INFO 151
Web Systems and Services

JavaScript

Programming

Debugging

Overview

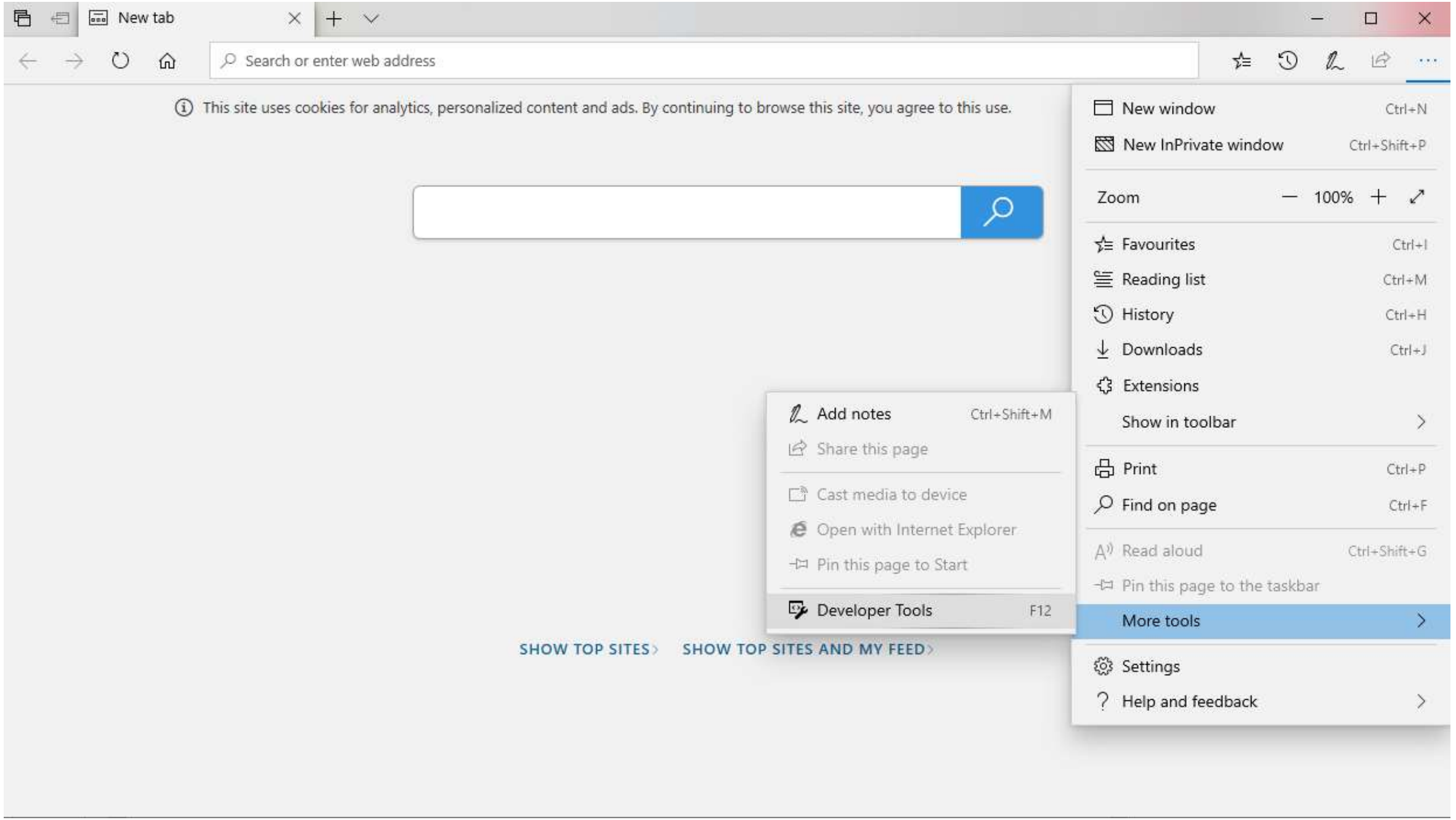
- In this tutorial I will introduce:
  - JavaScript programming including using:
    - The developer tools console in a web browser
    - A simple text editor
  - String output to the browser
  - The normal and `"strict"` modes
- I will introduce:
  - Documenting program code
  - Debugging program code
- In other tutorials I will introduce the new JavaScript ES6 language specification and the principles of program design

JavaScript Programming

Programming JavaScript

- In this course we are using the NetBeans IDE to program:
  - HTML (files stored in the NetBeans Projects folder)
  - JavaScript (files stored in the NetBeans Projects folder)
  - PHP and MySQL (files stored in the XAMPP htdocs Projects folder)
- We may also write HTML and JavaScript using:
  - The developer tools console in your web browser
  - A simple text editor such as Notepad or an application such as EMACS
- The following slides show the use of Notepad and developer tools

