CNT 4714: Enterprise Computing Spring 2010

Introduction To Servlet Technology – Part 1

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Client-Server Relationship Revisited

- In a client-server relationship, the client requests that some action be performed and the server performs the action and responds to the client.
- This request-response model of communication is the foundation for the highest-level view of networking in Java – servlets and JavaServer Pages (JSP).
- A servlet extends the functionality of a server, such as a Web server that serves Web pages to a user's browser using the HTTP protocol. A servlet can almost be thought of as an applet that runs on the server side--without a face. Java servlets make many Web applications possible.
- Packages `javax.servlet` and `javax.servlet.http` provide the classes and interfaces to define servlets. Packages `javax.servlet.jsp` and `javax.servlet.jsp.tagext` provide the classes and interfaces that extend the servlet capabilities for JSP.

Client-Server Relationship Revisited (cont.)

- Using special syntax, JSP allows Web-page implementers to create pages that encapsulate Java functionality and even to write scriplets of actual Java code directly into the page.
- A common implementation of the request-response model is between Web browsers and Web servers. When a user selects a Web site to browse through the browser (the client application), a request is sent to the appropriate Web server (the server application). The server normally responds to the client by sending the appropriate XHTML Web page.
- Servlets are effective for developing Web-based solutions that help provide secure access to a Web site, interact with databases on behalf of a client, dynamically generate custom XHTML documents to be displayed by browsers and maintain unique session information for each client.

Static and Dynamic Web Content

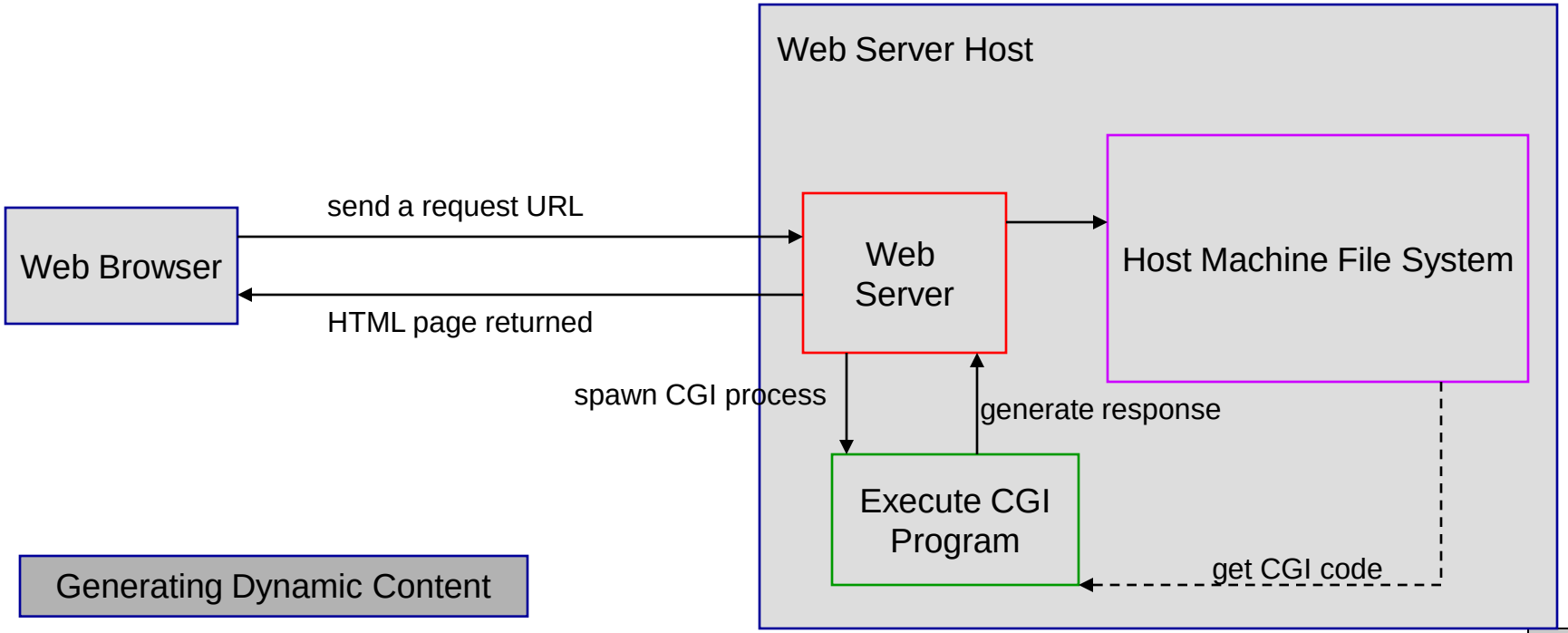
- Consider how a web page is displayed by a browser.
  - Typically, the web page is created using HTML and stored as a file on the web server. A user enters a URL for the file from a web browser. The browser contacts the web server and requests the file. The server finds the file and returns it to the browser. The browser then displays the file for the user.
- Static information is stored in HTML files. The HTML files can be updated, but at any given time, every request for the same file returns exactly the same content. The contents do not change regardless of who requested the file.

Static and Dynamic Web Content (cont.)

- Not all information, however, is static in nature. Often HTML pages need to generate information dynamically.
- Dynamic web pages are generated by web server. The web server will execute certain programs to process user requests from browsers in order to produce a customized response.
- The Common Gateway Interface (CGI) was proposed to generate dynamic web content. The interface provides a standard framework for web servers to interact with external program known as CGI programs.

CGI Programming

- When a web server receives a request from a browser it passes it to the CGI program. The CGI program processes the request and generates a response at runtime. CGI programs can be written in any language, but Perl is the most popular choice.



Generating Dynamic Content

The GET and POST Methods

- The two most common HTTP requests, also known as methods, are GET and POST.
- The web browser issues a request using a URL or an HTML form to trigger the web server to execute a CGI program. (We'll deal with forms later.) When issuing a CGI request directly from a URL, the GET method is used.
- This form of a URL is known as a query string. The URL query string consists of the location of the CGI program, parameters, and their values.
- When issuing a request from an HTML form, either a GET or POST method can be used.

The GET and POST Methods (cont.)

- The form explicitly specifies which of the two is used.
- If the GET method is used, the data in the form are appended to the request string as if they were submitted using a URL.
- If the POST method is used, the data in the form are packaged as part of the request file. The server program obtains the data by reading the file.

The GET and POST methods both send requests to the web server. The POST method always triggers the execution of the corresponding CGI program. The GET method may not cause the CGI program to be executed if the previous same request is cached in the web browser. Browsers often cache web pages so that the same request can be quickly responded to without contacting the web server. The browser checks the request sent through the GET method as a URL query string. If the results for the exact same URL are cached on a disk, then the previous web page for the URL may be displayed. To ensure that a new web page is always displayed, use the POST method.

From CGI To Java Servlets

- CGI provides a relatively simple approach for creating dynamic web applications that accept a user request, process it on the server side, and return responses to the user's browser.
- However, CGI is extremely slow when handling a large number of requests simultaneously, because the web server must spawn a process for executing each CGI program.
- Java servlets were developed to remedy the performance problem of CGI programs. Java servlets are basically Java programs that behave like CGI programs.

Java Servlets

- Java servlets are executed upon request from a web browser.
- All servlets execute inside a servlet container, also referred to as a servlet server or a servlet engine.
- A servlet container is a single process that runs a JVM (Java Virtual Machine). The JVM creates a thread to handle each servlet (recall that threads have considerably less overhead than full-blown processes). All the threads share the same memory allocated to the JVM. Since the JVM persists beyond the lifecycle of a single servlet execution, servlets can share objects already created in the JVM.
  - For example, if multiple servlets access the same database, they can share the connection object.

Thin Clients

- Servlets are the ideal solution for database-intensive applications that communicate with thin clients.
  - Thin clients are applications that provide presentation but do not process data, thus requiring few computing resources.
- The server is responsible for database access. Clients connect to the server using standard protocols available on most client platforms. The presentation-logic code for generating dynamic content can be written once and reside on the server for access by clients, to allow programmers to create efficient thin clients.

Apache Tomcat Server

- Sun Microsystems, through the Java Community Process is responsible for the development of the servlet and JSP specifications.
- To run Java servlets, you need a servlet container. While many servlet containers are available, the reference implementation of both these standards developed by the Apache Software Foundation (www.apache.org) is known as Tomcat.
- Tomcat was developed as part of the Jakarta Project. The Jakarta Project contains many subprojects designed to help commercial server-side developers.
- Tomcat became a top-level project at Apache in early October 2005.
- Tomcat is the official reference implementation of the JSP and servlet standards. Tomcat can be used standalone as a web server or plugged into a web server like Apache, IIS, etc.. The current stable implementation is Tomcat 5.5.28 (as of June 2009).

