

(Advances in)

Web Programming Languages

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Why?

Why do we need more languages?

- C++ gives me low-level control
- Java keeps me safe
- Ruby lets me write code quickly

We want it all.

The web is different.

Ways of operating on each list element

C

```
cats = malloc(sizeof(int)*numBlogPosts);  
for (int i = 0; i < numPosts; i++) {  
    cats[i] = blogPosts[i].categoryID;  
}
```

Java

```
Vector<Integer> cats = new Vector();  
for (int p : blogPosts) {  
    cats.add(p.categoryID);  
}
```

Perl

```
@cats = map { $_->categoryID } @blogPosts
```

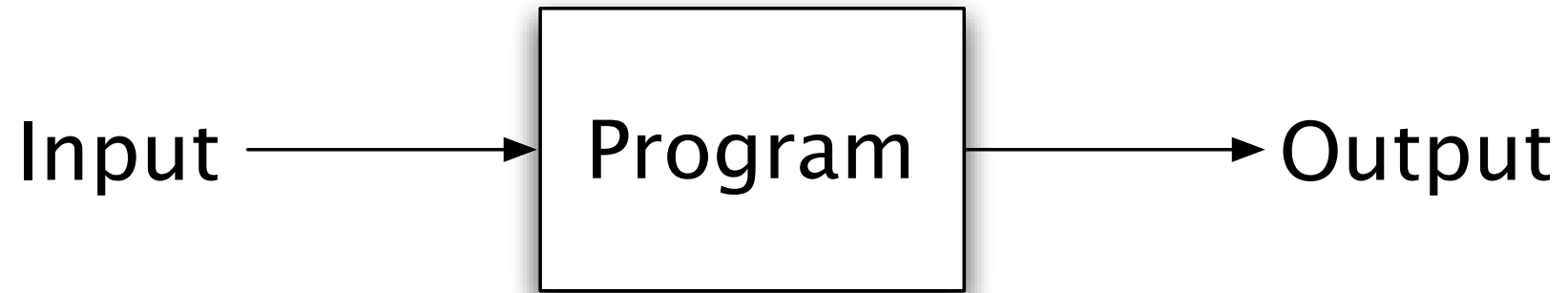
Ruby

```
cats = blogPosts.map { |post| post.categoryID }
```

