DSL vs. Library API Shootout

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Agenda

- What do we mean by DSL?
- What do we mean by library?
- When is it good to use a DSL?
- When is it a bad idea?
- Evolution
- Versioning
- Tooling
- Q/A

What is a DSL?

A *programming* language or *specification* language dedicated to

- a particular **problem domain**,
- a particular **problem representation technique**, and/or
- a particular **solution technique**.

--wikipedia (http://en.wikipedia.org/wiki/Domain_Specific_Language)

DSL Classification

- Processing style
  - Own parser (External)
  - XML based
  - Embedded in other programming language (Internal)
- Computational power
  - Declarative programming
  - Turing complete
- Not quite here: Tooling
  - Need to extend IDEs to support the DSL
  - Tooling standardized for all IDEs

DSL Examples

- LOGO (or Karel)
- SQL
- ZIL (Zork Implementation Language)
- Postscript
- TeX
- CSS
- BNF Grammars (YACC, Antlr, etc)
- Apex
- XML variants (Ant, VoiceXML, XSLT, Docbook, SVG)
- Embedded/Internal (in Haskell, Scala, Java6)

It's Okay to Use XML?

- Quick to develop
- Free lexing
- Lots of existing libraries to manipulate it
- Standard syntax for AST representation
- Poor performance
- Completely unreadable to humans

```
<one-of>
  <item>Michael</item>
  <item>Yuriko</item>
  <item>Mary</item>
  <item>Duke</item>
  <item>
    <ruleref uri="#otherNames"/>
  </item>
</one-of>

<one-of>
  <item weight="10">small</item>
  <item weight="2">medium</item>
  <item>large</item>
</one-of>
```

```
Michael | Yuriko | Mary
 | Duke | $otherNames

/10/ small | /2/ medium | large
```

Libraries and Embedded DSLs

- Lexing automated
- Free interpretation
- Targeting wide audience of developers
- Bound to syntax of the language
  - Not a real problem for functional languages
  - People like Java
- Creates de-facto new language
  - Reading on paper?

```
expr   ::= expr '+' term | term
term   ::= term '*' factor | factor
factor ::= '(' expr ')' | digit+
digit  ::= '0' | '1' | ... | '9'
```

```
object arithmeticParser extends StdTokenParsers {
  type Tokens = StdLexical ; val lexical = new StdLexical
  lexical.delimiters ++= List("(", ")", "+", "*")

  lazy val expr =   term*("+" ^^^ {(x: int, y: int) => x + y} )
  lazy val term = factor*("*" ^^^ {(x: int, y: int) => x * y} )
  lazy val factor: Parser[int] = "(" ~> expr <~ ")" | numericLit ^^ (_.toInt)
}
```

When is it good to use a DSL?

1. Targeting Domain Experts, Not Java Experts

- ZIL: lets novel authors program whole games
- TeX: used in academia across many disciplines

Would a Java API for outputting typography even make sense?

- Excel formulas: non-programmers do amazing things with excel

This is a sliding scale...

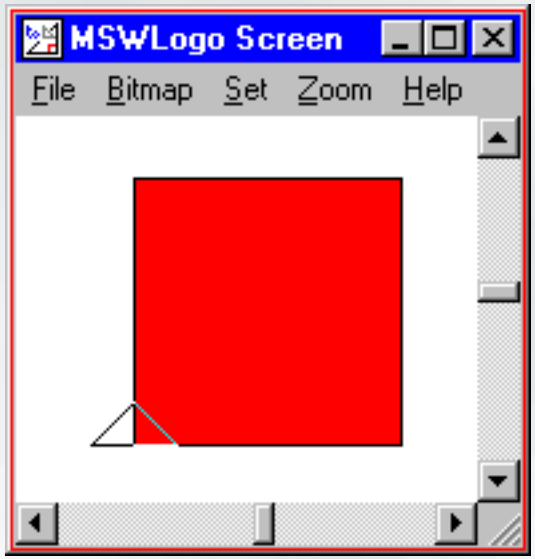
2. The Domain Lends Itself to an Idiom Expressed in a Simple Syntax

```
TO REDSQUARE
; draw the outline
REPEAT 4 [FORWARD 100 RIGHT 90]

; move into the square
PENUP
RIGHT 45
FORWARD 4

; fill the square with red
SETFLOODCOLOR 4
FILL

; move back
BACK 4
LEFT 45
PENDOWN
END
```



http://et.bgcbellevue.org/logo/

Example: Apex Triggers

Actual Trigger

```
trigger CashOnlyPlease on Account (before insert, before update) {
  for (Account a : Trigger.new) {
    if (a.name == 'Deadbeat Inc.')
      a.credit_terms = 'COD';
  }
}
```