Servlet Overview and Architecture

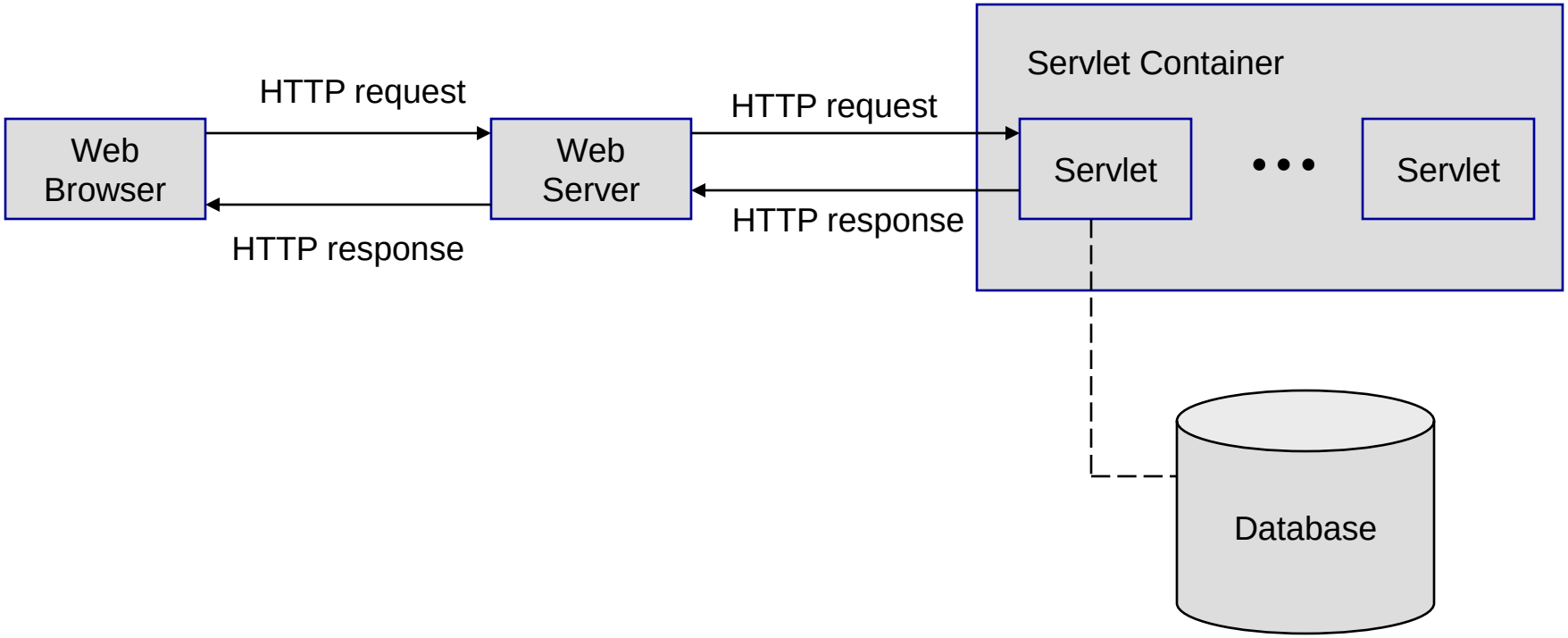
- The Internet offers many protocols. The HTTP (Hypertext Transfer Protocol) that forms the basis of the WWW uses URLs (Uniform Resource Locators) to locate resources on the Internet.
- URLs can represent files or directories and can represent complex tasks such as database lookups and Internet searches.
- JSP technology, basically an extension of servlet technology, simplifies the process of creating pages by separating presentation from content.
- Typically, JSPs are used when most of the content sent to the client is static text and markup, and only a small portion of the content is generated dynamically with Java code.

Servlet Overview and Architecture (cont.)

- Servlets are more commonly used when a small portion of the content sent to the client is static text or markup. In fact, some servlets do not produce content. Rather, they perform a task on behalf of the client, then invoke other servlets or JSPs to provide a response.
- Note that in most cases servlet and JSP technologies are interchangeable.
- The server that executes a servlet is referred to as the servlet container or servlet engine.
- Servlets and JSP have become so popular that they are now supported directly or with third-party plug-ins by most major Web servers and application servers (servers that execute applications to generate dynamic Web pages in response to requests).

Servlet Overview and Architecture (cont.)

- We'll look at servlets that implement the request-response model between clients and servers using the HTTP protocol. This architecture is shown in the diagram below.



Servlet Overview and Architecture (cont.)

Explanation of the architecture diagram on previous page

- A client application sends an HTTP request to the server.
- The servlet container receives the request and directs it to be processed by the appropriate servlet.
- The servlet does its processing, which may include interacting with a database or other server-side components, such as other servlets or JSPs.
- The servlet returns its results to the client – normally in the form of an HTML, XHTML, or XML document to display in a browser.

Interface Servlet and the Servlet Lifecycle

- Architecturally speaking, all servlets must implement the `Servlet` interface of package `javax.servlet`.
- The methods of interface `Servlet` are invoked by the servlet container. This interface declares five methods which deal with the execution of a servlet. These methods are shown on the next page. For the details see: www.java.sun.com/j2ee/1.4/docs/api/javax/servlet/Servlet.html
- A servlet's life cycle begins when the servlet container loads it into memory – normally, in response to the first request for the servlet.
- Before the servlet can handle that request, the container invokes the servlet's `init` method.

Methods of the Servlet Interface

Method	Description
destroy( )	Called by the servlet container to indicate to a servlet that the servlet is being taken out of service.
getServletConfig( )	Returns a ServletConfig object, which contains initialization and startup parameters for this servlet.
getServletInfo( )	Returns information about the servlet, such as author, version, and copyright.
init( )	Called by the servlet container to indicate to a servlet that the servlet is being placed into service.
service( )	Called by the servlet container to allow the servlet to respond to a request.

The Servlet Lifecycle

- After `init` completes execution, the servlet can respond to its first request.
- All requests are handled by the a servlet's `service` method, which receives the request, processes it and sends a response to the client.
- During the servlet's lifecycle, the method `service` is invoked once per request. Each new request is typically handled in a separate thread of execution (managed by the servlet container) in which method `service` executes.
- When the servlet container terminates the servlet (whenever the servlet needs more memory or when it is shutdown), the servlet's `destroy` method is invoked to release servlet resources.

Setting Up Tomcat

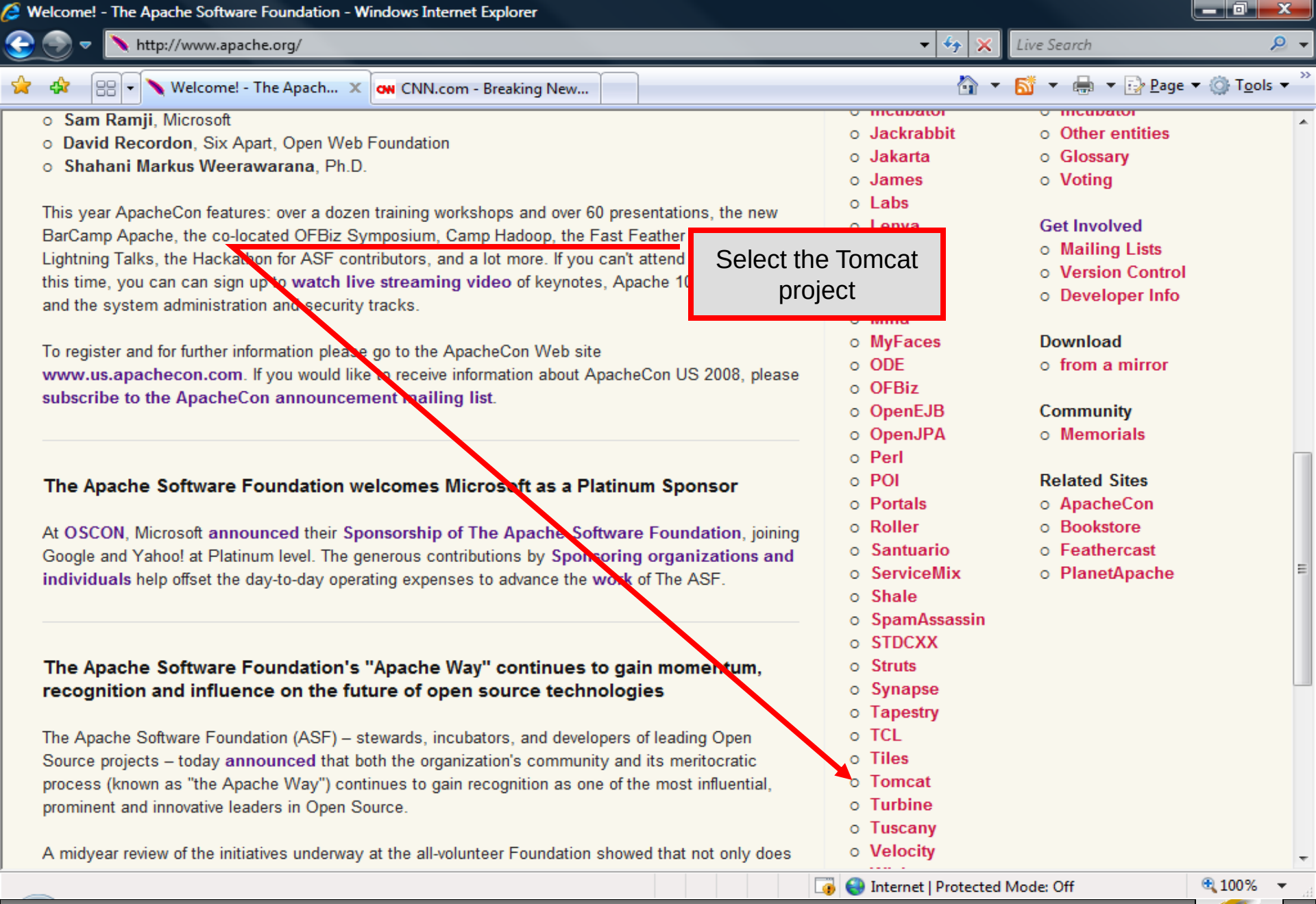
- Tomcat is a fully functional implementation of servlets and JSPs. It includes a Web server, so it can be used as a standalone test container for servlets and JSPs.

- The current stable version is 5.5.28 available from www.apache.org. This version was declared stable on June 19, 2009.