Developer Tools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More tools
Settings
Help and feedback
Add notes Ctrl+Shift+M
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Cast media to device
Open with Internet Explorer
Pin this page to Start
Developer Tools F12
SHOW TOP SITES
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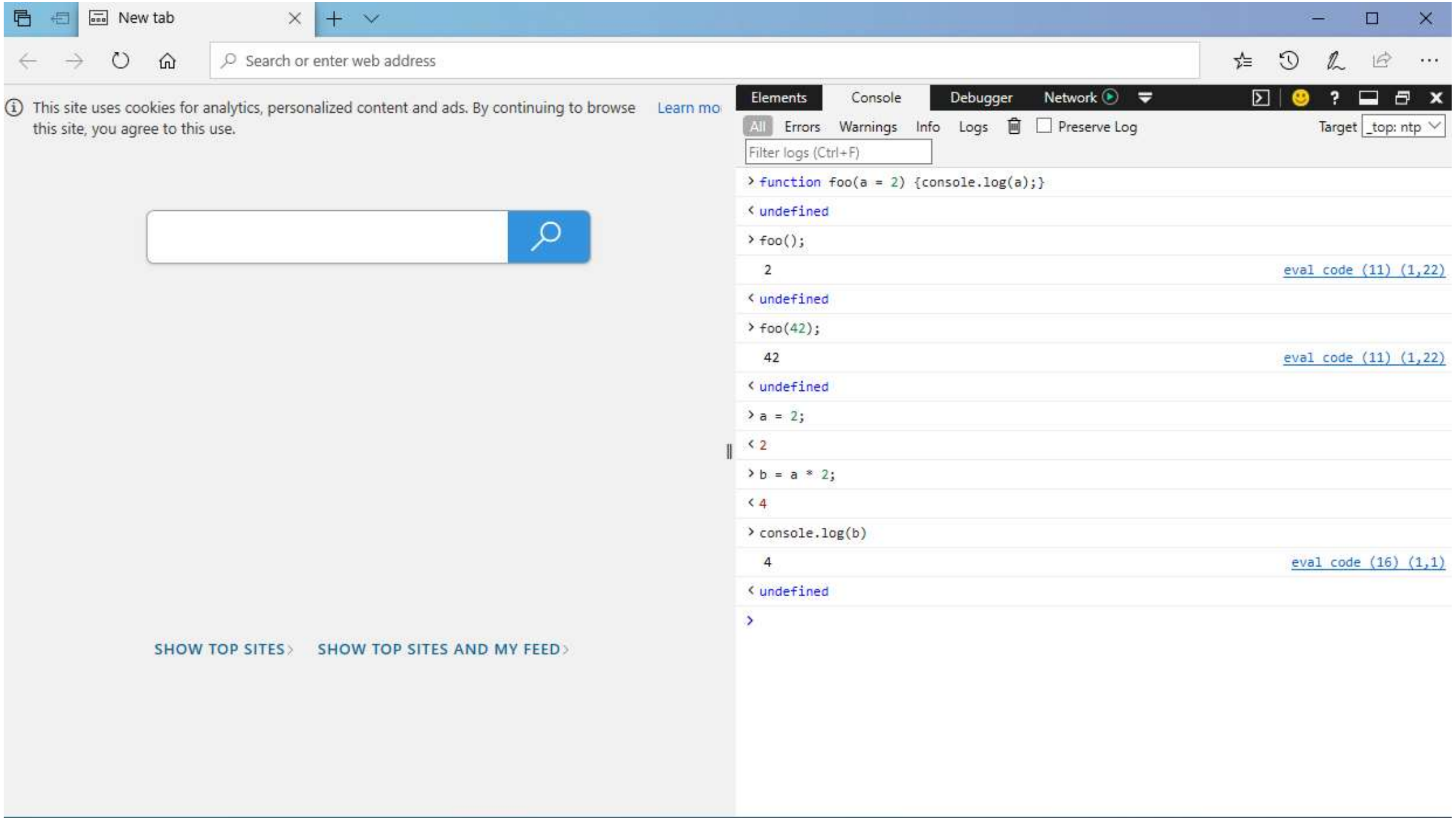
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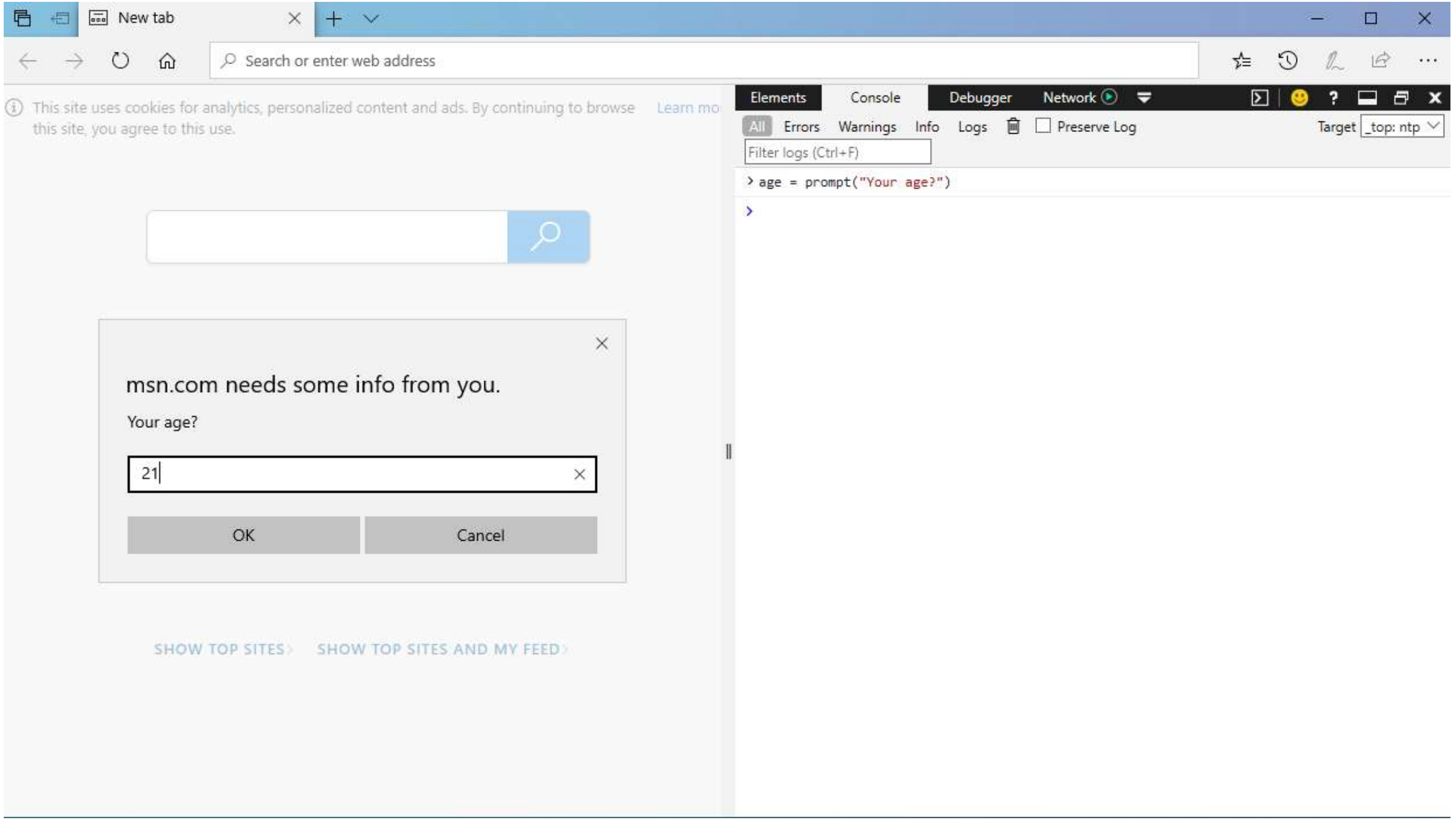
Elements
Console
Debugger
Network
All
Errors
