NexTGen Web

Session: 17

Canvas and JavaScript

Objectives

- Describe Canvas in HTML5
- Explain the procedure to draw lines
- Explain the procedure to use color and transparency
- Explain the procedure to work with various drawing objects
- Describe working with images and text
- Describe the procedure to create Web page events with JavaScript and jQuery
- Describe the process of including external content in Web pages

Canvas Element 1-6

The <canvas> element in HTML5 can be used to draw shapes on Web sites as well as to dynamically draw graphics using JavaScript.

The <canvas> element is represented like a rectangle on a page and allows the user to draw arcs, text, shapes, gradients, and patterns.

The <canvas> in HTML5 is like the , <table>, or <a> tag except that the content used in it is rendered through JavaScript.

The <canvas> element does not contain any drawing abilities, instead, the drawing is done using a JavaScript code.

To make use of the <canvas> element, a user has to add the <canvas> tag on the HTML page.

Using <canvas> with JavaScript improves the overall performance of Web sites and avoids the requirement to download images from the sites.

Canvas Element 2-6

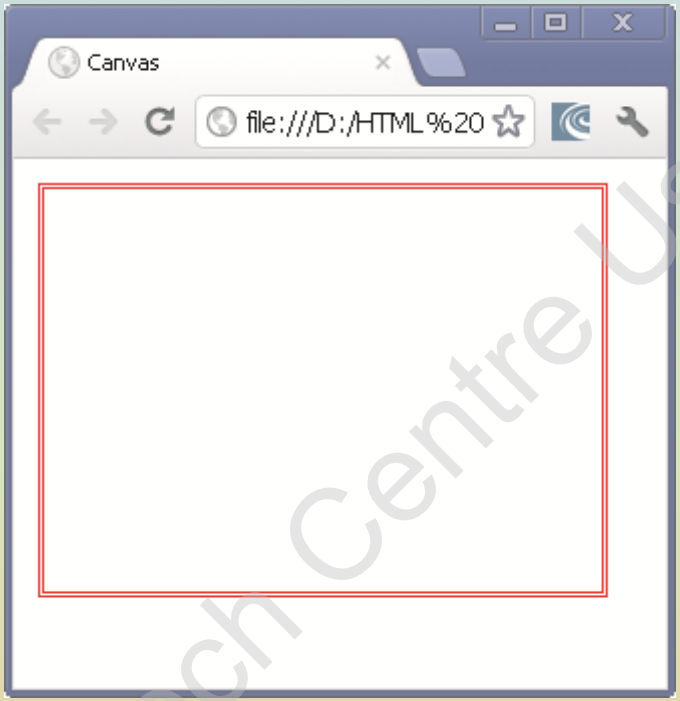
- The Code Snippet demonstrates the use of <canvas> element.

```
<!DOCTYPE HTML>
 <html>
  <head>
   <title> Canvas </title>
    <style>
          canvas{border: medium double red; margin: 4px}
       </style>
     </head>
  <body>
    <canvas width="278" height="200"></canvas>
  </body>
 </html>
```

- In the code, the <style> element is used to display the border of the <canvas> element.
- The height and width attributes specify the size of the <canvas> element on the page.

Canvas Element 3-6

- Following figure displays the <canvas> element.



To draw a <canvas> element, the user can use a context object.

The context object contains the drawing functions for a specific style of graphics.

Two-Dimensional (2d) context is used to work with 2d operations.

Canvas Element 4-6

The <canvas> element in DOM exposes the `HTMLCanvasElement` interface.

This interface provides the methods and properties for changing the presentation and layout of canvas elements.

The `HTMLCanvasElement` has a `getContext(context)` method that returns the drawing context for the canvas.

- The Code Snippet demonstrates the 2d context object for the canvas.

```
<!DOCTYPE HTML>
<html>
  <head>
   <title> Canvas </title>
    <script>
      window.onload = function()
      {
        var canvas = document.getElementById('mCanvas');
        var ctext = canvas.getContext('2d');
```

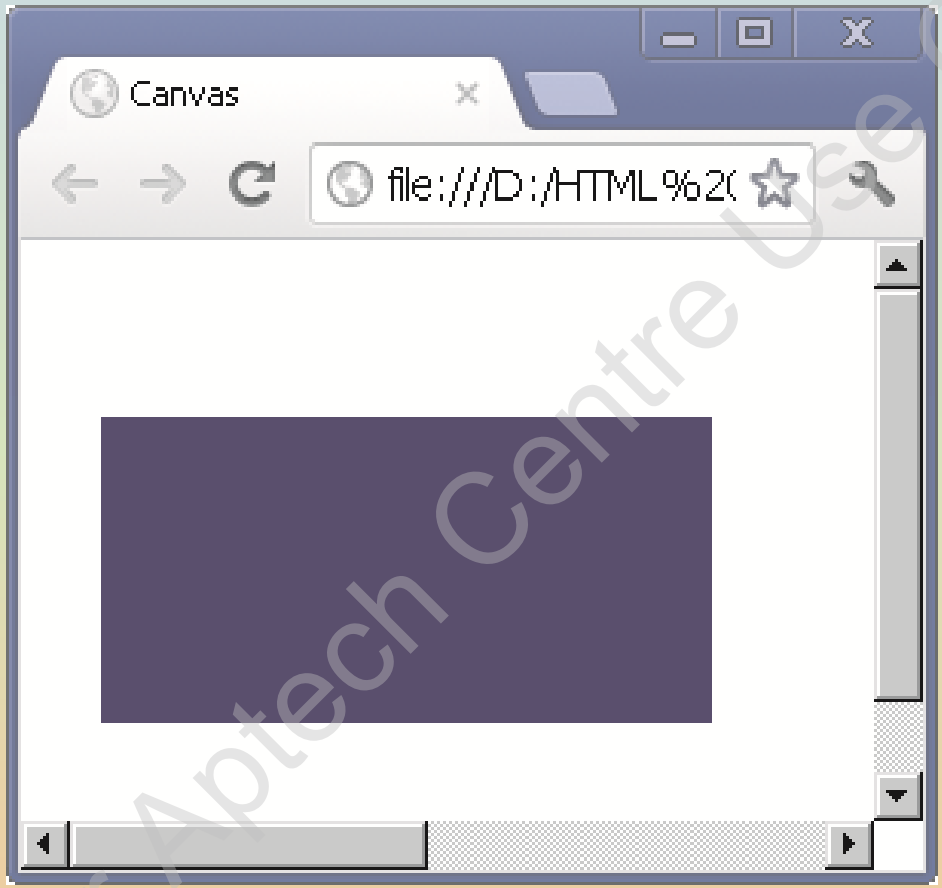
Canvas Element 5-6

```
            ctext.beginPath();
            ctext.rect(18, 50, 200, 100);
            ctext.fillStyle = ”DarkBlue”;
            ctext.fill();
            };
        </script>
    </head>
    <body>
        <canvas id=”mCanvas” width=”578” height=”200”></canvas>
    </body>
</html>
```

- In the code, the `height` and `width` attributes define the height and width of the canvas element respectively.
- In the initializer function, the DOM object is accessed through the id attribute and gets a 2d context by using the `getContext()` method.
- The rectangle is created by using the `rect(18, 50, 200, 100)` method with `x`, `y`, `height`, and `width` parameters and is positioned at left corner of the page.

