

14. ArchJava – A Java Extension for Architecture

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Literature (To Be Read)

- ▶ J. Aldrich, G. Chambers, D. Notkin. Architectural Reasoning in ArchJava. European Conference on Object-Oriented Programming (ECOOP) 2002, LNCS
- ▶ <http://www.archjava.org>



The Problem

- ▶ An architectural description language needs many constructs that are already available in a standard language
 - Control-flow constructs
 - Iteration, Recursion
 - Data types
- ▶ Reasoning is simpler if components and architecture are described in the same language (same analysis tools)

Communication Integrity

Provided and required interfaces enable **communication integrity**:

Every implementation component can only communicate with the neighbors that were specified in the interface or the architecture (connection topology)



Ports in ArchJava

- ▶ In ArchJava, ports are *call services (call ports)*
 - Required, provided, broadcast ports

```
public component class Parser {
  public port in {
    provides void setInfo(Token symbol, SymTabEntry e);
    requires Token nextToken() throws ScanException;
  }
  public port out {
    provides SymTabEntry getInfo(Token t);
    requires void compile(AST ast);
  }
  public void parse() {
    Token tok = in.nextToken();
    AST ast = parseFile(tok);
    out.compile(ast);
  }
  AST parseFile(Token lookahead) { ... }
  void setInfo(Token t, SymTabEntry e) {...}
  SymTabEntry getInfo(Token t) { ... }
  ...
}
```



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Connections and Subcomponents

- ▶ Connectors specified with **connect** keyword (as in Unicon)
- ▶ Broadcast ports are similar to required ports, but can be connected to many recipients
- ▶ Nested component hierarchies are possible with nested subcomponents (*final* means *atomic*)

```
public component class Compiler {
  private Scanner scanner = ...;
  private final Parser parser = ...;
  private final CodeGen codegen = ...;

  connect scanner.out, parser.in;
  connect parser.out, codegen.in;

  public static void main(String args[]) {
    new Compiler().compile(args);
  }
  public void compile(String args[]) {
    // for each file in args do:
    ...parser.parse();...
  }
}
```

Nested subcomponents
also atomic ones



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Asynchronous Connections

- ▶ By default, only call connectors (and broadcasting call connectors) are supplied
- ▶ Asynchronous connectors must be defined by the user



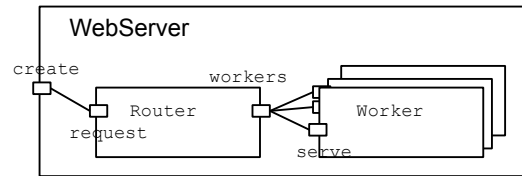
Architecture Modelling

- ▶ All object-oriented concepts can be used to model architectures
 - Inheritance for sharing features of architectures
 - Abstract and generic classes for architectural frameworks
 - Framework hook technology for frameworks
 - Dynamic architectures with polymorphism, constructors, and abstract factories





Run-Time, Dynamic Architectures



```

public component class WebServer {
  private final Router r = new Router();
  // initial configuration
  connect r.request, create;
  // A connection pattern allows for dynamic calls to connect function
  connect pattern Router.workers, Worker.serve;

  public void run() { r.listen(); }
  private port create {
    provides r.workers requestWorker() {
      final Worker newWorker = new Worker();
      // dynamic connection of new workers with port r.workers
      r.workers.connection = connect(r.workers, newWorker.serve);
      // connect expressions return connection objects
      return connection;
    }
  }
}
  
```

Port interface type



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What Have We Learned?

- ▶ ArchJava is a ready-to-use architectural extension of Java
- ▶ Inherits benefits from object-orientation and architectural languages
- ▶ Violations of the Law of Demeter create problems



Experience

- ▶ Taprats is a pattern-designing program for islamic tile patterns
 - 12.5 KLOC Java
- ▶ Was reengineered with
 - 5.5 hours, 30 minutes per KLOC
 - Since ArchJava enforces communication integrity, code had to be reengineered, dependencies must be cut
 - Violations of the Law of Demeter create problems
 - Law of Demeter: "Don't call grandneighbors, only neighbors"



The End

