# Component-base development and Open architecture

## Component-base development

Hardware engineers create circuits by mounting pre-fabricated chips on circuit boards. Component-based development extends this idea to software engineering: software engineers should be able to create applications by deploying and connecting pre-fabricated software components into containers that provide infrastructure services such as discovery, lifecycle management, and communication. Ideally, deploying and connecting components could be done using some graphical drag-and-drop interface. There should be no need to understand how the components are implemented.

Examples:

·       Several companies provide components for enterprise resource planning (logistics, human resources, billing, etc.) and a container for these components. Customers can buy the components they need and can afford. Examples include SAP and Netsuite.

·       Servlets and Java Beans are examples of component architectures for J2EE web servers (e.g., Tomcat) and application servers (e.g., JBoss).

·       Visual Basic was the original component container. Users could drag calendar, calculator, input, and output components into the container, graphically connect them and compile. This idea later evolved into[OLE containers and components](https://en.wikipedia.org/wiki/Object_Linking_and_Embedding).

·       [Service-Oriented Architectures](https://en.wikipedia.org/wiki/Service-oriented_architecture) are closely related to Container-Component architectures. Web service architectures are an example of SOA.

Definitions

Internally, a component is a collection of encapsulated functions and data.

Externally, a component is a set of realized interfaces together with a set of required interfaces.

An interface is a set of related operations, attributes, and receptions (i.e., signal receptors or handlers).

## Open architecture

Two competitors A and B have similar products. Company A uses a proprietary architecture. This forces their customers to purchase add-on components from them or companies explicitly licensed by them. A collects the profits and controls the price. Company B uses an open architecture. They publish the interfaces implemented by their product and invite random third-party developers to build add-on components and sell them directly to A's customers. Although company B does not directly profit from the sales of these components, a large, competitive market develops. B's customers can choose from a large selection of competitively-priced components. In turn, this drives sales of B's product.

Examples:

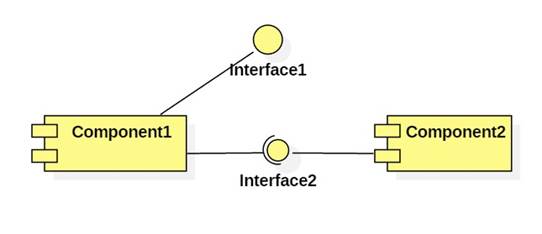
·       Companies A and B are veiled references to Apple and IBM. IBM published details of the PC motherboard, thus creating a market for expansion cards.

·       [Eclipse](https://help.eclipse.org/neon/index.jsp?topic=%2Forg.eclipse.platform.doc.isv%2Fguide%2Farch.htm)championed the container-component architecture.

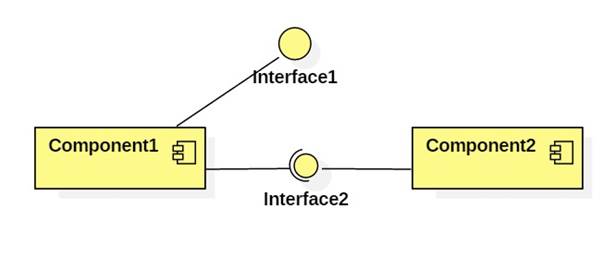
·       Most browsers employ some form of container-component architecture.

## UML Notation for container-component

In the following diagram Component1 realizes (or implements) Interface1 and requires Interface2, which is realized by Component2.



Modern UML favors using class icons with a component decoration or stereotype:



# What is Java EE (Jakarta EE) and Spring

## Jakarta EE

Since 2019, Java EE’s name has been Jakarta EE.

Java EE is indeed an **abstract** specification. Anybody is open to develop and provide a working implementation of the specification. The concrete implementations are the so-called application servers, like [WildFly](http://wildfly.org/), [TomEE](http://tomee.apache.org/), [GlassFish](http://glassfish.org/), [Liberty](http://www-03.ibm.com/software/products/en/appserv-was-liberty-core), [WebLogic](http://www.oracle.com/technetwork/middleware/weblogic/overview/index.html), etc. There are also servlet containers which implement only the JSP/Servlet part of the huge Java EE API, such as [Tomcat](http://tomcat.apache.org/), [Jetty](http://www.eclipse.org/jetty/), etc.

We, Java EE developers, should write code utilizing the specification (i.e. import only javax.\* classes in our code instead of implementation specific classes such as org.jboss.wildfly.\*, com.sun.glassfish.\*, etc) and then we'll be able to run our code on any implementation (thus, on any application server). (If you're familiar with JDBC, it's basically the same concept as how JDBC drivers work. See also a.o. [In simplest terms, what is a factory?](https://stackoverflow.com/questions/7550612/in-simplest-terms-what-is-a-factory))

Java EE SDK = Java SE SDK + GlassFish

The [Java EE SDK download](http://www.oracle.com/technetwork/java/javaee/downloads/index.html) from Oracle.com contains basically the GlassFish server along a bunch of documentation and examples and optionally also the NetBeans IDE. You don't need it if you want a different server and/or IDE.

EJB is part of the Java EE specification. Look, [it's in the Java EE API](http://download.oracle.com/javaee/6/api/javax/ejb/package-summary.html). Full-fledged Java EE application servers support it out the box, but simple JSP/Servlet containers don't.

## Spring

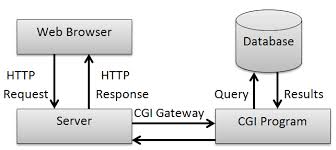
Spring is a standalone framework which substitutes and improves many parts of Java EE. Spring doesn't necessarily require Java EE to run. A bare-bones servlet container like Tomcat is already sufficient. Simply put, Spring is a competitor of Java EE. E.g. "Spring" (standalone) competes EJB/JTA, Spring MVC competes JSF/JAX-RS, Spring DI/IoC/AOP competes CDI, Spring Security competes JAAS/JASPIC, etc.