1. Select the Tomcat page from the menu on the right-hand side of the screen. As shown on page 21.

2. Once in the Tomcat project, select Download binaries from the left-hand side of the screen as shown on page 22.

3. Once in the download binaries screen, select the option of your choice. This is shown on page 24.


Welcome! - The Apache Software Foundation - Windows Internet Explorer
http://www.apache.org/
Live Search
Welcome! - The Apach...
CNN.com - Breaking New...
Page
Tools
Sam Ramji, Microsoft
David Recordon, Six Apart, Open Web Foundation
Shahani Markus Weerawarana, Ph.D.
This year ApacheCon features: over a dozen training workshops and over 60 presentations, the new BarCamp Apache, the co-located OFBiz Symposium, Camp Hadoop, the Fast Feather Lightning Talks, the Hackathon for ASF contributors, and a lot more. If you can't attend this time, you can can sign up to watch live streaming video of keynotes, Apache 10 and the system administration and security tracks.
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At OSCON, Microsoft announced their Sponsorship of The Apache Software Foundation, joining Google and Yahoo! at Platinum level. The generous contributions by Sponsoring organizations and individuals help offset the day-to-day operating expenses to advance the work of The ASF.
The Apache Software Foundation's "Apache Way" continues to gain momentum, recognition and influence on the future of open source technologies
The Apache Software Foundation (ASF) – stewards, incubators, and developers of leading Open Source projects – today announced that both the organization's community and its meritocratic process (known as "the Apache Way") continues to gain recognition as one of the most influential, prominent and innovative leaders in Open Source.
A midyear review of the initiatives underway at the all-volunteer Foundation showed that not only does
Select the Tomcat project
Jackrabbit
Jakarta
James
Labs
MyFaces
ODE
OFBiz
OpenEJB
OpenJPA
Perl
POI
Portals
Roller
Santuario
ServiceMix
Shale
SpamAssassin
STDCXX
Struts
Synapse
Tapestry
TCL
Tiles
Tomcat
Turbine
Tuscany
Velocity
Other entities
Glossary
Voting