Warnings
Info
Logs
Preserve Log
Target
_top: ntp
Filter logs (Ctrl+F)
> function foo(a = 2) {console.log(a);}
< undefined
> foo();
2
eval code (11) (1,22)
< undefined
> foo(42);
42
eval code (11) (1,22)
< undefined
> a = 2;
< 2
> b = a * 2;
< 4
> console.log(b)
4
eval code (16) (1,1)
< undefined
>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msn.com needs some info from you.
Your age?
21
OK
Cancel
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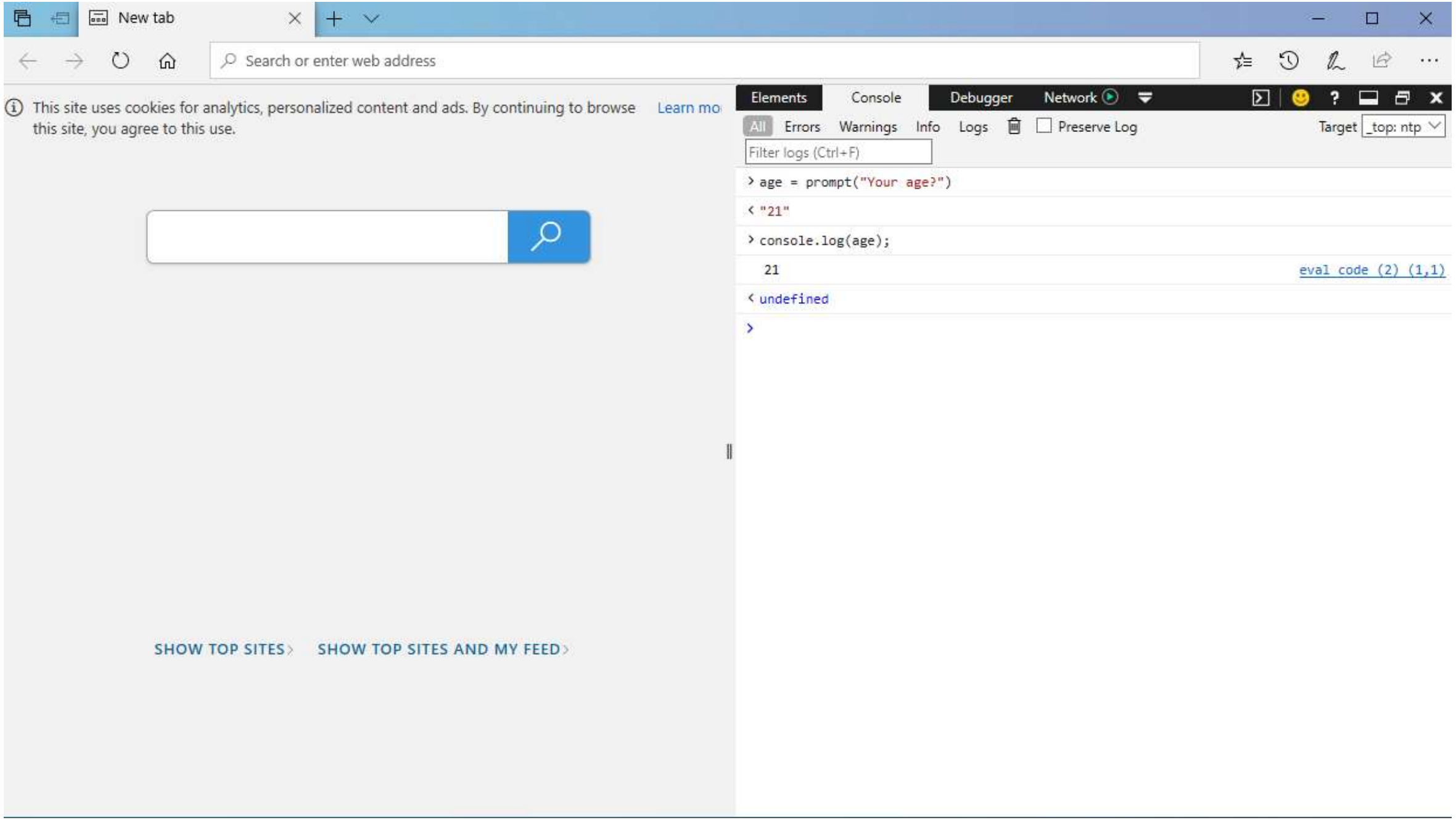
Elements
Console
