ICT in SES

Interactivity

Lesson №15

Working with the mouse

Events

Events and interactivity

- Events are DOM-related objects
- Originally covered in Lesson №6
- Used to implement interactivity

Events are used to process

- Mouse movements
- Mouse button clicks
- Using the keyboard

Mouse events

Mouse movement

- mousemove – movement
- mouseenter – entering HTML element
- mouseleave – exiting HTML element
- mouseover – movement over HTML element or its subelements
- mouseout – exiting HTML element and its subelements

Mouse buttons

- mousedown – button is pressed
- mouseup – button is released
- click – click
- dblclick – double click
- contextmenu – click with the right (secondary) button

Other events

- Not directly related to graphics:
  - Events for drag and drop of elements and files
  - Events for controlling multimedia

Properties

Event object

- Every event is represented by a JS object
- The object’s properties inform about the event

Properties

- target – DOM element where the event occurred
- clientX, clientY – coordinates in the window
- screenX, screenY – coordinates in the screen
- buttons – what buttons are pressed
- altKey, ctrlKey, shiftKey – press status of Alt, Ctrl, Shift

Coordinates

Local coordinates

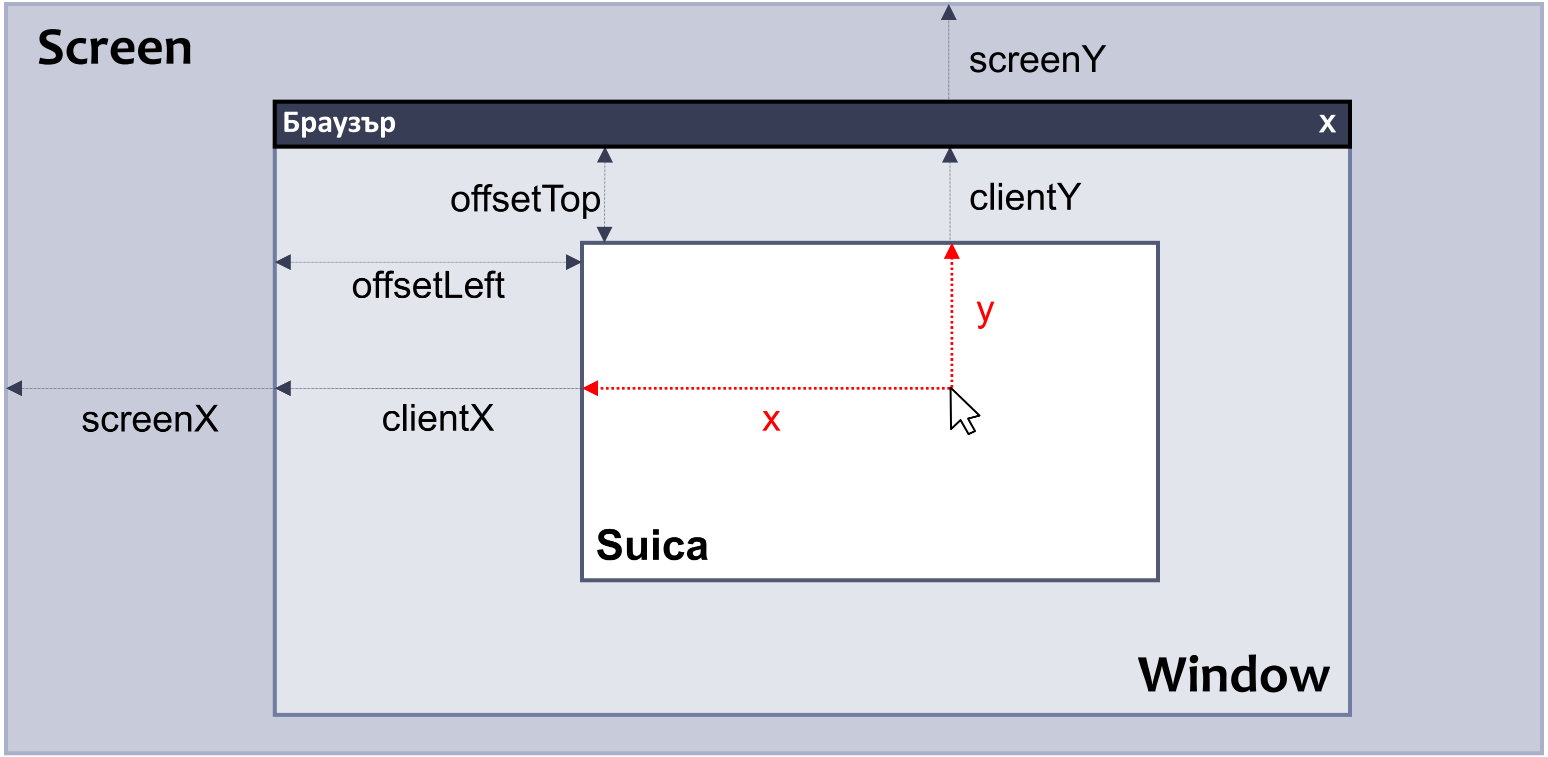
- Graphic element canvas
- Calculating coordinates (x, y) of the mouse cursor relative to the upper left corner of the Suica object

x = clientX – offsetLeft

y = clienyY – offsetTop

x = clientX – offsetLeft

y = clienyY – offsetTop



Example

Blank graphic box

- Showing mouse coordinates when it is moved
- Coordinates are relative to the graphical canvas
- No coordinates when moving outside the canvas

Idea

- Using two events
  - mousemove - movement inside the canvas
  - mouseout - exiting the canvas

Adding event listeners

- Coordinates are shown in info
- Every Suica object contains WebGL object gl, that keeps reference to the DOM element canvas
- Creating two event listeners for p.gl.canvas
- Mouse movement is processed by mouseMove
- Exiting the canvas is processed by mouseOut

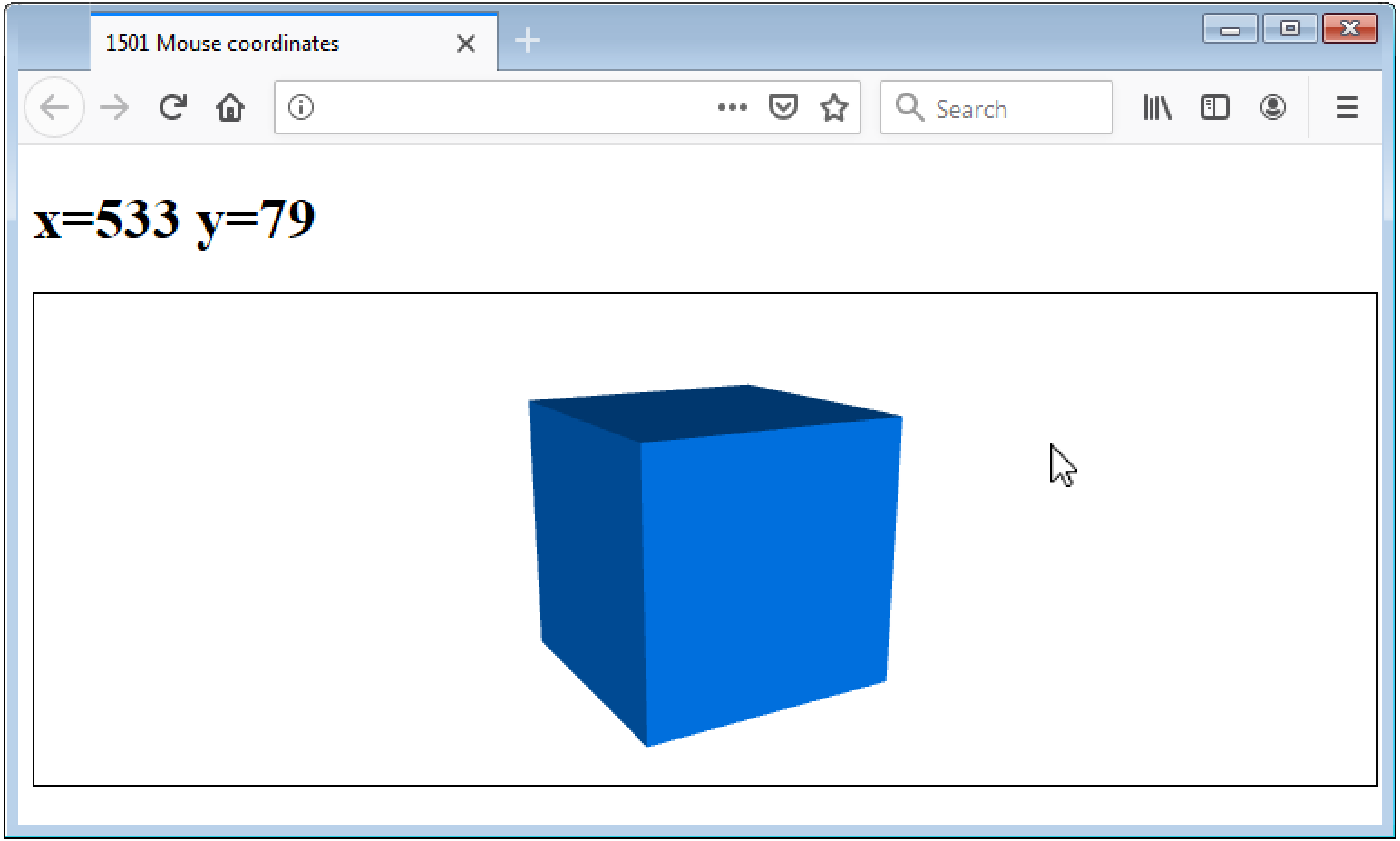
```
info = document.getElementById('info');

p = new Suica();
p.gl.canvas.addEventListener('mouseout',mouseOut,false);
p.gl.canvas.addEventListener('mousemove',mouseMove,false);
```