Get Involved
Mailing Lists
Version Control
Developer Info
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Memorials
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Bookstore
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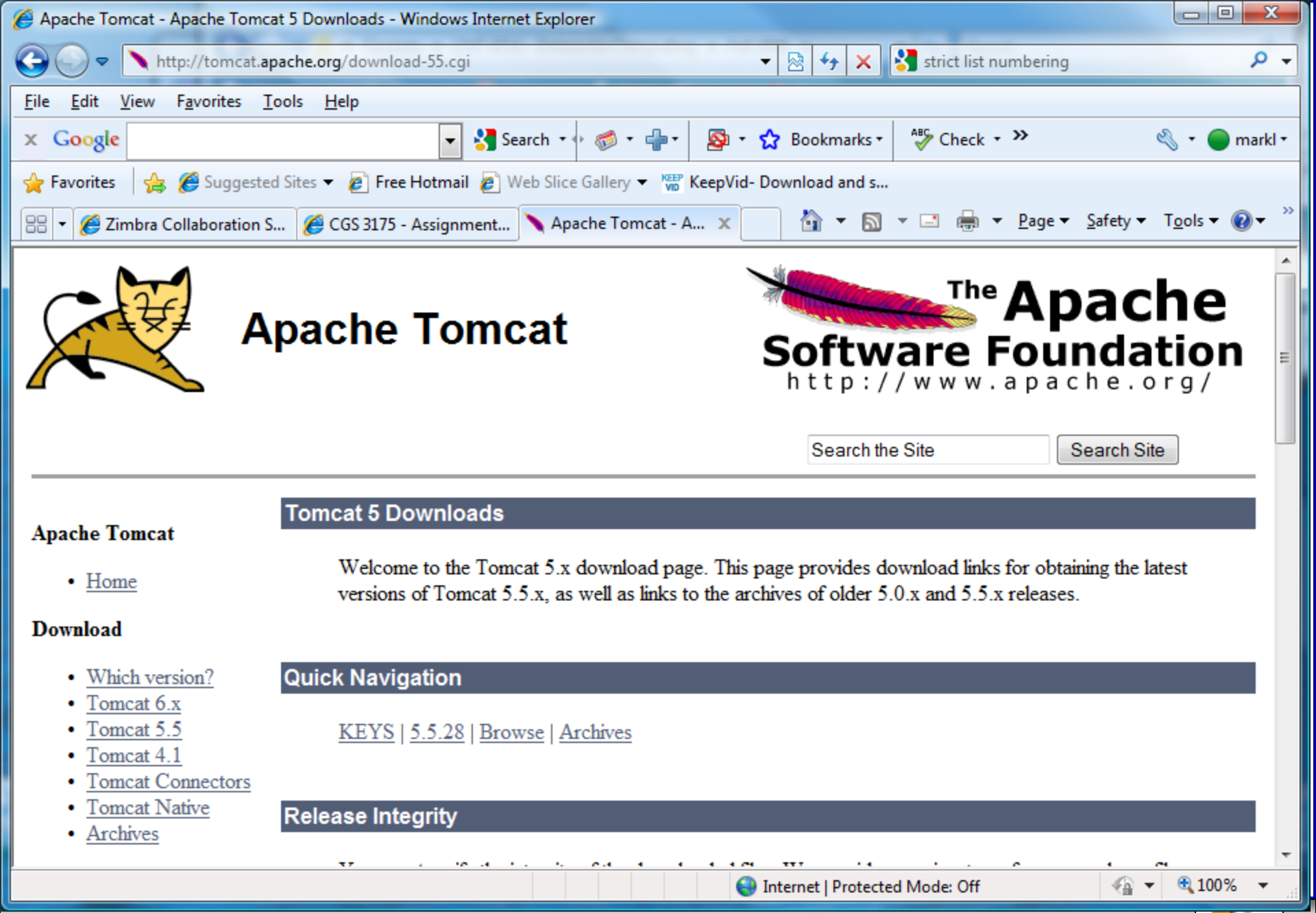
Apache Tomcat - Apache Tomcat 5 Downloads - Windows Internet Explorer
http://tomcat.apache.org/download-55.cgi
strict list numbering
File Edit View Favorites Tools Help
Google
Search
Bookmarks
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Favorites
Suggested Sites
Free Hotmail
Web Slice Gallery
KeepVid- Download and s...
Zimbra Collaboration S...
CGS 3175 - Assignment...
Apache Tomcat - A...
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Home
Download
Which version?
Tomcat 6.x
Tomcat 5.5
Tomcat 4.1
Tomcat Connectors
Tomcat Native
Archives
Tomcat 5 Downloads
Welcome to the Tomcat 5.x download page. This page provides download links for obtaining the latest versions of Tomcat 5.5.x, as well as links to the archives of older 5.0.x and 5.5.x releases.
Quick Navigation
KEYS | 5.5.28 | Browse | Archives
Release Integrity
Internet | Protected Mode: Off
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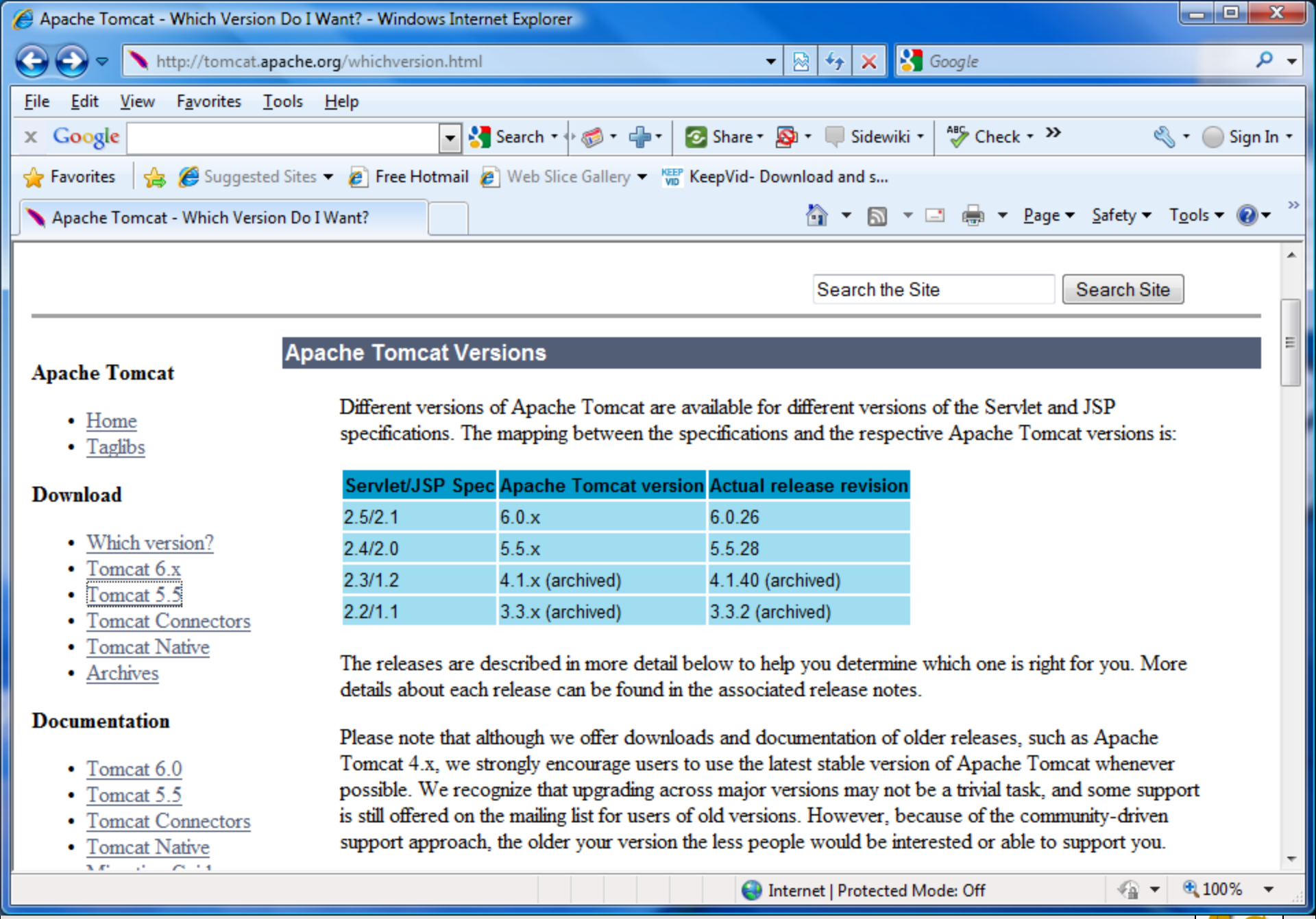
Apache Tomcat - Which Version Do I Want? - Windows Internet Explorer
http://tomcat.apache.org/whichversion.html
Google
File Edit View Favorites Tools Help
Search Share Sidewiki Check Sign In
Favorites Suggested Sites Free Hotmail Web Slice Gallery KeepVid- Download and s...
Apache Tomcat - Which Version Do I Want?
Page Safety Tools
Search the Site
Search Site
Apache Tomcat
Home
Taglibs
Download
Which version?
Tomcat 6.x
Tomcat 5.5
Tomcat Connectors
Tomcat Native
Archives
Documentation
Tomcat 6.0
Tomcat 5.5
Tomcat Connectors
Tomcat Native
Apache Tomcat Versions
Different versions of Apache Tomcat are available for different versions of the Servlet and JSP specifications. The mapping between the specifications and the respective Apache Tomcat versions is:
Servlet/JSP Spec
Apache Tomcat version
Actual release revision
2.5/2.1
6.0.x
6.0.26
2.4/2.0
5.5.x
5.5.28
2.3/1.2
4.1.x (archived)
4.1.40 (archived)