Canvas Element 6-6

- Following figure displays the <canvas> element.



Drawing a Line in Canvas 1-4

- You can create lines in a canvas using the `stroke()`, `beginPath()`, `lineTo()`, and `moveTo()` methods.
- The following is the syntax to create a line in canvas :

Syntax:

```
ctext.beginPath();

ctext.moveTo(x,y);

ctext.lineTo(x,y);

ctext.stroke();
```

where,

- `ctext` - specifies a context object
- `beginPath()` - Specifies a new drawing path
- `moveTo()` - Specifies the creation of new sub path to the given position
- `lineTo()` - Specifies the drawing of a line from the context position to the given position
- `stroke()` - Specifies how to assign a color to the line and display it

Drawing a Line in Canvas 2-4

- The Code Snippet demonstrates creating a line in HTML5 canvas.

```
<!DOCTYPE HTML>
<html>
  <head>
  <title>Line</title>
    <style>
      body
      { margin: 0px;
        padding: 0px;
      }
      #mCanvas
      {
        border: 1px solid red;
      }
    </style>
  </head>
  <body>
    <canvas id="mCanvas" width="360" height="200"></canvas>
  </body>
</html>
    <script>
        window.onload = function() {
        var canvas = document.getElementById("mCanvas");
        var ctext = canvas.getContext("2d");
        ctext.beginPath();
        ctext.moveTo(100, 150);
        ctext.lineTo(250, 50);
        ctext.lineWidth = 5;
        ctext.strokeStyle = "blue";
        ctext.stroke();
```

Drawing a Line in Canvas 3-4

- In the code, the `height` and `width` attributes are defined.
- The initializer function has the DOM object which is accessed through the id attribute and gets a 2d context by using the `getContext()` method.
- The `beginPath()` method is called through the context object to draw the path of the line.
- The `moveTo(100, 150)` method is called that creates a new path for the given point to place the drawing cursor and moves the position of the window to the upper-left corner by giving the x and y coordinates.
- The `lineTo(250, 50)` method is called to draw the line from the context point to given point.
- The `lineWidth` property is specified as 5 to define the width of the line on the canvas.
- The `strokeStyle` property sets the color of the line to blue.
- The `stroke()` method assigns the color to the line.

Drawing a Line in Canvas 4-4

- Following figure displays a line drawn in a canvas.

Working with Drawing Objects 1-17

- HTML5 canvas allows the user to work with different types of drawing objects.
- Following objects can be drawn on a canvas element:

➢ Rectangle

- With HTML5 canvas, the user can create a rectangle using the `rect()` method.
- The HTML5 canvas is placed by using the x and y parameters and appropriately sized through height and width properties.
- Following table lists the common properties and methods of various shapes.

Properties and Methods	Description
`fillStyle`	The values can be gradient, pattern, or a CSS color. The default property style is solid black, but the user can set the color according to the requirements.
`filRect(x, y, width, height)`	Enables the user to draw a rectangle with the existing fill style.
`strokeStyle()`	The values can be gradient, pattern, or a CSS color.

Working with Drawing Objects 2-17

Properties and Methods	Description
`strokeRect(x, y, width, height)`	Enables the user to draw a rectangle with the existing stroke style. This property is used to draw the edges of the rectangle.
`clearRect(x, y, width, height)`	Used to clear the pixels in a rectangle.

- The Code Snippet demonstrates how to create a rectangle in HTML5 canvas.

```
<!DOCTYPE HTML>
<html>
  <head>
    <style>
      #mCanvas {
        border: 1px solid green;
      }
      body {
        margin: 0px;
        padding: 0px;
      }
    </style>
```

Working with Drawing Objects 3-17

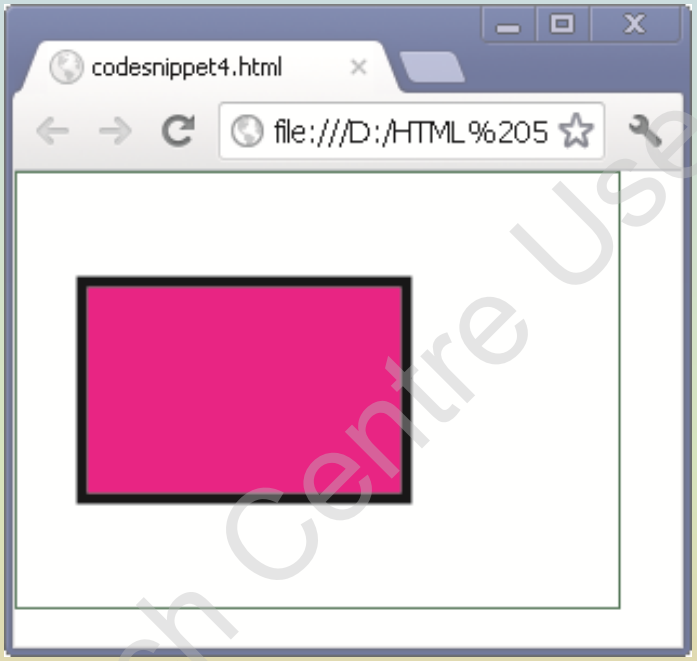
```
<script>
      window.onload = function() {
      var canvas = document.getElementById('mCanvas');
      var ctext = canvas.getContext('2d');
      ctext.beginPath();
      ctext.rect(30, 50, 150, 100);
      ctext.fillStyle = "Magenta";
      ctext.fill();
      ctext.lineWidth = 5;
      ctext.strokeStyle = 'black';
      ctext.stroke();
    };
 </script>
</head>
<body>
  <canvas id="mCanvas" width="278" height="200"></canvas>
</body>
</html>
```

Working with Drawing Objects 4-17

- In the code, the `height` and `width` attributes are defined.
- The initializer function has the DOM object which is accessed through the id attribute and gets a 2d context by using the `getContext()` method.
- The `beginPath()` method is called through the context object to draw the rectangle.
- The `rect(30, 50, 150, 100)` method takes `x`, `y`, `height`, and `width` as the parameters.
- The `fillStyle` property fills the rectangle with magenta color.
- The `fill()` method is used to paint the rectangle.
- The `lineWidth` property is specified as 5 to define the width of line on the canvas.
- The `strokeStyle` property sets the stroke style of the rectangle to black.
- The `stroke()` method assigns the color to the rectangle.

