

On Security of an Identity- based Dynamic Data Auditing Protocol

*A Project Report submitted
in partial fulfillment of the requirements
for the award of the degree of*

BACHELOR OF TECHNOLOGY

In

COMPUTER SCIENCE & ENGINEERING

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CERTIFICATE

*This is to certify that the project entitled "**On Security of an Identity- based Dynamic Data Auditing Protocol**", is being submitted by **P.S.N.S.SOWMYA, M.SOWMYA, S.TEJA SRI, S.VAISHNAVI DEVI, M.HARITHA** bearing the **Regd. No. 18B01A05B1, 18B01A0575, 18B01A0584, 18B01A05B9, 18B01A05A2** in partial fulfilment of the requirements for the award of the degree of "**Bachelor of Technology in Computer Science & Engineering**" is a record of bonafide work carried out by them under my guidance and supervision during the academic year **2021–2022** and it has been found worthy of acceptance according to the requirements of the university.*

Internal Guide

Head of the Department

External Examiner:

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INTRODUCTION

CLOUD platform provides powerful storage services to individuals and organizations. It brings great benefits of allowing on-the-move access to the outsourced files, simultaneously relieves file-owners from complicated local storage management and maintenance. However, some security concerns may impede users to use cloud storage. Among them, the integrity of outsourced files is considered as a main obstacle, since the users will lose physical control of their files after outsourced to a cloud storage server maintained by some cloud service provider (CSP). Thus, the file-owners may worry about whether their files have been tampered with, especially for those of importance.

Considerable efforts have been made to address this issue. Among existing proposals, provable data possession is a promising approach in proof of storage .With PDP, the file-owner only needs to retain a small amount of parameters of outsourced files and a secret key. To check whether or not the outsourced files are kept intact, the file owner or an auditor can challenge the cloud server with low communication overheads and computation costs. If some part of the file has been altered or deleted, for example, due to random hardware failures, the cloud storage server would not be able to prove the data integrity to convince the clients.

We observe two critical issues not well addressed in existing proposals. First, most schemes lack a controlled way of delegable outsourcing. One may note that many cloud storage systems (e.g., Amazon, Dropbox, Google Cloud storage) allow the account owner to generate signed URLs using which any other designated entity can upload and modify content on behalf of the user. However, in this scenario, the delegator cannot validate whether or not the authorized one has uploaded the file as specified or verify whether or not the uploaded file has been kept intact. Hence, the delegator has to fully trust the delegates and the cloud server. In fact, the file-owner may not only need to authorize some others to generate files and upload to a cloud, but also need to verifiably guarantee that the uploaded files have been kept unchanged. For instance, in Electronic Health Systems (EHS) when consulting a doctor, the patient needs to delegate her doctor to generate electronic health records and store them at a remote EHRs center maintained by a CSP. In another typical scenario of cloud-aided office

applications, a group of engineers in different places may fulfill a task in cooperation. The group leader can create a cloud storage account and authorize the members with secret warrants. The behavior of the group members and the cloud server should be verifiable. Second, existing PoS-like schemes, including PDP and Proofs of Retrievability (PoR) do not support data log related auditing in the process of data possession proof. The logs are critical in addressing disputes in practice. For example, when the patient and doctor in EHS get involved medical disputes, it would be helpful if some specific information such as outsourcer, type and generating time of the outsourced EHRs are auditable. However, there exist no PoS-like schemes that can allow validation of these important information in a multi-user setting.

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM:

Among existing proposals, provable data possession (PDP) is a promising approach in proof of storage (PoS). With PDP, the file-owner only needs to retain a small amount of parameters of outsourced files and a secret key. To check whether or not the outsourced files are kept intact, the file owner or an auditor can challenge the cloud server with low communication overheads and computation costs. If some part of the file has been altered or deleted, for example, due to random hardware failures, the cloud storage server would not be able to prove the data integrity to convince the clients.

Disadvantages:

- The users will lose physical control of their files after outsourced to a cloud storage server maintained by some cloud service provider (CSP). Thus, the file-owners may worry about whether their files have been tampered with, especially for those of importance.
- We observe two critical issues not well addressed in existing proposals. First, most schemes lack a controlled way of delegable outsourcing.

2.2 PROPOSED SYSTEM:

Our scheme has the following distinguishing features.

- **Identity-based outsourcing.** A user and his/her authorized proxies can securely outsource files to a remote cloud server which is not fully trustable, while any unauthorized ones cannot outsource files on behalf of the user. The cloud clients, including the file-owners, proxies and auditors, are recognized with their identities, which avoids the usage of complicated cryptographic certificates. This delegate mechanism allows our scheme to be efficiently deployed in a multi-user setting.
- **Comprehensive auditing.** Our IBDO scheme achieves a strong auditing mechanism. The integrity of outsourced files can be efficiently verified by an auditor, even if the files might be outsourced by different clients. Also, the information about the origin,

type and consistence of outsourced files can be publicly audited. The auditor can run the auditing protocol to provide convincing judicial witnesses without requiring disputing parties to be corporative.

2.3 FEASIBILITY STUDY:

The feasibility of the project is analyzed in this phase and a business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential. Three key considerations involved in the feasibility analysis are

- Operational Feasibility
- Economical Feasibility
- Technical Feasibility

2.3.1 OPERATIONAL FEASIBILITY:

Operational Feasibility deals with the study of prospects of the system to be developed. This system operationally eliminates all the tensions of the admin and helps him in effectively tracking the project progress. This kind of automation will surely reduce the time and energy, which previously consumed in manual work. Based on the study, the system is proved to be operationally feasible.

2.3.2 ECONOMICAL FEASIBILITY:

Economic Feasibility or Cost-benefit is an assessment of the economic justification for a computer-based project. As hardware was installed from the beginning and for lots of purposes thus the cost on project of hardware is low. Since the system is a network based, any number of employees connected to the LAN within that organization can use this tool from at any time. The Virtual Private Network is to be developed using the existing resources of the organization. So the project is economically feasible.

2.3.3 TECHNICAL FEASIBILITY:

According to Roger S. Pressman, Technical Feasibility is the assessment of the technical resources of the organization. The organization needs IBM compatible machines with a

graphical web browser connected to the Internet and Intranet. The system is developed for platform independent environment. Java Server Pages, JavaScript, HTML, SQL server and WebLogic Server are used to develop the system. The technical feasibility has been carried out. The system is technically feasible for development and can be developed with the existing facility.

SYSTEM REQUIREMENT SPECIFICATION

3.1 SOFTWARE REQUIREMENTS:

- Operating system : Windows 10.
- Tool : Spring tool
- Database : MySQL
- Cloud server : Cloud me
- Server : Tomcat Server

3.2 HARDWARE REQUIREMENTS

- Processor : Pentium Dual Core
- Hard Disk : 500G
- RAM : 4 GB

SYSTEM DESIGN

4.1 INTRODUCTION:

System Design/Software design sits at the technical kernel of the software engineering process and is applied regardless of the development paradigm and area of application. Design is the first step in the development phase for any engineered product or system. The designer's goal is to produce a model or representation of an entity that will later be built. Once system requirements have been specified and analyzed, system design is the first of the three technical activities - design, code and test that is required to build and verify software.

The importance can be stated with a single word "Quality". Design is the place where quality is fostered in software development. Design provides us with representations of software that can assess quality. Design is the only way that we can accurately translate a customer's view into a finished software product or system. Software design serves as a foundation for all the software engineering steps that follow. Without a strong design we risk building an unstable system – one that will be difficult to test, one whose quality cannot be assessed until the last stage.

During design, progressive refinement of data structure, program structure, and procedural details are developed, reviewed and documented. System design can be viewed from either a technical or project management perspective. From the technical point of view, design consists of four activities – architectural design, data structure design, interface design and procedural design.

4.2 UML DIAGRAMS:

The elements are like components which can be associated in different ways to make a complete UML picture, which is known as a diagram. Thus, it is very important to understand the different diagrams to implement the knowledge in real-life systems.

Any complex system is best understood by making some kind of diagrams or pictures. These diagrams have a better impact on our understanding. If we look around, we will realize that the diagrams are not a new concept but it is used widely in different forms in different industries.

We prepare UML diagrams to understand the system in a better and simple way. A single diagram is not enough to cover all the aspects of the system. UML defines various kinds of diagrams to cover most of the aspects of a system.

You can also create your own set of diagrams to meet your requirements. Diagrams are generally made in an incremental and iterative way.

- There are two broad categories of diagrams and they are again divided into subcategories –
 - 1) Structural Diagrams
 - 2) Behavioral Diagrams

Structural Diagrams:

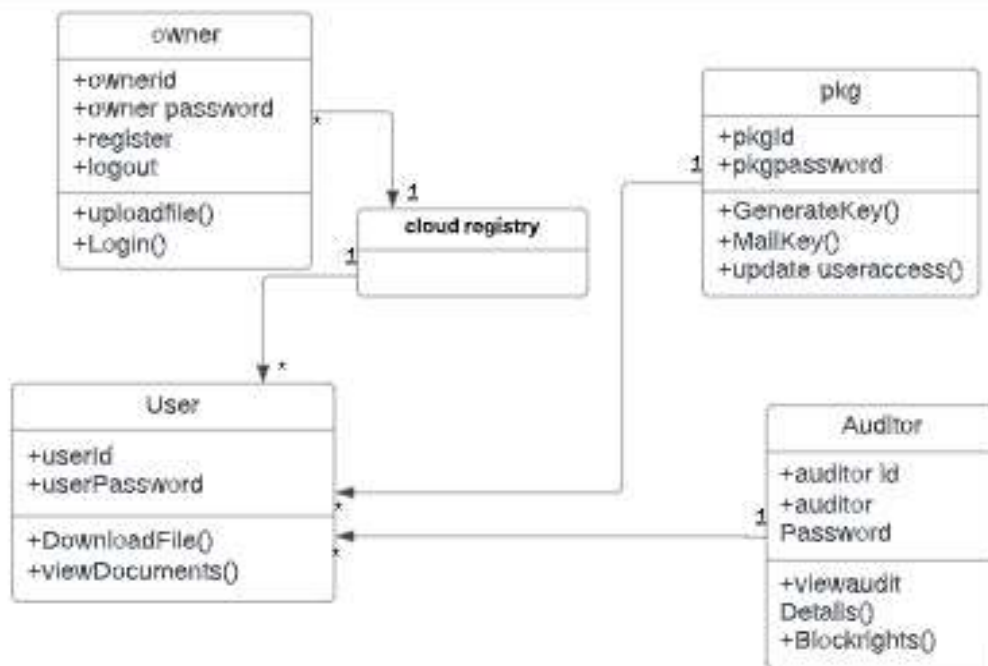
- The structural diagrams represent the static aspect of the system. These static aspects represent those parts of a diagram, which forms the main structure and are therefore stable.
- These static parts are represented by classes, interfaces, objects, components, and nodes. The four structural diagrams are –
 - 1) Class diagram
 - 2) Object diagram
 - 3) Component diagram
 - 4) Deployment diagram

Class Diagram:

- Class diagrams are the most common diagrams used in UML. Class diagram consists of classes, interfaces, associations, and collaboration. Class diagrams basically represent the object-oriented view of a system, which is static in nature.
- Active class is used in a class diagram to represent the concurrency of the system.
- Class diagram represents the object orientation of a system. Hence, it is generally used for development purposes. This is the most widely used diagram at the time of system construction.
- Class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing, and documenting different aspects of a system but also for constructing executable code of the software application.
- Class diagram describes the attributes and operations of a class and also the constraints imposed on the system. The class diagrams are widely used in the modeling of object oriented systems because they are the only UML diagrams, which can be mapped directly with object-oriented languages.
- Class diagram shows a collection of classes, interfaces, associations, collaborations, and constraints. It is also known as a structural diagram.

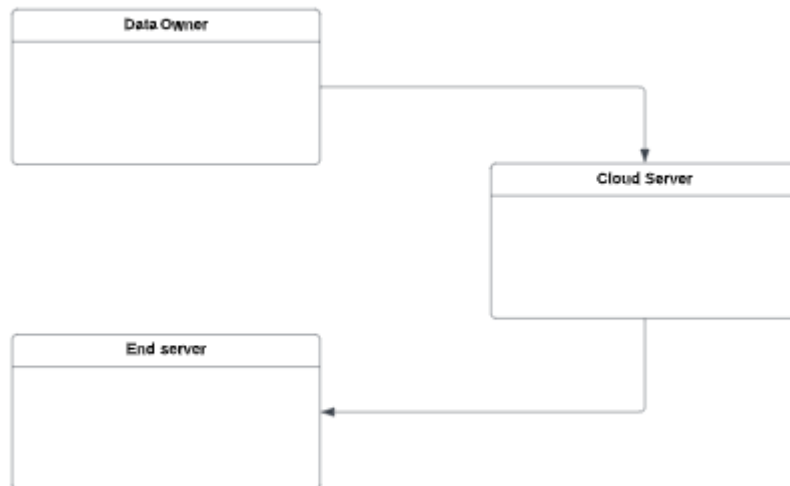
Purpose of Class Diagrams:

- The purpose of the class diagram is to model the static view of an application. Class diagrams are the only diagrams which can be directly mapped with object-oriented languages and thus widely used at the time of construction.
- UML diagrams like activity diagram, sequence diagrams can only give the sequence flow of the application, however the class diagram is a bit different. It is the most popular UML diagram in the coder community.
- The purpose of the class diagram can be summarized as –
 - Analysis and design of the static view of an application.
 - Describe responsibilities of a system.
 - Base for component and deployment diagrams.
 - Forward and reverse engineering.



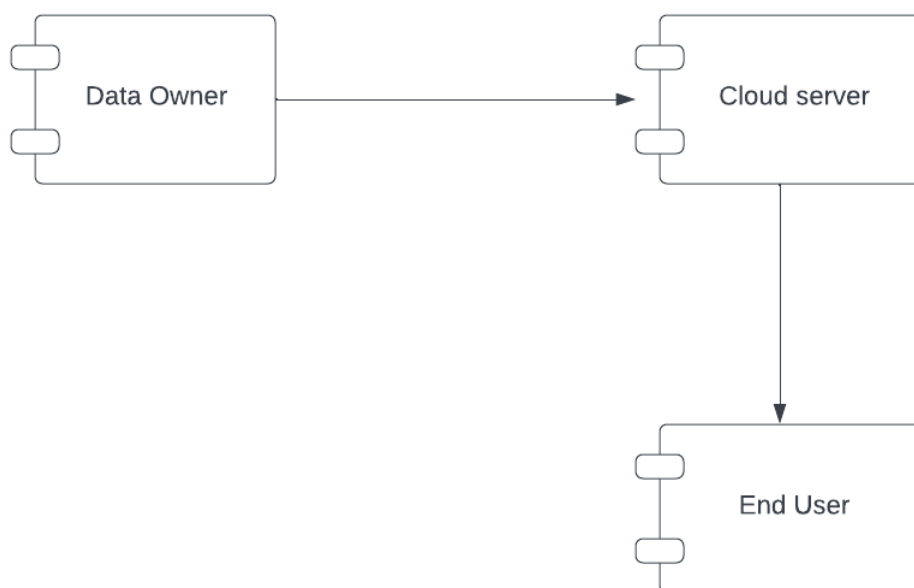
Object Diagram:

- Object diagrams can be described as an instance of a class diagram. Thus, these diagrams are more close to real-life scenarios where we implement a system.
- Object diagrams are a set of objects and their relationship is just like class diagrams. They also represent the static view of the system.
- The usage of object diagrams is similar to class diagrams but they are used to build a prototype of a system from a practical perspective.



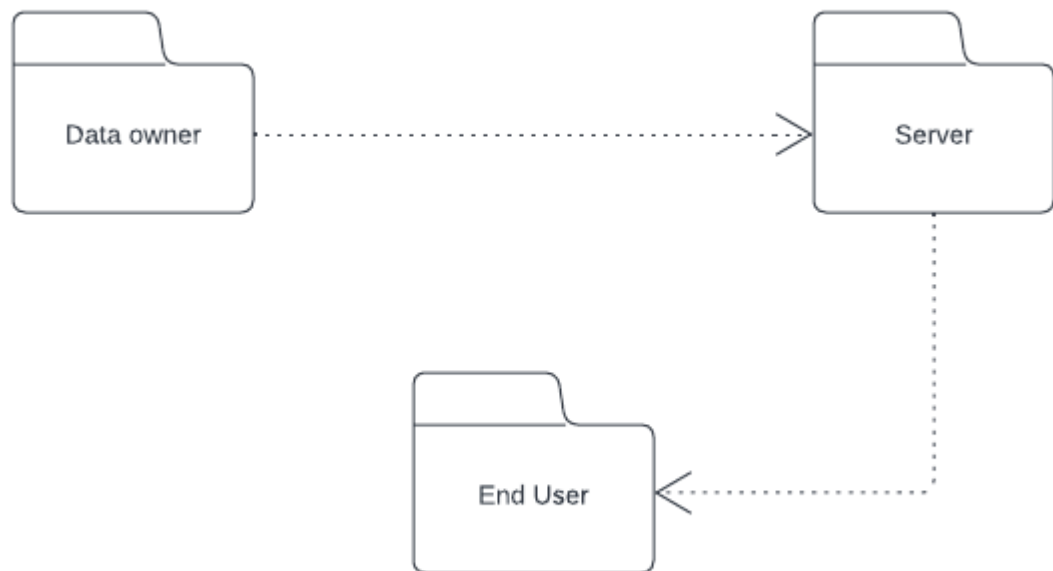
Component Diagram:

- Component diagrams represent a set of components and their relationships. These components consist of classes, interfaces, or collaborations. Component diagrams represent the implementation view of a system.
- During the design phase, software artifacts (classes, interfaces, etc.) of a system are arranged in different groups depending upon their relationship. Now, these groups are known as components.
- Finally, it can be said component diagrams are used to visualize the implementation.



Deployment Diagram:

- Deployment diagrams are a set of nodes and their relationships. These nodes are physical entities where the components are deployed.
- Deployment diagrams are used for visualizing the deployment view of a system. This is generally used by the deployment team.
- Note – If the above descriptions and usages are observed carefully then it is very clear that all the diagrams have some relationship with one another. Component diagrams are dependent upon the classes, interfaces, etc. which are part of the class/object diagram. Again, the deployment diagram is dependent upon the components, which are used to make component diagrams.



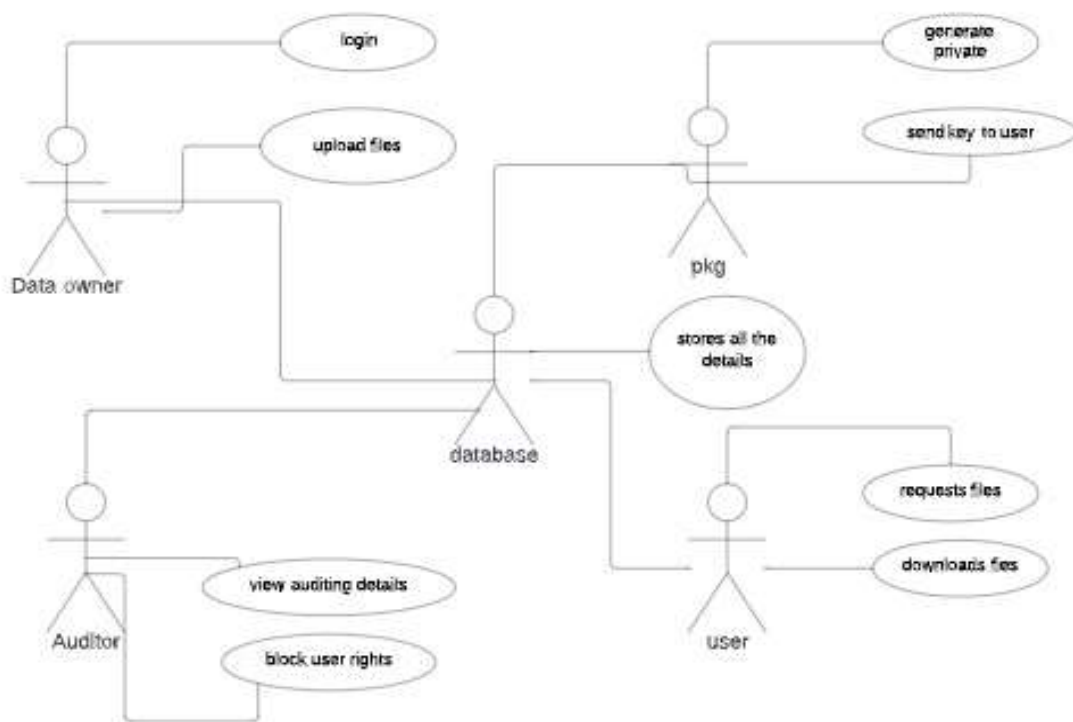
Behavioral Diagrams:

- Any system can have two aspects, static and dynamic. So, a model is considered as complete when both the aspects are fully covered.
- Behavioral diagrams basically capture the dynamic aspect of a system. Dynamic aspects can be further described as the changing/moving parts of a system.
- UML has the following five types of behavioral diagrams –
 - 1) Use case diagram

- 2) Sequence diagram
- 3) Collaboration diagram
- 4) Statechart diagram
- 5) Activity diagram

Use Case Diagram:

- Use case diagrams are a set of use cases, actors, and their relationships. They represent the use case view of a system.
- A use case represents a particular functionality of a system. Hence, a use case diagram is used to describe the relationships among the functionalities and their internal/external controllers. These controllers are known as actors.