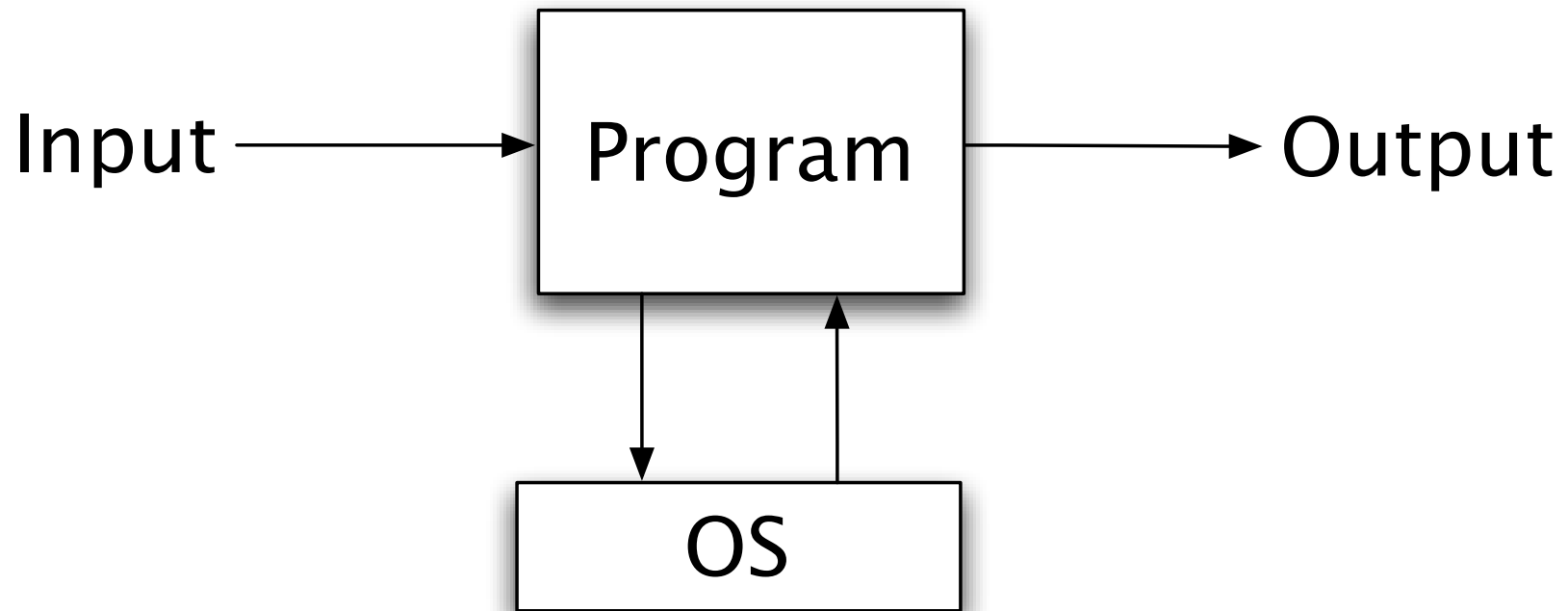
The web computation model

(Why the web is special.)

