Web Frameworks

web development done right

Course of Web Technologies
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Valerio Maggio, PhD Student
Prof.ssa Anna Corazza

Outline

- Web technologies evolution
- Web frameworks
  - Design Principles
- Case Study
  - Django and GAE (Google App Engine)
- Working Example

Intruduction

- Nowadays **frameworks** has become a *buzzword*
  - *Software framework*
  - *Web framework*
  - *Development framework*
  - ...
- So, what do you expect a web framework is?

1. Web Technologies Evolution

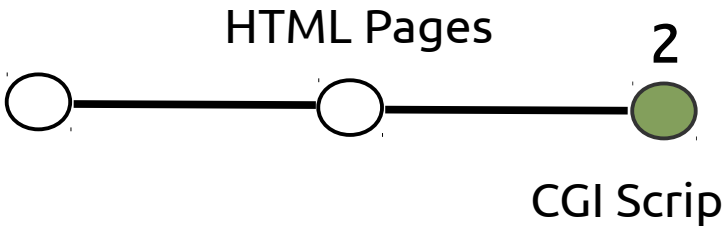
Web: Evolution Roadmap

HTML Pages

HTML Pages:

- Web developers wrote every page “by hand”
- Update a web site means editing HTML
- “redesign” involved redoing **every** page
  - One at a time
- Solution **not scalable**

Web: Evolution Roadmap



CGI – *Common Gateway Interface*

- (+) Pages intended as **resources**
  - Pages are generated dynamically on demand
  - Raise of (so called) server side technologies
- (-) Code reuse difficult
  - Lot of “boilerplate” code
- (-) High learning curve

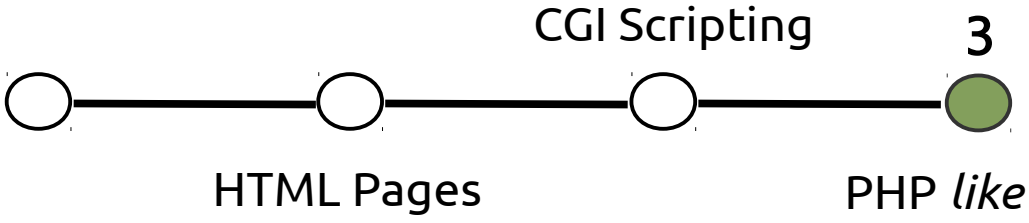
CGI Perl Example

```
#!/usr/bin/perl

print "Content-type:text/html\r\n\r\n";
print '<html>';
print '<head>';
print '<title>Hello Word - First CGI Program</title>';
print '</head>';
print '<body>';
print '<h2>Hello Word! This is my first CGI program</h2>';
print '</body>';
print '</html>';
```

```
#!/usr/bin/perl

print "Content-type: text/html\n\n";
print "<font size=+1>Environment</font>\n";
foreach (sort keys %ENV)
{
  print "<b>$_</b>: $ENV{$_}<br>\n";
}
```

- What are pros and cons of these two CGI examples ?

Web: Evolution Roadmap



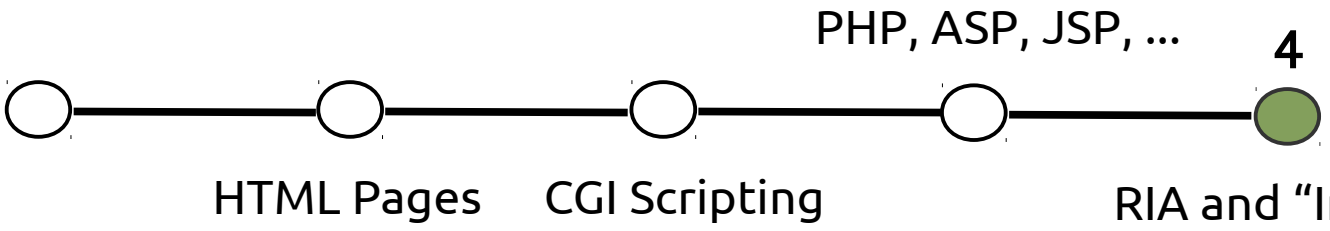
PHP *like* solutions

- (+) Learning curve extremely shallow
  - Code directly embedded into HTML
- (-) No security and/or protection mechanism provided
- (**?**) Bunch of HTML, (Business Logic) Code, (Data) SQL code **all together**

JSP Example: Pros and Cons ?

```
<%@ page import="java.util.Hashtable,java.sql.*,javax.naming.*,javax.sql.*" %>
<html><head><title>Database Query in WebLogic</title></head>
<body>
<h2>Querying a database with a JSP</h2>
<%  String sql = "select * from user";
    Connection conn = null;
    Statement stmt = null;
    ResultSet rs = null;
    ResultSetMetaData rsm = null; %>
 <table border='1'><tr>
  <% try{
            conn = pool.getConnection( );
            stmt = conn.createStatement( );
            rs = stmt.executeQuery(sql);
            rsm = rs.getMetaData( );
            int colCount =  rsm.getColumnCount( );
            for (int i = 1; i <=colCount; ++i) { %>
            <th><%=rsm.getColumnName(i)%> </th>
          <%  } %>
           </tr>
          <% while( rs.next( )){ %>
                <tr>
            <%     for (int i = 1;  i <=colCount; ++i) { %>
                <td>    <%= rs.getString(i) %> </td>
            <%}//for %>
                </tr>
          <%} //while
  } catch (Exception e) {
      throw new JspException(e.getMessage( ));
      .....
    }                %>
</body></html>
```

Web: Evolution Roadmap



RIA and “Integrated Solutions”

- RIA: Rich Internet Applications
  - **Q:** Do you know what RIA means?
  - **A: Desktop-like web applications**
    - **(Ajax and javascript intensive web apps)**
- A.k.a. *Solutions battery included*
- CMS and Web Frameworks

CMS: Content Management System

- **Aim to** manage work-flows and contents in a collaborative environment
- **Designed to** simplify the publication of contents to web sites and mobile devices
- Examples: Joomla, Drupal, Wordpress, ….