2.2/1.1
3.3.x (archived)
3.3.2 (archived)
The releases are described in more detail below to help you determine which one is right for you. More details about each release can be found in the associated release notes.
Please note that although we offer downloads and documentation of older releases, such as Apache Tomcat 4.x, we strongly encourage users to use the latest stable version of Apache Tomcat whenever possible. We recognize that upgrading across major versions may not be a trivial task, and some support is still offered on the mailing list for users of old versions. However, because of the community-driven support approach, the older your version the less people would be interested or able to support you.
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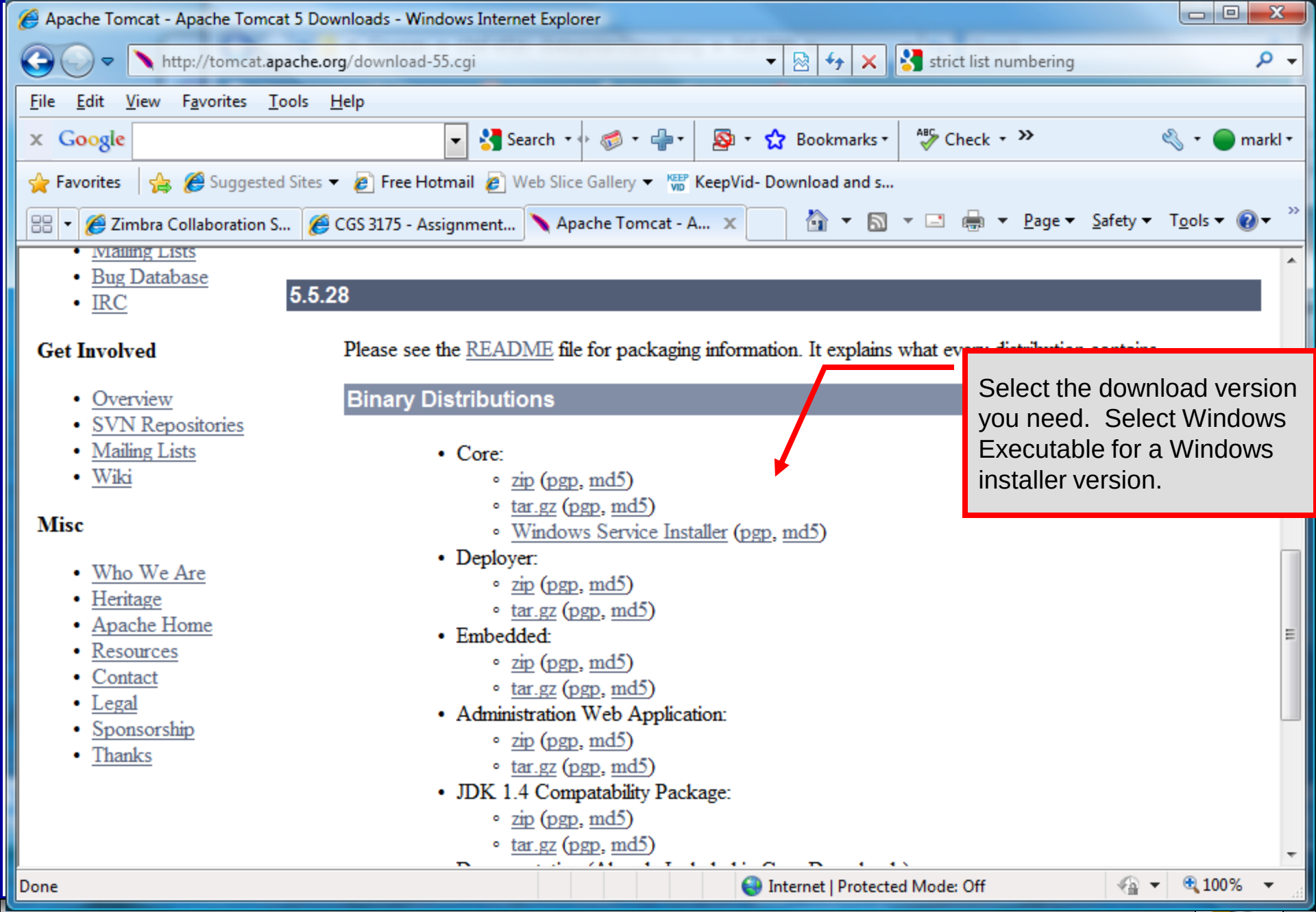
Apache Tomcat - Apache Tomcat 5 Downloads - Windows Internet Explorer
http://tomcat.apache.org/download-55.cgi
strict list numbering
File Edit View Favorites Tools Help
Search
Bookmarks
Check
markl
Favorites
Suggested Sites
Free Hotmail
Web Slice Gallery
KeepVid- Download and s...
Zimbra Collaboration S...
CGS 3175 - Assignment...
Apache Tomcat - A...
Page
Safety
Tools
Mailing Lists
Bug Database
IRC
Get Involved
Overview
SVN Repositories
Mailing Lists
Wiki
Misc
Who We Are
Heritage
Apache Home
Resources
Contact
Legal
Sponsorship
Thanks
5.5.28
Please see the README file for packaging information. It explains what
Binary Distributions
Core:
zip (pgp, md5)
tar.gz (pgp, md5)
Windows Service Installer (pgp, md5)
Deployer:
zip (pgp, md5)
tar.gz (pgp, md5)
Embedded:
zip (pgp, md5)
tar.gz (pgp, md5)
Administration Web Application:
zip (pgp, md5)
tar.gz (pgp, md5)
JDK 1.4 Compatability Package:
zip (pgp, md5)
tar.gz (pgp, md5)
Select the download version you need. Select Windows Executable for a Windows installer version.
Done
Internet | Protected Mode: Off
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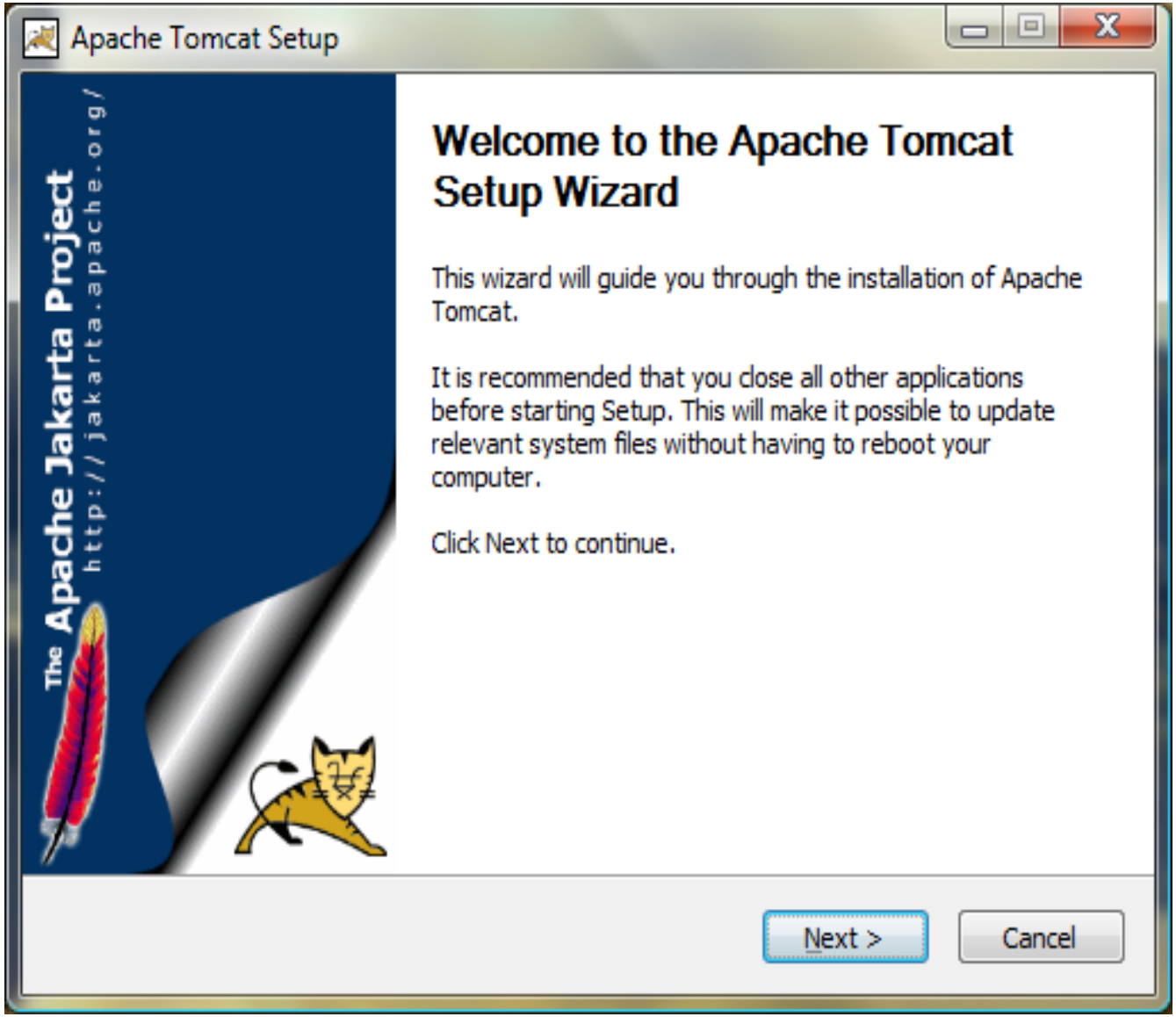
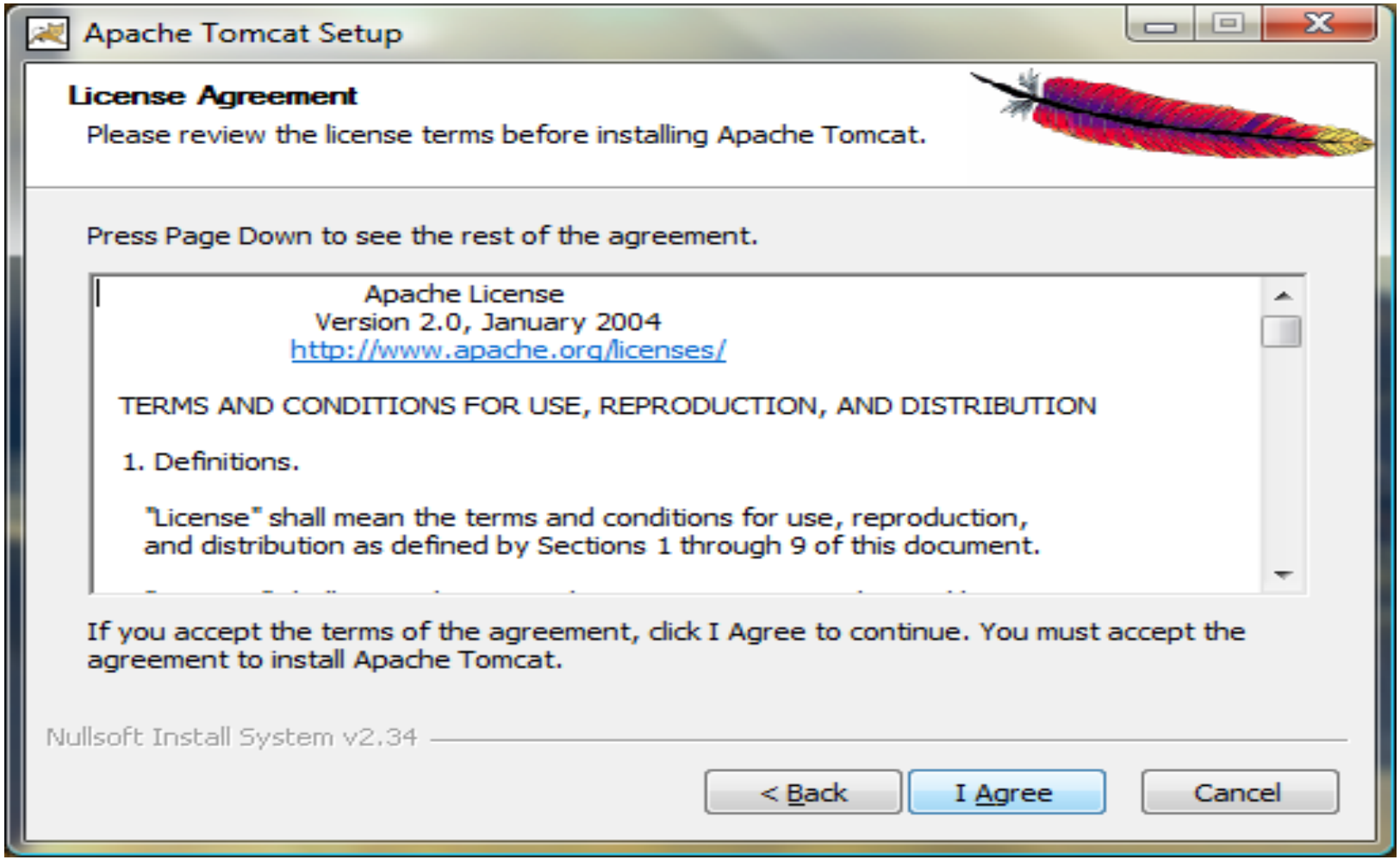
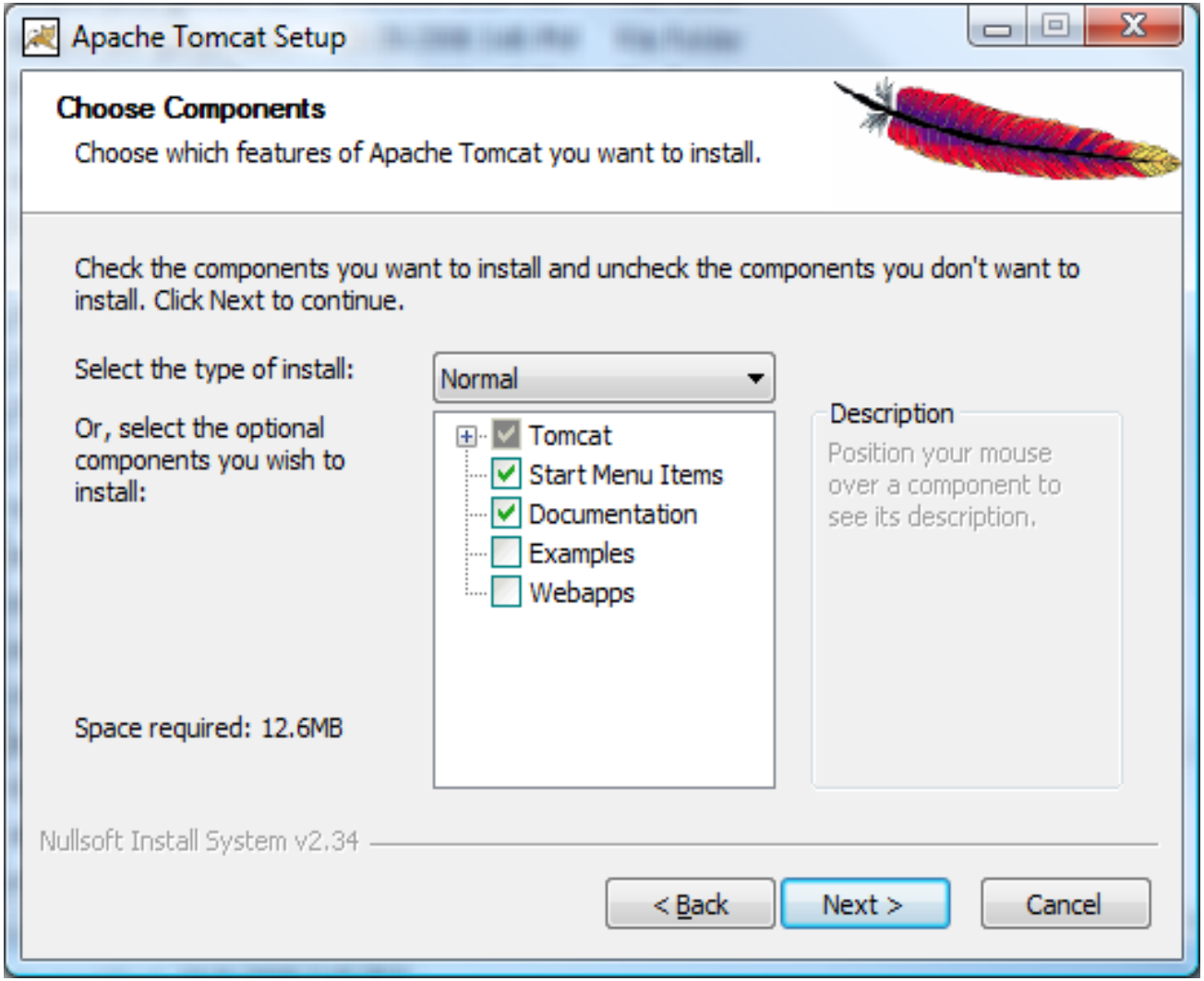
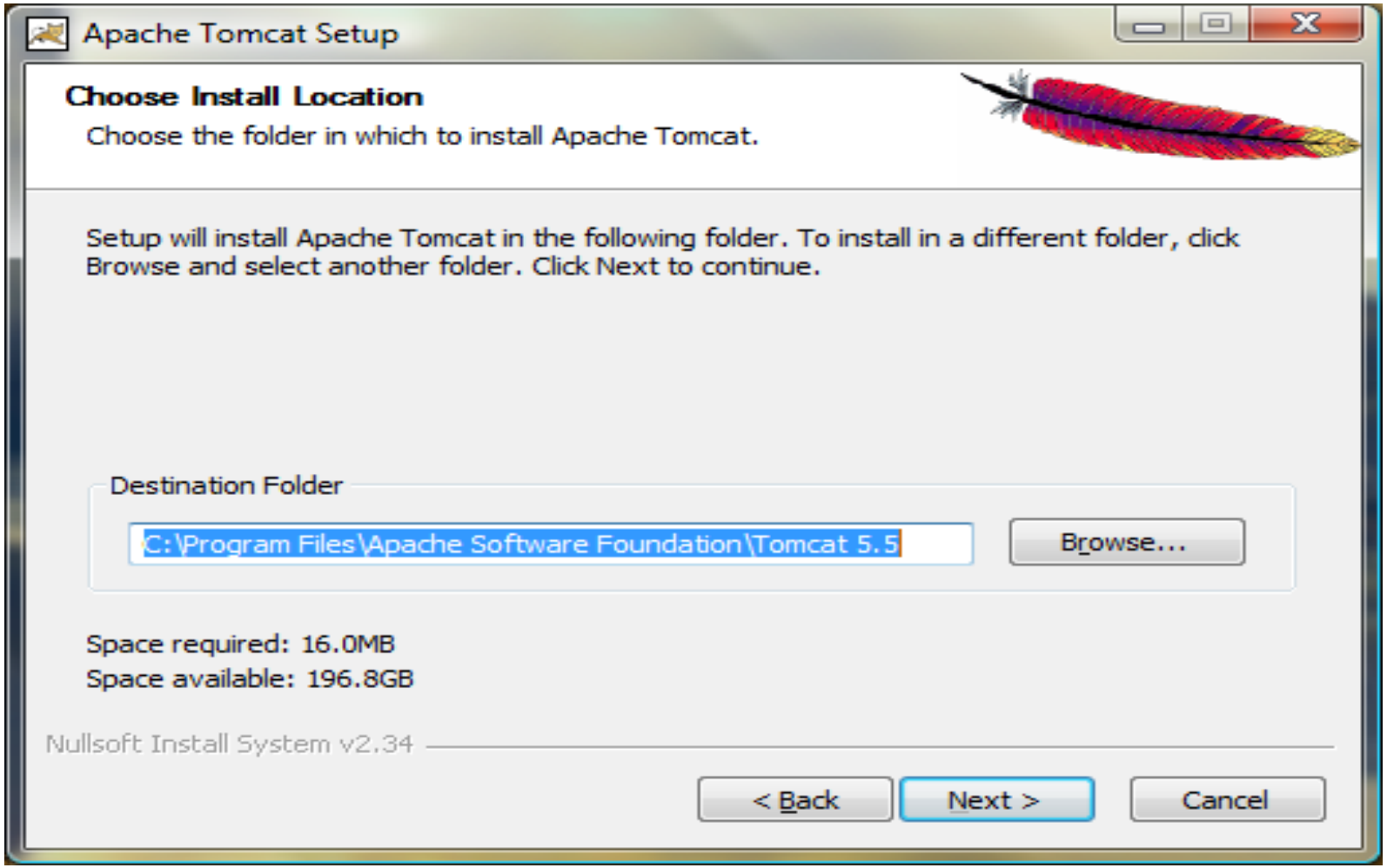
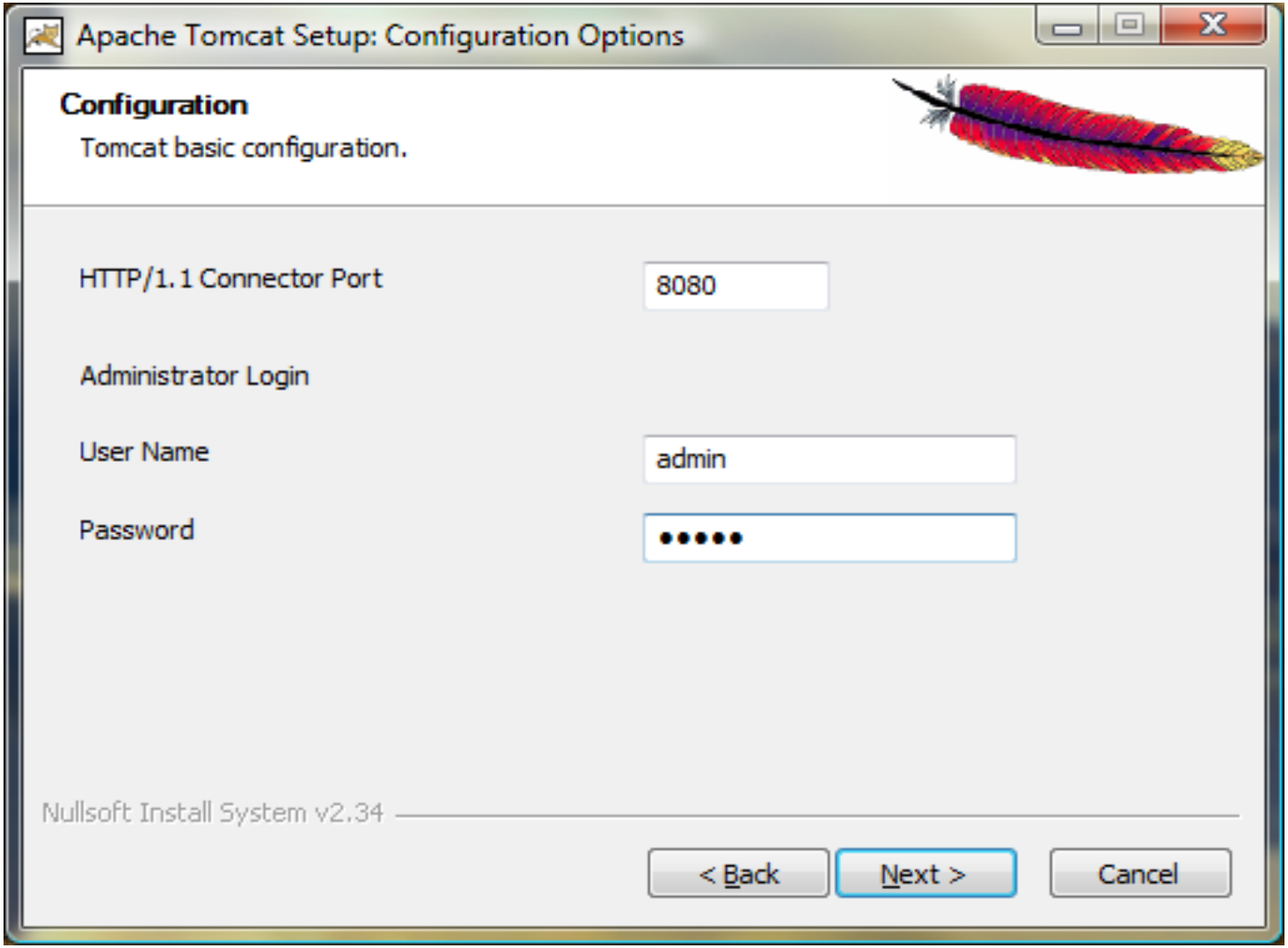