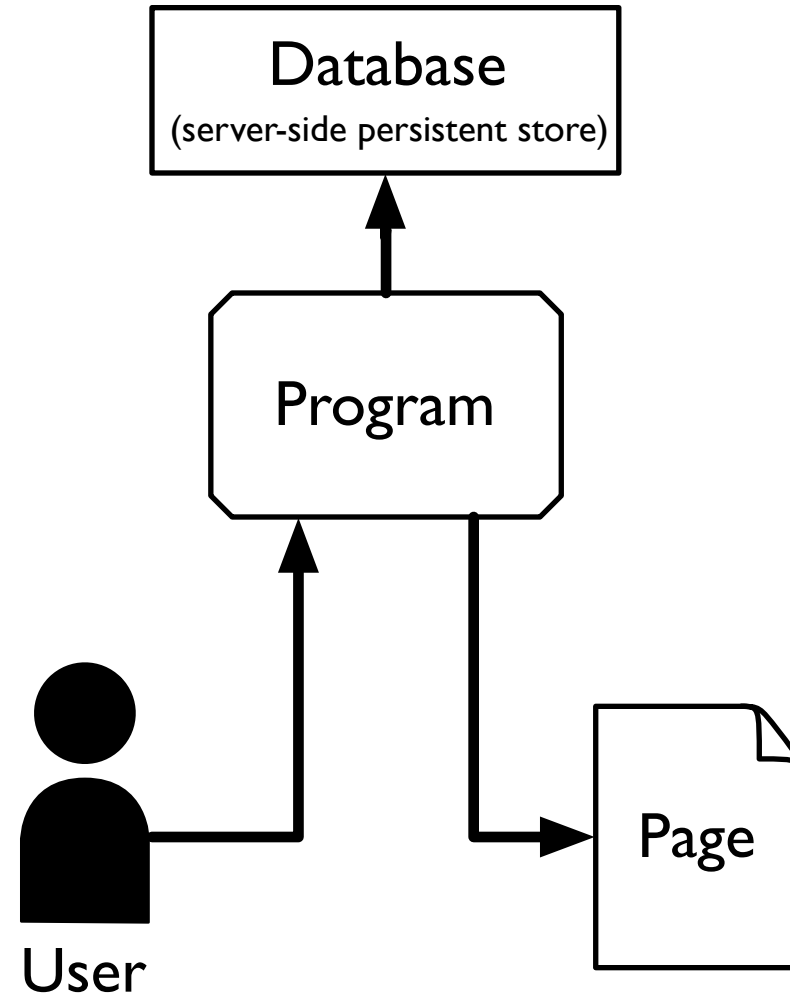
The I/O model



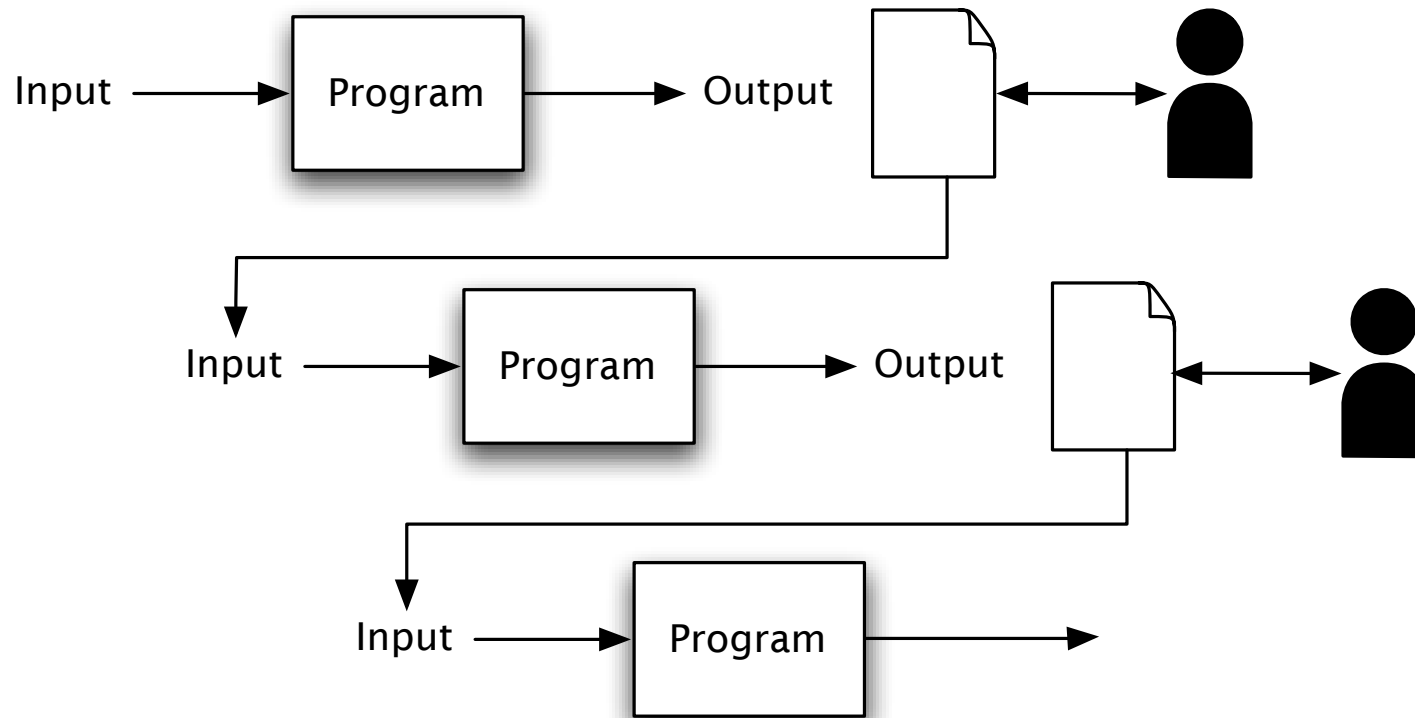
I/O model revised



Web Programming



Building a web experience with the I/O model

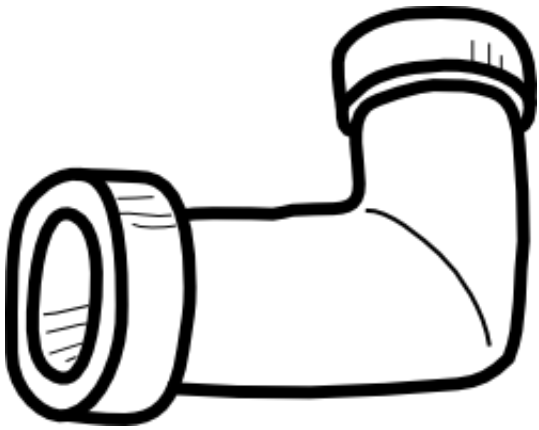


... a pain!

