合肥學院
HEFEI UNIVERSITY

Distributed Computing
Lesson 21: Cloud Computing

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Outline

1. Cloud Computing
2. Google App Engine
3. GAE Projects: Servlets and JSPs
4. GAE Example

website

Overview

- Get to know the different aspects of Cloud Computing
- Discuss one specific Platform-as-a-Service environment: GAE (but there are *many* others)

Definition (Cloud Computing)

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- user perspective: accesses services in transparent way, through a *cloud*
- offer of service & use: only via interfaces and protocols
- range of services: whole spectrum from infrastructure, platforms, to software

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- Accessed through network, e.g., internet or company network

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  - large-scale grids: central Europe, State Grid Corporation of China (SGCC)

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  - location transparency: user does not know exact location of resources

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  - cloud systems can automatically control and optimize resources by using these measurements

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  - Yahoo! Zimbra: Email+Calender+...-server [15]

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  - universities, companies with similar intrests, etc.

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    - international law enforcement: Megaupload Case [17], Twitter case [18]

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    - international law enforcement: Megaupload Case [17], Twitter case [18]
    - international connectivity / Firewalls (volatility?)

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    - international legal situation and cyber-war: Patriot Act [19–23], FISA [19, 20, 24, 25], Snowden case [26, 27], etc [28]

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    - Goal of BI Vendor: many customers (hotels), all customers should be happy. Knows: data of many hotels...

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- Good for start-up companies: can safe time and money because don't need to buy infrastructure

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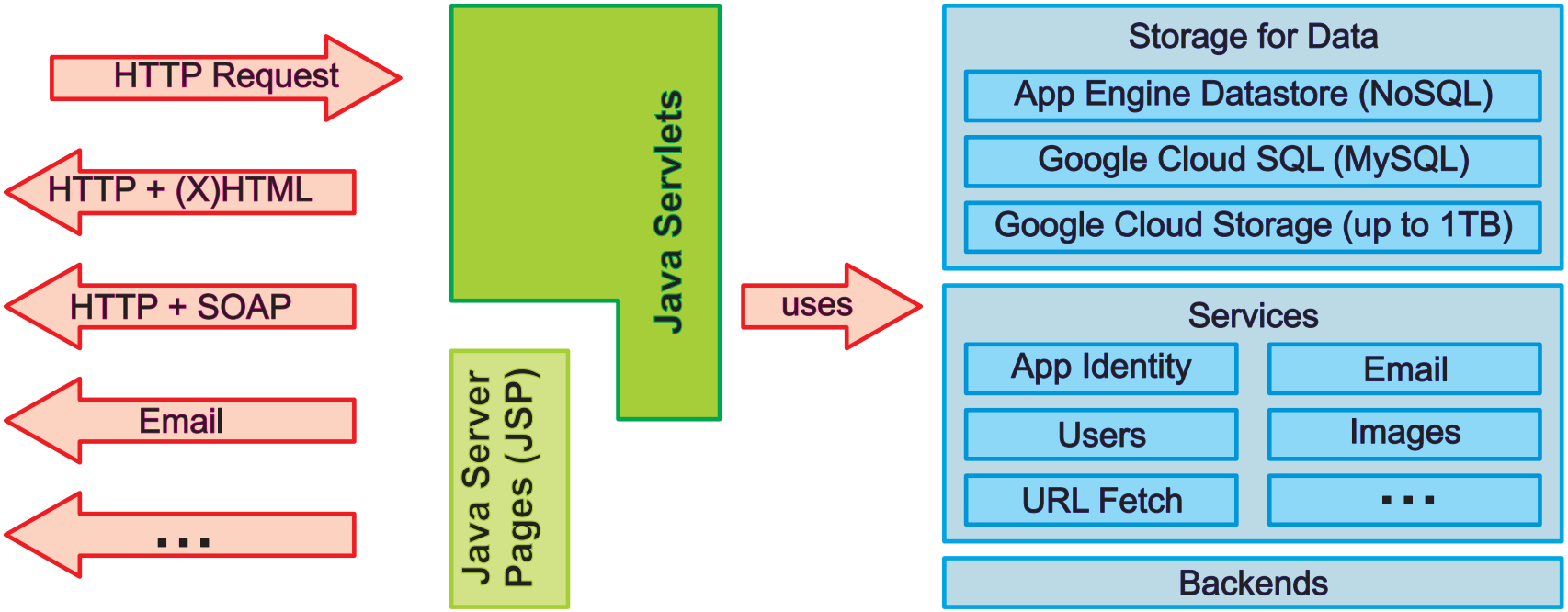
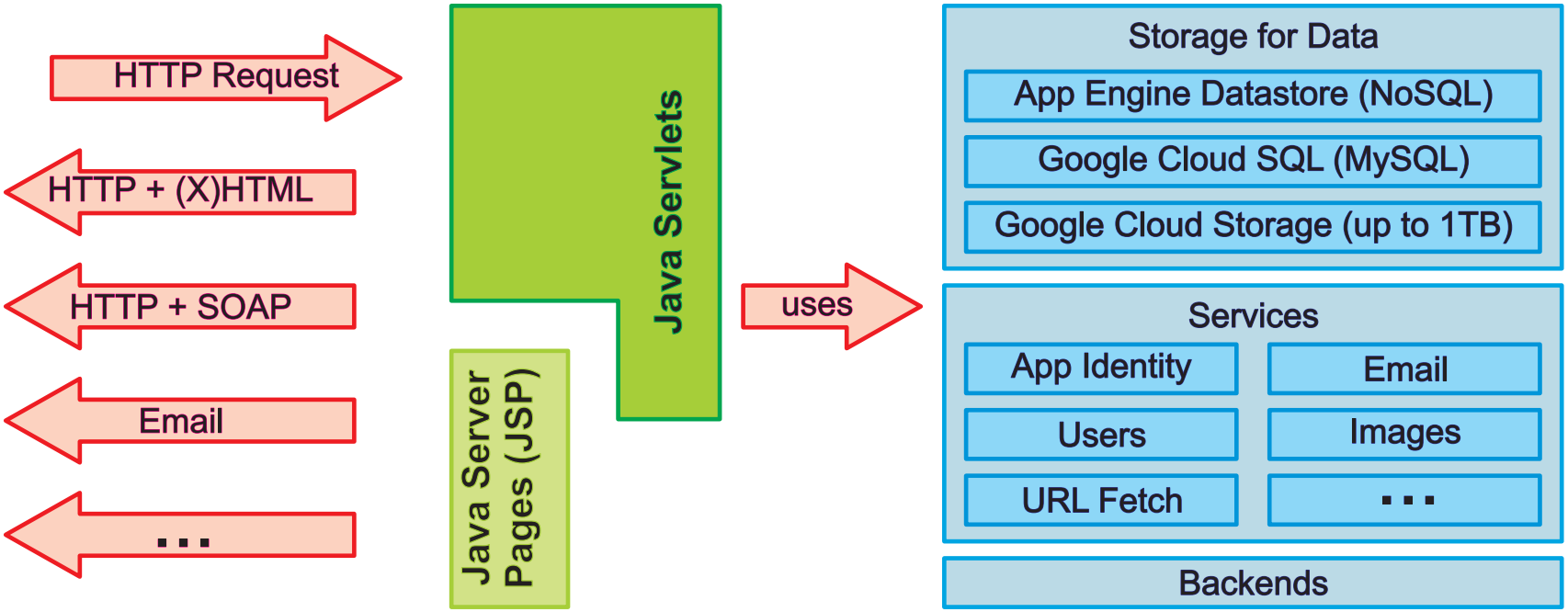
  - Limited access to standard library (no sockets, no file writes, etc.
  - Allows for easy replication and dynamic scaling

GAE Java Environment



- Java 5 to 6 (Java 1.5 and 1.7)

GAE Java Environment



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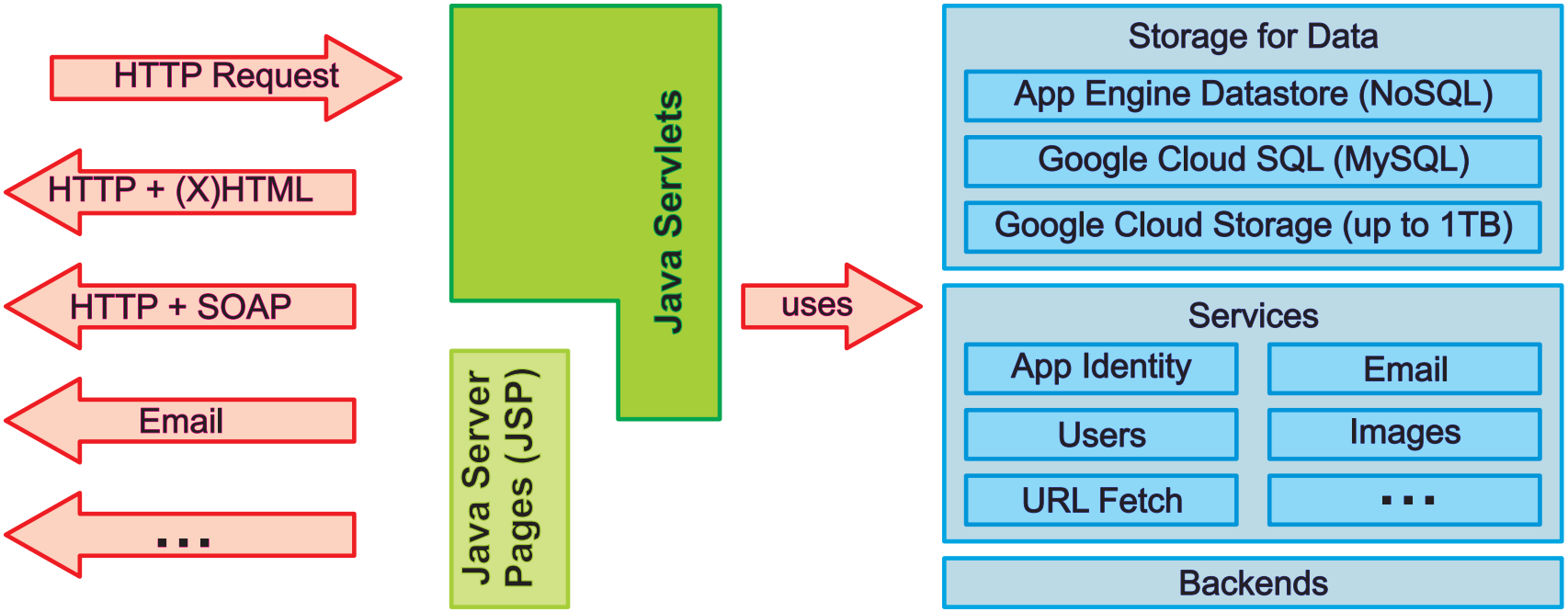
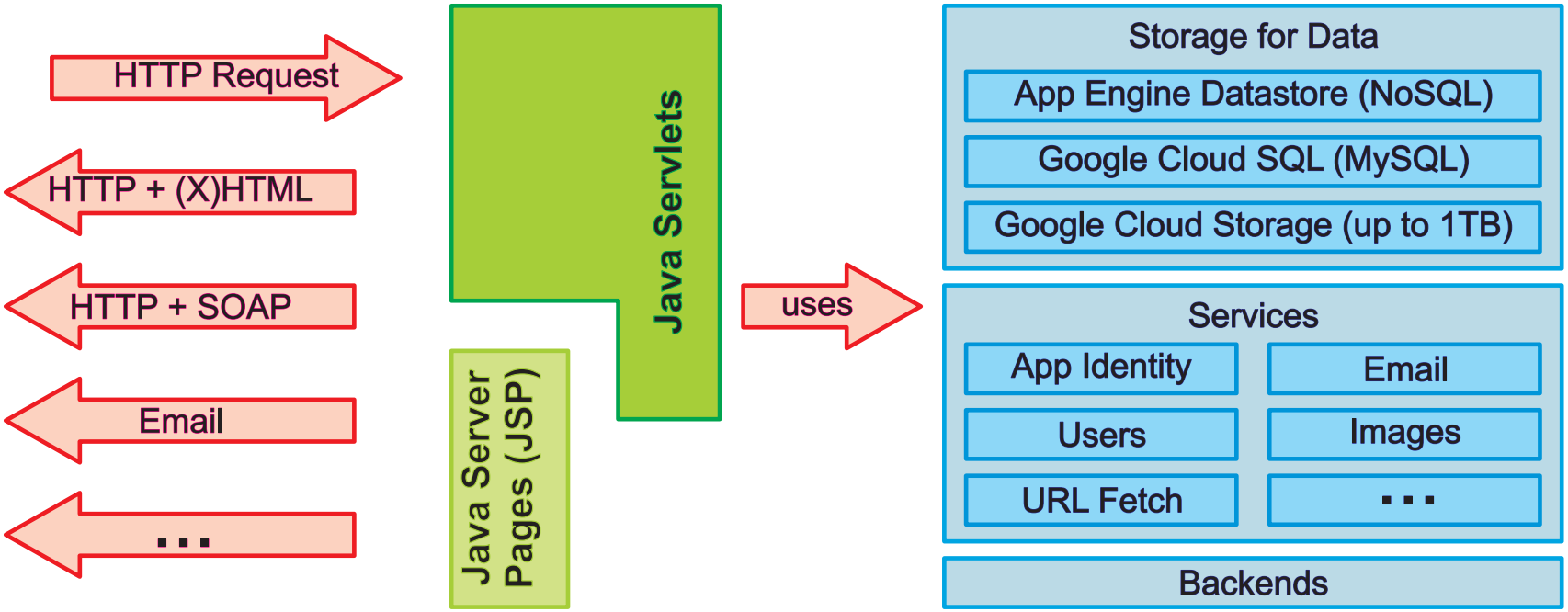


- Application usually presented to user as HTML website (but could also be a Web Service or whatever)
- Users (or other applications) interact with an App via HTTP [44, 45] requests, e.g., coming from a web browser

GAE Java Environment



- Actions within the scope of a HTTP request that can be processed in two ways

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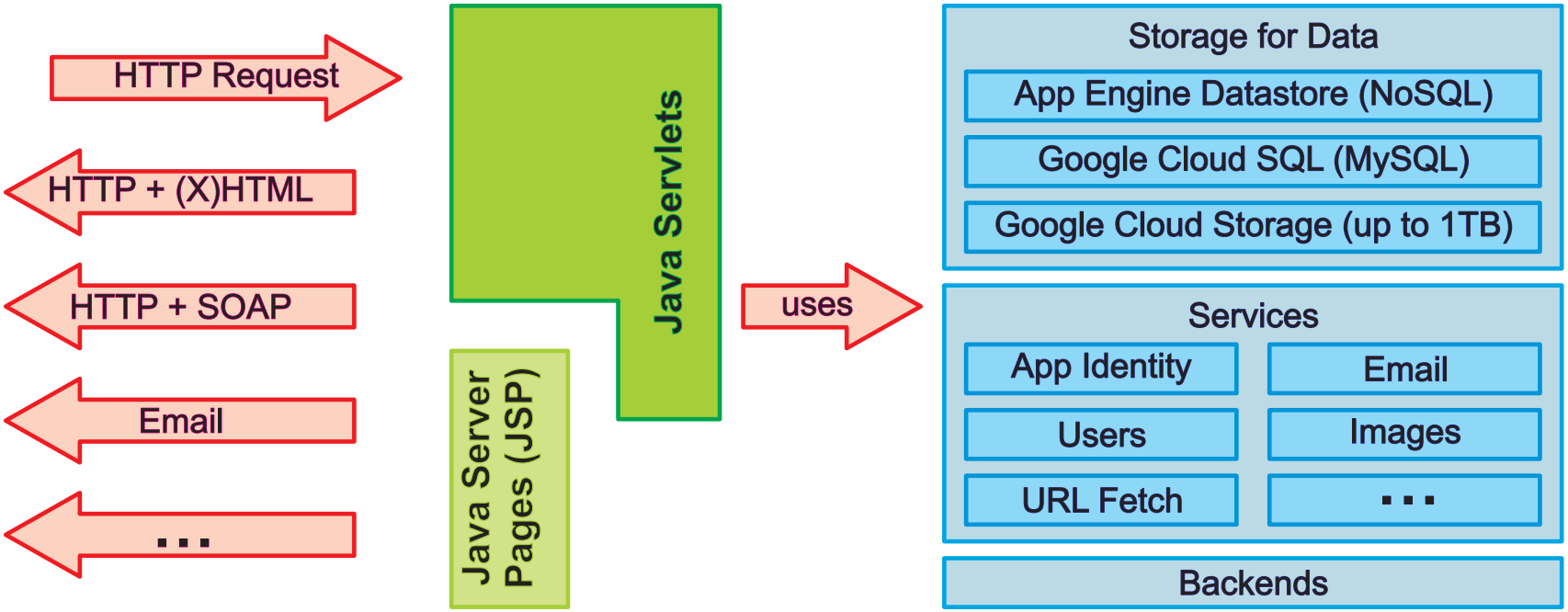

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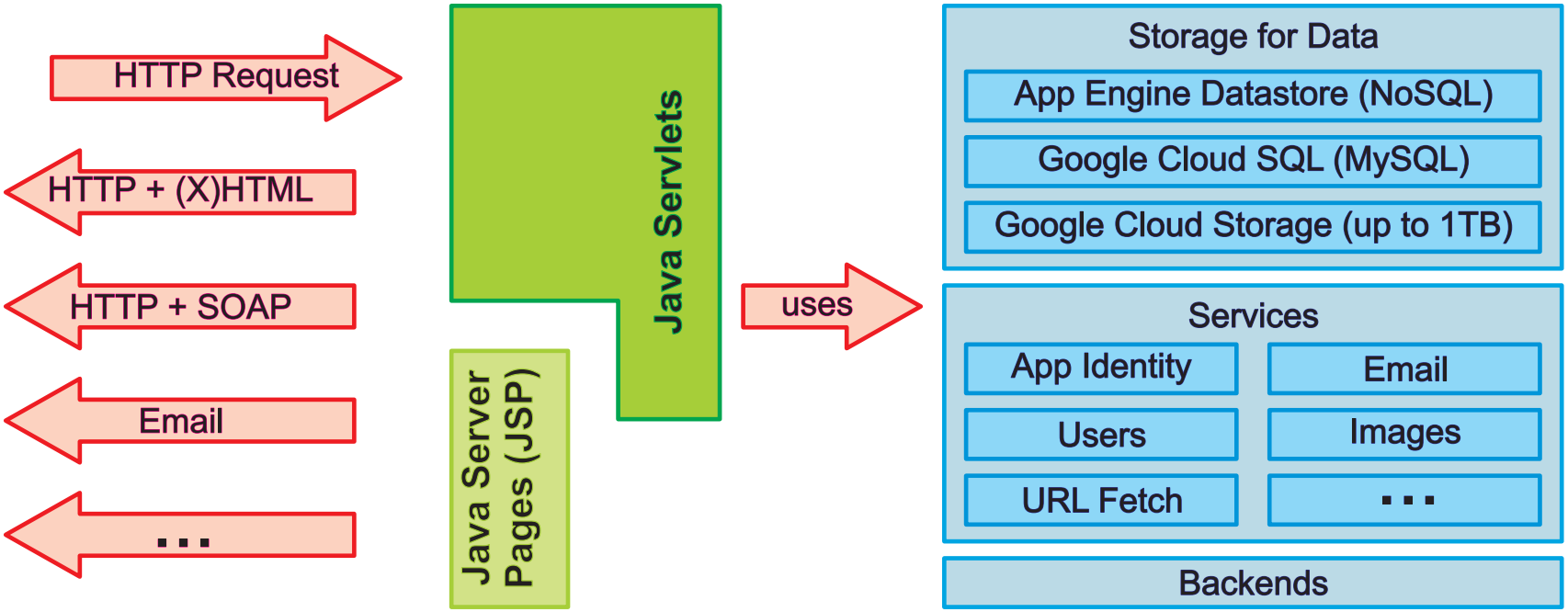

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  - JavaServer Pages (JSP) [46–49]:
    - template-language that mixes text (e.g., HTML, SOAP, ...) with `Java` code (similar to PHP [50] or Perl [51])

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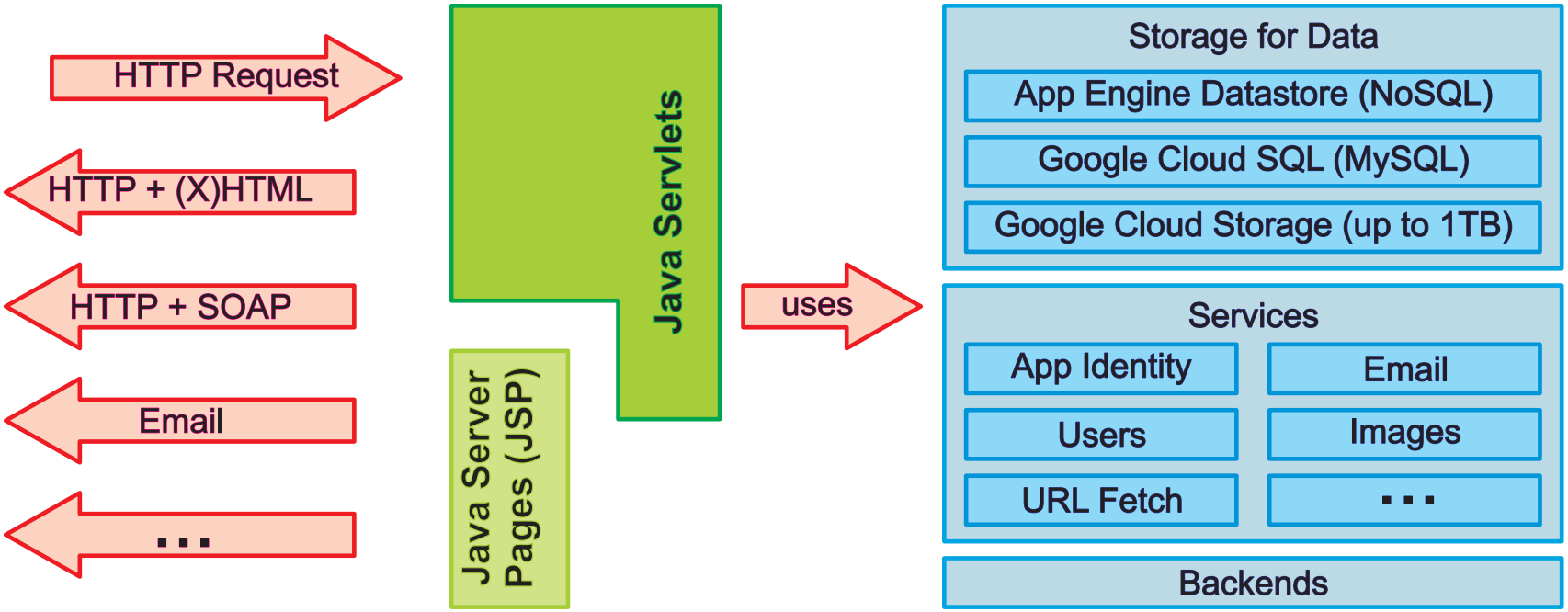

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    - can access all GAE/`Java` functionality, is compiled to Java Servlets

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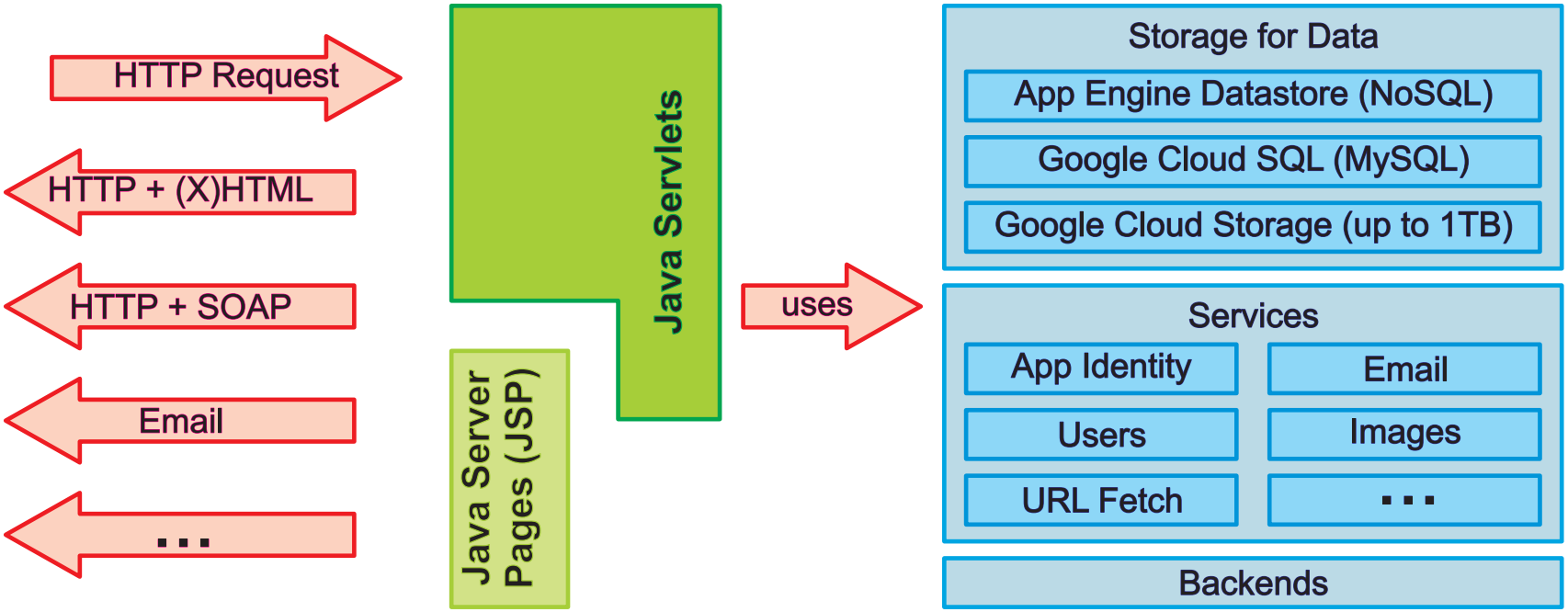

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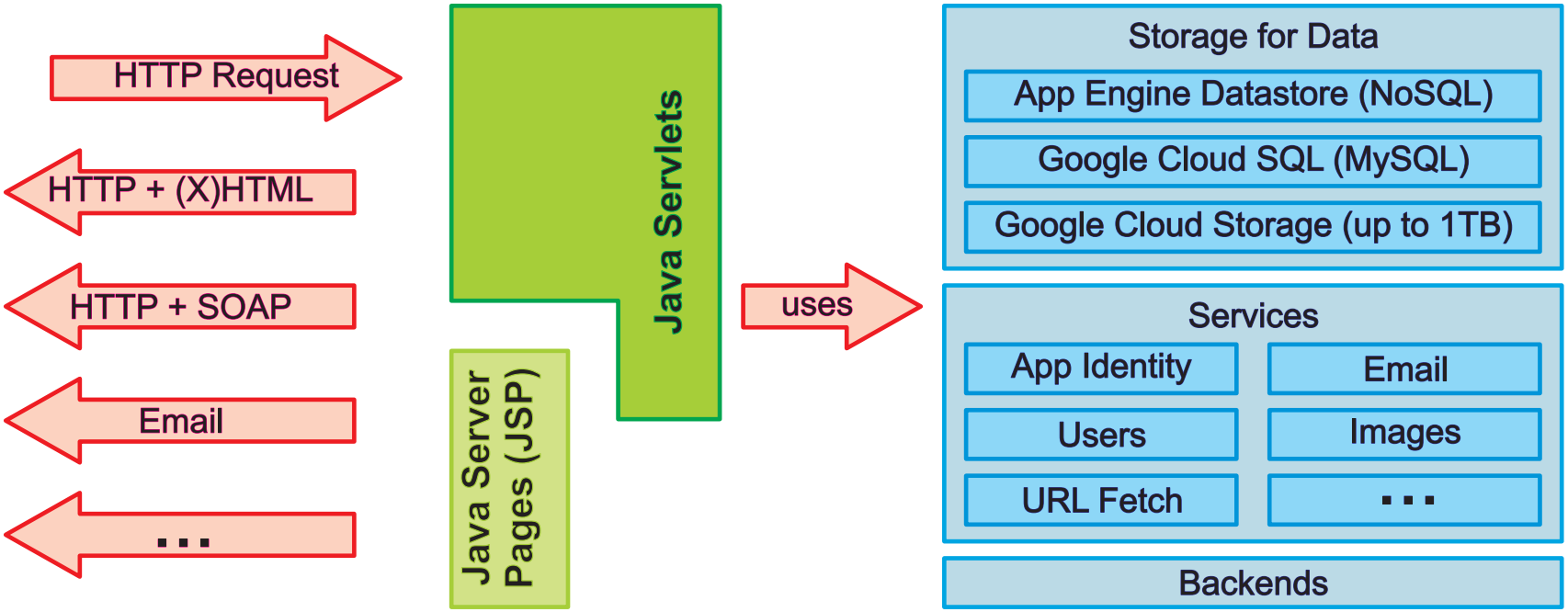

- Actions within the scope of a HTTP request that can be processed in two ways:
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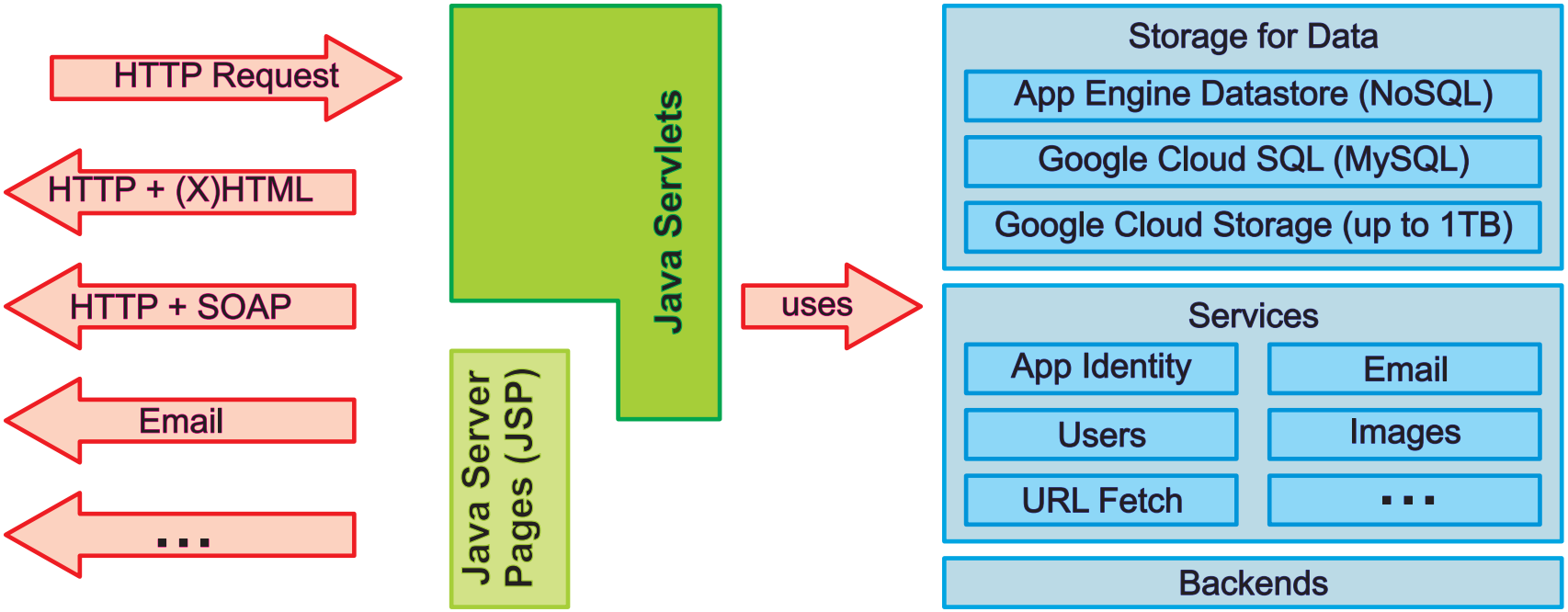

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    - Axis Web Services are also implemented as Java Servlets