Working with Drawing Objects 5-17

- Following figure displays a rectangle drawn on the canvas.



Arcs

- With HTML5 canvas, the user can create an arc by using the arc() method.
- Arcs are represented using a start angle, an end angle, a radius, a center point, and the drawing direction (anticlockwise or clockwise).

Working with Drawing Objects 6-17

- The syntax to draw an arc in HTML5 is as follows:

Syntax:

```
arc(x, y, radius, startAngle, endAngle, anticlockwise)
```

where,

- `x, y` - Specifies the coordinates of the center of an arc
- `radius` - Specifies the distance from the center to any point on the circle
- `startAngle, endAngle` - Specifies the start and end points in the arc
- `anticlockwise` - Draws the arc clockwise or anticlockwise and accepts a `boolean` value

- The Code Snippet demonstrates how to create an arc in HTML5 canvas.

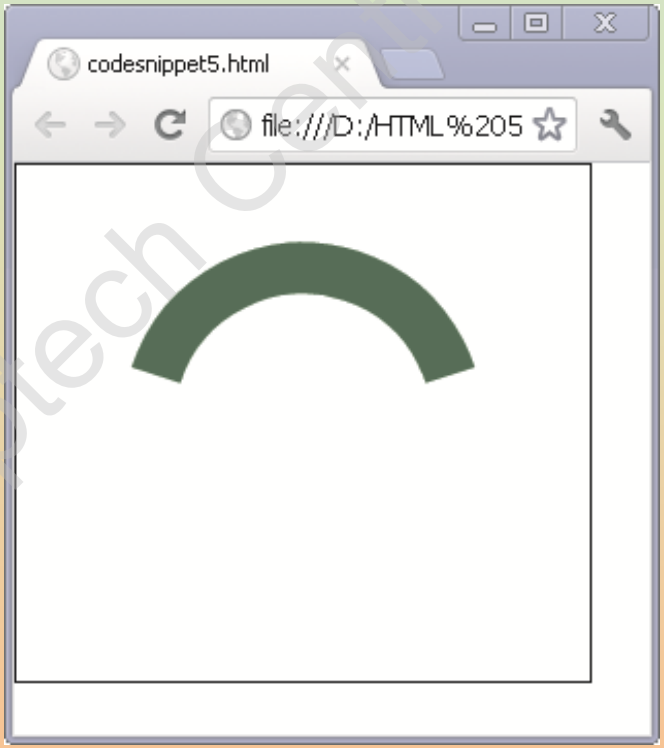
```
<!DOCTYPE HTML>
<html>
  <head>
    <style>
      body
       {
        margin: 0px;
        padding: 0px;
       }
```

Working with Drawing Objects 7-17

```
    #mCanvas {
      border: 1px solid black; }
  </style>
  <script>
    window.onload = function() {
    var canvas = document.getElementById("mCanvas");
    var ctext = canvas.getContext("2d");
    var x = canvas.width / 2;
    var radius = 75;
    var startAngle = 1.1 * Math.PI;
    var endAngle = 1.9 * Math.PI;
    var ctrClockwise = false;
    ctext.beginPath();
    ctext.arc(x, y, radius, startAngle, endAngle, ctrClockwise);
    ctext.lineWidth = 25;
    // line color
    ctext.strokeStyle = "DarkGreen";
    ctext.stroke();
    };
  </script> </head>
<body>
  <canvas id="mCanvas" width="278" height="250"></canvas>
</body></html>
```

Working with Drawing Objects 8-17

- In the code, the `beginPath()` method is called through the context object to draw an arc by using the `arc()` method which has `x`, `y`, and `radius` as the parameters.
- The `startAngle` and the `endAngle` are the start and end points of the arc.
- The `anticlockwise` specifies the direction of the arc between the two start and end points.
- Following figure displays an arc in HTML5 canvas.



Working with Drawing Objects 9-17

Circle

- In HTML5, you can draw a circle using the `arc()` method.
- You have to set the start angle with 0 and the end angle is specified as `2 * PI`.
- Following is the syntax to draw a circle in HTML5 is as follows:

Syntax:

```
arc(x, y, radius, startAngle, endAngle, anticlockwise)
```

where,

- `x, y` - Specifies the coordinates of the center of an arc
- `radius` - Specifies the distance from the center to any point on the circle
- `startAngle, endAngle` - Specifies the start and end points in the arc
- `anticlockwise` - Draws the arc clockwise or anticlockwise and accepts a `boolean` value