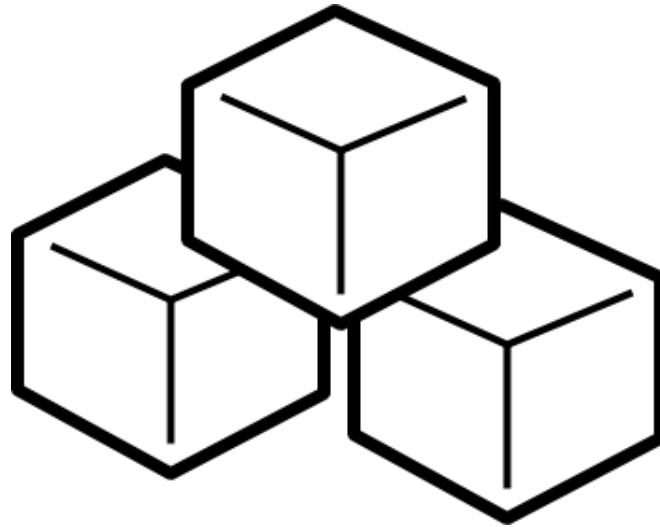
map fits tightly around
many list operations

What fits tightly around
the web?

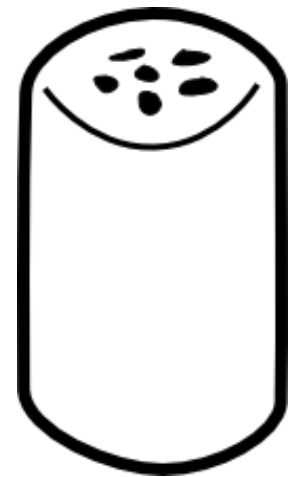
Links



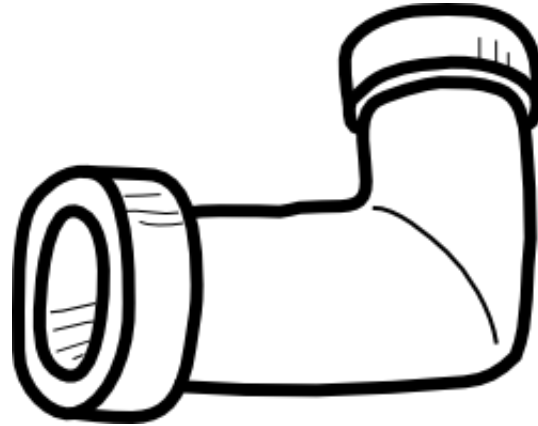
Continuations



Forms

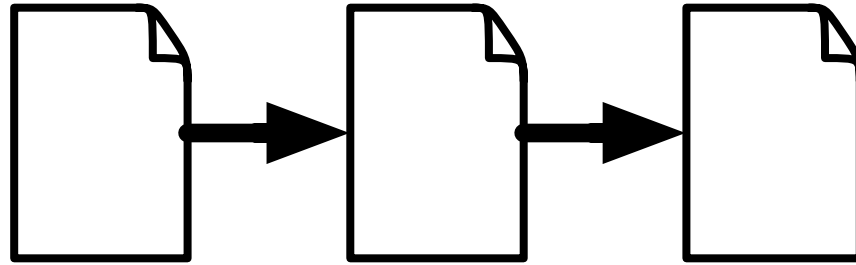


AJAX



Web continuations

💡 Wizards & pipelines made easy



A wizard (in Perl)

A wizard, in Perl

```
my %dispatchTable = (  
    'wiz1'    => \& wiz1,  
    'wiz2'    => \& wiz2,  
    'finish' => \& finish,  
);  
  
my $defaultAction = \& wiz1;
```