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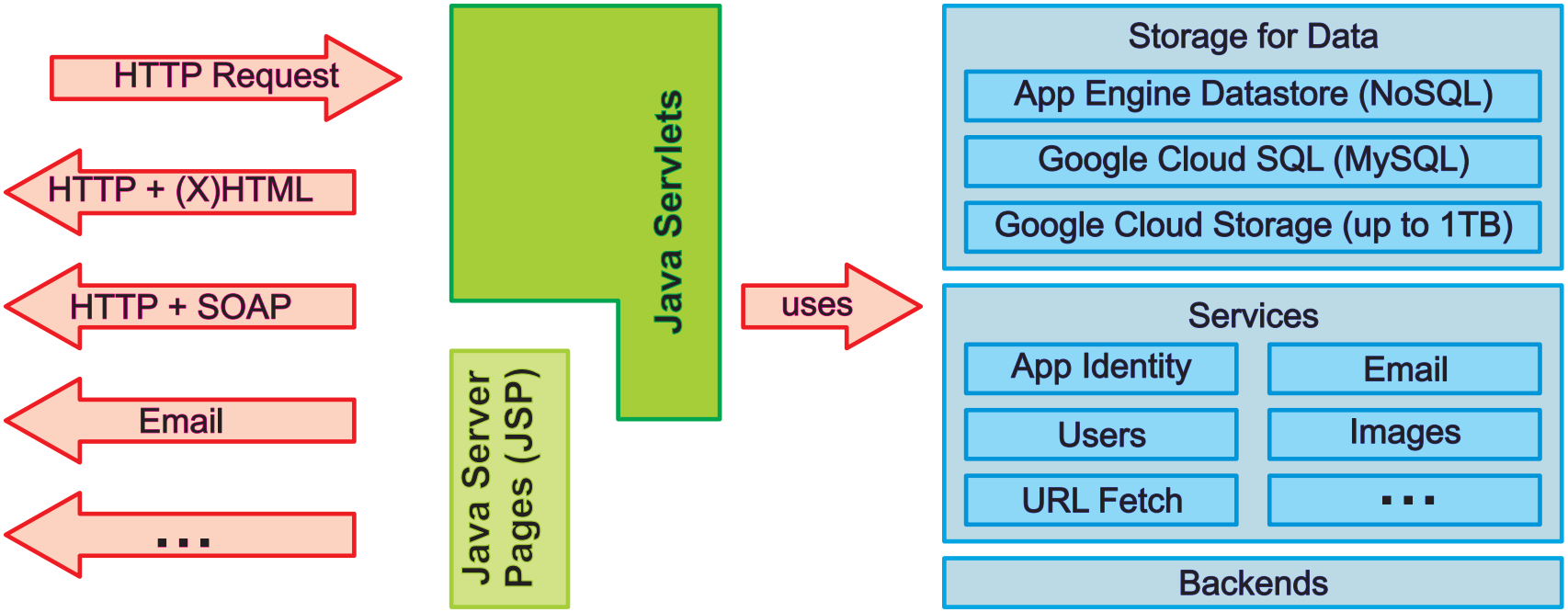
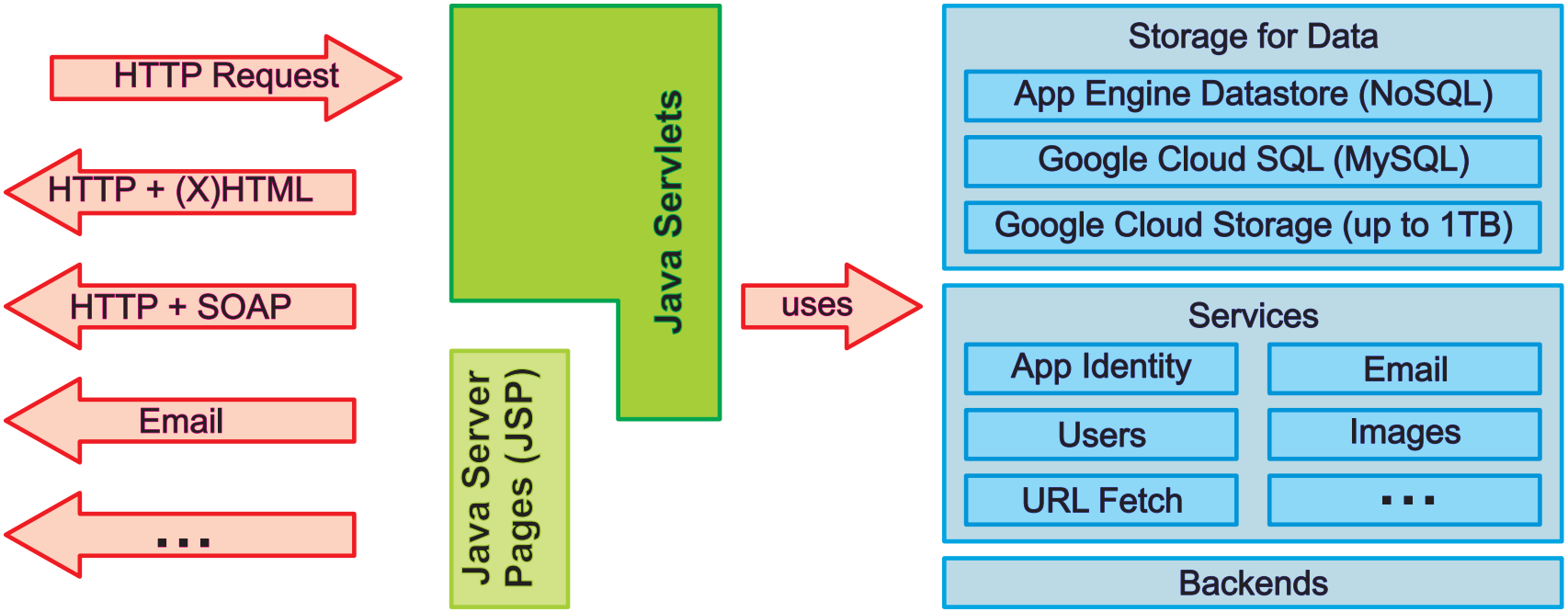


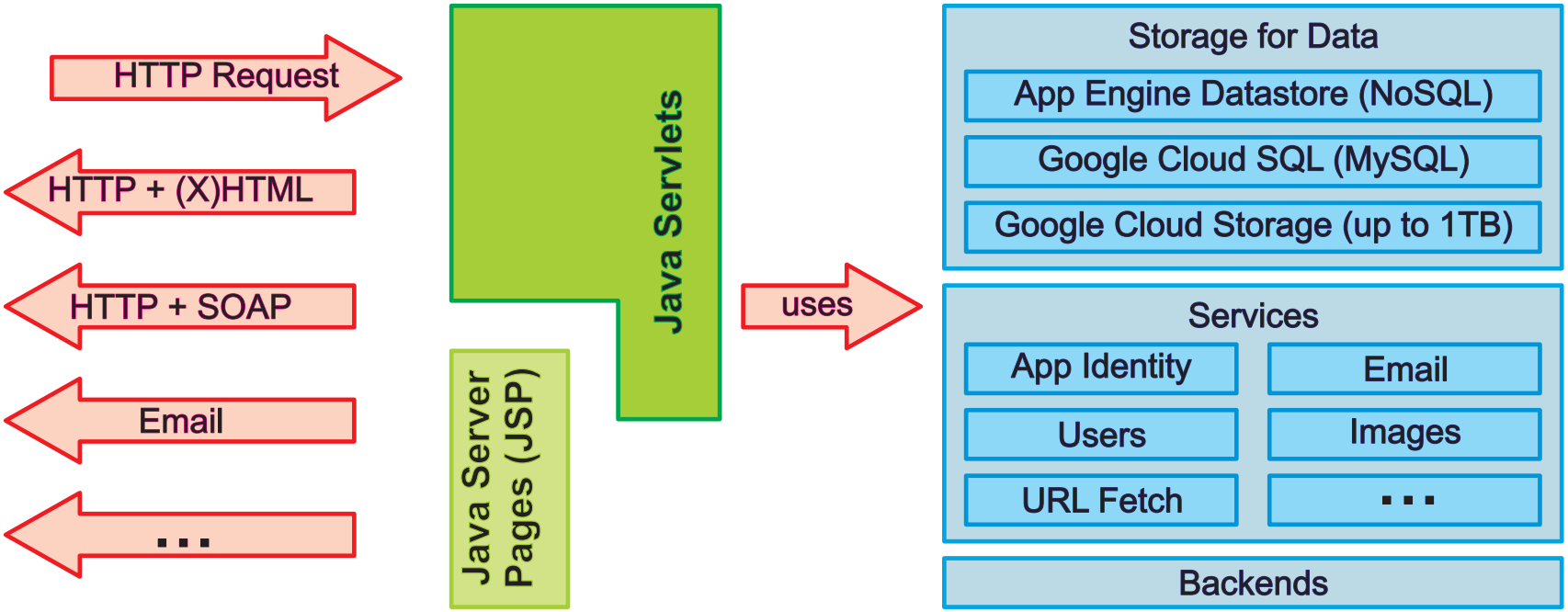
- Different models for storing data

GAE Java Environment



- Different models for storing data:
  - App Engine Datastore: simple hierarchical NoSQL database, consistency, atomic transactions, but: 1 write to an entity group per second

GAE Java Environment



- Different models for storing data:
  - App Engine Datastore: simple hierarchical NoSQL database
  - Cloud SQL: provides SQL database, JDBC access, replicates data to different regions for fast access

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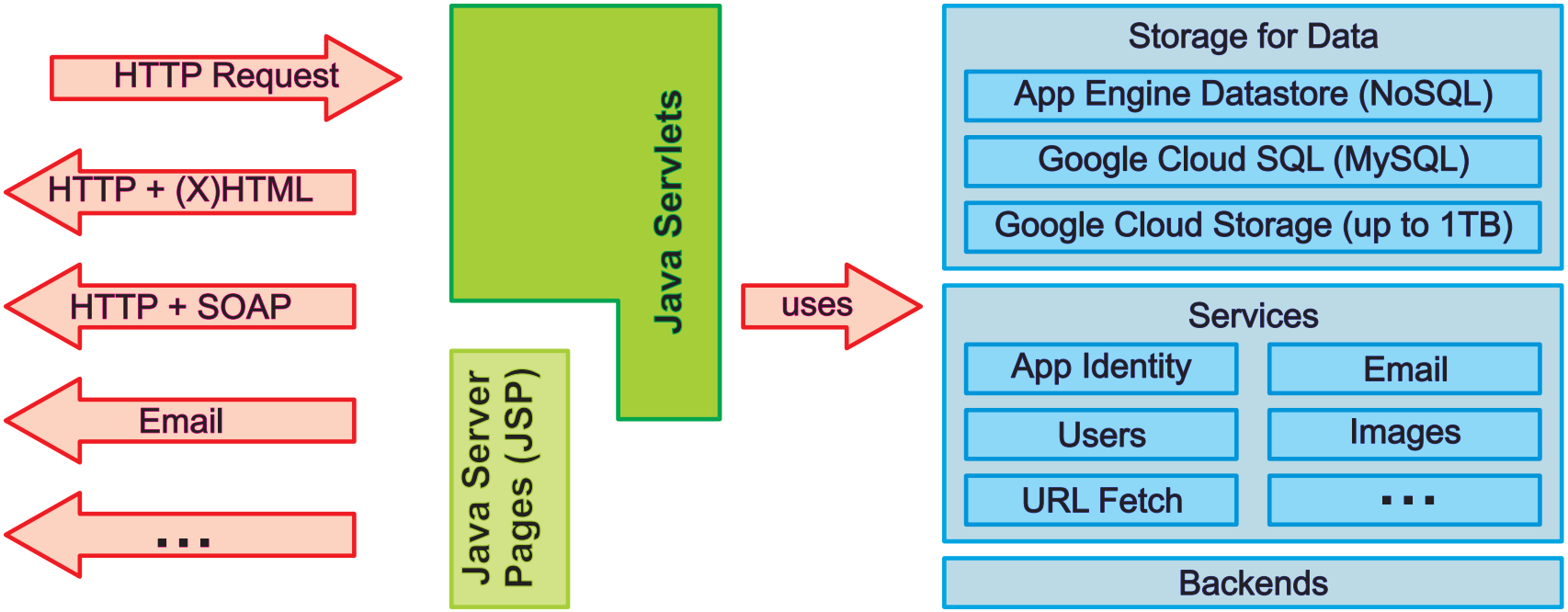

- Different models for storing data:
  - App Engine Datastore: simple hierarchical NoSQL database
  - Cloud SQL: provides SQL database
  - Cloud Storage API: experimental API

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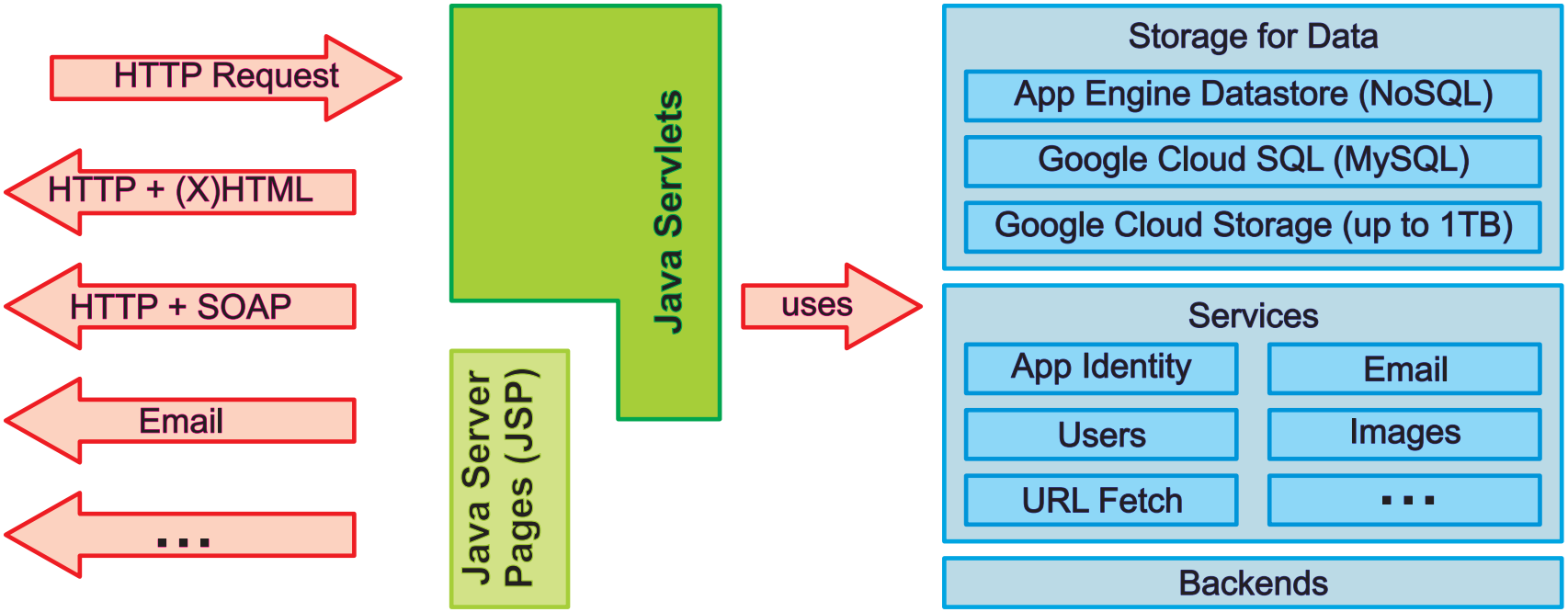
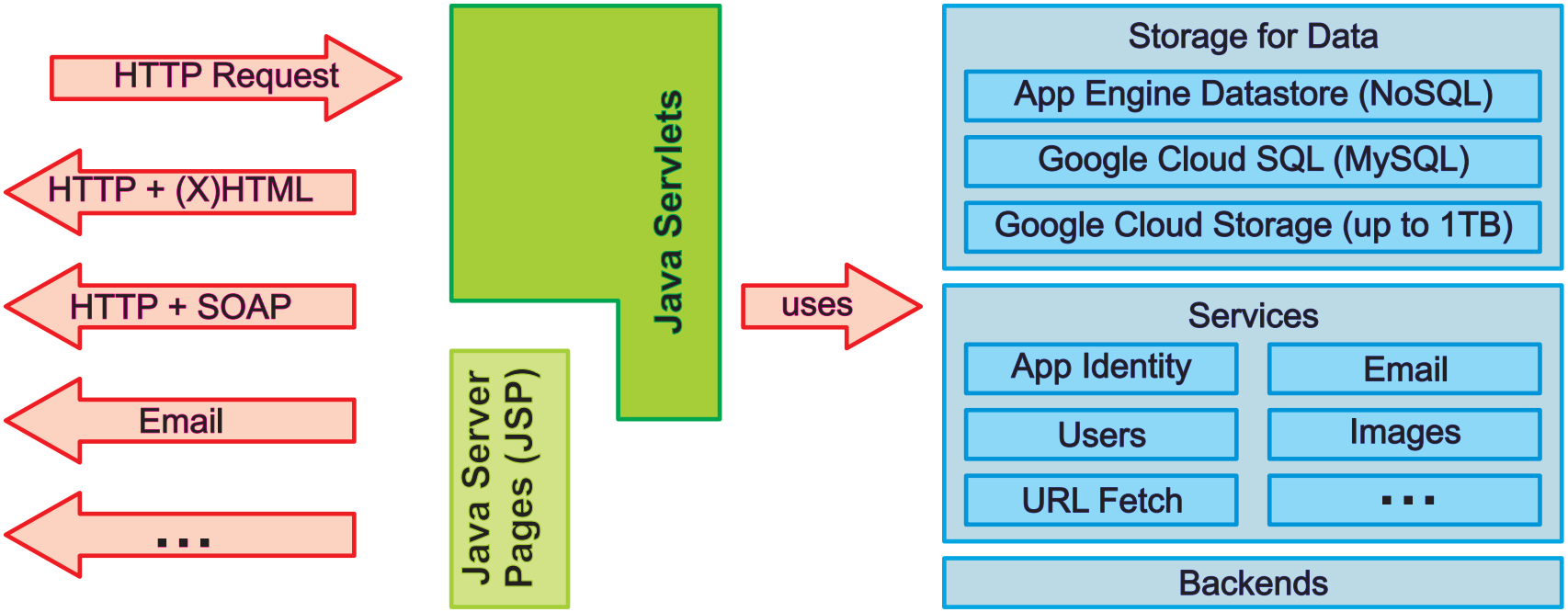


- Many additional services

GAE Java Environment



- Many additional services:
  - AppIdentity: application can assert its own identiy

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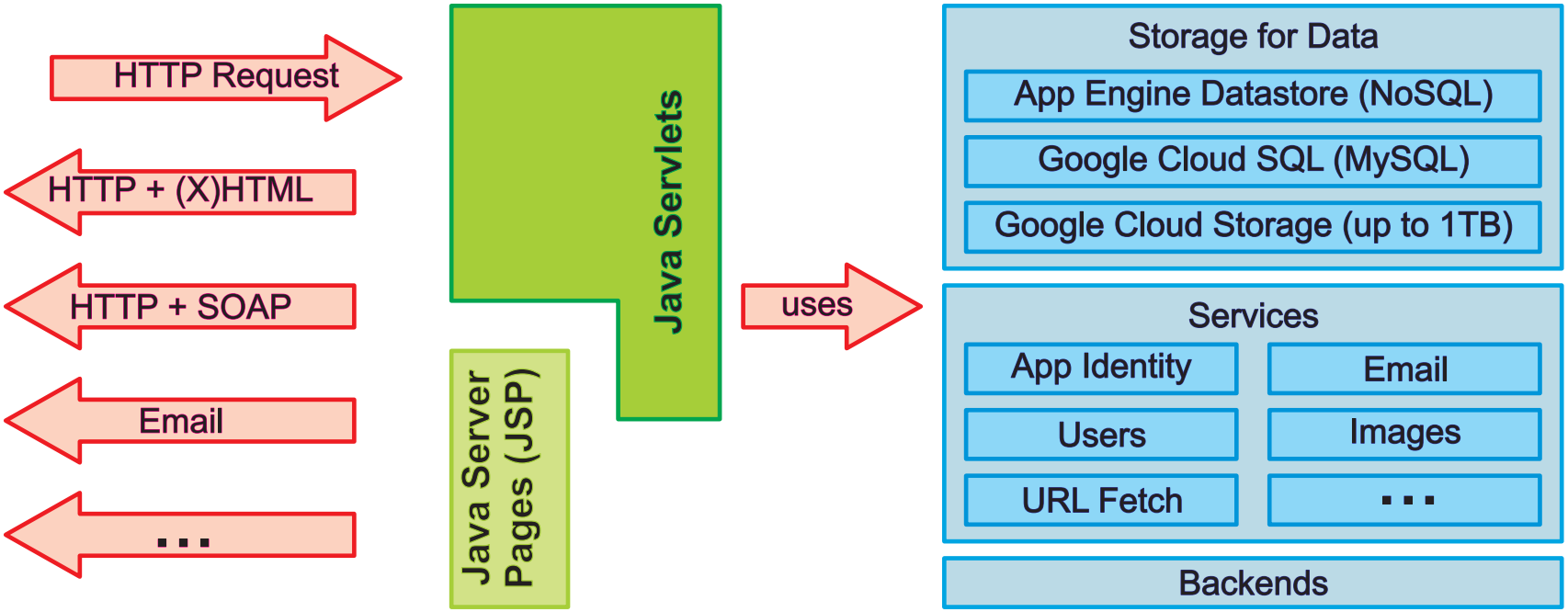

- Many additional services:
  - BlobStore: store/serve large data objects

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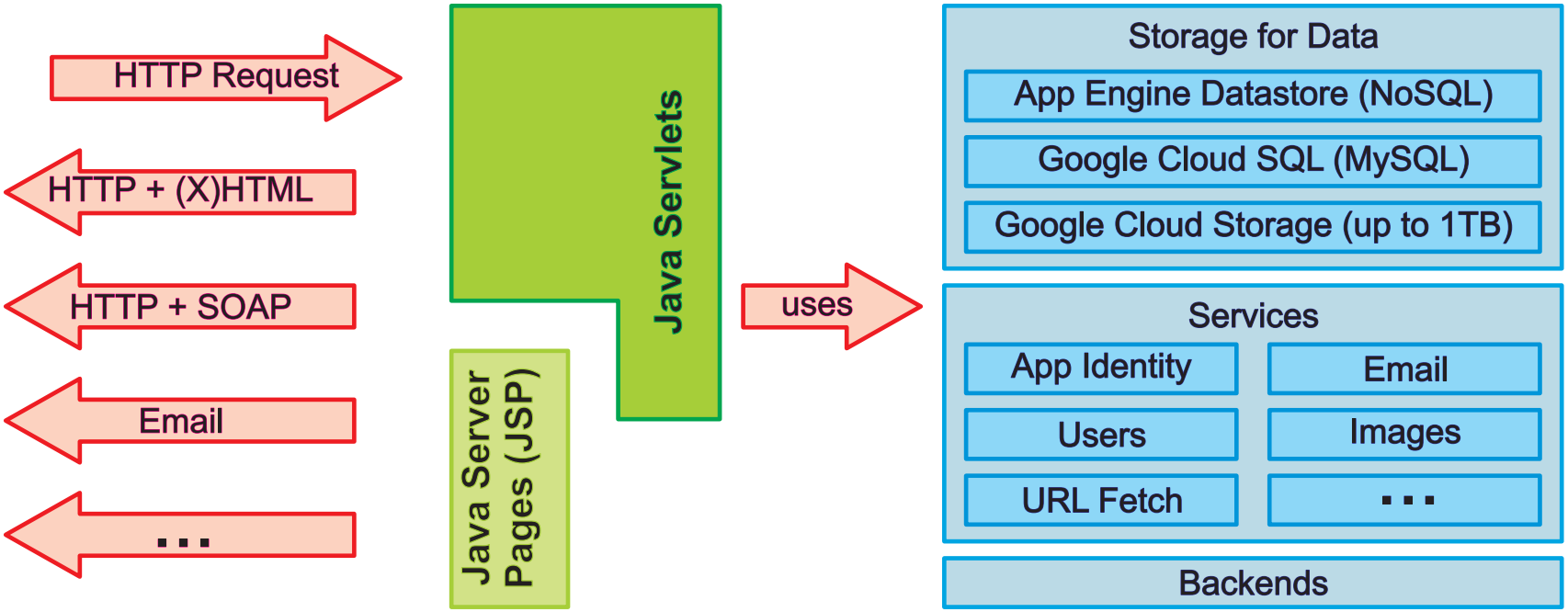

- Many additional services:
  - Capabilities: detect outages and react to them (e.g., by deactivating user options that are not available)

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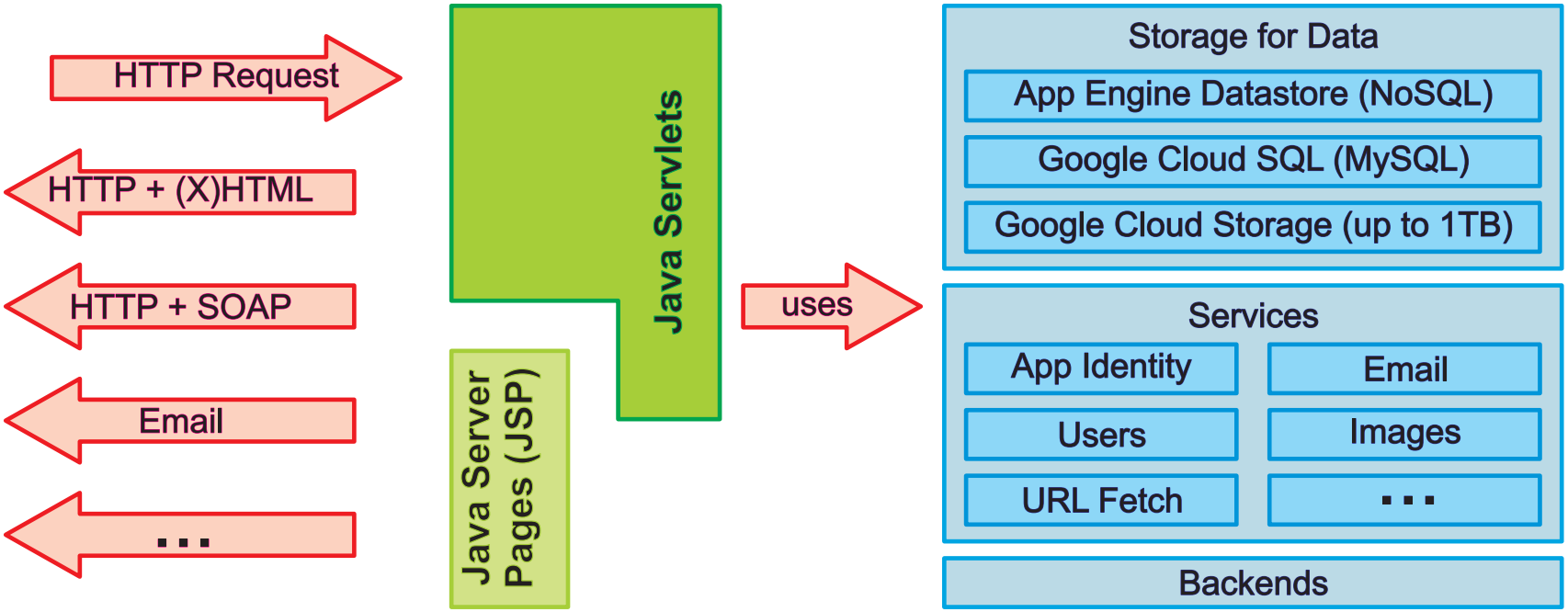

- Many additional services:
  - Conversion: convert different data formats (HTML, text, PDF, images, perform OCT)

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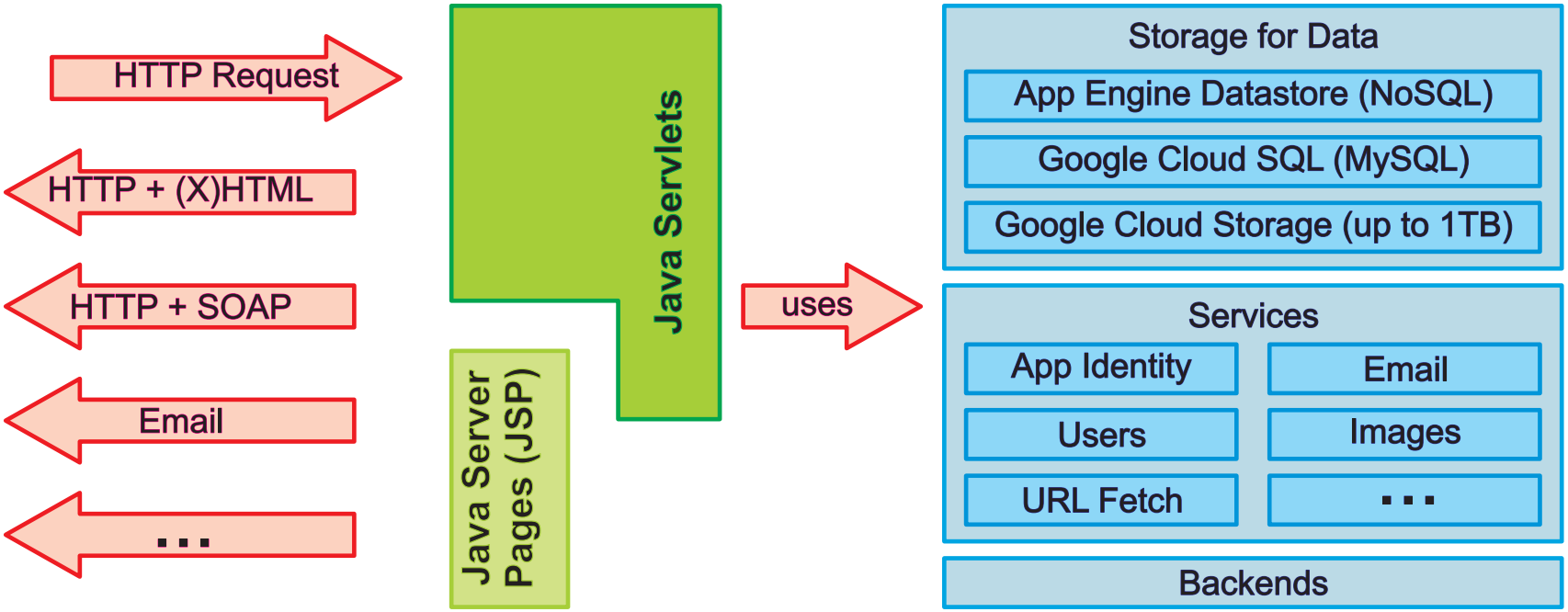