Back during the old J2EE/EJB2 times, the EJB2 API was terrible to implement and maintain. Spring was then a much better alternative to EJB2. But since EJB3 (Java EE 5), the EJB API was much improved based on lessons learnt from Spring. Since CDI (Java EE 6), there's not really a reason to look at again another framework like Spring to make the developers more easy as to developing among others the service layer.

Only when you're using a bare-bones servlet container such as Tomcat and can't move on to a Java EE server, then Spring is more attractive as it's easier to install Spring on Tomcat. It isn't possible to install e.g. an EJB container on Tomcat without modifying the server itself, you would basically be reinventing TomEE.

# Web server vs web container vs application server

## Web server and CGI



CGI (common gateway interface) is an interface specification between a web server (HTTP server) and an executable program of some type that is to handle a particular request. It describes how certain properties of that request should be communicated to the environment of that program and how the program should communicate the response back to the server and how the server should 'complete' the response to form a valid reply to the original HTTP request.

Programs implementing a CGI interface can be written in any language runnable on the target machine. They must be able to access environment variables and usually standard input and they generate their output on standard output. Compiled languages such as C were commonly used as were scripting languages such as Perl, often using libraries to make accessing the CGI environment easier.

One of the big disadvantages of CGI is that a new program is spawned for each request so maintaining state between requests could be a major performance issue. The state might be handled in cookies or encoded in a URL, but if it gets to large it must be stored elsewhere and keyed from encoded url information or a cookie. Each CGI invocation would then have to reload the stored state from a store somewhere. For this reason, and for a greatly simple interface to requests and sessions, better integrated environments between web servers and applications are much more popular.

## Web server vs web container vs application server

A web server is a software that serves HTTP request, usually by returning HTML pages. A pure web server can deliver only static web pages; however, with add-on modules, a web server can serve dynamic web.

A web container is a web server with servlet, JSP technology. A web container, or a servlet container, manages Java classes, called servlets, that generate dynamic HTML pages for HTTP requests. Receiving a HTTP request, a web container will call a corresponding servlet that handle the request. A more advanced technology is Java Server Page (JSP). (Note: a servlet is a Java class with HTML code, a JSP is a HMTL page with Java code).

An application server is a web server with Java EE technology; it has two components: Web container for processing presentation layer on server and Enterprise Java Bean (aka Application container) for processing business logic on server.

Most popular:

* Web server: **Apache**, NginX, IIS
* Web container: **Tomcat**, Jetty
* Application server: WebLogic (Oracle), Websphere (IBM), WildFly (Red Hat), **GlassFish** (Oracle)

## Web container (apache tomcat, jetty) vs web server (apache httpd)

"Apache" is the name of a foundation that write open-source software.

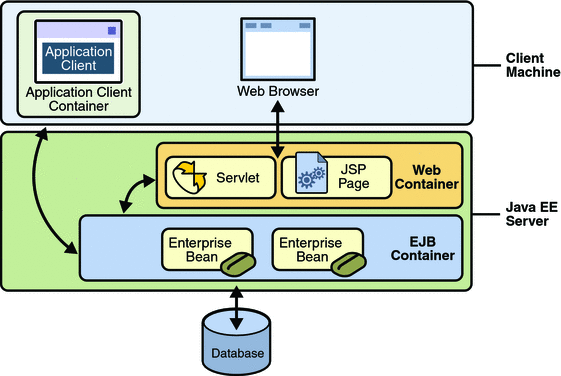
Apache web server (apache HTTPD server) is a web server written in portable C. It mostly serves static content by itself, but there are many add-on modules (some of which come with Apache itself) that let it modify the content and also serve dynamic content written in Perl, PHP, Python, Ruby, or other languages.  
  
Apache Tomcat is primarily a servlet/JSP container. It's written in [Java](http://www.javaranch.com/). It can serve static content, too, but its main purpose is to host [servlets](http://www.coderanch.com/forums/f-7/servlets) and JSPs. Although it's possible to get Tomcat to run Perl scripts and the like, you wouldn't use Tomcat unless most of your content was Java.  
  
It's actually possible to use both Apache and Tomcat together, so that Apache serves the static content, and Tomcat the Servlets and JSPs. Depending on various factors, this may or may not be a good idea.