Web frameworks

- **Aim to** alleviate the overhead associated with common Web development
  - Databases, templates, sessions, …
- **Designed to** support the development of dynamic websites, web applications and web services
- Examples: Struts, Spring, Ruby on Rails, Django, Google App Engine, ...

So, What is a Web Framework?

```
#!/usr/bin/env python
import MySQLdb

print "Content-Type: text/html\n"
print "<html><head><title>Books</title></head>"
print "<body>"
print "<h1>Books</h1>"
print "<ul>"
connection = MySQLdb.connect(user='me', passwd='letmein', db='my_db')
cursor = connection.cursor()
cursor.execute("SELECT name FROM books ORDER BY pub_date DESC LIMIT 10")
for row in cursor.fetchall():
    print "<li>%s</li>" % row[0]
print "</ul>"
print "</body></html>"
connection.close()
```

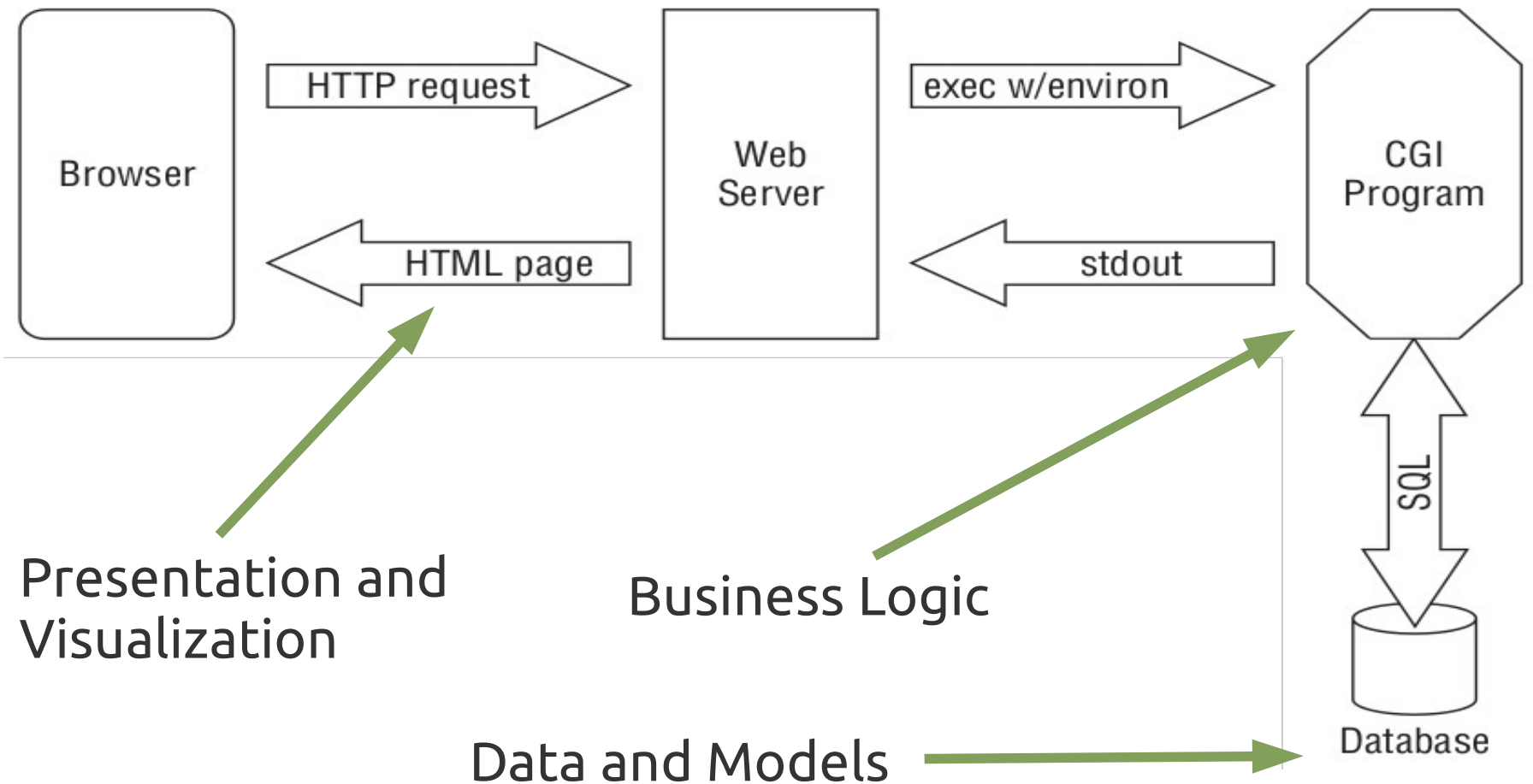
- What does this code do?
- What happens when multiple pages need to connect to database?
- Should a developer *really* have to worry about printing the *Content-type?*
- Is this code reusable in multiple environments with different DB connection parameters?
- What happens when a web designer have to redesign the page?

