Ex. No.: 20

Date:

Cryptographic File Systems – Mini Project

AIM :

The aim of this cryptographic file system is to enable users to securely encrypt and decrypt files using web browser-based JavaScript functionalities along with HTML and CSS.

This system allows users to encrypt and decrypt files using a web browser, requiring a password for both encryption and decryption operations.

PROBLEM DESCRIPTION:

The system provides the following functionalities:

File Encryption:

- Allow users to encrypt a selected file using a strong password.
- Use AES (Advanced Encryption Standard) in CBC (Cipher Block Chaining) mode for encryption.
- Derive encryption keys using PBKDF2 (Password-Based Key Derivation Function 2) with a user-provided password and a random salt.
- Enable the download of the encrypted file after encryption.

File Decryption:

- Enable users to decrypt a previously encrypted file using the same password used for encryption.
- Use the password and the salt stored within the encrypted file to derive decryption keys using PBKDF2.
- Utilize AES-CBC decryption to decrypt the file contents.

User Interface:

Offer an intuitive and user-friendly interface to facilitate file selection, password entry, and drag-and-drop file interactions.

Security Considerations:

- Implement strong encryption mechanisms following best practices to ensure data confidentiality.
- Handle errors gracefully and provide clear instructions to users during encryption and decryption processes.