- Many additional services:
  - Images: create/process images

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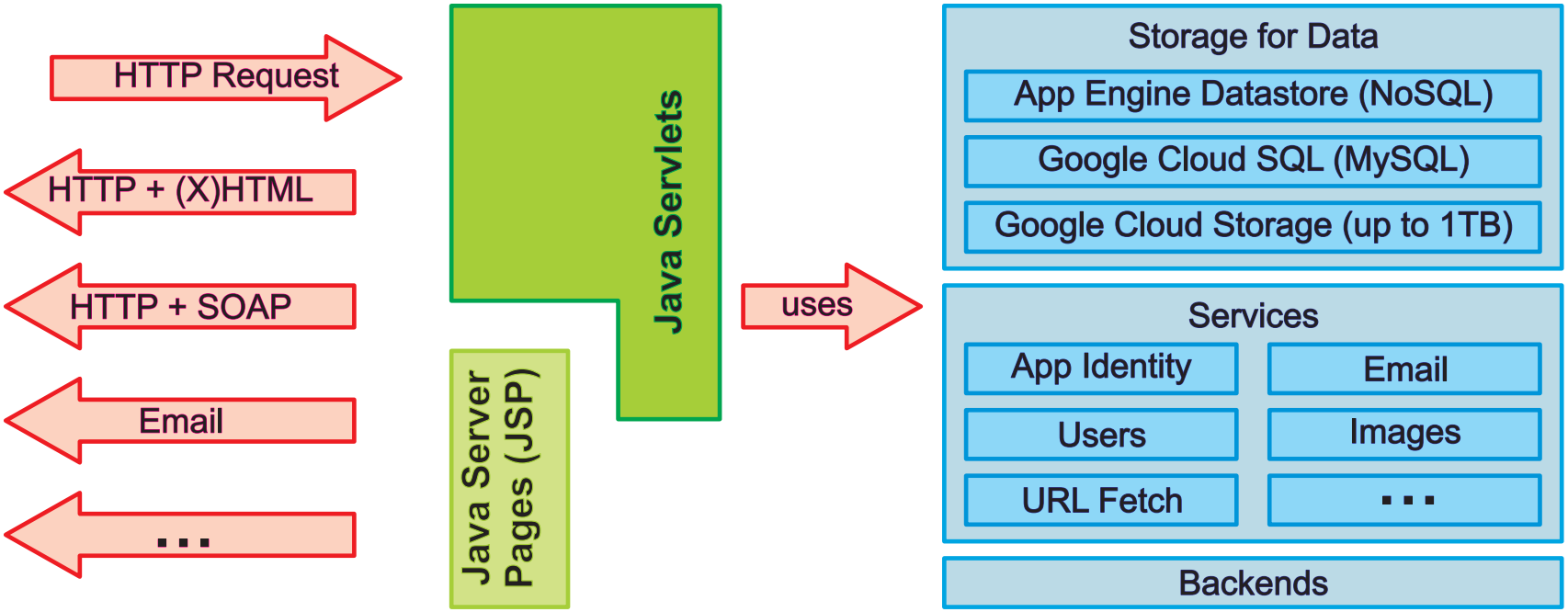

- Many additional services:
  - Mail: send email

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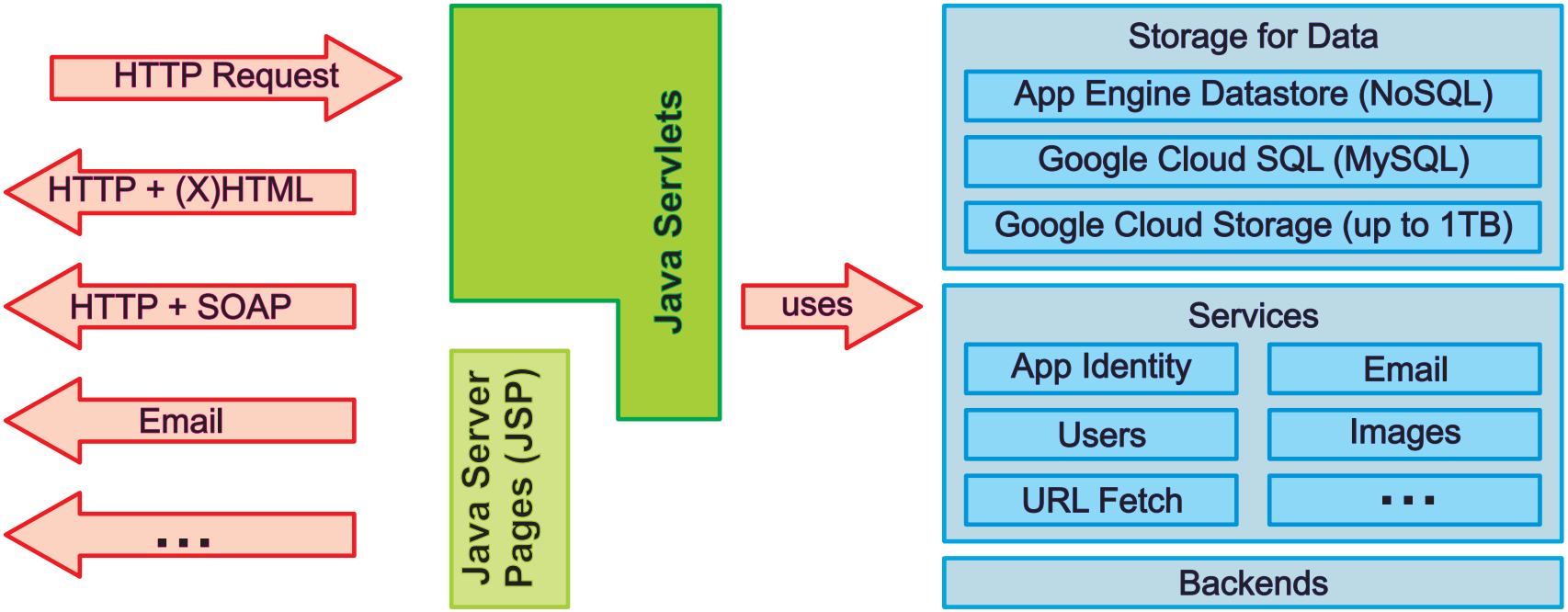

- Many additional services:
  - MemCache: well, a cache in memory

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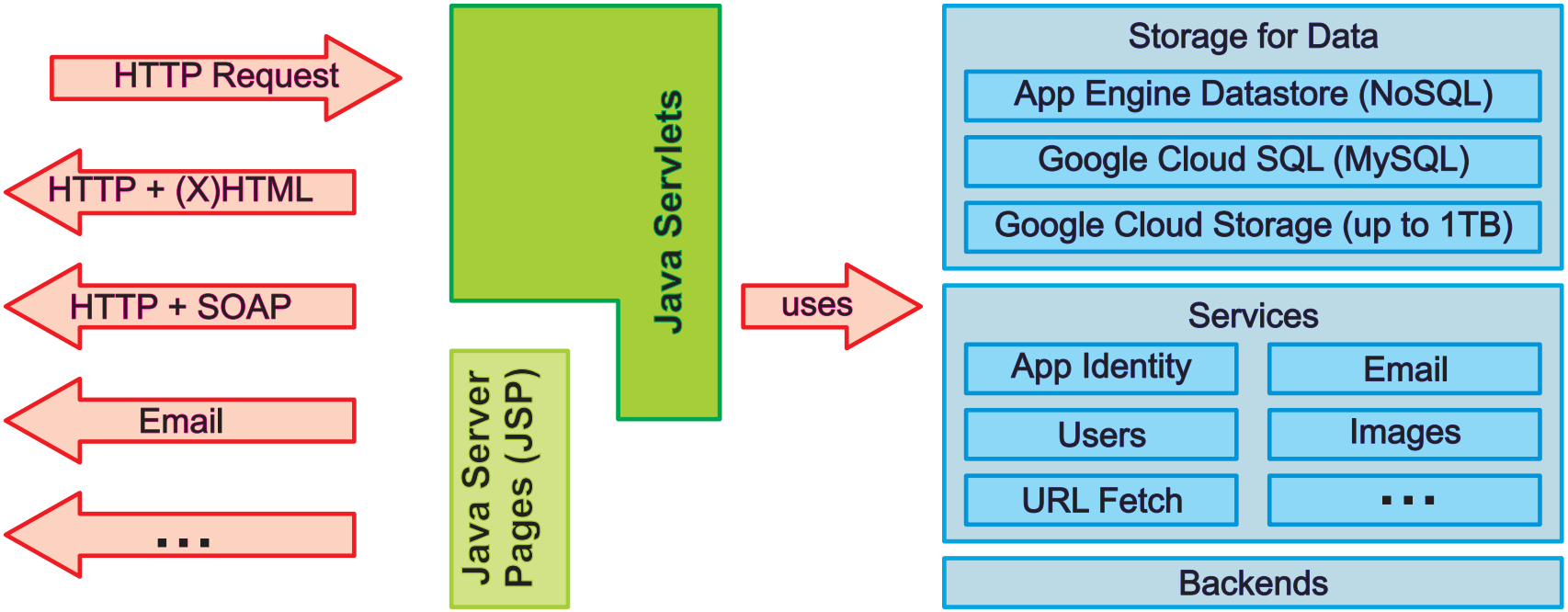

- Many additional services:
  - Prospective Search: perform many queries to an input document at once

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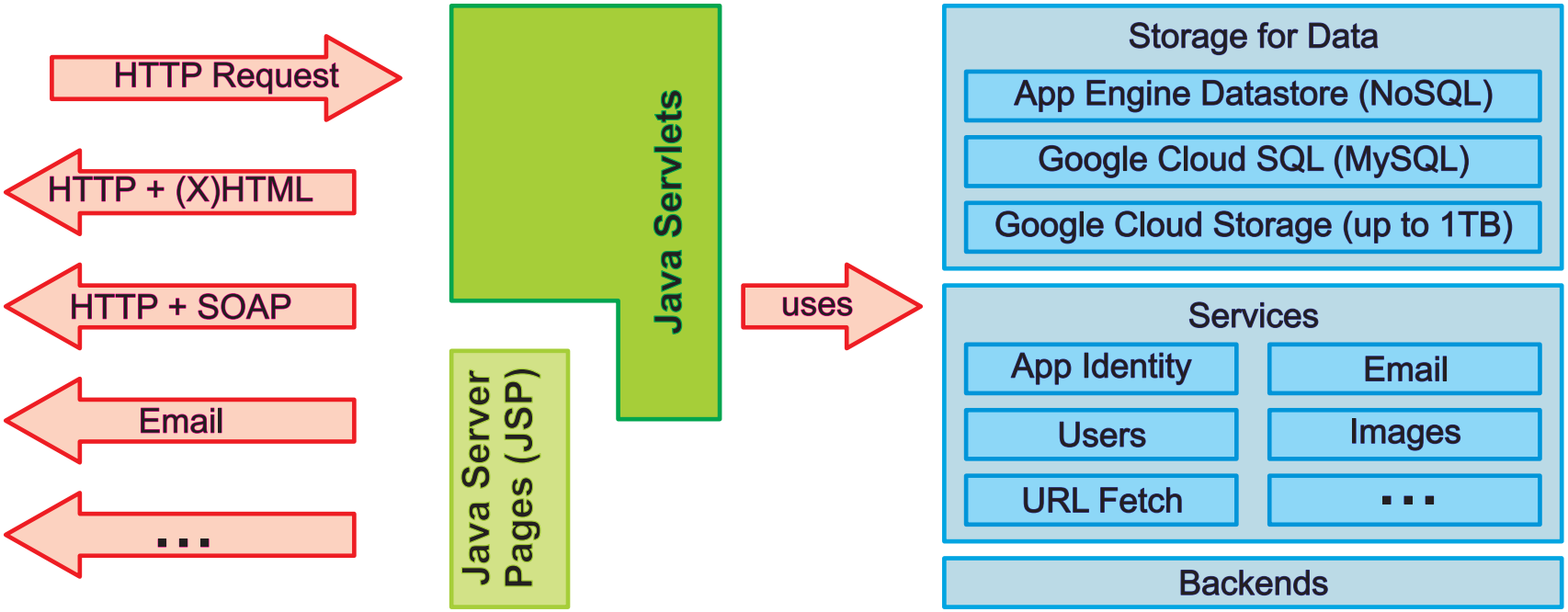

- Many additional services:
  - Task Queues: within a request, initiate some work to be performed outside that request

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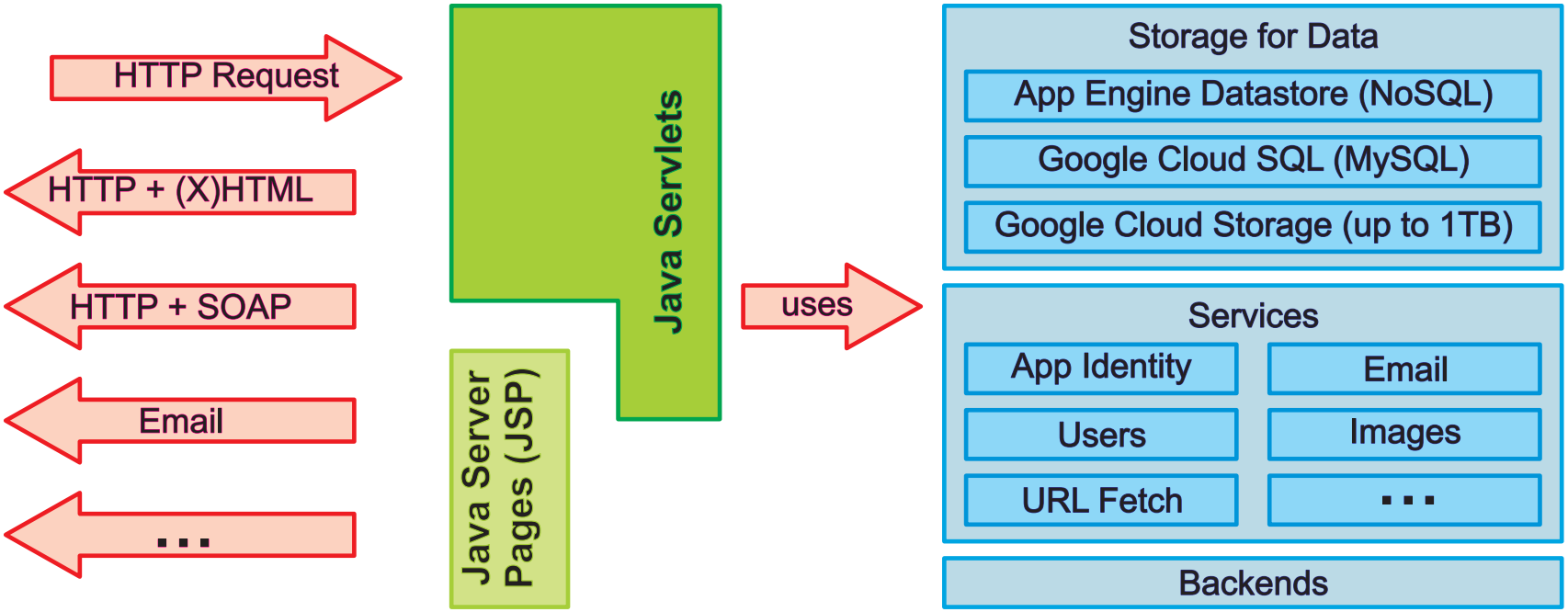

- Many additional services:
  - URL Fetch: perform a HTTML request to a URL outside the application

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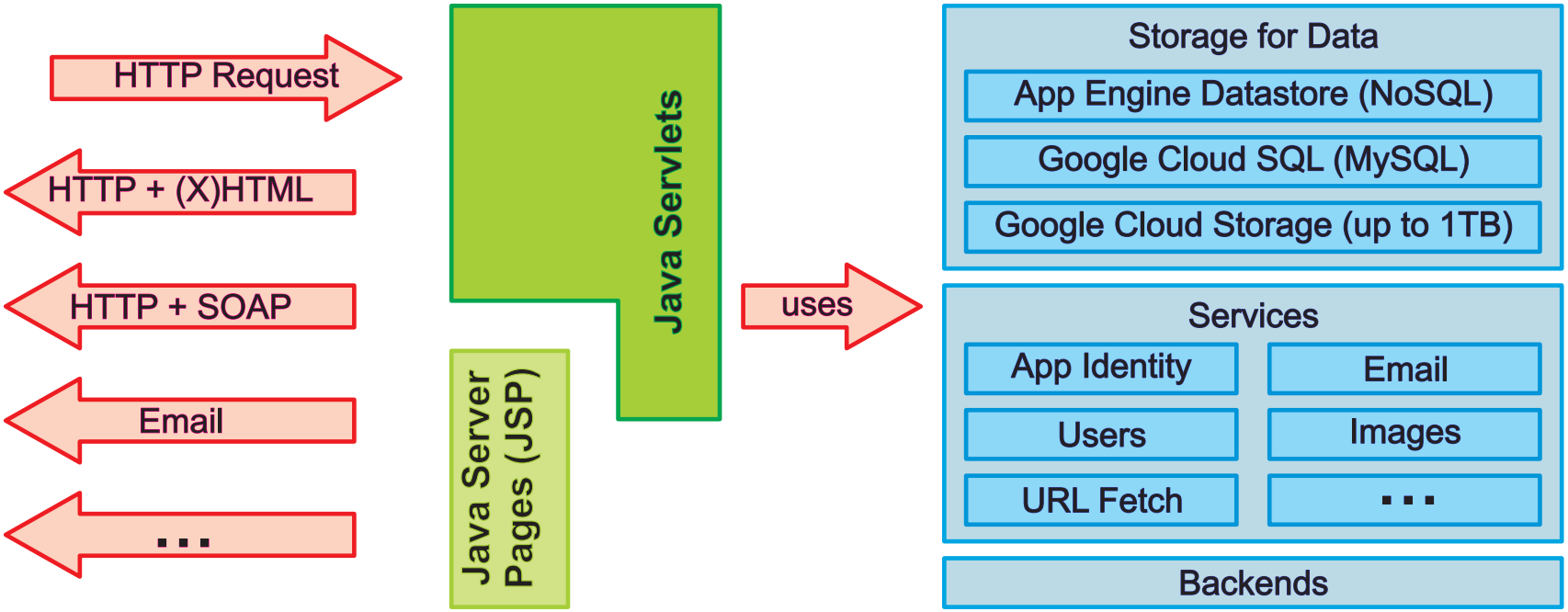

- Many additional services:
  - Users: authenticate users by their Google accounts

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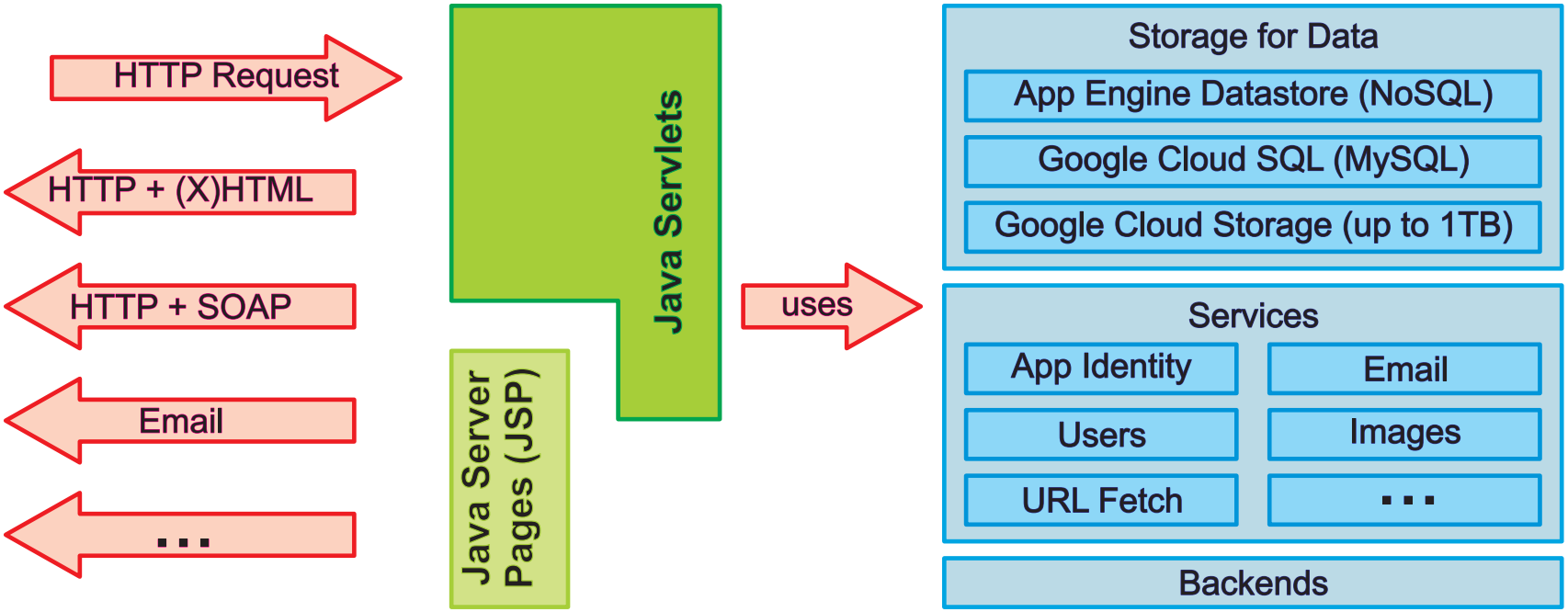

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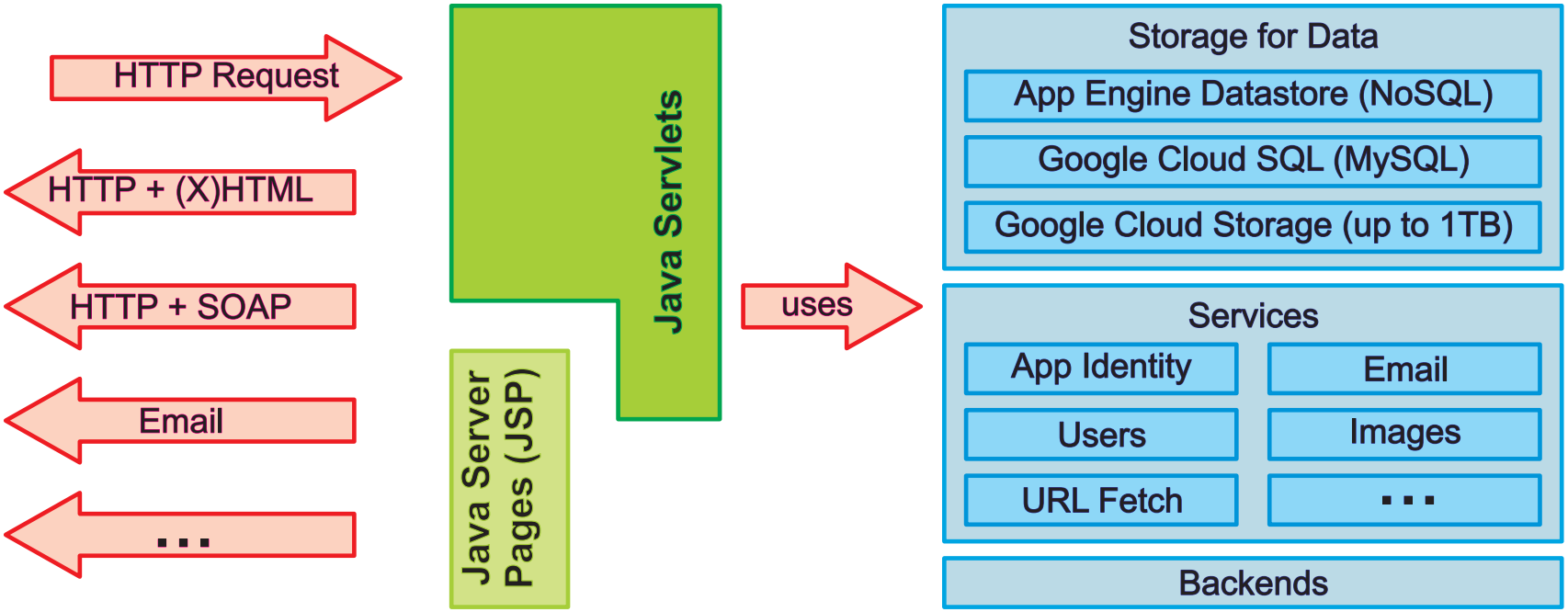

- Backends: Perform large, time and memory consuming tasks outside the scope of HTTP requests

GAE Java Philosophy

- Develop web applications based on standard techniques: Java Servlets, JavaServer Pages
- Almost exactly as you would do it for systems that you host by yourself
- But instead of running in Tomcat [55, 56], Axis [57–59], GlassFish [60], or Jetty [61], it will be deployed on Google's infrastructure

GAE Setup

- Install the newest version of Eclipse [62]. I did it for Eclipse Juno, i.e., Eclipse 4.2, downloaded, e.g., from `http://www.eclipse.org`, e.g., from mirror `http://www.eclipse.org/downloads/download.php?file=/technology/epp/downloads/release/juno/SR2/eclipse-java-juno-SR2-win32.zip&mirror_id=1093`

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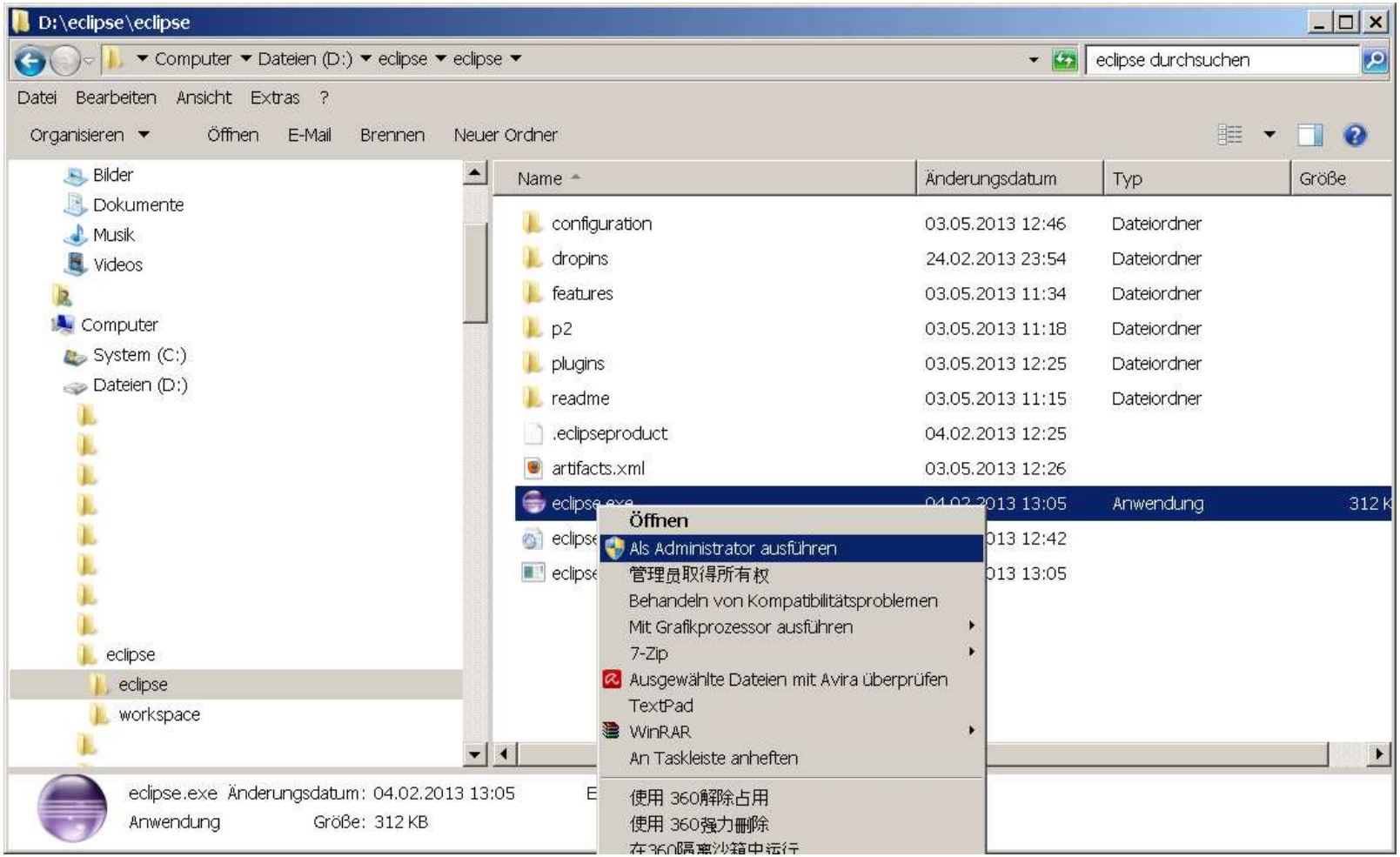
- Start Eclipse as Administrator

GAE Setup


D:\eclipse\eclipse
Computer ▸ Dateien (D:) ▸ eclipse ▸ eclipse
eclipse durchsuchen
Datei Bearbeiten Ansicht Extras ?
Organisieren Öffnen E-Mail Brennen Neuer Ordner
Bilder
Dokumente
Musik
Videos
Computer
System (C:)
Dateien (D:)
eclipse
eclipse
workspace
Name
Änderungsdatum
Typ
Größe
configuration 03.05.2013 12:46 Dateiordner
dropins 24.02.2013 23:54 Dateiordner
features 03.05.2013 11:34 Dateiordner
p2 03.05.2013 11:18 Dateiordner
plugins 03.05.2013 12:25 Dateiordner
readme 03.05.2013 11:15 Dateiordner
.eclipseproduct 04.02.2013 12:25
artifacts.xml 03.05.2013 12:26
eclipse.exe 04.02.2013 13:05 Anwendung 312 K
Öffnen
Als Administrator ausführen
管理员取得所有权
Behandeln von Kompatibilitätsproblemen
Mit Grafikprozessor ausführen
7-Zip
Ausgewählte Dateien mit Avira überprüfen
TextPad
WinRAR
An Taskleiste anheften
使用 360解除占用
使用 360强力删除
eclipse.exe Änderungsdatum: 04.02.2013 13:05
Anwendung Größe: 312 KB

GAE Setup

- Install the newest version of Eclipse [62]. I did it for Eclipse Juno, i.e., Eclipse 4.2, downloaded, e.g., from `http://www.eclipse.org`, e.g., from mirror `http://www.eclipse.org/downloads/download.php?file=/technology/epp/downloads/release/juno/SR2/eclipse-java-juno-SR2-win32.zip&mirror_id=1093`
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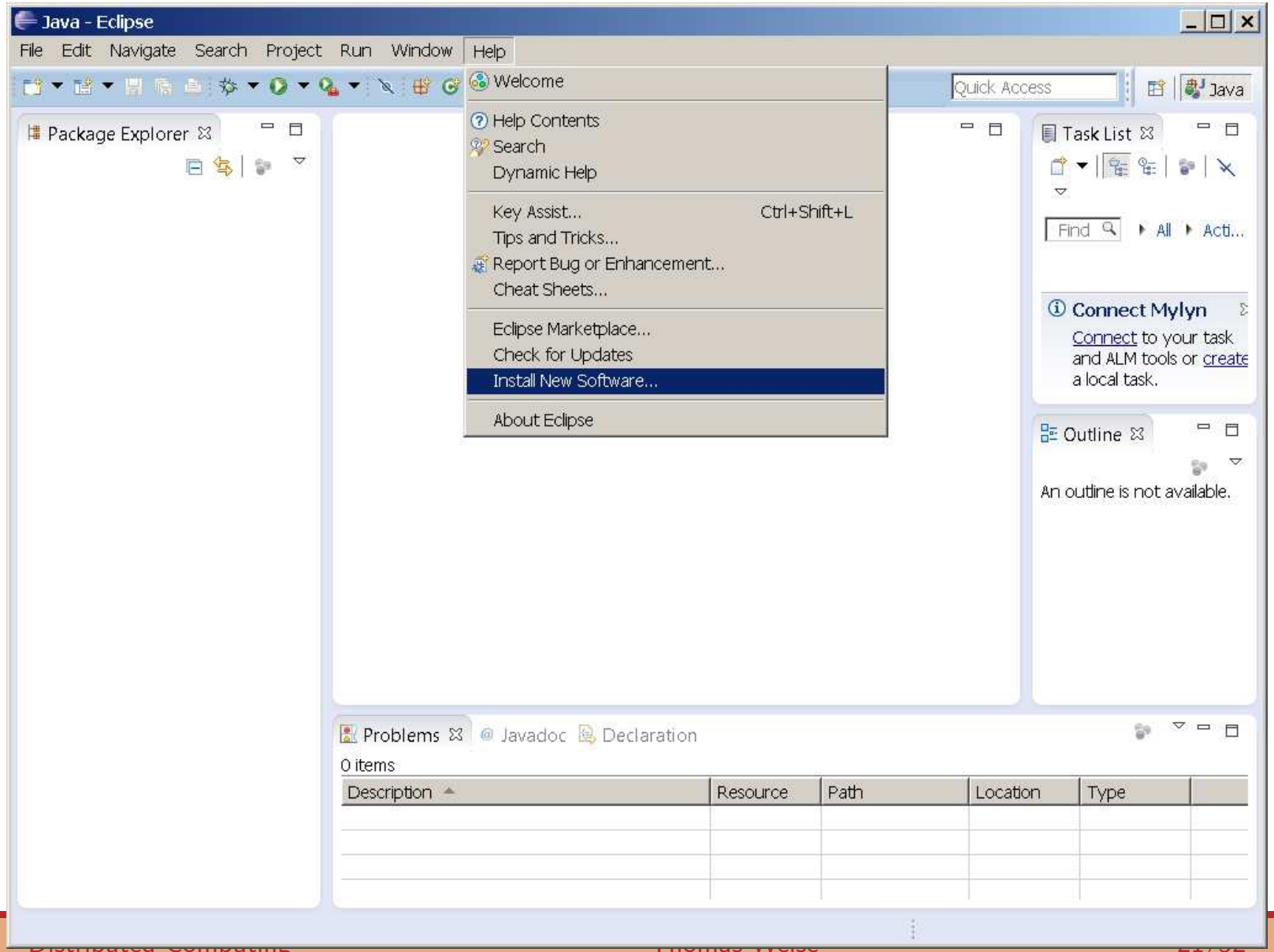
GAE Setup


