208673.html

The Java Technology Superclass

```
package st.extreme.jython;

public class SecondHand implements IClockPath {

    public GeneralPath getPath() { .. }

    public Color getColor() { .. }

    public boolean isVisible() { .. }

}
```

SecondHand Usage

```
public class Clock extends JPanel {

  public void paint(Graphics g) {
    Graphics2D = (Graphics2D) g;

    IClockPath secondHand = getProvider().getSecondHand();
    if (secondHand.isVisible()) {
      g2.setPaint(secondHand.getColor());
      g2.fill(secondHand.getPath().
        createTransformedShape(getSecondTransform()));
  }

}
```

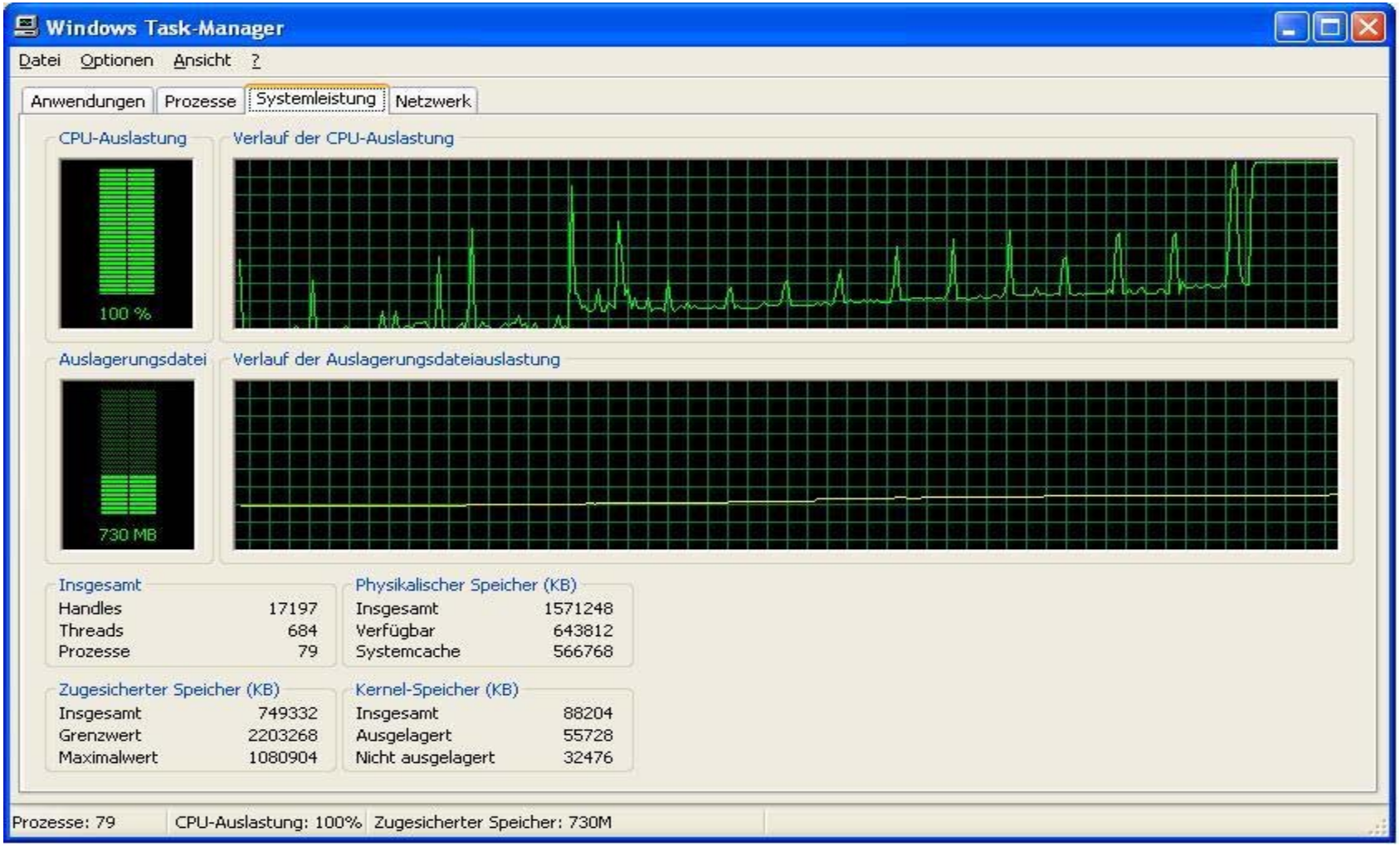
Interpreted Mode Using javax.script

```
import st.extreme.jython.util.JyClass;

public IClockPath
  createSecondHand(String secondHandScript)
{

  return JyClass.newInterpretedInstance(IClockPath.class,
    secondHandScript, "secondHand");

}
```