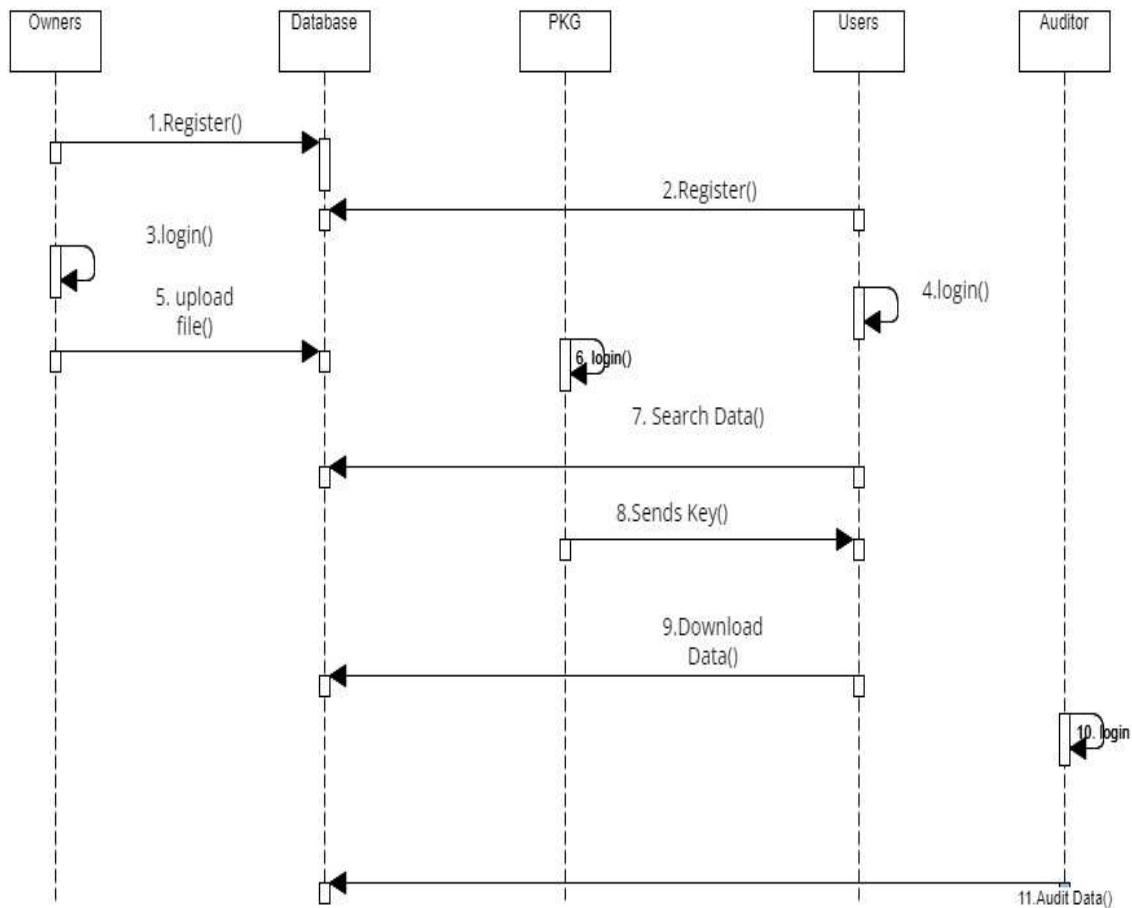


Sequence Diagram:

- A sequence diagram is an interaction diagram. From the name, it is clear that the diagram deals with some sequences, which are the sequence of messages flowing from one object to another.

- Interaction among the components of a system is very important from implementation and execution perspective. Sequence diagram is used to visualize the sequence of calls in a system to perform a specific functionality.

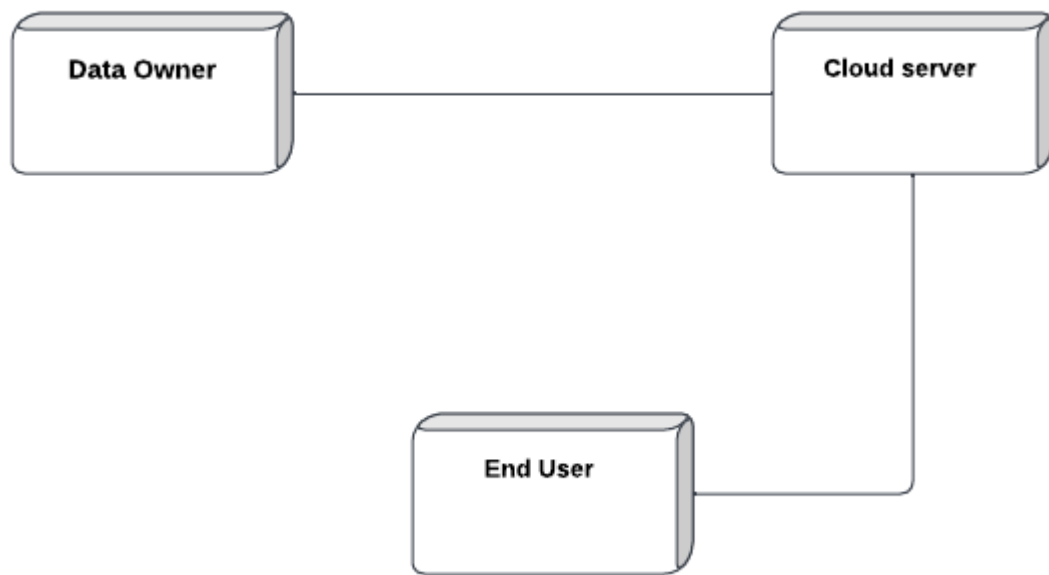
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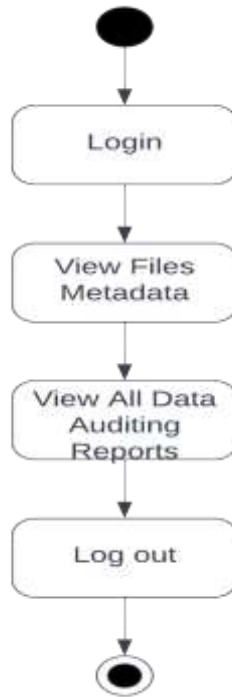
Collaboration Diagram:

- Collaboration diagram is another form of interaction diagram. It represents the structural organization of a system and the messages sent/received. Structural organization consists of objects and links.
- The purpose of the collaboration diagram is similar to a sequence diagram. However, the specific purpose of the collaboration diagram is to visualize the organization of objects and their interaction.

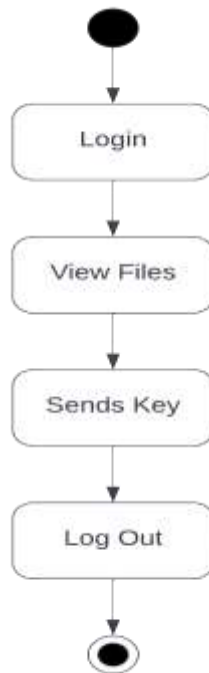


Statechart Diagram:

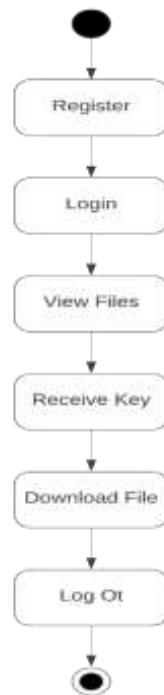
- Any real-time system is expected to be reacted by some kind of internal/external events. These events are responsible for state change of the system.
- Statechart diagram is used to represent the event driven state change of a system. It basically describes the state change of a class, interface, etc.
- State chart diagram is used to visualize the reaction of a system by internal/external factors.



Above diagram is the StateChart Diagram for Auditor



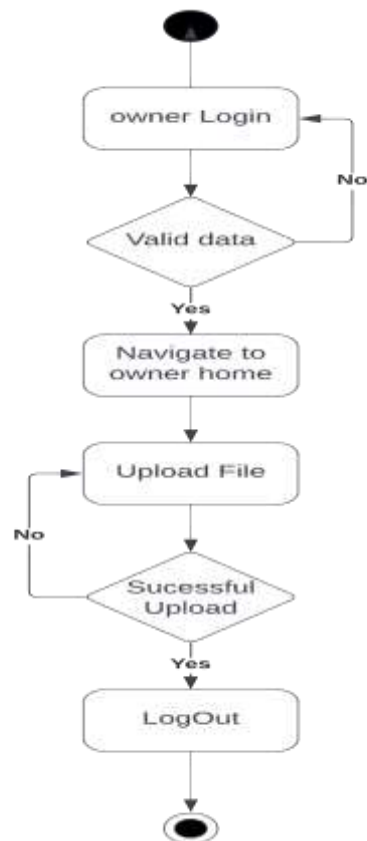
Above is the StateChart diagram for PKG



Above is the StateChart diagram for Users

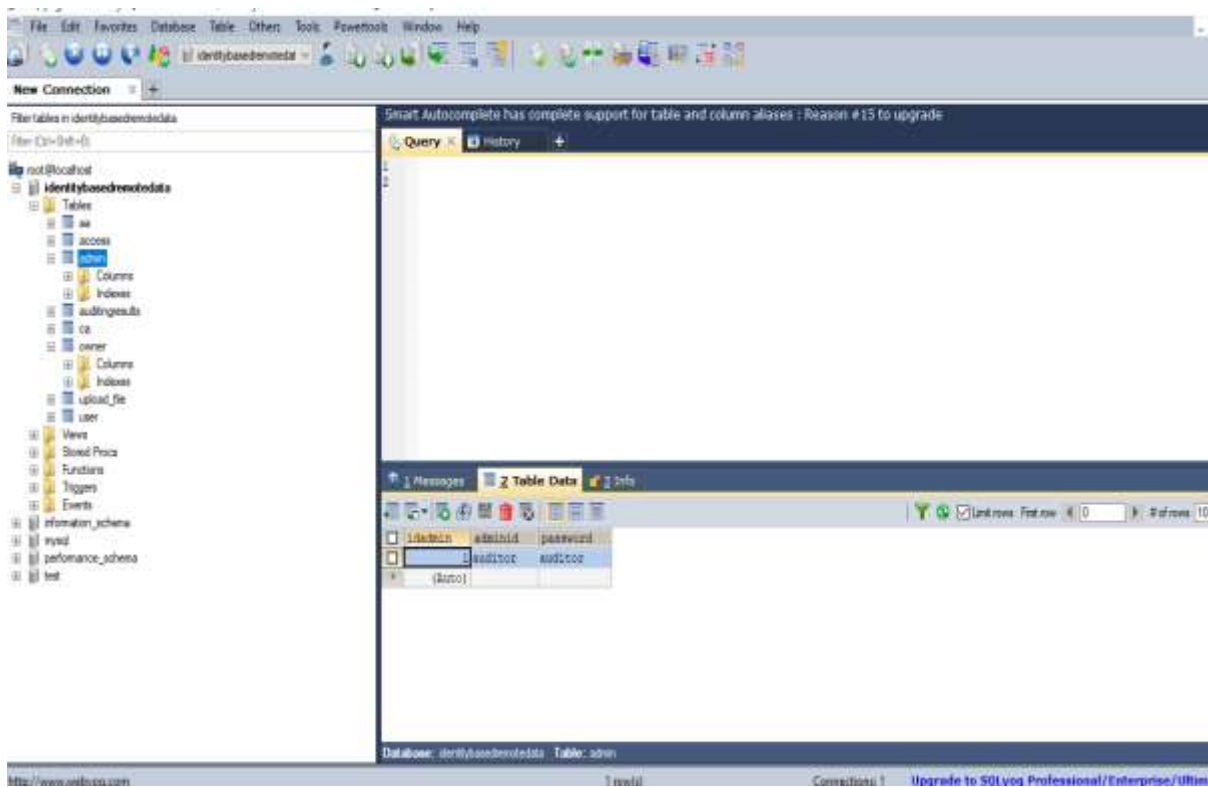
Activity Diagram:

- Activity diagram describes the flow of control in a system. It consists of activities and links. The flow can be sequential, concurrent, or branched.
- Activities are nothing but the functions of a system. Numbers of activity diagrams are prepared to capture the entire flow in a system.
- Activity diagrams are used to visualize the flow of controls in a system. This is prepared to have an idea of how the system will work when executed.
- Note – Dynamic nature of a system is very difficult to capture. UML has provided features to capture the dynamics of a system from different angles. Sequence diagrams and collaboration diagrams are isomorphic, hence they can be converted from one another without losing any information. This is also true for Statechart and activity diagram.



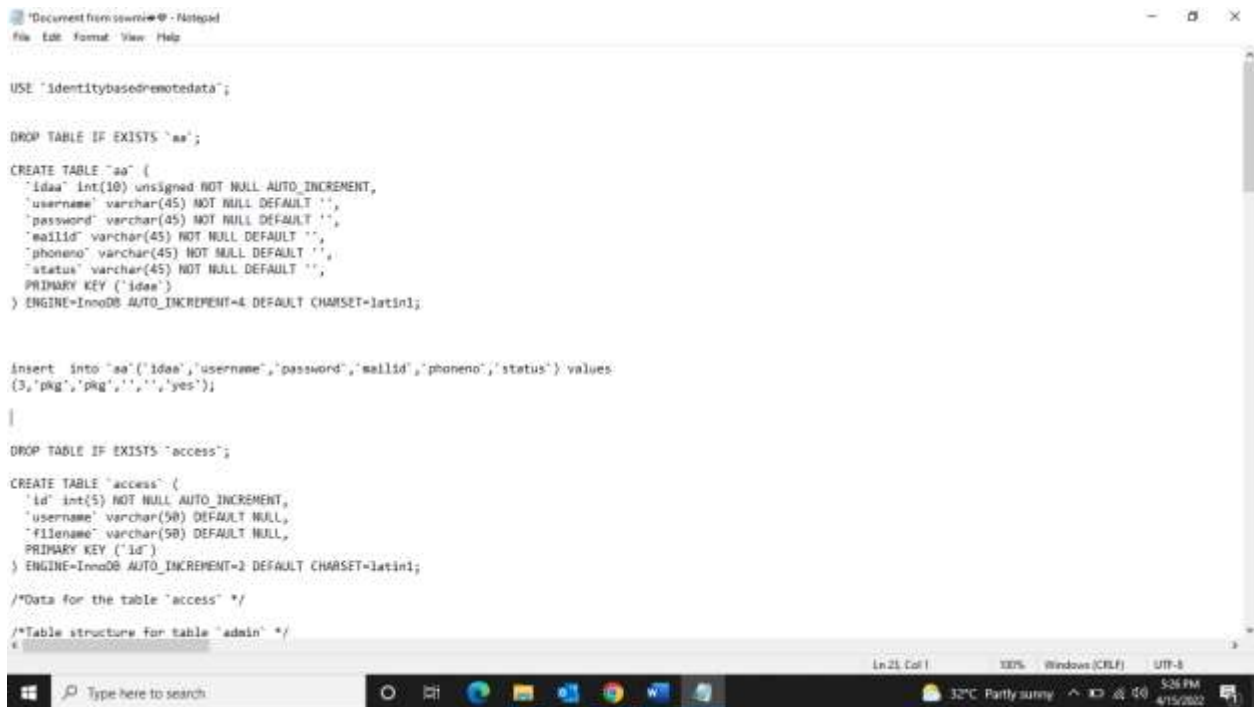
4.3 DATABASE DESIGN:

- Database design is the organization of data according to a database model. The designer determines what data must be stored and how the data elements interrelate.
- Data to be stored can be determined by Requirement Specification.
- Once a database designer is aware of the data which is to be stored within the database, they must then determine where dependency is within the data.
- Once the relationships and dependencies amongst the various pieces of information have been determined, it is possible to arrange the data into a logical structure which can then be mapped into the storage objects supported by the database management system. In the case of relational databases the storage objects are tables which store data in rows and columns.



This is the database design in the SqlYog Community. Upon executing the external script which comprises of sql commands the tables gets updated in the interface. The data inside the tables can be viewed in the Table Data column.

1 Messages					
2 Table Data					
3 Info					
<input type="checkbox"/> Limit rows First row					
<input type="checkbox"/>	idowner	username	mailid	password	phoneno
<input type="checkbox"/>	2	sowmya penmatsa	sowmyapenmatsa4@gmail.com	S5mrdtmp	9851212777
*	(Auto)				



```
USE 'identitybasedremotedata';

DROP TABLE IF EXISTS `aa`;

CREATE TABLE `aa` (
  `idaa` int(10) unsigned NOT NULL AUTO_INCREMENT,
  `username` varchar(45) NOT NULL DEFAULT '',
  `password` varchar(45) NOT NULL DEFAULT '',
  `emailid` varchar(45) NOT NULL DEFAULT '',
  `phoneno` varchar(45) NOT NULL DEFAULT '',
  `status` varchar(45) NOT NULL DEFAULT '',
  PRIMARY KEY (`idaa`)
) ENGINE=InnoDB AUTO_INCREMENT=4 DEFAULT CHARSET=latin1;

insert into `aa`(`idaa`,`username`,`password`,`emailid`,`phoneno`,`status`) values
(3,'pkg','pkg','','','yes');

DROP TABLE IF EXISTS `access`;

CREATE TABLE `access` (
  `id` int(5) NOT NULL AUTO_INCREMENT,
  `username` varchar(50) DEFAULT NULL,
  `filename` varchar(50) DEFAULT NULL,
  PRIMARY KEY (`id`)
) ENGINE=InnoDB AUTO_INCREMENT=2 DEFAULT CHARSET=latin1;

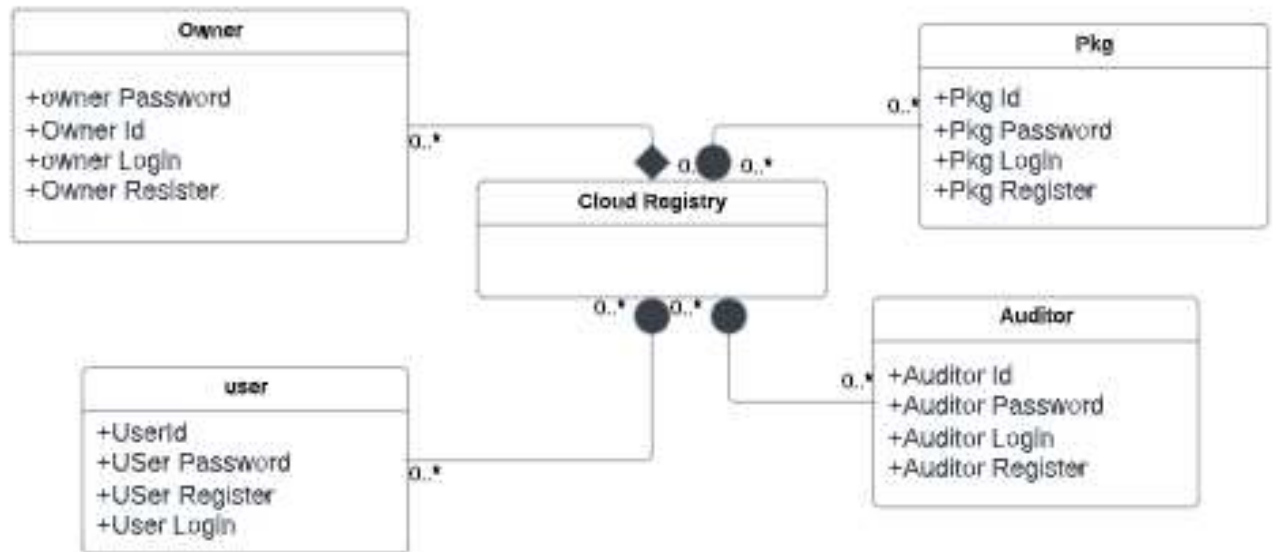
/*Data for the table 'access' */

/*Table structure for table 'admin' */
```

This is the external SQL Script comprising of all the tables creation.