Apache Tomcat Setup
The Apache Jakarta Project
http://jakarta.apache.org/
Welcome to the Apache Tomcat Setup Wizard
This wizard will guide you through the installation of Apache Tomcat.
It is recommended that you close all other applications before starting Setup. This will make it possible to update relevant system files without having to reboot your computer.
Click Next to continue.
Next >
Cancel


Apache Tomcat Setup
License Agreement
Please review the license terms before installing Apache Tomcat.
Press Page Down to see the rest of the agreement.
Apache License
Version 2.0, January 2004
http://www.apache.org/licenses/
TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION
1. Definitions.
"License" shall mean the terms and conditions for use, reproduction,
and distribution as defined by Sections 1 through 9 of this document.
If you accept the terms of the agreement, click I Agree to continue. You must accept the agreement to install Apache Tomcat.
Nullsoft Install System v2.34
< Back
I Agree
Cancel


Apache Tomcat Setup
Choose Components
Choose which features of Apache Tomcat you want to install.
Check the components you want to install and uncheck the components you don't want to install. Click Next to continue.
Select the type of install:
Normal
Or, select the optional components you wish to install:
Tomcat
Start Menu Items
Documentation
Examples
Webapps
Description
Position your mouse over a component to see its description.
Space required: 12.6MB
Nullsoft Install System v2.34
< Back
Next >
Cancel


Apache Tomcat Setup
Choose Install Location
Choose the folder in which to install Apache Tomcat.
Setup will install Apache Tomcat in the following folder. To install in a different folder, click Browse and select another folder. Click Next to continue.
Destination Folder
C:\Program Files\Apache Software Foundation\Tomcat 5.5
Browse...
Space required: 16.0MB
Space available: 196.8GB
Nullsoft Install System v2.34
< Back
Next >
Cancel


Apache Tomcat Setup: Configuration Options
Configuration
Tomcat basic configuration.
HTTP/1.1 Connector Port
8080
Administrator Login
User Name
admin
Password
Nullsoft Install System v2.34
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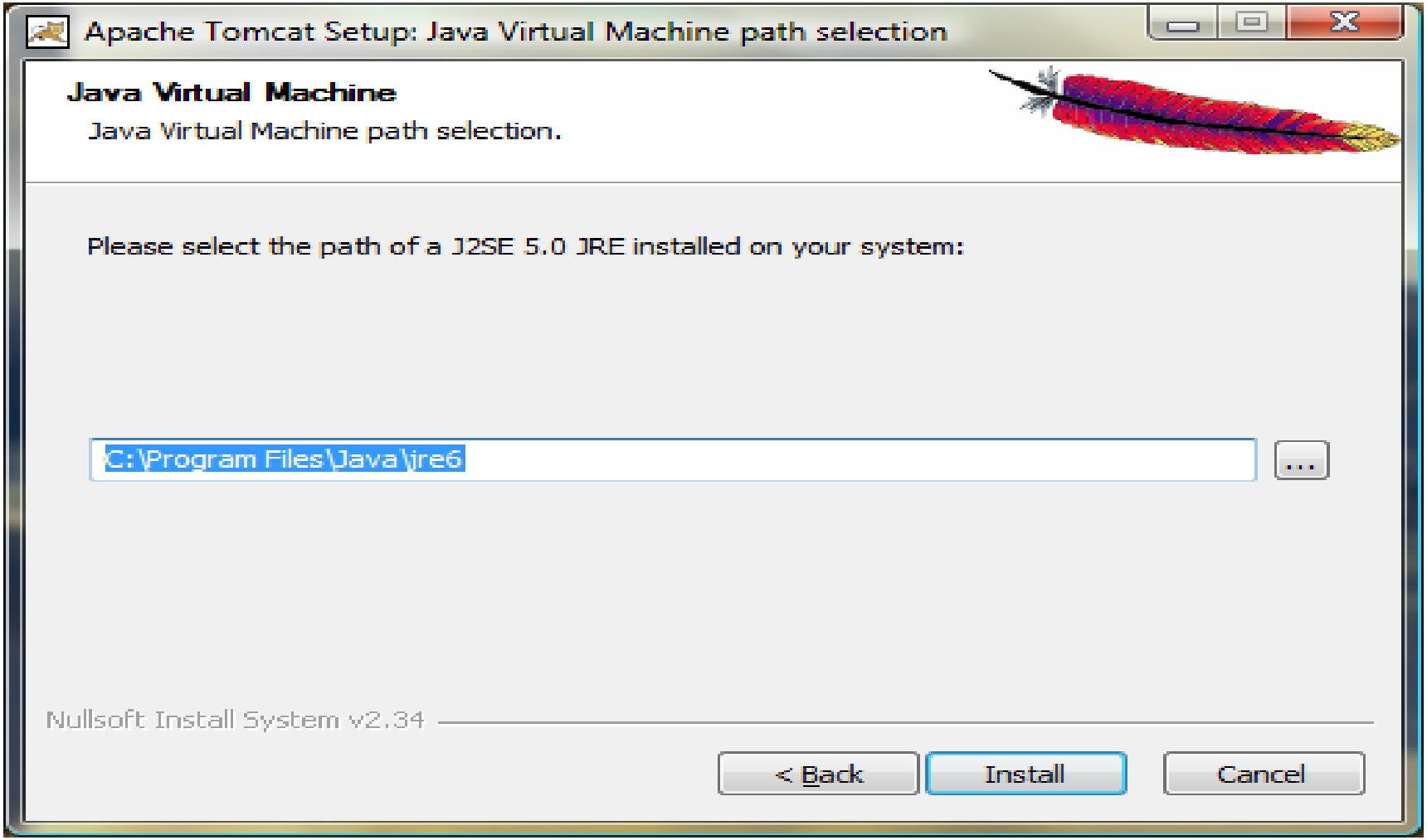
Cancel