Processing events

- Parameter event provides mouse coordinates and the offset in target

```
function mouseMove(event)
{
  var x = event.clientX-event.target.offsetLeft;
  var y = event.clientY-event.target.offsetTop;
  info.innerHTML = 'x='+x+' y='+y;
}
function mouseOut(event)
{
  info.innerHTML = 'Пример 1501:... ';
}
```



x=533 y=79

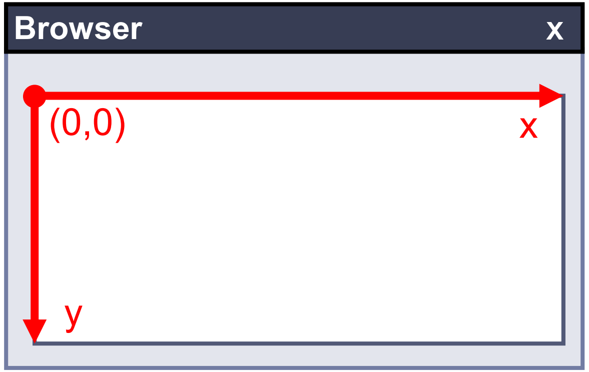
TRY IT

Drawing with the mouse

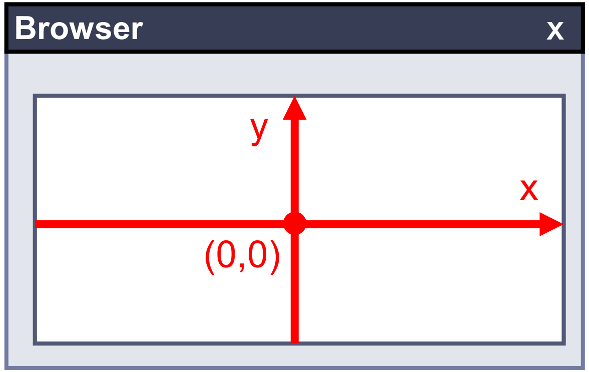
Graphical coordinates

Graphical coordinates

- Coordinates of objects in the canvas
- Differ from mouse coordinates
- Point (0,0) is in the center, X is towards right, Y is upwards



Mouse coordinates

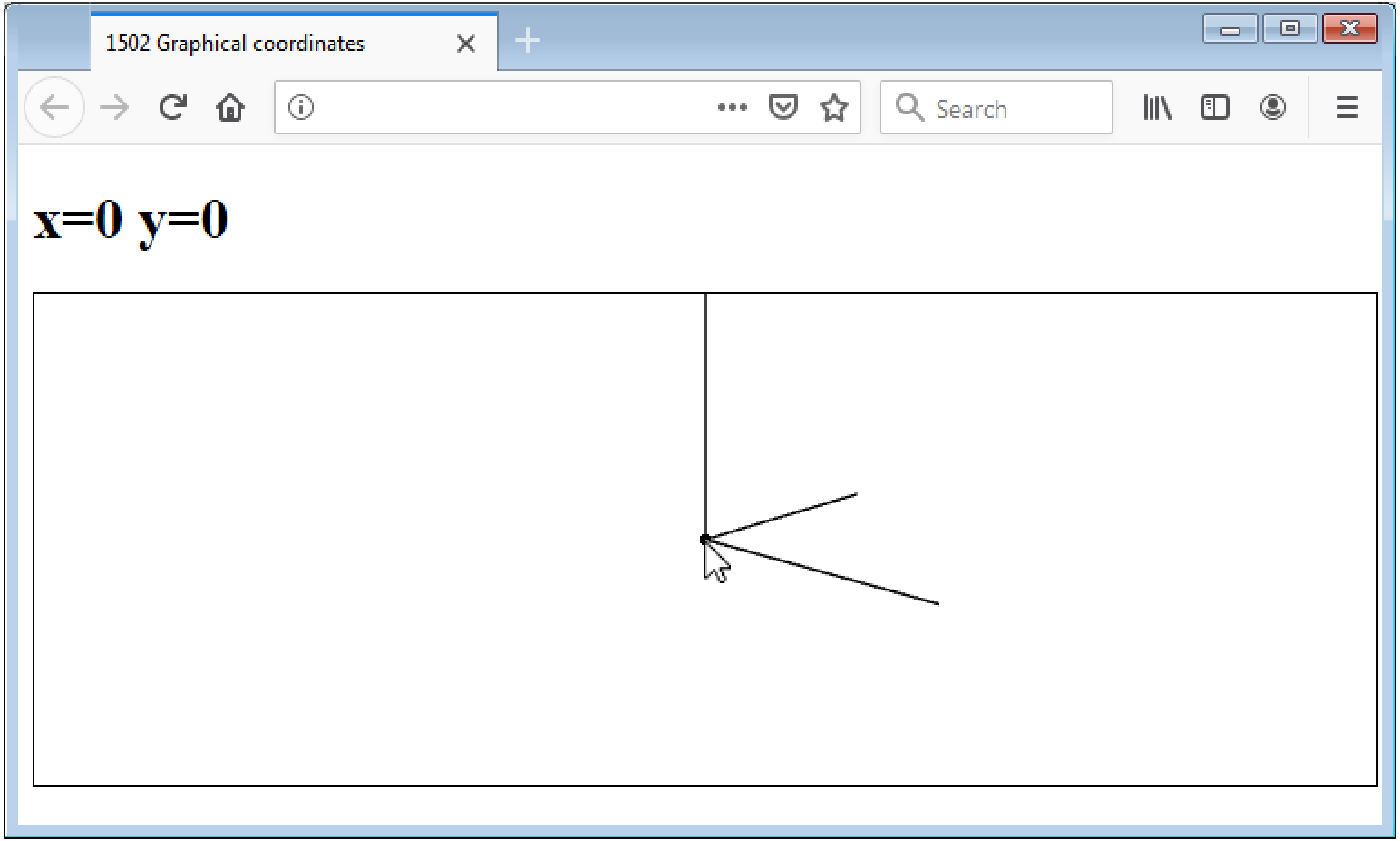


Graphical coordinates

Calculating graphical coordinates

- Center offset and halves of offsetWidth and offsetHeight
- Y coordinates must have opposite sign

```
var x = event.clientX
        - event.target.offsetLeft
        - event.target.offsetWidth/2;
var y = -(event.clientY
          - event.target.offsetTop
          - event.target.offsetHeight/2);
```



