AspectJ as a Polyglot extension

- the frontend of abc -

Roadmap

- What is Polyglot?
- Brief overview of the AspectJ extension
- Sketch of disambiguation of “this” in ITDs
- Summary

What is Polyglot?

An *extensible* Java compiler

Sample extensions:

- Jif : Java information flow and program partitioning
- PolyJ 2.0 : Java with parameterized types
- JMatch : Abstract iterable pattern matching for Java
- Jx: Nested inheritance in Java
- Jedd: BDD-based analyses
- JPred : Practical predicate dispatch

Produced by Andrew Myers, Nate Nystrom *et al.* at Cornell

How does Polyglot do it?

- Structured as a series of visitors
- Each visitor pass rewrites AST; about 15 such visitors
- Rigorous use of interfaces and factories makes it easy to change type system, environment, ...
- Delegates for overriding members of non-final AST classes (*cf.* intertype decls)

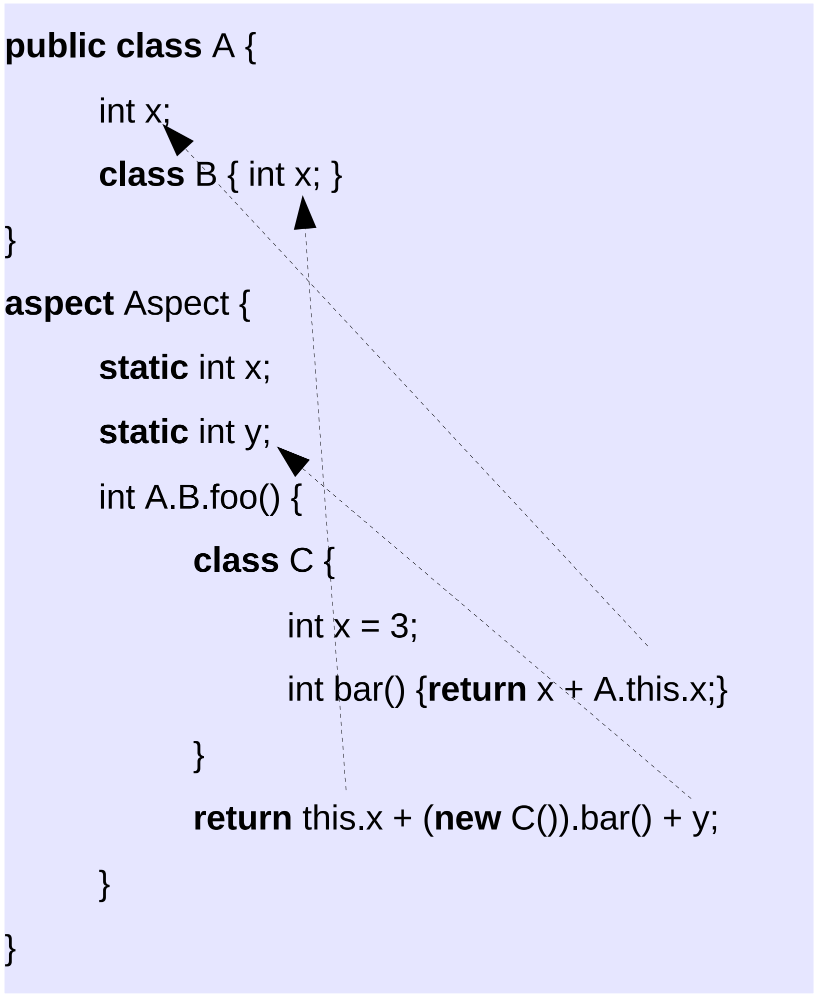
The AspectJ extension

Like any other Polyglot extension, five new packages:

- AST: new ast nodes (89 classes)
- Extension: overrides of existing Java AST nodes (13 classes)
- Parse: new lexer and grammar (2 files)
- Types: new types and type system (8 classes)
- Visit: new passes (35 classes)

- Includes Java/AspectInfo separator
- Many AST classes in pointcut language are light-weight
- The tricky bits are the type rules for ITDs, and the separator into Java & AspectInfo

Example: intertype scope rules



```
public class A {
    int x;
    class B { int x; }
}
aspect Aspect {
    static int x;
    static int y;
    int A.B.foo() {
        class C {
            int x = 3;
            int bar() {return x + A.this.x;}
        }
        return this.x + (new C()).bar() + y;
    }
}
```

Example: intertype scope rules

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aspect Aspect {
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                return this.x + (new C()).bar() + y;
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```

need to disambiguate field references:

- may be a reference to aspect fields,

- local class fields,

- or host (=target) of intertype declaration

Rules:

- no explicit receiver? if it was introduced into environment by the host, give it “**this**” from host.
- explicit “**this**” or “**super**”? if there is no qualifier and we're not inside a local class, it refers to the host. If there is a qualifier Q, and there is no enclosing instance of type Q nested inside the ITD, it refers to the host if the host has an enclosing instance of type Q.

How to disambiguate “*this*”

- Extend *context* type in Polyglot
- Test to determine whether *this* refers to host
- Override *disambiguate* for Polyglot *this*.

New context type

types.Context:

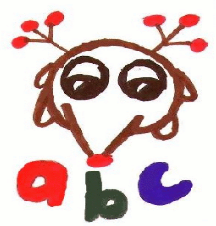
```
public interface AJContext extends Context {
    Context pushHost(ClassType ct, boolean declaredStatic);
                                    // called when entering itd
    ClassType hostClass();          // return target of current itds
    boolean inInterType();          // are we inside an intertype declaration?
    boolean nested();               // are we inside a local class in an intertype declaration?

    // other itd-related members...
    boolean varInHost(String name);
    boolean methodInHost(String name);
    ClassType findFieldScopeInHost(String name);
    ClassType findMethodScopeInHost(String name) throws SemanticException;
    // ... more for advice and declare decls ...
}
```

Does “*this*” refer to host of ITD?

types.AJTypeSystem_c

```
public boolean refHostOfITD(AJContext c, Typed qualifier) {
    if (!c.inInterType())           // if not inside an ITD, cannot refer to a host
        return false;
    if (qualifier == null)          // if there is no qualifier
        return !c.nested();         // it refers to the host if we're not in a local class
    else                            // otherwise look for enclosing instance in host
        return c.hostClass().hasEnclosingInstance(qualifier.type().toClass());
}
```



Override disambiguate

extension.AJSpecial_c *(Special is the Polyglot class to represent “this”)***:**

```
public Node disambiguate(AmbiguityRemover ar) throws SemanticException {
        AJContext c = (AJContext) ar.context();
        AJTypeSystem ts = (AJTypeSystem) ar.typeSystem();
        if (!(ts.refHostOfITD(c,qualifier()))) {
                // this is an ordinary special, it does not refer to the host
                return super.disambiguate(ar);
        } else {
                // this is a host special
                AJNodeFactory nf = (AJNodeFactory) ar.nodeFactory();
                HostSpecial_c hs = (HostSpecial_c) nf.hostSpecial(position,kind,
                                                        qualifier,((AJContext)c).hostClass());
                return hs.type(type()).disambiguate(ar);
        }
}
```

Frontend summary

- Extensible in all dimensions:
  - syntax, type system, visitors
- Potential merge problems with pure Java compiler only occur in extension dir and type system
- Extensions to *abc* have same structure as *abc* itself