Apache Tomcat Setup: Java Virtual Machine path selection
Java Virtual Machine
Java Virtual Machine path selection.
Please select the path of a J2SE 5.0 JRE installed on your system:
C:\Program Files\Java\jre6
...
Nullsoft Install System v2.34
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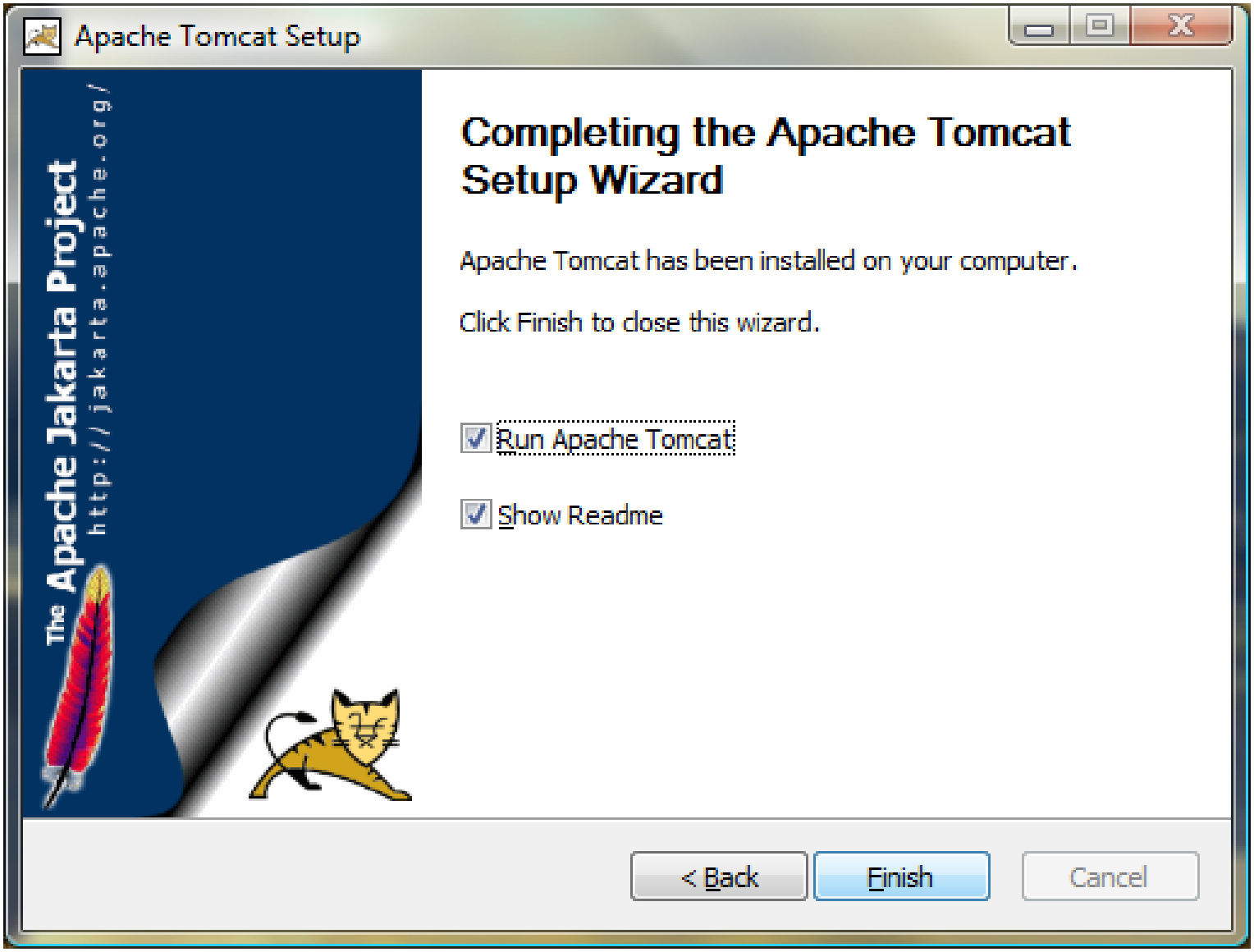
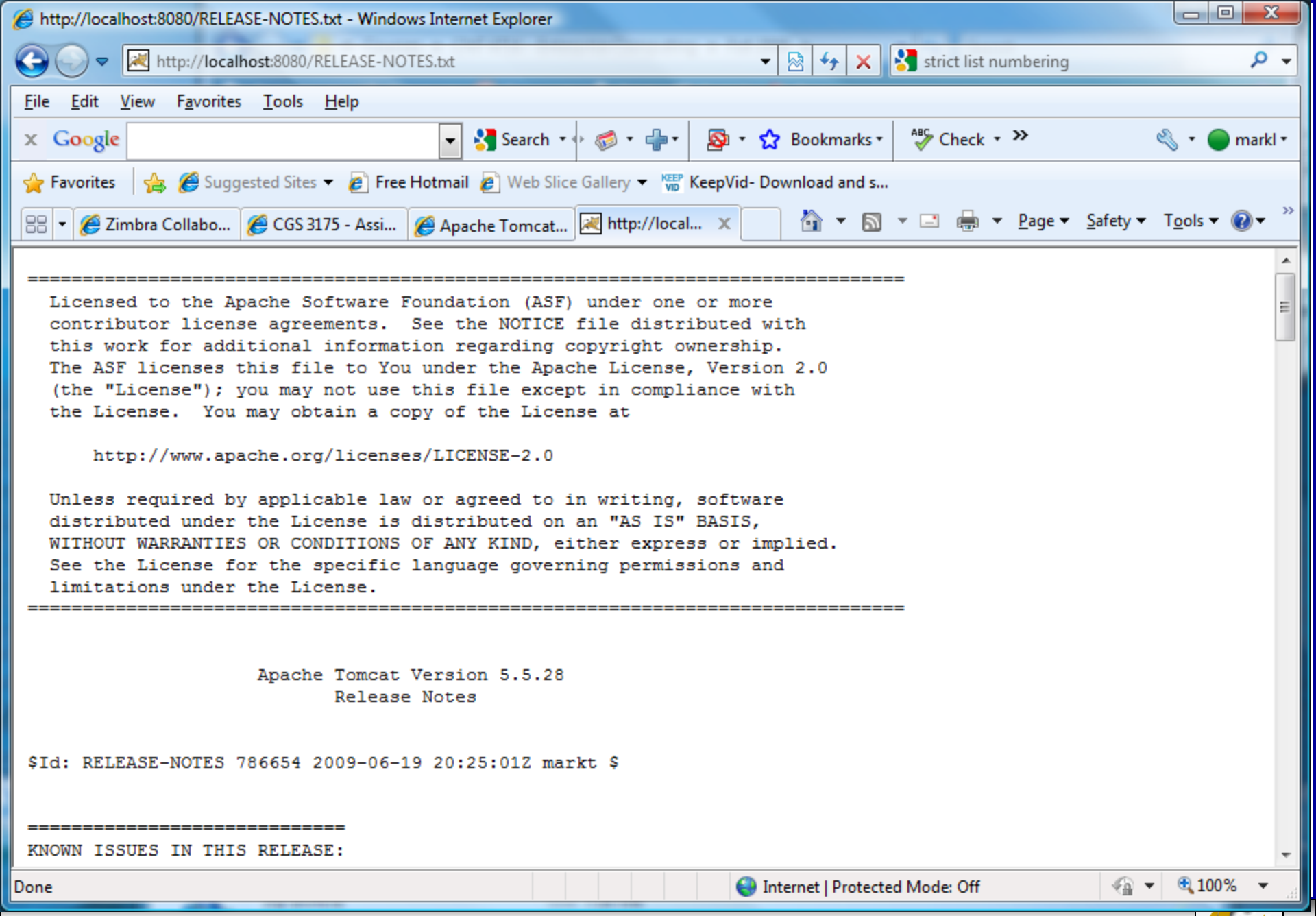
Install
Cancel


Apache Tomcat Setup
The Apache Jakarta Project
http://jakarta.apache.org/
Completing the Apache Tomcat Setup Wizard
Apache Tomcat has been installed on your computer.
Click Finish to close this wizard.
Run Apache Tomcat
Show Readme
< Back
Finish
Cancel


http://localhost:8080/RELEASE-NOTES.txt - Windows Internet Explorer
http://localhost:8080/RELEASE-NOTES.txt
strict list numbering
File Edit View Favorites Tools Help
Google
Search
Bookmarks
Check
markl
Favorites
Suggested Sites
Free Hotmail
Web Slice Gallery
KeepVid- Download and s...
Zimbra Collabo...
CGS 3175 - Assi...
Apache Tomcat...
http://local...
Page
Safety
Tools
==========
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distributed under the License is distributed on an "AS IS" BASIS,
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
See the License for the specific language governing permissions and
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==========
Apache Tomcat Version 5.5.28
Release Notes
$Id: RELEASE-NOTES 786654 2009-06-19 20:25:01Z markt $
==========
KNOWN ISSUES IN THIS RELEASE:
Done
Internet | Protected Mode: Off
100%

Setting Up Tomcat

- Once you've downloaded and installed Tomcat you're ready to run a demonstration test that will tell you if you've got everything set-up properly.

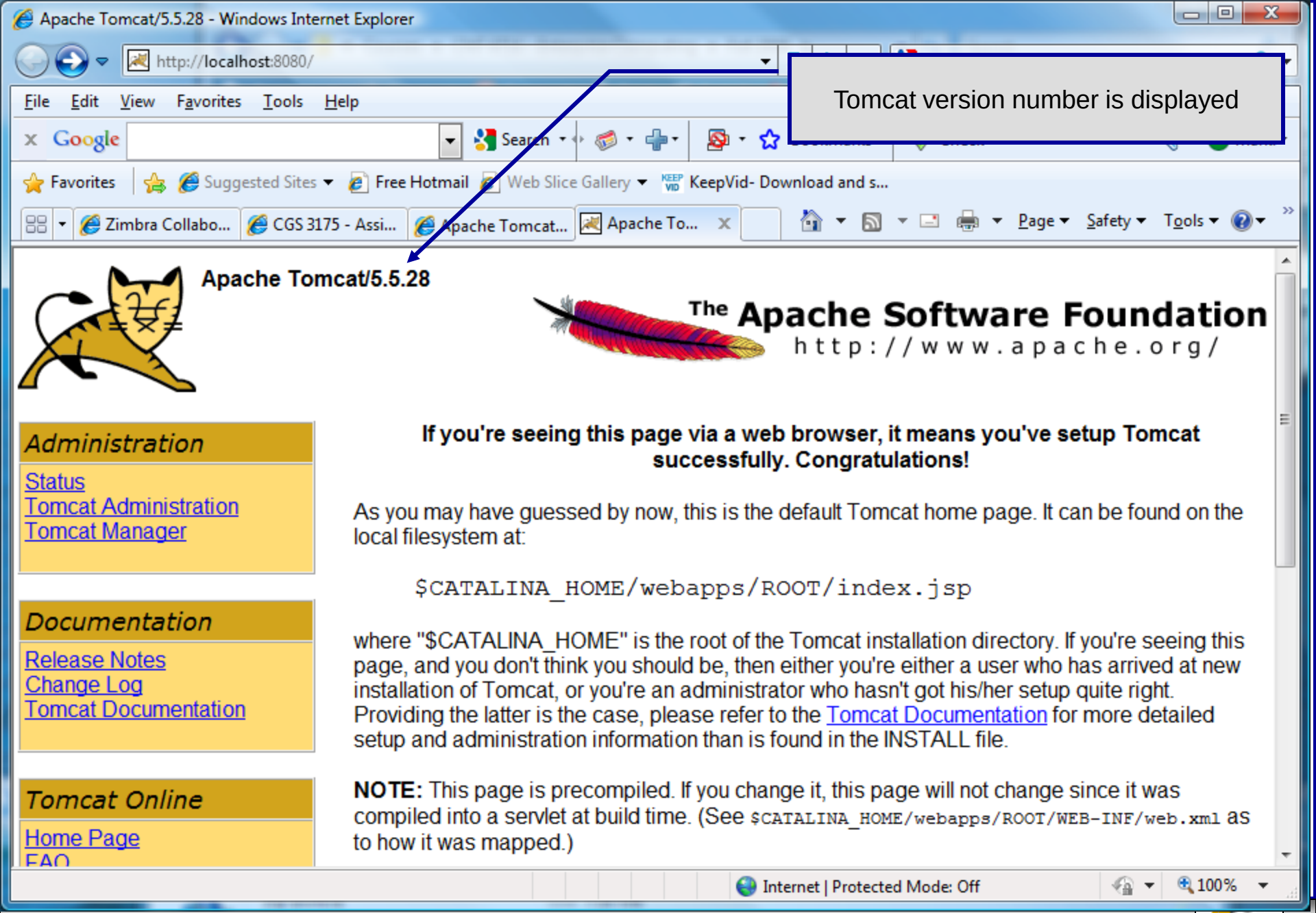
NOTE: During the install, Tomcat will ask you which TCP port Tomcat should run on. To avoid any conflict with standard Web servers which default to TCP port 80, Tomcat is set to default to TCP port 8080. If you have any other service running on this port change the port number at this time to one on which no conflict will occur.