Java - Eclipse
File Edit Navigate Search Project Run Window Help
Welcome
Help Contents
Search
Dynamic Help
Key Assist... Ctrl+Shift+L
Tips and Tricks...
Report Bug or Enhancement...
Cheat Sheets...
Eclipse Marketplace...
Check for Updates
Install New Software...
About Eclipse
Quick Access
Java
Package Explorer
Task List
Find
All
Acti...
Connect Mylyn
Connect to your task and ALM tools or create a local task.
Outline
An outline is not available.
Problems
Javadoc
Declaration
0 items
Description
Resource
Path
Location
Type

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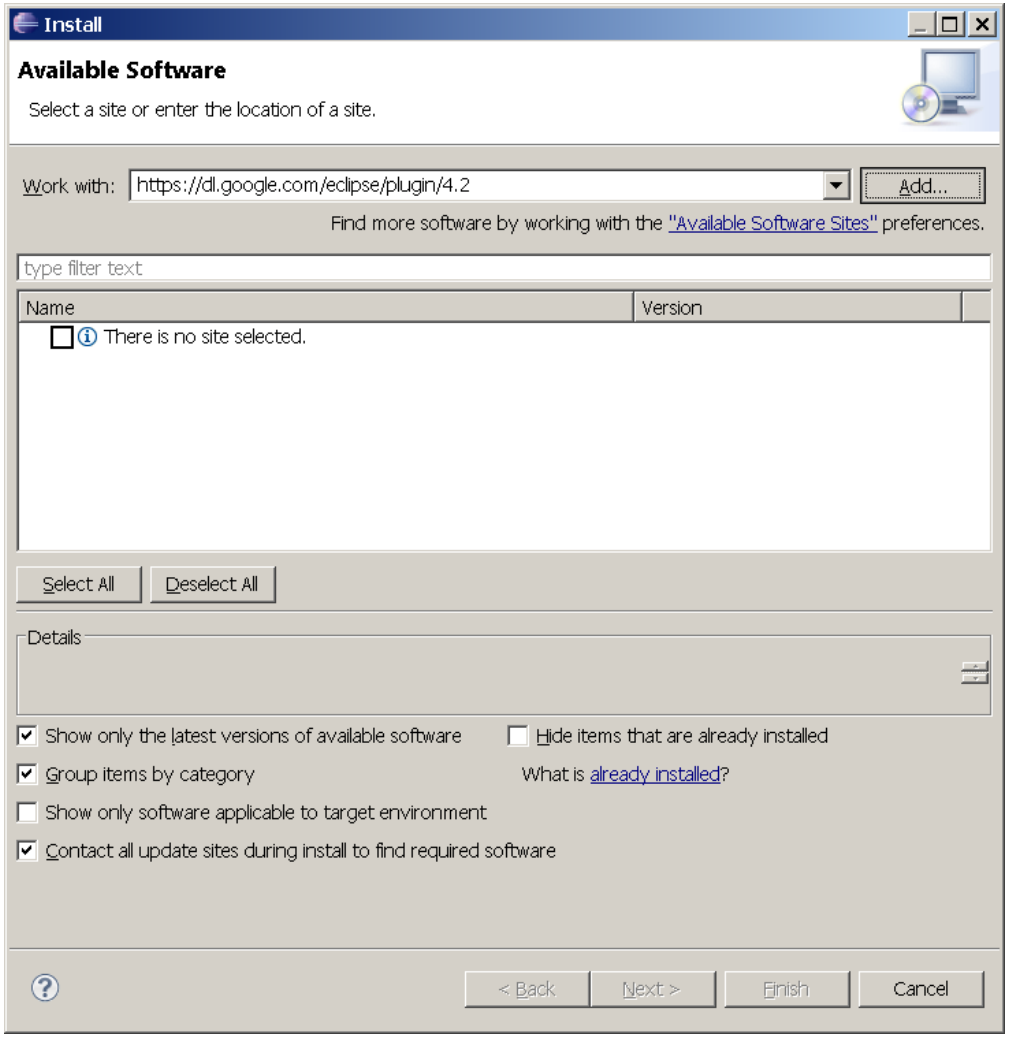
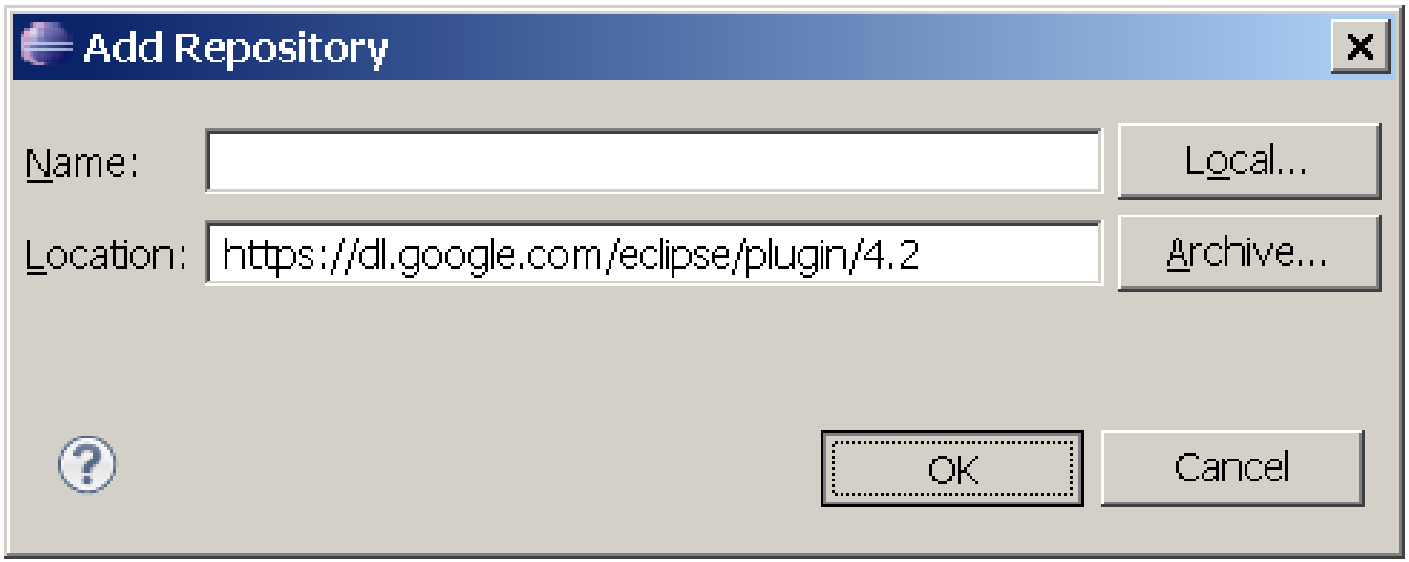

Install
Available Software
Select a site or enter the location of a site.
Work with:
https://dl.google.com/eclipse/plugin/4.2
Add...
Find more software by working with the "Available Software Sites" preferences.
type filter text
Name
Version
There is no site selected.
Select All
Deselect All
Details
Show only the latest versions of available software
Hide items that are already installed
Group items by category
What is already installed?
Show only software applicable to target environment
Contact all update sites during install to find required software
< Back
Next >
Finish
Cancel

GAE Setup


Add Repository
Name:
Local...
Location:
https://dl.google.com/eclipse/plugin/4.2
Archive...
OK
Cancel

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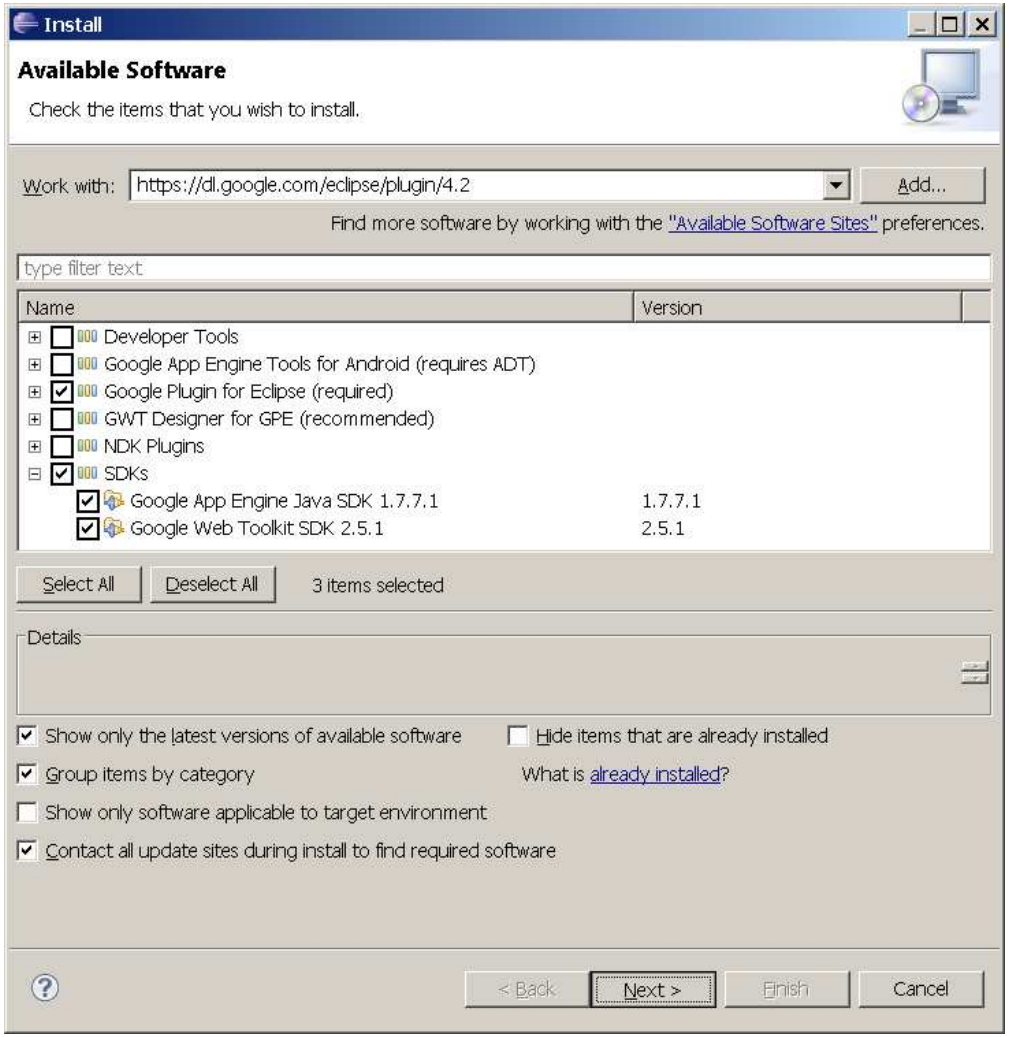
- Select *Google Plugin for Eclipse*, *Google App Engine Java SDK*, and *Google Web Toolkit*

GAE Setup


Install
Available Software
Check the items that you wish to install.
Work with: https://dl.google.com/eclipse/plugin/4.2
Add...
Find more software by working with the "Available Software Sites" preferences.
type filter text
Name
Version
Developer Tools
Google App Engine Tools for Android (requires ADT)
Google Plugin for Eclipse (required)
GWT Designer for GPE (recommended)
NDK Plugins
SDKs
Google App Engine Java SDK 1.7.7.1
1.7.7.1
Google Web Toolkit SDK 2.5.1
2.5.1
Select All
Deselect All
3 items selected
Details
Show only the latest versions of available software
Hide items that are already installed
Group items by category
What is already installed?
Show only software applicable to target environment
Contact all update sites during install to find required software
< Back
Next >
Finish
Cancel

GAE Setup

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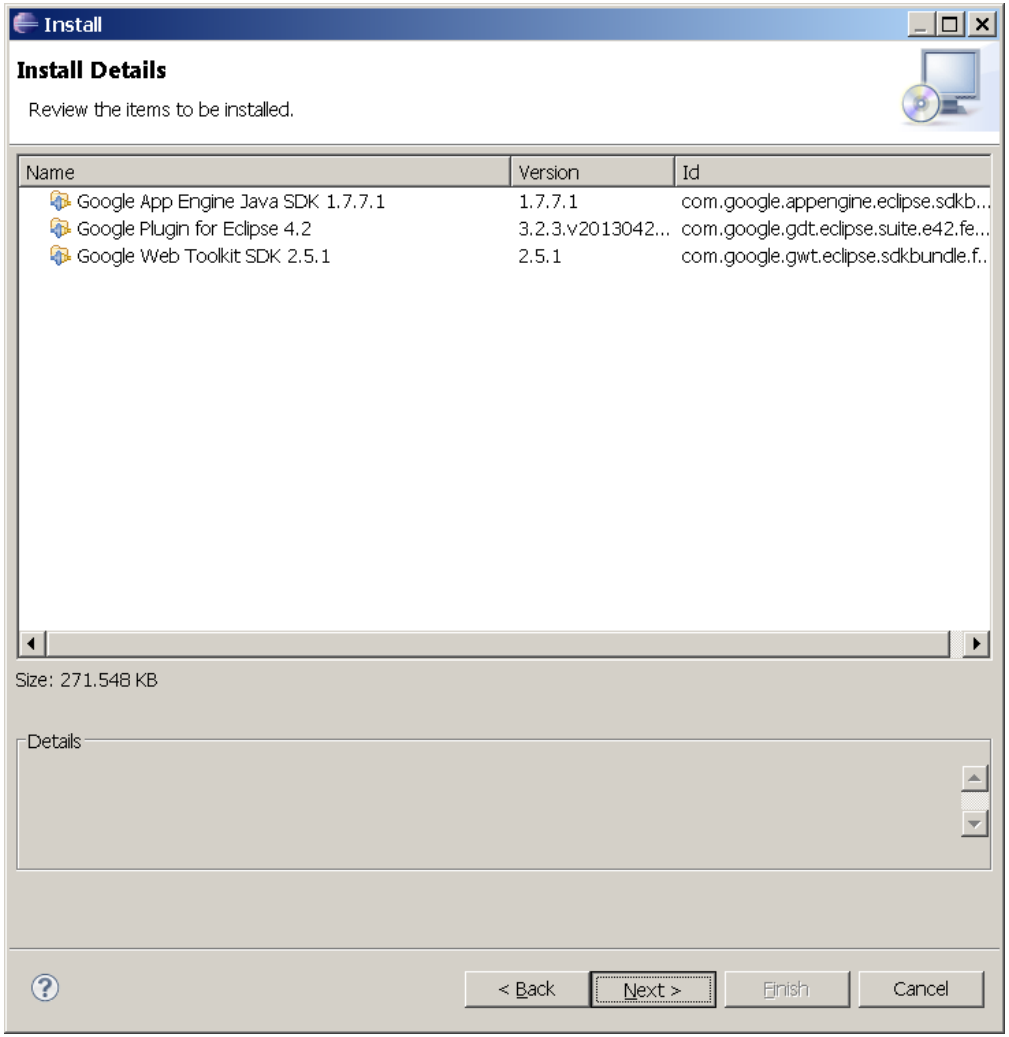
- Install them

GAE Setup


Install
Install Details
Review the items to be installed.
Name
Version
Id
Google App Engine Java SDK 1.7.7.1
1.7.7.1
com.google.appengine.eclipse.sdkb...
Google Plugin for Eclipse 4.2
3.2.3.v2013042...
com.google.gdt.eclipse.suite.e42.fe...
Google Web Toolkit SDK 2.5.1
2.5.1
com.google.gwt.eclipse.sdkbundle.f..
Size: 271.548 KB
Details
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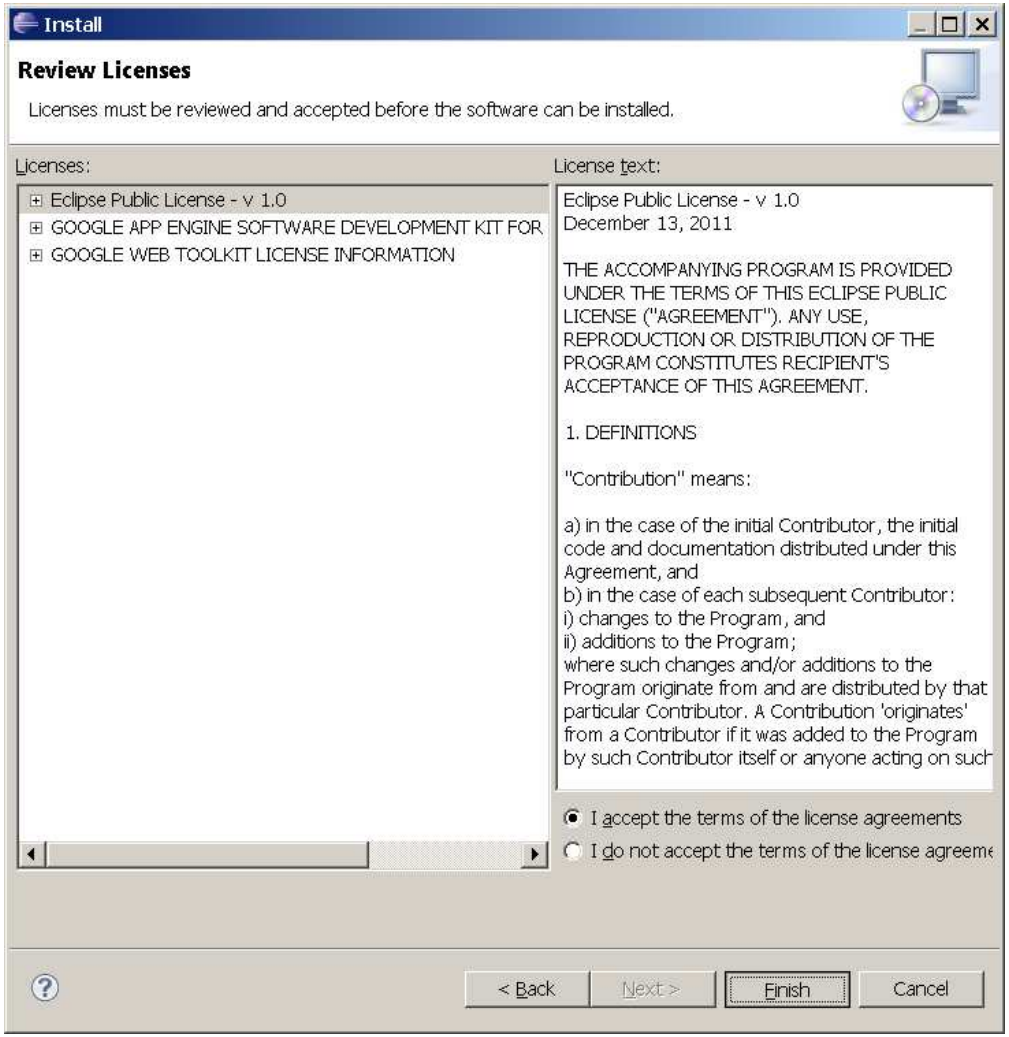
GAE Setup


Install
Review Licenses
Licenses must be reviewed and accepted before the software can be installed.
Licenses:
License text:
Eclipse Public License - v 1.0
GOOGLE APP ENGINE SOFTWARE DEVELOPMENT KIT FOR
GOOGLE WEB TOOLKIT LICENSE INFORMATION
Eclipse Public License - v 1.0
December 13, 2011
THE ACCOMPANYING PROGRAM IS PROVIDED UNDER THE TERMS OF THIS ECLIPSE PUBLIC LICENSE ("AGREEMENT"). ANY USE, REPRODUCTION OR DISTRIBUTION OF THE PROGRAM CONSTITUTES RECIPIENT'S ACCEPTANCE OF THIS AGREEMENT.
1. DEFINITIONS
"Contribution" means:
a) in the case of the initial Contributor, the initial code and documentation distributed under this Agreement, and
b) in the case of each subsequent Contributor:
i) changes to the Program, and
ii) additions to the Program;
where such changes and/or additions to the Program originate from and are distributed by that particular Contributor. A Contribution 'originates' from a Contributor if it was added to the Program by such Contributor itself or anyone acting on such
I accept the terms of the license agreements
I do not accept the terms of the license agreeme
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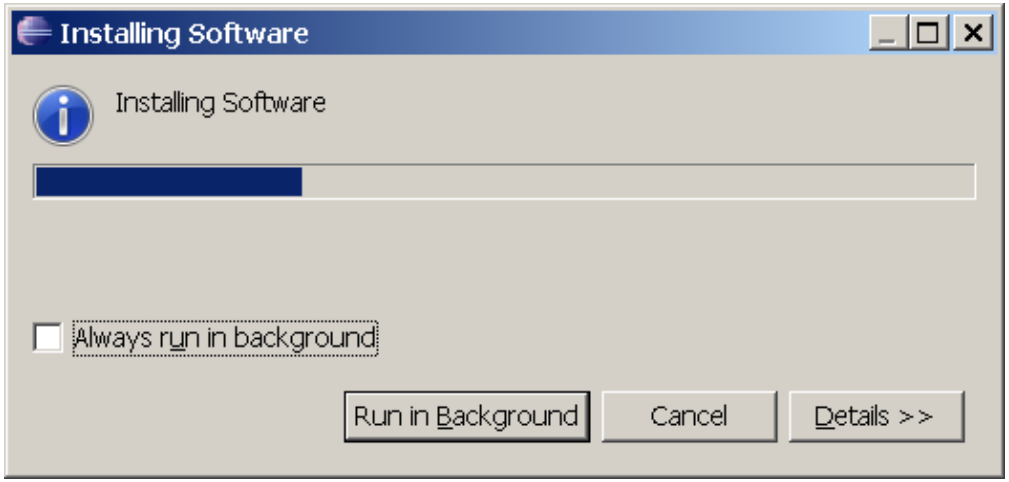
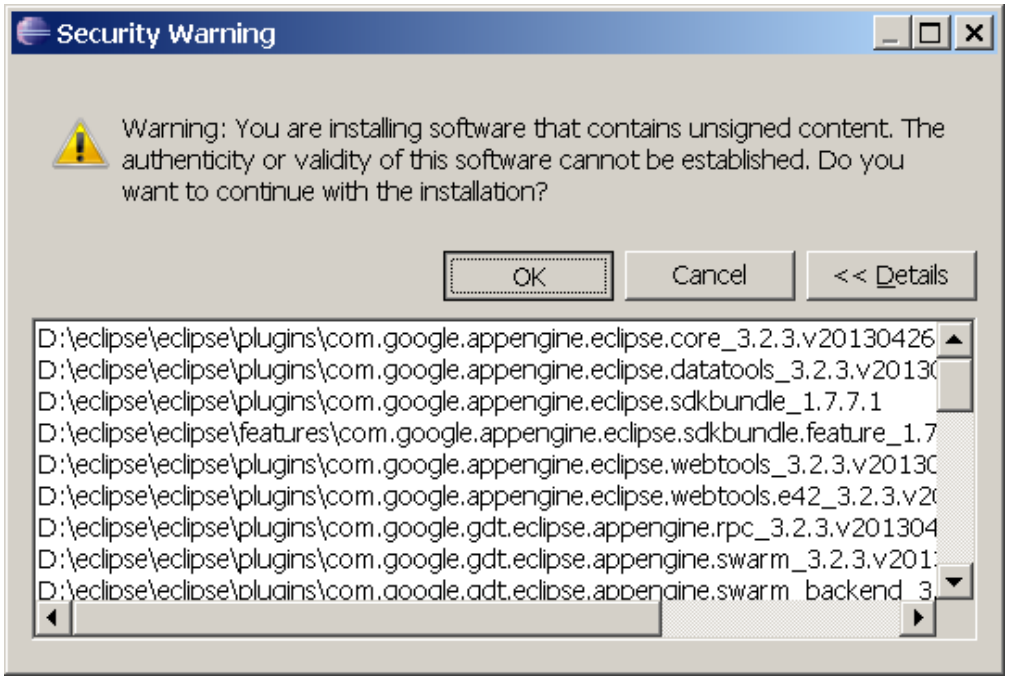
GAE Setup


Installing Software
Installing Software
Always run in background
Run in Background
Cancel
Details >>


Security Warning
Warning: You are installing software that contains unsigned content. The authenticity or validity of this software cannot be established. Do you want to continue with the installation?
OK
Cancel
<< Details
D:\eclipse\eclipse\plugins\com.google.appengine.eclipse.core_3.2.3.v20130426
D:\eclipse\eclipse\plugins\com.google.appengine.eclipse.datatools_3.2.3.v2013
D:\eclipse\eclipse\plugins\com.google.appengine.eclipse.sdkbundle_1.7.7.1
D:\eclipse\eclipse\features\com.google.appengine.eclipse.sdkbundle.feature_1.7
D:\eclipse\eclipse\plugins\com.google.appengine.eclipse.webtools_3.2.3.v2013
D:\eclipse\eclipse\plugins\com.google.appengine.eclipse.webtools.e42_3.2.3.v2
D:\eclipse\eclipse\plugins\com.google.gdt.eclipse.appengine.rpc_3.2.3.v201304
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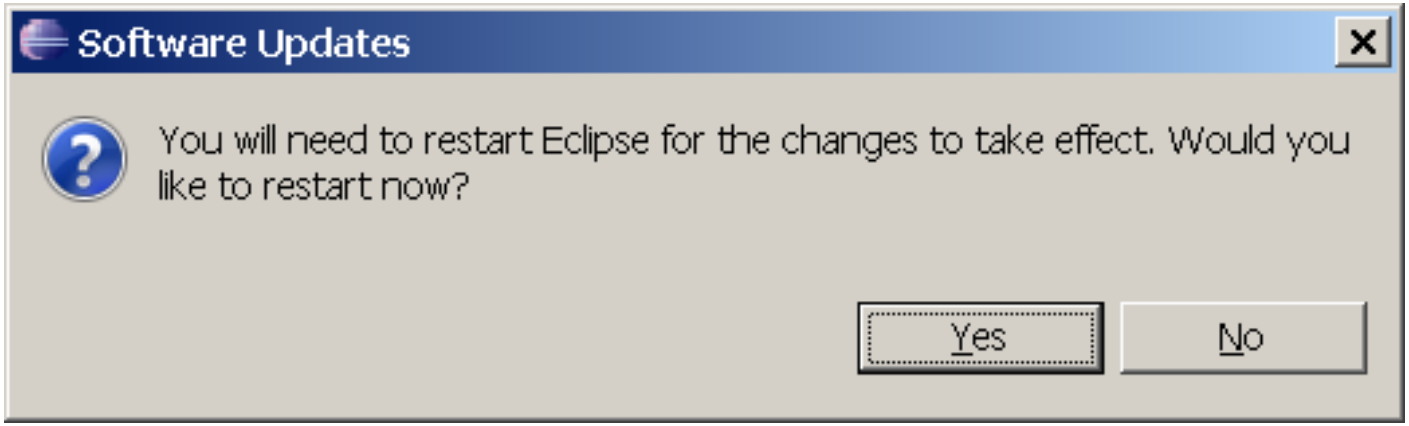
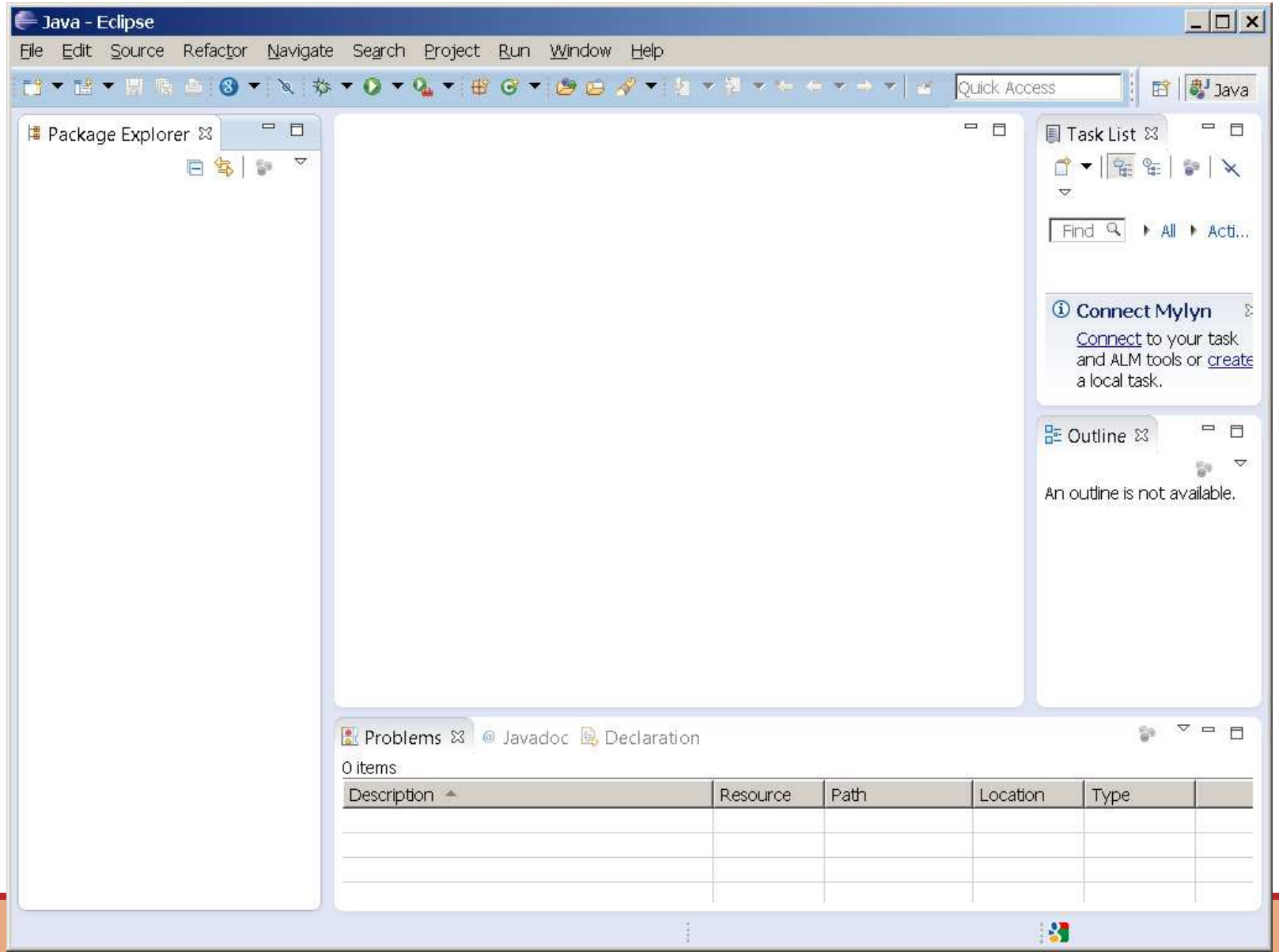
D:\eclipse\eclipse\plugins\com.google.gdt.eclipse.appengine.swarm_backend_3

GAE Setup


Software Updates
You will need to restart Eclipse for the changes to take effect. Would you like to restart now?
Yes
No

GAE Setup


Java - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help
Quick Access
Java
Package Explorer
Task List
Find
All
Acti...
Connect Mylyn
Connect to your task and ALM tools or create a local task.
Outline
An outline is not available.
Problems
Javadoc
Declaration
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Description
Resource
Path
Location
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GAE Project Creation

- With Eclipse, it is very easy to create and edit GAE projects

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- Click `File` ⇒ `New` ⇒ `Other` ⇒ `Web Application Project`