Debugger
Network
All
Errors
Warnings
Info
Logs
Preserve Log
Target
_top: ntp
Filter logs (Ctrl+F)
> age = prompt("Your age?")
>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Elements
Console
Debugger
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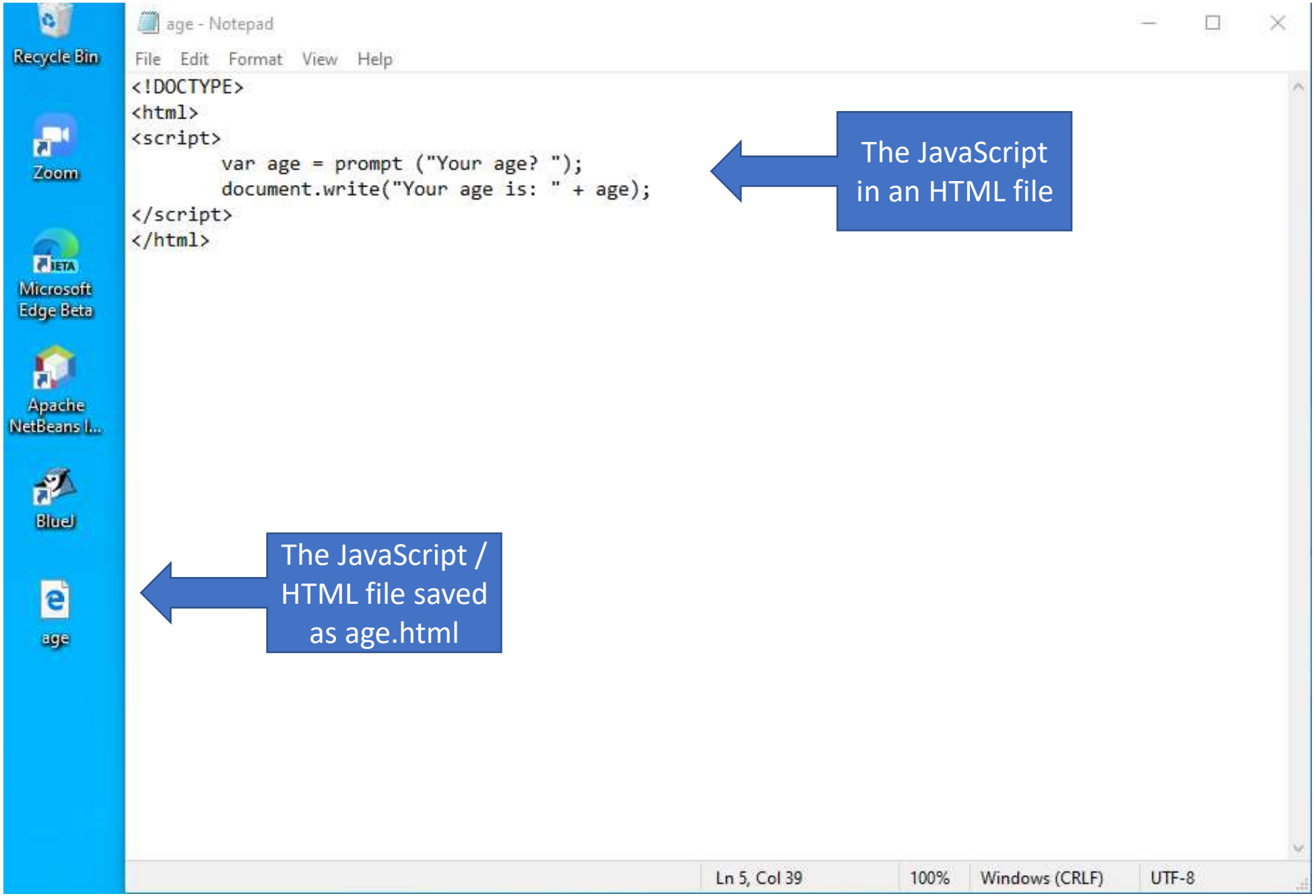
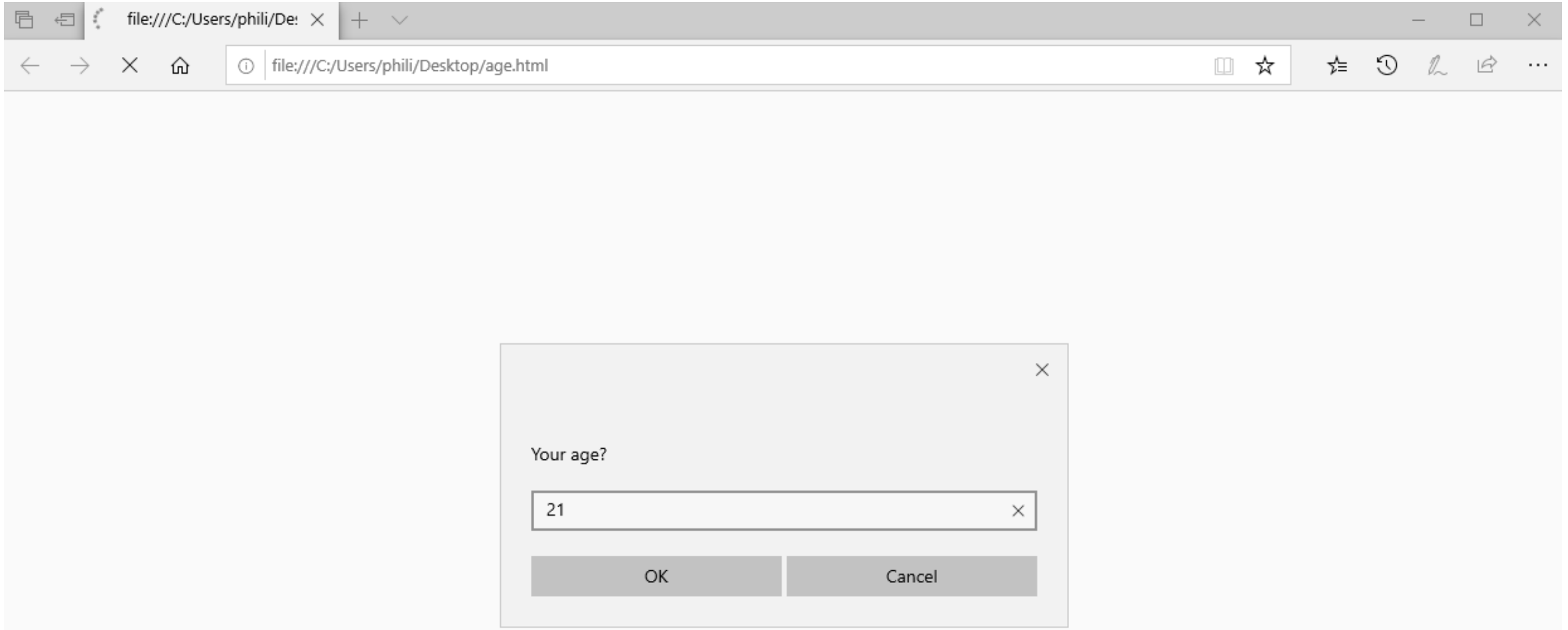
All
Errors
Warnings
Info
Logs
Preserve Log
Target
_top: ntp
Filter logs (Ctrl+F)
> age = prompt("Your age?")
< "21"
> console.log(age);
21
eval code (2) (1,1)
< undefined
>