Proposed Java Library Syntax

```
@DbTrigger("BEFORE_INSERT, BEFORE_UPDATE")
public class CashOnlyPlease implements Trigger<Account> {
  public void execute(List<Account> triggerOld, List<Account> triggerNew) {
    for (Account a : triggerNew) {
      if ("Deadbeat Inc.".equals(a.getName())
        a.setCreditTerms("COD");
    }
  }
}
```

Example: Apex Triggers

Actual Trigger

```
trigger CashOnlyPlease on Account (before insert, before update) {
  for (Account a : Trigger.new) {
    if (a.name == 'Deadbeat Inc.')
      a.credit_terms = 'COD';
  }
}
```

Proposed Java Library Syntax

```
  @DbTrigger({Before.INSERT, Before.UPDATE})
  public static void execute(TriggerContext<Account> ctx) {
    for (Account a : ctx.getNew()) {
      if ("Deadbeat Inc.".equals(a.getName())
        a.setCreditTerms("COD");
    }
  }
```

3. You Can Eliminate Boilerplate or Do Validation Based on Domain Assumptions

*If it doesn't make sense **for the domain**, it shouldn't compile.*

Static type checking for domain objects

```
Account[] accs =
[SELECT firstname, lastname FROM Contact] // compile error
```

Bring in a set of assumptions from the domain

```
public class Foo with sharing { ... }
```

Example: Apex SOAP Endpoints

Apex Syntax

```
webservice String getSomething(integer someParam) { ... }
```

Proposed Java Syntax

```
@webservice public String getSomething(integer someParam) { ... }
```

But the *intent* of `webservice` is to define a scope (the web).

You wouldn't say:

```
@public private String ...
```

Why not use DSL?

- Industry is conservative
- Developers love Java
- Libraries naturally extend the language
- Good library increases adoption
- People don't know better options than DSL
  - Annotation Processors
  - Natural like syntax
- Can Java be DSL meta language?

Demo

"Java on Rails"
Compile time live access to Data Base

Evolution

Requirements change over time. How do you evolve a DSL to **sunset** old features and **compatibly introduce** new ones?

Goodbye @Deprecated

New versions can completely change syntax/semantics

- Complete Control over Parser
- Allows you to keep the **intent** clear in the syntax

Mechanism: *versioning*

Example: VoiceXML

- Version is in the file itself

```
<vxml version="2.0">
```

- Can use transforms, intermediate representations, or just multiple parsers

Example: Apex

- Classes/Triggers stored in the DB
  - Column for version
  - User editable
- One parser internally
  - Checks version when behavior differs

New | Generate from WSDL | Run All Tests | Schedule Apex

Action	Name	Namespace Prefix	Api Version	Valid	Status	Size Without Comments	Last Modified By
Edit | Del | Security	anExt	rungerdev	20.0	✓	Active	481	Test User, 7/15/2010 3:43 PM
Edit | Del | Security	DescTest	rungerdev	19.0	✓	Active	595	Test User, 3/18/2010 6:50 PM
Edit | Del | Security	FooBatch	rungerdev	19.0	✓	Active	418	Test User, 2/10/2010 11:25 AM
Edit | Del | Security	Ret	rungerdev	20.0	✓	Active	172	Test User, 5/14/2010 4:16 PM
Edit | Del | Security	startHereController	rungerdev	14.0	✓	Active	3,223	Test User, 1/23/2010 12:42 PM
Edit | Del | Security	TestClass	rungerdev	19.0	✓	Active	118	Test User, 1/23/2010 12:48 PM
Edit | Del | Security	TestController	rungerdev	19.0	✓	Active	194	Test User, 2/23/2010 9:41 AM
Edit | Del | Security	XMLDom	rungerdev	14.0	✓	Active	6,713	Test User, 1/23/2010 12:42 PM

Example: Apex

Floating point literals:

- In version 16.0, this literal is a double

```
12.4
```

- If you change the class to 17.0, it's a BigDecimal. To get a double, you need

```
12.4d
```