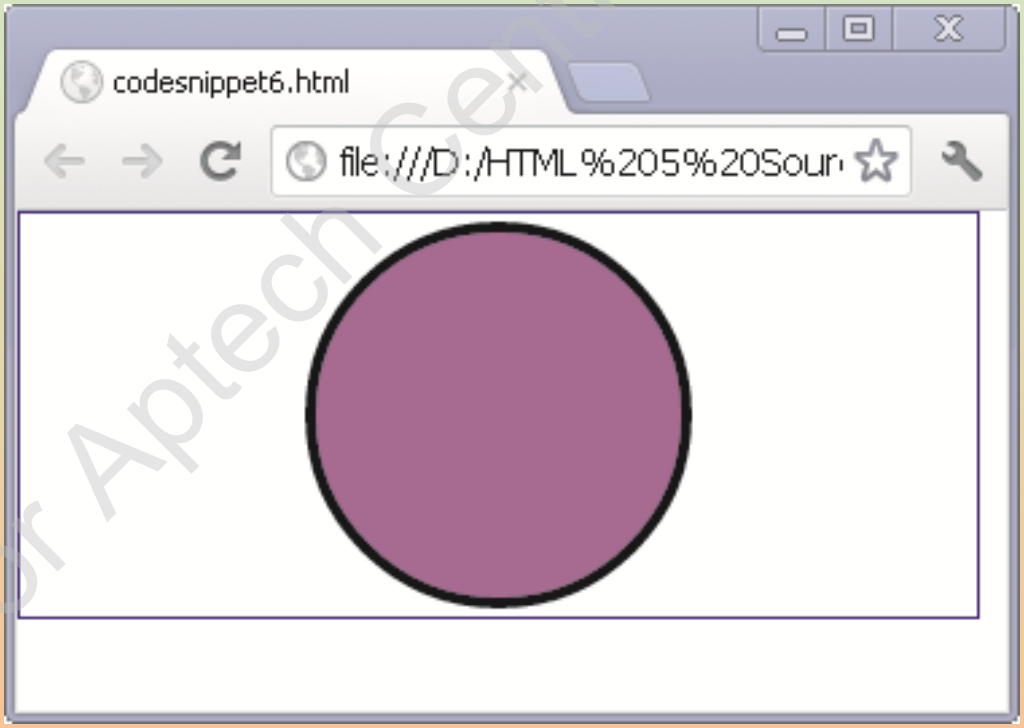
Working with Drawing Objects 10-17

- The Code Snippet demonstrates how to create a circle using HTML5.

```
<!DOCTYPE HTML>
<html>
  <head>
    <style>
      body
      { margin: 0px;
        padding: 0px;
      }#mCanvas
      {
        border: 1px solid blue;
      }
    </style>
  </head>
  <body>
    <canvas id="mCanvas" width="356" height="150"></canvas>
  </body>
  <script>
    window.onload = function() {
      var canvas = document.getElementById("mCanvas");
      var ctext = canvas.getContext("2d");
      var ctrX = canvas.width / 2;
      var ctrY = canvas.height / 2;
      var radius = 70;
      ctext.beginPath();
      ctext.arc(ctrX, ctrY, radius, 0, 2 * Math.PI, false);
      ctext.fillStyle = "DarkOrchid";
      ctext.fill();
      ctext.lineWidth = 4;
      ctext.strokeStyle = "black";
      ctext.stroke();
    }
  </script>
</html>
```

Working with Drawing Objects 11-17

- In this code, a circle is defined by using the `arc()` method which has `ctrX`, `ctrY`, and `radius` as the parameters.
- To define the arc with the points the `startAngle` is set to `0` and the `endAngle` is specified as `2*PI`.
- The `anticlockwise` defines the direction of the path of an arc between the two start and end points.
- Following figure displays a circle in HTML5 canvas.



Working with Drawing Objects 12-17

Bezier Curves

- Using HTML5 canvas, you can create a Bezier curve using the `bezierCurveTo()` method.
- Bezier curves are represented with the two control points, context points, and an end point.
- The Code Snippet demonstrates how to create a Bezier curve using HTML5.

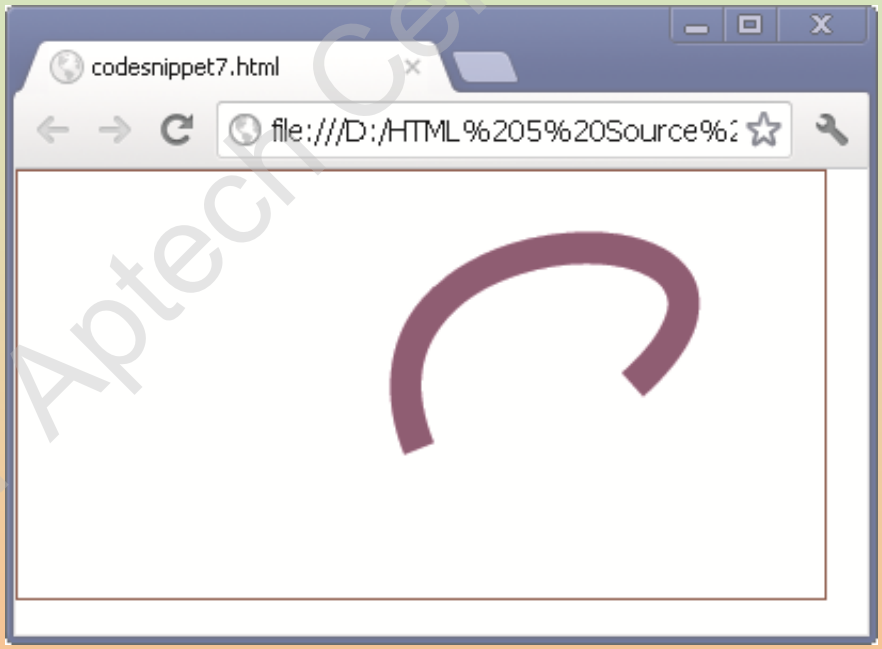
```
<!DOCTYPE HTML>
<html>
  <head>
    <style>
      body
      {
        margin: 0px;
        padding: 0px;
      }
      #mCanvas
      {
        border: 1px solid maroon;
      }
    </style>
```

Working with Drawing Objects 13-17

```
<script>
      window.onload = function()
      {
        var canvas = document.getElementById("mCanvas");
        var ctext = canvas.getContext("2d");
        ctext.beginPath();
        ctext.moveTo(188, 130);
        ctext.bezierCurveTo(140, 10, 388, 10, 288, 100);
        ctext.lineWidth = 15;
        // line color
        ctext.strokeStyle = "purple";
        ctext.stroke();
      };
    </script>
  </head>
  <body>
    <canvas id="mCanvas" width="378" height="200"></canvas>
  </body>
</html>
```

Working with Drawing Objects 14-17

- In this code, the Bezier curve uses the `bezierCurveTo()` method.
- This method defines the current context point, two control points, and an end point.
- The context point uses the `moveTo()` method.
- The first portion of the curve is tangential to the imaginary line defined in the context point and first control point.
- The second portion of the curve is tangential to the imaginary line which is defined by the second control point and the ending point.
- Following figure displays a Bezier curve in a canvas.



Working with Drawing Objects 15-17

Quadratic Curves

- HTML5 canvas allows the user to create quadratic curves using the `quadraticCurveTo()` method.
- Quadratic curves are represented through the context point, an end point, and a control point.
- The Code Snippet demonstrates how to create a quadratic curve using HTML5.

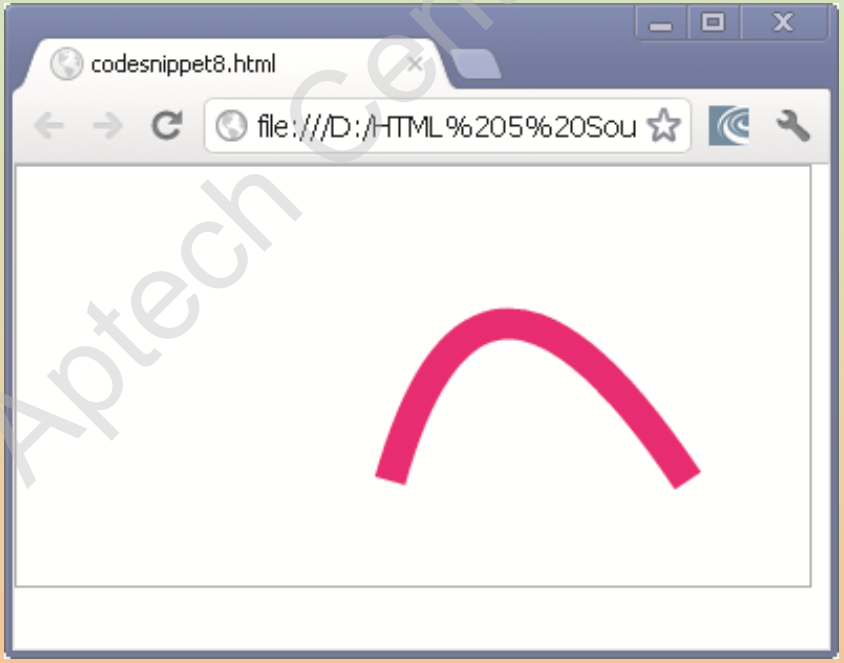
```
<!DOCTYPE HTML>
<html>
  <head>
    <style>
      body
      {
        margin: 0px;
        padding: 0px;
      }
      #mCanvas
      {
        border: 1px solid #9C9898;
      }
```