Web Frameworks in a nutshell

- These problems are exactly what a web frameworks tries to solve
- Web frameworks provides a *programming infrastructure* for applications
- Focus on developing code without *having to reinvent the wheel*

2. Web Frameworks Design Principles

CGI Architecture Model



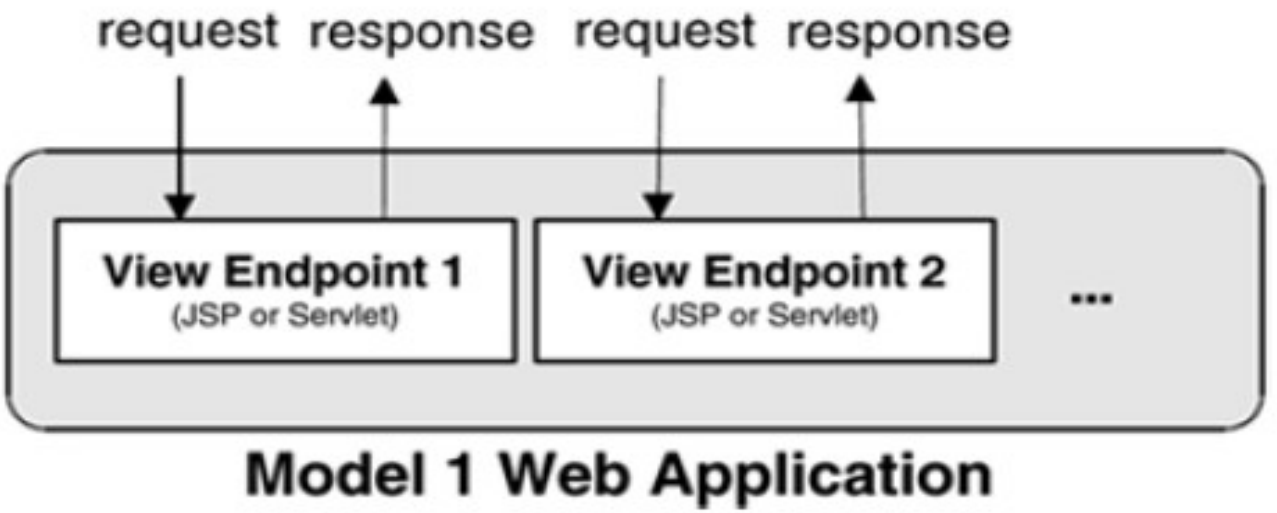
CGI Architecture Model

- *Task centric architecture* (*a.k.a. Model 1*)
  - Difficult reusability and maintenance of code
  - Requires different skill-sets

High coupling among:

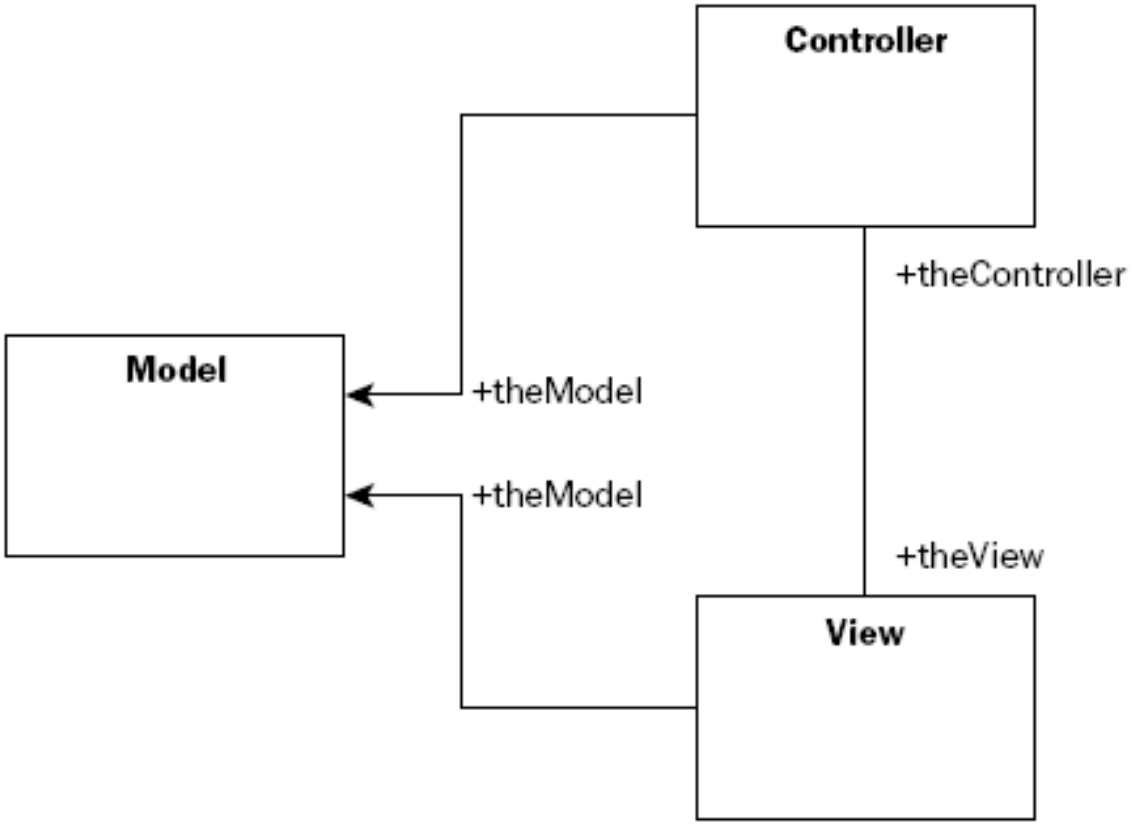
- **Presentation (View)**
  - How to show data
- **Processing (Controller)**
  - What information to show
- **Data Acquisition (Model)**
  - What information to extract (from DB)

Model 1 Architecture (Java)



- Processing delegates as JSP and Servlets
- Is there any difference between CGI and Servlet?