A wizard, in Perl

```
sub finish {
    my ($q) = @_;
    my $name = $q->param('name');
    my $ship_address = $q->param('ship_address');
    my $bill_address = $q->param('bill_address');
    my $city = $q->param('city');
    my $postcode = $q->param('postcode');
    # validation goes here

    commitOrder($name, $ship_address,
                $bill_address, $city, $postcode);

    useTemplate('finish.tmpl',
                { name          => $name,
                  ship_address => $ship_address,
                  bill_address => $bill_address,
                  city         => $city,
                  postcode     => $postcode });
}
```

A wizard, in Perl: template (p. 1)

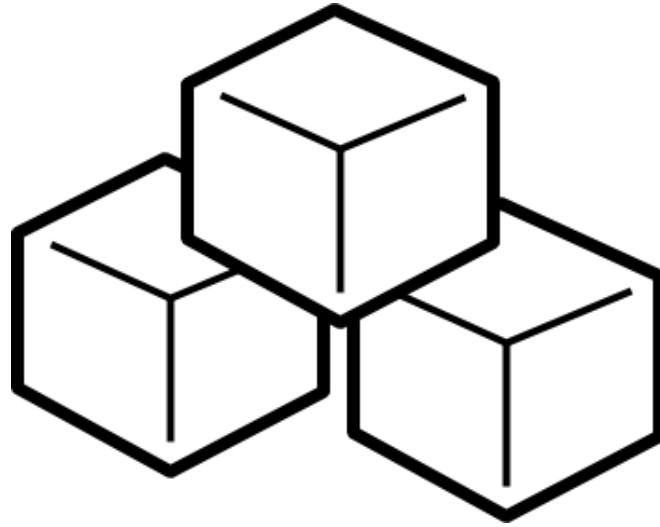
```
<form action="">
  <table>
    <tr>
      <label><td>Billing Address:</td>
      <td><input name="bill_address" /></td></label>
    </tr><tr>
      <label><td>City:</td>
      <td><input name="city" /></td></label>
    </tr><tr>
      <label><td>Postcode:</td>
      <td><input name="postcode" /></td></label>
    </tr><tr>
      <td></td>
      <td><input type="submit" value="Continue" /></td>
    </tr>
  </table>
```


A wizard, in Perl: template (p. 2)

```
<input type="hidden" name="action" value="finish" />
<input type="hidden" name="name"
value="<TMPL_VAR NAME="NAME">" />
<input type="hidden" name="ship_address"
value="<TMPL_VAR NAME="SHIP_ADDRESS">" />
</form>
```

A wizard, in Links

```
fun pipeline() {
  var (name=name, ship_addr=ship_addr) =
    sendSuspend(wiz1Tpl);
  # validation goes here
  var (bill_addr=bill_addr, city=city,
      postcode=postcode) =
    sendSuspend(wiz2Tpl);
  # validation goes here
  commitOrder(name, ship_addr, bill_addr, city,
              postcode);
  finishTpl(name, ship_addr, bill_addr, city,
            postcode)
}
```



Forms abstraction



Building blocks for forms

Forms abstraction (Links)

form

```
<table>
  <tr>
    <label><td>Name:</td>
      <td>{input -> name}</td></label>
    </tr><tr>
    <label><td>Desired Arrival:</td>
      <td>{date() -> arrival}</td></label>
    </tr><tr>
    <td></td>
      <td><input type="submit" value="Continue" /></td>
    </tr>
</table>
```

```
yields {
  (name = name, arrival = arrival)
}
```

Forms abstraction (Links)

```
sig date : () -> Form (Int, Int)
fun date() {
  form
    <#>{input -> dateStr}</#>
  yields {
    var (dayStr, moStr) = splitAt('/', dateStr);
    (stringToInt(dayStr), stringToInt(moStr))
  }
}
```