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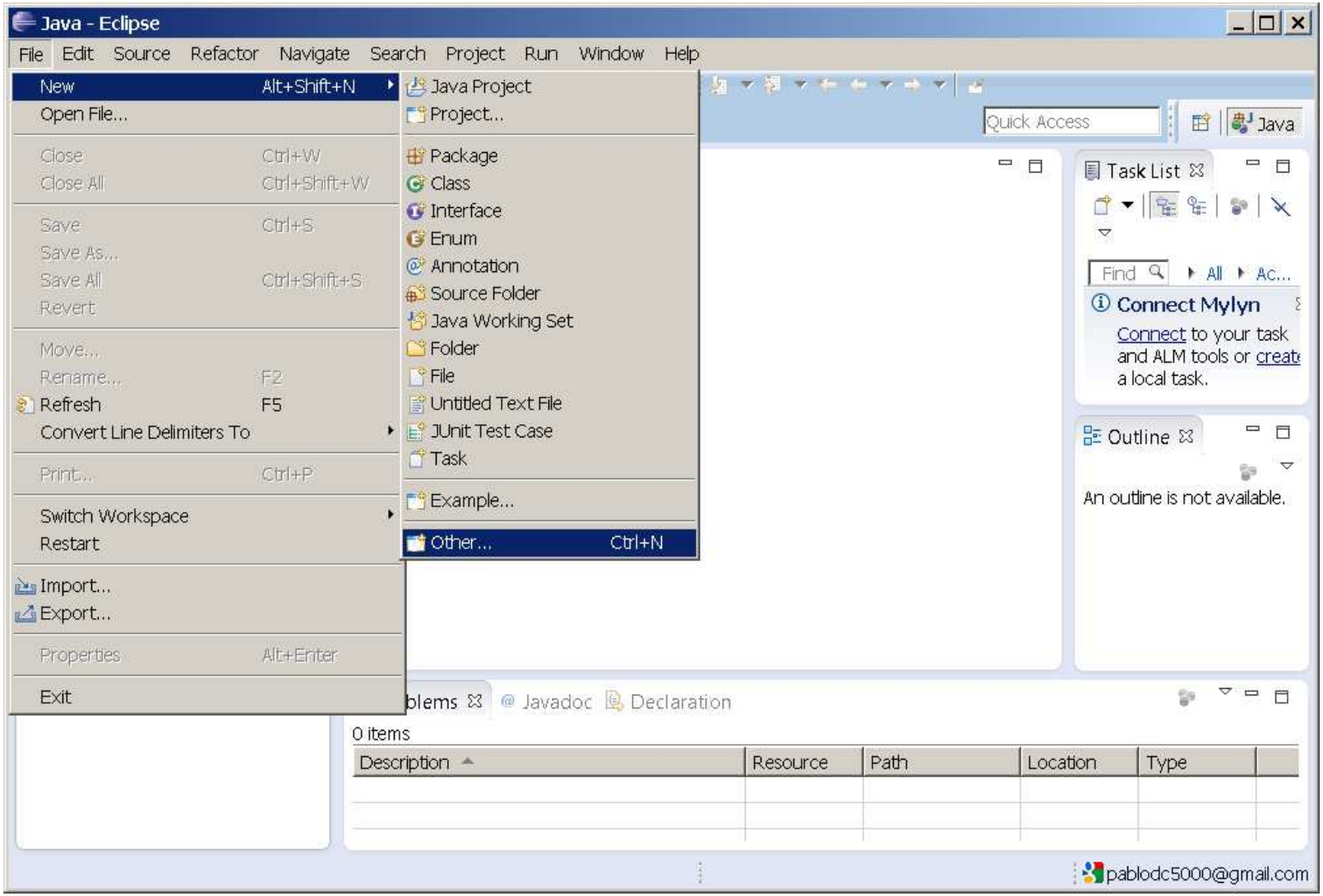
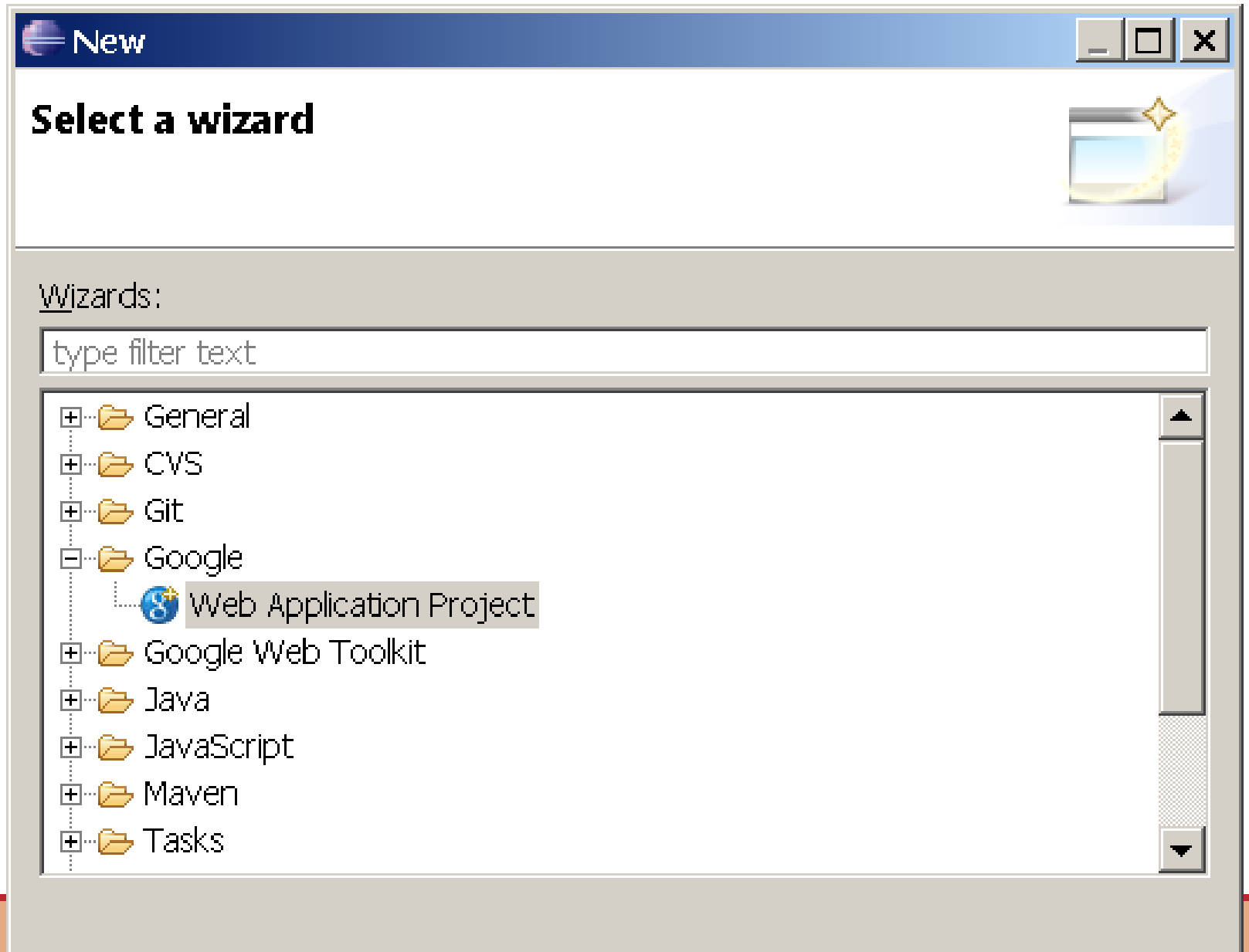


GAE Project Creation



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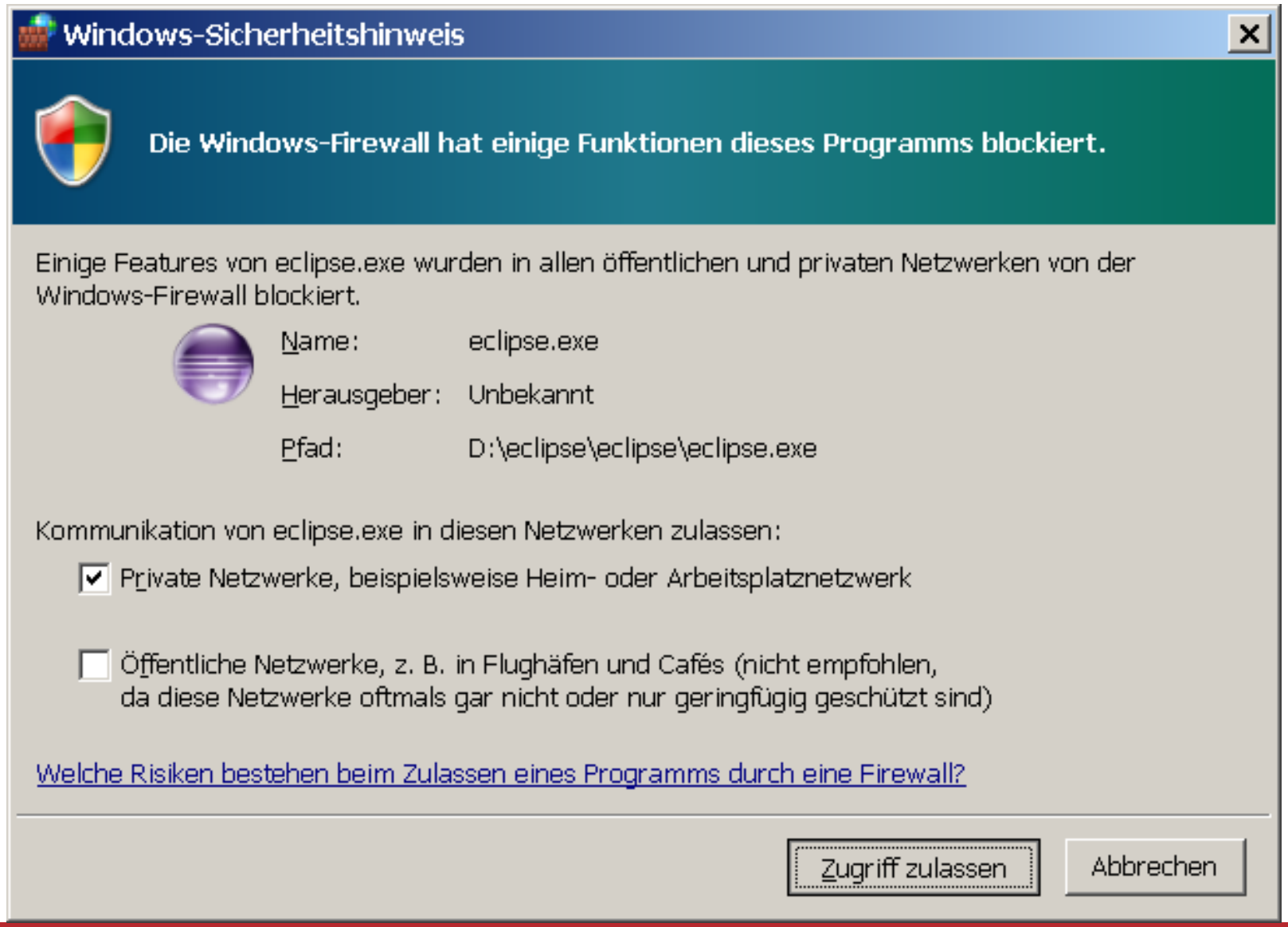

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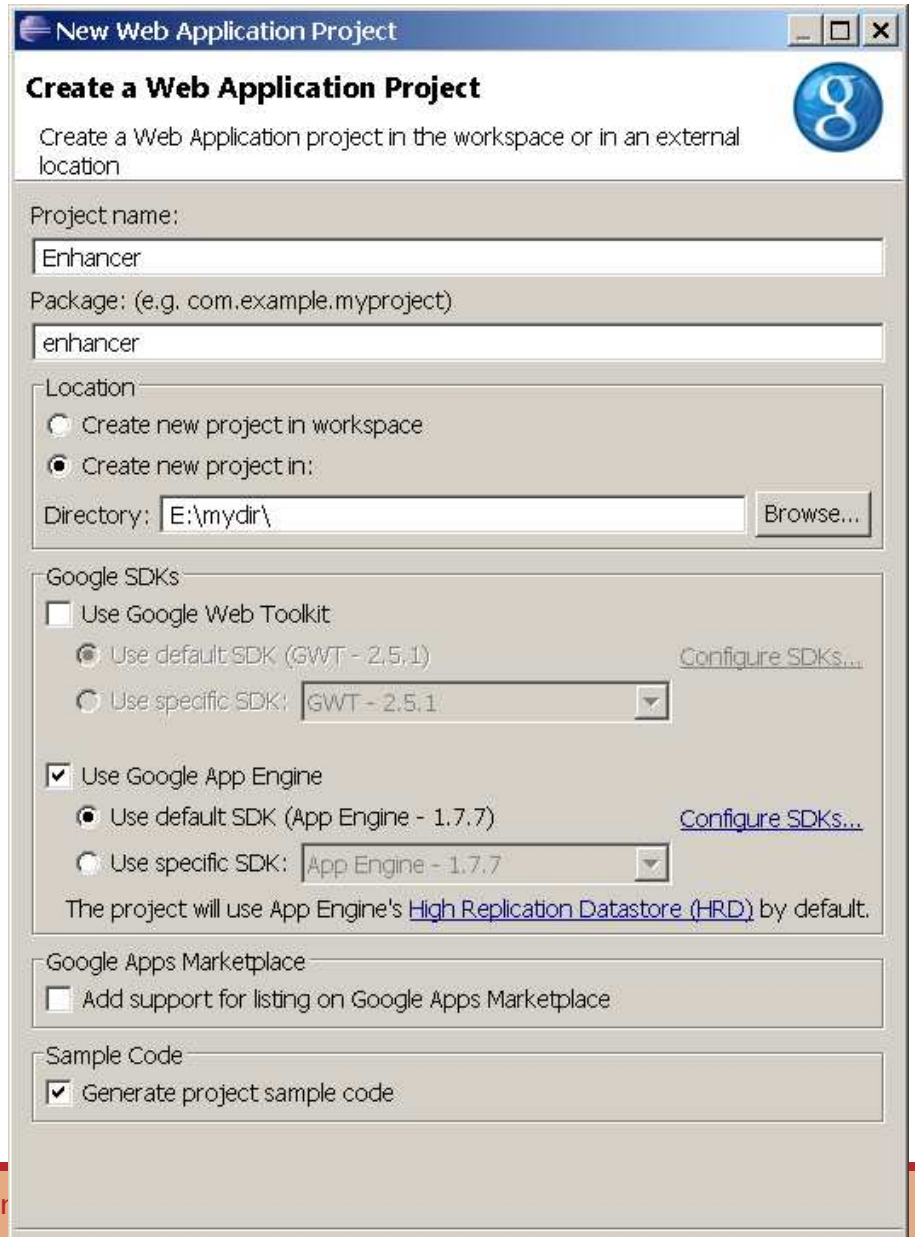

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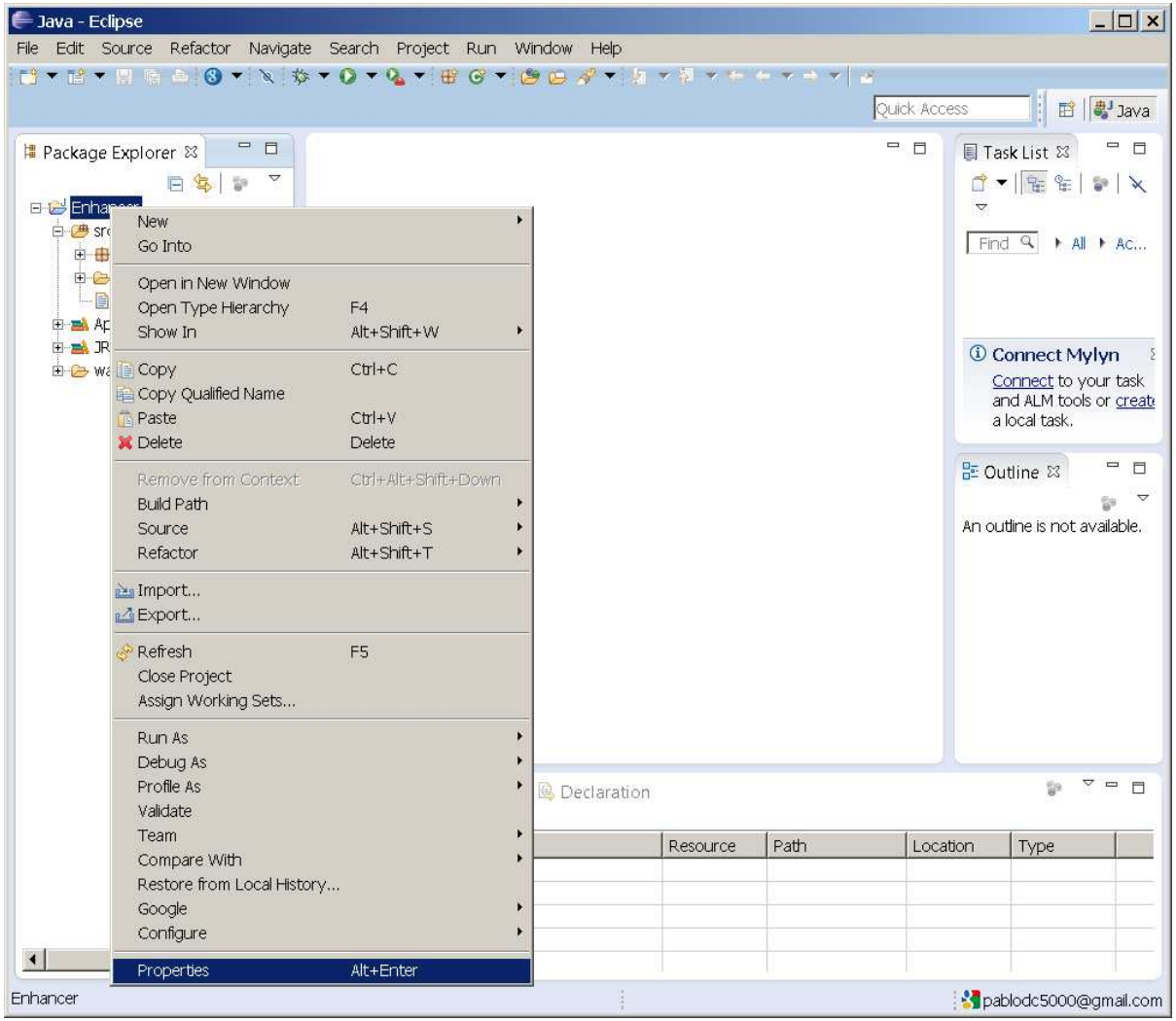
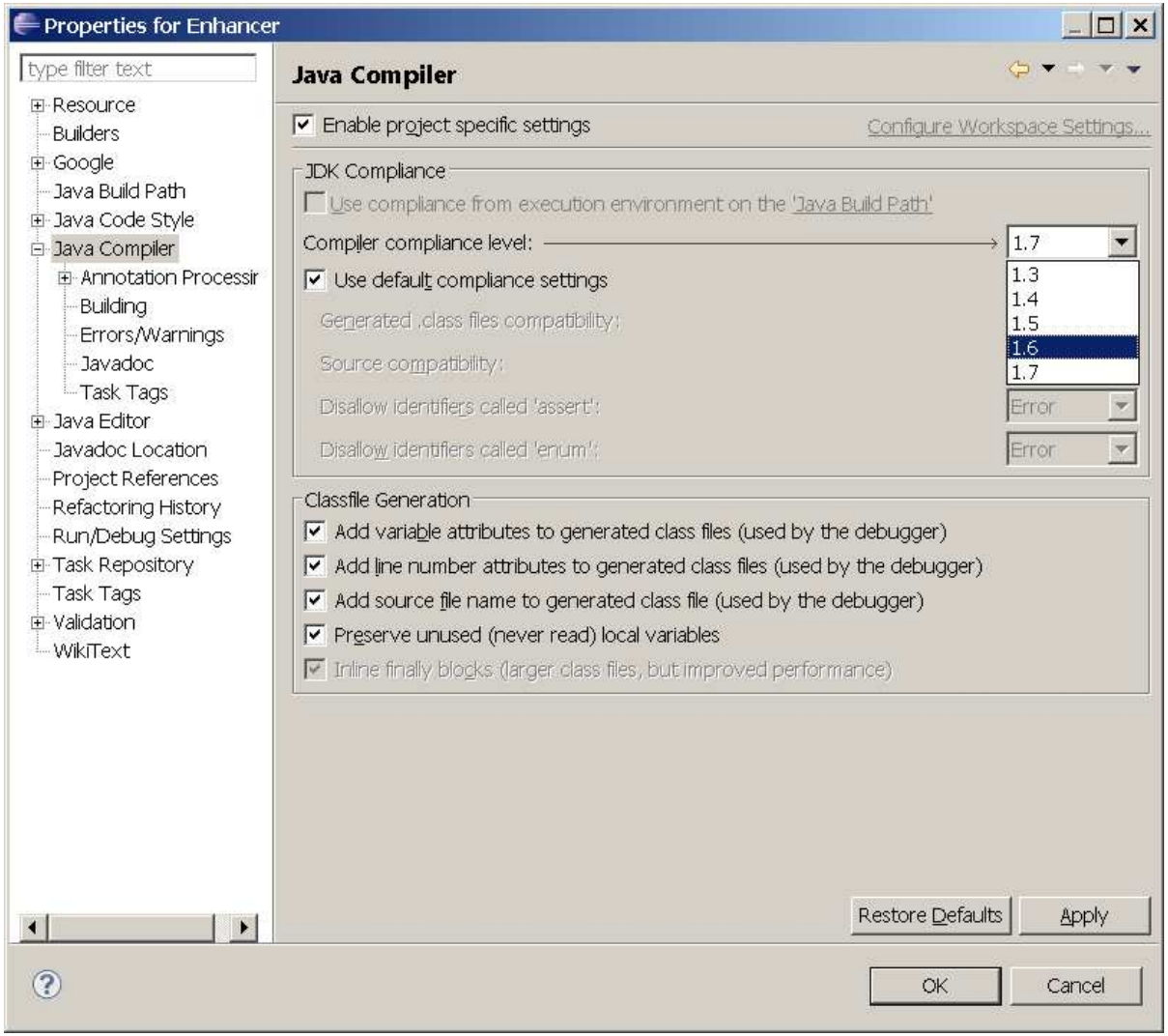
GAE Project Creation



GAE Project Creation



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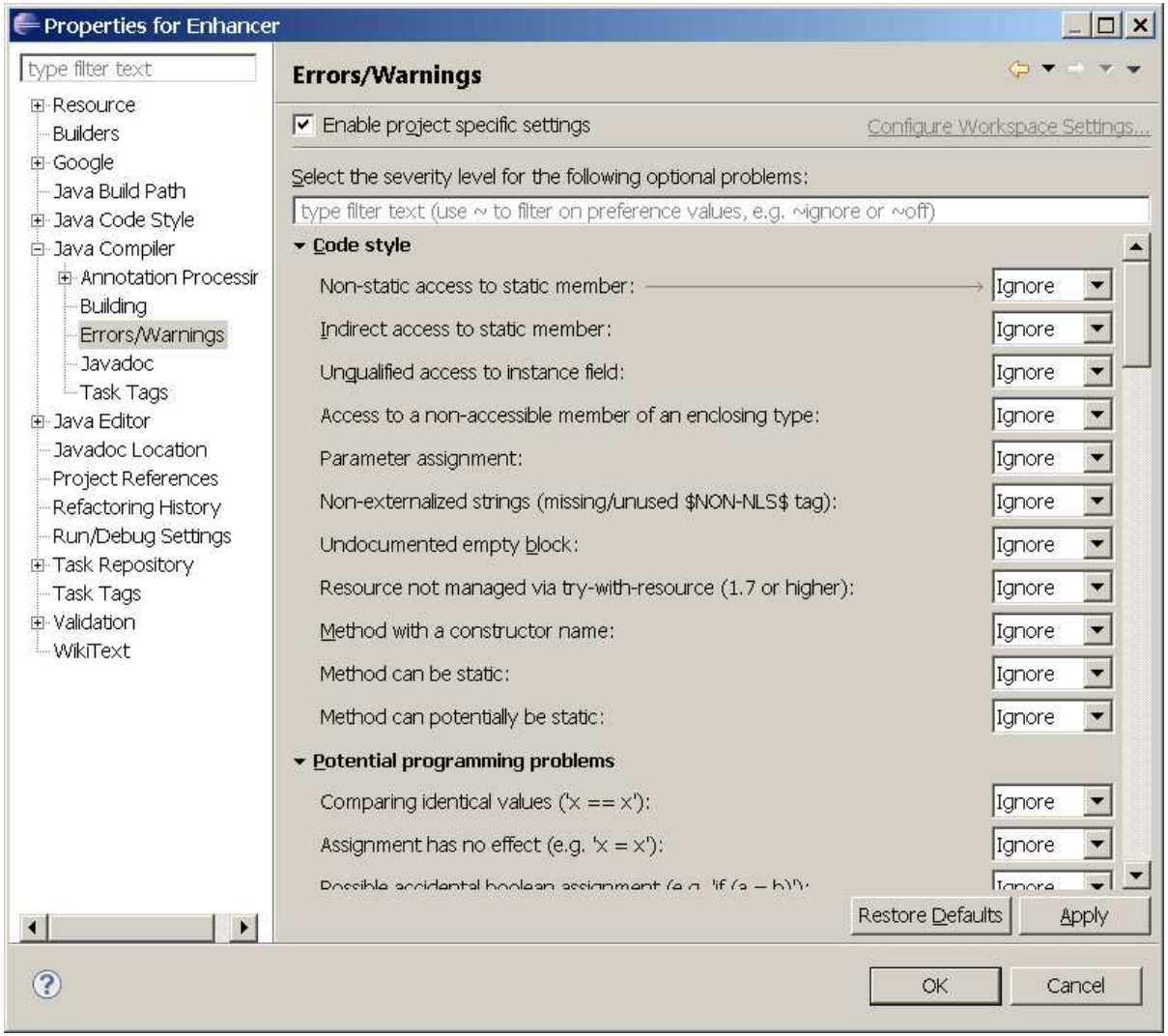
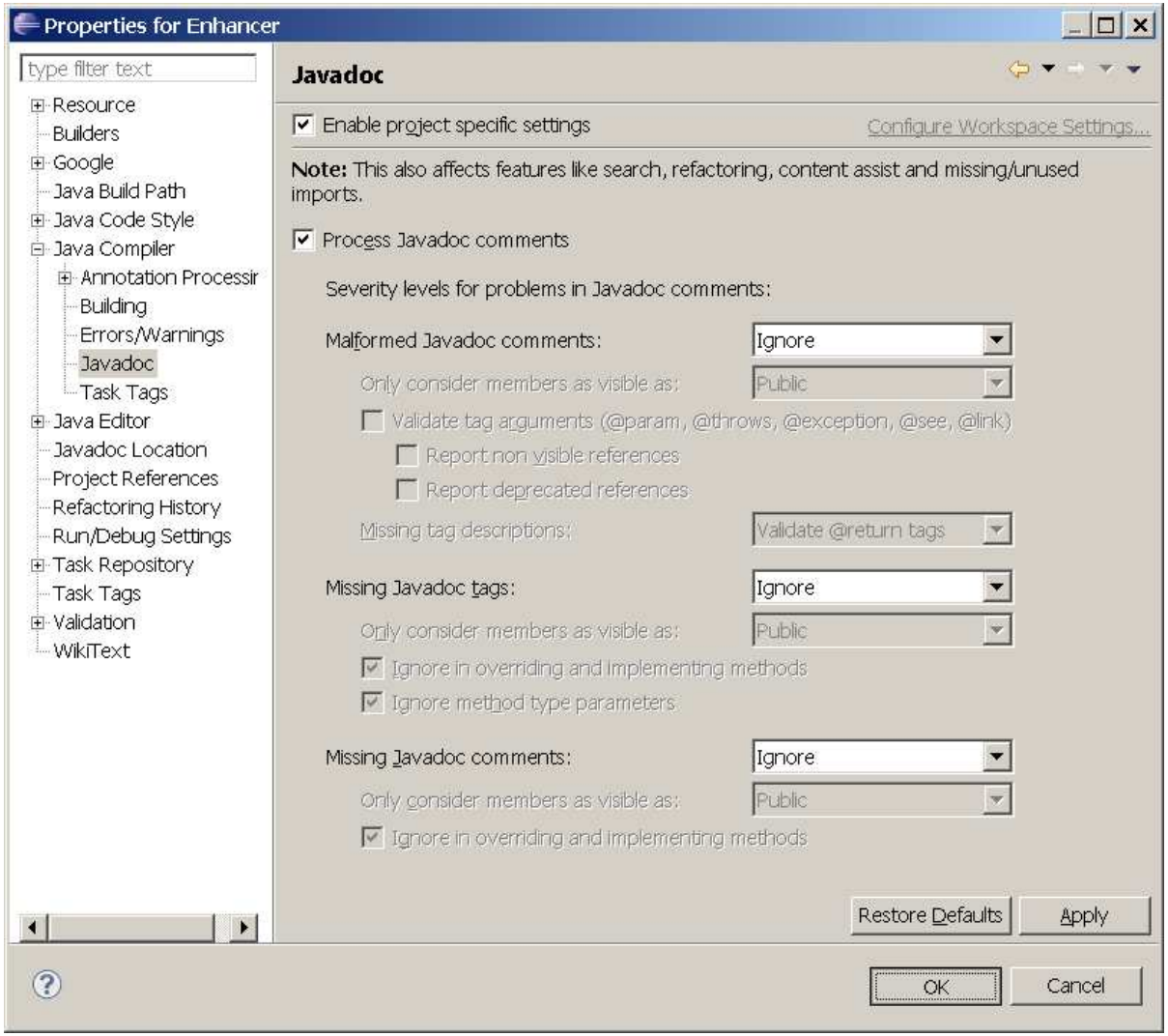
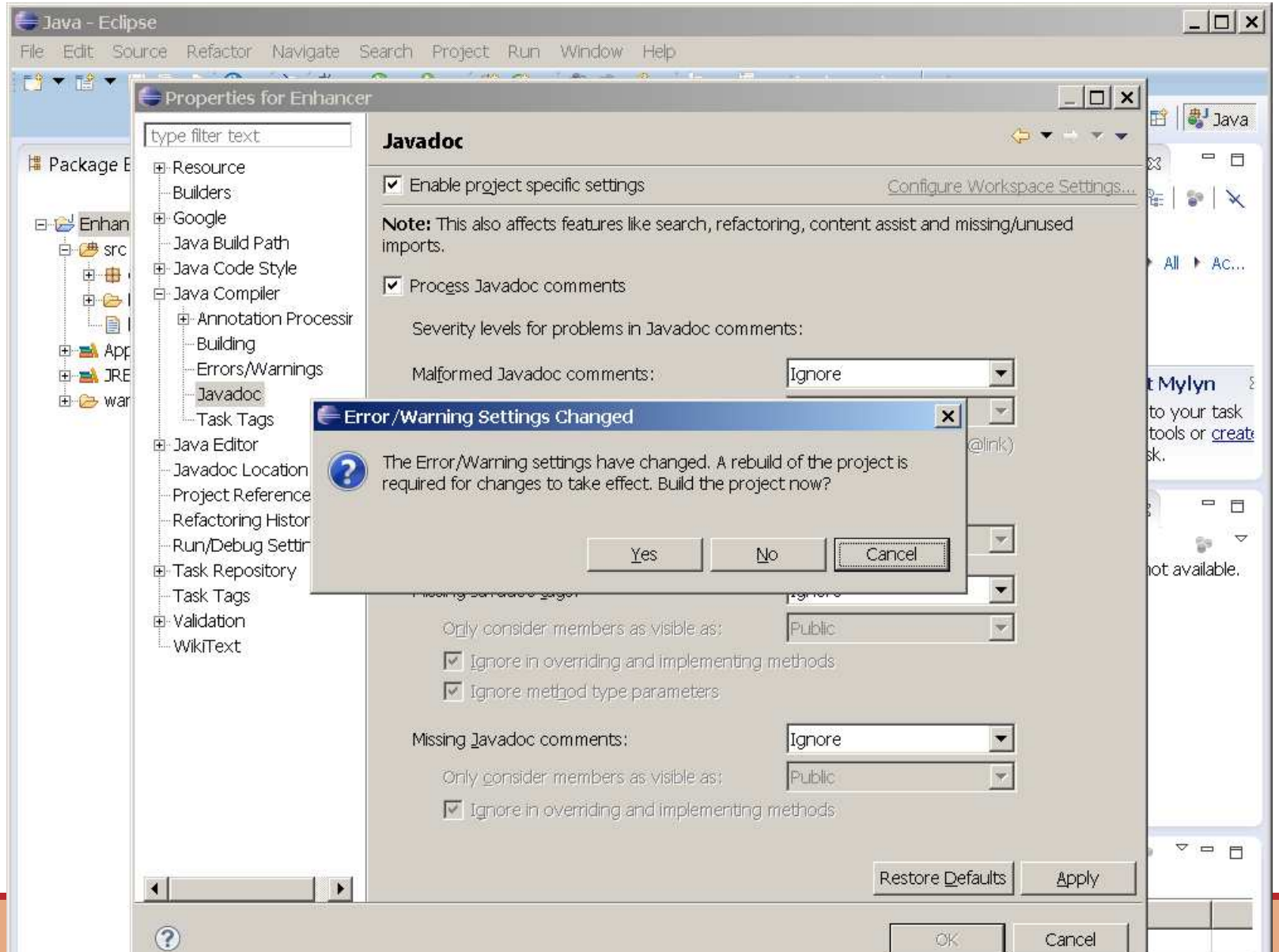
GAE Project Creation