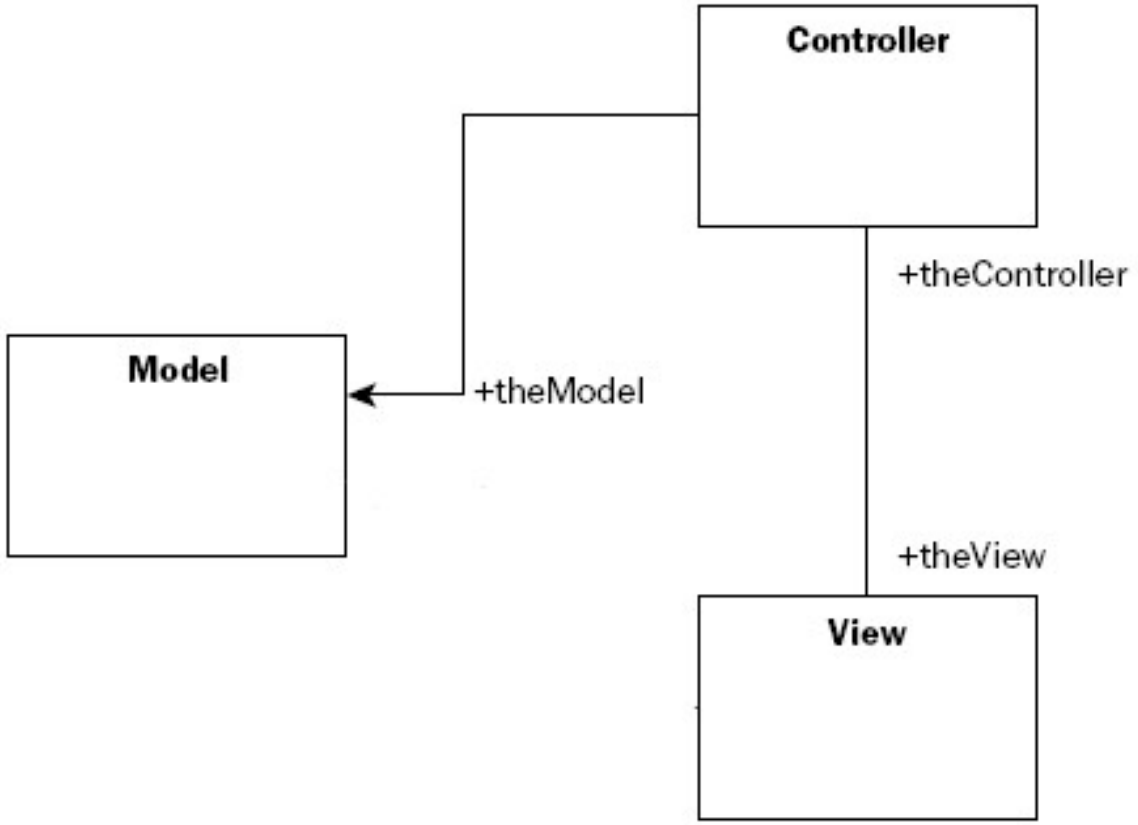
MVC Architecture Model



- **Model:**
  - Manages domain and data acquisition
- **View:**
  - Manages the visualization of data
- **Controller:**
  - Manages domain and data processing

Q: Do you think this model is feasible to be used on the web as is?

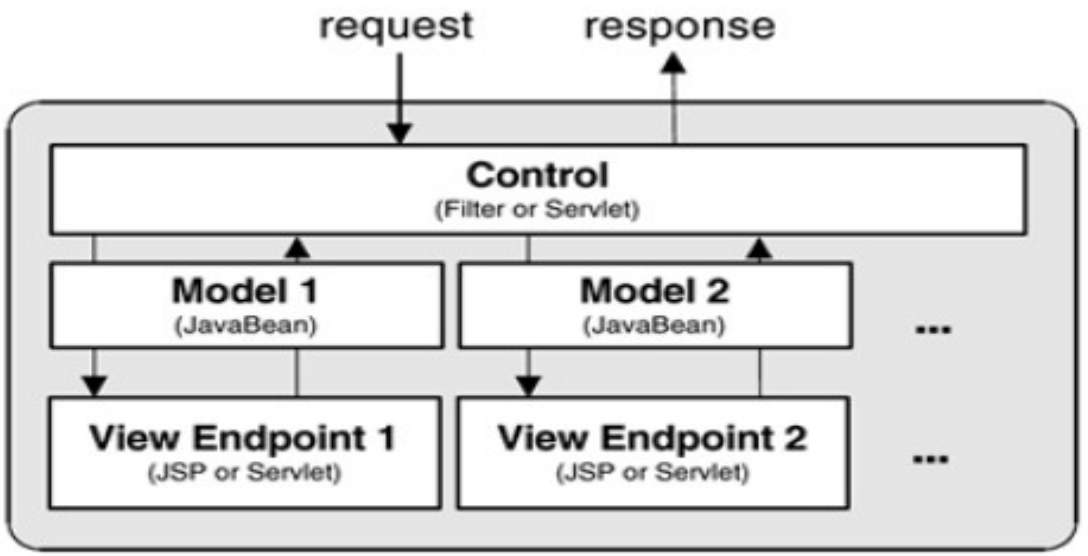
Web-MVC Architecture Model



- **Model:**
  - Manages domain and data acquisition
- **View:**
  - Manages the visualization of data
- **Controller:**
  - Manages domain and data processing

A: No (direct) relationship between the view and the model

Model 2 Architecture (Java)



Model 2 Web Application

- **Model:**
  - EJB and Javabeans
- **View:**
  - JSP and JFaces
- **Controller:**
  - Servlets

Fulll-stack web frameworks

- From **Python.org wiki**:

  *[..] frameworks provide support for a number of activities such as interpreting requests, producing responses, storing data persistently, and so on. [..] those frameworks [..] are often known as **full-stack** frameworks in that they attempt to supply components for each layer in the stack.*