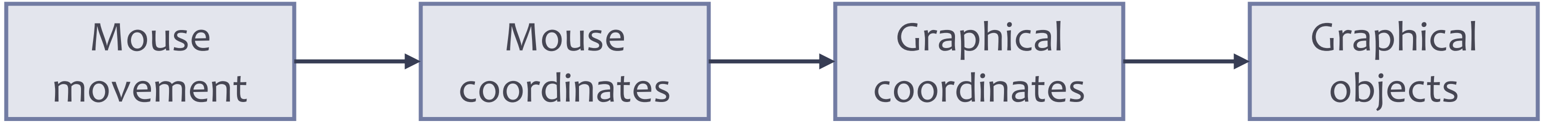
x=0 y=0

TRY IT

Drawing

Drawing of points

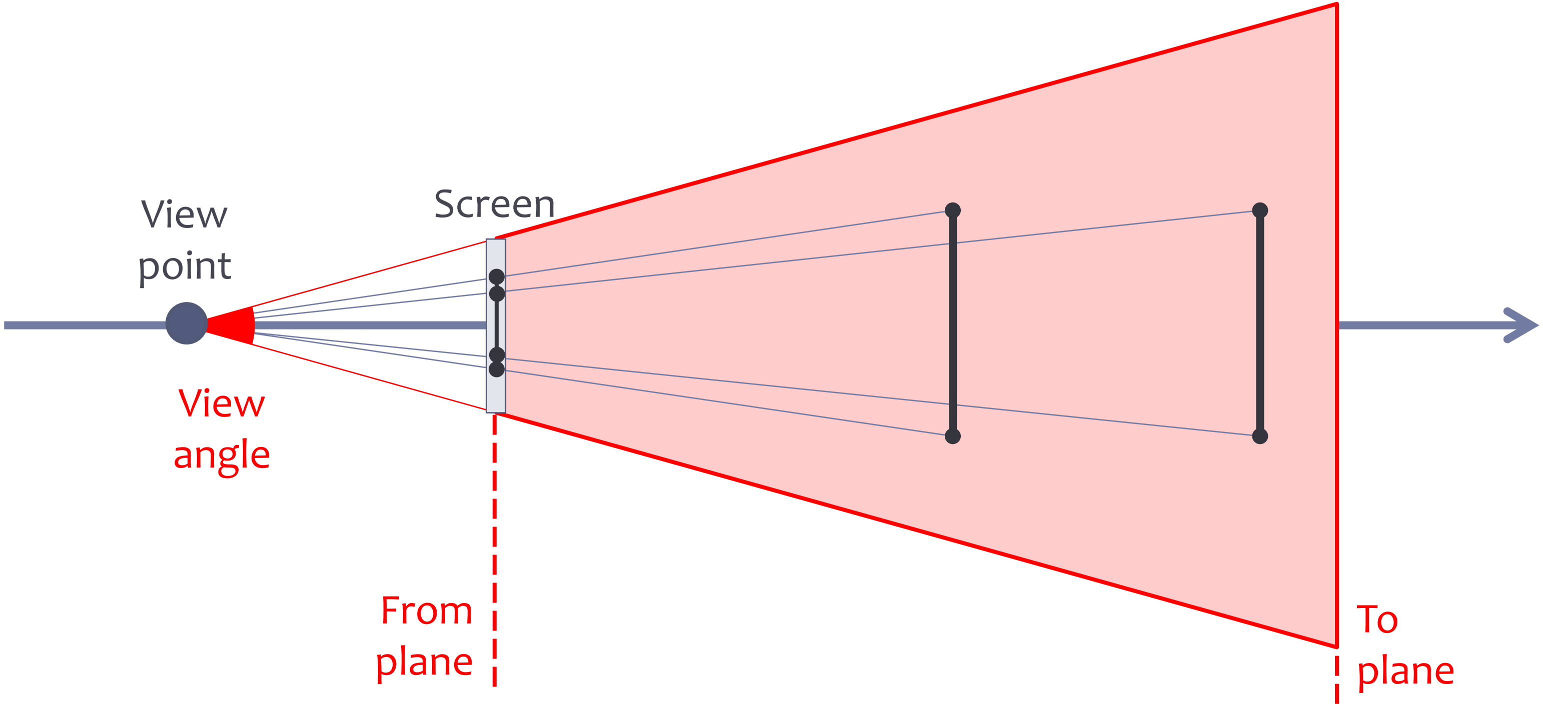
- Mouse movement leaves trace



- Looking at a 2D scene “from top”
- Mapping 1:1 between mouse and graphical coordinates

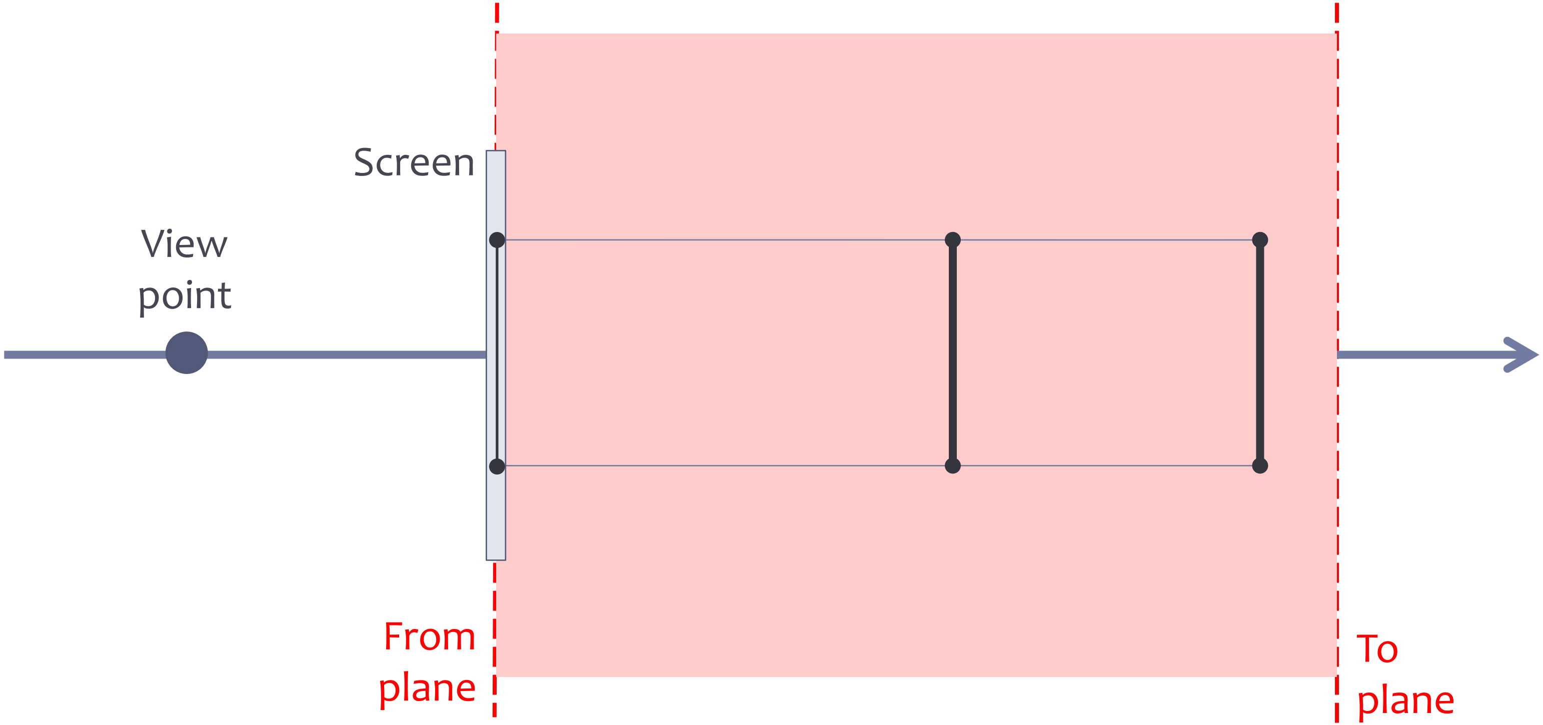
Perspective projection

- Objects farther away appear smaller
- Function perspective (angle, from, to)



Orthographic projection

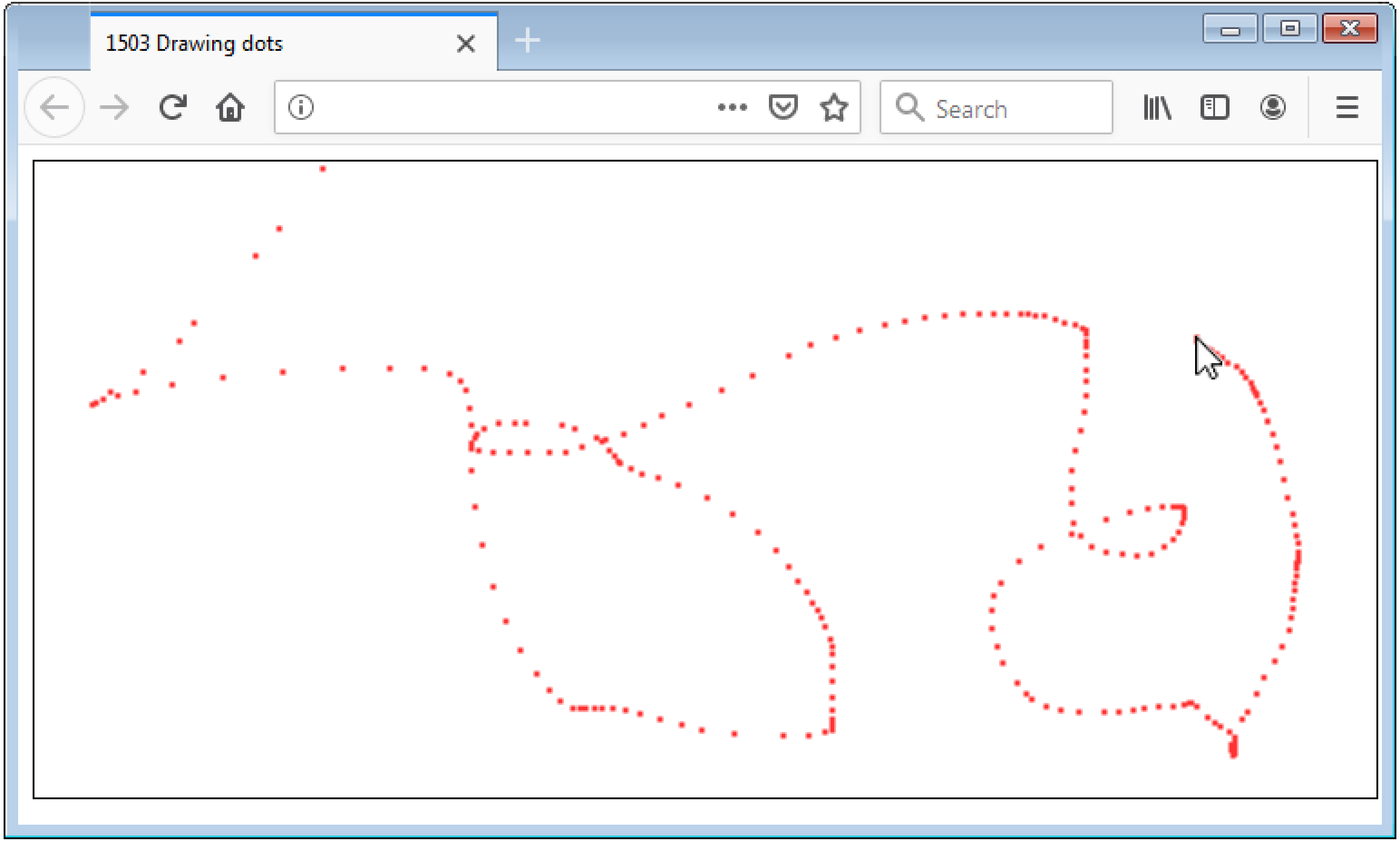
- Object size does not depend on distance
- Function orthographic (from, to)