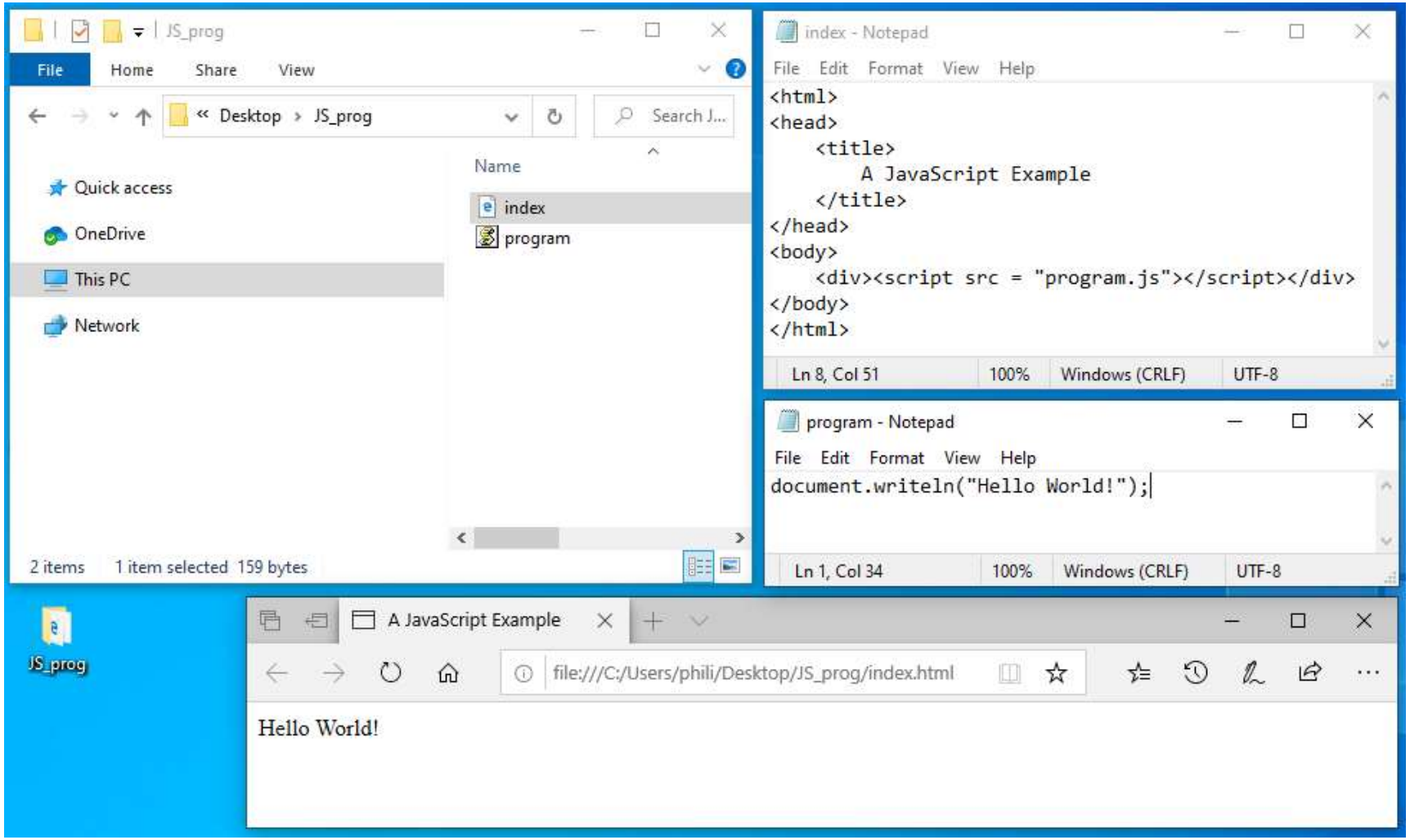
Notepad


Recycle Bin
Zoom
Microsoft Edge Beta
Apache NetBeans I...
BlueJ
age
age - Notepad
File Edit Format View Help
<!DOCTYPE>
<html>
<script>
var age = prompt ("Your age? ");
document.write("Your age is: " + age);
</script>
</html>
Ln 5, Col 39
100%
Windows (CRLF)
UTF-8
The JavaScript in an HTML file
The JavaScript / HTML file saved as age.html


file:///C:/Users/phili/De
file:///C:/Users/phili/Desktop/age.html
Your age?
21
OK
Cancel