- **So, what are such components?**

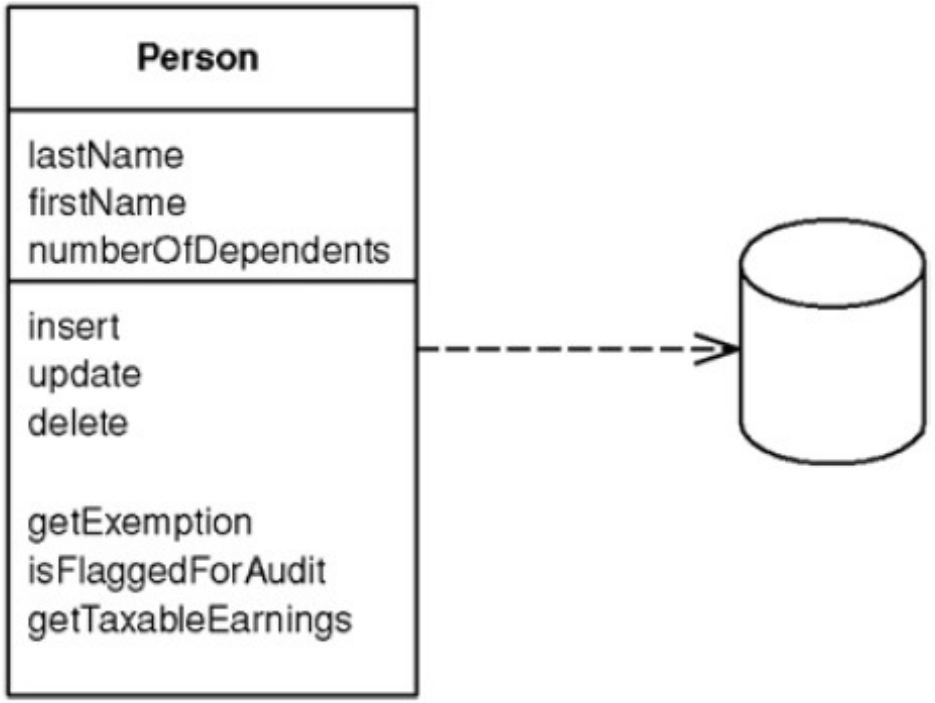
Web Frameworks Capabilities

- **View**
  - JavaScript Library
  - Template Engine and View Composition
  - Development Server
- **Controller**
  - URL Routing
  - Controller-view Association
- **Model**
  - Database Abstraction
  - ORM (Object Relational Mapping)

Database Access

- **Distributed Access Logic** (JSP, Servlets)
- **Centralized Access Logic**
- **Q:** How easy is modify the db schema?

Active Record pattern



- An object encapsulates both data and behavior
- Put data access logic in the domain object

http://martinfowler.com/eaaCatalog/activeRecord.html

Heavy-weight vs Light-weight Frameworks

- Heavy-weight frameworks:
  - (Mostly) Java Based
  - Based on Model 2 Architecture
  - High learning curve
  - Bunch of (XML) Configuration Files
- Light-weight frameworks:
  - Convention over Configuration and DRY Principles
  - Shallow learning curve
  - Use of Dynamic Languages
    - Python, Ruby, Groovy, Scala

H-W Java frameworks: Struts

```
<?xml version="1.0" encoding="ISO-8859-1" ?>
....
<struts-config>
  <form-beans>
    <form-bean name="LoginForm"
        type="com.oreilly.jent.struts.library.ui.LoginActionForm"/>
    <form-bean name="AddBookForm"
        type="org.apache.struts.validator.DynaValidatorForm">
      <form-property name="title" type="java.lang.String"/>
      <form-property name="author" type="java.lang.String"/>
      <form-property name="isbn" type="java.lang.String"/>
      <form-property name="addBookAction" type="java.lang.String"/>
    </form-bean>
  </form-beans>
  <global-forwards>
    <forward name="home"       path="/home.do"/>
    <forward name="login"      path="/login/index.jsp"/>
    ....
  </global-forwards>
  <action-mappings>
    <action path="/home" parameter="/home.jsp"
        type="org.apache.struts.actions.ForwardAction" />
    <action path="/login" name="LoginForm"
        scope="request" validate="true" input="/login/index.jsp"
        type="com.oreilly.jent.struts.library.ui.LoginAction">
      <forward name="success" path="/login/success.jsp" redirect="false"/>
      <forward name="failure" path="/login/index.jsp" redirect="false"/>
    </action>
    ....
  </action-mappings>

  <controller processorClass=
      "com.oreilly.jent.struts.library.ui.LibraryRequestProcessor"/>
  <message-resources parameter="application"/>
</struts-config>
```

H-W Java frameworks: Hibernate


```
<hibernate-mapping>
<class name="User" table="users">
  <id name="ID" column="id" type="string">
      <generator class="assigned"></generator>
  </id>
  <property name="password"  column="password"  type="string" />
</class>
</hibernate-mapping>
```

```
CREATE TABLE users (
  id VARCHAR(20) NOT NULL,
  password VARCHAR(20),
  PRIMARY KEY(id)
);
```

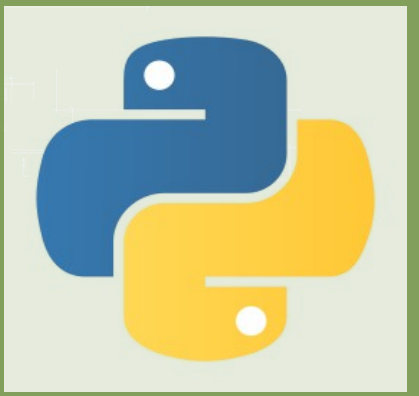
Design Principles

- *Convention over configuration*
  - *“Convention over Configuration is a programming design that favors following a certain set of programming conventions instead of configuring an application framework. [...]”*
- *DRY (Don't repeat yourself)*
  - *“DRY is a principle that focuses on reducing information duplication by keeping any piece of knowledge in a system in only one place.*