GAE Project Creation



GAE Project Creation



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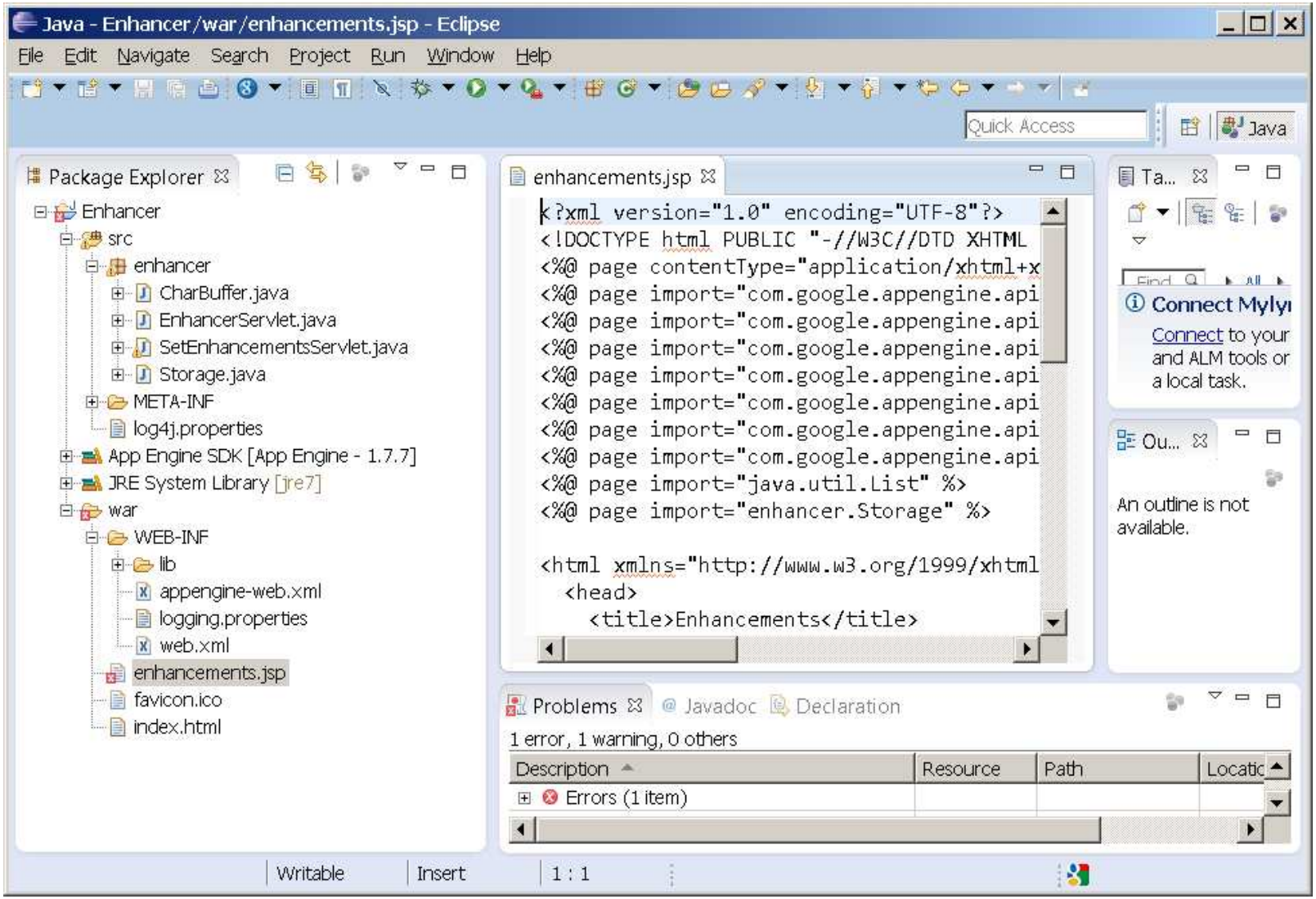
- Turn off compiler/JavaDoc warnings and errors (to not get errors for auto-generated code!)
- When using JavaServer Pages (JSPs), you may (or may not) get compiler errors – ignore them, it will work anyway

GAE Project Creation



Application Development with GAE

- In GAE, we can use several different techniques to build web applications

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- Two of them are `Java` HTTP Servlets and and JavaServer Pages that we have already learned!

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Application Development with GAE

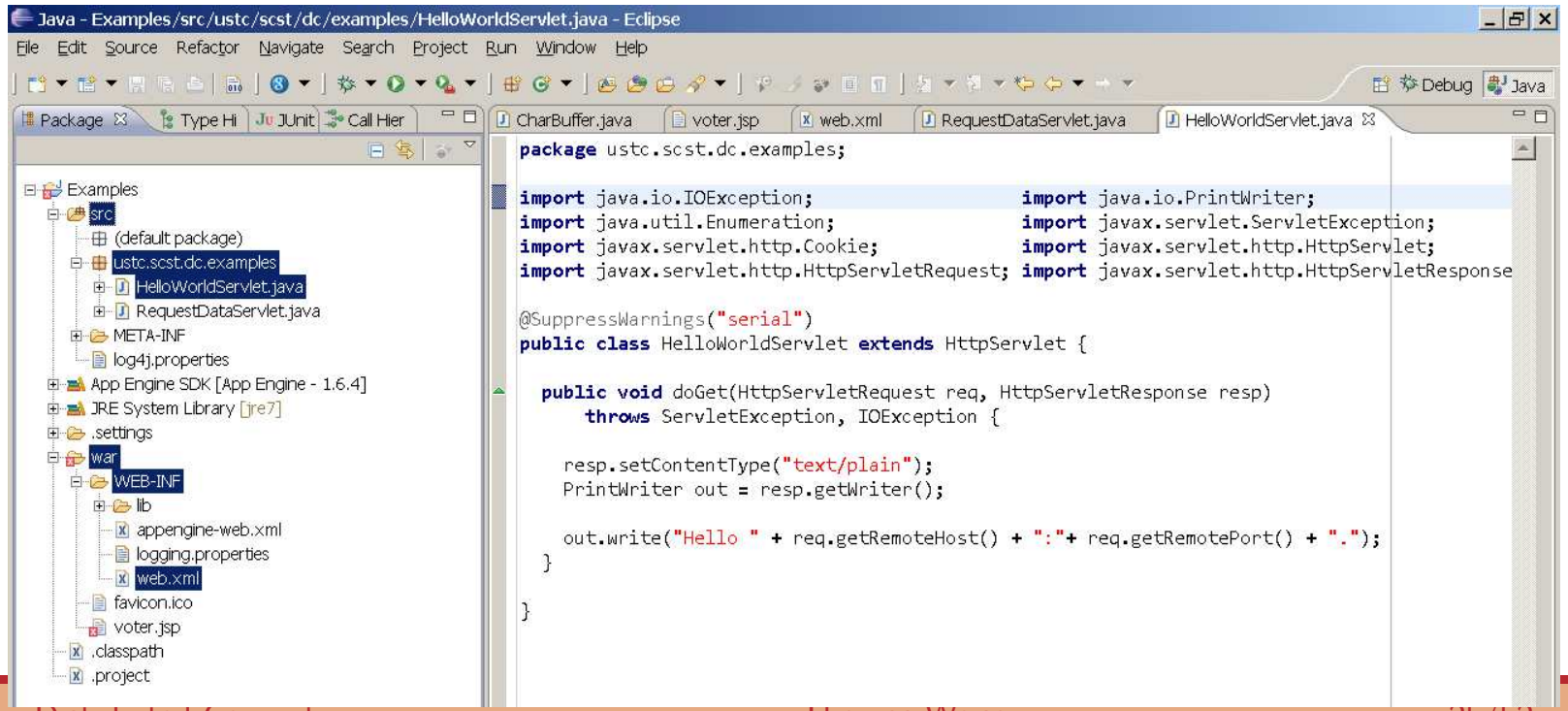
- In GAE, we can use several different techniques to build web applications
- Two of them are `Java` HTTP Servlets and and JavaServer Pages that we have already learned!
- We will look at them from the view point of GAE
- And repeat some simple examples that we had in the Java Servlets and JSP lessons
- Let's start with a simple "Hello World!" servlet

Listing: A simple servlet serving some text (HelloWorldServlet.java).

```
package ustc.scst.dc.examples;

import java.io.IOException;                    import java.io.PrintWriter;
import java.util.Enumeration;                  import
    javax.servlet.ServletException;
import javax.servlet.http.Cookie;              import
    javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest; import
    javax.servlet.http.HttpServletResponse;

@SuppressWarnings("serial")
public class HelloWorldServlet extends HttpServlet {

  public void doGet(HttpServletRequest req, HttpServletResponse resp)
      throws ServletException, IOException {

    resp.setContentType("text/plain");
    PrintWriter out = resp.getWriter();

    out.write("Hello␣" + req.getRemoteHost() + ":"+ req.getRemotePort() + ".");
  }

}
```

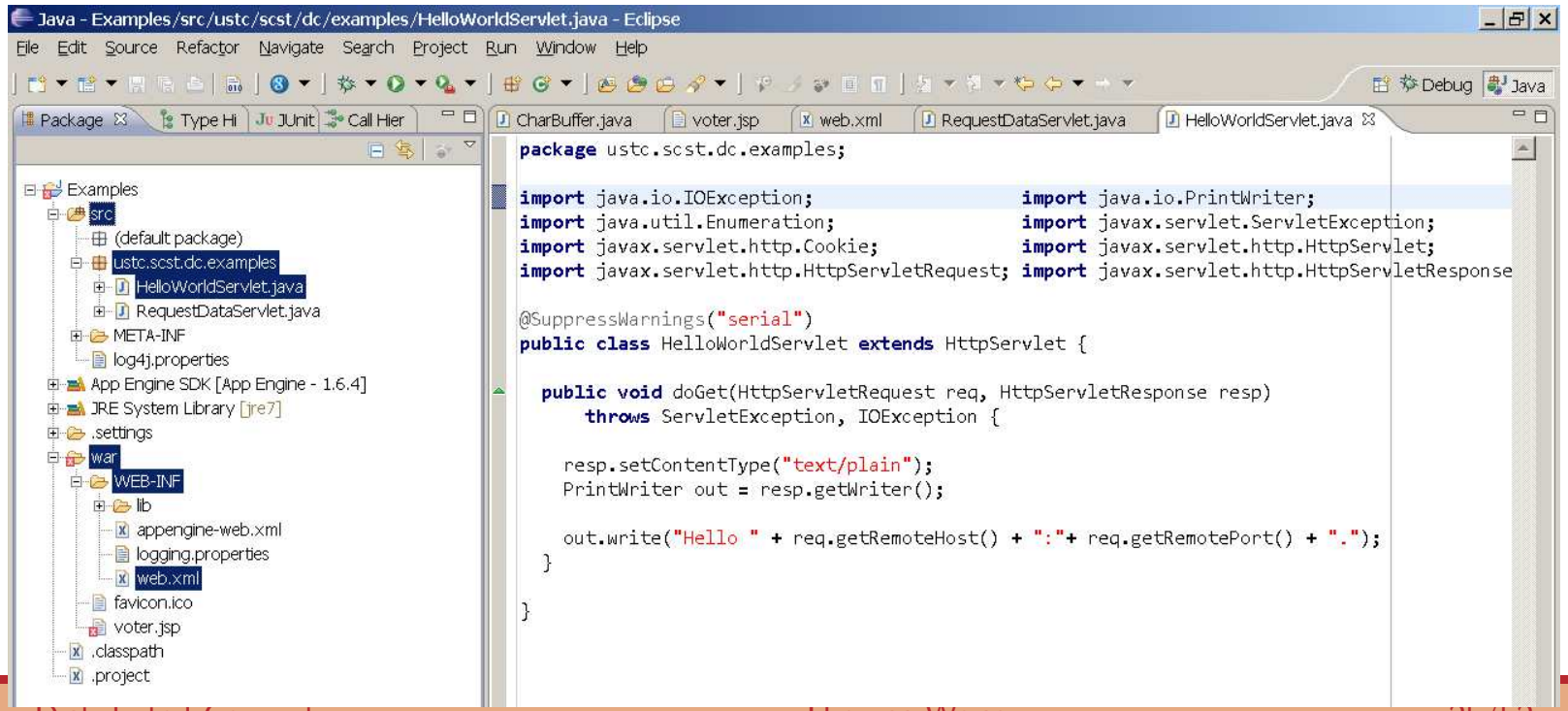
Deployment

- As discussed previously, Java Servlets and JSPs are deployed in `.war` (Web application ARchive) files formats



Deployment

- As discussed previously, Java Servlets and JSPs are deployed in `.war` (Web application ARchive) files formats
- a `.war` is basically `.zip`, with an additional `/WEB-INF` folder



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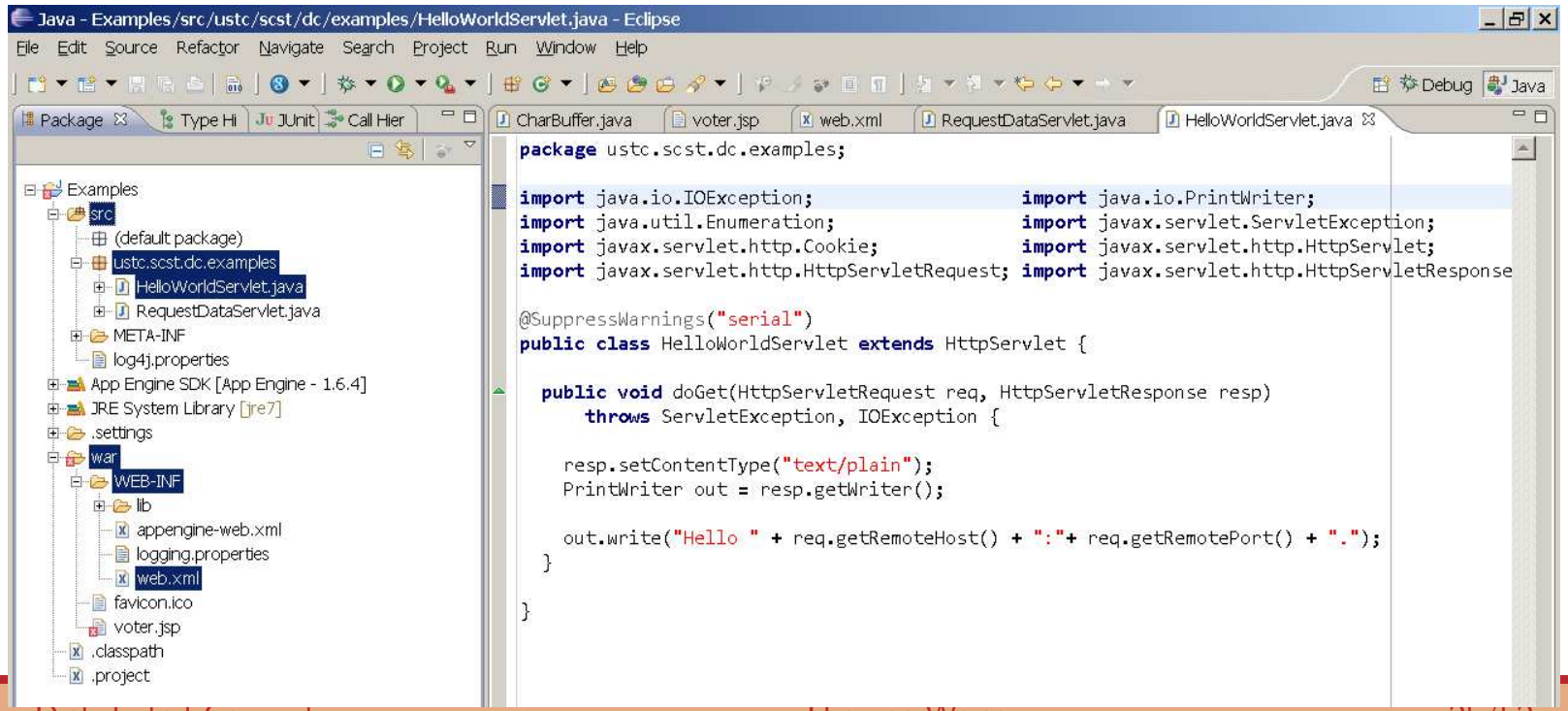
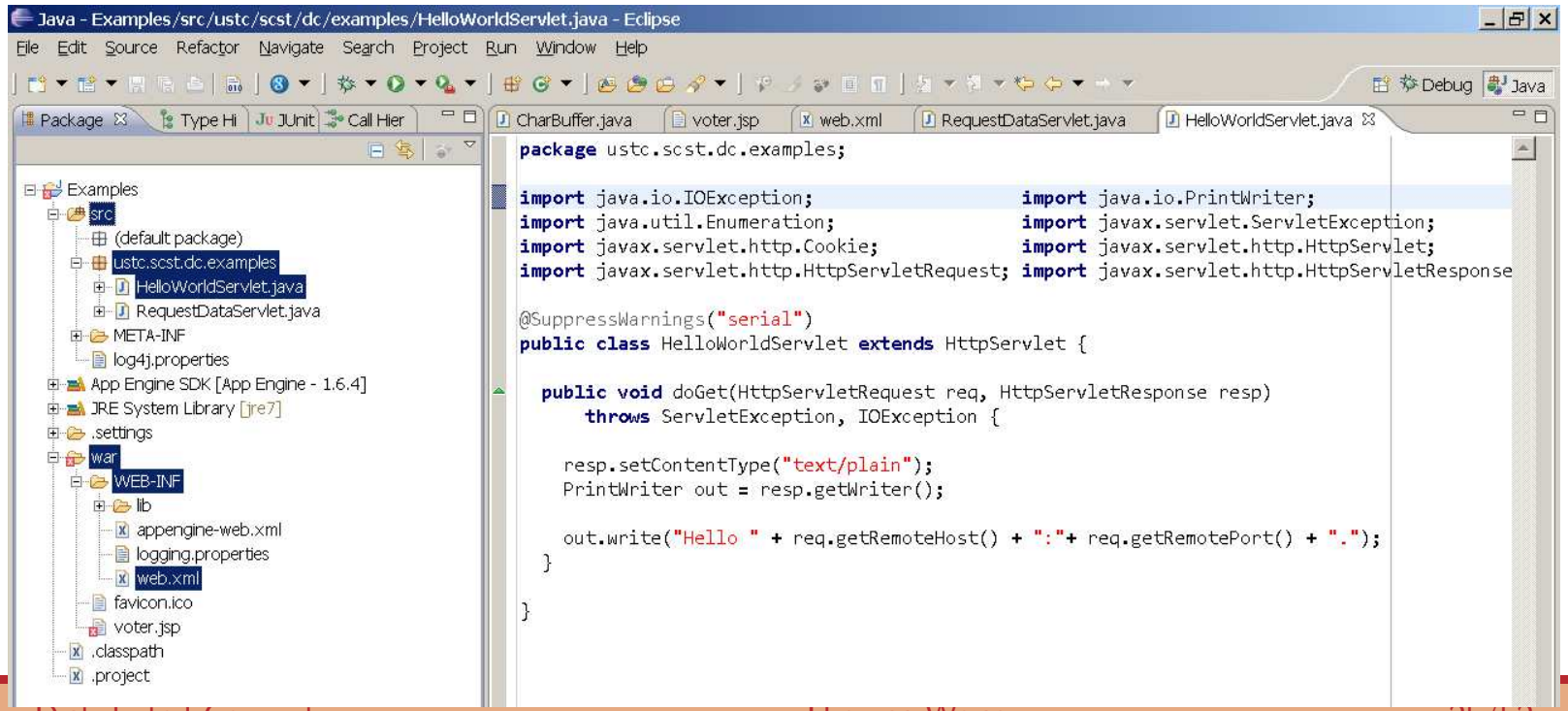
- this folder contains a file `web.xml`



Deployment

- As discussed previously, Java Servlets and JSPs are deployed in `.war` (Web application ARchive) files formats
- a `.war` is basically `.zip`, with an additional `/WEB-INF` folder
- this folder contains a file `web.xml`
- in `web.xml`, we specify the Servlets and JSPs provided in the archive and how they can be accessed



Listing: The web.xml specification for the HelloWorldServlet (web.xml).

```
<?xml version="1.0" encoding="utf-8"?>
<web-app xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://java.sun.com/xml/ns/javaee"
      xmlns:web="http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
  xsi:schemaLocation="http://java.sun.com/xml/ns/javaee␣
      http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
  version="2.5">

  <servlet>
    <servlet-name>HelloWorld</servlet-name>
    <servlet-class>ustc.scst.dc.examples.HelloWorldServlet</servlet-class>
  </servlet>

  <servlet-mapping>
    <servlet-name>HelloWorld</servlet-name>
    <url-pattern>/HelloWorld</url-pattern>
  </servlet-mapping>

</web-app>
```

Access

- Start servlet container (e.g., Glassfish, Tomcat, Jetty, GAE)

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- Access the assigned URL, e.g., `http://localhost:8888/HelloWorld`

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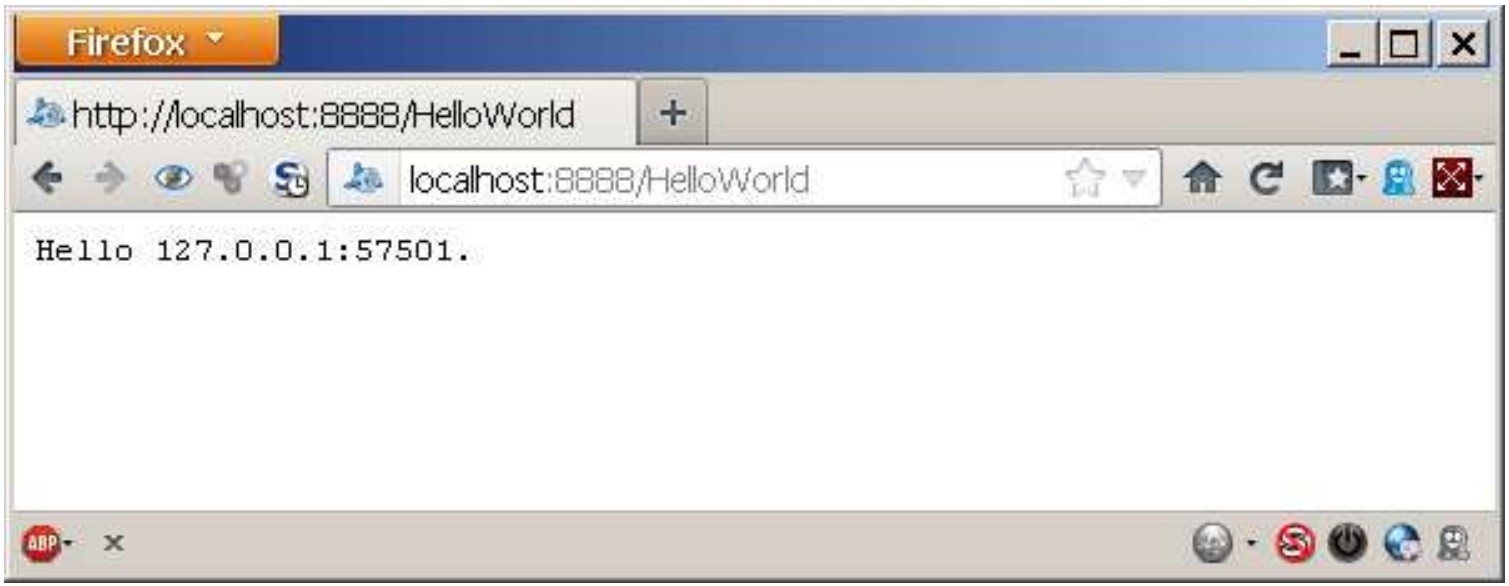
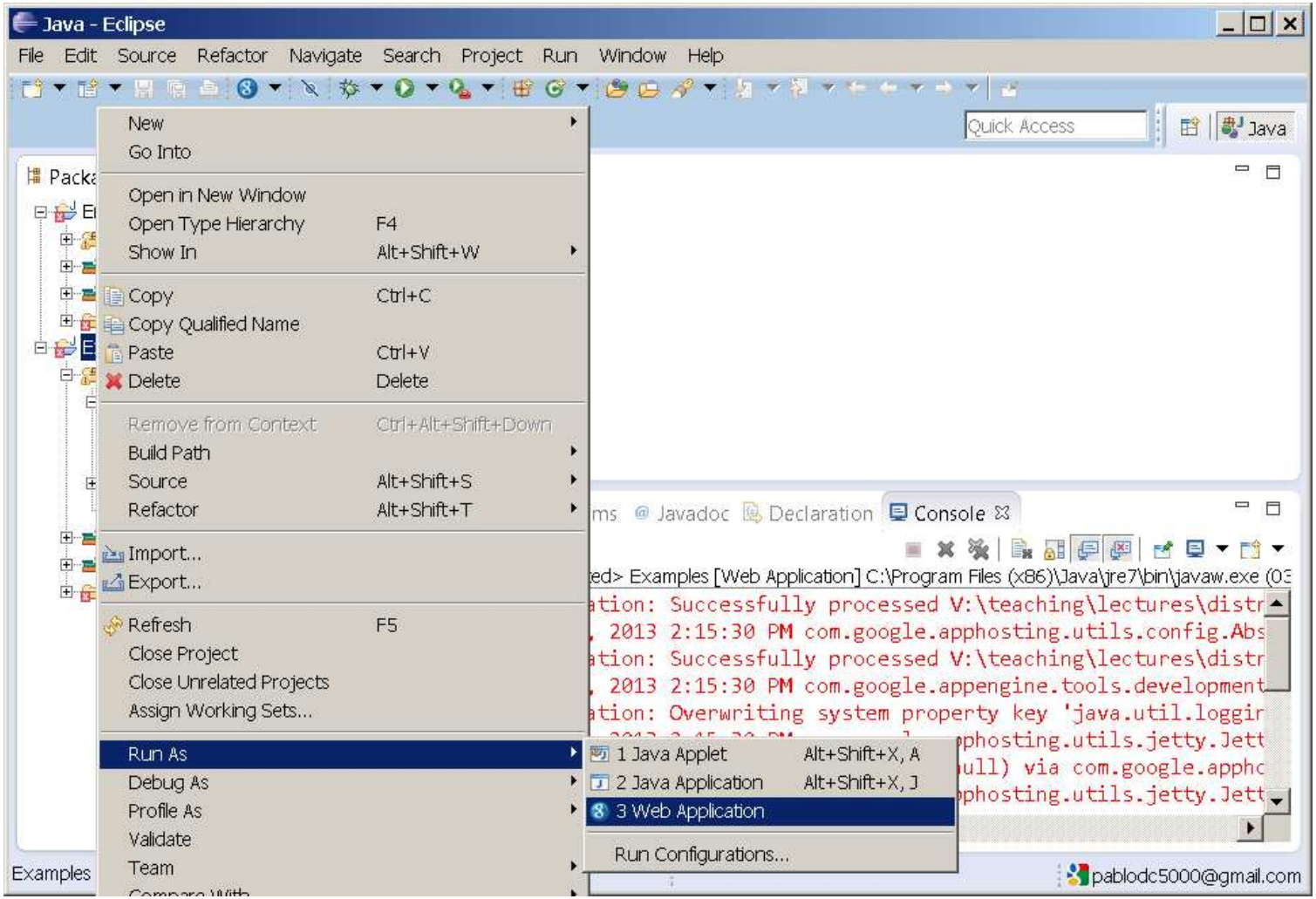


Access

- Start servlet container (e.g., Glassfish, Tomcat, Jetty, GAE)
- Access the assigned URL, e.g., `http://localhost:8888/HelloWorld`
- In GAE: run project as *Web Application*, click away/ignore all errors

Access


Java - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help
Quick Access
Java
New
Go Into
Open in New Window
Open Type Hierarchy F4
Show In Alt+Shift+W
Copy Ctrl+C
Copy Qualified Name
Paste Ctrl+V
Delete Delete
Remove from Context Ctrl+Alt+Shift+Down
Build Path
Source Alt+Shift+S
Refactor Alt+Shift+T
Import...
Export...
Refresh F5
Close Project
Close Unrelated Projects
Assign Working Sets...
Run As
Debug As
Profile As
Validate
Team
1 Java Applet Alt+Shift+X, A
2 Java Application Alt+Shift+X, J
3 Web Application
Run Configurations...
Javadoc
Declaration
Console
Examples [Web Application] C:\Program Files (x86)\Java\jre7\bin\javaw.exe
Examples
pablodc5000@gmail.com

Java Servlets in GAE

- Servlets are packaged in WAR archives [63]

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Java Servlets in GAE

- Servlets are packaged in WAR archives [63]
- All processing of a request should happen within one of `doXXX` methods of a servlet class, e.g.,
- No longer-living `java.lang.Thread` can be created
- Each request must be processed within 60s or is terminated thereafter automatically

Request Data Servlet

- Let's start the Java Servlet returning the HTTP request information in GAE

Request Data Servlet

- Let's start the Java Servlet returning the HTTP request information in GAE
- And access it via `http://localhost:8888/RequestData`

Listing: Servlet that returns HTML with request data (RequestDataServlet.java).

```
package ustc.scst.dc.examples;

import java.io.IOException;                    import java.io.PrintWriter;       import java.util.Enumeration;
import javax.servlet.ServletException;         import javax.servlet.http.Cookie; import
    javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest; import javax.servlet.http.HttpServletResponse;

@SuppressWarnings("serial")
public class RequestDataServlet extends HttpServlet {

  public void doGet(HttpServletRequest req, HttpServletResponse resp)
      throws ServletException, IOException {
    resp.setContentType("text/html");

    PrintWriter out = resp.getWriter();
    out.println("<html><body><pre>");
    out.println("Method=" + req.getMethod());
    out.println("URI=" + req.getRequestURI());
    out.println("RemoteAddr=" + req.getRemoteAddr());

    out.println("\nRequest␣headers:");
    Enumeration e = req.getHeaderNames();
    while (e.hasMoreElements()) {
      String name = ((String) (e.nextElement()));
      out.println(name + "=" + req.getHeader(name));
    }

    out.println("\nForm␣data:");
    e = req.getParameterNames();
    while (e.hasMoreElements()) {
      String name = (String) (e.nextElement());
      out.println(name + "=" + req.getParameter(name));
    }

    out.println("\nCoockies:");
    Cookie[] cookies = req.getCookies();
    if (cookies != null) {
      for (int i = 0; i < cookies.length; i++) {
        Cookie c = cookies[i];
        out.println(c.getName() + "=" + c.getValue());
      }
    }

    Cookie cn = new Cookie("Counting", "0815");
    resp.addCookie(cn);
```

Listing: The web.xml specification for the RequestDataServlet (web.xml).

