Extracting Typed Values from XML Data

Fabio Simeoni David Lievens Paolo Manghi

Steve Neely Richard Connor

Outline

- Language Bindings
  - XML and Language Values
  - Programming Models over XML
  - Low-Level Bindings
- A High-Level Binding
  - Architecture
  - The SNAQue Prototype
  - Related Work
  - Conclusions

XML and Language Values

Language values are increasingly generated and manipulated outside the language jurisdiction, and occur instead as **fragments** of XML documents

- Semistructured Documents
  - irregular structure
  - unstable structure
- Portable Documents
  - regular structure
  - self-describing

XML and Language Values

d

```
<staff>
   <member code = “123517”>
   <name>Richard Connor</name>
      <home>www.cis.strath...</home>
   </member>
   <member code = “123345”>
      <name>Steve Neely</name>
      <ext>4565</ext>
      <project>
         <name>SNAQue</name>
      </project>
   </member>
   <member code = “175417”>
      <ext>4566</ext>
      <name>Fabio Simeoni</name>
   </member>
</staff>
```

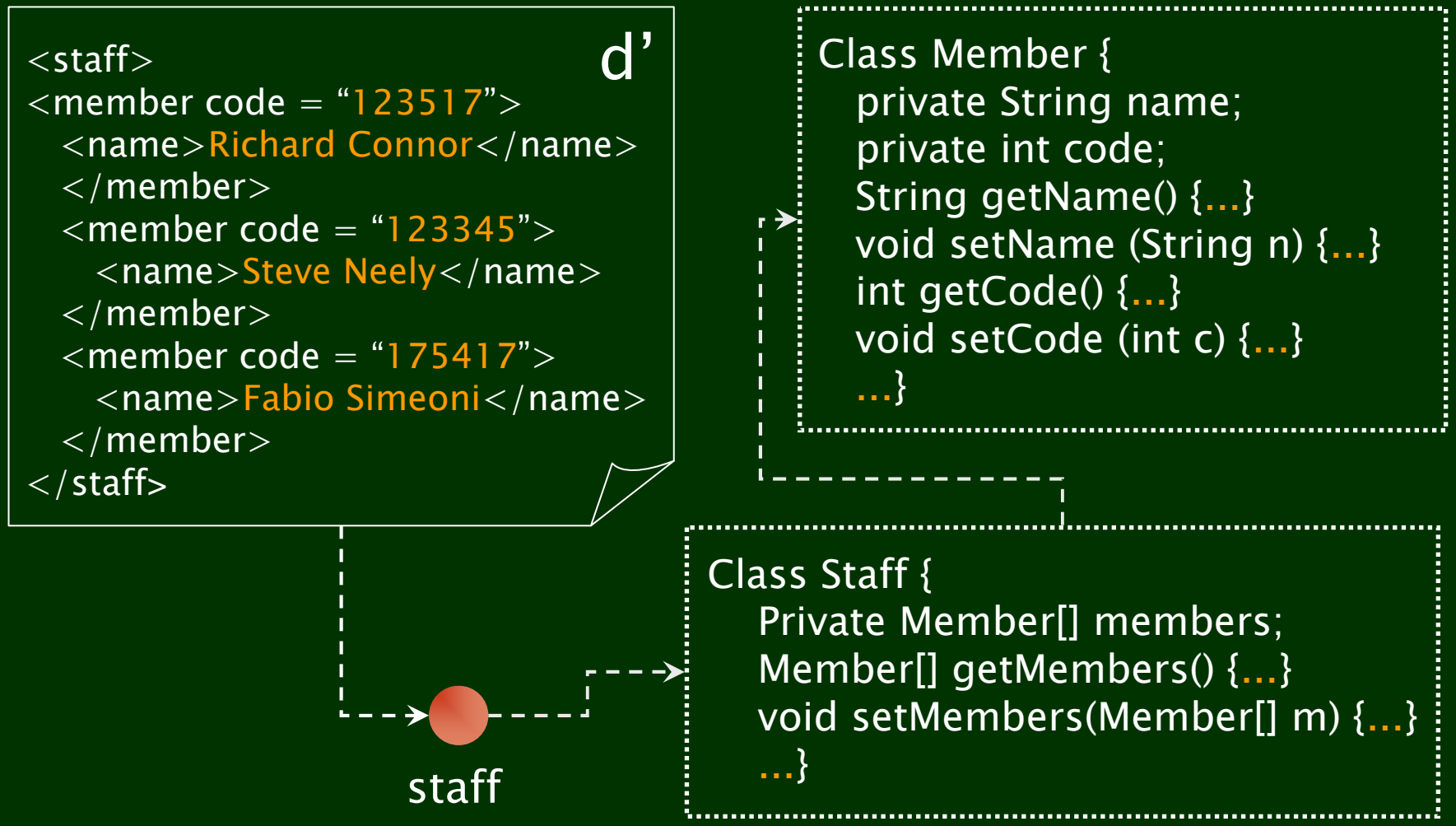
Semistructured Document

d’

```
<staff>
<member code = “123517”>
  <name>Richard Connor</name>
  </member>
  <member code = “123345”>
    <name>Steve Neely</name>
  </member>
  <member code = “175417”>
    <name>Fabio Simeoni</name>
  </member>
</staff>
```

Portable Document

XML and Language Values



A Computational Requirement

Programming over d' should be as:

- simple
- safe
- efficient

as programming over staff with existing programming languages.

Programming Models over XML

- **Dedicated QLs**
  (XQL, XML-QL, Lorel, etc.)
  - computationally incomplete
  - not well suited to complex tasks
  - essentially untyped
- **Research Models**
  (XDuce, Tequila, etc.)
  - graph types vs. language types
  - steep learning curve/lack of tool support
- **Language Bindings** (DOM, SAX) ...

SAX & DOM

- **Data Structure:**
  - SAX: a string served as a temporal sequence of tokens
  - DOM:a tree
- **Programming Model:**
  - SAX: events and call-backs
  - DOM: tree navigation

SAX & DOM Limitations

Data structures do not support data semantics
(staff members are neither strings nor tree nodes)

SAX supports the syntactic structure of the data.

Think as a Parser !