CODE:

```
<!DOCTYPE html>
<html lang="en">
   <head>
      <meta charset="utf-8">
      <title>Web Browser Based File Encryption / Decryption</title>
   </head>
   <style>
      body {
         font-family: 'Helvetica', 'Arial', 'sans-serif';
         color: black;
         font-size: 11pt;
      }

      a, a:link, a:visited, a:active {
         color: blue;
         text-decoration: underline;
      }

      a:hover {
         cursor:pointer;
         color: red;
      }

      .black10pointcourier {
         font-family: 'courier';
         color: black;
         font-size: 10pt;
      }

      .container {
         width: 80%;
         margin: 0 auto;
      }

      .dropzone {
         border: 10px dashed gray;
         width: 20%;
         padding: 2% 2% 5% 2%;
         text-align: center;
         margin: 5px 0 5px 0;
      }

      .divTablefullwidth{
         display: table;
         width: 100%;
      }
```

```
      .divTable{
        display: table;
      }

      .divTableRow {
        display: table-row;
      }
      .divTableCell {
        display: table-cell;
        padding: 3px 3px;
      }
      .divTableBody {
        display: table-row-group;
      }

      .greenspan {
        color: green;
      }

      .redspan {
        color: red;
      }
    </style>
    <body>
      <div class=container>
        <div class="divTablefullwidth">
          <div class="divTableBody">
            <div class="divTableRow">
              <div class="divTableCell" style="float: left;">
                <h1>Web Browser Based File Encryption / Decryption</h1>
                <h4>Use your web browser to encrypt and decrypt files.</h4>
              </div>
              <div class="divTableCell" style="float: right;">
                <h1>
                <button id="btnRefresh" onClick="javascript:location.reload();">Refresh
Page</button>
                <button id="btnDivEncrypt"
onClick="javascript:switchdiv('encrypt');">Encrypt a File</button>
                <button id="btnDivDecrypt"
onClick="javascript:switchdiv('decrypt');">Decrypt a File</button>
                </h1>
              </div>
            </div>
          </div>
        </div>


      <div class=container>
        <hr>
```

```
    </div>

    <div class="container" id=divEncryptfile>
      <h2>Encrypt a File</h2>
      <p>To encrypt a file, enter a password and drop the file to be encrypted into the
dropzone below.  The file will then be encrypted using the password, then you'll be given an
opportunity to save the encrypted file to your system.</p>

      <div class="divTable">
        <div class="divTableBody">
          <div class="divTableRow">
            <div class="divTableCell">Password</div>
            <div class="divTableCell"><input id=txtEncpassphrase type=password
size=30 onkeyup=javascript:encvalidate(); value=""></div>
            <div class="divTableCell">(minumum length eight characters, make sure it
strong!)</div>
          </div>
          <div class="divTableRow">
            <div class="divTableCell">Password (retype)</div>
            <div class="divTableCell"><input id=txtEncpassphraseretype type=password
size=30 onkeyup=javascript:encvalidate(); value=""></div>
            <div class="divTableCell"><span class=greenspan
id=spnCheckretype></span></div>
          </div>
        </div>
      </div>

      <p> </p>

      <div>
        <div class=dropzone id="encdropzone" ondrop="drop_handler(event);"
ondragover="dragover_handler(event);" ondragend="dragend_handler(event);">
          <p>Drag and drop the file to be encrypted into this dropzone, or click <a
onclick=javascript:encfileElem.click();>here</a> to select file.</p>
          <p><span id=spnencfilename></span></p>
        </div>
        <input type="file" id="encfileElem" style="display:none"
onchange="selectfile(this.files)">
      </div>

      <p> </p>

      <div class="divTable">
        <div class="divTableBody">
          <div class="divTableRow">
            <div class="divTableCell"><button id=btnEncrypt
onclick=javascript:encryptfile(); disabled>Encrypt File</button></div>
            <div class="divTableCell"><span id=spnEncstatus></span></div>
          </div>
        </div>
```

```
        </div>

        <p> </p>

        <div>
           <a id=aEncsavefile hidden><button>Save Encrypted File</button></a>
        </div>

        <p> </p>
      </div>

      <div class="container" id=divDecryptfile>
        <h2>Decrypt a File</h2>
        <p>Decrypt a file using the password that was previously used to encrypt the