Implementaiton of drawing

- Using orthographic projection for 1:1 mapping
- Looking "from top" with lookAt: looking from [0,0,1] towards [0,0,0] and [0,1,0] points up
- Finding graphical coordinates and creating a point

```
orthographic(-2,2);
lookAt([0,0,1],[0,0,0],[0,1,0]);
...
function mouseMove(event)
{
   var x = event.clientX - ...;
   var y = -(event.clientY - ...);
   point([x,y,0]);
}
```



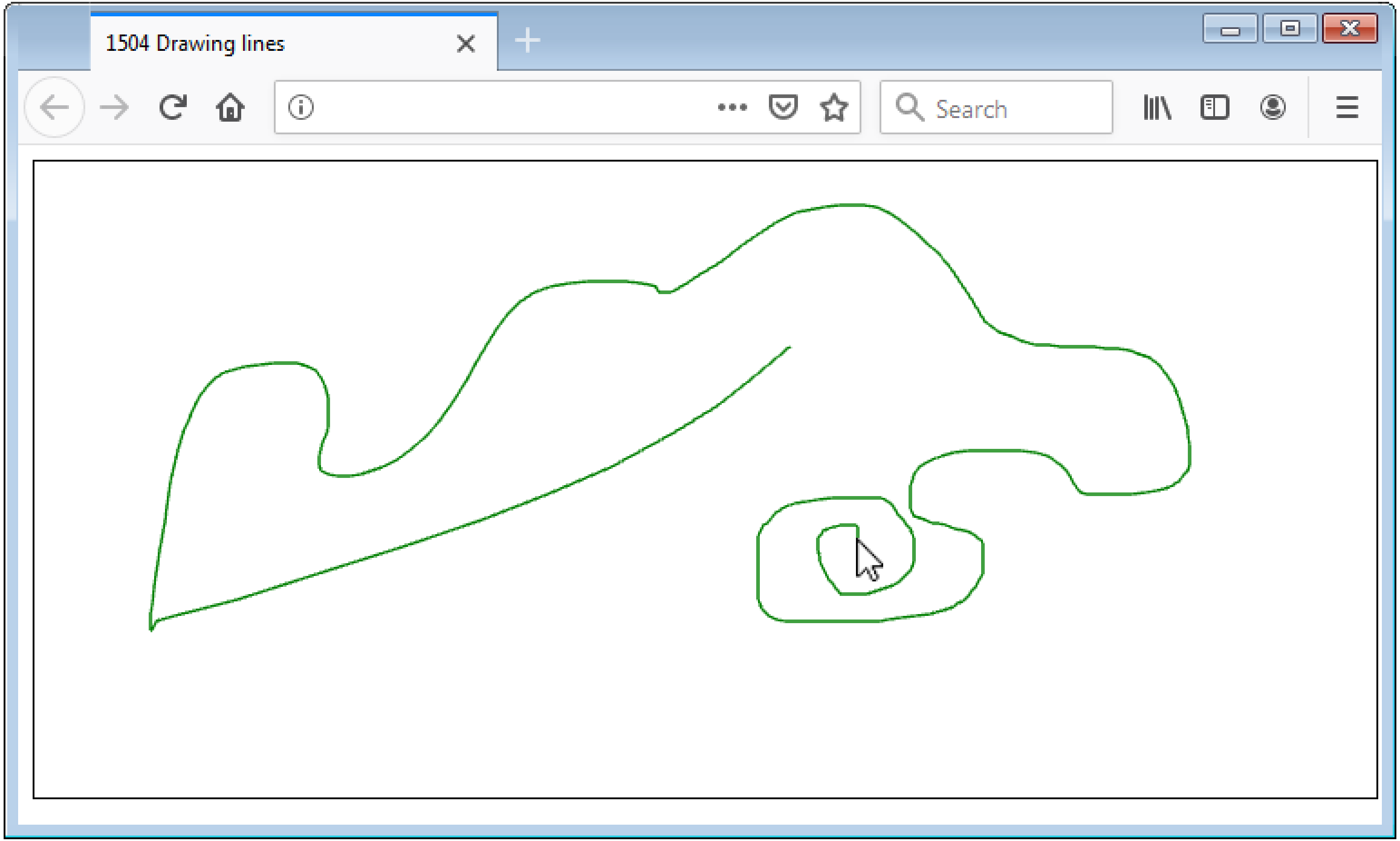
TRY IT

Drawing lines

- Remembering the last point in last
- Drawing a segment if last has a value
- Otherwise draw nothing

```
var last;

function mouseMove(event)
{
   ...
   if (last) segment(last,[x,y,0]);
   last = [x,y,0];
}
```



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New functionality

- Drawing starts with pressing the left mouse button
- Drawing ends with releasing the button

Idea

- When pressing – enter a drawing mode
- When releasing – exit the drawing mode
- When moving – draw if in the drawing mode

Implementation

- Listening to three events

```
...addEventListener('mousemove',mouseMove,false);
...addEventListener('mousedown',mouseDown,false);
...addEventListener('mouseup',mouseUp,false);
```

- In mouseUp exit drawing mode and forget the last remembered position

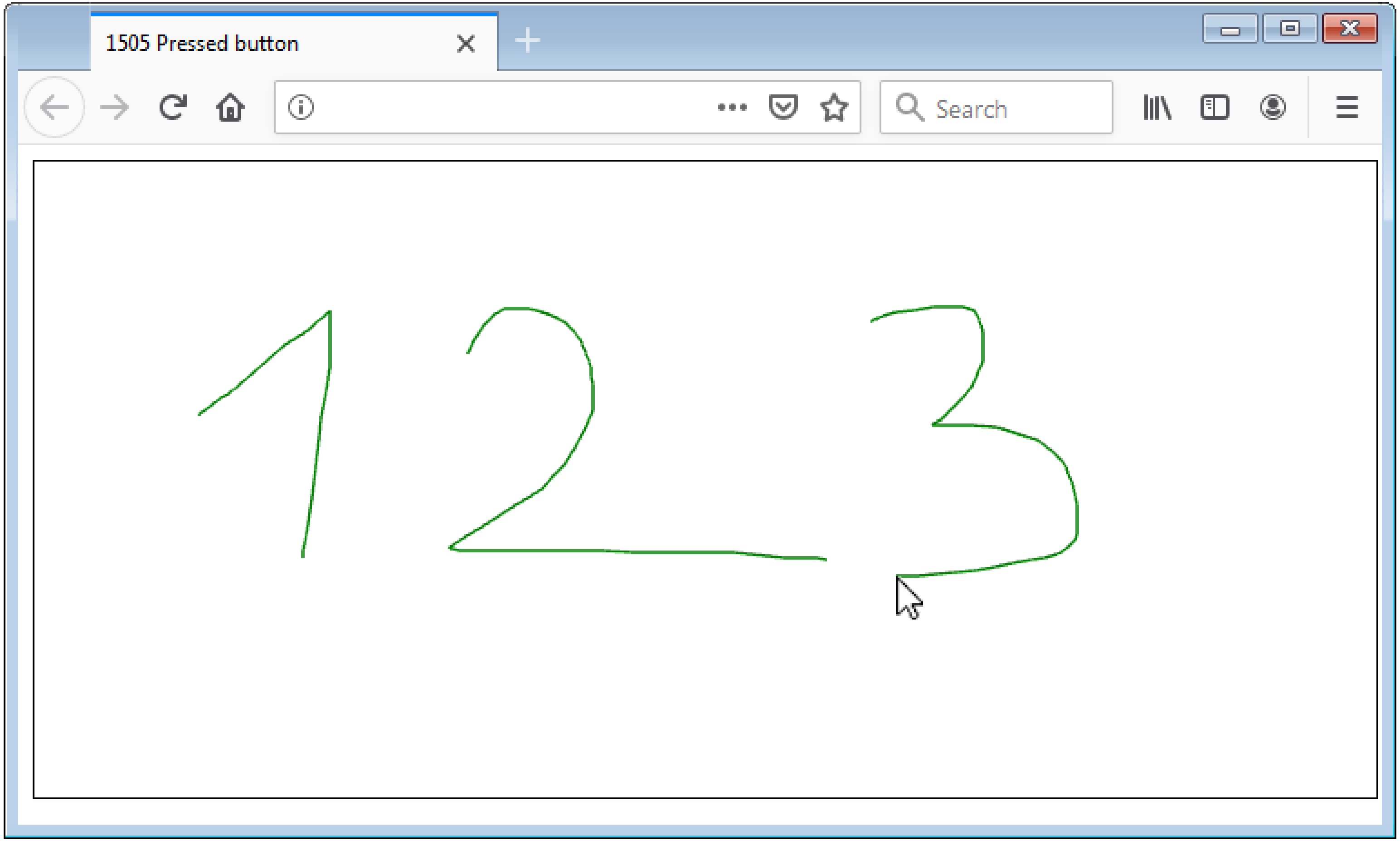
```
draw = false;
last = undefined;
```

- In mouseDown start a drawing mode if the left button is pressed and remember the current position

```
if (event.buttons==1)
{  ...
   draw = true;
   last = [x,y,0];
}
```

- In mouseMove check for the drawing mode

```
if (draw)
{  ...
   if (last) segment(last,[x,y,0]);
   last = [x,y,0];
}
```