Your age is: 21

JavaScript in Notepad with a Separate File



Programming JavaScript

- The developer tools and Notepad approaches:
  - Can be useful when learning to program HTML and JavaScript
- However:
  - Real programs will require multiple files
  - Notepad can accommodate multiple files in a single folder
  - Developer tools make complex programs difficult to code and run
- In the ‘real-world’:
  - IDE tools (such a NetBeans and other similar tools) will be used

String Output to Browser

JavaScript String Output

- To print JavaScript strings and variables there are two methods:
- One:

```
document.write("Hello JavaScript!");
```

- Two:

```
<p id="demo"></p>
document.getElementById("demo").innerHTML = ("Hello
JavaScript!");
```

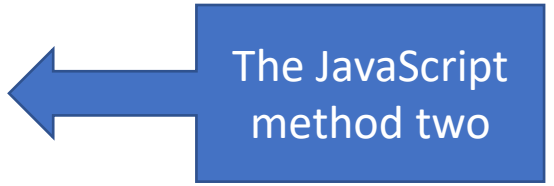
- Both methods produce the same output!

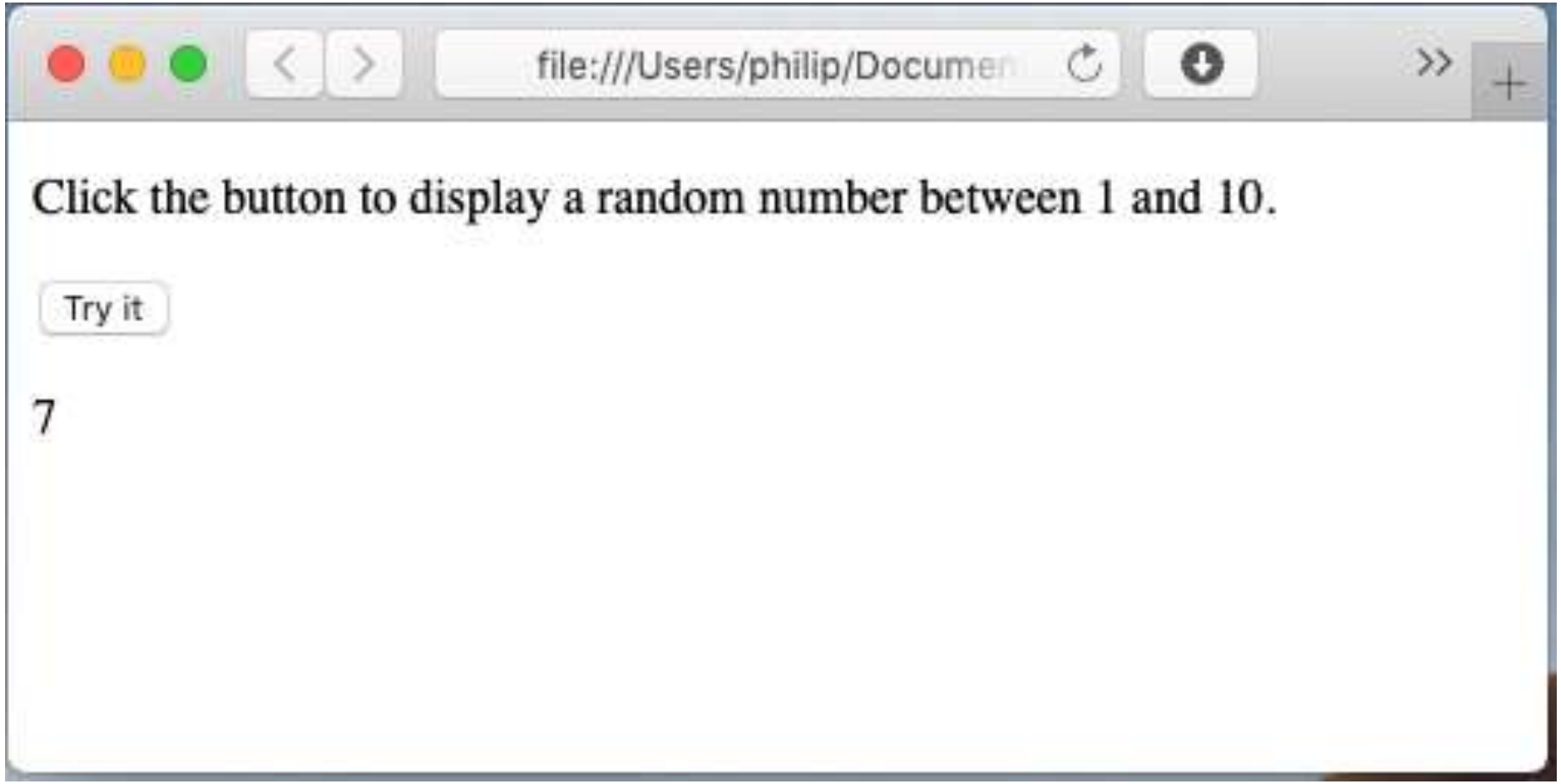
document Output

- Method one: `document.write()`:
  - Writes HTML expressions or JavaScript code to a document
  - The `write()` method is mostly used for testing
  - If it is used after an HTML document is fully loaded it will delete all existing HTML
- Method two: `document.getElementById()`:
  - The `documentElement` property returns the `documentElement` of the `document` as an `Element object` – for HTML documents the returned `object` is the <html> `element`

```
<!DOCTYPE html>
<!--
A JavaScript examples to create random integers between 1 and 10
-->
<html>
    <head>
        <title>Math.random() 1-10</title>
        <meta charset="UTF-8">
        <meta name="viewport" content="width=device-width, initial-scale=1.0">
    </head>
   <body>
       <p>Click the button to display a random number between 1 and 10.</p>