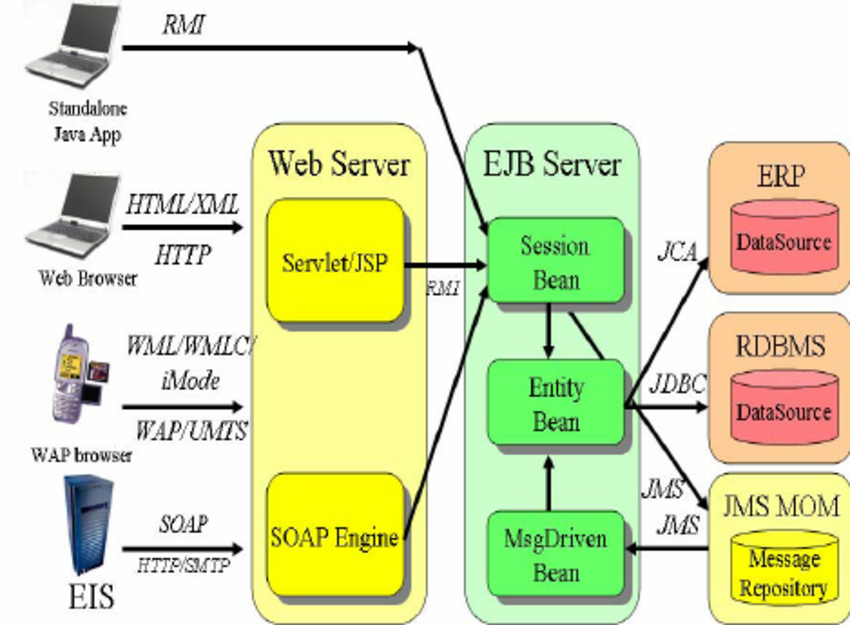
# Java EE

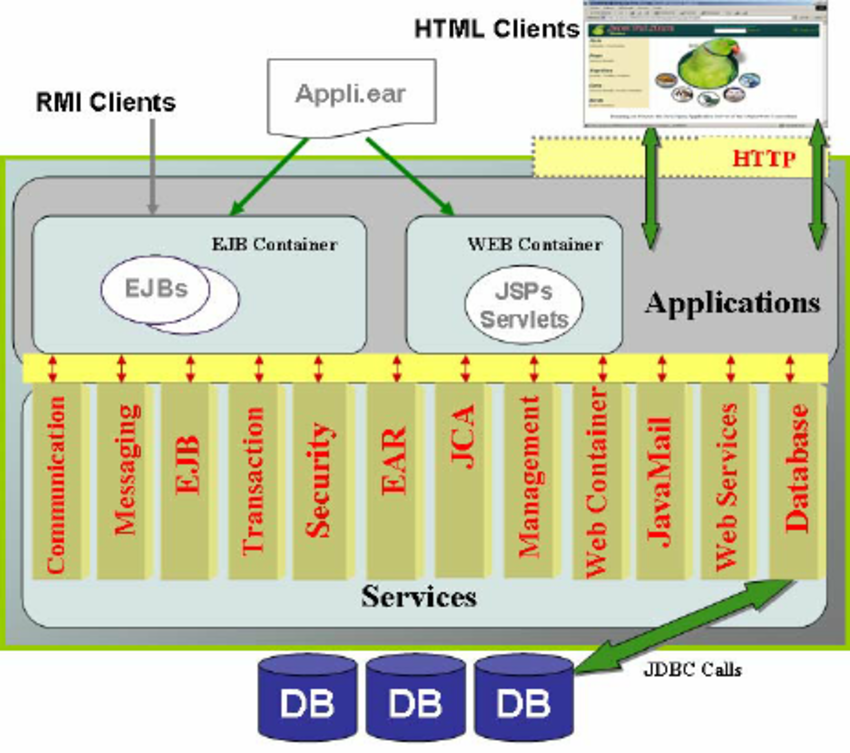
## The best tutorial

<https://docs.oracle.com/javaee/6/tutorial/doc/>

<https://javajee.com/category/java-web-java-ee>







software that serves HTTP request usually by

# Tomcat

## Configuration

In the following, a “**Context”** meansa web application.

### Directories and Files

These are some of the key tomcat directories:

* **/bin** - Startup, shutdown, and other scripts. The \*.sh files (for Unix systems) are functional duplicates of the \*.bat files (for Windows systems). Since the Win32 command-line lacks certain functionality, there are some additional files in here.
* **/conf** - Configuration files. The most important file is server.xml - main configuration file for the container.
* **/logs** - Log files are here by default.
* **/webapps** - This is where your webapps go.

### CATALINA\_HOME and CATALINA\_BASE

Throughout the documentation, there are references to the two following properties:

* **CATALINA\_HOME**: Represents the root of your Tomcat installation, for example /home/tomcat/apache-tomcat-9.0.10 or C:\Program Files\apache-tomcat-9.0.10.
* **CATALINA\_BASE**: Represents the root of a runtime configuration of a specific Tomcat instance. By default, CATALINA\_HOME and CATALINA\_BASE point to the same directory. Set CATALINA\_BASE manually when you require running multiple Tomcat instances on one machine.

If you set CATALINA\_HOME, CATALINA to different locations, the CATALINA\_HOME location contains static sources, such as .jar files, or binary files. The CATALINA\_BASE location contains configuration files, log files, deployed applications, and other runtime requirements. Because all instances with single CATALINA\_HOME location share one set of .jar files and binary files, you can easily upgrade the files to newer version and have the change propagated to all Tomcat instances using the same CATALIA\_HOME directory.

## Install and start up/shut down Tomcat

Configuration and start-up is described in [RUNNING.txt](https://tomcat.apache.org/tomcat-9.0-doc/RUNNING.txt)file in the Tomcat folder.

You need JDK first.

To install Tomcat, you can:

* Either use the binary distribution and configure it manually
* Or use Tomcat installer and install Tomcat as a Windows service

### Use binary distribution and manually configure Tomcat.

Step 1: Configure Environment Variables

Tomcat is a Java application and does not use environment variables directly, but the scripts that starts Tomcat uses environment variables.

* 1. Set CATALINA\_HOME (required) and CATALINA\_BASE (optional)

The CATALINA\_HOME environment variable should be set to the location of the root directory of the "binary" distribution of Tomcat.

The Tomcat startup scripts often does it automatically, based on the location of the startup script in \*nix and on the current directory in Windows, s*o, it’s likely that you don’t need to do anything.*

* 1. Set JAVA\_HOME (required)

The JAVA\_HOME variable is used to specify location of a JDK that is used to start Tomcat. In Windows:

set “JAVA\_HOME=C:\path\to\JDK”