3. Case Study: Django and Google App Engine

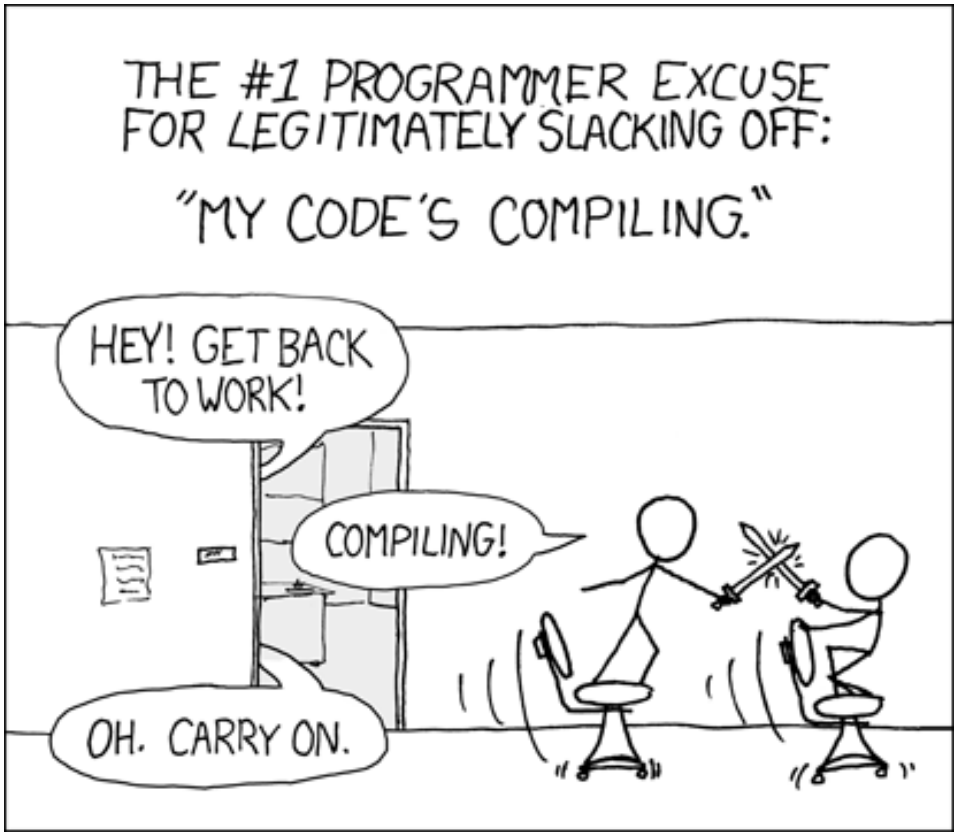
Frameworks and Languages

django



Python Programming Language

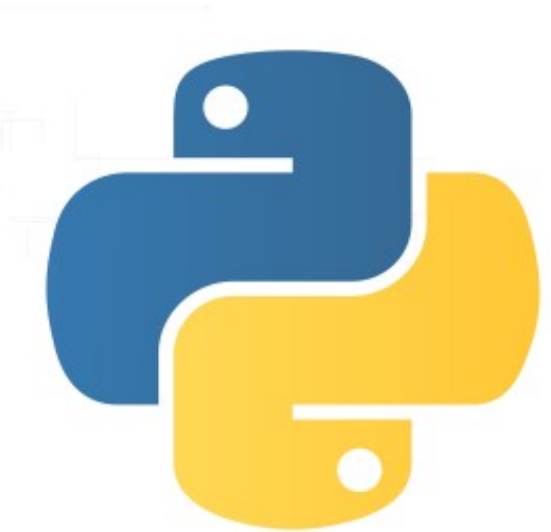
"Speed and flexibility of development are critical. Dynamic languages let you get more done with less lines of code (which means less bugs)"



- Object oriented languages
- Clean and simple syntax
  - **Strong Typed**
  - **Dynamic Typed**

Python Programming Language

- Is there someone that uses python in professional projects?
  - IBM, Google, Sun, HP, Industrial Light and Magic, NASA, Microsoft



- **Goggle it:**
  - **site:microsoft.com** python
  - You'll get more than 9 thousands results

Python: Language of the year 2010

Programming language Python has become programming language of 2010. This award is given to the programming language that gained most market share in 2010.

Python grew 1.81% since January 2010. This is a bit more than runner up Objective-C (+1.63%).

Objective-C was favorite for the title for a long time thanks to the popularity of Apple's iPhone and iPad platforms. However, it lost too much popularity the last couples of months.

Python has become the "de facto" standard in system scripting (being a successor of Perl in this), but it is used for much more different types of application areas nowadays.

Python is for instance very popular among web developers, especially in combination with the **Django** framework.

Since Python is easy to learn, more and more universities are using Python to teach programming languages.

Source: tiobe.com

TIOBE: Programming Languages ranking

Year	Winner
2010	Python
2009	Go
2008	C
2007	Python
2006	Ruby
2005	Java
2004	PHP
2003	C++

Category	Ratings Jan 2011	Delta Jan 2010
Object-Oriented Languages	55.8%	+1.4%
Procedural Languages	39.2%	-2.1%
Functional Languages	3.5%	+0.4%
Logical Languages	1.5%	+0.2%

http://www.tiobe.com

Python Dynamic Typing

“Duck Typing”

Walks like a duck?

Quacks like a duck?

It's a duck!

```
def half (n):
    return n/2.0
```

Q: What is the type of variable n?

Django web framework

Design characteristics

- ***Model-View-Controller for the Web***
- *Written in Python*
- *Explicit instead of implicit*
- ***Loose Coupling***
- *Don't repeat yourself*

Django Architecture Model

- Django is based on a slightly different version of MVC
  - a.k.a. **MVT:** Model View Template
- **Model:** Domain Objects
  - Python Classes
- **View:** contains business logic for the pages
  - *Callback* as python functions
- **Templates:** describes the design of the page
  - Template Language HTML based

Django Stack

- *Database wrapper (ORM)*
- ***URL dispatcher***
- ***Template system***
- ***Admin Framework***
- *I18n & l10n*
- *Authentication*
- *RSS*
- *.....*

Projects and Applications

- Projects:
  - Composed by different applications
  - Glued together by unique configuration file
- Applications:
  - Set of **portable** functionalities
  - Code is more reusable
  - *Django Plugables*
    - (djangoplugables.com)

```
books/
      __init__.py
      models.py
      views.py
```