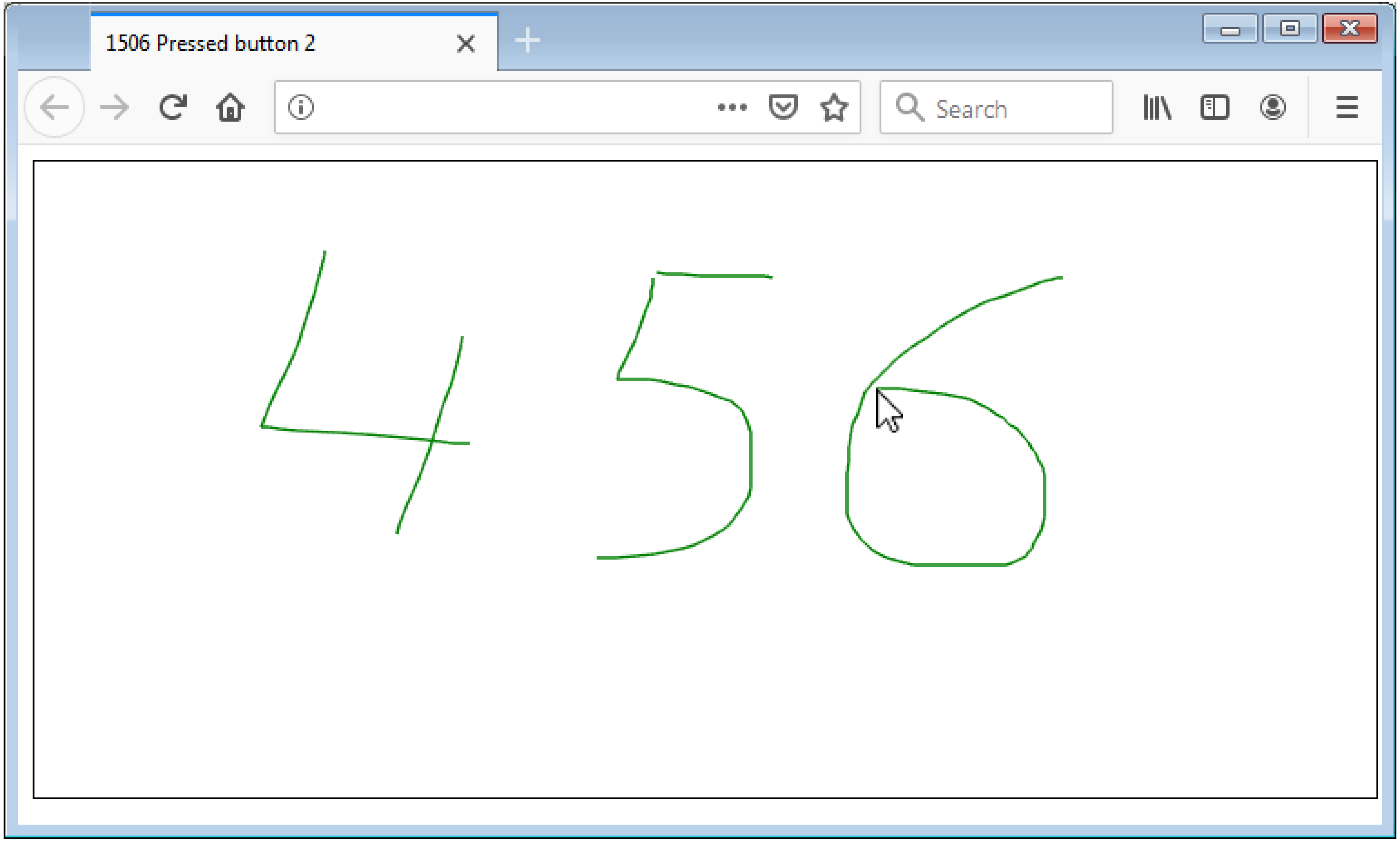


TRY IT

Shorter code? (won’t work in some browsers, like FireFox)

- The last remembered position last is a drawing flag
- If it has a value, then the drawing mode in on
- Ignoring events mousedown and mouseup, considering only mousemove

```
if (event.buttons==1)
{
   ...
   if (last) segment(last,[x,y,0]);
   last = [x,y,0];
}
else
   last = undefined;
```



TRY IT

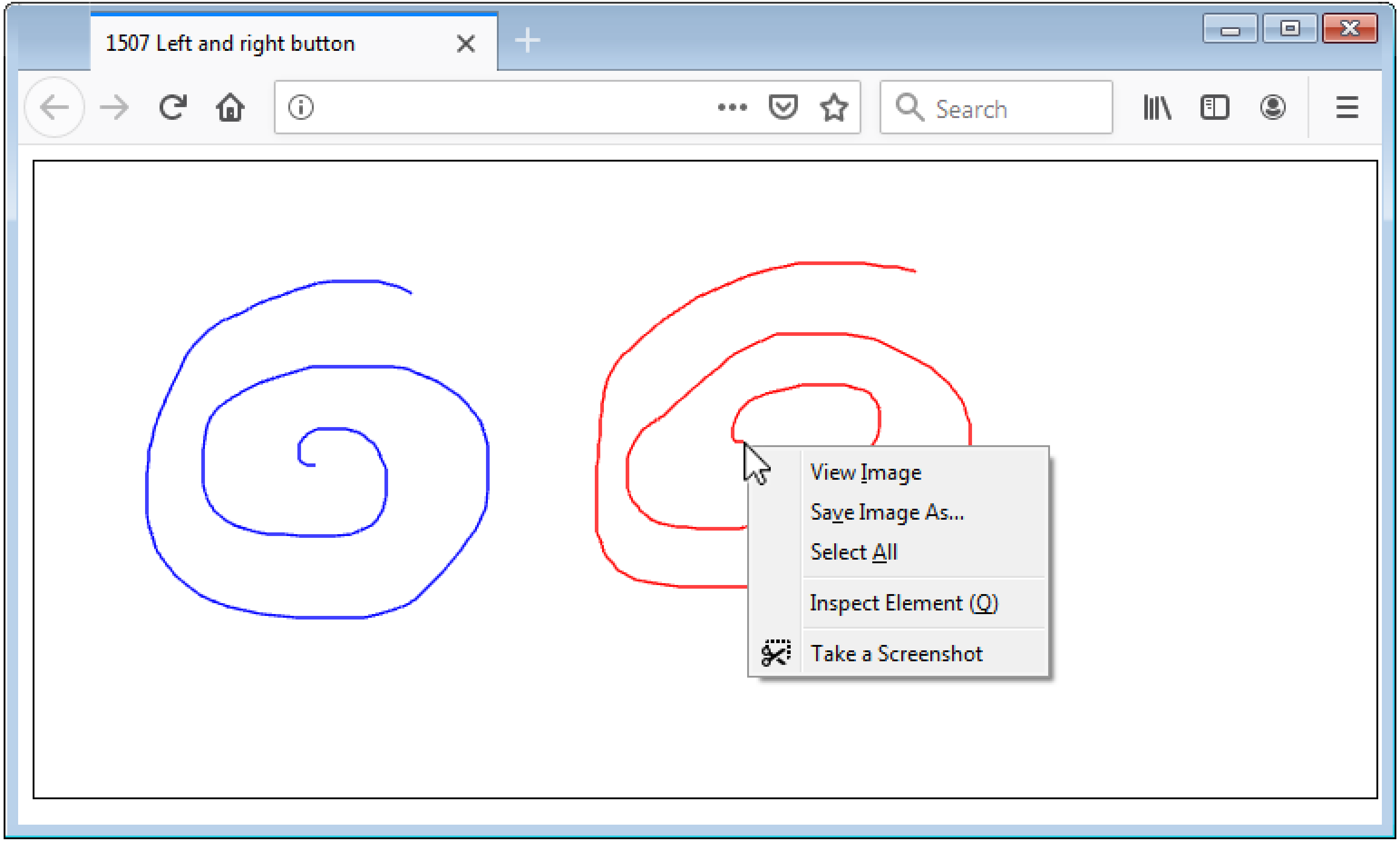
Left and right buttons

- Left button draw blue line, right button – red line

Implementation

- Drawing when a button is pressed
- Storing the colour in style

```
if (event.buttons)
{
    ...
    var style = {color:event.buttons==1?[0,0,1]:[1,0,0]};
    if (last) segment(last,[x,y,0]).custom(style);
    last = [x,y,0];
}
```