Step 2: Run Tomcat

%JAVA\_HOME%\bin\startup.bat for starting up Tomcat

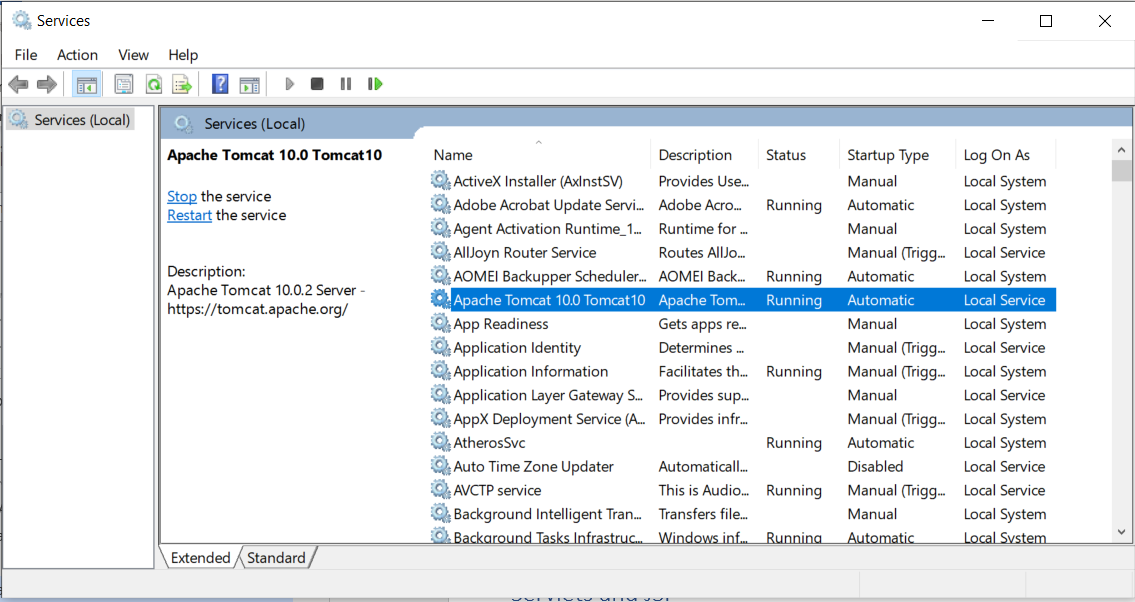
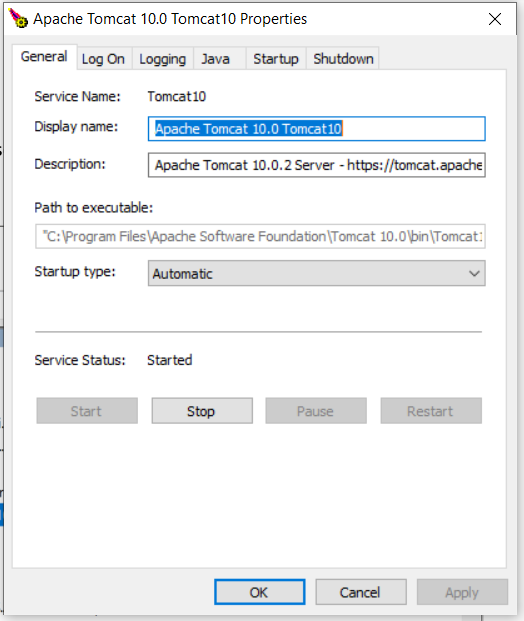
%JAVA\_HOME%\bin\shutdonw.bat for shutting down Tomcat.

Browse localhost:8080 to check if Tomcat runs.

### Install Tomcat as a Windows service

If you run Tomcat installer, it will be installed as a Windows service, so you can use Services to manage it.

Tomcat itself has a GUI for managing itself.

# JAR and WAR package format

JAR – or Java Archive – is a package file format.

## **JAR Packaging**

Simply put, JAR – or Java Archive – is a package file format. JAR files have the .jar extension and may contain **libraries, resources, and metadata files.**

Essentially, it's a zipped file containing the compressed versions of .class files and resources of compiled Java libraries and applications.

For example, here's a simple JAR file structure:

META-INF/

MANIFEST.MF

com/

baeldung/

MyApplication.class

The [META-INF/MANIFEST.MF file](https://www.baeldung.com/java-jar-executable-manifest-main-class) may contain additional metadata about the files stored in the archive.

We can [create a JAR](https://www.baeldung.com/java-create-jar) file using the jar command or with tools like [Maven](https://www.baeldung.com/executable-jar-with-maven).

## **WAR Packaging**

WAR stands for Web Application Archive or Web Application Resource. These archive files have the .war extension and are **used to package web applications** that we can deploy on any Servlet/JSP container.

Here's an example layout of a typical WAR file structure:

META-INF/

MANIFEST.MF

WEB-INF/

web.xml

jsp/

helloWorld.jsp

classes/

static/

templates/

application.properties

lib/

// \*.jar files as libs

Inside, it has a META-INF directory holding useful information in the MANIFEST.MF about the web archive. The META-INF directory is private and can't be accessed from the outside.

On the other hand, it also contains the WEB-INF public directory with all the static web resources, including HTML pages, images, and JS files. Moreover, it contains the web.xml file, servlet classes, and libraries.

We can use the same tools and commands that we used to build a JAR to build a .war archive.

## **Key Differences**

**File extension**. JARs have the .jar extension, whereas the WAR file has the .war extension.

**Purpose.** JAR files allow us to package multiple files in order to use it as a library, plugin, or any kind of application. On the other hand, WAR files are used only for web applications.

**The archive structure.** We can create a JAR with any desired structure. In contrast, WAR has a predefined structure with WEB-INF and META-INF directories.

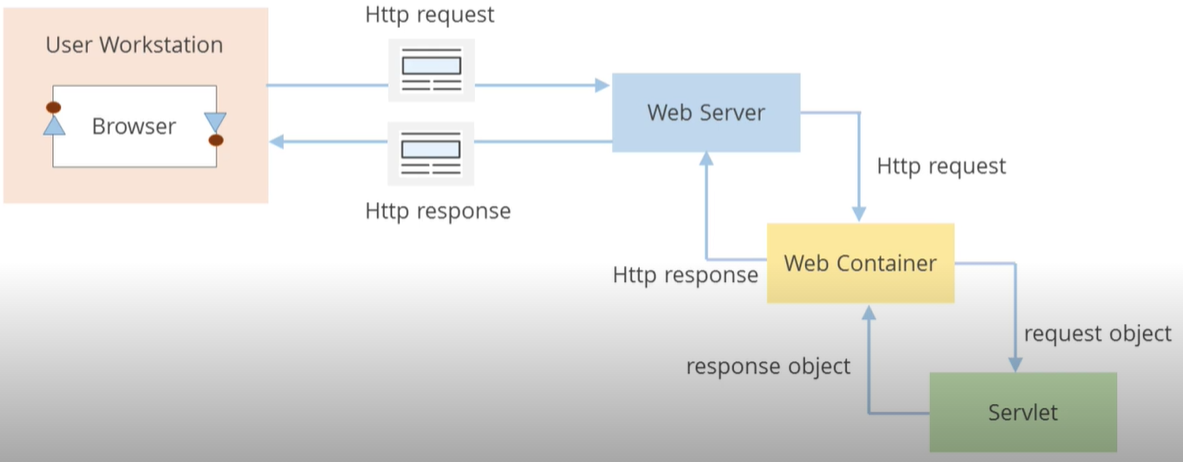
Finally, we can **run a JAR from the command line** if we build it as an [executable JAR](https://www.baeldung.com/executable-jar-with-maven) without using additional software. Or, we can use it as a library. In contrast, we **need a server to execute a WAR**.