Working with Drawing Objects 16-17

```
        window.onload = function() {
        var canvas = document.getElementById("mCanvas");
        var ctext = canvas.getContext("2d");
        ctext.beginPath();
        ctext.moveTo(178, 150);
        ctext.quadraticCurveTo(220, 0, 320, 150);
        ctext.lineWidth = 15;
        // line color
        ctext.strokeStyle = "Fuchsia";
        ctext.stroke();
      };
    </script>
  </head>
  <body>
    <canvas id="mCanvas" width="378" height="200"></canvas>
  </body>
</html>
```

Working with Drawing Objects 17-17

- In the code, the control point defines the curve of the quadratic by two tangential lines that are connected to both the context point and the end point.
- The context point is represented using the `moveTo()` method.
- This method moves the control point from the context point and the end point to create a sharper curve.
- It also moves the control point close to the context point and end point to create broad curves.
- Following figure displays a quadratic curve in a canvas.



Working with Images 1-3

- In HTML5, the user can draw image objects on canvas using the `drawImage()` method.
- The `drawImage()` method can also draw parts of an image and increase or reduce the size of the image.
- This method accepts nine parameters, depending on editing that is required on the image.
- The image object can be a video, an image, or another canvas element.
- The Code Snippet demonstrates how to create an image using HTML5.

```
<!DOCTYPE HTML>
<html>
  <head>
    <style>
      body {
        margin: 0px;
        padding: 0px;
       }
       #mCanvas {
        border: 1px solid #9C9898;
       }
     </style>
```

Working with Images 2-3

```
<script>
      window.onload = function()
      {
        var canvas = document.getElementById("mCanvas");
        var ctext = canvas.getContext("2d");
        var imgObj = new Image();
        imgObj.onload = function()
        {
        ctext.drawImage(imgObj, 69, 50);
        };
        imgObj.src = "bird.jpg";
      };
     </script>
</head>
<body>
    <canvas id="mCanvas" width="368" height="300"></canvas>
  </body>
</html>
```

Working with Images 3-3

- In the code, the `onload` property is used.
- The source of the object is defined by using the `src` property.
- The image has to be loaded first and then instantiated with the `drawImage()` method.
- This method takes image object as the parameter with the x and y coordinates of the image.
- Following figure displays an image drawn on a HTML5 canvas.

Working with Text 1-5

- HTML5 canvas enables you to set the font, style, and size of text by using the font properties.
- The font style can be italic, normal, or bold.
- To set the text color, the fillStyle property of the canvas can be used.
- The Code Snippet demonstrates how to set the font, size, style, and color of the text on a HTML5 canvas.

```
<!DOCTYPE HTML>
<html>
  <head>
    <style>
      body {
        margin: 0px;
        padding: 0px;
      }
      #mCanvas {
        border: 1px solid blue;
      }
    </style>
```

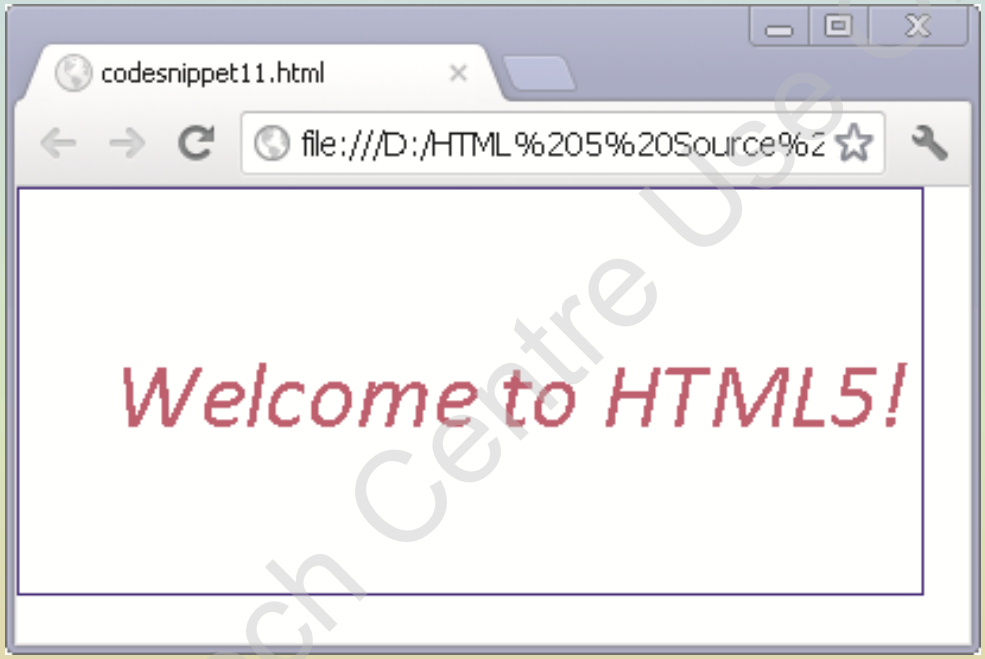
Working with Text 2-5

```
<script>
    window.onload = function() {
    var canvas = document.getElementById("mCanvas");
    var ctext = canvas.getContext("2d");
    ctext.font = "italic 30pt Calibri";
    ctext.fillStyle = "MediumVioletRed";
    ctext.fillText("Welcome to HTML5!", 40, 100);
   };
  </script>
</head>
<body>
  <canvas id="mCanvas" width="380" height="170"></canvas>
</body>
</html>
```

- In this code, the font text is specified as `Calibri`, style as `italic`, and size is set to `30pt`.
- The `fillStyle` property specifies the text color and the `fillText` property is used to set the text on the canvas.

Working with Text 3-5

- Following figure displays working with text in a HTML5 canvas.



- In HTML5 canvas, the user can set the stroke color by using the `strokeText()` method and `strokeStyle` property of the canvas context.