ER Diagram:

- An entity relationship diagram (ERD) shows the relationships of entity sets stored in a database. An entity in this context is an object, a component of data. An entity set is a collection of similar entities. These entities can have attributes that define its properties.
- By defining the entities, their attributes, and showing the relationships between them, an ER diagram illustrates the logical structure of databases.
- ER diagrams are used to sketch out the design of a database.



SYSTEM IMPLEMENTATION

5.1 INTRODUCTION:

System Implementation with the enhancement of women's harassment in social media like Twitter which contains lots of tweets that show the insecurities of the women. So, in this project, we try to reduce this risk of women's harassment by using the sentiment analysis of the tweets given by people about the area where the incidents happened before.

This is done by analyzing the tweets given by the people about the selected city by previous harmful incidents that happened in that city. The analyzed data is plotted in the form of a pie and also a line chart. This chart represents how safe it is for women to visit a city. The various actors of the application are

- Data Owners
- Users
- Private Key Generator (PKG)
- Auditor

1. Data Owner

In this application, the data owners upload their data with its chunks in the cloud server. For the security purpose the data owner encrypts the data file's blocks and then store in the cloud. The data owners are doing following operations such as Register, Login, Upload files.

2. Cloud Server

The cloud service provider manages a cloud to provide data storage service. Data owners encrypt their data files and store them in the cloud for sharing with data consumers. To access the shared data files, data consumers download encrypted data files of their interest from the cloud and then decrypt them. In our application we have used an open-source cloud named CloudMe. In the cloud we can create a folder into which the files that the data owners upload gets loaded.

3. Data Users

The Data Users are the actors of our application which uses the data over the cloud. This available data is being uploaded by the data owners. The data users have the functionalities of user Register, User Login, Download File. To download a file any user needs a private key. The key has to be sent by the Private Key Generator (PKG).

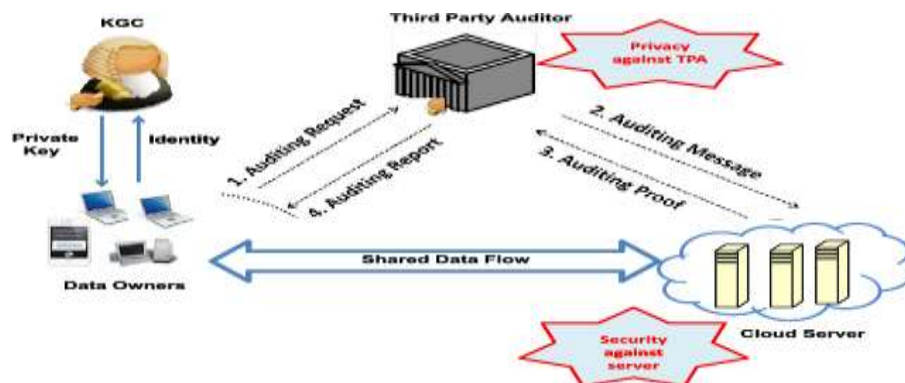
4. Data Auditor

The Data Auditor is another major actor of the application whose functionality is to perform auditing. He is a third-party lender of an organization. One objective of the application which is comprehensive auditing is performed by the data auditor. He would generate an auditing report as requested by the data owners and give back to them.

5. PKG

The PKG is the Private Key Generator. It is responsible for generating system public parameters and the private key for the files uploaded by the data owners. It is also responsible for sending the key to the users through Gmail service.

Data Flow Diagram

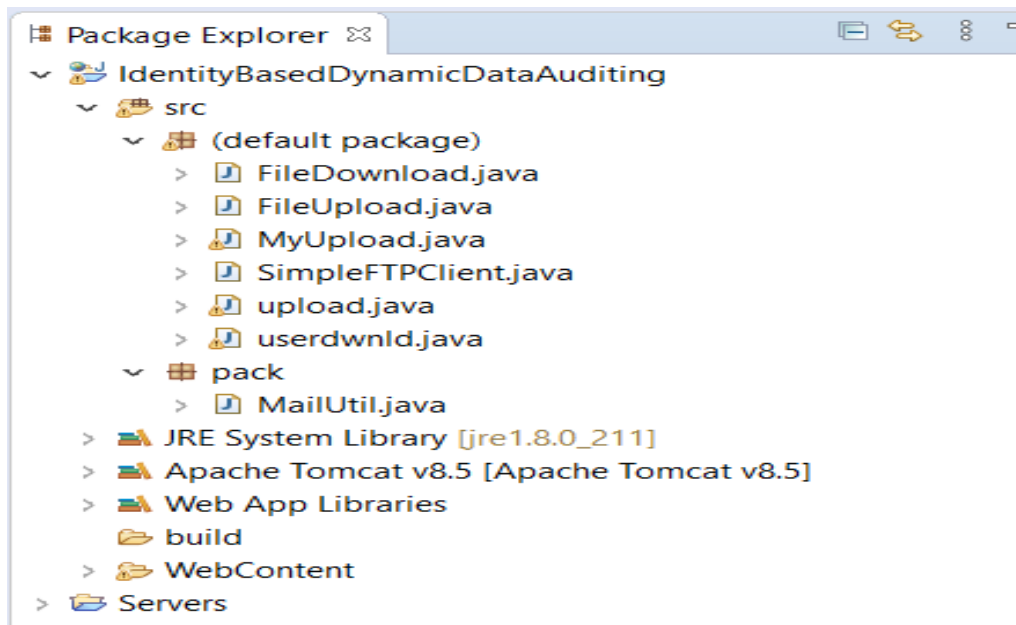


5.2 FUNCTIONALITIES:

Various functionalities of the IBDO application are:

- Upload File ----- Data Owners
- View Files ----- Data Users
- View Audit Results ----- Data Auditor
- View Users ----- Data Auditor
- Grant Permissions ----- Data Auditor
- Send Access key ----- PKG
- Validate Access key ----- PKG
- Download File ----- Data Users

The application is implemented using the SpringTool. The name of the project is titled as "IdentityBasedDynamicDataAuditing". The project hierarchy looks as below. It comprises of a folder called src which comprises of 2 packages – a default package, pack. The default package comprises of the java files.



Upload Functionality

FileUpload.java

```
public static synchronized boolean fileUpload(String filePath)
{
    try {
        CloudmeUser user = new CloudmeUser("vodmain","void@1234");
        CloudmeFolderNode node = user.getFolderManager().getFolderTree();
        for(CloudmeFolderNode n : node.getChildren()){
            if(n.getFolder().getName().equals("audit"))
            {
                n.getFolder().uploadFile(filePath);
            }
        }
        user.killUser();
        return true;
    } catch (Exception e) {
        e.printStackTrace();
        return false;
    }
}
```

This file comprises of a method named fileUpload() which takes a filepath as a parameter. This method takes the username and password which is of the CloudMe account. Then uploads the file to a folder inside the cloud account.

The file which gets uploaded also needs to be updated into the database table. For this we have the file MyUpload.java

Firstly, for any data to go to the database tables, MySQL driver needs to be registered inside the project. The Database driver connection is as follows

```
try {
    Class.forName("com.mysql.jdbc.Driver");
    Connection con = DriverManager.getConnection(
        "jdbc:mysql://localhost:3306/identitybasedremotedata", "root",
        "root");
    Statement st = con.createStatement();
    ResultSet rt = st
```

```

        .executeQuery("select * from
identitybasedremotedata.upload_file where status='no' and
filename='"+request.getParameter("filename")+"'");
}

```

Next, while uploading the files, data owners use a key to encrypt the files. Here we generated a random key of length 9.

```

Random r=new Random();

String key="";

String
pattern="ABCDEFGHILMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789";

for(int i=0;i<9;i++)
{
    key=key+pattern.charAt(r.nextInt(60));
}

```

For encryption we use the class SimpleFTPClient and the method encrypt().

```

public static void encryptOrDecrypt(String key, int mode, InputStream is,
OutputStream os) throws Exception {

    DESKeySpec dks = new DESKeySpec(key.getBytes());
    SecretKeyFactory skf = SecretKeyFactory.getInstance("DES");
    SecretKey desKey = skf.generateSecret(dks);

    Cipher cipher = Cipher.getInstance("DES");

    if (mode == Cipher.ENCRYPT_MODE) {
        cipher.init(Cipher.ENCRYPT_MODE, desKey);
        CipherInputStream cis = new CipherInputStream(is, cipher);
        doCopy(cis, os);
    } else if (mode == Cipher.DECRYPT_MODE) {
        System.out.println("in decrypton");
        cipher.init(Cipher.DECRYPT_MODE, desKey);
        CipherOutputStream cos = new CipherOutputStream(os, cipher);
        doCopy(is, cos);
    }
}

```

Once the encryption is done and file is uploaded successfully the status of the file needs to be updated to "yes" in the database table .

```

if(FileUpload.fileUpload(path)){

    PreparedStatement ps = con.prepareStatement("update upload_file set skey='"
        + key + "','status='yes' where userid='"+ user + "' AND filename='" +
        fileItem.getName() + "'");
    ps.execute();

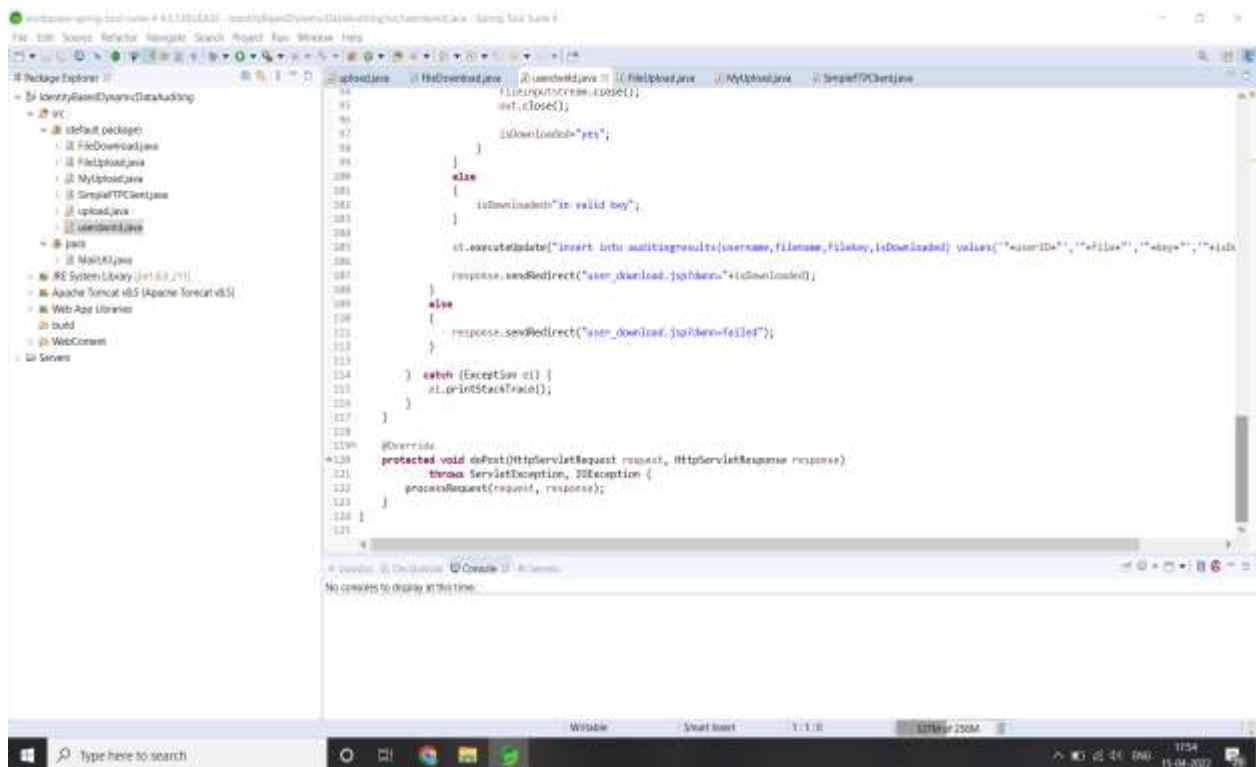
    response.sendRedirect("owner_page.jsp?db='uploaded'");

}

```

Download Functionality

The data users have the functionality of downloading a file. It is implemented through userdwlnld.java. The file is as follows



If the file is downloaded successfully the information needs to be updated in the database table as

```

else{
    isDownloaded="in valid key";
}

```

```
st.executeUpdate("insert into auditingresults(username,filename,filekey,isDownloaded)
values('"+userID+"','"+file+"','"+key+"','"+isDownloaded+"')");

response.sendRedirect("user_download.jsp?dwnn="+isDownloaded);
```

For a file to download, user needs a key. The file is sent using Gmail service. This is implemented through MailUtil.java

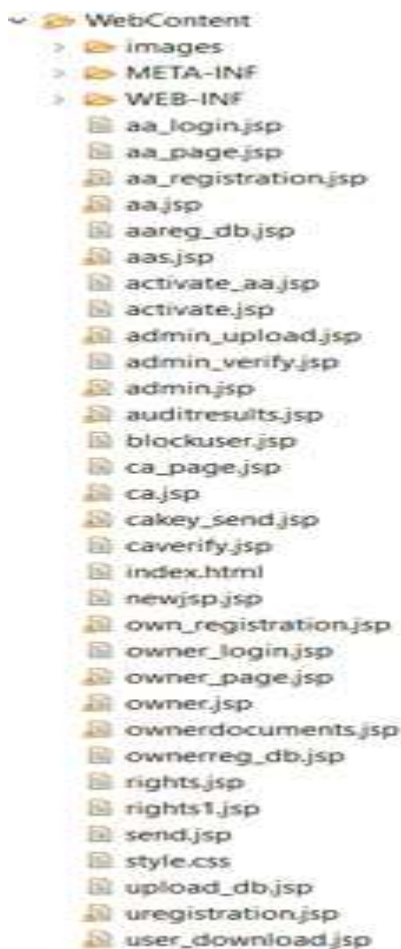
```
String host = "smtp.gmail.com";
String from = "identityauditing@gmail.com";
String pass = "majorprojectb4";

Properties props = System.getProperties();

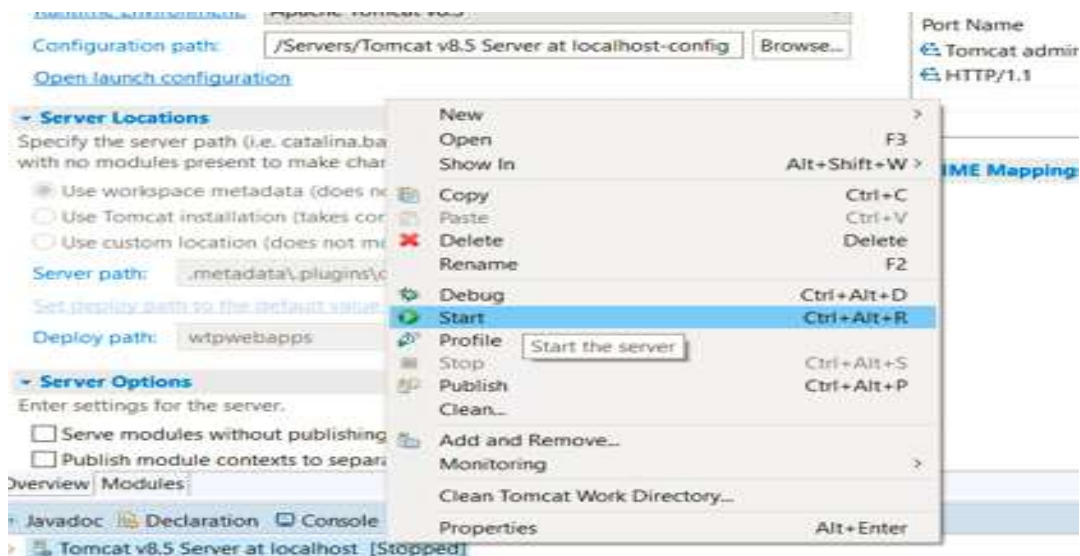
props.put("mail.smtp.starttls.enable", "true");
props.put("mail.smtp.host", host);
props.put("mail.smtp.user", from);
props.put("mail.smtp.password", pass);
props.put("mail.smtp.port", "587");
props.put("mail.smtp.auth", "true");
```

“from” is the one which contains the mail id from which the mail is being sent.

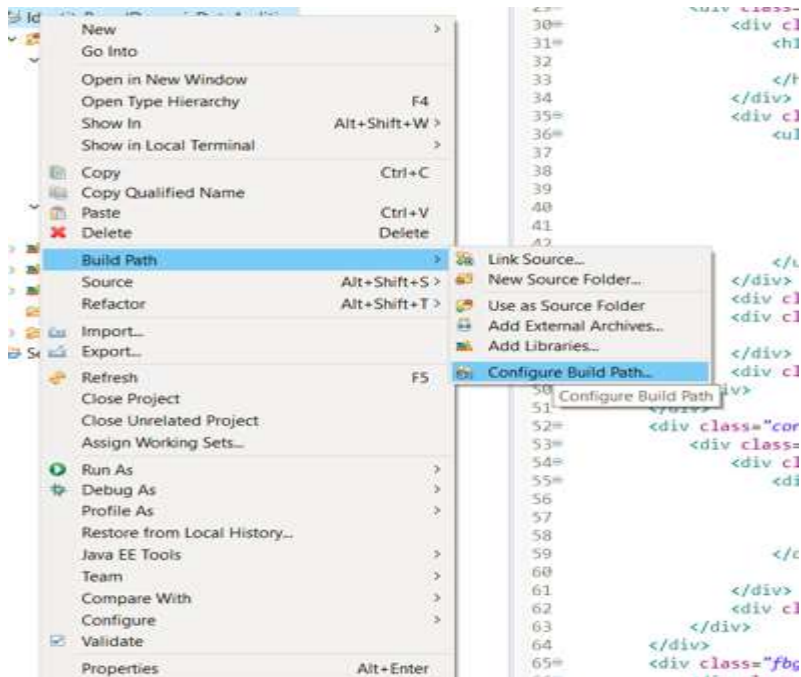
The interface for the application is built through jsp pages. These jsp pages are embedded into the web-content folder.



Later after implementing the interface, to run the project Tomcat Server has to be added at the "Servers" tab.