In all subsequent examples, I'm running Tomcat on TCP port 8080.

Starting Up Tomcat

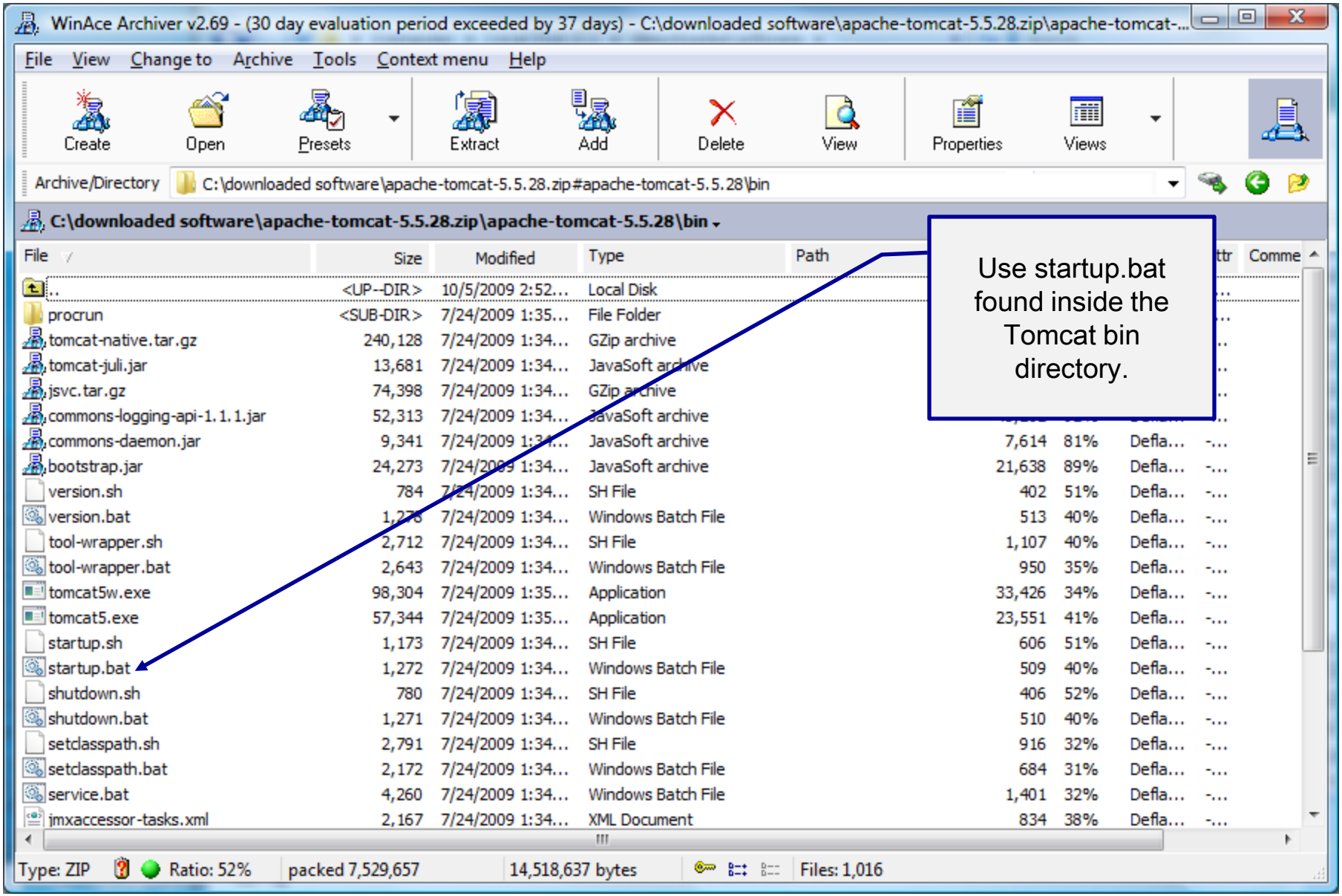
- Once Tomcat is installed, you need to start it as a service. On Windows machines, the current versions of Tomcat are installed as a service that will start when Windows starts. On Unix/Linux a startup.sh file is included so you just type startup (assuming you are in the bin directory where you located Tomcat).

1. Start Tomcat running.
2. Start your Web browser.
3. Enter URL: http://localhost:8080
4. You should see the screen on the following page if everything is set up ok.


Apache Tomcat/5.5.28 - Windows Internet Explorer
http://localhost:8080/
File Edit View Favorites Tools Help
Favorites
Suggested Sites
Free Hotmail
Web Slice Gallery
KeepVid- Download and s...
Page Safety Tools
Tomcat version number is displayed
Apache Tomcat/5.5.28
The Apache Software Foundation
http://www.apache.org/
Administration
Status
Tomcat Administration
Tomcat Manager
Documentation
Release Notes
Change Log
Tomcat Documentation
Tomcat Online
Home Page
FAQ
If you're seeing this page via a web browser, it means you've setup Tomcat successfully. Congratulations!
As you may have guessed by now, this is the default Tomcat home page. It can be found on the local filesystem at:
$CATALINA_HOME/webapps/ROOT/index.jsp
where "$CATALINA_HOME" is the root of the Tomcat installation directory. If you're seeing this page, and you don't think you should be, then either you're either a user who has arrived at new installation of Tomcat, or you're an administrator who hasn't got his/her setup quite right. Providing the latter is the case, please refer to the Tomcat Documentation for more detailed setup and administration information than is found in the INSTALL file.
NOTE: This page is precompiled. If you change it, this page will not change since it was compiled into a servlet at build time. (See $CATALINA_HOME/webapps/ROOT/WEB-INF/web.xml as to how it was mapped.)
Internet | Protected Mode: Off
100%

Problems Starting Up Tomcat

- On some machines running Vista, depending on the various settings (usually security related), Tomcat may be reluctant to start using the normal techniques through the Tomcat Manager or the Tomcat Monitor.
- In this case, you will need to start Tomcat running using a startup.bat file found in the Tomcat directory structure as shown on the next slide:


WinAce Archiver v2.69 - (30 day evaluation period exceeded by 37 days) - C:\downloaded software\apache-tomcat-5.5.28.zip\apache-tomcat-...
File View Change to Archive Tools Context menu Help
Create Open Presets Extract Add Delete View Properties Views
Archive/Directory C:\downloaded software\apache-tomcat-5.5.28.zip#apache-tomcat-5.5.28\bin
C:\downloaded software\apache-tomcat-5.5.28.zip\apache-tomcat-5.5.28\bin
File Size Modified Type Path
.. <UP--DIR> 10/5/2009 2:52... Local Disk
procrun <SUB-DIR> 7/24/2009 1:35... File Folder
tomcat-native.tar.gz 240,128 7/24/2009 1:34... GZip archive
tomcat-juli.jar 13,681 7/24/2009 1:34... JavaSoft archive
jsvc.tar.gz 74,398 7/24/2009 1:34... GZip archive
commons-logging-api-1.1.1.jar 52,313 7/24/2009 1:34... JavaSoft archive
commons-daemon.jar 9,341 7/24/2009 1:34... JavaSoft archive 7,614 81% Defla...
bootstrap.jar 24,273 7/24/2009 1:34... JavaSoft archive 21,638 89% Defla...
version.sh 784 7/24/2009 1:34... SH File 402 51% Defla...
version.bat 1,278 7/24/2009 1:34... Windows Batch File 513 40% Defla...
tool-wrapper.sh 2,712 7/24/2009 1:34... SH File 1,107 40% Defla...
tool-wrapper.bat 2,643 7/24/2009 1:34... Windows Batch File 950 35% Defla...
tomcat5w.exe 98,304 7/24/2009 1:35... Application 33,426 34% Defla...
tomcat5.exe 57,344 7/24/2009 1:35... Application 23,551 41% Defla...
startup.sh 1,173 7/24/2009 1:34... SH File 606 51% Defla...
startup.bat 1,272 7/24/2009 1:34... Windows Batch File 509 40% Defla...
shutdown.sh 780 7/24/2009 1:34... SH File 406 52% Defla...
shutdown.bat 1,271 7/24/2009 1:34... Windows Batch File 510 40% Defla...
setclasspath.sh 2,791 7/24/2009 1:34... SH File 916 32% Defla...
setclasspath.bat 2,172 7/24/2009 1:34... Windows Batch File 684 31% Defla...
service.bat 4,260 7/24/2009 1:34... Windows Batch File 1,401 32% Defla...
jmxaccessor-tasks.xml 2,167 7/24/2009 1:34... XML Document 834 38% Defla...
Type: ZIP Ratio: 52% packed 7,529,657 14,518,637 bytes Files: 1,016
Use startup.bat found inside the Tomcat bin directory.