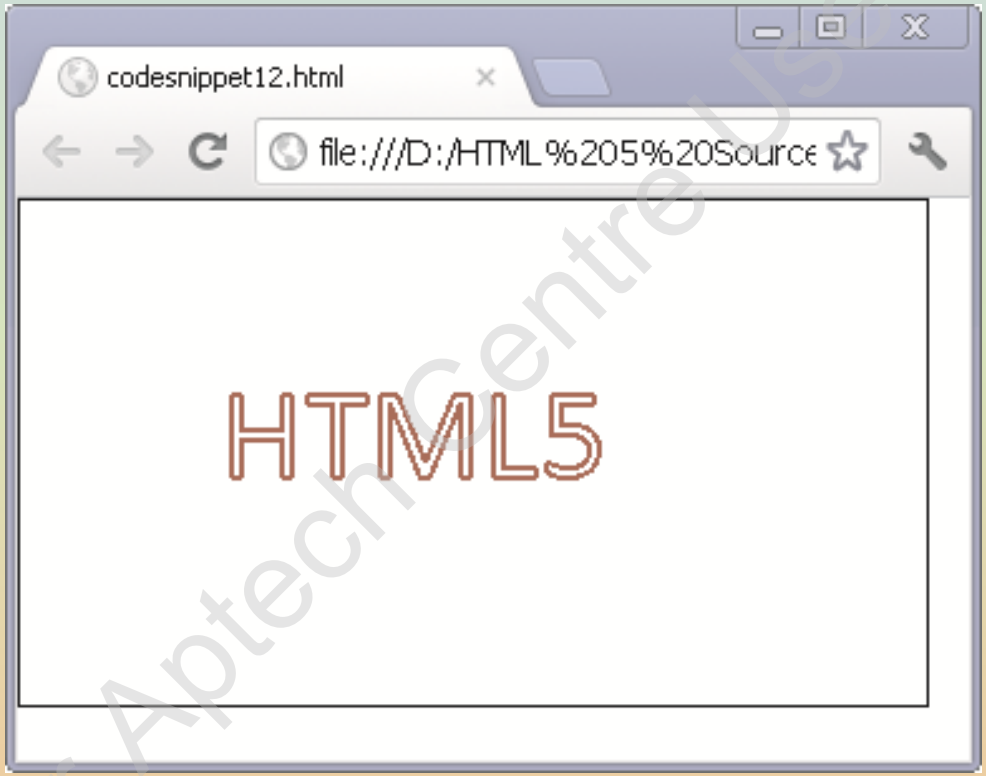
Working with Text 4-5

- The Code Snippet demonstrates the use of stroke text in HTML5 canvas.

```
<!DOCTYPE HTML>
<html>
 <head>
  <style type="text/css">
   body {
    #mCanvas {
     border: 1px solid black;
    }
   </style>
  </head>
  <body>
   <canvas id="mCanvas" width="360" height="200"></canvas>
  </body>
</html>
<script>
        window.onload = function() {
        var canvas = document.getElementById("mCanvas");
        var ctext = canvas.getContext("2d");
        var x = 110;
        var y = 110;
        ctext.font = "40pt Calibri";
        ctext.lineWidth = 2;
        ctext.strokeStyle = "Brown";
        ctext.strokeText("HTML5", x, y);
        }
</script>
```

Working with Text 5-5

- In this code, the stroke color is set by using the `strokeStyle` property and the `strokeText()` method.
- Following figure displays the stroke text in HTML5 canvas.



Using Transparency for Text in Canvas 1-3

- There are two ways to set the transparency for the text and shapes.
- The first method is to use the `strokeStyle` and `fillStyle` by using the `rgb` function.
- The second method is to use `globalAlpha` drawing state property, which can be applied universally.
- The `globalAlpha` property is a value that ranges between `0` (fully transparent) and `1` (fully opaque).
- The Code Snippet demonstrates the use of `globalAlpha` property.

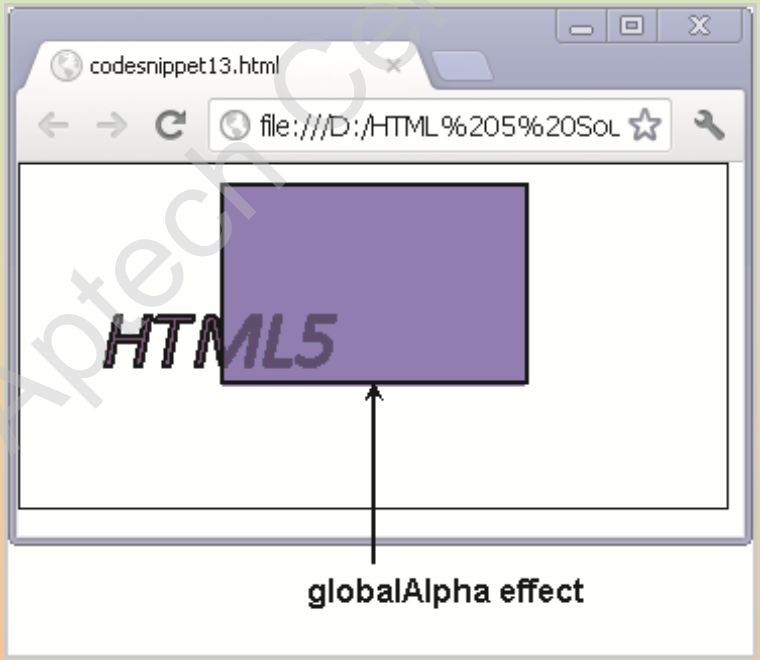
```
<!DOCTYPE HTML>
<html>
  <head>
    <style>
      body {
        margin: 0px;
        padding: 0px;
      }
      #mCanvas {
        border: 1px solid black;
      }
    </style>
```

Using Transparency for Text in Canvas 2-3

```
<script>
      window.onload = function()
      {
        var canvas = document.getElementById("mCanvas");
        var ctext = canvas.getContext("2d");
        ctext.fillStyle = "Indigo";
        ctext.strokeStyle ="black";
        ctext.lineWidth=2;
        ctext.font = "italic 30pt Calibri";
        ctext.fillText("HTML5", 40, 100);
        ctext.strokeText("HTML5", 40, 100);
        ctext.fillStyle="blue";
        ctext.globalAlpha=0.5;
        ctext.fillRect(100, 10, 150, 100);
      };
    </script>
  </head>
  <body>
    <canvas id="mCanvas" width="350" height="170"></canvas>
  </body>
</html>
```

Using Transparency for Text in Canvas 3-3

- In the code, the `fillStyle` and `strokeStyle` is used to color the text.
- The 'HTML5' text `lineWidth` is specified as `2` and the `font-family` is set to `Calibri` with `italic` style and `font-size` to 30pt.
- The `fillText` property fills the color and `strokeText` property applies the stroke color to the HTML5 text.
- The `fillStyle` is set to `blue` and `globalAlpha` property is set to `0.5`.
- The `fillRect(100, 10, 150, 100)` specifies the `x`, `y`, `height`, and `width` of the rectangle.
- Following figure displays the stroke text in HTML5 canvas.