file.  After the file is decrypted, you'll be given an opportunity to save the decrypted file to
your system.</p>

        <div class="divTable">
          <div class="divTableBody">
            <div class="divTableRow">
              <div class="divTableCell">Password</div>
              <div class="divTableCell"><input id=txtDecpassphrase type=password
size=30 onkeyup=javascript:decvalidate(); value=""></div>
            </div>
          </div>
        </div>

        <p> </p>

        <div>
            <div class=dropzone  id="decdropzone" ondrop="drop_handler(event);"
ondragover="dragover_handler(event);" ondragend="dragend_handler(event);">
              <p>Drag and drop file to be decrypted into this dropzone, or click <a
role=button onclick=javascript:decfileElem.click();>here</a> to select file.</p>
              <p><span id=spndecfilename></span></p>
            </div>
            <input type="file" id="decfileElem" style="display:none"
onchange="selectfile(this.files)">
        </div>

        <p> </p>

        <div class="divTable">
          <div class="divTableBody">
            <div class="divTableRow">
              <div class="divTableCell"><button id=btnDecrypt
onclick=javascript:decryptfile(); disabled>Decrypt File</button></div>
              <div class="divTableCell"><span id=spnDecstatus></span></div>
            </div>
          </div>
```

```
        </div>

        <p> </p>

        <div>
           <a id=aDecsavefile hidden><button>Save Decrypted File</button></a>
        </div>

        <p> </p>
      </div>

      <div class="container">
        <hr>
        <h3>Usage</h3>
        <p>
        This web page to encrypt a file using a password, then use the same password later to decrypt the file.  IMPORTANT:  The same password that was used to encrypt the file must be used to decrypt the file later. If you loose or forget the password, it cannot be recovered!
        </p>

      </div>
      <BR>
   </body>
</html>


<script type="text/javascript">
   var mode=null;
   var objFile=null;
   switchdiv('encrypt');

   function switchdiv(t) {
      if(t=='encrypt') {
         divEncryptfile.style.display='block';
         divDecryptfile.style.display='none';
         btnDivEncrypt.disabled=true;
         btnDivDecrypt.disabled=false;
         mode='encrypt';
      } else if(t=='decrypt') {
         divEncryptfile.style.display='none';
         divDecryptfile.style.display='block';
         btnDivEncrypt.disabled=false;
         btnDivDecrypt.disabled=true;
         mode='decrypt';
      }
   }

   function encvalidate() {
      if(txtEncpassphrase.value.length>=8 &&
txtEncpassphrase.value==txtEncpassphraseretype.value) {
```

```
        spnCheckretype.classList.add("greenspan");
        spnCheckretype.classList.remove("redspan");
        spnCheckretype.innerHTML='&#10004;';
      } else {
        spnCheckretype.classList.remove("greenspan");
        spnCheckretype.classList.add("redspan");
        spnCheckretype.innerHTML='&#10006;';
      }

      if( txtEncpassphrase.value.length>=8 &&
txtEncpassphrase.value==txtEncpassphraseretype.value && objFile ) {
btnEncrypt.disabled=false; } else { btnEncrypt.disabled=true; }
   }

   function decvalidate() {
      if( txtDecpassphrase.value.length>0 && objFile ) { btnDecrypt.disabled=false; } else {
btnDecrypt.disabled=true; }
   }

   //drag and drop functions:
   //https://developer.mozilla.org/en-
US/docs/Web/API/HTML_Drag_and_Drop_API/File_drag_and_drop
   function drop_handler(ev) {
      console.log("Drop");
      ev.preventDefault();
      // If dropped items aren't files, reject them
      var dt = ev.dataTransfer;
      if (dt.items) {
         // Use DataTransferItemList interface to access the file(s)
         for (var i=0; i < dt.items.length; i++) {
            if (dt.items[i].kind == "file") {
               var f = dt.items[i].getAsFile();
               console.log("... file[" + i + "].name = " + f.name);
               objFile=f;
            }
         }
      } else {
         // Use DataTransfer interface to access the file(s)
         for (var i=0; i < dt.files.length; i++) {
            console.log("... file[" + i + "].name = " + dt.files[i].name);
         }
         objFile=file[0];
      }
      displayfile()
      if(mode=='encrypt') { encvalidate(); } else if(mode=='decrypt') { decvalidate(); }
   }

   function dragover_handler(ev) {
      console.log("dragOver");
      // Prevent default select and drag behavior
```