Forms abstraction: *Two* dates

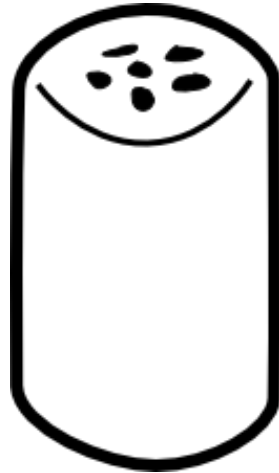
form

```
<table>
  <tr>
    <label><td>Arrival:</td>
      <td>{date() -> arrival}</td></label>
  </tr><tr>
    <label><td>Departure:</td>
      <td>{date() -> departure}</td></label>
  </tr><tr>
    <td></td>
      <td><input type="submit" value="Continue" /></td>
  </tr>
</table>
```

yields {

```
(arrival = arrival, departure = departure)
```

}



Simplified AJAX



Treat AJAX calls as simple RPC calls

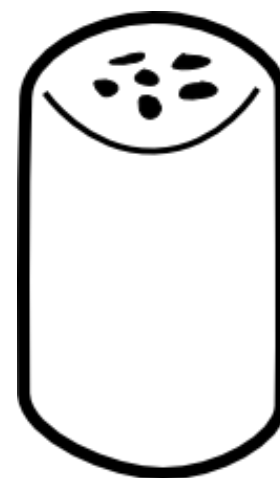
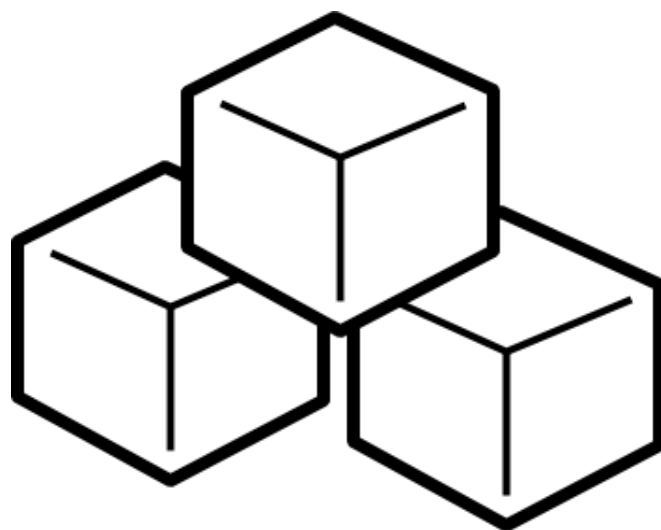
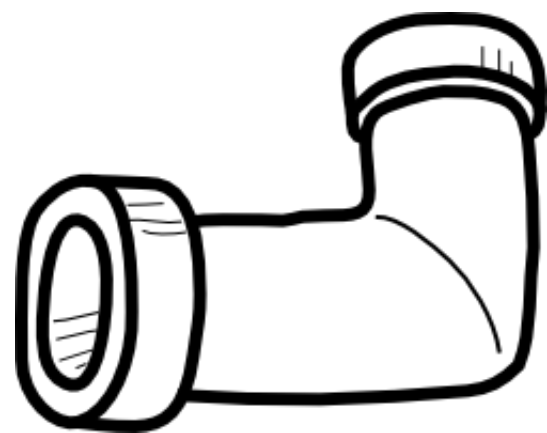
Simplifying AJAX

```
fun list(items) client {  
  <ul>  
    {for (var x <- items)  
      <li id="{x}">  
          
        {stringToXml(x)}  
      </li>  
    }  
  </ul>  
}
```