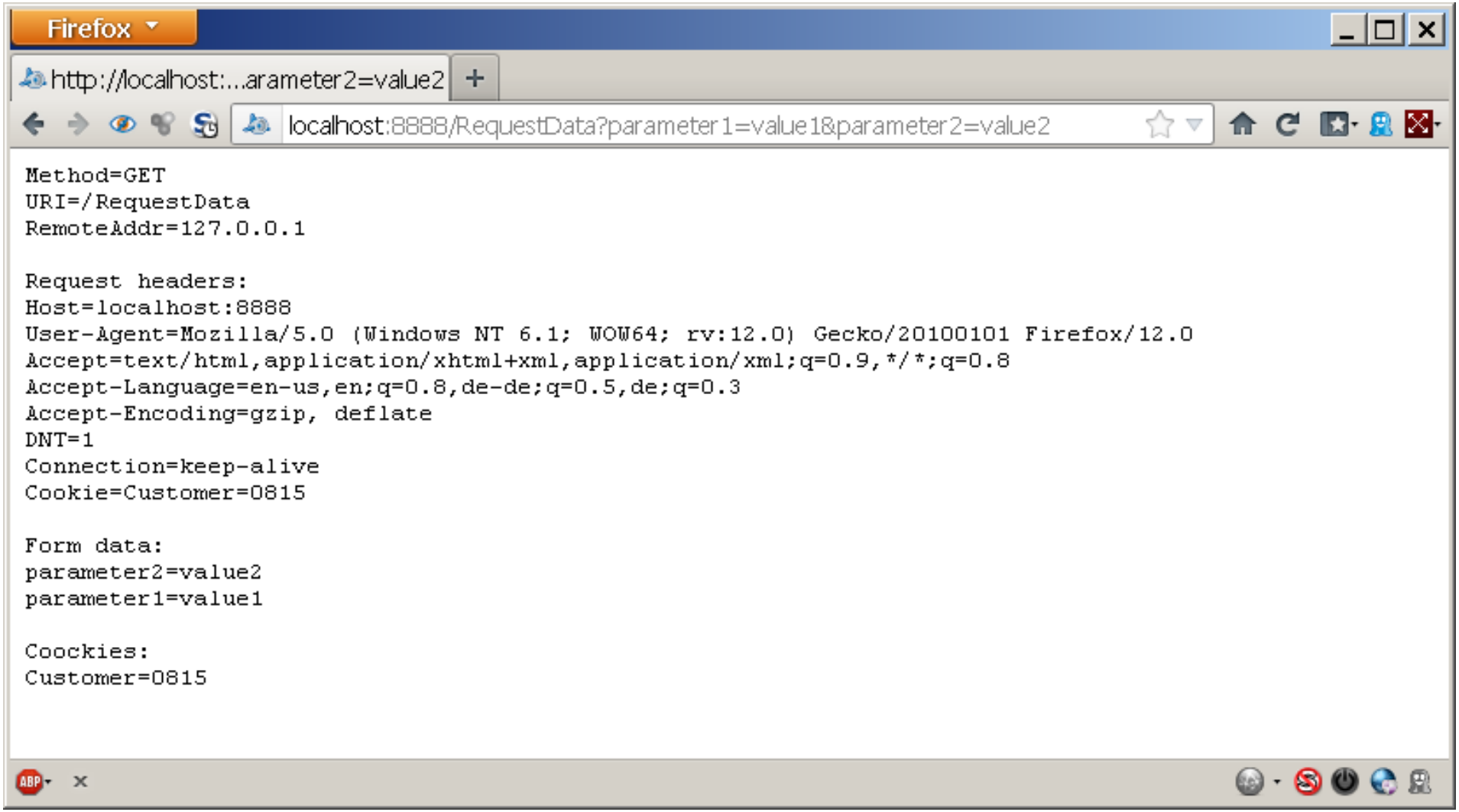
```
<?xml version="1.0" encoding="utf-8"?>
<web-app xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://java.sun.com/xml/ns/javaee"
      xmlns:web="http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
  xsi:schemaLocation="http://java.sun.com/xml/ns/javaee␣
      http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
  version="2.5">

  <servlet>
    <servlet-name>RequestData</servlet-name>
    <servlet-class>ustc.scst.dc.examples.RequestDataServlet</servlet-class>
  </servlet>

  <servlet-mapping>
    <servlet-name>RequestData</servlet-name>
    <url-pattern>/RequestData</url-pattern>
  </servlet-mapping>

</web-app>
```

Access


Firefox
http://localhost:...arameter2=value2
localhost:8888/RequestData?parameter1=value1&parameter2=value2
Method=GET
URI=/RequestData
RemoteAddr=127.0.0.1
Request headers:
Host=localhost:8888
User-Agent=Mozilla/5.0 (Windows NT 6.1; WOW64; rv:12.0) Gecko/20100101 Firefox/12.0
Accept=text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language=en-us,en;q=0.8,de-de;q=0.5,de;q=0.3
Accept-Encoding=gzip, deflate
DNT=1
Connection=keep-alive
Cookie=Customer=0815
Form data:
parameter2=value2
parameter1=value1
Coockies:
Customer=0815

Web Enhancer: Idea

- Goal: make funny modifications to web sites

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  1. our app has one parameter `url` in its url, e.g.,
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  5. return the "enhanced" version of the web page as result of the query!
  6. We can use a Java Servlet to implement all that!

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- Idea...

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  3. When processing a web page, we also need to re-write all outgoing URLs to be piped through our enhancer:

     `http://www.ustc.edu.cn/xygk/xxjj/` ⇒

     `http://localhost:8888/enhancer?url=http://www.ustc.edu.cn/xygk/`

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     `http://www.ustc.edu.cn/xygk/xxjj/` ⇒

     `http://localhost:8888/enhancer?url=http://www.ustc.edu.cn/xygk/`
  4. References to images must be re-written to become absolute urls

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  1. Allow the user to edit the "replacements" in an additional website (implemented as JavaServer Page)
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  3. When processing a web page, we also need to re-write all outgoing URLs to be piped through our enhancer:

     `http://www.ustc.edu.cn/xygk/xxjj/` ⇒

     `http://localhost:8888/enhancer?url=http://www.ustc.edu.cn/xygk/`
  4. References to images must be re-written to become absolute urls:

     `./images/index_mainall.jpg` ⇒ `http://www.ustc.edu.cn/images/index_mainall.jpg`

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  1. Allow the user to edit the "replacements" in an additional website (implemented as JavaServer Page)
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  3. When processing a web page, we also need to re-write all outgoing URLs to be piped through our enhancer:

     `http://www.ustc.edu.cn/xygk/xxjj/` ⇒

     `http://localhost:8888/enhancer?url=http://www.ustc.edu.cn/xygk/`
  4. References to images must be re-written to become absolute urls:

     `./images/index_mainall.jpg` ⇒ `http://www.ustc.edu.cn/images/index_mainall.jpg`

     because otherwise, they will be "relative to our service's server"

Example Structure

- One Java Servlet that "enhances" the web pages: `EnhancerServlet`

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- One JavaServer Page where the string replacements can be edited: `enhancements.jsp`
- These are edited in a form, the form's content is sent via HTTP Post to another Java Servlet: `SetEnhancementsServlet`

Listing: Snipped from Enhancer Servlet 1

```
public class EnhancerServlet extends HttpServlet {
  public void doGet(HttpServletRequest req, HttpServletResponse resp)
      throws IOException {
    URL           url        = makeRequestURL(req.getParameter("url")); // translate
        request parameter to real url
    URLConnection connection = url.openConnection();                    // open
        connection: use URL Fetch service
    connection.setReadTimeout(60000);                                   // some websites
        may be slow to load
    CharBuffer data          = new CharBuffer();                        // Implement:
        internal class for loading data

    data.load(connection);                                              // Implement:
        load a website from connection
    rewriteURLS(data, url.toString());                                  // Implement:
        re-write urls in the website

    performReplacements(data);                                          // Implement:
        perform all replacements

    resp.setContentType(makeContentType(connection.getContentType())); // make sure to
        use original content type
    resp.setCharacterEncoding("utf-8");                                 // but our
        encoding will be UTF-8[64–66]
    data.flush(resp.getWriter());                                       // send all the
        web page data to the client
  }
...
}
```

Listing: A utility class holding field names (Storage.java).

```
package enhancer;

public class Storage {
  // some constants for field and entity names shared throughout the application
  public static final String KIND       = "enhancement";  // the kind for all data sets
  public static final String FROM_FIELD = "from";         // the from field name
  public static final String TO_FIELD   = "to";           // the to field name
  public static final String DELETE_STR = "delete";       // the "delete" identifier

  // utility method to ensure that target value is not null
  public static final String makeToValue(final String to) {
    return (to == null) ? "" : to.trim();
  }

  // make a string html conform
  public static final String makeHTMLString(final Object s) {
    if ((s != null) && (s instanceof String)) {
      return ((String) s).replace("&", "&amp;").replace("<", "&lt;")//
          .replace(">", "&gt;").replace("\"", "&quot;");
    }
    return "";
  }
}
```

Listing: Snippet from Enhancer Servlet 2

```
public class EnhancerServlet extends HttpServlet {
...
  private static final void performReplacements(final CharBuffer data) {
    DatastoreService store = DatastoreServiceFactory.getDatastoreService();       //
        access Google DataStore service
    Query query            = new Query(Storage.KIND);                             //
        query all elements of kind  "enhancement"
    List<Entity> res       = store.prepare(query).asList(                         // get
        these elements as a list
                                       FetchOptions.Builder.withDefaults());

    for (Entity e : res) {                                                        // for
        each such replacement
      data.replace(                                                               //
          replace all occurences in the website data
                  ((String) (e.getProperty(Storage.FROM_FIELD))).toCharArray(), // of
                      the string stored in field "from"
                  ((String) (e.getProperty(Storage.TO_FIELD))));                  //
                      with string stored in field "to"
    }
  }
...
}
```

Listing: A form where we can edit the replacements (enhancements.jsp).

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD␣XHTML␣1.1//EN" "http://www.w3.org/TR/xhtml11/DTD/xhtml11.dtd">
<%@ page contentType="application/xhtml+xml;charset=UTF-8" language="java" %>
<%@ page import="com.google.appengine.api.datastore.DatastoreServiceFactory" %>
<%@ page import="com.google.appengine.api.datastore.DatastoreService" %>
<%@ page import="com.google.appengine.api.datastore.Query" %>
<%@ page import="com.google.appengine.api.datastore.Entity" %>
<%@ page import="com.google.appengine.api.datastore.FetchOptions" %>
<%@ page import="com.google.appengine.api.datastore.Key" %>
<%@ page import="com.google.appengine.api.datastore.KeyFactory" %>
<%@ page import="java.util.List" %>
<%@ page import="enhancer.Storage" %>

<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en">
  <head>
    <title>Enhancements</title>
  </head>
  <body>
  <h1>Website Enhancements</h1>
  <p>Welcome to the website enhancement service. Here you can add and remove keywords for replacement.</p>
    <div>
      <form action="/setEnhancements" method="post">
        <table border="0">
          <%
          DatastoreService store = DatastoreServiceFactory.getDatastoreService();
          Query            query = new Query(Storage.KIND);
          List<Entity>     res   = store.prepare(query).asList(FetchOptions.Builder.withDefaults());

          for(Entity e : res) { %>
            <tr><td>from</td><td><%= Storage.makeHTMLString(e.getProperty(Storage.FROM_FIELD)) %></td>
                <td>to</td><td><%= Storage.makeHTMLString(e.getProperty(Storage.TO_FIELD)) %></td>
                <td>(<input type="checkbox" name="<%=␣Storage.DELETE_STR␣%>" value="<%=␣Long.toString(e.getKey().getId())%>"
                    /> remove)</td>
            </tr>
          <% } %>

          <tr><td>from</td><td><input name="<%=␣Storage.FROM_FIELD␣%>" type="text" size="30" maxlength="2048" /></td>
              <td>to</td><td><input   name="<%=␣Storage.TO_FIELD␣␣␣%>" type="text" size="30" maxlength="2048" /></td><td/>
            </tr>
        </table>

        <div><input type="submit" value="Commit␣Enhancements" /></div>
      </form>
    </div>
  </body>
</html>
```

Listing: Snipped from SetEnhancementsServlet

```
// a servlet that receives the posted replacements, coming from the form in
    enhancements.jsp
public class SetEnhancementsServlet extends HttpServlet {

  public void doPost(HttpServletRequest req, HttpServletResponse resp)          //
      receive all form parameters via post
      throws IOException {

    DatastoreService datastore = DatastoreServiceFactory.getDatastoreService(); //
        access the Google DataStore service

    String newFrom = req.getParameter(Storage.FROM_FIELD);                      // get
        the "from" parameter
    if ((newFrom != null) && ((newFrom = newFrom.trim()).length() > 0)) {       // ok, a
        new string to be replaced was added
      Entity enh = new Entity(Storage.KIND);                                    //
          create a new record
      enh.setProperty(Storage.FROM_FIELD, newFrom);                             // set
          the record's "from" field
      enh.setProperty(Storage.TO_FIELD,
                      Storage.makeToValue(req.getParameter(Storage.TO_FIELD))); // set
                         the record's to field
      datastore.put(enh);                                                       // store
          the entry - it will get an unique key
    }

    String[] del = req.getParameterValues(Storage.DELETE_STR);                  // now
        check if the user wants to delete some
    if (del != null) {                                                          //
        current replacements
      for (String d : del) {                                                    // we
          used the unique keys to identify these
        datastore.delete(KeyFactory.createKey(Storage.KIND, Long.parseLong(d)));// in
            the form and now can delete them
      }
    }

    resp.sendRedirect("/enhancements.jsp");                                     // ok,
        back to the main form
  }
}
```

Listing: The web.xml specification for the Enhancer (web.xml).

```
<?xml version="1.0" encoding="utf-8"?>
<web-app xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://java.sun.com/xml/ns/javaee"
xmlns:web="http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd" version="2.5">

  <servlet>
    <servlet-name>Enhancer</servlet-name>
    <servlet-class>enhancer.EnhancerServlet</servlet-class>
  </servlet>

  <servlet-mapping>
    <servlet-name>Enhancer</servlet-name>
    <url-pattern>/enhancer</url-pattern>
  </servlet-mapping>


  <servlet>
    <servlet-name>setEnhancements</servlet-name>
    <servlet-class>enhancer.SetEnhancementsServlet</servlet-class>
  </servlet>

  <servlet-mapping>
    <servlet-name>setEnhancements</servlet-name>
    <url-pattern>/setEnhancements</url-pattern>
  </servlet-mapping>


  <welcome-file-list>
    <welcome-file>enhancements.jsp</welcome-file>
  </welcome-file-list>
```

Example of Use

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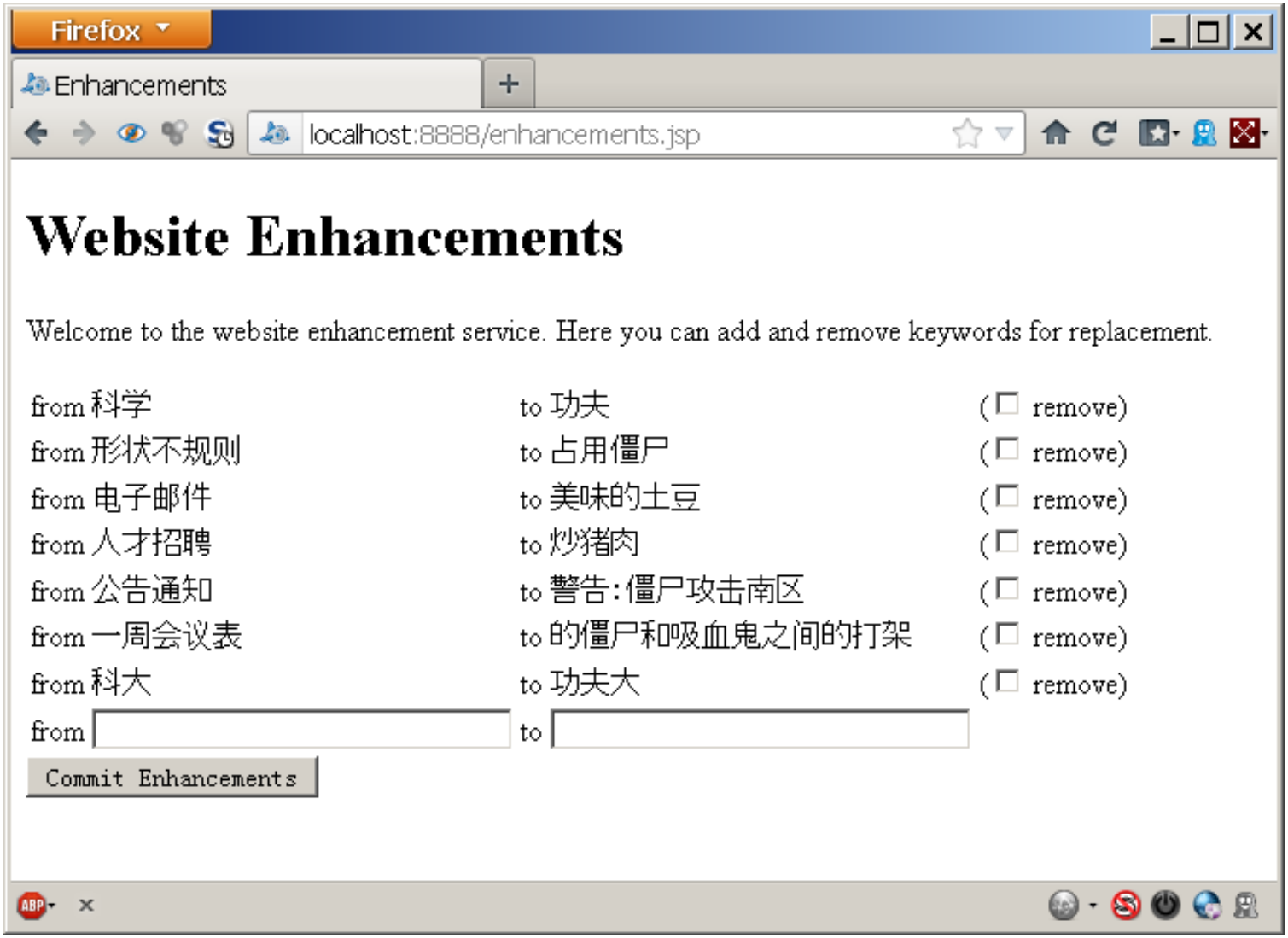

Example of Use

Deployment

- go to `https://appengine.google.com/` and log in with your Google account

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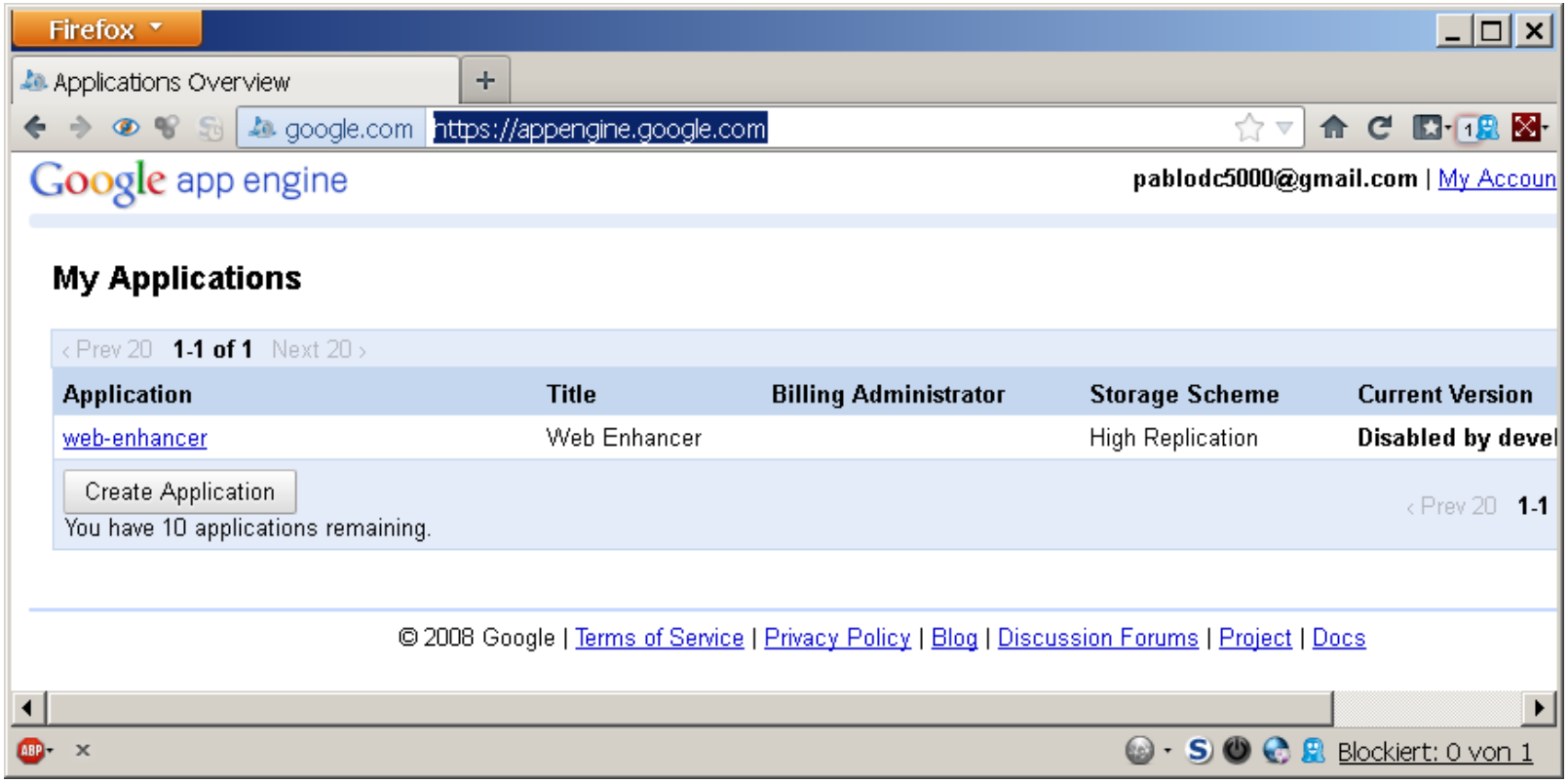
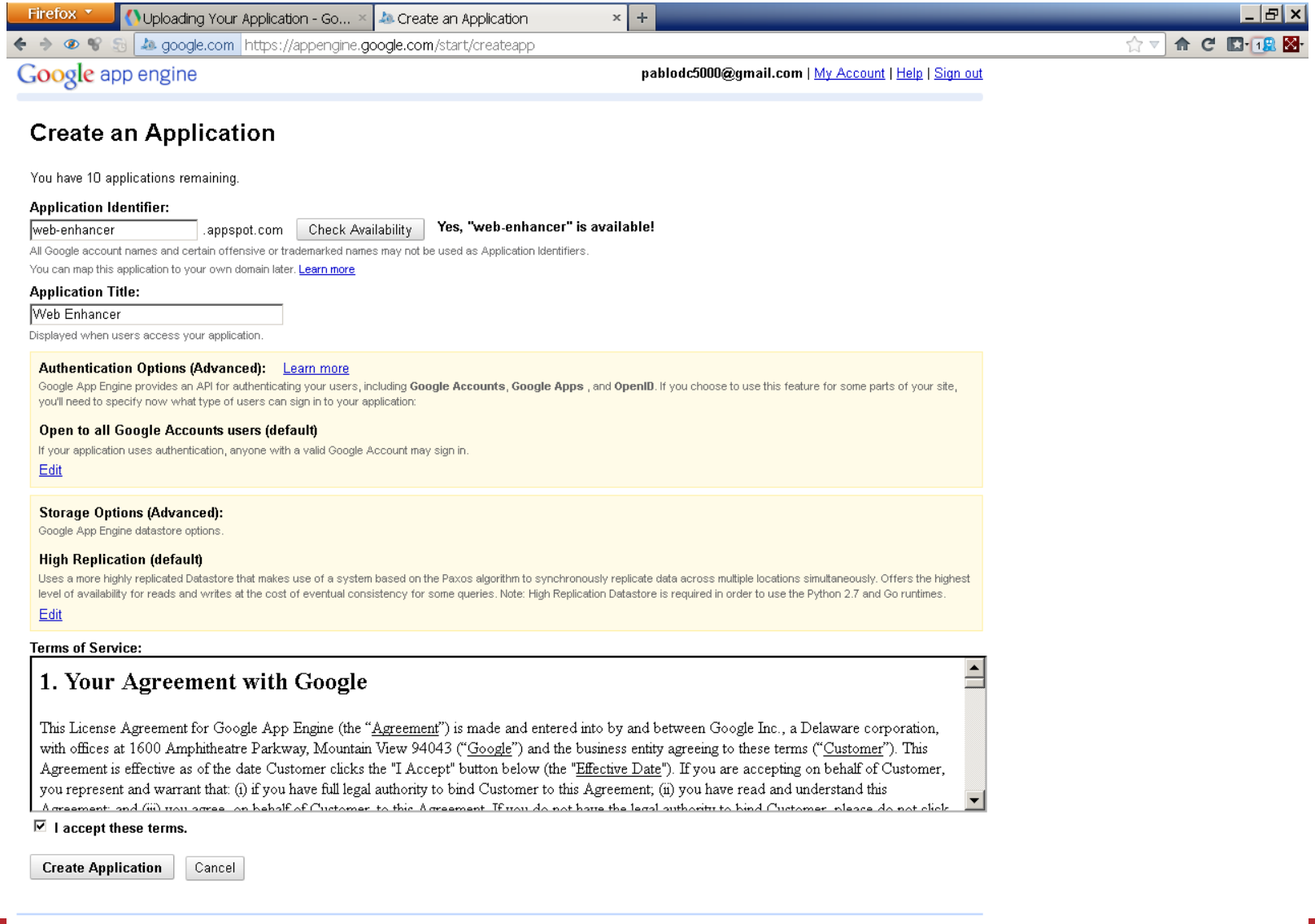


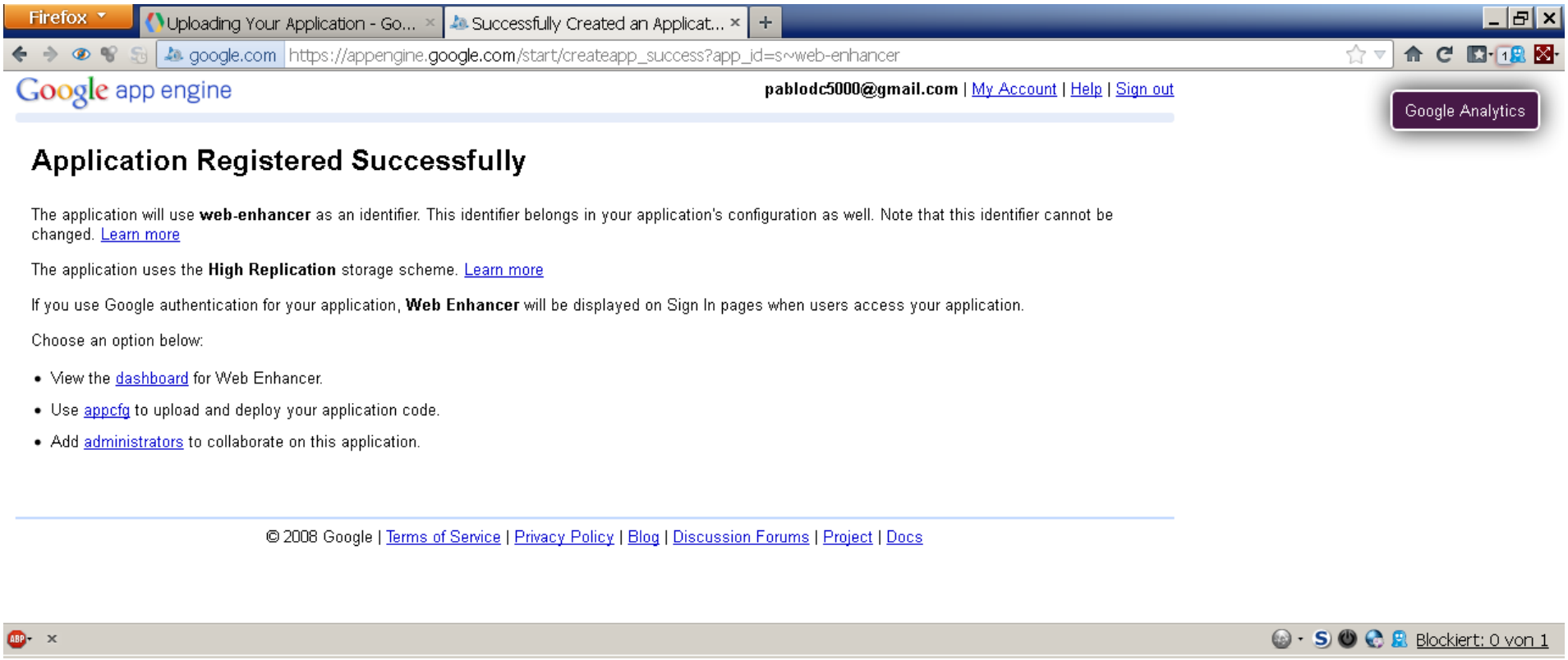
Deployment

- go to `https://appengine.google.com/` and log in with your Google account
- Choose `Create an Application` and fill out and submit the form

Deployment


Firefox
Uploading Your Application - Go...
Create an Application
google.com
https://appengine.google.com/start/createapp
Google app engine
pablodc5000@gmail.com | My Account | Help | Sign out
Create an Application
You have 10 applications remaining.
Application Identifier:
web-enhancer
.appspot.com
Check Availability
Yes, "web-enhancer" is available!
All Google account names and certain offensive or trademarked names may not be used as Application Identifiers.
You can map this application to your own domain later. Learn more
Application Title:
Web Enhancer
Displayed when users access your application.
Authentication Options (Advanced): Learn more
Google App Engine provides an API for authenticating your users, including Google Accounts, Google Apps , and OpenID. If you choose to use this feature for some parts of your site, you'll need to specify now what type of users can sign in to your application:
Open to all Google Accounts users (default)
If your application uses authentication, anyone with a valid Google Account may sign in.
Edit
Storage Options (Advanced):
Google App Engine datastore options.
High Replication (default)
Uses a more highly replicated Datastore that makes use of a system based on the Paxos algorithm to synchronously replicate data across multiple locations simultaneously. Offers the highest level of availability for reads and writes at the cost of eventual consistency for some queries. Note: High Replication Datastore is required in order to use the Python 2.7 and Go runtimes.
Edit
Terms of Service:
1. Your Agreement with Google
This License Agreement for Google App Engine (the "Agreement") is made and entered into by and between Google Inc., a Delaware corporation, with offices at 1600 Amphitheatre Parkway, Mountain View 94043 ("Google") and the business entity agreeing to these terms ("Customer"). This Agreement is effective as of the date Customer clicks the "I Accept" button below (the "Effective Date"). If you are accepting on behalf of Customer, you represent and warrant that: (i) if you have full legal authority to bind Customer to this Agreement; (ii) you have read and understand this
I accept these terms.
Create Application
Cancel
© 2008 Google | Terms of Service | Privacy Policy | Blog | Discussion Forums | Project | Docs

Deployment


Firefox
Uploading Your Application - Go...
Successfully Created an Applicat...
google.com
https://appengine.google.com/start/createapp_success?app_id=s~web-enhancer
Google app engine
pablodc5000@gmail.com | My Account | Help | Sign out
Google Analytics
Application Registered Successfully
The application will use web-enhancer as an identifier. This identifier belongs in your application's configuration as well. Note that this identifier cannot be changed. Learn more
The application uses the High Replication storage scheme. Learn more
If you use Google authentication for your application, Web Enhancer will be displayed on Sign In pages when users access your application.
Choose an option below:
View the dashboard for Web Enhancer.
Use appcfg to upload and deploy your application code.
Add administrators to collaborate on this application.
© 2008 Google | Terms of Service | Privacy Policy | Blog | Discussion Forums | Project | Docs
Blockiert: 0 von 1

Deployment

- go to `https://appengine.google.com/` and log in with your Google account
- Choose `Create an Application` and fill out and submit the form
- Fill out the fields in the `/war/WEB-INF/appengine-web.xml` file with the information (application id) that you have registered

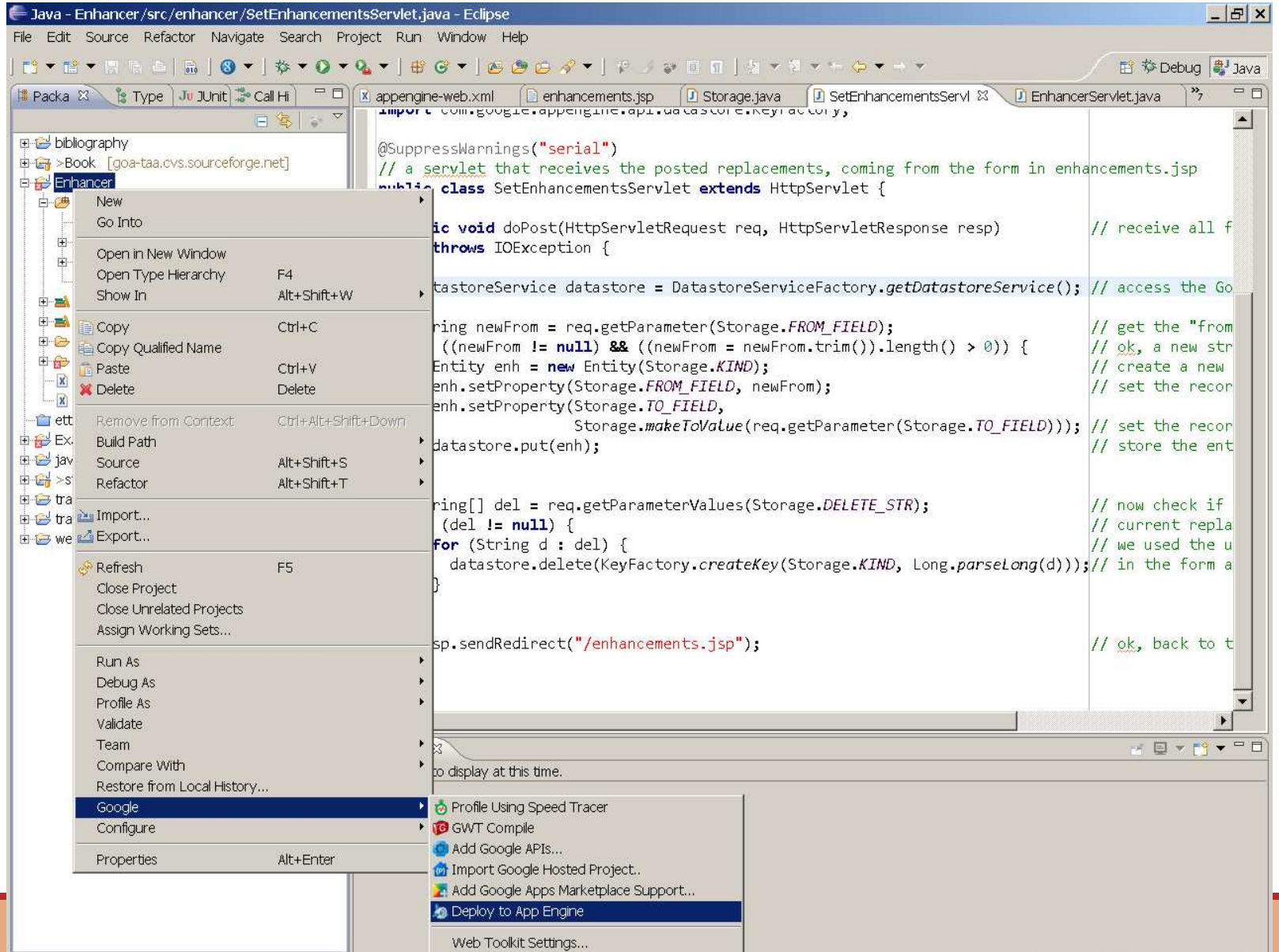
Listing: The appengine-web specification for the Enhancer (appengine-web.xml).