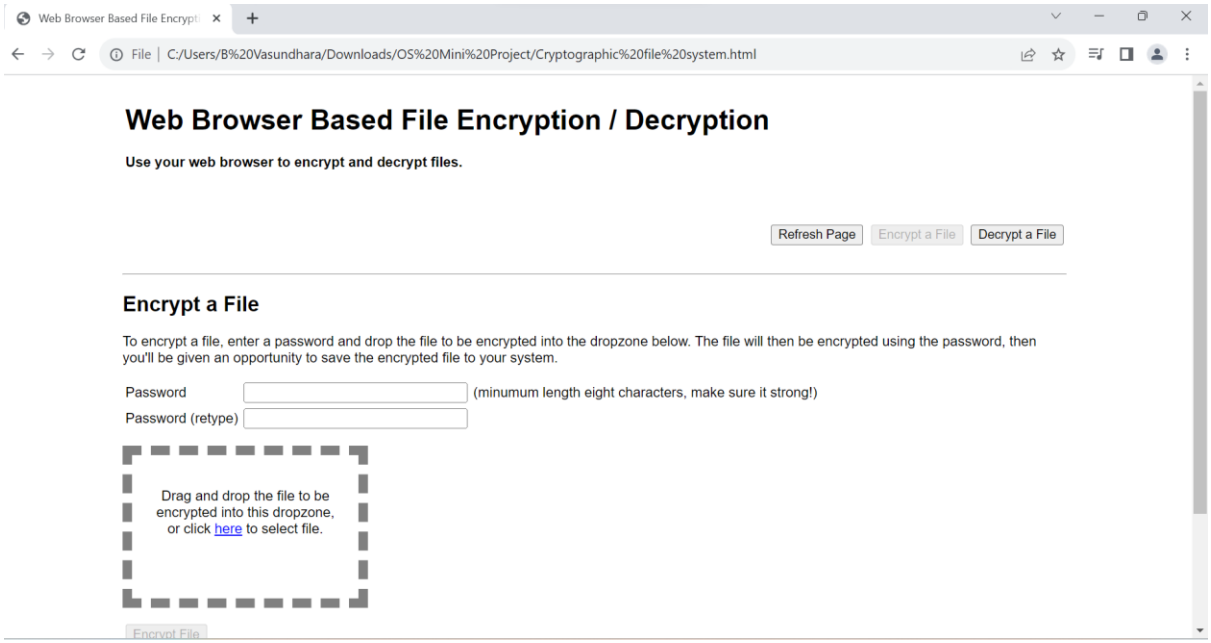
```
    ev.preventDefault();
  }

  function dragend_handler(ev) {
    console.log("dragEnd");
    // Remove all of the drag data
    var dt = ev.dataTransfer;
    if (dt.items) {
      // Use DataTransferItemList interface to remove the drag data
      for (var i = 0; i < dt.items.length; i++) {
        dt.items.remove(i);
      }
    } else {
      // Use DataTransfer interface to remove the drag data
      ev.dataTransfer.clearData();
    }
  }

  function selectfile(Files) {
    objFile=Files[0];
    displayfile()
    if(mode=='encrypt') { encvalidate(); } else if(mode=='decrypt') { decvalidate(); }
  }

  function displayfile() {
    var s;
    var sizes = ['Bytes', 'KB', 'MB', 'GB', 'TB'];
    var bytes=objFile.size;
    var i = parseInt(Math.floor(Math.log(bytes) / Math.log(1024)));
    if(i==0) { s=bytes + ' ' + sizes[i]; } else { s=(bytes / Math.pow(1024, i)).toFixed(2) + ' '
+ sizes[i]; }

    if(mode=='encrypt') {
      spnencfilename.textContent=objFile.name + ' (' + s + ')';
    } else if(mode=='decrypt') {
      spndecfilename.textContent=objFile.name + ' (' + s + ')';
    }
  }

  function readfile(file){
    return new Promise((resolve, reject) => {
      var fr = new FileReader();
      fr.onload = () => {
        resolve(fr.result )
      };
      fr.readAsArrayBuffer(file);
    });
  }

  async function encryptfile() {
```