       <button onclick="myFunction()">Try it</button>
       <p id="demo"></p>
       <script>
           function myFunction() {
               var n = Math.floor((Math.random() * 10) + 1);
               document.getElementById("demo").innerHTML = n;
            }
       </script>
    </body>
</html>

U:---  index.html      Top L1      (HTML+)
```




file:///Users/philip/Documer
Click the button to display a random number between 1 and 10.
Try it
7

document.getElementById():

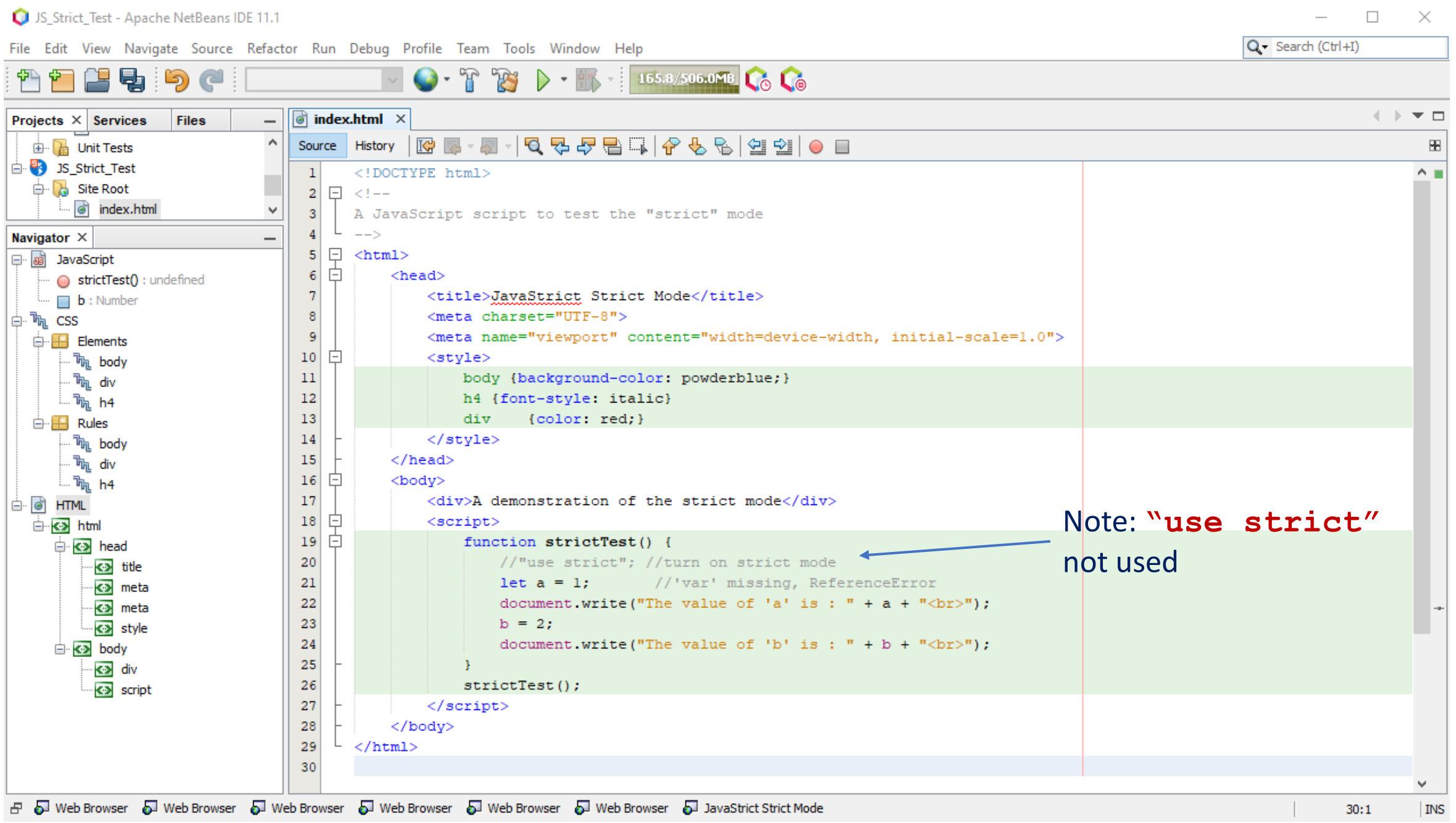
- The `document` variable exists as a GLOBAL variable when the code is running in a browser
- It is in fact a `non-JavaScript element` as it is controlled by the DOM API
- The `document` variable appears to be a normal JavaScript `object` while in practice it is a special `object`
- While `document.getElementById()` method seems to be a normal JavaScript method: it is in practice an interface to a built-in method in the Document Object Model (DOM) provided by the browser
- In some later browsers the layer may be also be in the JavaScript

Running a JavaScript program

"strict"

Running a JavaScript program

- To run a JavaScript program (the script either alone or when embedded in a HTML web page file) there are two run modes:
  - The normal mode (and)
  - The **"strict"** mode (added to the JavaScript language specification in ES5)
- The effect of running a JavaScript program as **"strict"** is:
  - To enforce the language rules for many behaviors
  - To make the code more easily optimized by the compiler
  - The downside is: if the code has syntax errors, they will be reported
- The following worked example demonstrates the **"strict"** mode