Later we need to build path for the project as

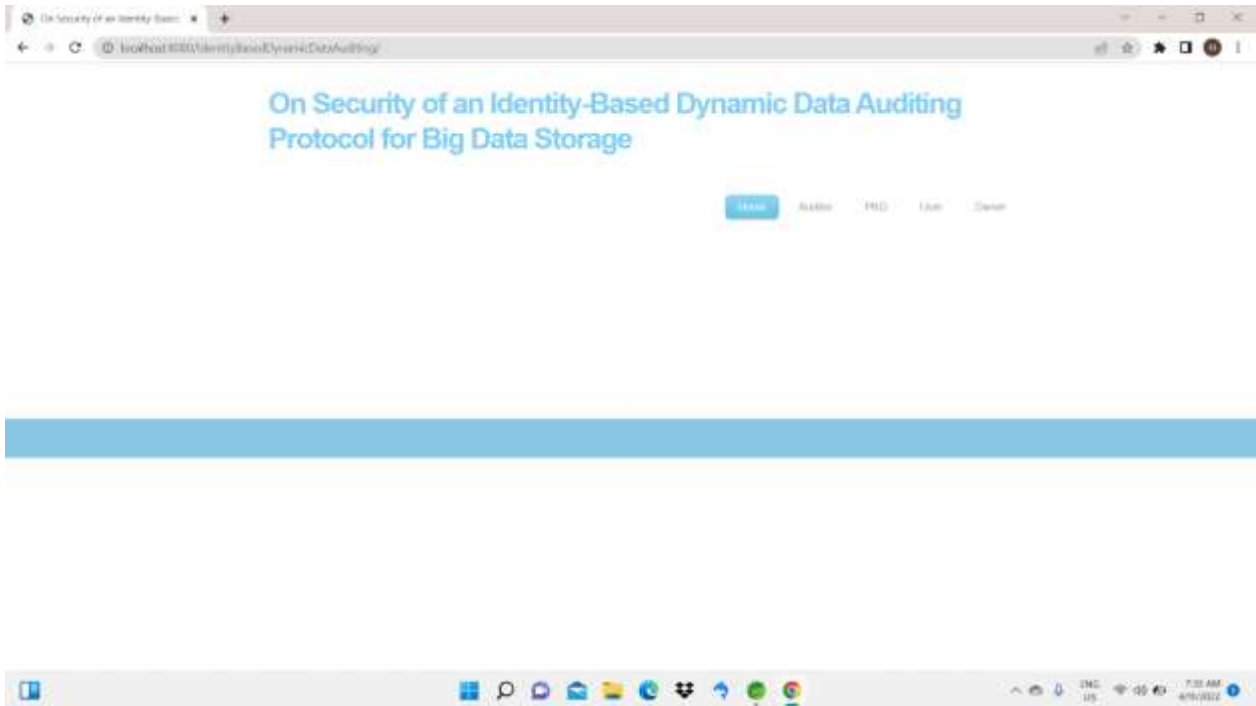


After adding the Server, to run the project right click on the project and click Run As -> Run on Server

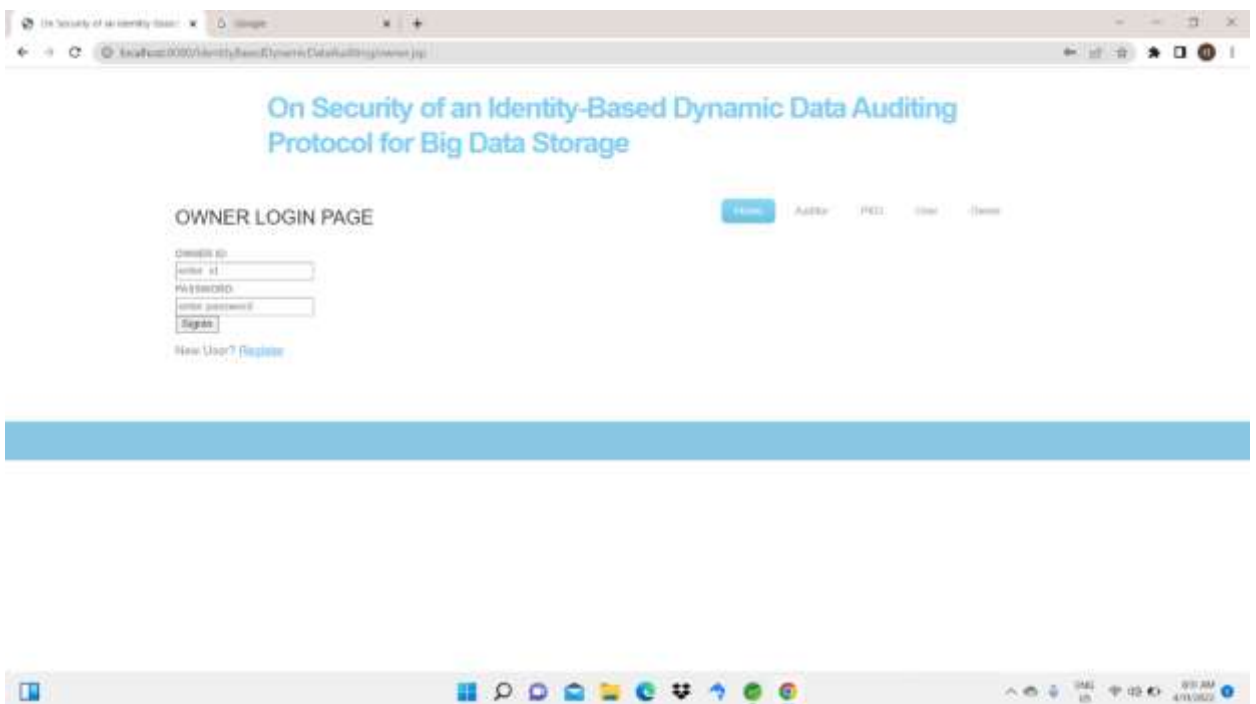


5.3 Screens:

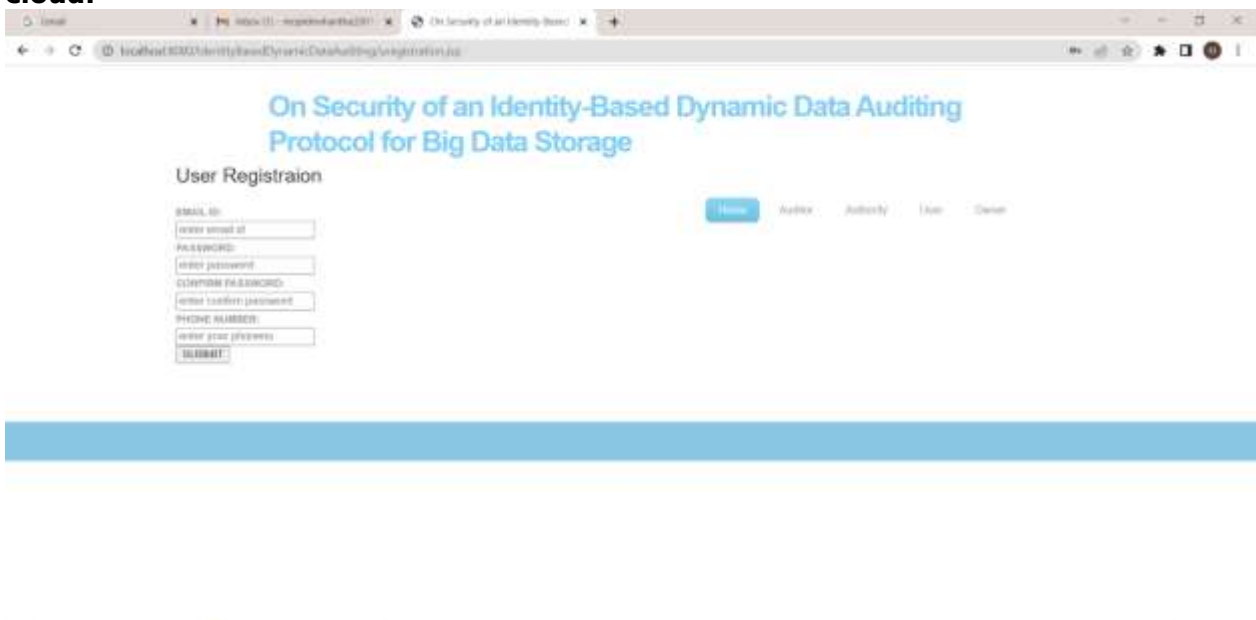
USER INTERFACE:



The Application comprises of varied users like dataowners, users, private key generator ,auditor.

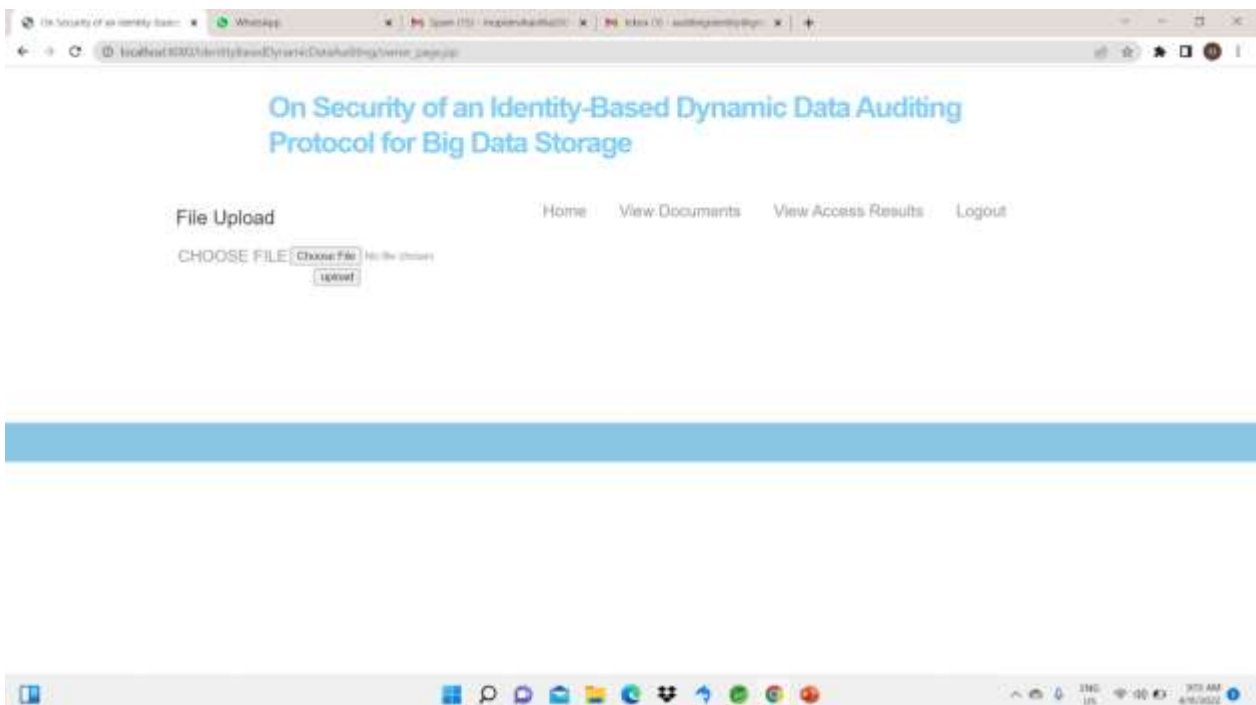


In owner login page a user can login as a data owner to upload data files on to the cloud.



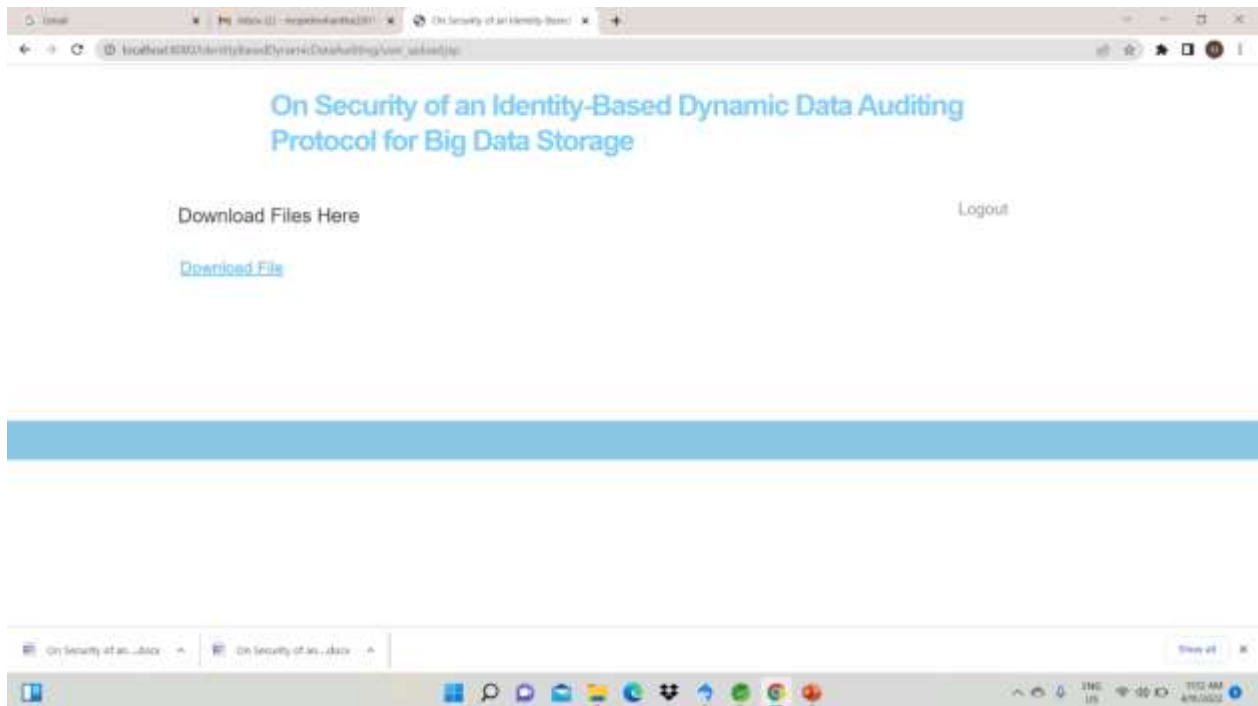
The screenshot shows a web browser window with the URL `localhost:8080/identity-based-dynamic-data-auditing/registration.jsp`. The page title is "On Security of an Identity-Based Dynamic Data Auditing Protocol for Big Data Storage". Below the title, there is a "User Registration" section. It contains a form with the following fields: "EMAIL ID:", "ENTER EMAIL ID:", "PASSWORD:", "ENTER PASSWORD:", "CONFIRM PASSWORD:", "ENTER CONFIRM PASSWORD:", "PHONE NUMBER:", "ENTER YOUR PHONE NO:", and a "SUBMIT" button. To the right of the form, there are navigation links: "Home", "Auditor", "Authority", "User", and "Owner".

In the user Registration page a new user will create his own account by providing personal information.

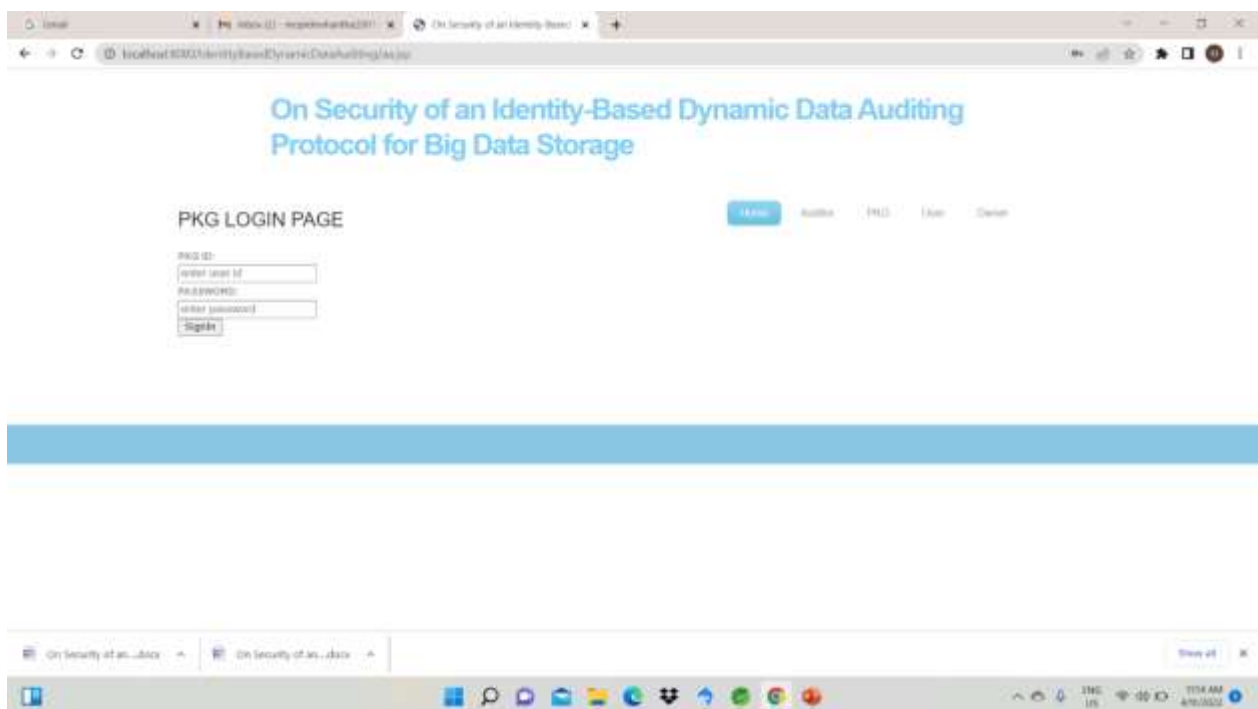


The screenshot shows a web browser window with the URL `localhost:8080/identity-based-dynamic-data-auditing/viewer_page.jsp`. The page title is "On Security of an Identity-Based Dynamic Data Auditing Protocol for Big Data Storage". Below the title, there is a "File Upload" section. It contains a form with the following fields: "CHOOSE FILE:" and a "Choose File" button. To the right of the form, there are navigation links: "Home", "View Documents", "View Access Results", and "Logout".

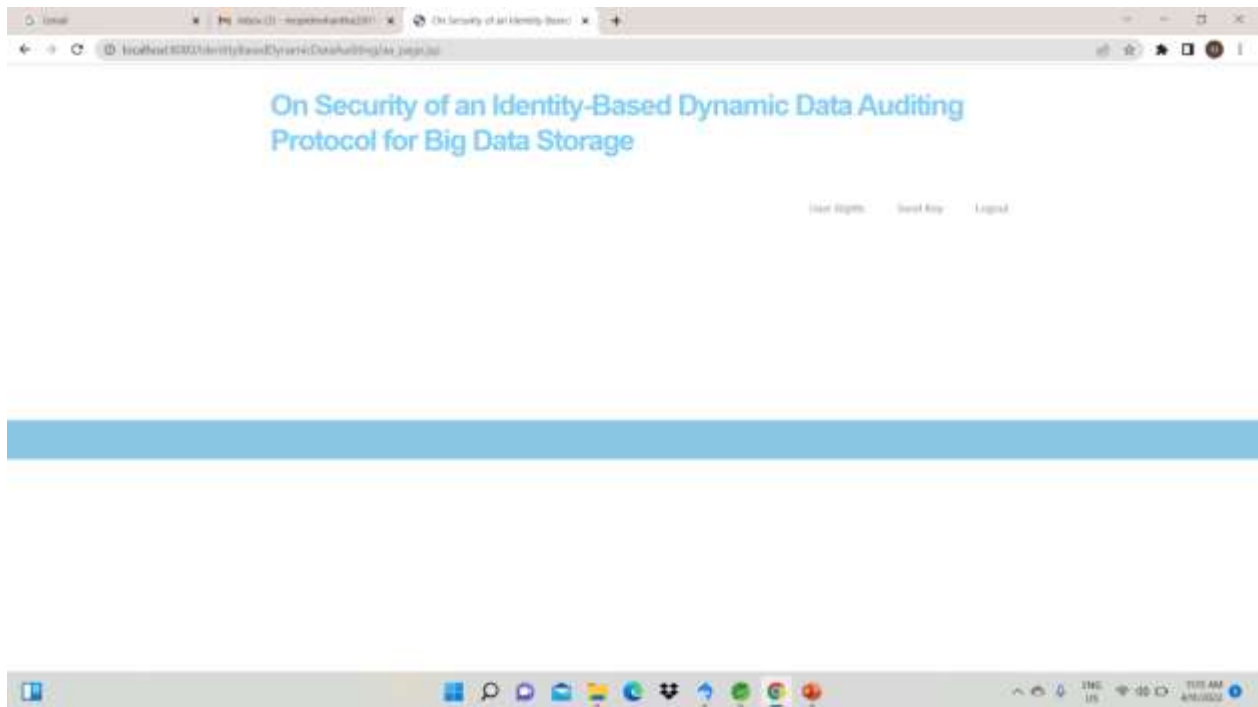
Inside an owner profile, a user will be able to upload files through file upload module. He can also view documents over the cloud .