URL Dispatcher

- Loose coupling principle between URLs and Views
  - *Based on regular expressions*

```
from django.conf.urls.defaults import *
from mysite.views import current_datetime, hours_ahead

urlpatterns = patterns('',
    (r'^time/$', current_datetime),
    (r'^time/plus/\d+/$', hours_ahead),
)
```

Template Language

- Very restrictive *specific*-language
  - Allows only *presentation operations*
  - No logic and/or processing allowed
- Less Pythonic
  - Oriented to web designers
  - HTML based
- Templates Inheritance Mechanism
  - *Code Reuse*

Template Language (2)

- Template Inheritance
  - Templates are composed by ***Blocks***

base.html

```
<html>
  <body>
    <h1>
      {% block title %}
      {% endblock %}
    </h1>
    <div id="content">
      {% block content %}
      {% endblock %}
    </div>
  </body>
</html>
```

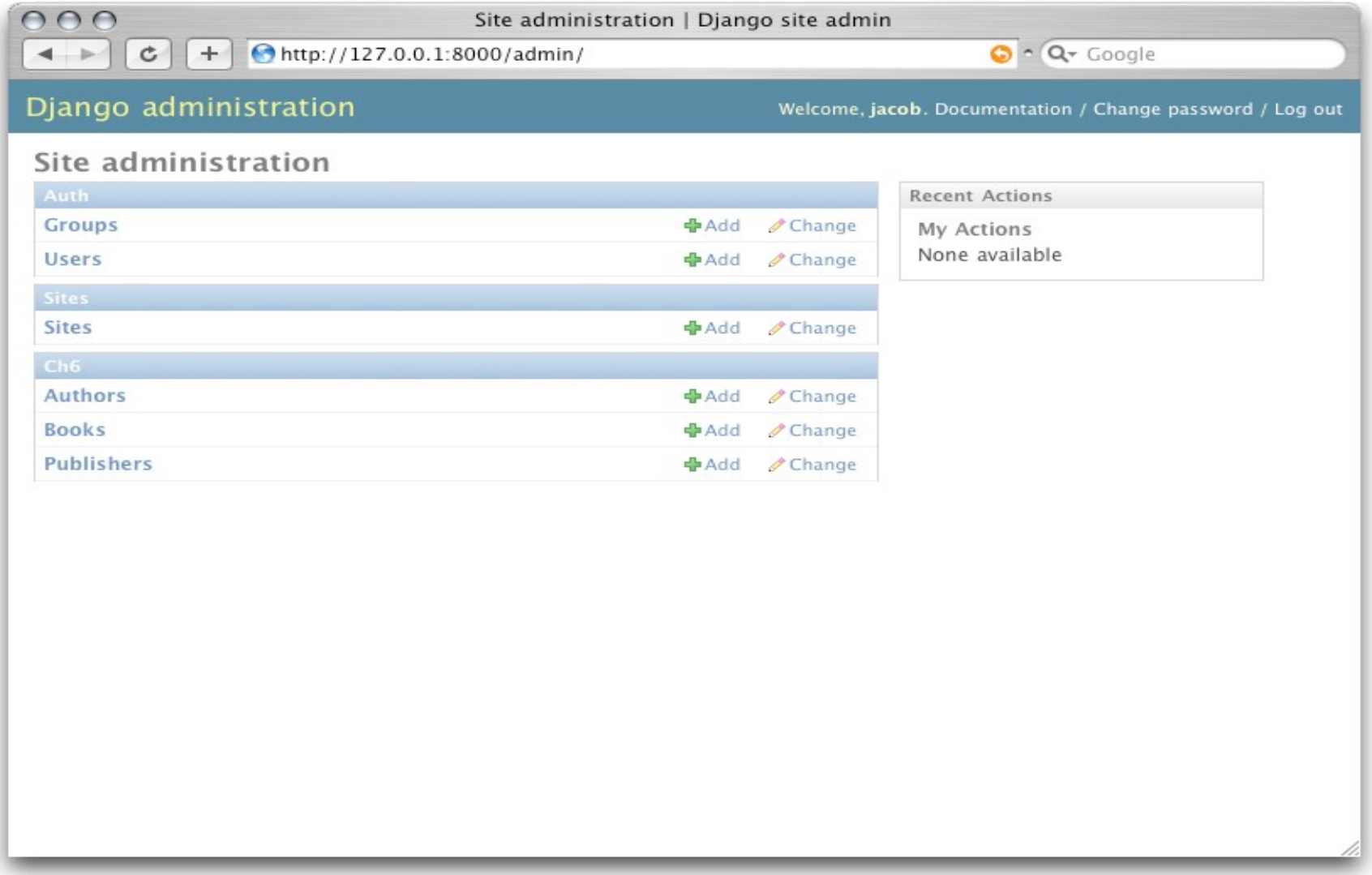
index.html

```
{% extends 'base.html' %}
{% block title %}
    Index page
{% endblock %}
{% block content %}
    ...
{% endblock %}
```

Template Language (3)

- **Variables:** `{{ variable_name }}`
- **Tags:** `{% template_tag %}`
  - Board definition: Tags tell the framework to do *something*
- **Filters:** `{{ variable|filter }}`
  - Alters the formatting of variables

Django Admin Framework



- So called *Killer-application*
- Compliant with Active record Pattern

Django Included Apps

- django.contrib.auth
  - An authentication system.
- django.contrib.contenttypes
  - A framework for content types.
- django.contrib.sessions
  - A session framework.
- django.contrib.sites
  - A framework for managing multiple sites with one Django installation.
- django.contrib.messages
  - A messaging framework.