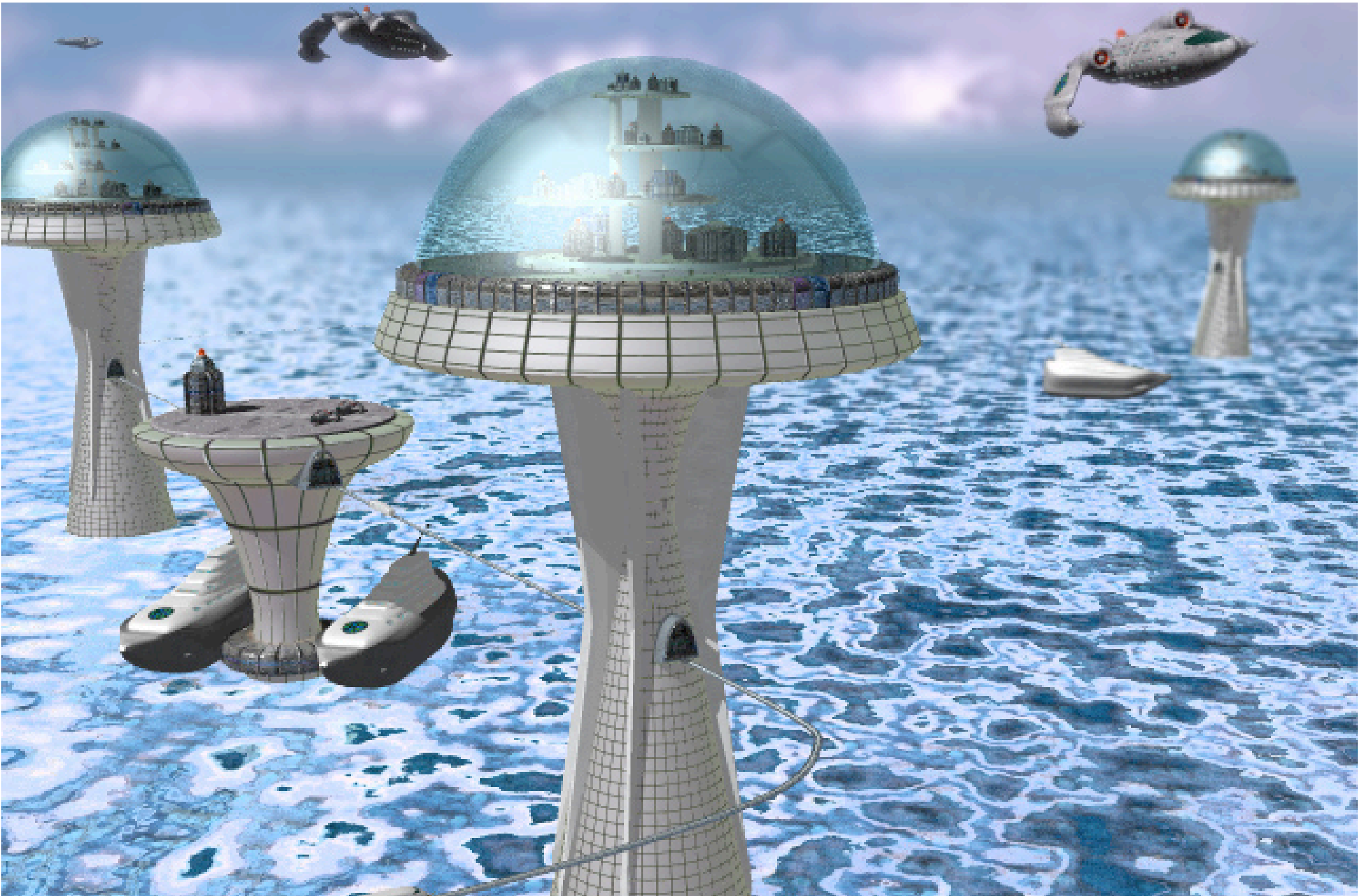

Simplifying AJAX

```
fun removeFromDB(item) server {  
    var todoTable = table "todo"  
        with (item : String)  
        from (database "ezra");  
    delete (var itemRow <-- todoTable)  
        where (itemRow.item == item)  
}
```

```
fun remove(item) client {  
    removeNode(getNodeById(item));  
    removeFromDB(item)  
}
```