Under the user profile, a user have the functionality of Download File from where any user can download files present over the cloud with the correct key.

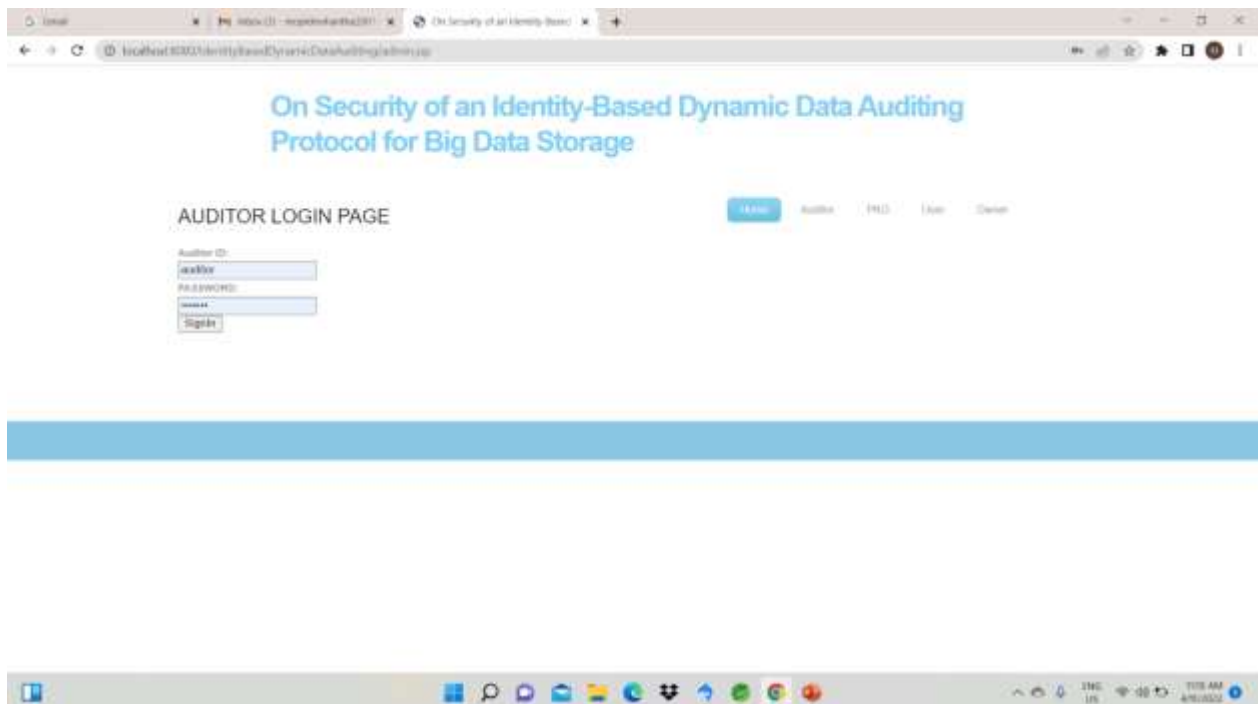


Under the pkg profile various functionalities available are send key, view user rights. The pkg can send the key of a particular file to an identity verified user.

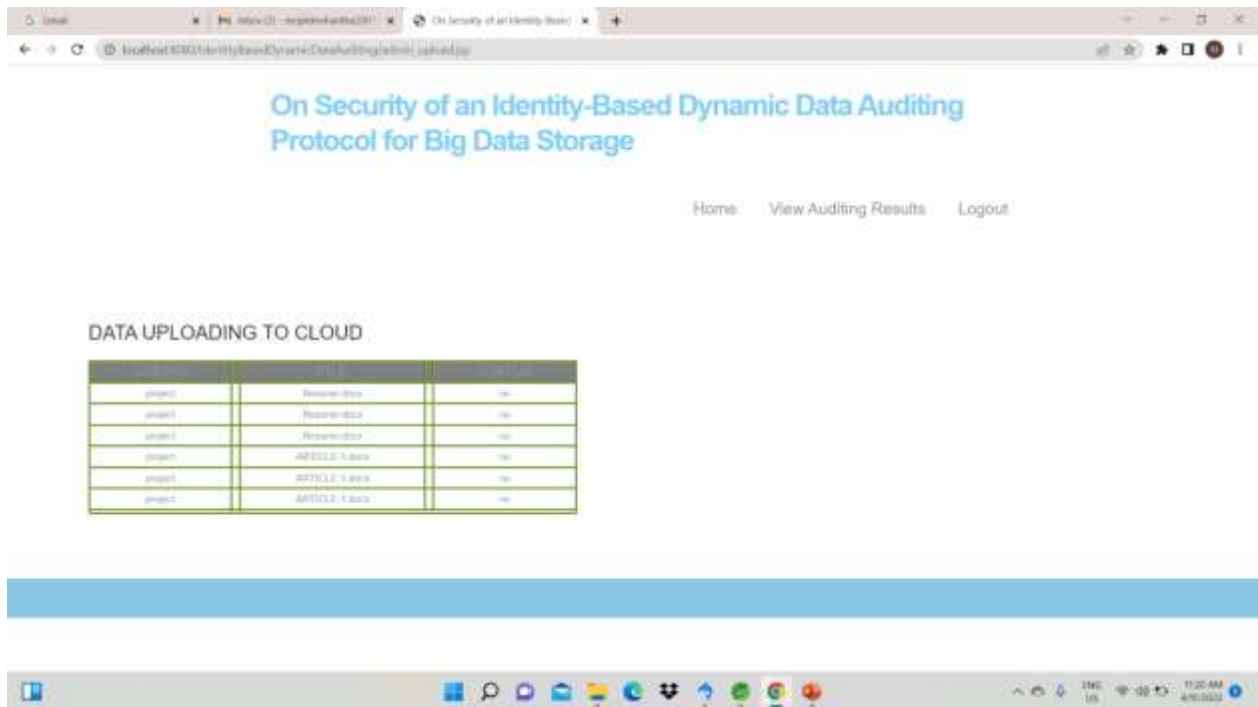


Pkg – Private Key Generator is the other kind of user of the application who is responsible for key generation and sending it to the users over the gmail service.

AUDITOR INTERFACE:



In this application Auditor is the one who acts as an admin overseeing all the actions performed by the data owners and data users.



In the auditor profile, the auditor can have the functionality of View Auditing Results.

SYSTEM TESTING

6.1. INTRODUCTION:

System Testing is a level of testing that validates the complete and fully integrated software product. The purpose of a system test is to evaluate the end-to-end system specifications. Usually, the software is only one element of the large computer-based system. Ultimately, the software is interfaced with other software/hardware systems. System Testing is a series of different tests whose sole purpose is to exercise the full computer-based system.

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies, and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail unacceptably. There are various types of tests. Each test type addresses a specific testing requirement.

It can also be stated as the process of validating and verifying that a software program or application or product:

- ✓ Meets the business and technical requirements that guided its design and development.
- ✓ Works as expected.
- ✓ Can be implemented with the same characteristic.

Software testing is an important part of software development. If software testing is not performed properly, applications can have errors which may lead to rework, costly failure or worse.

6.2. TESTING METHODS:

6.2.1. White Box Testing:

White Box Testing is testing in which the software tester knows the inner workings, structure, and language of the software, or at least its purpose. It has a purpose. It is used to test areas that cannot be reached from a black-box level.

6.2.2. Black Box Testing:

Black Box Testing is testing the software without any knowledge of the inner working, structure, or language of the module being tested. Black box tests, like most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a test in which the software under test is treated as a black box. You cannot “see” into it. The test provides inputs and responds to outputs without considering how the software works.

6.2.3. Unit Testing:

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .It is done after the completion of an individual unit before integration. This is structural testing that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at the component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

Test strategy and approach:

Field testing will be performed manually, and functional tests will be written in detail.

Test objectives:

- All field entries must work properly.
- Pages must be activated from the identified link.
- The entry screen, messages, and responses must not be delayed.

Features to be tested:

- Verify that the entries are of the correct format.
- No duplicate entries should be allowed.
- All links should take the user to the correct page.

6.2.4. Integration Testing:

Integration tests are designed to test integrated software components to determine if they run as one program. Testing is event-driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfied, as shown by successful unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects. The task of the integration test is to check that components or software applications, e.g., components in a software system or – one step up – software applications at the company level – interact without error.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

6.2.5. Functional Testing:

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items:

- ✓ Valid Input : identified classes of valid input must be accepted.
- ✓ Invalid Input : identified classes of invalid input must be rejected.
- ✓ Functions : identified functions must be exercised.
- ✓ Output : identified classes of application outputs must be exercised.
- ✓ Systems/Procedures : interfacing systems or procedures must be invoked.

The organization and preparation of functional tests are focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identifying Business process flows; data fields, predefined processes, and successive processes must be considered for testing. Before functional testing is complete, additional tests are identified and the effective value of current tests is determined.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

6.2.6. Acceptance Testing:

User Acceptance Testing is a critical phase of any project and requires significant participation by the end-user. It also ensures that the system meets the functional requirements.

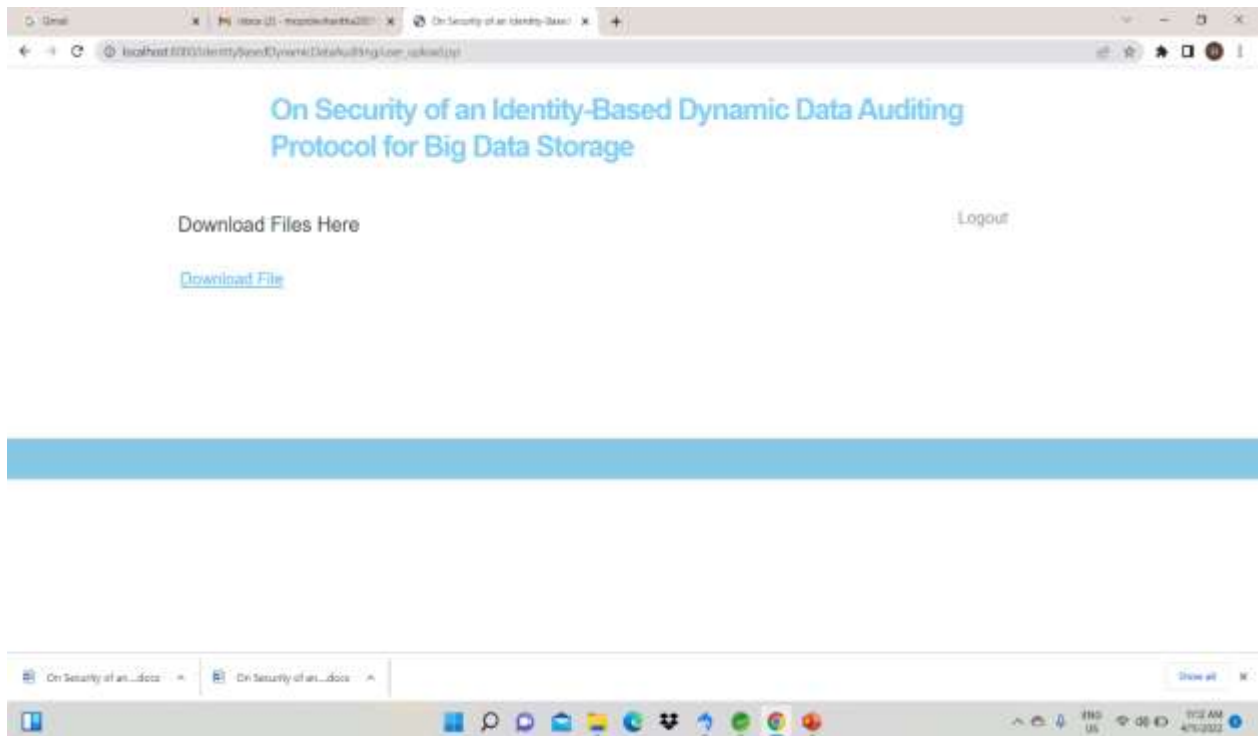
Test Results: All the test cases mentioned above passed successfully. No defects encountered.

6.3. Test Cases:

A test case is a set of conditions or variables under which a tester will determine whether a system under test satisfies requirements or works correctly. The purpose of a test case is to determine if different features within a system are performing as expected and to confirm that the system satisfies all related standards, guidelines and customer requirements. The process of writing a test case can also help reveal errors or defects within the system. A Test Case contains test steps, test data, precondition, postcondition developed for specific test scenarios to verify any requirement.

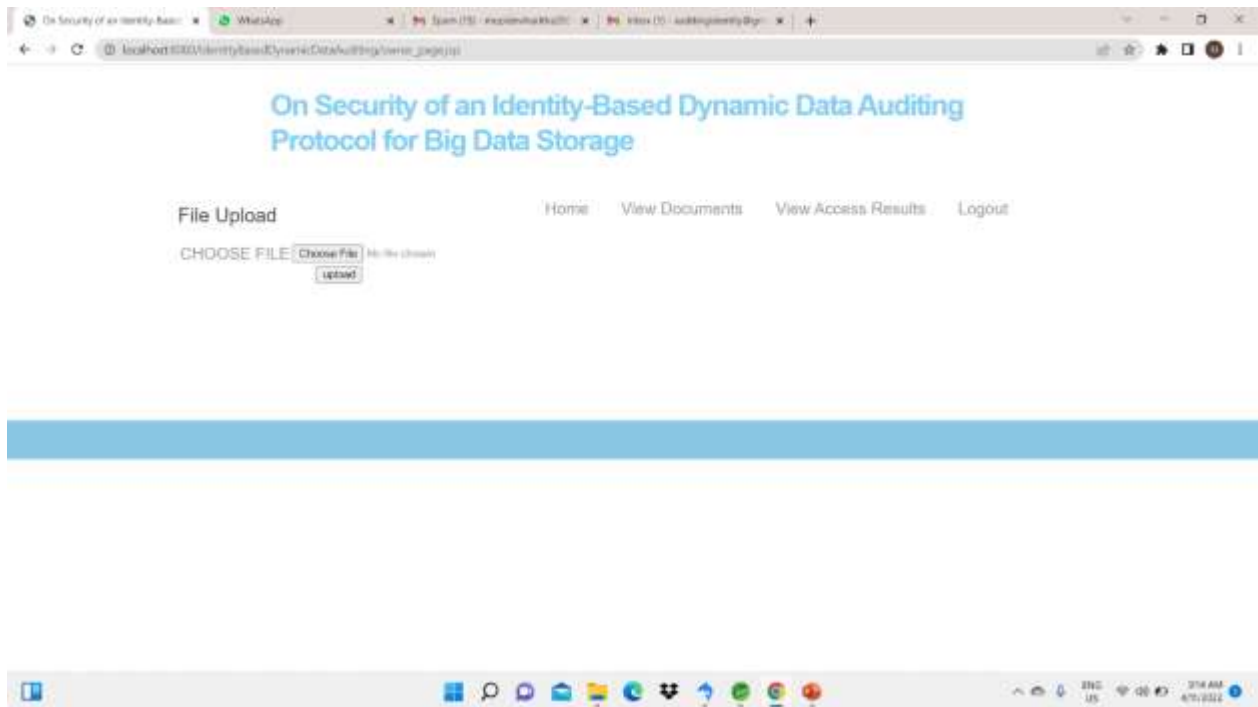
Test Case #1:

Test Objective:	To check whether the users can download files
Test Description:	It verifies whether the users of the application are able to download the files on correct key
Requirement Verified:	Yes
Expected Result:	Files to be downloaded into the local system
Result:	Files got downloaded from the cloud
Issues:	No issues and Execution is successful



Test Case #2:

Test Objective:	To check if the data owner can upload files
Test Description:	It is to verify if the data owners can successfully upload files into the cloud
Requirement Verified:	Yes
Expected Result:	Moving files to Cloud
Result:	Files Uploaded
Issues:	No issues and Execution is successful



CONCLUSION

In this application, we implemented proofs of storage in cloud in a multi-user setting. We introduced the notion of identity-based data outsourcing and proposed a secure IBDO scheme. It allows the file-owner to delegate his/her data to cloud service providers . Both the file origin and file integrity can be verified by a public auditor. The identity-based feature and the comprehensive auditing feature make our scheme advantageous over existing schemes. Security analyses and experimental results show that the proposed scheme is secure and has optimized performance.

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BIBLIOGRAPHY

Paper Title 1: On Security of an Identity-Based Dynamic Data Auditing Protocol for Big Data Storage

Publisher: IEEE

Year Of Publication: 2020

Authors: Xiong Li,Shanpeng Liu,Rongxing Lu,Xiaosong Zhang

Methodology:

In this article, we point out the security weakness of Shang et al. 's identity-based dynamic data auditing protocol for big data storage.

Specifically, we identify that their protocol is vulnerable to a secret key reveal attack, i.e., the service provider (SP) can reveal the secret key of the data owner (DO) from the stored data.

Further, SP can also generate a proof to pass the challenge of TPA (third party auditor) even if all block and tag pairs have been deleted.

We hope that by identifying these design flaws, similar weaknesses can be avoided in future designs.

Link: <https://ieeexplore.ieee.org/document/9205624/authors#authors>

Paper Title 2:OUTSOURCING OF FILES BASED ON IDENTITY WITH AUDITING IN CLOUDS

Year Of Publication: 2018

Authors: Marunnisa Begum,Dr. A. Amarendra Babu,Ayesha Sania,A. Nikhil Kumar

Methodology:

In IBDO, it is challenging to accomplish both proxy information outsourcing and comprehensive auditing functionalities. At a first, it appears that if the owner of the data has delegated his/her outsourcing rights to some proxy, at that point the authenticated proxy can

essentially utilize the existing PDP/PoR proposals for processing and outsourcing data files. But, there exists a gap that the information of the owner of the file isn't bounded with the

data, which leaves a Vulnerability that the proxy may abuse the delegation without being caught, even though this delegation has been signed by the owner of the data. In our IBDO development we will fill this gap. In our IBDO framework, the owner of the file signs a dedicated warrant for the proxy in order to delegate outsourcing rights to a proxy. The warrant may determine who can outsource which sort of files amid what time on behalf of owner of the file, and so on. At the point file is divided into blocks when it is processed in order to create metadata for each block individually. The warrant ought to be embedded into each metadata, to portray that the metadata are produced by the authenticated proxy. The auditor also asks for the aggregate metadata and the signed warrant except the aggregate file blocks during the execution of origin and integrity auditing. To conclude that data is intact and is indeed outsourced by the one as specified in the warrant then both the aggregate metadata and signed warrant ought to be audited. From a specialized perspective, we utilize Paterson and Schuldt's identity based signature proposals as building block. In this way the delegation which is produced as a identity based signature on a warrant by their proposal, can be publicly verified in Audit protocol of IBDO framework. Additionally, we follow the system due to Shacham and Waters to part the file blocks while creating metadata, which gives a trade-off between communication overheads and storage costs in auditing.

Link: <https://www.ijcrt.org/papers/IJCRT1802914.pdf>

APPENDIX

JSP:

Java Server Pages (JSP) is a programming tool on the application server side that supports platform-independent and dynamic methods to construct Web-based applications.