DOM supports the logical structure of the data.

Think as a Botanist !

Good for syntactic (SAX) and structural (DOM) manipulations, not domain-specific tasks.

SAX Programming

```
Class SaxTask extends DefaultHandler {
private String name, code;
private boolean inProject;

private CharArrayWriter buffer = new CharArrayWriter();

public void characters (char[ ] ch, int start, int length) {buffer.write(ch,start,length);}

public void startElement (String uri, String name, String qName, Attributes atts)
  {if (name.equals("member")) code=atts.getValue("code");
    if (name.equals("project")) inProject=true;
    buffer.reset();}

public void endElement (String uri, String name, String qName)
{   if (name.equals("project")) inProject=false;
    if (name.equals("name") && !inProject)
        name=buffer.toString().trim()
    … do something with name and code…}}
```

DOM Programming

```
String name=null;
int code;

Element staff = d.getDocumentElement();
NodeList members =staff.getElementsByTagName("member");
int membCount = members.getLength();

for (int i=0;i<membCount;i++) {
    Element member = (Element) members.item(i);
    code = Integer.parseInt(member.getAttribute("code"));
    NodeList children = member.getChildNodes();
    int length = children.getLength();

    for (int j=0;j<length;j++) {
        Node child = children.item(j);
        if (child.getNodeType()==Node.ELEMENT_NODE) {
            String tagName = ((Element) child).getTagName();
            if (tagName.equals("name")) name=
                ((character data) child.getFirstChild()).getData();}}
            … do something with name and code…}
```

SAX & DOM Programming

- How easy is to write, maintain, and evolve the code?
  - ✓ Programming is tedious, redundant and error-prone
  - ✓ Code is convoluted even for simple tasks
- How safe is the code?

```
Nodelist members = staff.getElementsByTagName("mebmer");
```

  - ✓ Safety is responsibility of the programmer
  - ✓ Programmatic checks worsen code readability
  - ✓ Programmatic checks are simply not enough…

SAX & DOM Programming

Compare with:

```
Member[] members = staff.getMembers();
for (int i=0;i<members.length;i++) {
    code = members[I].code;
    name=members[i].name;
    {...do something with name and code...}
```