Google App Engine

- dynamic web serving **(built on top of Django)**
  - **e.g. supports Django Templating Language**
- persistent storage

- automatic scaling and load balancing
- APIs for authenticating
  - using Google Accounts

- a fully featured local development environment
- scheduled tasks for triggering events at specified times and regular intervals

References: Google App Engine

- http://code.google.com/appengine/

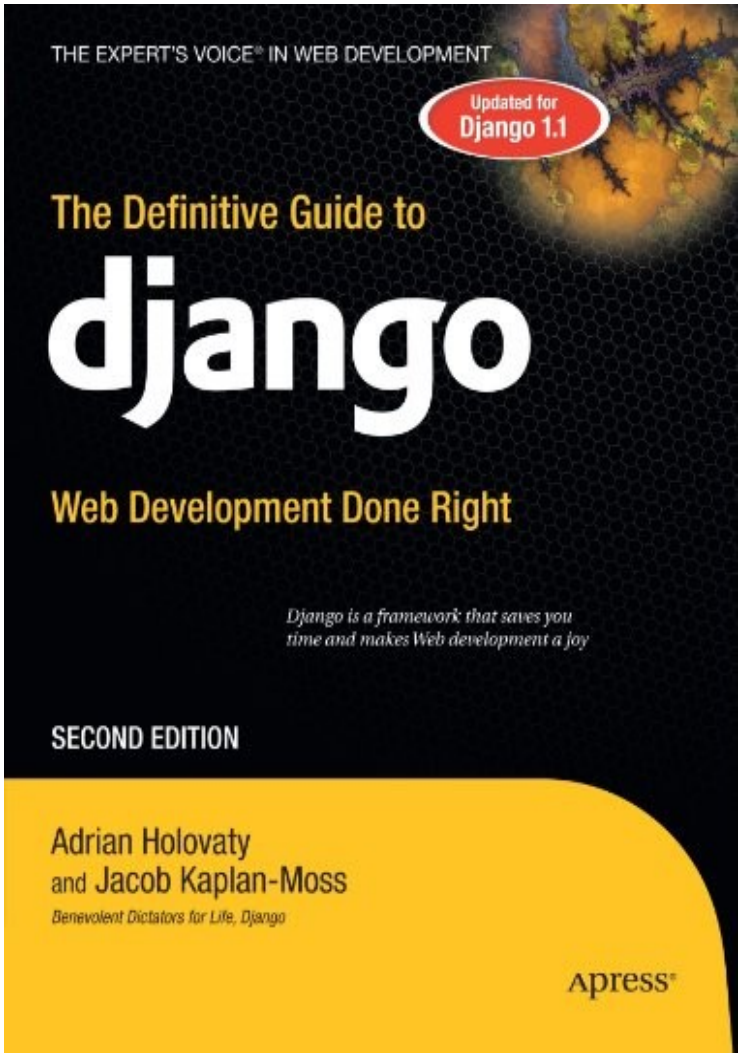
References: Django

- http://www.djangoproject.com/
  - Sito del Progetto
- https://groups.google.com/forum/#!forum/django-it
  - Google group Italiano di Django

References: Python

- http://www.python.org
  - Sito ufficiale di Python
- http://www.python.it
  - Sito ufficiale Python Italia
- https://groups.google.com/forum/#!forum/it.comp.lang.python
  - Google group Italiano di Python
- http://forum.python-it.org
  - Forum (~)official Python Italia
- http://www.pycon.it/
  - Python Italian Conference
  - **EuroPython 2011 – Florence, IT – across spring**

References: Titles

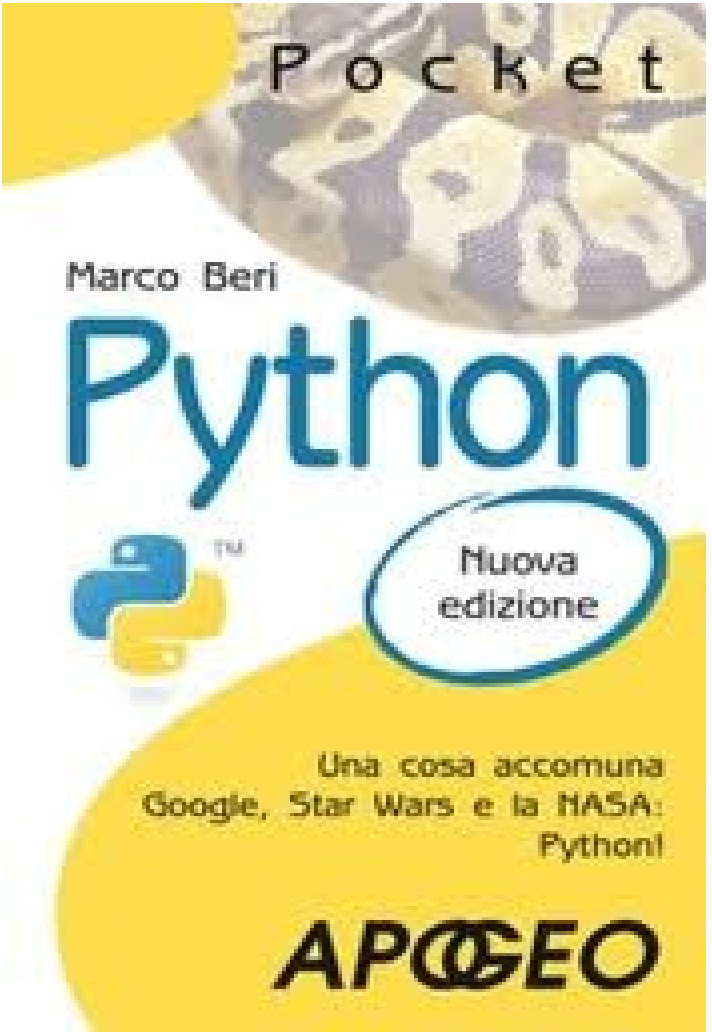


- *The definitive guide to Django*
  A. Holovaty and J.K. Moss, Apress

References: Titles

- *Sviluppare applicazioni web con Django*,
  Marco Beri,APOGEO

References: Titles



- *Python*,
  Marco Beri, APOGEO
  Serie Pocket

References: Titles

- *Programming Google App Engine*, D. Sanderson,O'Reilly

And last...

- Want to get some actions?
- Let's do together a working example