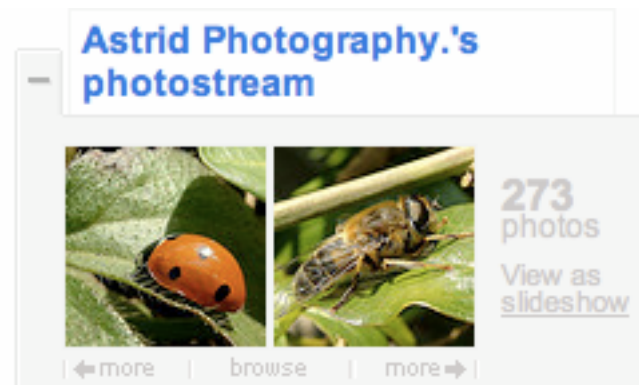
The Future



HTML+CSS

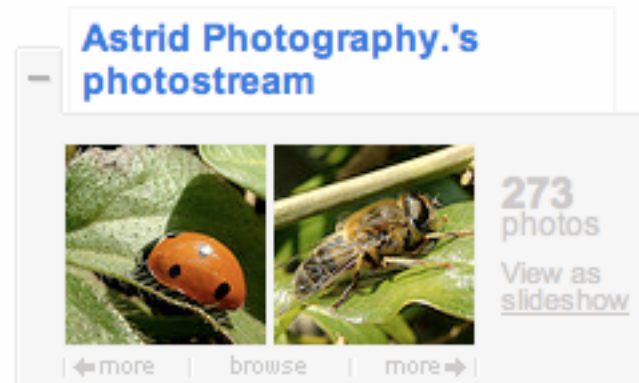
A declarative page-specification language.

Declarative & Interactive?

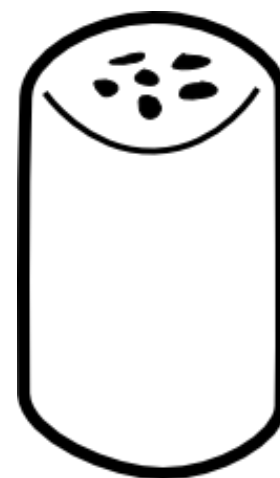
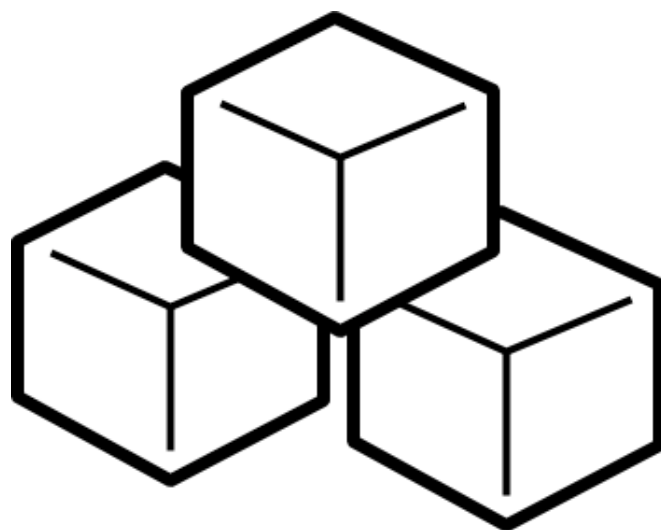
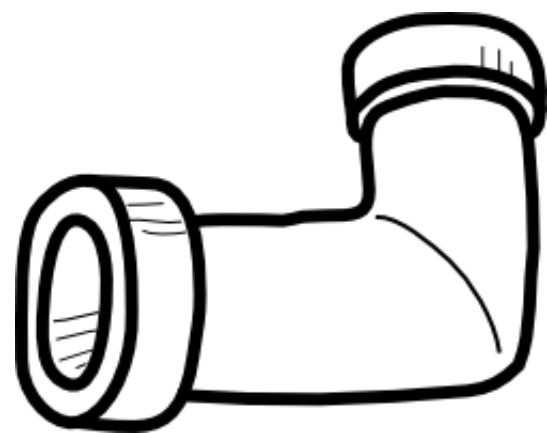


How do we make a declarative language that can express all the bells & whistles of Flickr?

Functional Reactive Programming



- On-screen objects behave as functions of (time-varying) input parameters



Links: Web Programming Without Tiers

Try it:

groups.inf.ed.ac.uk/links

Thank You