- ✓ Simple because the programming algebra is domain-specific
- ✓ Safe and efficient because static knowledge is domain-specific

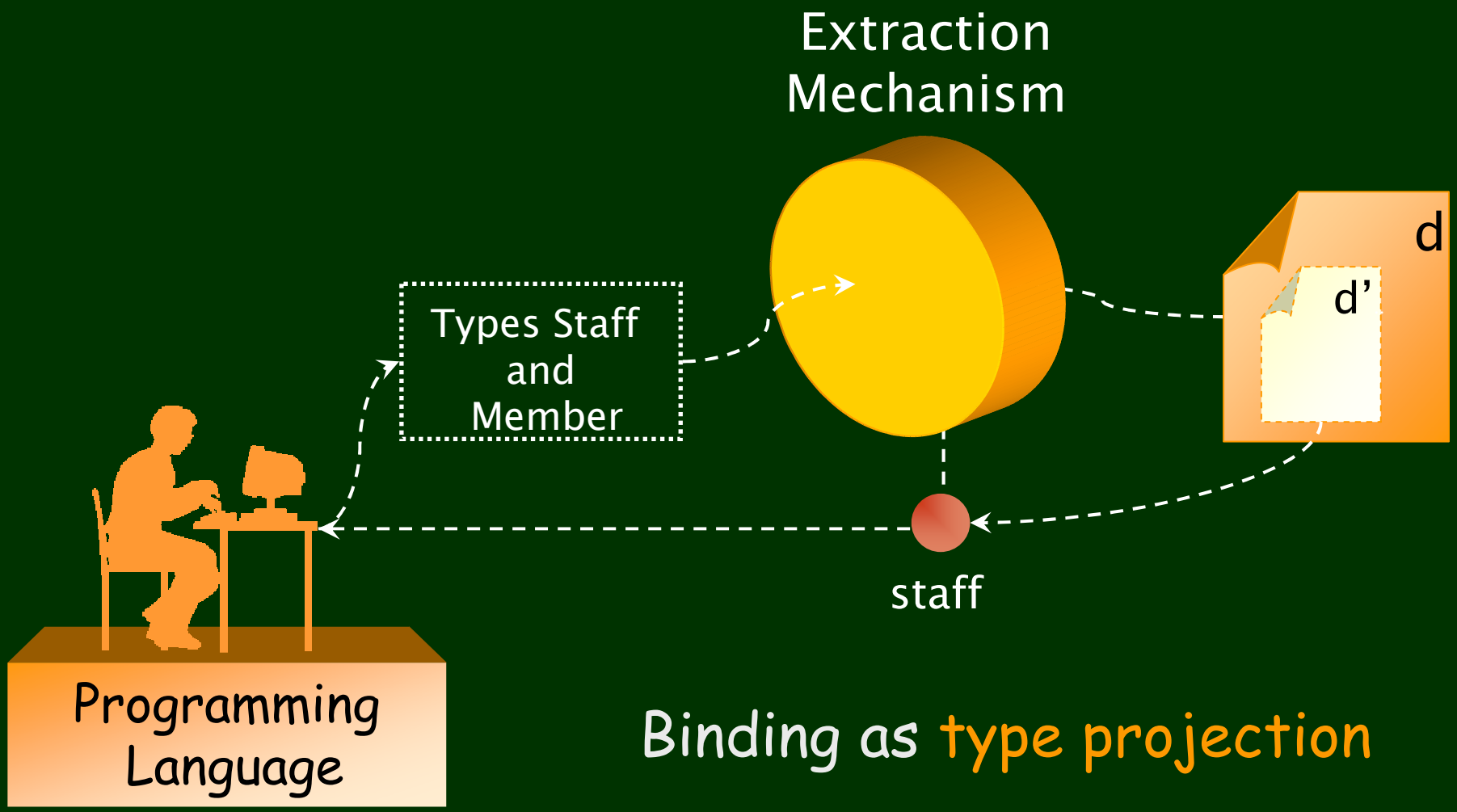
Think Straight !

High-Level Bindings

Conclusion:

- ✓ DOM & SAX are low-level bindings
- ✓ We need high-level bindings that automate the conversion of XML fragments into their counterpart within the language

A High-Level Binding



Binding as type projection