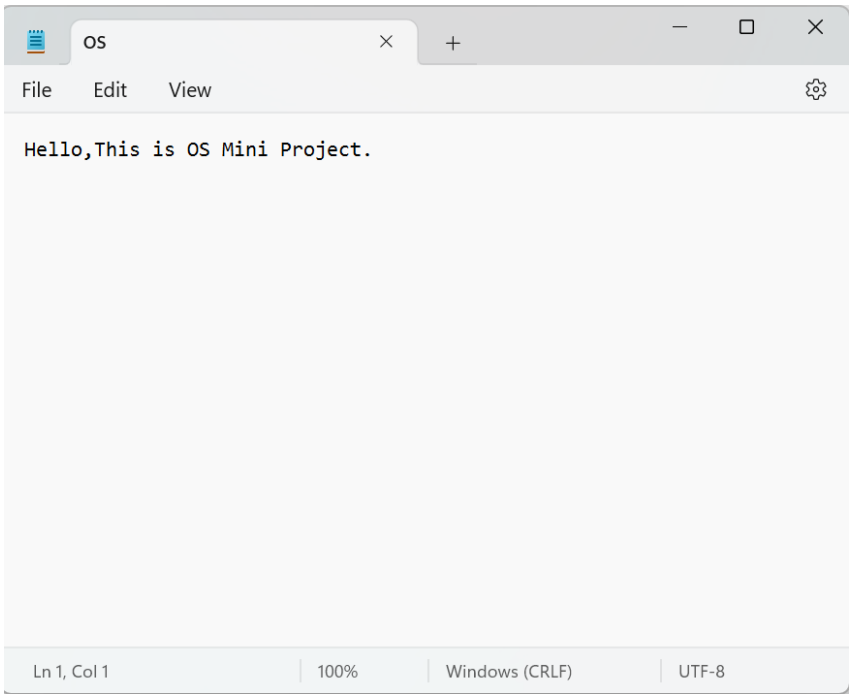
```
        btnEncrypt.disabled=true;

        var plaintextbytes=await readfile(objFile)
        .catch(function(err){
           console.error(err);
        });
        var plaintextbytes=new Uint8Array(plaintextbytes);

        var pbkdf2iterations=10000;
        var passphrasebytes=new TextEncoder("utf-8").encode(txtEncpassphrase.value);
        var pbkdf2salt=window.crypto.getRandomValues(new Uint8Array(8));

        var passphrasekey=await window.crypto.subtle.importKey('raw', passphrasebytes,
{name: 'PBKDF2'}, false, ['deriveBits'])
        .catch(function(err){
           console.error(err);
        });
        console.log('passphrasekey imported');

        var pbkdf2bytes=await window.crypto.subtle.deriveBits({"name": 'PBKDF2', "salt":
pbkdf2salt, "iterations": pbkdf2iterations, "hash": 'SHA-256'}, passphrasekey, 384)
        .catch(function(err){
           console.error(err);
        });
        console.log('pbkdf2bytes derived');
        pbkdf2bytes=new Uint8Array(pbkdf2bytes);

        keybytes=pbkdf2bytes.slice(0,32);
        ivbytes=pbkdf2bytes.slice(32);

        var key=await window.crypto.subtle.importKey('raw', keybytes, {name: 'AES-CBC',
length: 256}, false, ['encrypt'])
        .catch(function(err){
           console.error(err);
        });
        console.log('key imported');

        var cipherbytes=await window.crypto.subtle.encrypt({name: "AES-CBC", iv: ivbytes},
key, plaintextbytes)
        .catch(function(err){
           console.error(err);
        });

        if(!cipherbytes) {
           spnEncstatus.classList.add("redspan");
           spnEncstatus.innerHTML='<p>Error encrypting file.  See console log.</p>';
           return;
        }

        console.log('plaintext encrypted');
```

```
        cipherbytes=new Uint8Array(cipherbytes);

        var resultbytes=new Uint8Array(cipherbytes.length+16)
        resultbytes.set(new TextEncoder("utf-8").encode('Salted__'));
        resultbytes.set(pbkdf2salt, 8);
        resultbytes.set(cipherbytes, 16);

        var blob=new Blob([resultbytes], {type: 'application/download'});
        var blobUrl=URL.createObjectURL(blob);
        aEncsavefile.href=blobUrl;
        aEncsavefile.download= 'enc_'+objFile.name;

        spnEncstatus.classList.add("greenspan");
        spnEncstatus.innerHTML='<p>File encrypted.</p>';
        aEncsavefile.hidden=false;
    }

    async function decryptfile() {
        btnDecrypt.disabled=true;

        var cipherbytes=await readfile(objFile)
        .catch(function(err){
            console.error(err);
        });
        var cipherbytes=new Uint8Array(cipherbytes);

        var pbkdf2iterations=10000;
        var passphrasebytes=new TextEncoder("utf-8").encode(txtDecpassphrase.value);
        var pbkdf2salt=cipherbytes.slice(8,16);


        var passphrasekey=await window.crypto.subtle.importKey('raw', passphrasebytes,
{name: 'PBKDF2'}, false, ['deriveBits'])
        .catch(function(err){
            console.error(err);

        });
        console.log('passphrasekey imported');

        var pbkdf2bytes=await window.crypto.subtle.deriveBits({"name": 'PBKDF2', "salt":
pbkdf2salt, "iterations": pbkdf2iterations, "hash": 'SHA-256'}, passphrasekey, 384)
        .catch(function(err){
            console.error(err);
        });
        console.log('pbkdf2bytes derived');
        pbkdf2bytes=new Uint8Array(pbkdf2bytes);

        keybytes=pbkdf2bytes.slice(0,32);
        ivbytes=pbkdf2bytes.slice(32);
        cipherbytes=cipherbytes.slice(16);
```