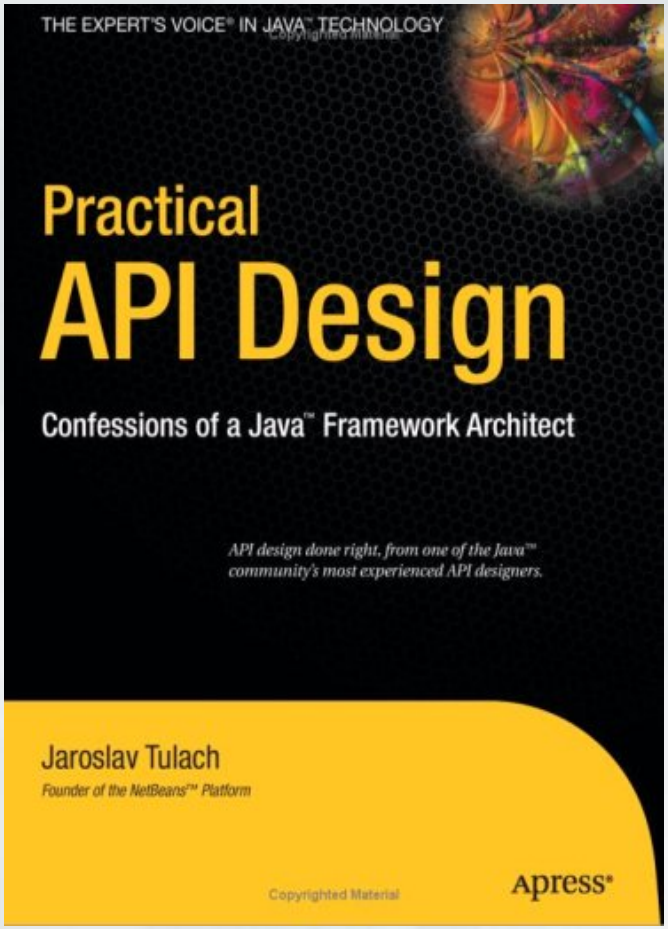
Example: Apex

Implementation:

```
Object value;
if (currentVersion > 16.0)
    value = new BigDecimal(floatingPointToken);
else
    value = Double.valueOf(floatingPointToken);
```

Evolution of Libraries

Requirements change over time. How do you evolve a library to **sunset** old features and **compatibly introduce** new ones?



Versioning of Libraries

- Library identification
  - code name
  - version
- Dependencies on other libraries
  - no classpath
  - specify code name and version
- Runtime Container
  - NetBeans, OSGi
- Backward Compatibility Rules
  - Bytecode is a "DSL" for compatibility

Deprecations in Libraries

- @Deprecated
- @Transformation
  - http://lang.dev.java.net
  - Support in all good IDEs
- @PatchByteCode
  - non public for compilation
  - public for execution
- Moving to separate library
  - dependency transformations

Versioning of Annotation Processors

- Compile time
- Complete control on generated code
- Annotations support default values
- Adding new annotations

```
/version 1.0
@ActionRegistration
class MyAction {
}
```

```
// version 1.1
@ActionRegistration(asynchronous=true)
class MyAction {
}
```

```
// alternative 1.1
@ActionRegistration
@ActionAsynchronous
class MyAction {
}
```

Tooling for Free

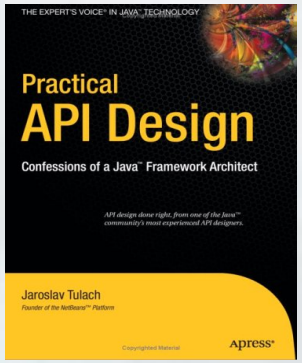
- IDEs support Java
  - code completion
  - javadoc
  - navigation
  - overrides, usages, refactoring
- Good IDEs support Java6 - e.g. annotation processors
  - to generate classes
  - to provide code completion
  - compilers yield errors
  - no changes to build process (javac is enough)
- Write once, edit, compile, publish anywhere!

DSL Tooling

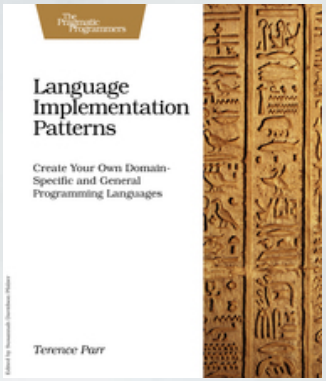
- Most IDEs provide easy tooling for creating support in that IDE for DSLs
- Language Workbenches (JetBrains MPS)
- Simple syntax? Restricted domain? Perhaps you don't need an IDE!

References

apidesign.org



antlr.org



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