Using Events with jQuery 1-6

- jQuery also offers different events to deal with common interactions when the user moves the mouse or switches between two actions while clicking.
- The following are the events:

➢ hover() event

- The mouseenter and mouseleave are the two events often used together.
- jQuery provides a `hover()` function that accepts two parameters.
- The first parameter executes when the mouse moves over the element and the second function executes when the mouse moves away from the element.
- The Code Snippet demonstrates the hover event.

```
<!DOCTYPE html>
 <html>
  <head>
   <script src="jquery-1.7.2.min.js"></script>
   <script>
      $(document).ready(function(){
```

Using Events with jQuery 2-6

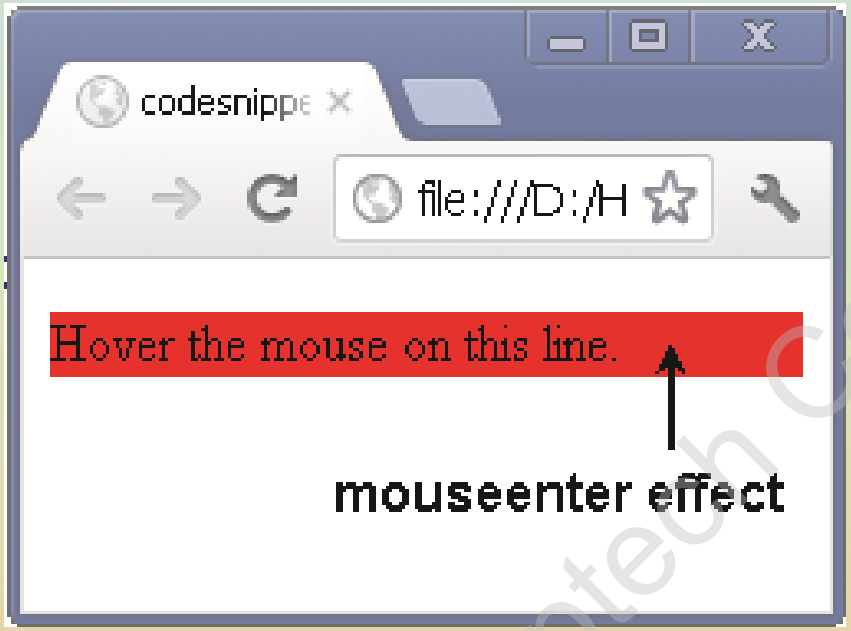
```
    $("p").hover(function(){
    $("p").css("background-color","red");
    },function(){
    $("p").css("background-color","maroon");
    });
  });
  </script>
</head>
  <body>
   <p>Hover the mouse on this line.</p>
  </body>

</html>
```

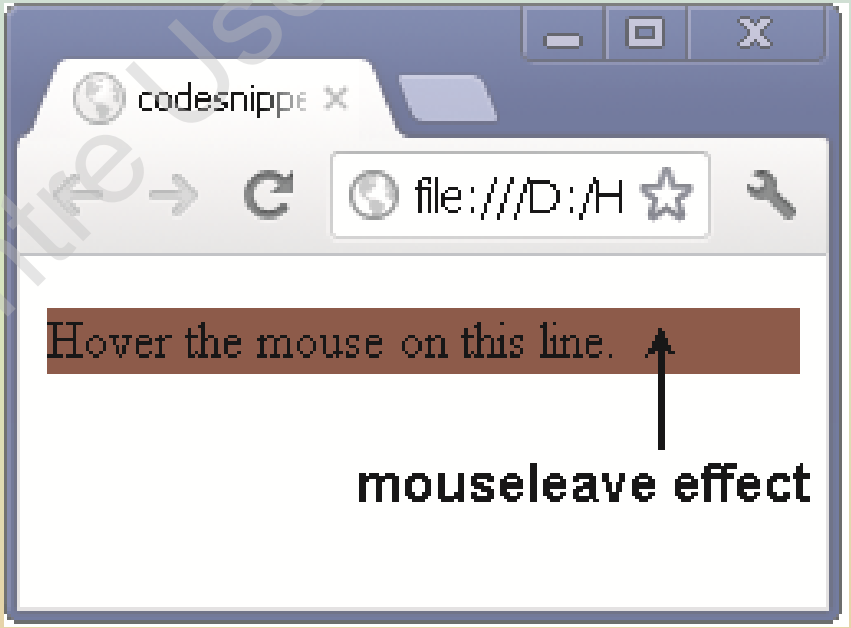
- In the code, the `hover()` method is used.
- When the mouse is placed on the text, then the background color changes to `red`.
- When the user moves the mouse outside the text, the background color changes to `maroon`.

Using Events with jQuery 3-6

- Following figure displays the mouseenter effect.



- Following figure displays the mouseleave effect.



Using Events with jQuery 4-6

➢ toggle() event

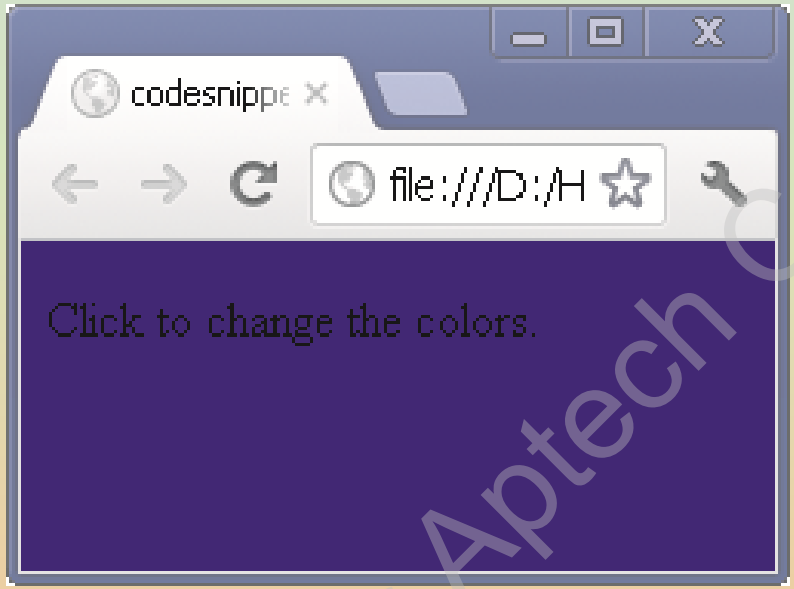
- The `toggle()` event works in a similar manner as that of the `hover()` event, except that it responds to mouse clicks.
- The `toggle()` function accepts more than two functions as arguments.
- All the functions passed to the toggle() event will react to its corresponding click action.
- The Code Snippet demonstrates the toggle event.

```
<!DOCTYPE html>
<html>
 <head>
  <script src="jquery-1.7.2.min.js"></script>
  <script>
  $(document).ready(function(){
  $("p").toggle(function(){
   $("body").css("background-color","blue");},
  function(){
   $("body").css("background-color","pink");},
  function(){
   $("body").css("background-color","grey");});
  });
  </script>
 </head>
 <body>
  <p>Click to change the colors.</p>
 </body>
</html>
```