```
<?xml version="1.0" encoding="utf-8"?>
<appengine-web-app xmlns="http://appengine.google.com/ns/1.0">
  <application></application>
  <version>1</version>

  <!--
    Allows App Engine to send multiple requests to one instance in parallel:
  -->
  <threadsafe>true</threadsafe>

  <!-- Configure java.util.logging -->
  <system-properties>
    <property name="java.util.logging.config.file" value="WEB-INF/logging.properties"/>
  </system-properties>

  <!--
    HTTP Sessions are disabled by default. To enable HTTP sessions specify:

      <sessions-enabled>true</sessions-enabled>

    It's possible to reduce request latency by configuring your application to
    asynchronously write HTTP session data to the datastore:

      <async-session-persistence enabled="true" />

    With this feature enabled, there is a very small chance your app will see
    stale session data. For details, see
    http://code.google.com/appengine/docs/java/config/appconfig.html#Enabling_Sessions
  -->

</appengine-web-app>
```

Deployment

- go to `https://appengine.google.com/` and log in with your Google account
- Choose `Create an Application` and fill out and submit the form
- Fill out the fields in the `/war/WEB-INF/appengine-web.xml` file with the information (application id) that you have registered
- Select `Google` $\Longrightarrow$ `Deploy to App Engine` for your project

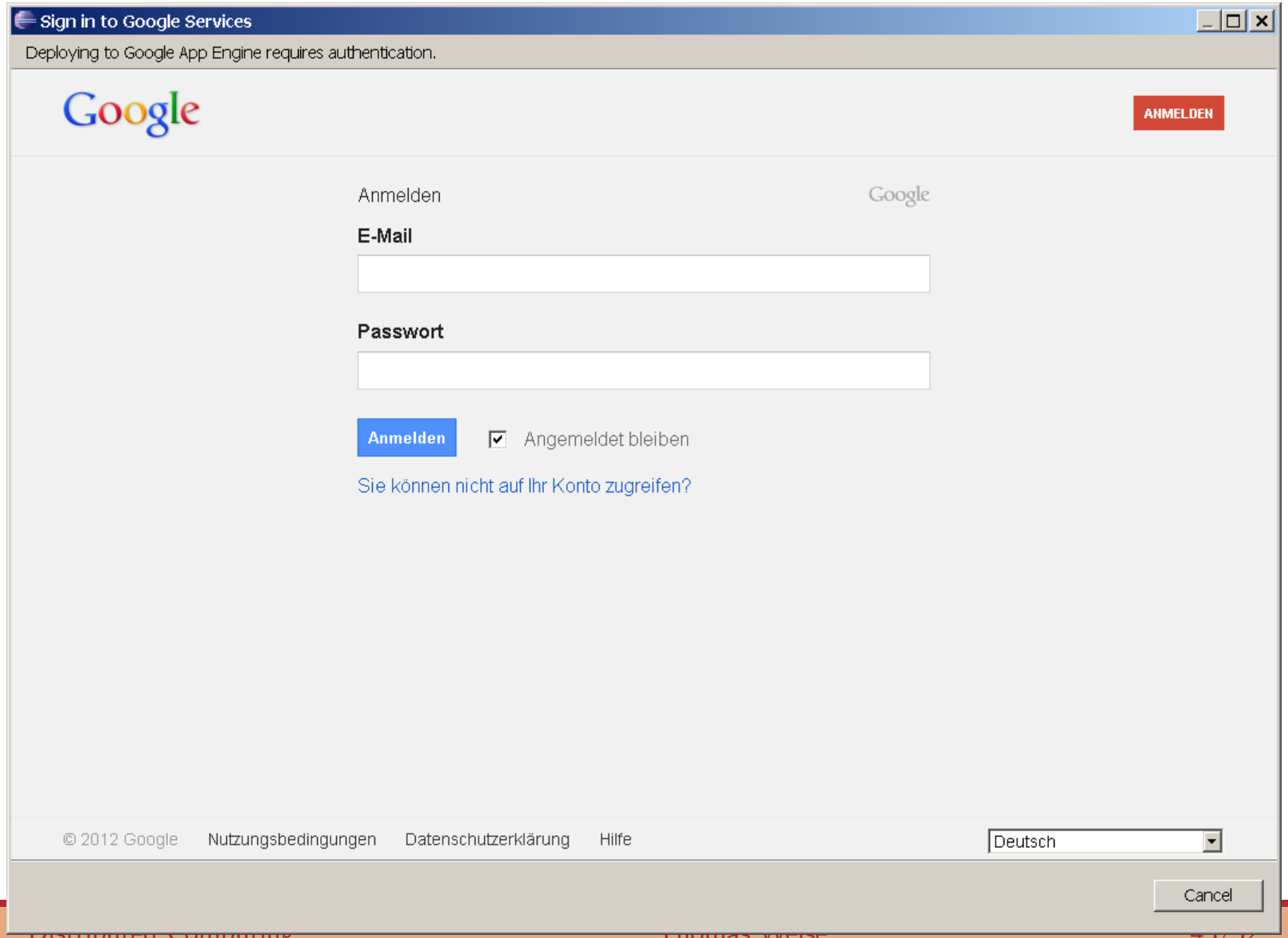
Deployment


Java - Enhancer/src/enhancer/SetEnhancementsServlet.java - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help
Debug Java
Packa Type JUnit Call Hi
appengine-web.xml enhancements.jsp Storage.java SetEnhancementsServl EnhancerServlet.java
bibliography
>Book [goa-taa.cvs.sourceforge.net]
Enhancer
New
Go Into
Open in New Window
Open Type Hierarchy F4
Show In Alt+Shift+W
Copy Ctrl+C
Copy Qualified Name
Paste Ctrl+V
Delete Delete
Remove from Context Ctrl+Alt+Shift+Down
Build Path
Source Alt+Shift+S
Refactor Alt+Shift+T
Import...
Export...
Refresh F5
Close Project
Close Unrelated Projects
Assign Working Sets...
Run As
Debug As
Profile As
Validate
Team
Compare With
Restore from Local History...
Google
Configure
Properties Alt+Enter
Profile Using Speed Tracer
GWT Compile
Add Google APIs...
Import Google Hosted Project..
Add Google Apps Marketplace Support...
Deploy to App Engine
Web Toolkit Settings...
@SuppressWarnings("serial")
// a servlet that receives the posted replacements, coming from the form in enhancements.jsp
class SetEnhancementsServlet extends HttpServlet {
ic void doPost(HttpServletRequest req, HttpServletResponse resp) // receive all f
throws IOException {
tastoreService datastore = DatastoreServiceFactory.getDatastoreService(); // access the Go
ring newFrom = req.getParameter(Storage.FROM_FIELD); // get the "from
((newFrom != null) && ((newFrom = newFrom.trim()).length() > 0)) { // ok, a new str
Entity enh = new Entity(Storage.KIND); // create a new
enh.setProperty(Storage.FROM_FIELD, newFrom); // set the recor
enh.setProperty(Storage.TO_FIELD,
Storage.makeToValue(req.getParameter(Storage.TO_FIELD))); // set the recor
datastore.put(enh); // store the ent
ring[] del = req.getParameterValues(Storage.DELETE_STR); // now check if
(del != null) { // current repla
for (String d : del) { // we used the u
datastore.delete(KeyFactory.createKey(Storage.KIND, Long.parseLong(d))); // in the form a
}
sp.sendRedirect("/enhancements.jsp"); // ok, back to t
to display at this time.

Deployment

- go to `https://appengine.google.com/` and log in with your Google account
- Choose `Create an Application` and fill out and submit the form
- Fill out the fields in the `/war/WEB-INF/appengine-web.xml` file with the information (application id) that you have registered
- Select `Google` $\Longrightarrow$ `Deploy to App Engine` for your project
- Log in again with your Google account, this time under Eclipse

Deployment


Sign in to Google Services
Deploying to Google App Engine requires authentication.
Google
ANMELDEN
Anmelden
Google
E-Mail
Passwort
Anmelden
Angemeldet bleiben
Sie können nicht auf Ihr Konto zugreifen?
© 2012 Google
Nutzungsbedingungen
Datenschutzerklärung
Hilfe
Deutsch
Cancel

Deployment

- go to `https://appengine.google.com/` and log in with your Google account
- Choose `Create an Application` and fill out and submit the form
- Fill out the fields in the `/war/WEB-INF/appengine-web.xml` file with the information (application id) that you have registered
- Select `Google` $\Longrightarrow$ `Deploy to App Engine` for your project
- Log in again with your Google account, this time under Eclipse
- Click OK in the following dialog

Deployment

- go to `https://appengine.google.com/` and log in with your Google account
- Choose `Create an Application` and fill out and submit the form
- Fill out the fields in the `/war/WEB-INF/appengine-web.xml` file with the information (application id) that you have registered
- Select `Google` $\Longrightarrow$ `Deploy to App Engine` for your project
- Log in again with your Google account, this time under Eclipse
- Click OK in the following dialog
- . . . your project will now automatically be deployed

Deployment

- go to `https://appengine.google.com/` and log in with your Google account
- Choose `Create an Application` and fill out and submit the form
- Fill out the fields in the `/war/WEB-INF/appengine-web.xml` file with the information (application id) that you have registered
- Select `Google` $\Longrightarrow$ `Deploy to App Engine` for your project
- Log in again with your Google account, this time under Eclipse
- Click OK in the following dialog
- ... your project will now automatically be deployed
- ... it is now running under `your-app-id.appspot.com`

Deployment

- go to `https://appengine.google.com/` and log in with your Google account
- Choose `Create an Application` and fill out and submit the form
- Fill out the fields in the `/war/WEB-INF/appengine-web.xml` file with the information (application id) that you have registered
- Select `Google` $\Longrightarrow$ `Deploy to App Engine` for your project
- Log in again with your Google account, this time under Eclipse
- Click OK in the following dialog
- ...your project will now automatically be deployed
- ...it is now running under `your-app-id.appspot.com`
- ...which is currently blocked, so we cannot do this...

Deployment

- go to `https://appengine.google.com/` and log in with your Google account
- Choose `Create an Application` and fill out and submit the form
- Fill out the fields in the `/war/WEB-INF/appengine-web.xml` file with the information (application id) that you have registered
- Select `Google` $\Longrightarrow$ `Deploy to App Engine` for your project
- Log in again with your Google account, this time under Eclipse
- Click OK in the following dialog
- ...your project will now automatically be deployed
- ...it is now running under `your-app-id.appspot.com`
- ...which is currently blocked, so we cannot do this...
- But: GAE is just ONE example and this is ONE example for the deployment process – there are several other similar products you can use

Summary

- Cloud computing is a the current trend/hype: IT becomes a commodity
- It touches many different aspects of IT, ranging from specific software products to whole infrastructures
- It offers many chances (price, convenience), but also many dangers (security, liability)
- GAE: one example for Platform-as-a-Service
- In its `Java` flavor: dynamic scaling, replication, and hosting of Java Servlets and JavaServer Pages
- These two techniques also exist independently!

谢谢

Thank you

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Caspar David Friedrich, “Der Wanderer über dem Nebelmeer”, 1818
http://en.wikipedia.org/wiki/Wanderer_above_the_Sea_of_Fog

Bibliography

Bibliography I

1. Peter Mell and Timothy Grance. *The NIST Definition of Cloud Computing – Recommendations of the National Institute of Standards and Technology – NIST Special Publication 800-145*. Gaithersburg, MD, USA: U.S. Department of Commerce, National Institute of Standards and Technology (NIST), Information Technology Laboratory (ITL), Computer Security Division, September 2011. URL http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf.
2. Anthony T. Velte, Toby J. Velte, and Robert C. Elsenpeter. *Cloud Computing: A Practical Approach*. Maidenhead, England, UK: McGraw-Hill Ltd., 2009. ISBN 0071626948 and 9780071626941. URL http://books.google.de/books?id=mf0LMXve2gEC.
3. Károly (Karl) Zipernowsky, Ottó (Otto Titus) Bláthy, and Miksa (Maximillian) Déri. *Induction Coil*, volume US0352105 of *United States Patent*. November 2, 1886. URL http://www.freepatentsonline.com/0352105.pdf.
4. Nikola Tesla. A new system of alternating current motors and transformers, May 16, 1888. URL http://en.wikisource.org/wiki/A_New_System_of_Alternating_Current_Motors_and_Transformers.
5. Larry Dignan. Comparing infrastructure as a service providers: Amazon, rackspace emerge. Technical report, San Francisco, CA, USA: CBS Interactive, July 9, 2009. URL https://www.zdnet.com/blog/btl/comparing-infrastructure-as-a-service-providers-amazon-rackspace-emerge/20689.
6. James Murty. *Programming Amazon Web Services: S3, EC2, SQS, FPS, and SimpleDB*. Safari Books Online. Sebastopol, CA, USA: O'Reilly Media, Inc., 2008. ISBN 0596515812 and 9780596515812. URL http://books.google.de/books?id=xIauw5xWTO8C.
7. Donald Robinson. *Amazon Web Services Made Simple: Learn How Amazon EC2, S3, Simpledb and Sqs Web Services Enables You to Reach Business Goals Faster*. Newstead, QLD, Australia: Emereo Pty Limited, 2008. ISBN 1921573066 and 9781921573064. URL http://books.google.de/books?id=jsxLPQAACAAJ.
8. Google app engine, 2012. URL https://developers.google.com/appengine/.
9. Dan Sanderson. *Programming Google App Engine*. Animal Guide. Sebastopol, CA, USA: O'Reilly Media, Inc., 2009. ISBN 059652272X and 9780596522728. URL http://books.google.de/books?id=6cL_kCZ4NJ4C.
10. Eugene Ciurana. *Developing With Google App Engine*. Berlin, Germany: Springer-Verlag GmbH, 2009. ISBN 1-4302-1831-2 and 978-1-4302-1831-9. URL http://books.google.de/books?id=_ks9HQLVxa.
11. Steven Holzner and Nancy Holzner. *Google Docs 4 Everyone*. Upper Saddle River, NJ, USA: FT Press (Financial Times, Pearson Education), 2009. ISBN 0789739364 and 9780789739360. URL http://books.google.de/books?id=kEitfopX7mMC.
12. Wyatt Andrews. China google hackers' goal: Spying on u.s. govt. *CBS Evening News with Scott Pelley*, June 2, 2011. URL http://www.cbsnews.com/2100-18563_162-20068474.html.

Bibliography II

13. Thomas Schneider. *SAP Business Bydesign Studio: Application Development*. SAP Press. Dedham, MA, USA: Galileo Press, Inc, 2011. ISBN 1592293670 and 9781592293674. URL http://books.google.de/books?id=dSLOSAAACAAJ.
14. David Kroenke and Donald Nilson. *Office 365 in Business*. New York, NY, USA: John Wiley & Sons Ltd., 2011. ISBN 1118150341 and 9781118150344. URL http://books.google.de/books?id=GvSBmTiNvqcC.
15. Marty Resnick. *Zimbra: Implement, Administer, Manage*. From Technologies to Solution. Birmingham, UK: Packt Publishing Limited, 2007. ISBN 1847192084 and 9781847192080. URL http://books.google.de/books?id=R-82IAAACAAJ.
16. Mat Honan. How apple and amazon security flaws led to my epic hacking. *WIRED.com*, August 6, 2012. URL http://www.wired.com/gadgetlab/2012/08/apple-amazon-mat-honan-hacking/all/.
17. Ben Sisario. Media decoder: Behind the screens, between the lines – digital notes: Judge sides with megaupload over police raid. *The New York Times*, March 19, 2012. URL http://mediadecoder.blogs.nytimes.com/2012/03/19/digital-notes-judge-sides-with-megaupload-over-police-raid/.
18. Twitter hands over messages at heart of occupy case. *BBC News*, September 14, 2012. URL http://www.bbc.co.uk/news/technology-19597437.
19. Joris Van Hoboken, Axel Arnbak, and Nico Van Eijk. Cloud computing in higher education and research institutions and the usa patriot act. Social science research network: Tomorrow's research today (ssrn), Rochester, NY, USA: Social Science Electronic Publishing, Inc, November 12, 2012. URL http://ssrn.com/abstract=2181534.
20. Didier Bigo, Gertjan Boulet, Caspar Bowden, Sergio Carrera, Julien Jeandesboz, and Amandine Scherrer. *Fighting Cyber Crime and Protecting Privacy in the Cloud [PE 462.509]*. Brussels, Belgium: European Parliament, Directorate General for Internal Policies, Policy Department C: Citizens' Rights and Constitutional Affairs, 2012. URL http://www.europarl.europa.eu/committees/en/studiesdownload.html?languageDocument=EN&file=79050.
21. Zack Whittaker. Microsoft admits patriot act can access eu-based cloud data. Zdnet – blog – igeneration: Charlie osborne talks about (and to) the next generation of it users., San Francisco, CA, USA: CBS Interactive, June 28, 2011. URL http://www.zdnet.com/blog/igeneration/microsoft-admits-patriot-act-can-access-eu-based-cloud-data/11225.
22. *USA PATRIOT Act (H.R. 3162)*. Washington, DC, USA: The Senate of the United States, October 24, 2001.
23. Trust center: Security, privacy and compliance information for microsoft online services. data use limits, 2012. URL https://www.microsoft.com/online/legal/v2/?docid=23.
24. Marcus Gallagher. U.s. spy law authorizes mass surveillance of european citizens: Report. *Slate*, January 8, 2013. URL http://www.slate.com/blogs/future_tense/2013/01/08/fisa_renewal_report_suggests_spy_law_allows_mass_surveillance_of_european.html.

Bibliography III

25. *Foreign Intelligence Surveillance Act ((FISA))*. Washington, DC, USA: United States House of Representatives, 110th congress 2d session edition, June 18, 2008. URL http://www.politico.com/static/PPM104_080619_fisapromise.htm.
26. Glenn Greenwald, Ewen MacAskill, and Laura Poitras. Edward snowden: The whistleblower behind the nsa surveillance revelations. July 11, 2013.
27. Thomas Drake. Snowden saw what i saw: Surveillance criminally subverting the constitution. June 10, 2013.
28. Declan McCullagh. U.s. gives big, secret push to internet surveillance. *CNET*, April 24, 2013. URL http://news.cnet.com/8301-13578_3-57581161-38/u.s-gives-big-secret-push-to-internet-surveillance/. Justice Department agreed to issue "2511 letters" immunizing AT&T and other companies participating in a cybersecurity program from criminal prosecution under the Wiretap Act, according to new documents obtained by the Electronic Privacy Information Center.
29. Glenn Greenwald. Are all telephone calls recorded and accessible to the us government? May 4, 2014. URL http://www.guardian.co.uk/commentisfree/2013/may/04/telephone-calls-recorded-fbi-boston.
30. Herbert Schildt. *Java 2: A Beginner's Guide*. Essential Skills for First-Time Programmers. Maidenhead, England, UK: McGraw-Hill Ltd., 2002. ISBN 0072225130 and 9780072225136. URL http://books.google.de/books?id=YWDJJGYaLG4C.
31. Learning java, 2007. URL http://en.wikiversity.org/wiki/Learning_JAVA.
32. Robert Sedgewick. *Algorithms in Java, Parts 1–4 (Fundamentals: Data Structures, Sorting, Searching)*. Reading, MA, USA: Addison-Wesley Professional, 3rd edition, September 2002. ISBN 0-201-36120-5 and 978-0-201-36120-9. URL http://books.google.de/books?id=hyvdUQUmf2UC. With Java consultation by Michael Schidlowsky.
33. Zbigniew Michael Sikora. *Java: Practical Guide for Programmers*. Morgan Kaufmann Practical Guides. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc., 2003. ISBN 1558609091 and 9781558609099. URL http://books.google.de/books?id=YQLj_AsVN9QC.
34. Santa Clara, CA, USA: Sun Microsystems, Inc. *Java™ 2 Platform Standard Edition 5.0 – API Specification*, October 19, 2010.
35. James Gosling, William Nelson Joy, Guy Lewis Steele Jr., and Gilad Bracha. *The Java™ Language Specification*. The Java Series. Upper Saddle River, NJ, USA: Prentice Hall International Inc., Santa Clara, CA, USA: Sun Microsystems Press (SMP), and Reading, MA, USA: Addison-Wesley Professional, 3rd edition, May 2005. ISBN 0-321-24678-0 and 978-0321246783. URL http://java.sun.com/docs/books/jls/.
36. James Gosling and Henry McGilton. The java language environment – a white paper. Technical report, Santa Clara, CA, USA: Sun Microsystems, Inc., May 1996. URL http://java.sun.com/docs/white/langenv/.

Bibliography IV

37. Guido Krüger. *Handbuch der Java-Programmierung*. 4. aktualisierte edition. ISBN 3-8273-2361-4 and 3-8273-2447-5. URL http://www.javabuch.de/.
38. Christian Ullenboom. *Java ist auch eine Insel – Programmieren mit der Java Standard Edition Version 6*. Bonn, North Rhine-Westphalia, Germany: Galileo-Press, 6. aktualisierte und erweiterte edition, 2007. ISBN 3-89842-838-9 and 978-3-89842-838-5. URL http://www.galileocomputing.de/openbook/javainsel6/.
39. William Crawford and Jonathan Kaplan. *J2EE Design Patterns*. Patterns of the Real World. Sebastopol, CA, USA: O'Reilly Media, Inc., 2003. ISBN 0596004273 and 9780596004279. URL http://books.google.de/books?id=x-7_W0P9KGsC.
40. Alex Martelli. *Python in a Nutshell*. Nutshell Series. Sebastopol, CA, USA: O'Reilly Media, Inc., 2006. ISBN 0596100469 and 9780596100469. URL http://books.google.de/books?id=JnR9hQA3SncC.
41. Mark Lutz. *Learning Python*. Learning Series. Sebastopol, CA, USA: O'Reilly Media, Inc., 2009. ISBN 0596158068 and 9780596158064. URL http://books.google.de/books?id=1HxWGezDZcgC.
42. John P. Baugh. *Go Programming*. Charleston, SC, USA: CreateSpace, a DBA of On-Demand Publishing, LLC, 2010. ISBN 1453636676 and 9781453636671. URL http://books.google.de/books?id=H91YSwAACAAJ.
43. David Chisnall. *The Go Programming Language Phrasebook*. Developer's Library. Reading, MA, USA: Addison-Wesley Professional, 2012. ISBN 0321817141 and 9780321817143. URL http://books.google.de/books?id=8chKXwAACAAJ.
44. Timothy John Berners-Lee, R. Fielding, and H. Frystyk. *Hypertext Transfer Protocol – HTTP/1.0*, volume 1945 of *Request for Comments (RFC)*. Network Working Group, May 1996. URL http://tools.ietf.org/html/rfc1945.
45. R. Fielding, J. Gettys, Jeffrey Mogul, H. Frystyk, L. Masinter, P. Leach, and Timothy John Berners-Lee. *Hypertext Transfer Protocol – HTTP/1.1*, volume 2616 of *Request for Comments (RFC)*. Network Working Group, June 1999. URL http://tools.ietf.org/html/rfc2616.
46. Pierre Delisle, Jan Luehe, and Mark Roth. *JSR 245: JavaServer Pages™ 2.1 Final Release*, volume 245 of *Java Specification Requests (JSR)*. May 8, 2006. URL http://jcp.org/aboutJava/communityprocess/final/jsr245/index.html.
47. Hans Bergsten. *JavaServer Pages*. The Java Series. Upper Saddle River, NJ, USA: Prentice Hall International Inc., Santa Clara, CA, USA: Sun Microsystems Press (SMP), and Reading, MA, USA: Addison-Wesley Professional, 2003. ISBN 0596005636 and 9780596005634. URL http://books.google.de/books?id=JNE8sqfQNAUC.
48. Vivek Chopra, Jon Eaves, Rupert Jones, Sing Li, and John T. Bell. *Beginning JavaServer Pages*. Wrox Beginning Guides. New York, NY, USA: John Wiley & Sons Ltd., 2005. ISBN 0764589520 and 9780764589522. URL http://books.google.de/books?id=du6Y1dROmAUC.
49. Marty Hall. Javaserver pages (jsp) 1.0, September 23, 2010. URL http://www.apl.jhu.edu/~hall/java/Servlet-Tutorial/Servlet-Tutorial-JSP.html.

Bibliography V

50. Steven Holzner. *PHP: The Complete Reference*. Maidenhead, England, UK: McGraw-Hill Ltd., 2007. ISBN 0071508546 and 9780071508544. URL http://books.google.de/books?id=Ee_22ndP6gIC.
51. Randal Schwartz, Brian Foy, and Tom Phoenix. *Learning Perl*. Sebastopol, CA, USA: O'Reilly Media, Inc., 2011. ISBN 1449313140 and 9781449313142. URL http://books.google.de/books?id=l2IwEuRjeNwC.
52. Rajiv Mordani. *JSR 315: Java™ Servlet 3.0 Specification Version 3.0 Rev a (Maintenance Release)*, volume 315 of *Java Specification Requests (JSR)*. Maintenance release edition, December 2010. URL http://download.oracle.com/otndocs/jcp/servlet-3.0-mrel-eval-oth-JSpec.
53. Karl Moss. *Java Servlets*. McGraw-Hill Java Masters. Maidenhead, England, UK: McGraw-Hill Ltd., 1999. ISBN 0071351884 and 9780071351881. URL http://books.google.de/books?id=ToBGAAAAYAAJ.
54. Jason Hunter and William Crawford. *Java Servlet Programming*. Java Series. Sebastopol, CA, USA: O'Reilly & Associates, Inc., 2001. ISBN 0596000405 and 9780596000400. URL http://books.google.de/books?id=dsU4Lk-GwkOC.
55. Jason Brittain and Ian F. Darwin. *Tomcat: The Definitive Guide*. Definitive Guide. Sebastopol, CA, USA: O'Reilly Media, Inc., 2007. ISBN 0596101066 and 9780596101060. URL http://books.google.de/books?id=vJttHyVF0SUC.
56. *Apache Tomcat*. Forest Hill, MD, USA: Apache Software Foundation, 1999. URL https://tomcat.apache.org/.
57. Deepal Jayasinghe. *Quickstart Apache Axis2*. Birmingham, UK: Packt Publishing Limited, 2008. ISBN 1847192866 and 9781847192868. URL http://books.google.de/books?id=wVdyNwAACAAJ.
58. Kent Ka Iok Tong. *Developing Web Services with Apache Axis2*. Charleston, SC, USA: BookSurge, 2008. ISBN 9993792918 and 9789993792918. URL http://books.google.de/books?id=O15OPwAACAAJ.
59. *Apache Axis2/Java*. Forest Hill, MD, USA: Apache Software Foundation, 2012. URL http://axis.apache.org/axis2/java/core/.
60. Antonio Goncalves. *Beginning Java EE 6 Platform with GlassFish 3. From Novice to Professional.* Expert's Voice in Java Technology. New York, NY, USA: Apress, Inc., 2010. ISBN 143022889X and 9781430228899. URL http://books.google.de/books?id=8pQbMr5X-yMC.
61. *Jetty WebServer*. Fortitude Valley BC, QLD, Australia: codehause foundation and Riverview, NSW, Australia: Mort Bay Consulting Pty. Ltd, 1995. URL http://jetty.codehaus.org/jetty/.
62. *Eclipse*. Ottawa, ON, Canada: Eclipse Foundation. URL http://www.eclipse.org/.
63. The j2ee™ tutorial: Web application archives, April 19, 2002. URL http://java.sun.com/j2ee/tutorial/1_3-fcs/doc/WCC3.html.

Bibliography VI

64. USA: The Unicode Consortium Mountain View, CA and Julie D. Allen. *The Unicode Standard, Version 5.0*. Reading, MA, USA: Addison-Wesley Professional, fifth edition, 2007. ISBN 0-321-48091-0 and 978-0-321-48091-0. URL http://books.google.de/books?id=Yn1UAAAAMAAJ.
65. The unicode consortium, 2011. URL http://www.unicode.org/.
66. Jukka K. Korpela. *Unicode Explained*. Internationalize Documents, Programs, and Web Sites. Sebastopol, CA, USA: O'Reilly Media, Inc., June 28, 2006. ISBN 059610121X and 9780596101213. URL http://books.google.de/books?id=PcWU2yxc8WkC.