DEMO

Interpreted Mode

What Went Wrong? (1/2)



What Went Wrong? (2/2)

- Every second, 60 ticks are created
- Each tick compiles and loads a class
- Improvements
  - Use compiled scripts
  - Reuse the 60 ticks

Compiled Mode Using javax.script

```
public Tick createTick(String tickScript,
                       int drawingMinute)
{
  Bindings bindings = new SimpleBindings();
  bindings.put("drawingMinute",
               new Integer(drawingMinute));

  // compile only once
  CompiledScript compiledTickScript =
    getCompiledTickScript(tickScript, bindings);

  return JyClass.newCompiledInstance(Tick.class,
    compiledTickScript, bindings, "tick");
}
```

Reuse the 60 Ticks

```
private Tick[] _tickCache = new Tick[60];

public Tick getTick(int drawingMinute,
  int realtimeSecond)
{
  Tick tick = _tickCache[drawingMinute];
  if (tick == null) {
    tick = /* create it as shown ... */
    _tickCache[drawingMinute] = tick;
  }
  tick.setRealtimeSecond(realtimeSecond);
  return tick;
}
```

Java Code Developers Have a Dream:

What if we could just write a class definition…

```
from st.extreme.jython import Tick

class OptimizedTick(Tick):
  def __init__(self, drawingMin):
    Tick.__init__(self, drawingMin)

  def isVisible(self):
    return 1
```

- Compile this into a Java class…
- Instantiate the same Java class over and over?

Optimized Mode

- Applies the “pattern”:
  - `JyClass jyClass = JyClass.forScript(…)`
  - `jyClass.newInstance(…)`

- 1:1 Relation between script and class in Java Virtual Machine™ (JVM™)

The terms “Java Virtual Machine” and “JVM” mean a Virtual Machine for the Java™ platform.

Optimized Mode for Tick Creation

```
private JyClass _tickJyClass;

private JyClass getTickJyClass(String tickScript) {
  if (_tickJyClass == null) {
    _tickJyClass =
      JyClass.forScript(tickScript, Tick.class);
  }
  return _tickJyClass;
}

public Tick createOptimizedTick(String tickScript,
  int drawingMinute)
{
  JyClass tickJyClass = getTickJyClass(tickScript);
  return tickJyClass.newInstance(Tick.class,
     new Integer(drawingMinute));
}
```

DEMO

1. Compiled Mode
2. Optimized Mode

What We Have Learned So Far

- Jython objects look like Java objects
- Take care when creating objects (reuse if possible)
- Optimize use of embedded scripts
  - Use compiled scripts
  - Use `JyClass.forScript()/newInstance()`
- Handle exceptions
  - At compile time
  - At run time

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The Alarm Class

```
public class Alarm {
  private JyDecimal _hour;
  private JyDecimal _minute;

  // bean property participant
  public void setHour(Object hour) {
    if (hour instanceof JyDecimal) {
      _hour = (JyDecimal) hour;
    } else {
      _hour.setValue(hour);
    }
  }
  // bean property participant
  public Object getHour() {
    return _hour;
  }
}
```