Much as Servlet technology does, the JSP method provides a web application. It can be considered an expansion of Servlet because it offers more features than servlet. Since we can differentiate design and development, the JSP pages are simpler to manage than Servlet. HTML tags and JSP tags are present in Java Server Pages. To access enterprise servers, Java Server Pages has an approach to the entire community of Java APIs, including the JDBC API. JavaServer Pages (JSP) is a Web page development technology that supports dynamic content. This allows programmers to use specific JSP tags to insert Java code into HTML pages. A part of JavaServer Pages is a type of Java servlet designed to perform the function of a Java web application user interface. JSPs are written as text files by Web developers that incorporate Html or XHTML script, XML components, and embedded JSP actions and commands.

For many purposes, JSP tags may be used, such as downloading data from the database or recording user interests, accessing modules of JavaBeans, transferring power between sites, exchanging information among queries, etc.

MySQL:

MySQL is an open-source relational database management system. As with other relational databases, MySQL stores data in tables made up of rows and columns. Users can define, manipulate, control, and query data using Structured Query Language, more commonly known as SQL. MySQL's name is a combination of "My," the name of MySQL creator Michael Widenius's daughter, and "SQL".

A flexible and powerful program, MySQL is the most popular open-source database system in the world. As part of the widely used LAMP technology stack (which consists of a Linux-based operating system, the Apache web server, a MySQL database, and PHP for processing), it's used to store and retrieve data in a wide variety of popular applications, websites, and services. MySQL Server was originally developed to handle large databases much faster than existing solutions and has been successfully used in highly demanding production environments for several years. Although under constant development, MySQL Server today

offers a rich and useful set of functions. Its connectivity, speed, and security make MySQL Server highly suited for accessing databases on the Internet. MySQL Server works in client/server or embedded systems.

The MySQL Database Software is a client/server system that consists of a multithreaded SQL server that supports different back ends, several different client programs and libraries, administrative tools, and a wide range of application programming interfaces (APIs).

We also provide MySQL Server as an embedded multithreaded library that you can link into your application to get a smaller, faster, easier-to-manage standalone product. A large amount of contributed MySQL software is available. MySQL Server has a practical set of features developed in close cooperation with our users. It is very likely that your favorite application or language supports the MySQL Database Server.

Spring Tool Suite:

(STS) is a Java IDE tailored for developing Spring-based enterprise applications. It is easier, faster, and more convenient. And most importantly it is based on Eclipse IDE. STS is free, open-source, and powered by VMware. Spring Tools 4 is the next generation of Spring tooling for the favorite coding environment. Largely rebuilt from scratch, it provides world-class support for developing Spring-based enterprise applications, whether you prefer Eclipse, Visual Studio Code, or Theia IDE.

Prerequisite: Make sure you have installed Java Development Kit (JDK) version 8 or newer. To check simply go to the terminal and enter the below command to check if it is present or not.

Procedure: These are steps to be followed sequentially which are discussed further with visual aids as listed:

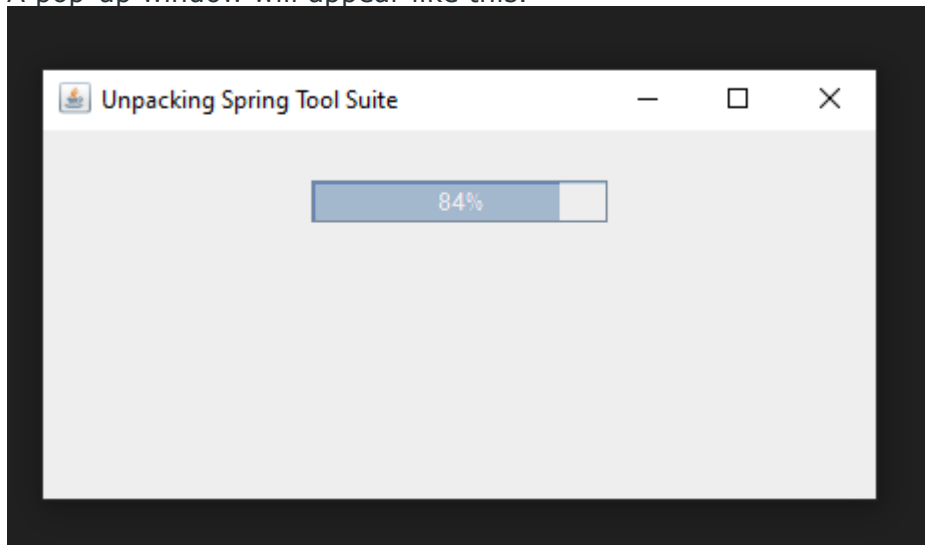
1. Download SpringToolSuite as per the operating system to the local machine.
2. Move the downloaded JAR file to the corresponding folder.
3. Unzip this JAR file and open the corresponding folder.
4. Click on the *SpringToolSuite4* Application file
5. Select the directory representing workspace and press the 'LAUNCH' button.

Step 1: [Go to their website and in Spring Tools 4 for the Eclipse section](#) in order to download. choose your corresponding file according to your OS.

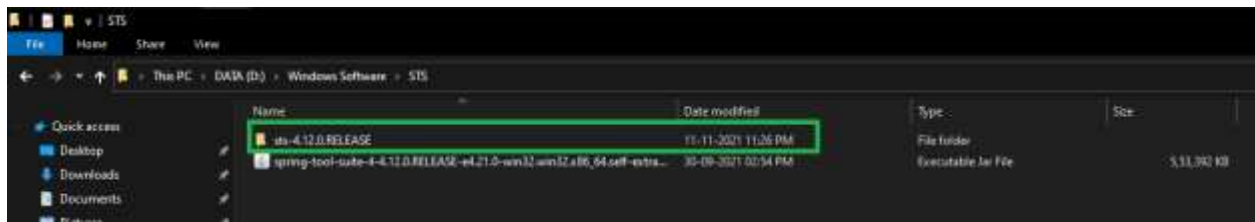
*Here we are going with Windows operating systems so do we have chosen **Windows** option as seen in the below image.*



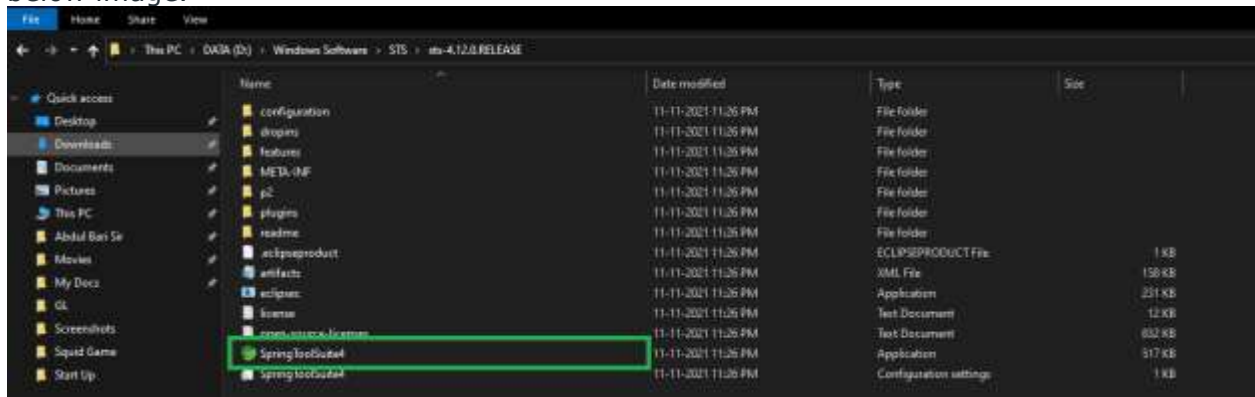
Step 2: After clicking on the button a **Jar file** will be downloaded to your local system. Now create a folder and move this Jar file to that folder. And double-click on that Jar file. A pop-up window will appear like this.



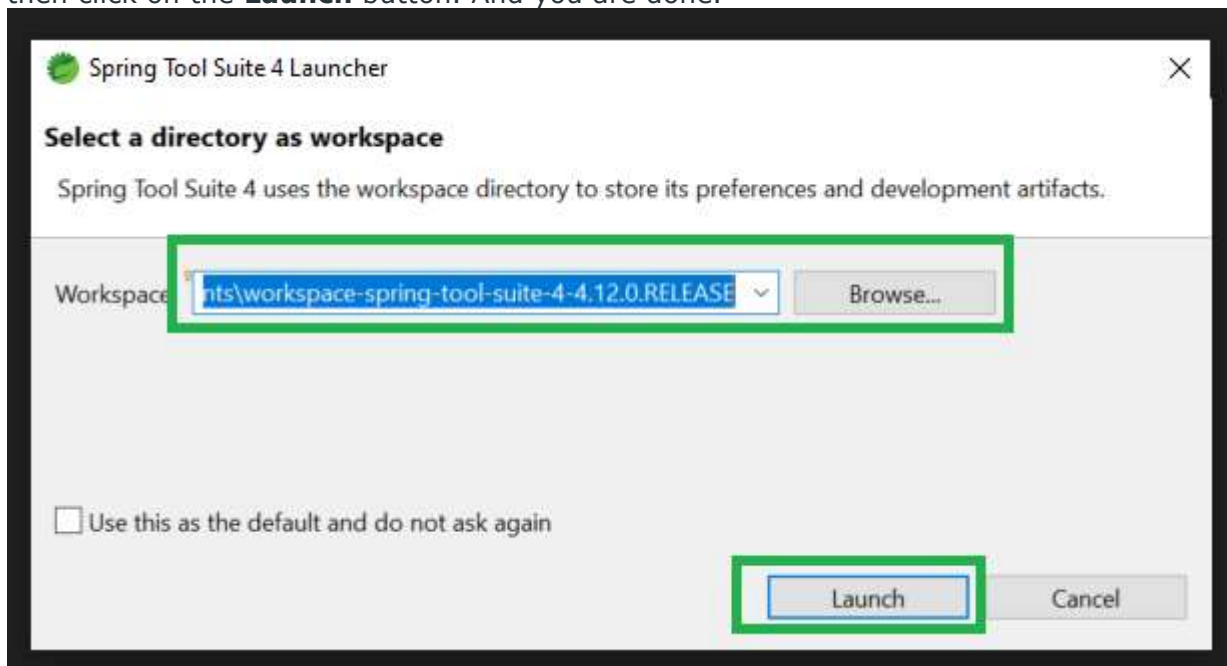
Step 3: After successfully Unpacking a new folder will create as shown in the below image. Now open the folder.



Step 4: In this folder now click on the **SpringToolSuite4** Application file as shown in the below image.



Step 5: Now select your directory as workspace by clicking on the **Browse** button and then click on the **Launch** button. And you are done.



JAVA:

Java is a general-purpose, class-based, object-oriented programming language designed for having lesser implementation dependencies. It is a computing platform for application development. Java is fast, secure, and reliable, therefore. It is widely used for developing Java applications in laptops, data centers, game consoles, scientific supercomputers, cell phones, etc. Java Platform is a collection of programs that help programmers to develop and

run Java programming applications efficiently. It includes an execution engine, a compiler, and a set of libraries in it. It is a set of computer software and specifications. James Gosling developed the Java platform at Sun Microsystems, and the Oracle Corporation later acquired it. It is used for developing Android Apps. The Java language was initially called OAK. Originally, it was developed for handling portable devices and set-top boxes. Oak was a massive failure. In 1995, Sun changed the name to "Java" and modified the language to take advantage of the burgeoning www (World Wide Web) development business. Later, in 2009, Oracle Corporation acquired Sun Microsystems and took ownership of three key Sun software assets: Java, MySQL, and Solaris. Important Java Features are It is one of the easy-to-use programming languages to learn.

Download Java for Windows 10

Download the latest Java Development Kit installation file for Windows 10 to have the latest features and bug fixes.

1. Using your preferred web browser, navigate to the [Oracle Java Downloads page](#).
2. On the *Downloads* page, click the **x64 Installer** download link under the **Windows** category. At the time of writing this article, Java version 17 is the latest long-term support Java version.

Linux	macOS	Windows
Product/file description		
File size		Download
x64 Compressed Archive		170.66 MB https://download.oracle.com/java/17/latest/jdk-17_windows-x64_bin.zip (sha256 [i])
x64 Installer		152 MB https://download.oracle.com/java/17/latest/jdk-17_windows-x64_bin.exe (sha256 [i])
x64 MSI Installer		150.89 MB https://download.oracle.com/java/17/latest/jdk-17_windows-x64_bin.msi (sha256 [i])

Wait for the download to complete.

Install Java on Windows 10

After downloading the installation file, proceed with installing Java on your Windows system.

Follow the steps below:

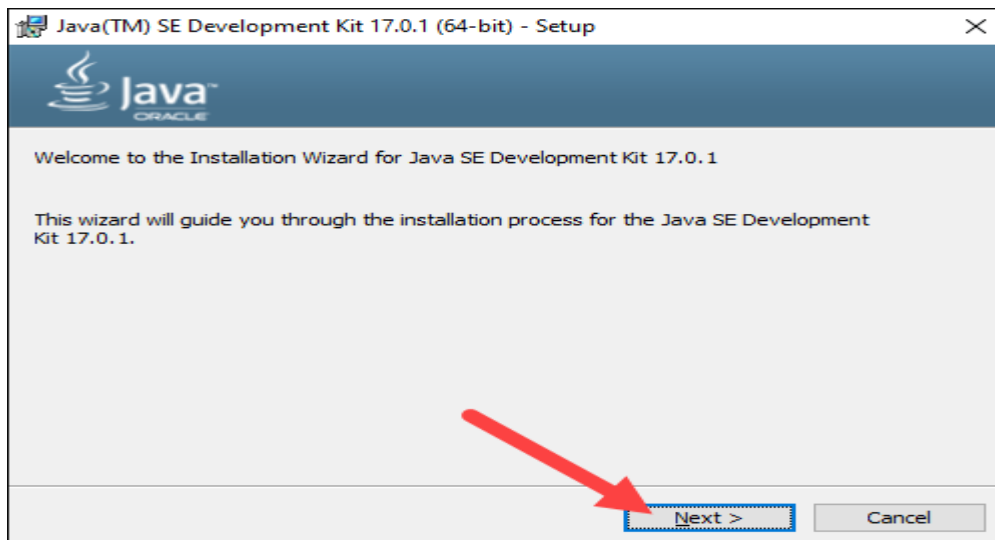
Step 1: Run the Downloaded File

Double-click the **downloaded file** to start the installation.

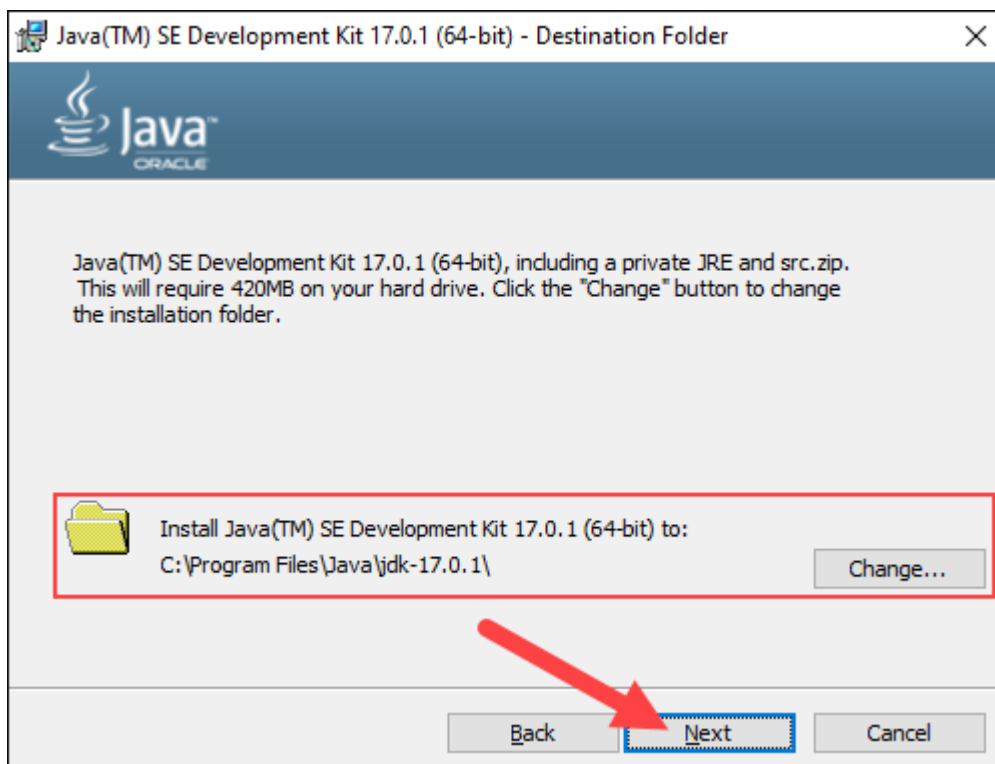
Step 2: Configure the Installation Wizard

After running the installation file, the installation wizard welcome screen appears.

1. Click **Next** to proceed to the next step.



2. Choose the destination folder for the Java installation files or stick to the default path. Click **Next** to proceed.



3. Wait for the wizard to finish the installation process until the *Successfully Installed* message appears. Click **Close** to exit the wizard.