1507 Left and right button
Search
View Image
Save Image As...
Select All
Inspect Element (Q)
Take a Screenshot

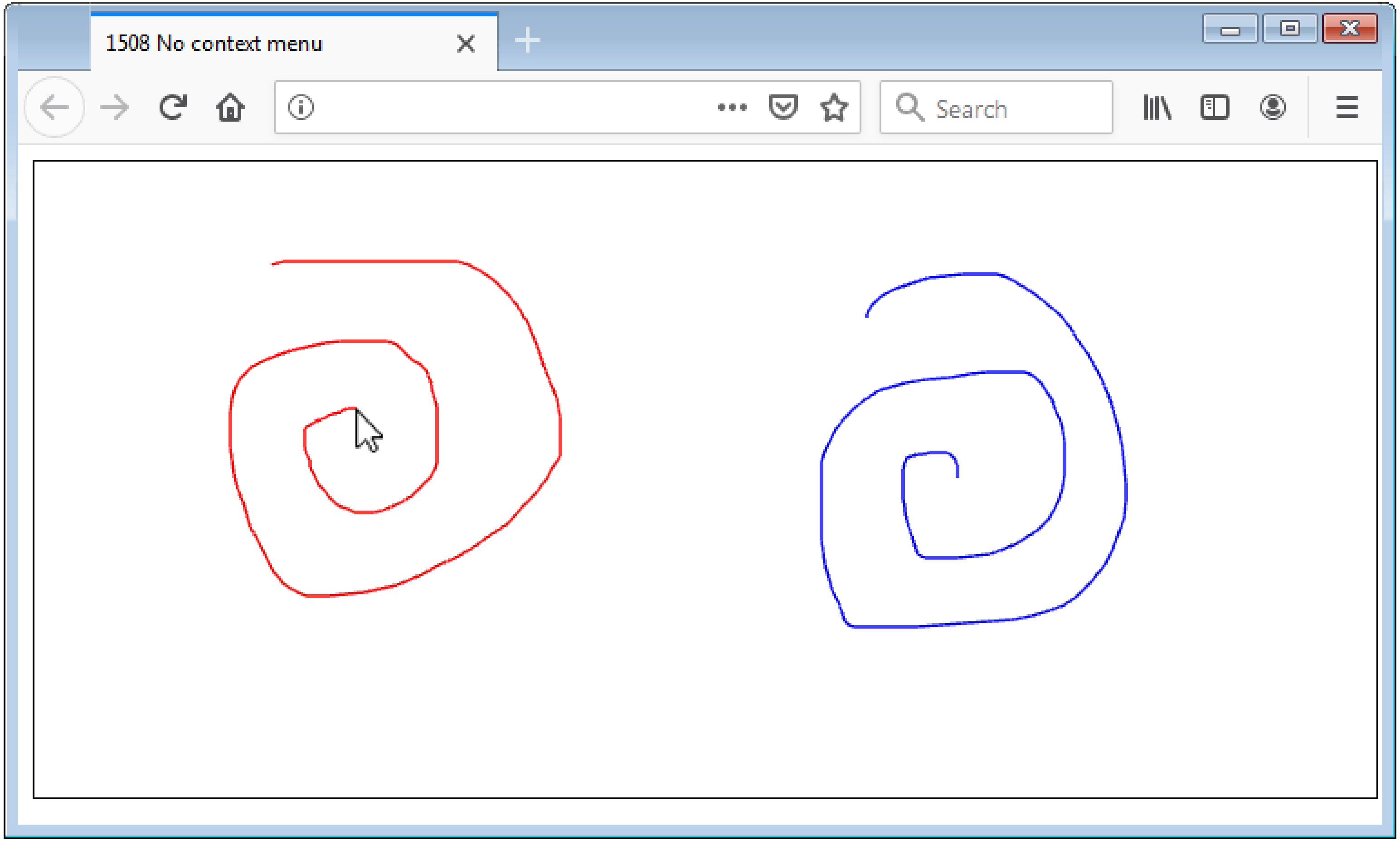
TRY IT

Context menu

- Clicking the right button pop ups the context menu
- Removing the context menu by listening to event contextmenu
- Using the method preventDefault to prevent the default action, which is to show the context menu

```
...addEventListener('contextmenu',contextMenu,false);

function contextMenu(event)
{
   event.preventDefault();
}
```



TRY IT

Sketching with the mouse

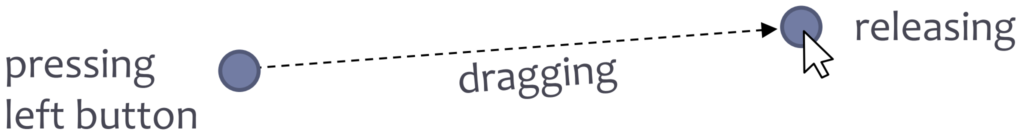
Sketching

Goal

- Making sketches with the mouse
- Drawing points, segments and circle

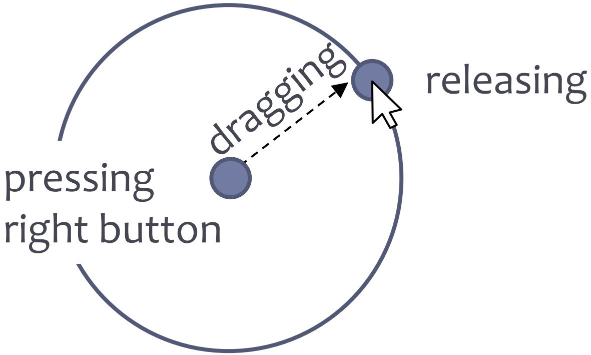
Drawing segments

- Pressing the left mouse button for beginning
- Dragging for construction and releasing for finalization



Drawing circles

- Press right button for the center
- Drag and release when the radius is correct



Drawing points

- Clicking with the left button

Help functions

- Function mouseXY calculates graphical coordinates, corresponding to the mouse coordinates in an event

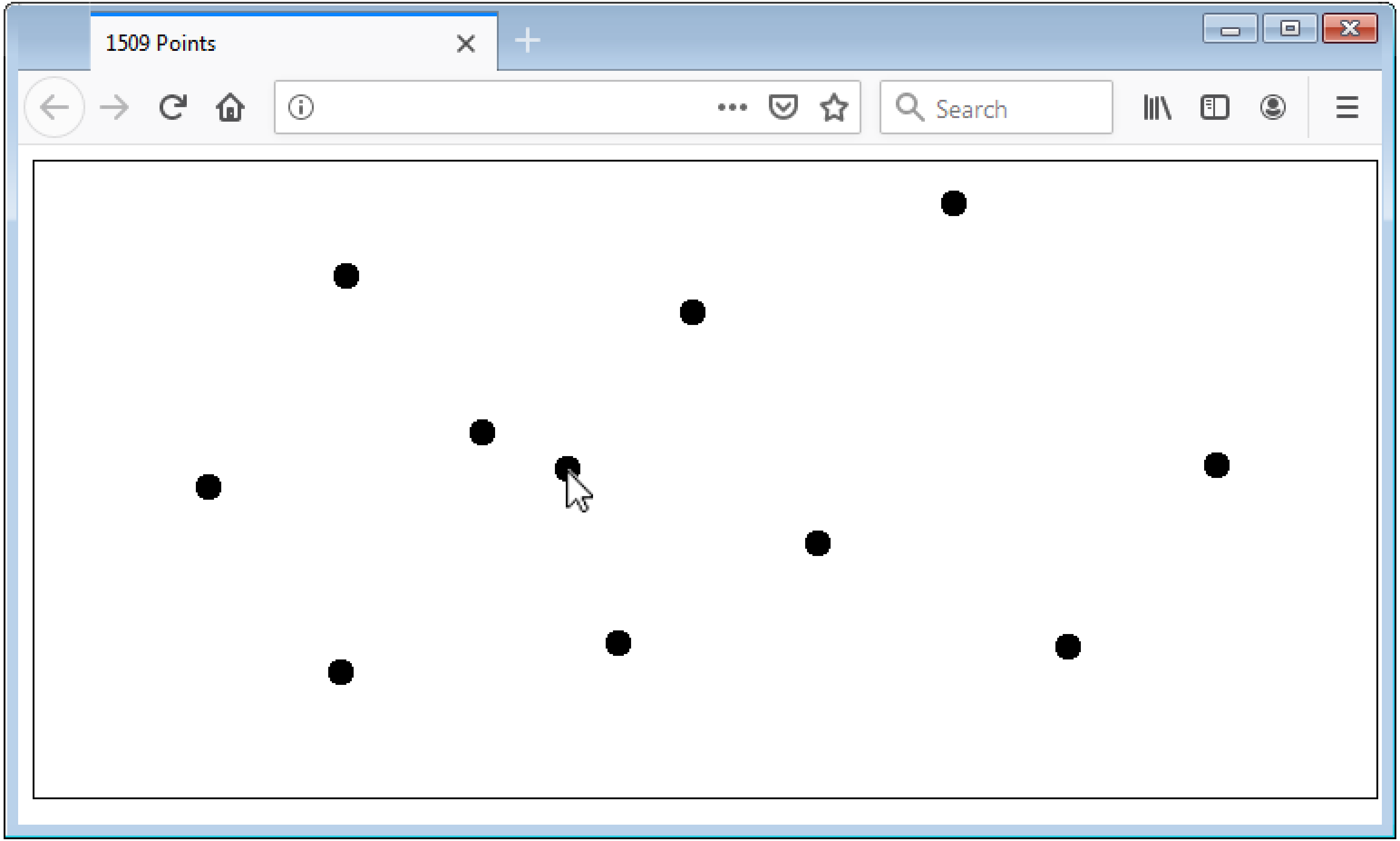
```
function mouseXY(event)
{
  var x = event.clientX
          - event.target.offsetLeft
          - event.target.offsetWidth/2;
  var y = -(event.clientY
            - event.target.offsetTop
            - event.target.offsetHeight/2);
  return [x,y,0];
}
```

Drawing points

- Capturing the pressing of a mouse button (left or right)
- Generating a point at these coordinates
- The style of all points is stored in pointStyle

```
pointStyle = {color:[0,0,0], pointSize:14.5};

function mouseDown(event)
{
   point(mouseXY(event)).custom(pointStyle);
}
```