DEMO

A simple alarm clock

JyDecimal Explained (Subtraction)

```
public JyDecimal sub(Object subtrahend) {
  return new
    JyDecimal(_value.subtract(makeNumeric(subtrahend)));
}

public Object __sub__(Object subtrahend) {
  return sub(subtrahend);
}

public Object __rsub__(Object minuend) {
  return new
    JyDecimal(makeNumeric(minuend).subtract(_value));
}

public JyDecimal __isub__(Object subtrahend) {
  setValue(sub(subtrahend));
  return this;
}
```

What We Have Learned So Far

- Bean properties for setter/getter pair methods
- Hook methods like `__sub__(Object obj)` (enable) operators
- Java objects behave like Python ones
- Familiar syntax for script authors

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Python Modules

- A Python module is a directory
  - Containing an `__init__.py` file (usually empty)
  - And any number of `*.py` files
- Example
  - `mymodules/__init__.py`
  - `mymodules/foo/__init__.py`
  - `mymodules/foo/bar.py`

See also: http://www.python.org

Easy Deployment

- You can pack all your modules in the standalone **`jython.jar`**
- Place the **`/mymodules`** directory in **`/Lib`**
  - **`jython.jar/Lib/mymodules/__init__.py`**
  - **`jython.jar/Lib/mymodules/foo/__init__.py`**
  - **`jython.jar/Lib/mymodules/foo/bar.py`**
- Deploy the **`jython.jar`** with your application
- You can then import as follows:
  - **`from mymodules.foo import bar`**

Tips

- Use different names for Java code packages and Python modules
- Physically separate directories containing Python modules from those containing Java code packages
- When importing Java class files, always use the following pattern:
  - from some.cool.java.package import AFancyClass
- Avoid inner classes named py or PyInner in your Java class files

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Progress on Jython

- Active mailing lists
- Increasing number of committers
- Build bots
- Automated tests
- Lots of other activities, for example:
  - Jim Baker/Michael Taylor working on an ANTLR parser for Python 2.5
  - “leouser” working on **`jythonx`**

Current Development Status

(As of March 2007)

- 2.2b1 released
- 2.2b2 in progress
- 2.2 (final) targeted for spring 2007
- Many 2.3 features already implemented
- Far less time expected for 2.2 → 2.3, compared to 2.1 → 2.2

Jython Roadmap

- Next release after 2.2
  - Primarily clean-up
    - Will catch up with latest CPython version (2.3, 2.4, or even 2.5 ?)
    - Improve Java code integration
- Jython 2.x (release after that)
  - Performance improvements
  - Enable CPython frameworks (Django?)
- Jython 3.0 (“Jython 3000”)
  - Twin of CPython 3.0
  - Backwards incompatible

See also: http://www.jython.org/Project/roadmap.html

Getting Involved

[Sure we need an active community!]

- Start with the wiki page at:
  - http://wiki.python.org/jython/HowToGetInvolved
- Pick an unimplemented module
- Solve bugs and provide patches:
  - http://sourceforge.net/projects/jython/

Summary

- Jython is easy…
  - To install
  - To use
  - To deploy
- Jython integrates seamlessly with your Java applications
- Jython dynamically extends your Java applications
- You get three for two ☺

For More Information

- Your backup
  - http://jython.extreme.st
- Python-related links
  - http://www.python.org
  - http://www.djangoproject.com

For More Information (Cont.)

- Jython-related links
  - http://www.jython.org
  - http://wiki.python.org/jython
  - https://scripting.dev.java.net
  - http://pydev.sourceforge.net/index.html

For More Information (Cont.)

Books

- **Jython Essentials**; by Samuele Pedroni and Noel Rappin
- **Jython for Java Programmers**; by Robert W. Bill
- **Python Programming With the Java Class Libraries, A Tutorial for Building Web and Enterprise Applications with Jython**; by Richard Hightower
- **Python in a Nutshell**; by Alex Martelli
- **Learning Python, Second Edition**; by Mark Lutz
- **Beginning Python, From Novice to Professional**; by Magnus Lie Hetland

Q&A

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http://jython.extreme.st

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