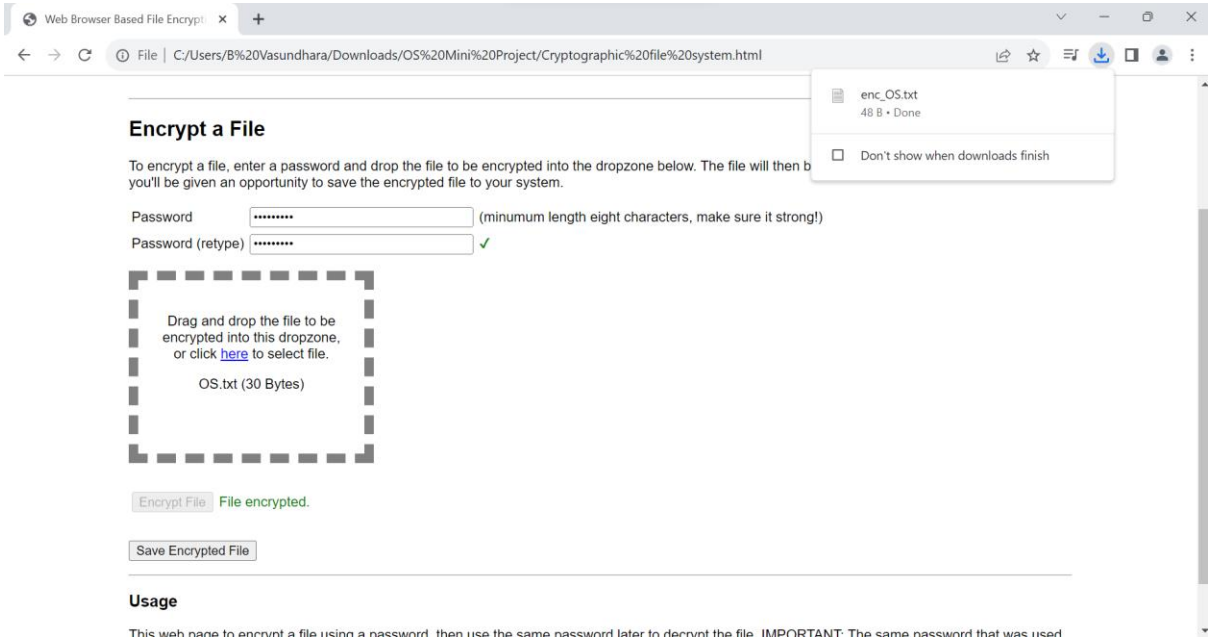
```
        var key=await window.crypto.subtle.importKey('raw', keybytes, {name: 'AES-CBC',
length: 256}, false, ['decrypt'])
        .catch(function(err){
            console.error(err);
        });
        console.log('key imported');

        var plaintextbytes=await window.crypto.subtle.decrypt({name: "AES-CBC", iv:
ivbytes}, key, cipherbytes)
        .catch(function(err){
            console.error(err);
        });

        if(!plaintextbytes) {
            spnDecstatus.classList.add("redspan");
            spnDecstatus.innerHTML='<p>Error decrypting file.  Password may be
incorrect.</p>';
            return;
        }

        console.log('ciphertext decrypted');
        plaintextbytes=new Uint8Array(plaintextbytes);

        var blob=new Blob([plaintextbytes], {type: 'application/download'});
        var blobUrl=URL.createObjectURL(blob);
        aDecsavefile.href=blobUrl;
        aDecsavefile.download='dec_'+objFile.name ;

        spnDecstatus.classList.add("greenspan");
        spnDecstatus.innerHTML='<p>File decrypted.</p>';
        aDecsavefile.hidden=false;
    }

</script>
```