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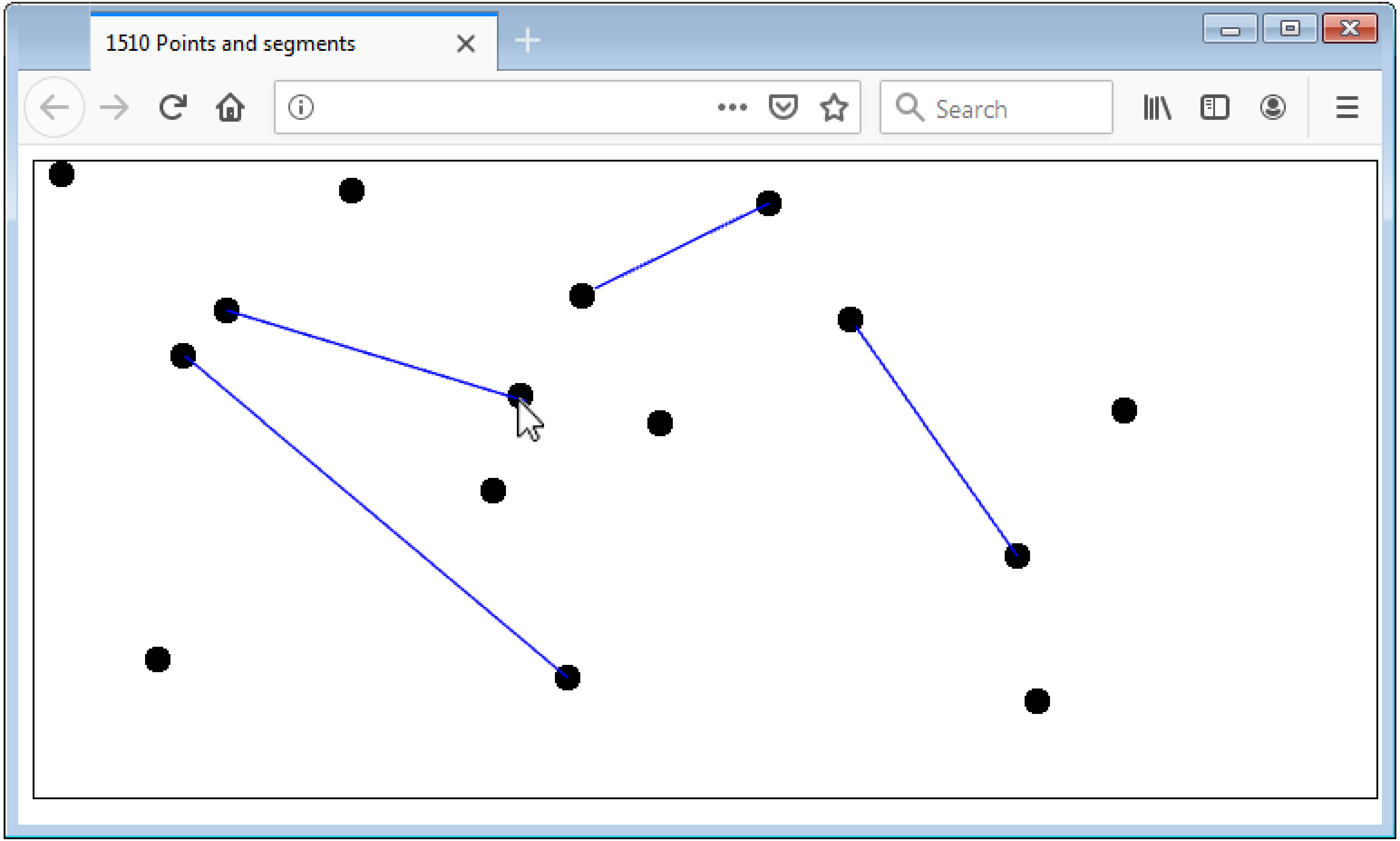
Drawing segments

- How to distinguish drawing points from drawing segments?
- Solution: drawing a point when a button is pressed
- This is either individual point or the beginning of a segment
- In pnt and obj are the other end of the segment and the segment itself – they still do not exist at the time of pressing the buttonсъществуват

```
function mouseDown(event)
{
   point(mouseXY(event)).custom(pointStyle);
   pnt = undefined;
   obj = undefined;
}
```

- Segment obj and its end point pnt are generated at the first mouse movement with pressed left button
- Following movements update them

```
function mouseMove(event)
{
   var pos = mouseXY(event);
   if (event.buttons==1)
   {
      if (!pnt) pnt = point(pos).custom(...);
      if (!obj) obj = segment(pos,pos).custom(...);
      pnt.center = pos;
      obj.to = pos;
   }
}
```



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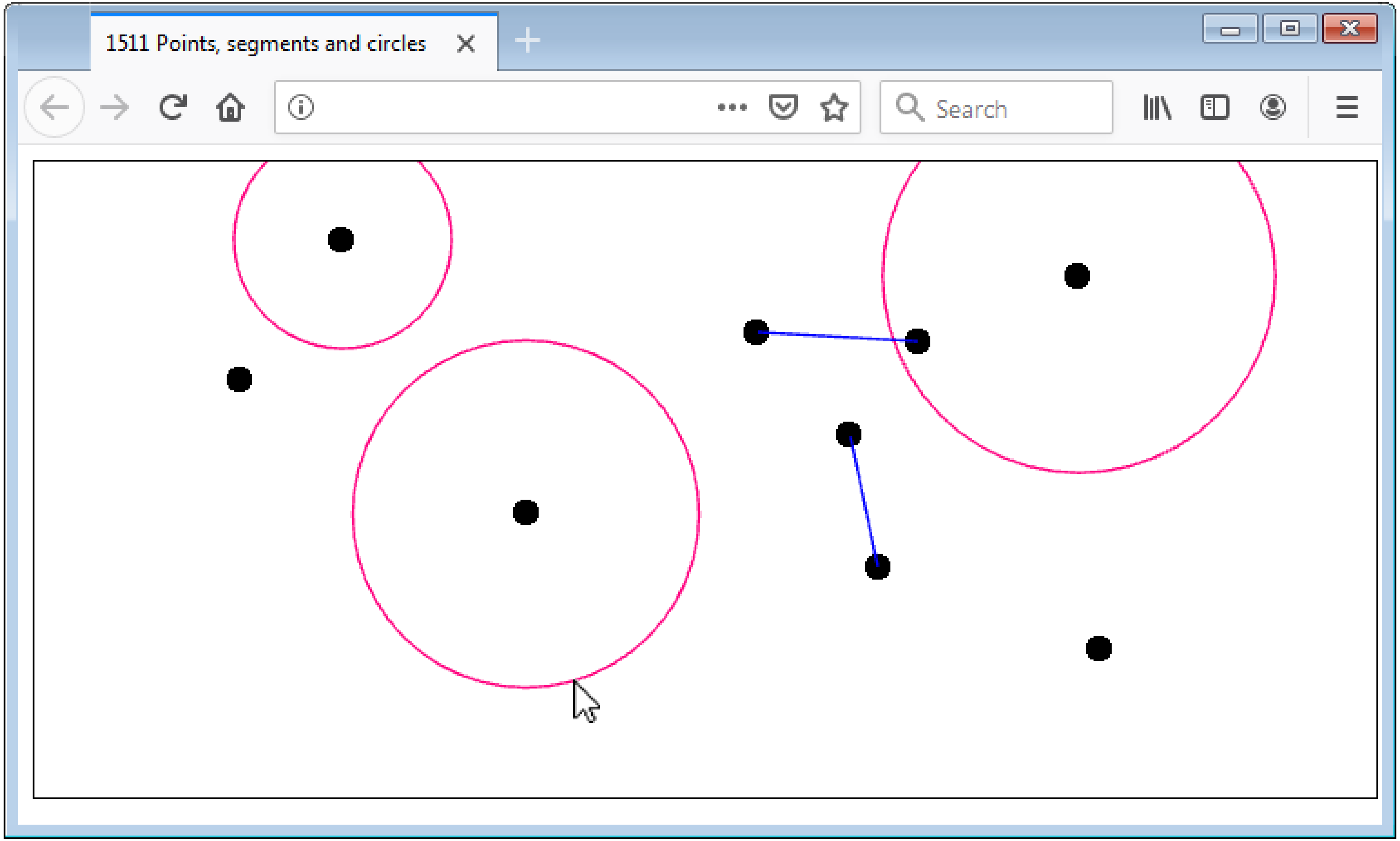
Drawing circles

- Drawing a point when pressing the right mouse button
- This is individual point or the center of a circle
- A point on the circle is in obj and the distance to the center defines the radius (distance is a help function)

```
function mouseMove(event)
{ ...
   if (event.buttons==2)
   {
      if (!obj) obj = circle(pos,0).custom(...);
      obj.radius = distance(obj.center,pos);
   }
}
```



