# 14. ArchJava – A Lightweight Java Extension for Architecture – Provided and Required Ports and Services

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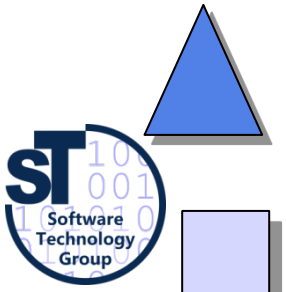
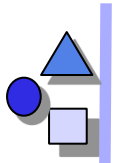
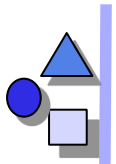
Version 13-1.0, May 14, 2013





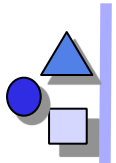
# Literature (To Be Read)

- 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)

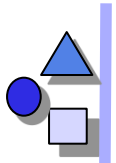


# Communication Integrity

Provided and required interfaces enable **explicit dependencies between components** and **communication integrity:**

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

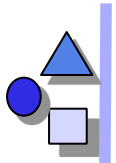
Communication integrity relies onprovided and required interfaces.



# 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) { ... }
  ...
}
```

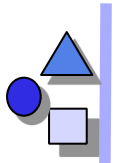


# Connections and Subcomponents

- Connections between ports are 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*)

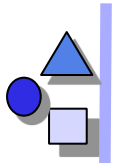
```
public component class Compiler {
   private       Scanner scanner = ...;
   private final Parser parser = ...;
   private final CodeGen codegen = ...;

   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



# Asynchronous Connections

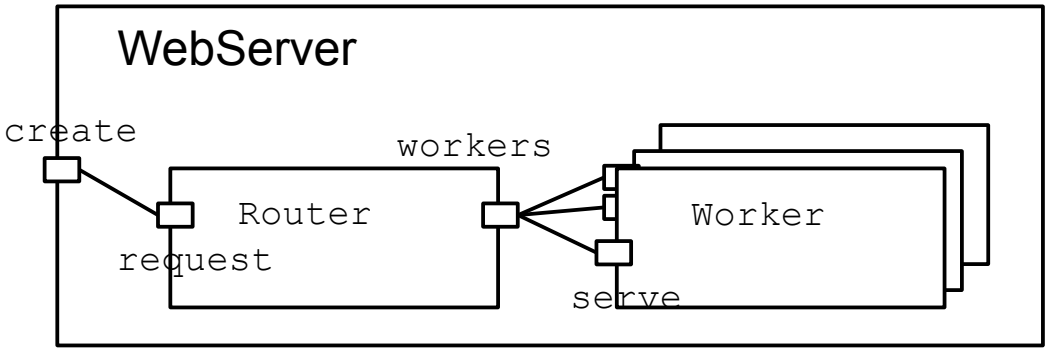
- By default, only call connections (and broadcasting call connections) are supplied
- Asynchronous connections must be defined by the user
- No connectors are provided
  - But can be programmed as specific communicating components



# Architecture Modelling

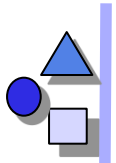
- All object-oriented concepts can be used to model architectures
  - Inheritance for sharing features of architectures
  - Abstract and generic classes for architectural frameworks
  - Framework hook technology for frameworks
  - Dynamic architectures with polymorphism, constructors, and abstract factories

# Run-Time, Dynamic Architectures



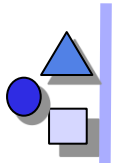

```
public component class WebServer {
  private final Router r = new Router();
  // initial configuration
  connect r.request, create;
  // A connection pattern allows for dynamic calls to connect function
  connect pattern Router.workers, Worker.serve;

  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



# Experience with ArchJava

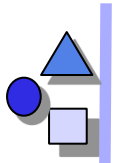
- Taprats is a pattern-designing program for islamic tile patterns
  - 12.5 KLOC Java
- Was reengineered with
  - 5.5 hours, 30 minutes per KLOC
  - Since ArchJava enforces communication integrity, code had to be reengineered, dependencies must be cut
  - Violations of the Law of Demeter create problems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



# 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

- ArchJava components, ports, and connections can easily be integrated into other modular and object-oriented languages



# The End