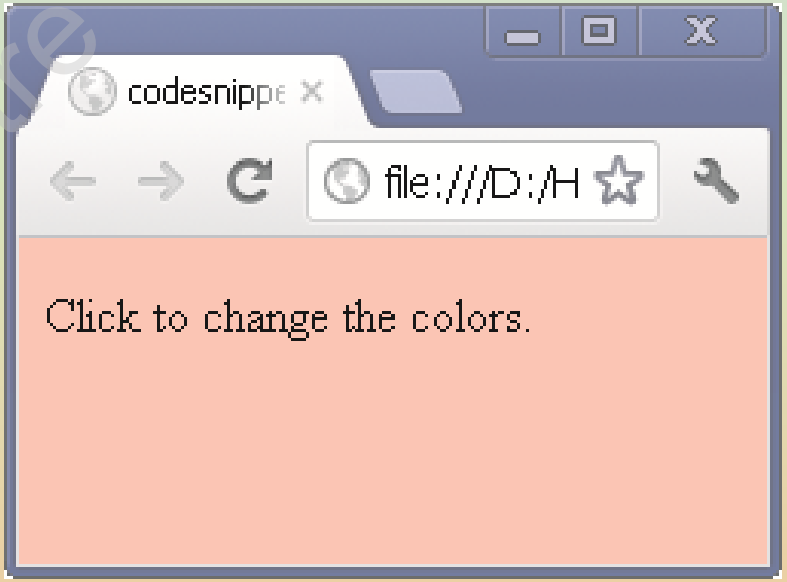
Using Events with jQuery 5-6

- In the code, the `toggle()` method is used.
- When the user clicks the text then the `background-color` of the document is changed to blue, pink, and grey respectively.

- Following figure displays the toggle effect to blue.

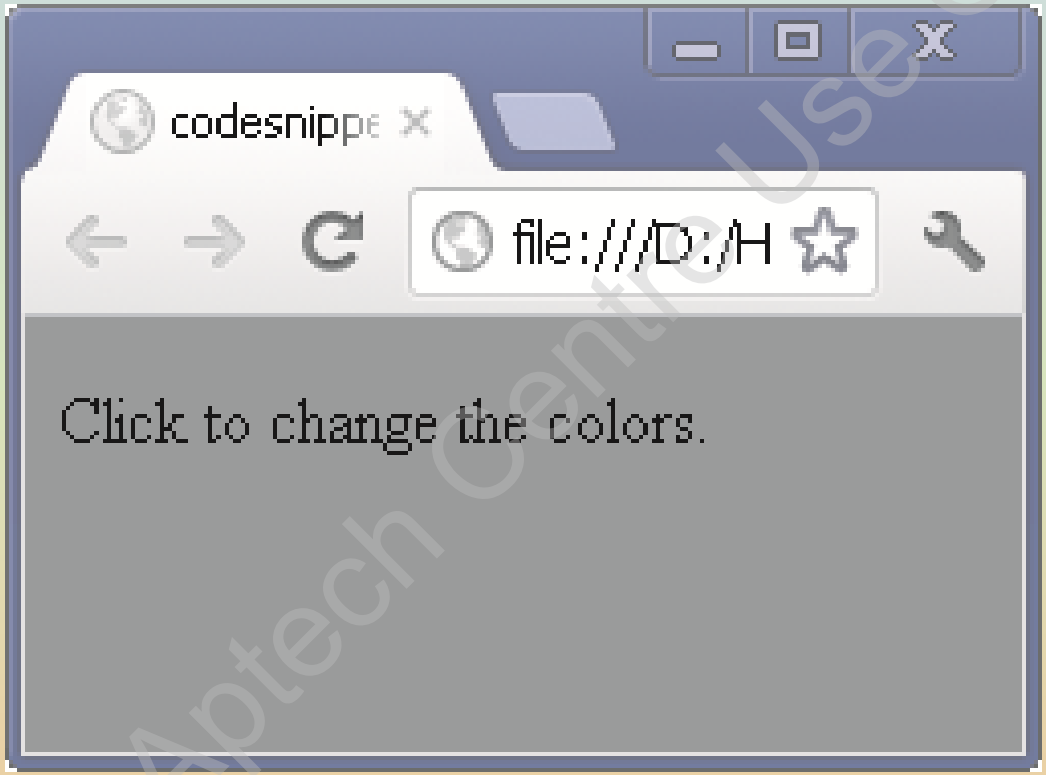


- Following figure displays the toggle effect to pink.



Using Events with jQuery 6-6

- Following figure displays the toggle effect to grey.



Inclusion of External Content in Web Pages

HTML5 introduces the `<eventsource>` tag that allows the user to push external content in the Web page. This model is referred to as push model.

Since the `<eventsource>` tag is not supported in many browsers, users make use of the <embed> tag for this purpose.

The `<embed>` tag is a new element in HTML5 and it is represented as a container for an interactive content or an external application.

The `<embed>` tag is often used to add elements such as image, audio, or video on a Web page.

- The Code Snippet demonstrates the use of <embed> tag.

```
<embed src="mymovie.mp3" />
```

- In this code, the `src` attribute specifies the path of an external file to embed.

Summary

- The <canvas> element is a drawing area where the user can draw graphics, use images, add animations, and also add text for enhancing the user experience on Web pages.
- To create a line, on a canvas one can use the stroke(), beginPath(), lineTo(), and moveTo() methods.
- Arcs are represented using a start angle, an end angle, a radius, a center point, and the drawing direction (anticlockwise or clockwise).
- With HTML5 canvas, the user can create a rectangle using the rect() method.
- Bezier curves are represented with the two control points, context points, and an end point.
- HTML5 canvas allows the user to create quadratic curves using the quadraticCurveTo() method.
- HTML5 canvas enables the user to draw image object on canvas using the drawImage() method.