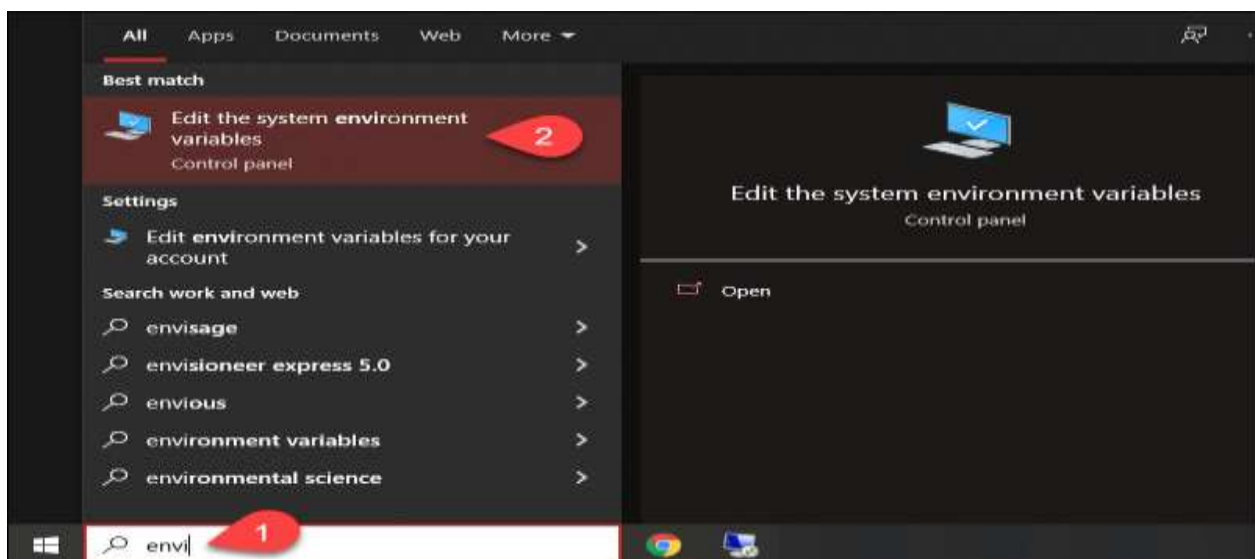


Set Environmental Variables in Java

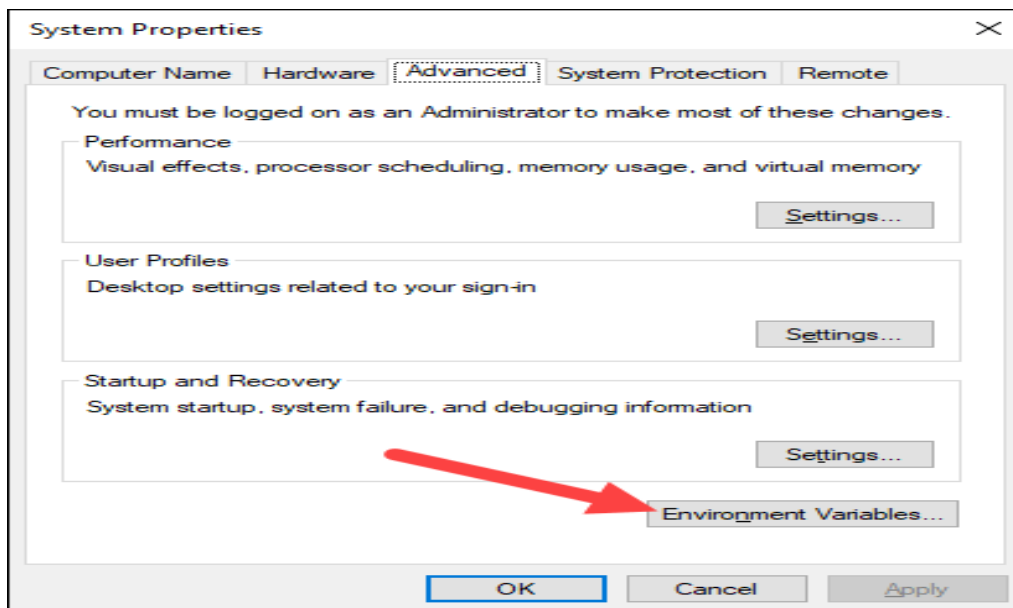
Set Java [environment variables](#) to enable program compiling from any directory. To do so, follow the steps below:

Step 1: Add Java to System Variables

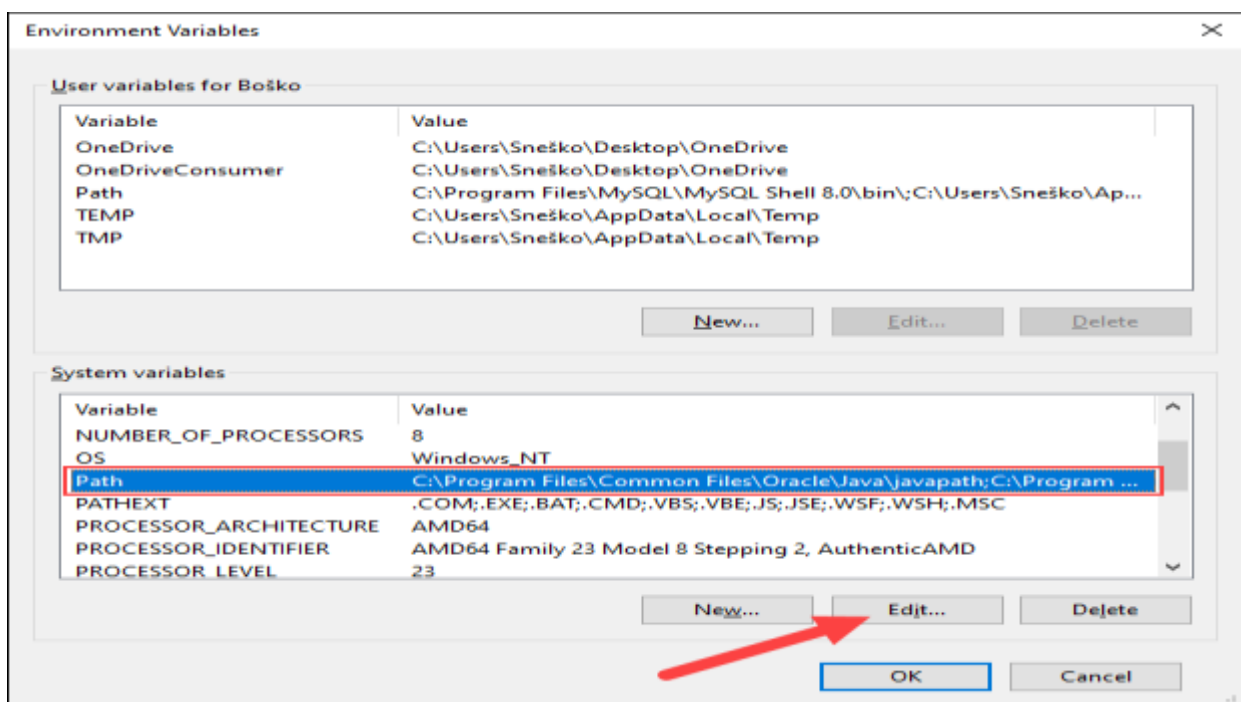
1. Open the **Start** menu and search for *environment variables*.
2. Select the **Edit the system environment variables** result.



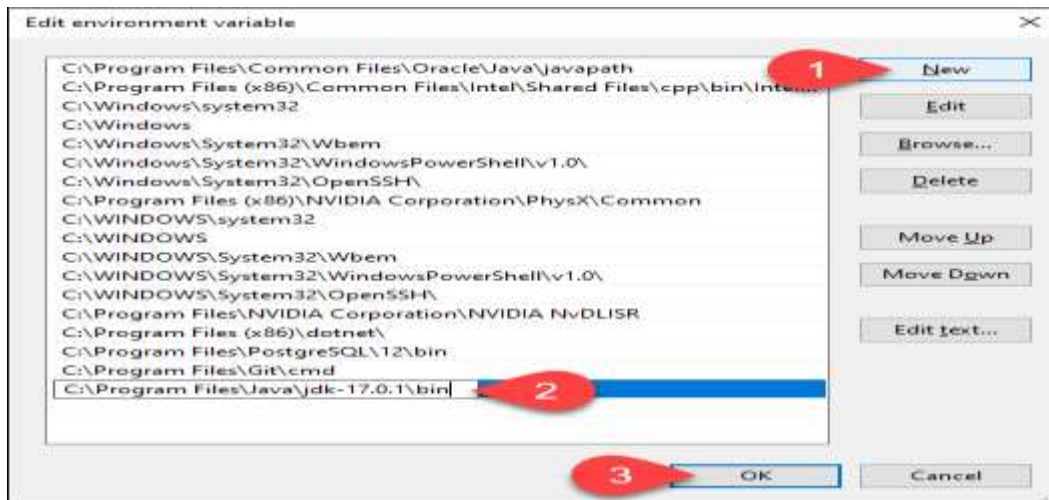
3. In the *System Properties* window, under the *Advanced* tab, click **Environment Variables...**



4. Under the *System variables* category, select the **Path** variable and click **Edit**:



5. Click the **New** button and enter the path to the Java bin directory:



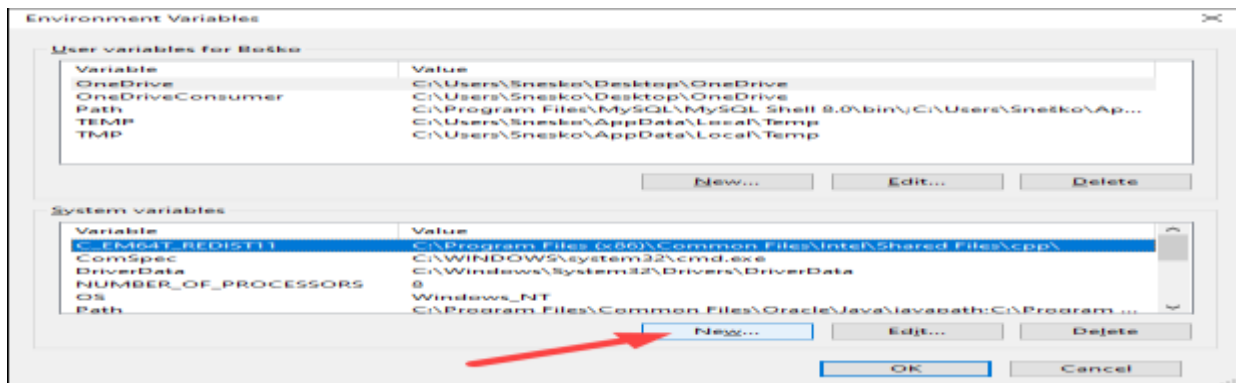
Note: The default path is usually *C:\Program Files\Java\jdk-17.0.1\bin*.

6. Click **OK** to save the changes and exit the variable editing window.

Step 2: Add JAVA_HOME Variable

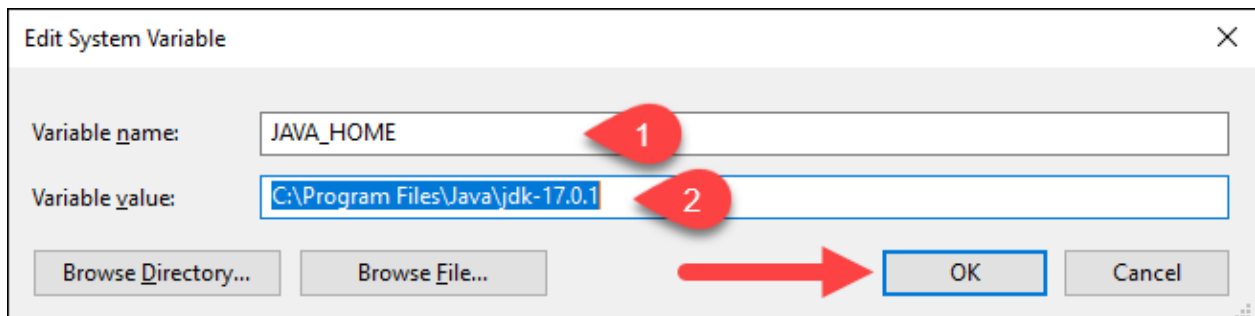
Some applications require the **JAVA_HOME** variable. Follow the steps below to create the variable:

1. In the *Environment Variables* window, under the *System variables* category, click the **New...** button to create a new variable.



2. Name the variable as **JAVA_HOME**.

3. In the variable value field, paste the path to your Java jdk directory and click **OK**.



4. Confirm the changes by clicking **OK** in the *Environment Variables* and *System properties* windows.

Test the Java Installation

Run the **java -version** command in the command prompt to make sure Java installed correctly:

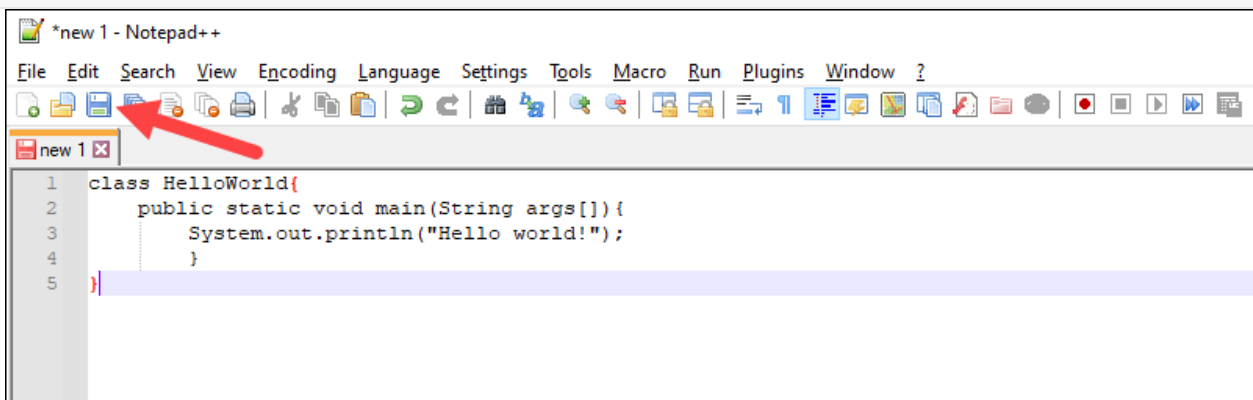
```
C:\Users\boskom>java -version
java version "17.0.1" 2021-10-19 LTS
Java(TM) SE Runtime Environment (build 17.0.1+12-LTS-39)
Java HotSpot(TM) 64-Bit Server VM (build 17.0.1+12-LTS-39, mixed mode, sharing)
```

If installed correctly, the command outputs the Java version. Make sure everything works by writing a simple program and compiling it. Follow the steps below:

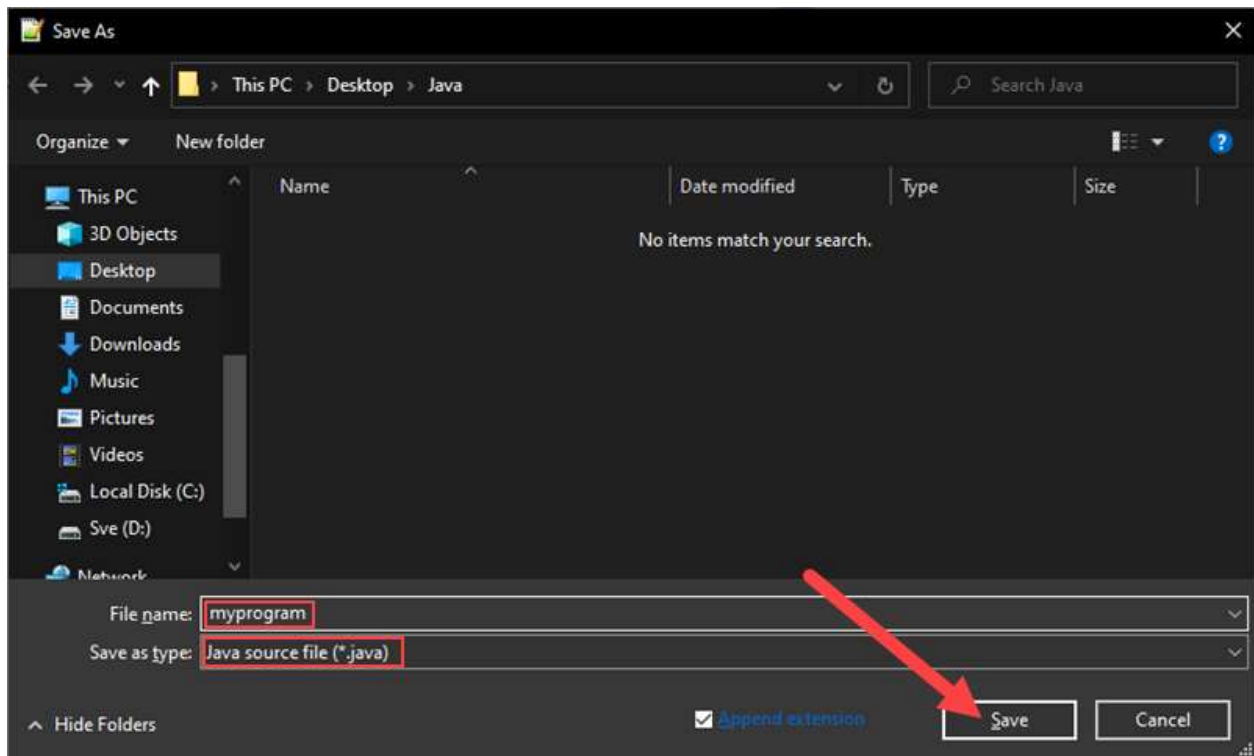
Step 1: Write a Test Java Script

1. Open a text editor such as Notepad++ and create a new file.
2. Enter the following lines of code and click **Save**:

```
class HelloWorld{
    public static void main(String args[]){
        System.out.println("Hello world!");
    }
}
```



3. Name the file and save it as a **Java source file (*.java)**.



Note: When using Notepad, select **All files** for the Save as type option and add the `.java` extension to the file name.

Step 2: Compile the Test Java Script

1. In the command prompt, change the directory to the file's location and use the following syntax to compile the program:

```
javac [filename]
```

For example:

```
C:\Users\boskom\Desktop\Java>javac myprogram.java  
C:\Users\boskom\Desktop\Java>
```

After a successful compilation, the program generates a `.class` file in the file directory.

2. Run the program with the following syntax:

```
java [filename]
```

```
C:\Users\boskom\Desktop\Java>java HelloWorld  
Hello world!
```

The output shows that the program runs correctly, displaying the *Hello world!* message.

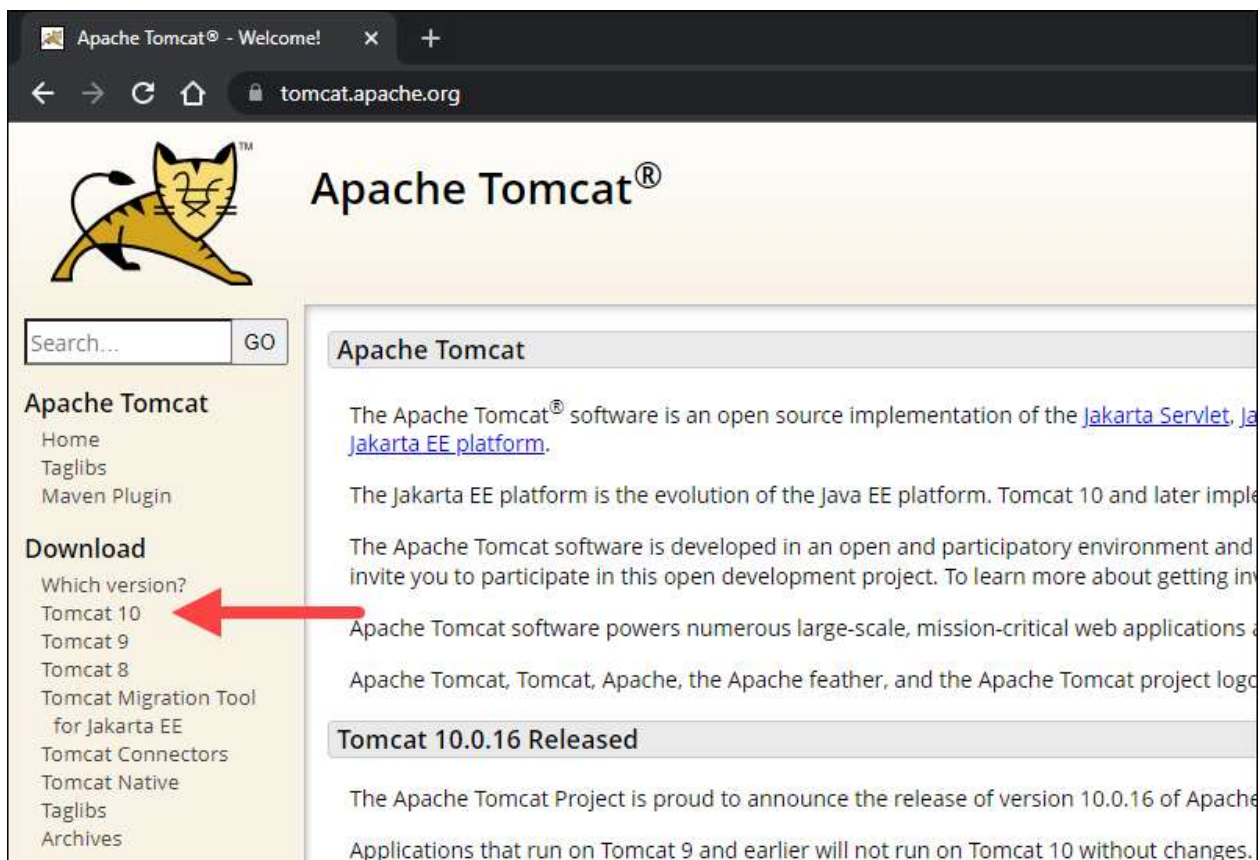
Tomcat Server

Apache Tomcat is an open-source web server and servlet container for Java code. Tomcat executes programs written in the Java programming language, and it implements many Java EE specifications, including Jakarta Servlet, Jakarta Server Pages, and others.