# Servlets

## Servlet and Web container

A servlet is a Java class that generate a HTTP response.

A web container is a program that forward request/receive response to/from a servlet as the diagram below. Web container manages servlet, web container – servlet follows the container – component design.



**Difference: Servlet (thread) vs CGI (process)**

For each request, CGI creates a new process while Servlet creates a new thread. Threads have many benefits over the Processes such as they share a common memory area, lightweight, cost of communication between the threads are low.

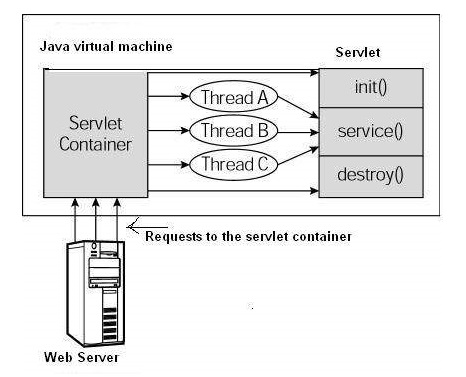




## Life cycle of servlet

A servlet life cycle can be defined as the entire process from its creation till the destruction. The web container controls servlet life cycles. The following are a a servlet’s life cycle:

* First the HTTP requests coming to the server are delegated to the servlet container (assuming that the servlet is mapped to the request).
* The servlet container create an instance of the servlet and runs **init()**.
* Then the servlet container handles multiple requests by spawning multiple threads, each thread executing the **service()** method of a single instance of the servlet.
* Eventually when the container or the application shuts down, or the container decides that there is a shortage of memory or when this servlet hasn't got a request in a long time, the servlet is terminated by calling the **destroy()** method.



### The init() Method

public void init() throws ServletException {

// Initialization code...

}

The init method is called only once. It is called only when the servlet is created, and not called for any user requests afterwards.

The servlet is normally created when a user first invokes a URL corresponding to the servlet, but you can also specify that the servlet be loaded when the server is first started.

When a user invokes a servlet, a single instance of each servlet gets created, with each user request resulting in a new thread that is handed off to doGet or doPost as appropriate. The init() method simply creates or loads some data that will be used throughout the life of the servlet.

### The service() Method

public void service(ServletRequest request, ServletResponse response)

throws ServletException, IOException {

}

The service() method is the main method to perform the actual task. The servlet container calls the service() method to handle requests coming from the client (browsers) and to write the formatted response back to the client.

Each time the server receives a request for a servlet, the server spawns a new thread and calls service. The service() method checks the HTTP request type (GET, POST, PUT, DELETE, etc.) and calls doGet, doPost, doPut, doDelete, etc. methods as appropriate.

The service () method is called by the container and service method invokes doGet, doPost, doPut, doDelete, etc. methods as appropriate. So you have nothing to do with service() method but you override either doGet() or doPost() depending on what type of request you receive from the client. The doGet() and doPost() are most frequently used methods with in each service request.

**The doGet() Method:** A GET request results from a normal request for a URL or from an HTML form that has no METHOD specified and it should be handled by doGet() method.

public void doGet(HttpServletRequest request, HttpServletResponse response)

throws ServletException, IOException {

// Servlet code

}

**The doPost() Method:** A POST request results from an HTML form that specifically lists POST as the METHOD and it should be handled by doPost() method.

public void doPost(HttpServletRequest request, HttpServletResponse response)

throws ServletException, IOException {

// Servlet code

}

### The destroy() Method

public void destroy() {

// Finalization code...

}

The destroy() method is called only once at the end of the life cycle of a servlet. This method gives your servlet a chance to close database connections, halt background threads, write cookie lists or hit counts to disk, and perform other such cleanup activities. After the destroy() method is called, the servlet object is marked for garbage collection.

## Deploy a servlet

### Write a servlet as a class that extends javax.servlet.Servlet

Servlets are Java classes which service HTTP requests and implement the **javax.servlet.Servlet** interface. Web application developers typically write servlets that extend javax.servlet.http.HttpServlet, an abstract class that implements the Servlet interface and is specially designed to handle HTTP requests.

Following is the sample source code structure of a servlet example to show Hello World −

// Import required java libraries

import java.io.\*;

import javax.servlet.\*;

import javax.servlet.http.\*;

// Extend HttpServlet class

public class HelloWorld extends HttpServlet {

private String message;

public void init() throws ServletException {

// Do required initialization

message = "Hello World";

}

public void doGet(HttpServletRequest request, HttpServletResponse response)

throws ServletException, IOException {

// Set response content type

response.setContentType("text/html");

// Actual logic goes here.

PrintWriter out = response.getWriter();

out.println("<h1>" + message + "</h1>");

}

public void destroy() {

// do nothing.

}

}

Compile the class above to HelloWorld.class.

### Tomcat’s standard directory layout

The folder that store the web application is: **webapps/root**. Under **webapps/root**, you should put:

**\*.html, \*.jsp, etc.** - The HTML and JSP pages, along with other files that must be visible to the client browser (such as JavaScript, stylesheet files, and images) for your application.

**/WEB-INF/web.xml** - The *Web Application Deployment Descriptor* for your application. This is an XML file describing the servlets and other components that make up your application, along with any initialization parameters and container-managed security constraints that you want the server to enforce for you.

**/WEB-INF/classes/** - This directory contains any Java class files (and associated resources) required for your application, including both servlet and non-servlet classes, that are not combined into JAR files. If your classes are organized into Java packages, you must reflect this in the directory hierarchy under /WEB-INF/classes/. For example, a Java class named com.mycompany.mypackage.MyServlet would need to be stored in a file named /WEB-INF/classes/com/mycompany/mypackage/MyServlet.class.