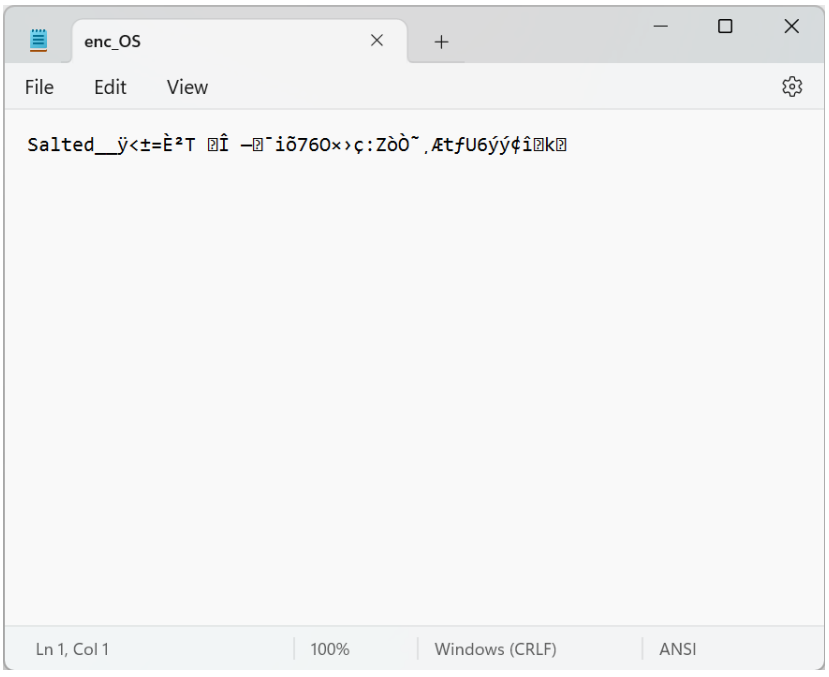
OUTPUT:


Web Browser Based File Encrypt
File | C:/Users/B%20Vasundhara/Downloads/OS%20Mini%20Project/Cryptographic%20file%20system.html
Web Browser Based File Encryption / Decryption
Use your web browser to encrypt and decrypt files.
Refresh Page
Encrypt a File
Decrypt a File
Encrypt a File
To encrypt a file, enter a password and drop the file to be encrypted into the dropzone below. The file will then be encrypted using the password, then you'll be given an opportunity to save the encrypted file to your system.
Password
(minumum length eight characters, make sure it strong!)
Password (retype)
Drag and drop the file to be encrypted into this dropzone, or click here to select file.
Encrypt File

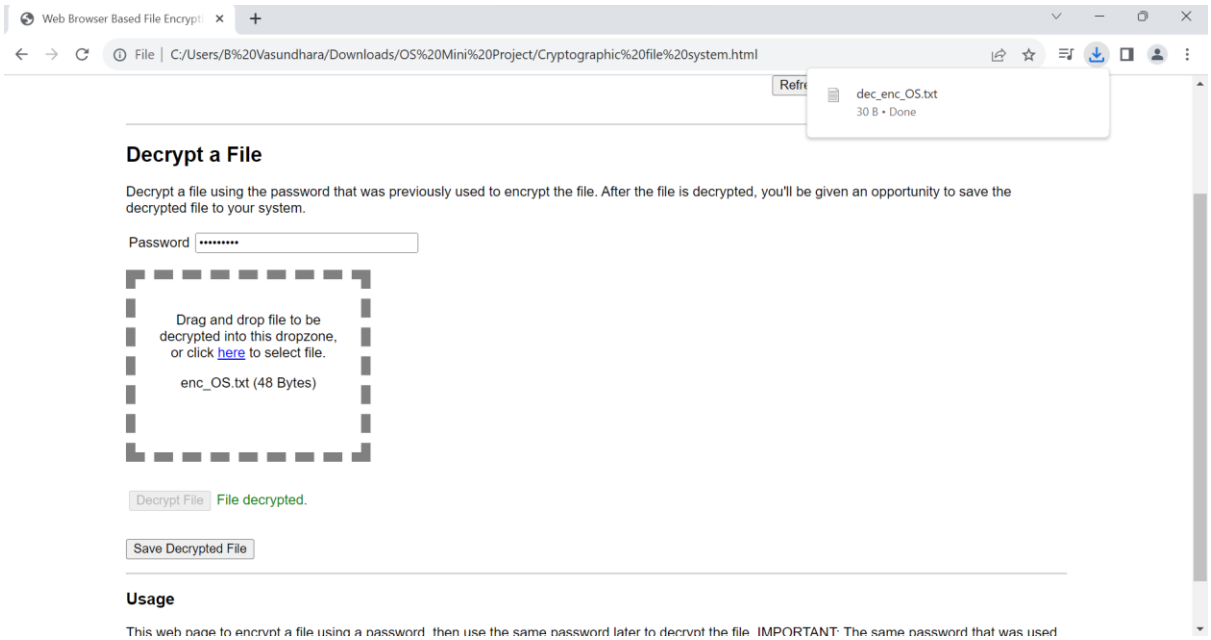

OS
File
Edit
View
Hello,This is OS Mini Project.
Ln 1, Col 1
100%
Windows (CRLF)
UTF-8

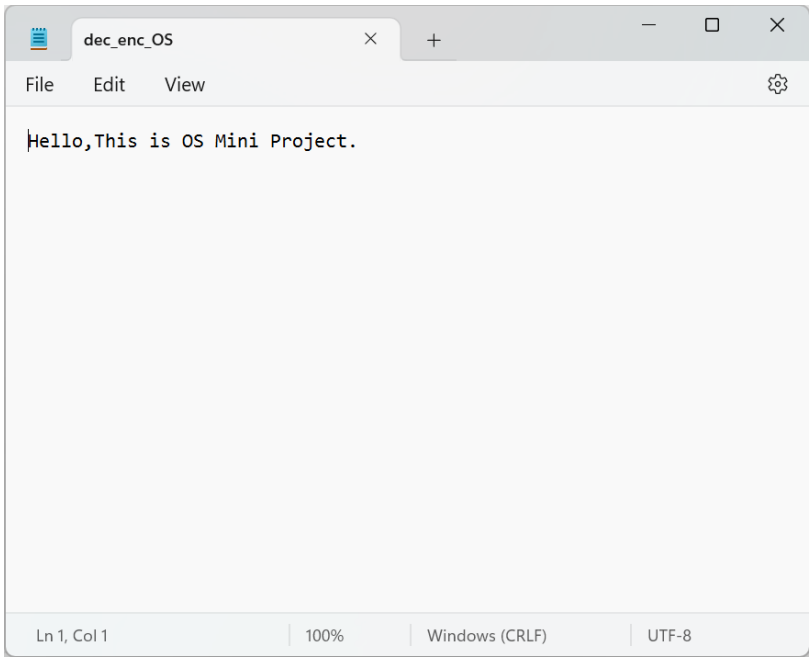
ENCRYPTION:


Web Browser Based File Encrypt
File | C:/Users/B%20Vasundhara/Downloads/OS%20Mini%20Project/Cryptographic%20file%20system.html
enc_OS.txt
48 B • Done
Don't show when downloads finish
Encrypt a File
To encrypt a file, enter a password and drop the file to be encrypted into the dropzone below. The file will then b
you'll be given an opportunity to save the encrypted file to your system.
Password
(minumum length eight characters, make sure it strong!)
Password (retype)
Drag and drop the file to be encrypted into this dropzone, or click here to select file.
OS.txt (30 Bytes)
Encrypt File
File encrypted.
Save Encrypted File
Usage
This web page to encrypt a file using a password, then use the same password later to decrypt the file. IMPORTANT: The same password that was used


enc_OS
File
Edit
View
Salted__ÿ<±=È²T Î —¯iõ76O×›ç:ZòÒ˜,ÆtƒU6ýý¢î k
Ln 1, Col 1
100%
Windows (CRLF)
ANSI

DECRYPTION:





RESULT:

Thus, the mini project – Cryptographic File Systems has been successfully implemented.