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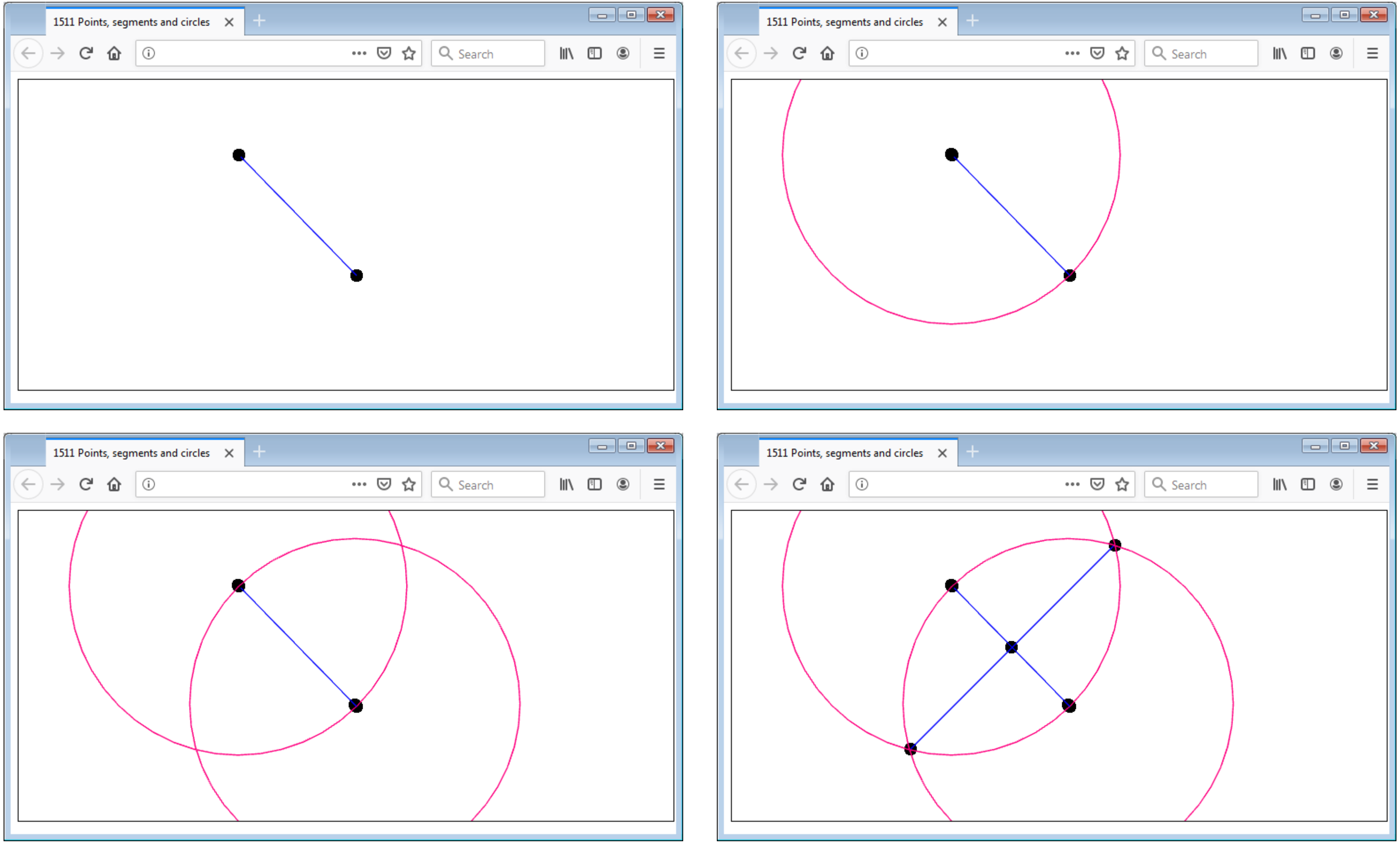
Functional testing

Finding the midpoint of a segment

Interactive procedure

- Construct two random points
- Connect them with a segment
- Draw two circle with centers these points and radii as the segment length
- Connect the intersecting point of the circles with a segment
- This segment intersect the first segment in the mid point


1511 Points, segments and circles
Search
1511 Points, segments and circles
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1511 Points, segments and circles
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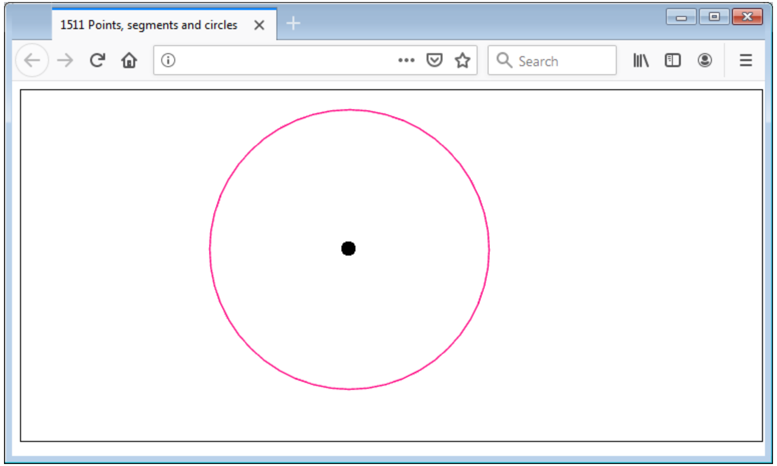
1511 Points, segments and circles
Search

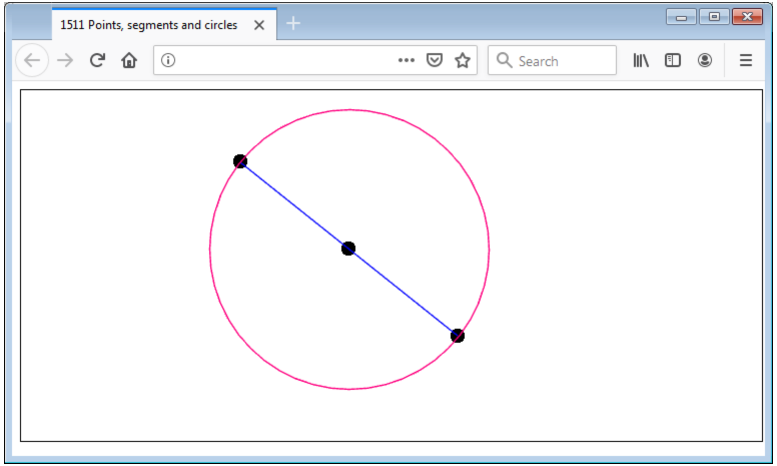
TRY IT

Drawing a right triangle

Interactive procedure

- Draw a circle
- Draw a diameter – a segment passing through the center
- Pick a point on the circle
- Connect it with the segment


1511 Points, segments and circles
Search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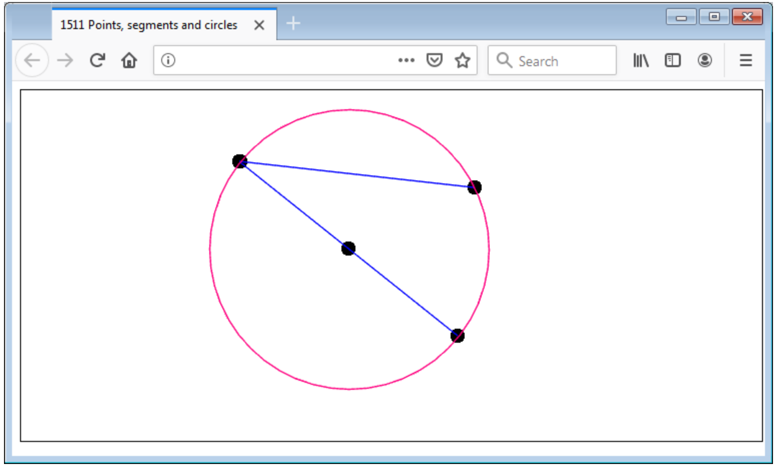
1511 Points, segments and circles
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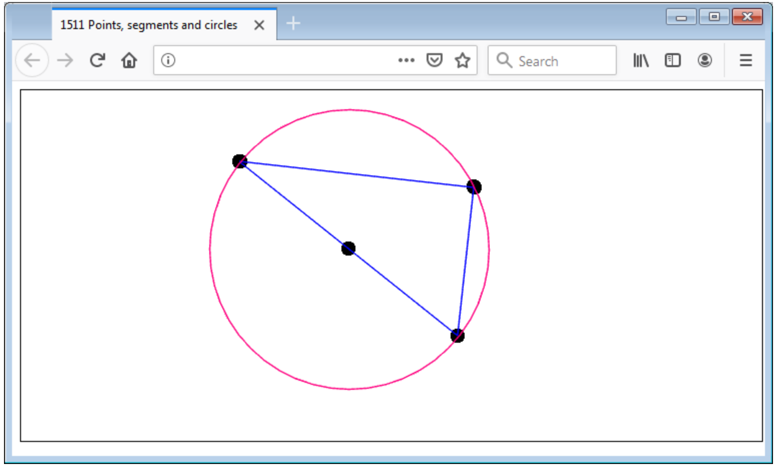
1511 Points, segments and circles
Search

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Summary

Working with the mouse

Useful events

- Mouse movement: mousemove, mouseenter, mouseleave, mouseover and mouseout
- Mouse buttons: mousedown, mouseup, click and dblclick
- Context menu: contextmenu

Properties

- DOM element of the event: target
- Coordinates: clientX, clientY, screenX and screenY
- Buttons and keys: buttons, altKey, ctrlKey and shiftKey

Drawing and sketching

Drawing with the mouse

- Transformation of coordinates
- Selected of proper projection (usually orthographic)
- Listening to button/key pressing
- Disabling context menu with preventDefault in contextmenu

Sketching with the mouse

- Object are created once, then are only modified

ICT in SES

The end

Comments, question