**/WEB-INF/lib/** - This directory contains JAR files that contain Java class files (and associated resources) required for your application, such as third party class libraries or JDBC drivers.

Example: the **helloworld.class** above should be put in **/WEB-INF/classes/helloworld.class**

Note that the directory layout of a web project in Eclipse is different from this.

### Web descriptor /web-inf/web.xml

Web descriptor /web-inf/web.xml is an .xml file that map servlets with URL request. Everything is put in <web-app> and each mapping is described by two tags: <servlet> to tell name and the servlet’s Java class, and <servlet-mapping> to map servlet to an url.

<web-app>

<servlet>

<servlet-name>HelloWorld</servlet-name>

<servlet-class>HelloWorld</servlet-class>

</servlet>

<servlet-mapping>

<servlet-name>HelloWorld</servlet-name>

<url-pattern>/HelloWorld</url-pattern>

</servlet-mapping>

</web-app>



# JPA and Hibernate

Annotation with jointable, one-to-one

# Tutorial Java EE

https://docs.oracle.com/javaee/6/tutorial/doc/

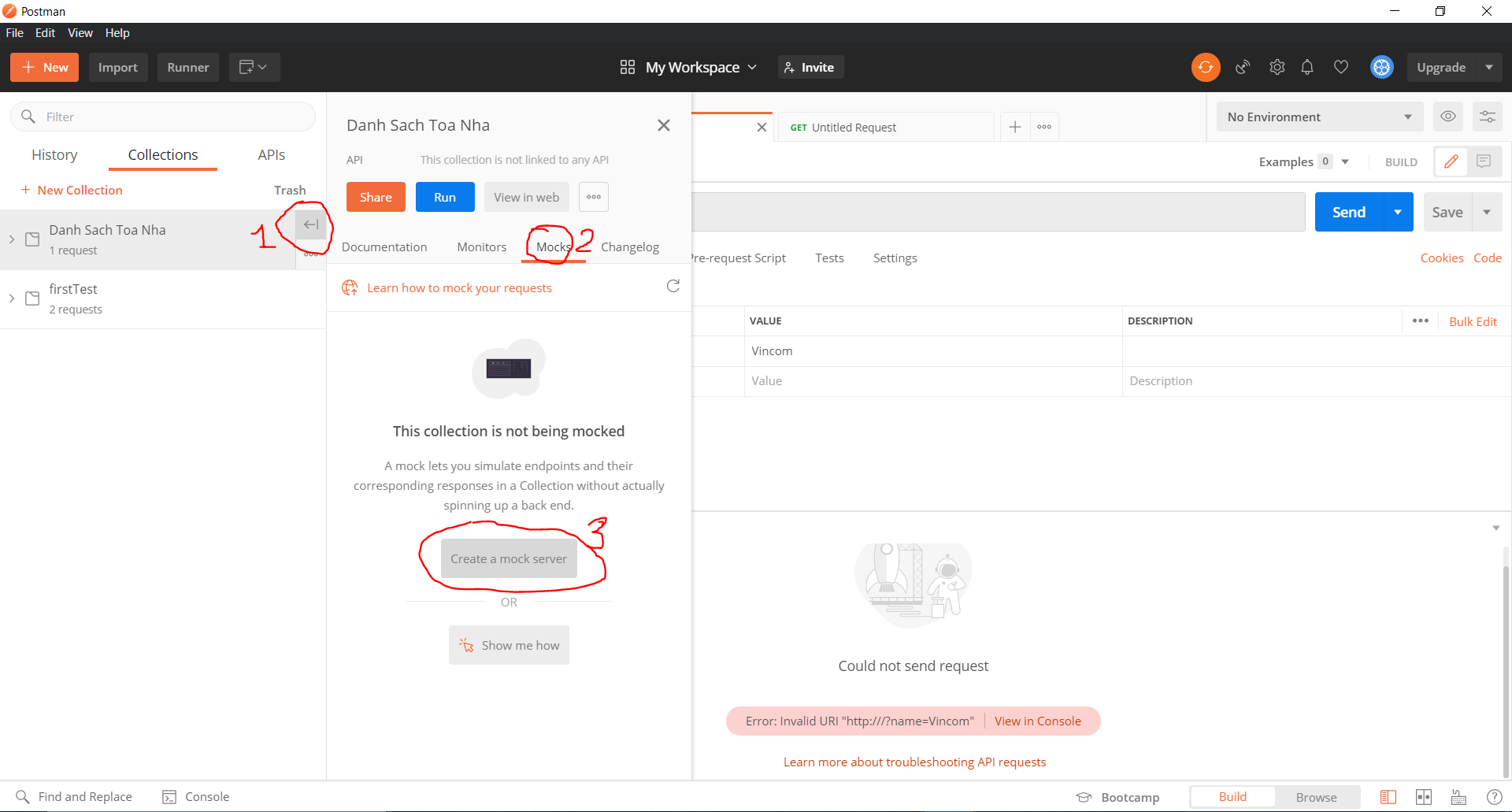
# POSTMAN - Create a mock server, mock response

To create a mock server and then some mock response from the server, you need to:

* Create a mock server
* Add a request that has a link to the server

## Create a mock server

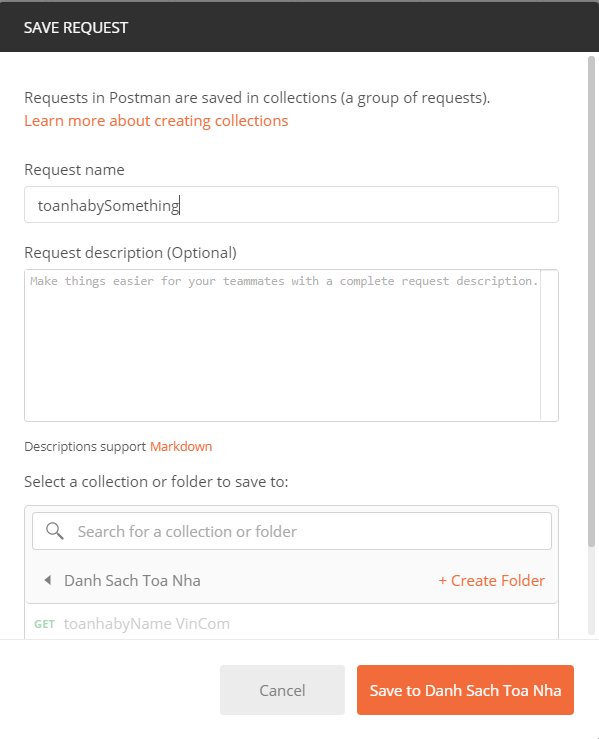
Create a collection first and then create a mock server or you create a mock server based on an existing collection:



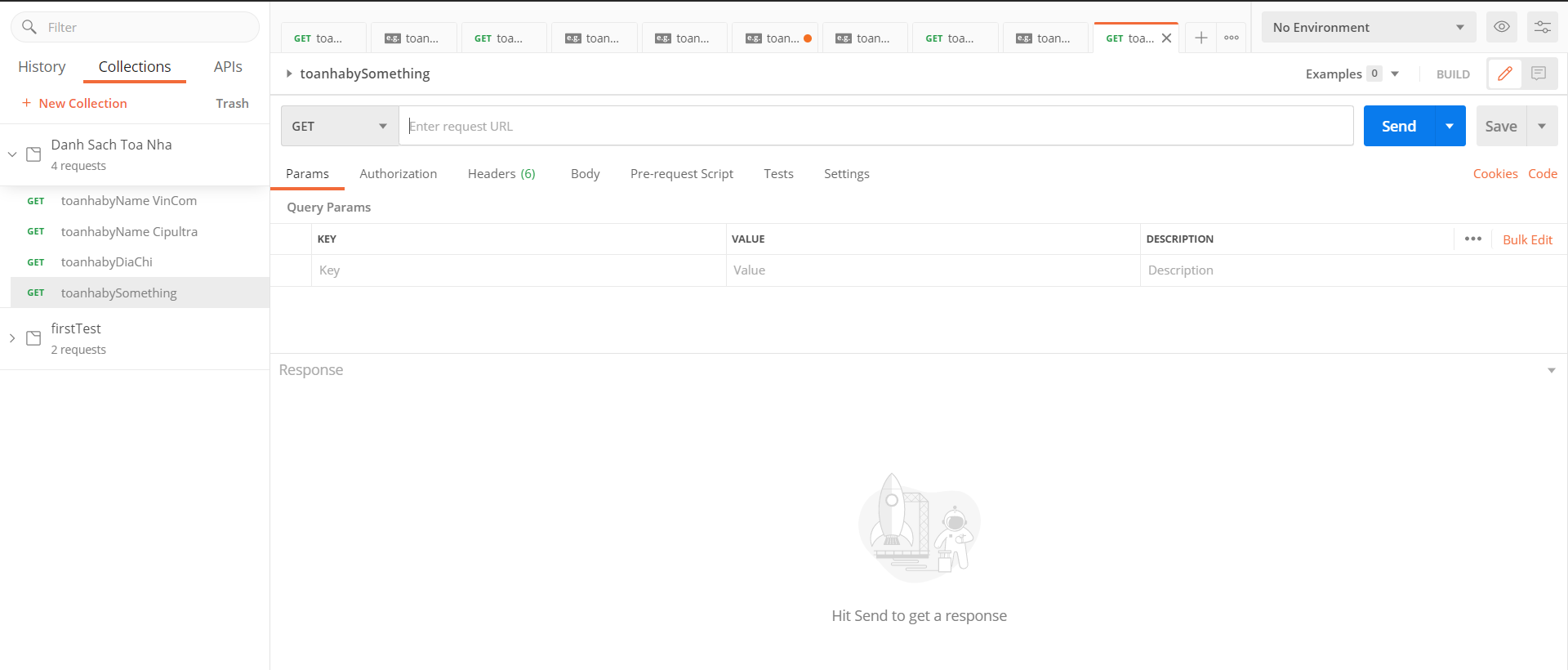
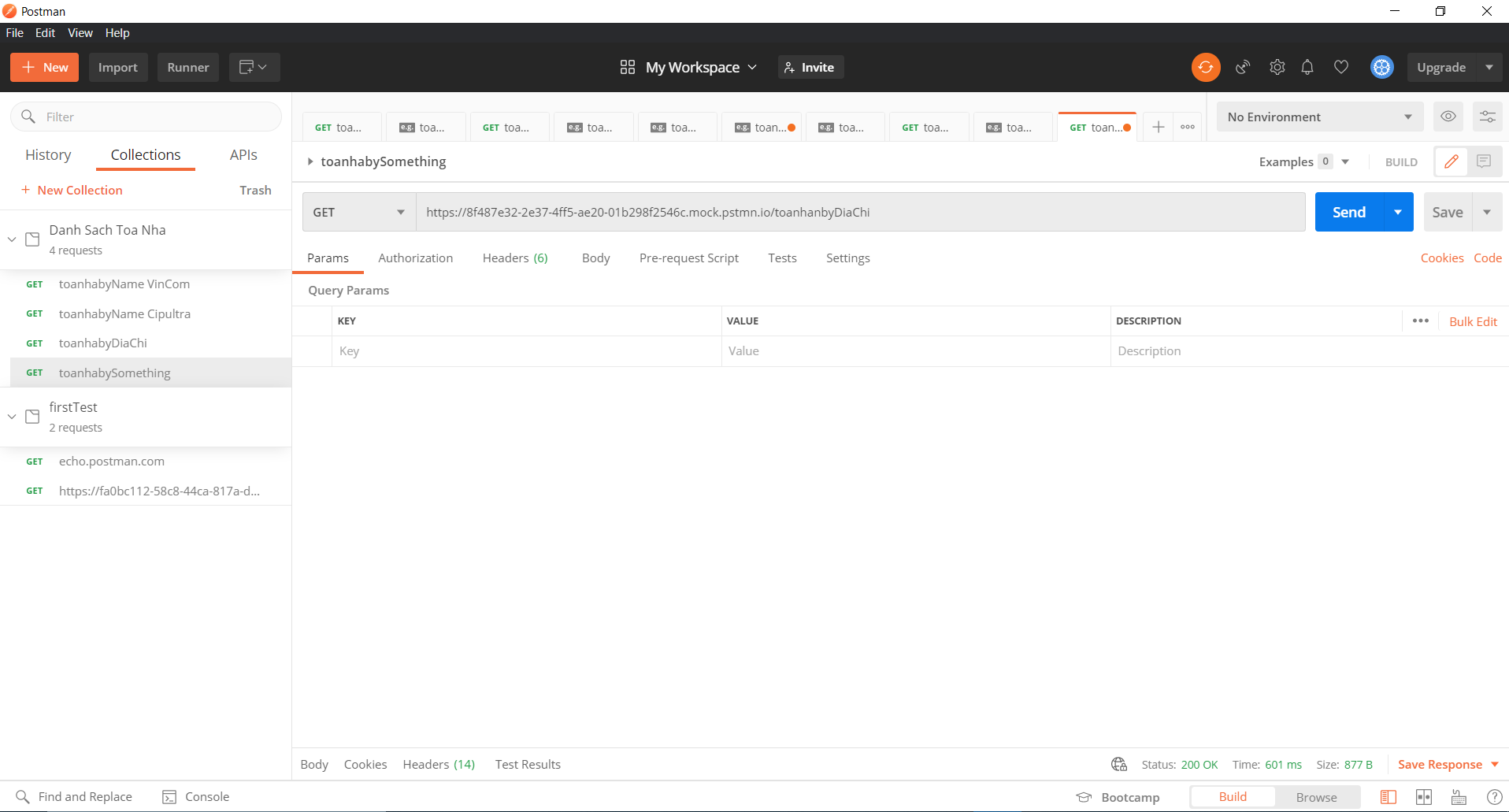
At the last step, note the URL for the mock server, which is needed in the next step.