Step 1: Download Tomcat for Windows

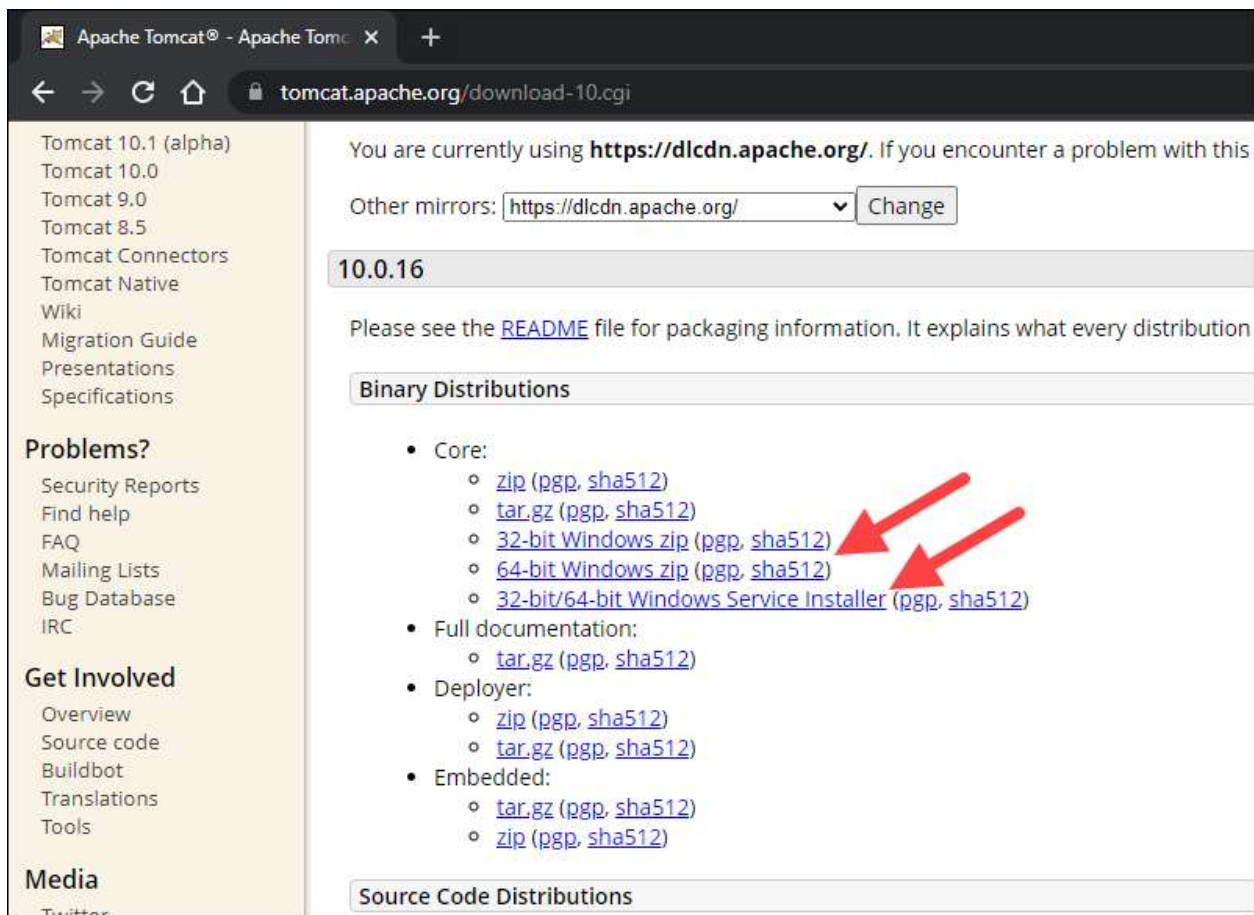
To download the Tomcat installation file, follow the steps below:

1. Browse to the [official Apache Tomcat website](https://tomcat.apache.org). Locate the *Download* section and click the **latest Tomcat version** available. At the time of writing this article, the latest Tomcat version was version 10.



2. On the *Download* page, scroll down and locate the *Binary Distributions* area.

In the *Core* list, depending on the installation type you prefer, click the download link for the **Windows Service Installer** or the **32bit/64bit Windows zip file**.



Step 2: Install Tomcat

Install Tomcat via the **Windows Service Installer** for an automated and wizard-guided experience. The service installer installs the Tomcat service and runs it automatically when the system boots.

For a portable experience, install Tomcat using the **zip file** and avoid installing the service. Easily uninstall Tomcat when it is no longer needed by deleting the Tomcat directory, or move it around when necessary.

Note: Take a look at our list of [13 best Java IDEs](#), which help write, debug, and test Java code.

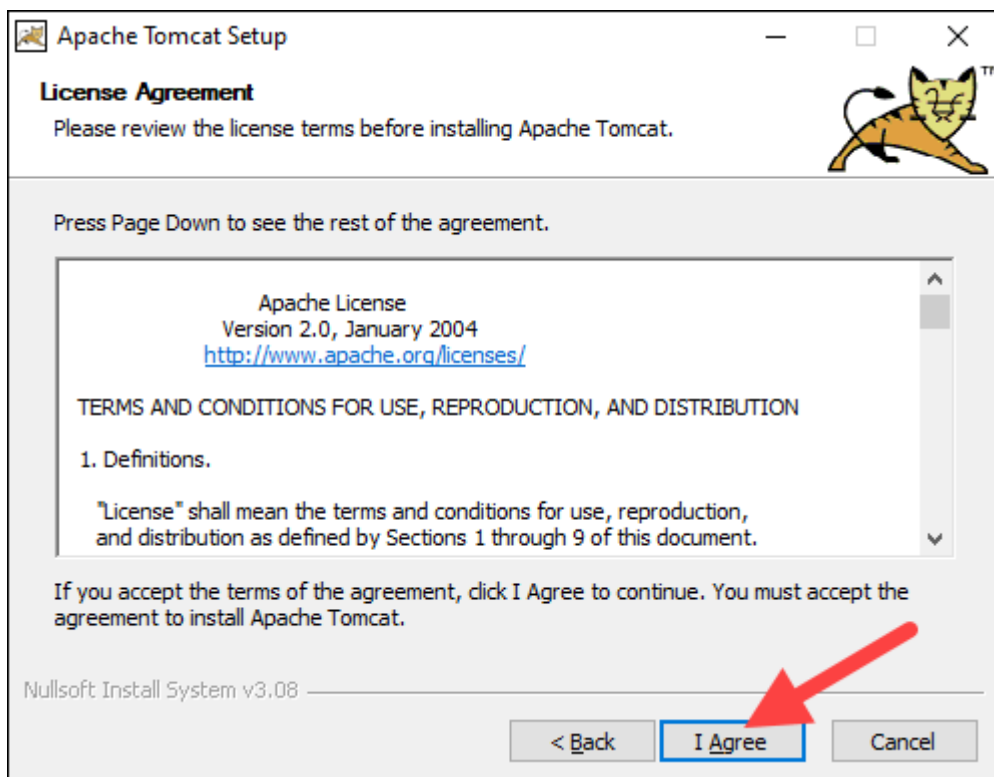
Method 1: Install Tomcat Using the Windows Service Installer

Follow the steps below to install Tomcat using the Windows Service Installer.

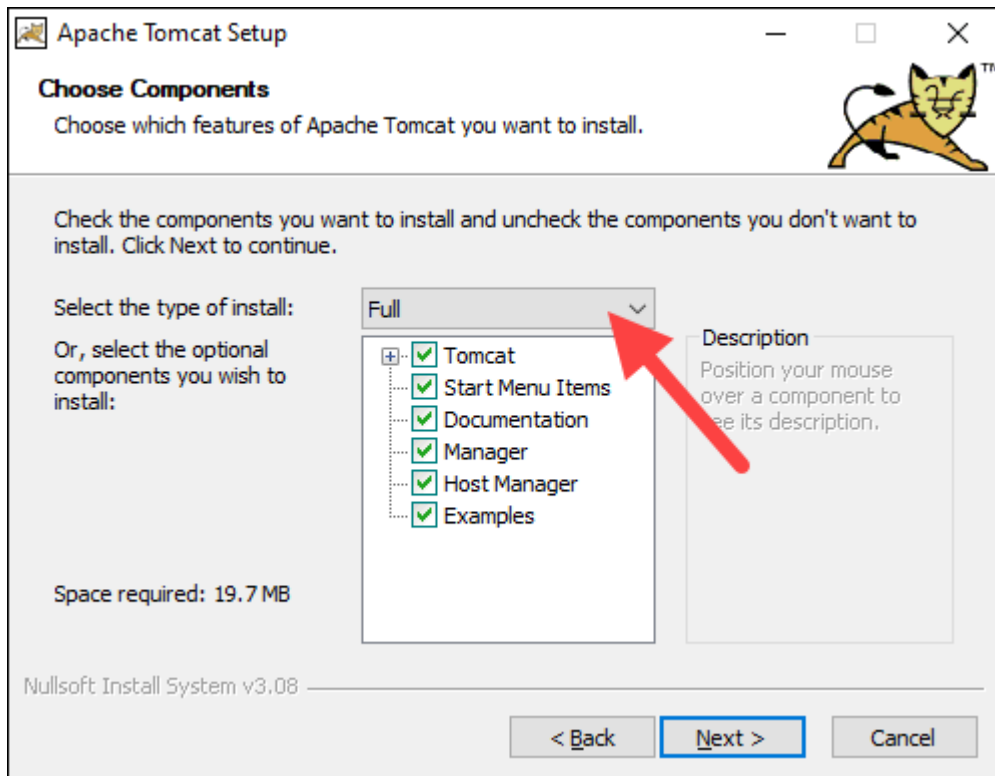
1. Open the downloaded **Windows Service Installer** file to start the installation process.
2. In the Tomcat Setup welcome screen, click **Next** to proceed.



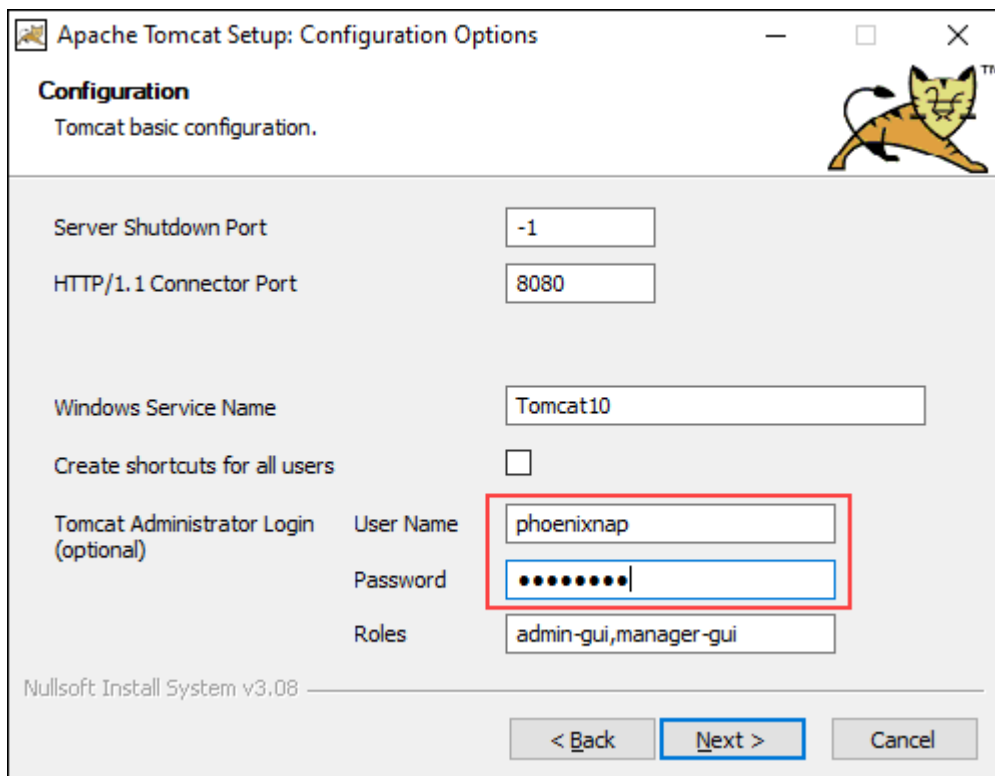
3. Read the License Agreement and if you agree to the terms, click **I Agree** to proceed to the next step.



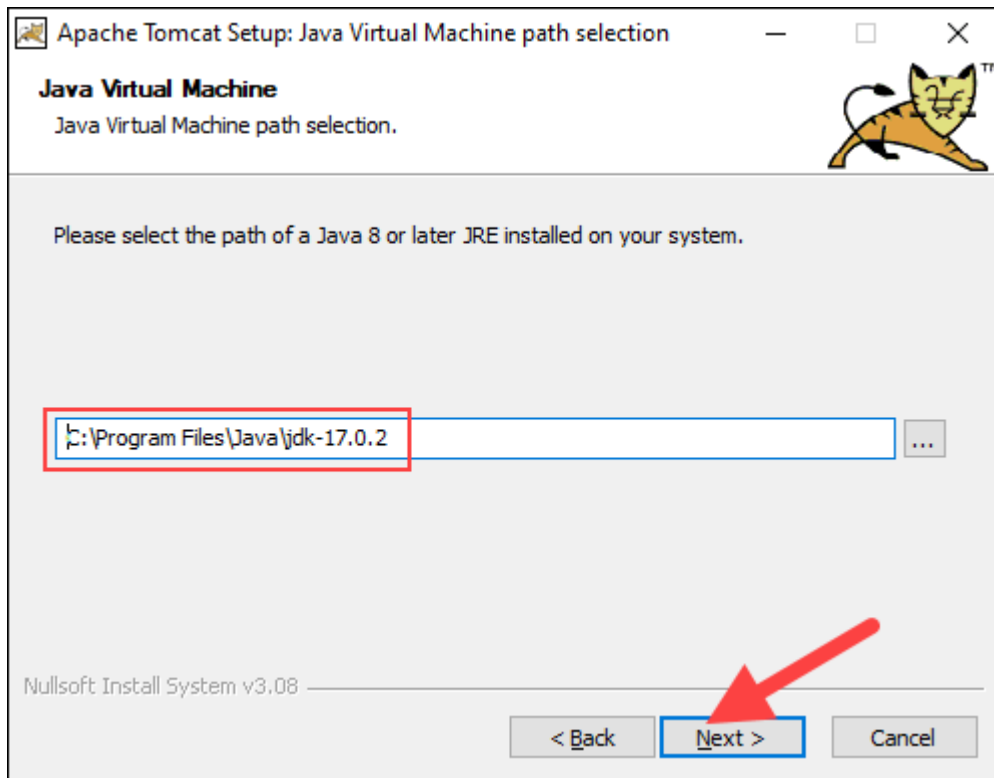
4. In the Tomcat component selection screen, choose **Full** in the dropdown menu to ensure the wizard installs the Tomcat Host Manager and Servlet and JSP examples web applications. Alternatively, keep the default **Normal** installation type and click **Next**.



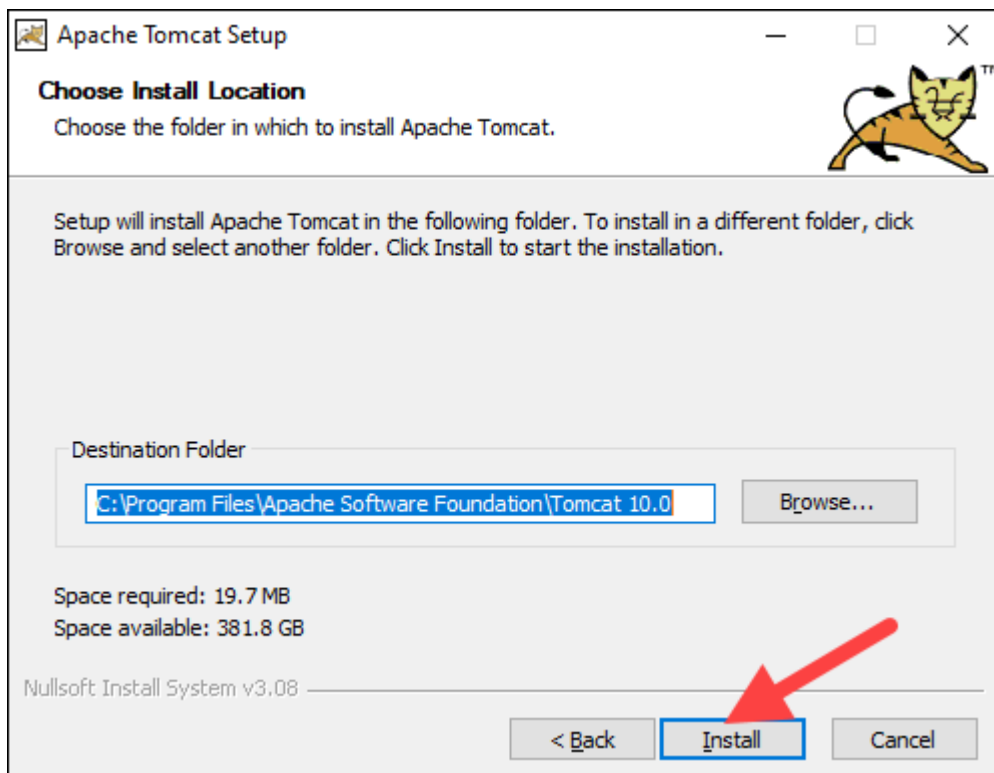
5. The next step configures the Tomcat server. For instance, enter the **Administrator login credentials** or choose a different **connection port**. When finished, click **Next** to proceed to the next step.



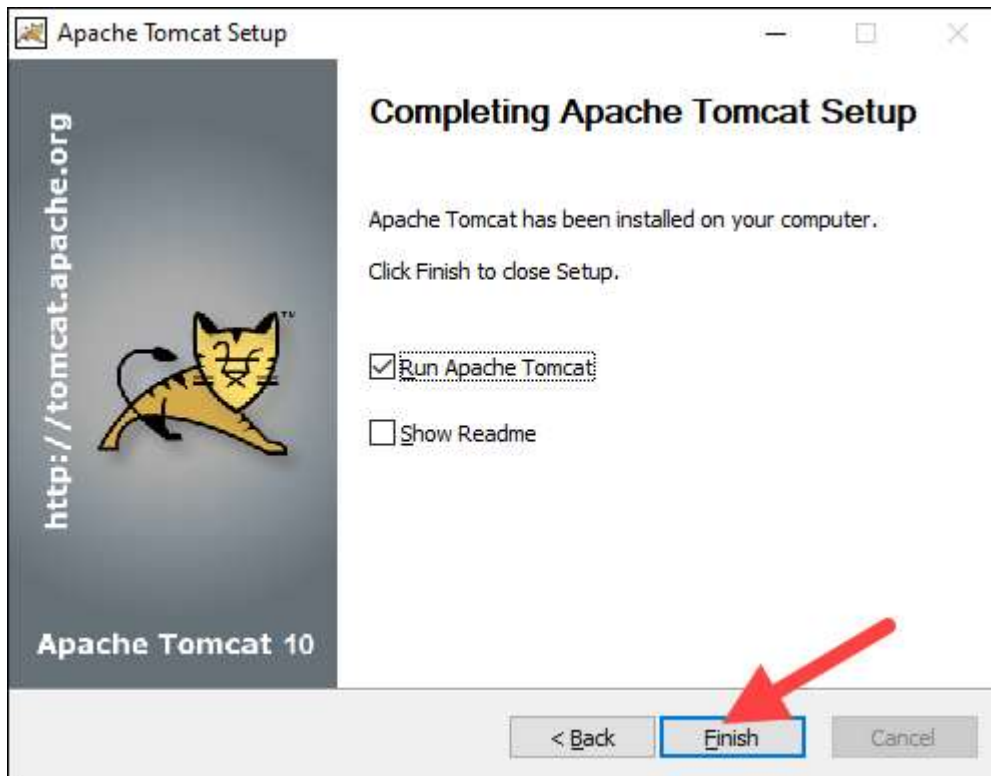
6. The next step requires you to enter the full path to the JRE directory on your system. The wizard auto-completes this if you have previously [set up the Java environment variables](#). Click **Next** to proceed to the next step.



7. Choose the Tomcat server install location or keep the default one and click **Install**.



8. Check the **Run Apache Tomcat** box to start the service after the installation finishes. Optionally, check the **Show Readme** box to see the Readme file. To complete the installation, click **Finish**.



9. A popup window appears that starts the Tomcat service. After the process completes, the window closes automatically. The Apache Tomcat web server is now successfully installed .