## Add a request-response example

When you add a request, add it to a collection

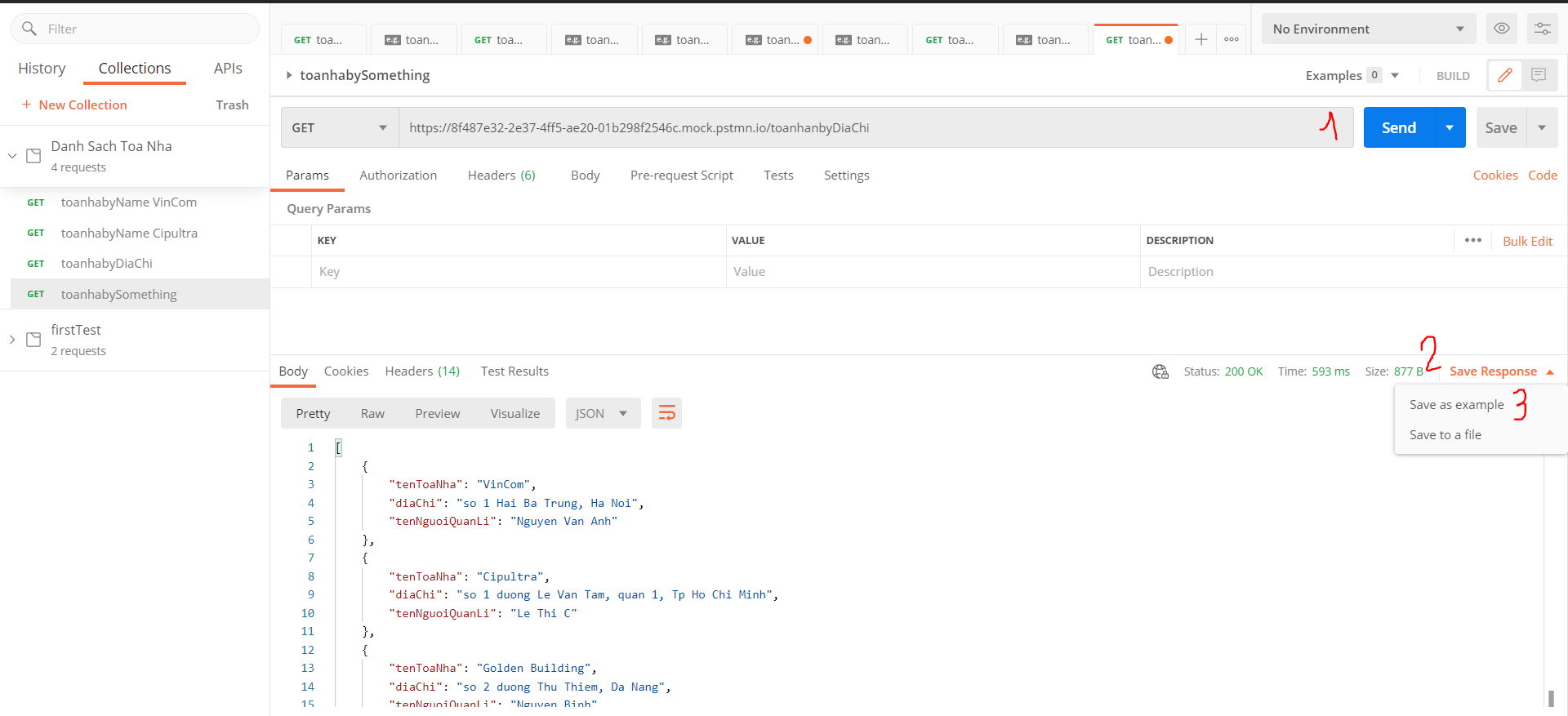


The newly added request has only Query Parameter, but not yet the Response like this:

or 

To open the Response part,

* Step 1: add the address that you created in the “Mock Server” stage
* Step 2: Hit SEND and then “Save Response”/”Save as example”



If the step above is right then the Example Response as below should appear