JS_Strict_Test - Apache NetBeans IDE 11.1
File Edit View Navigate Source Refactor Run Debug Profile Team Tools Window Help
Search (Ctrl+I)
165.8/506.0MB
Projects
Services
Files
Unit Tests
JS_Strict_Test
Site Root
index.html
Navigator
JavaScript
strictTest() : undefined
b : Number
CSS
Elements
body
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h4
Rules
body
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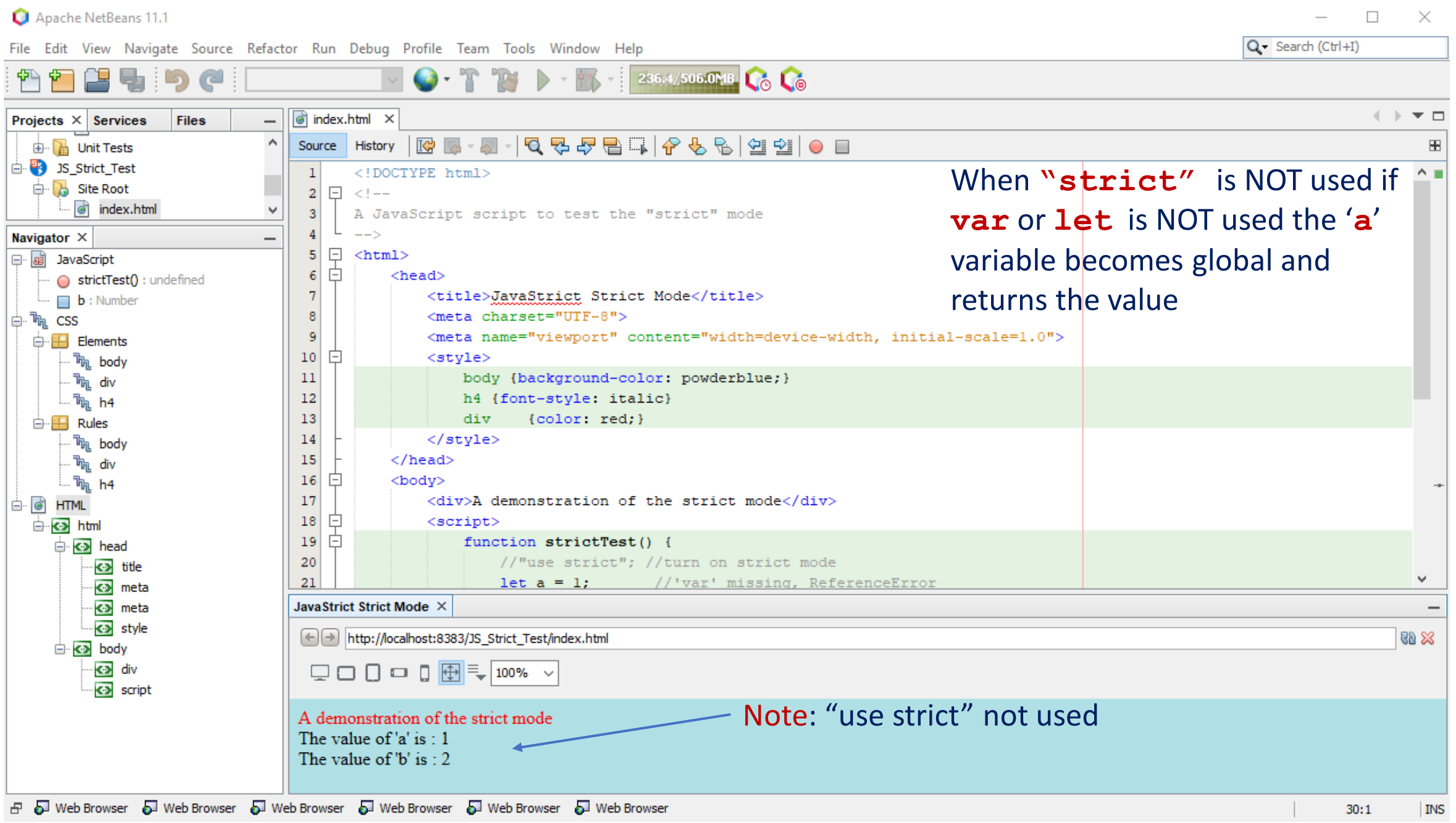
h4
HTML
html
head
title
meta
meta
style
body
div
script
index.html
Source
History
1 <!DOCTYPE html>
2 <!--
3 A JavaScript script to test the "strict" mode
4 -->
5 <html>
6 <head>
7 <title>JavaStrict Strict Mode</title>
8 <meta charset="UTF-8">
9 <meta name="viewport" content="width=device-width, initial-scale=1.0">
10 <style>
11 body {background-color: powderblue;}
12 h4 {font-style: italic}
13 div {color: red;}
14 </style>
15 </head>
16 <body>
17 A demonstration of the strict mode
18 <script>
19 function strictTest() {
20 //"use strict"; //turn on strict mode
21 let a = 1; //'var' missing, ReferenceError
22 document.write("The value of 'a' is : " + a + "
");
23 b = 2;
24 document.write("The value of 'b' is : " + b + "
");
25 }
26 strictTest();
27 </script>
28 </body>
29 </html>
30
Note: "use strict" not used
Web Browser Web Browser Web Browser Web Browser Web Browser Web Browser JavaStrict Strict Mode
30:1
INS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index.html
Navigator
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strictTest() : undefined
b : Number
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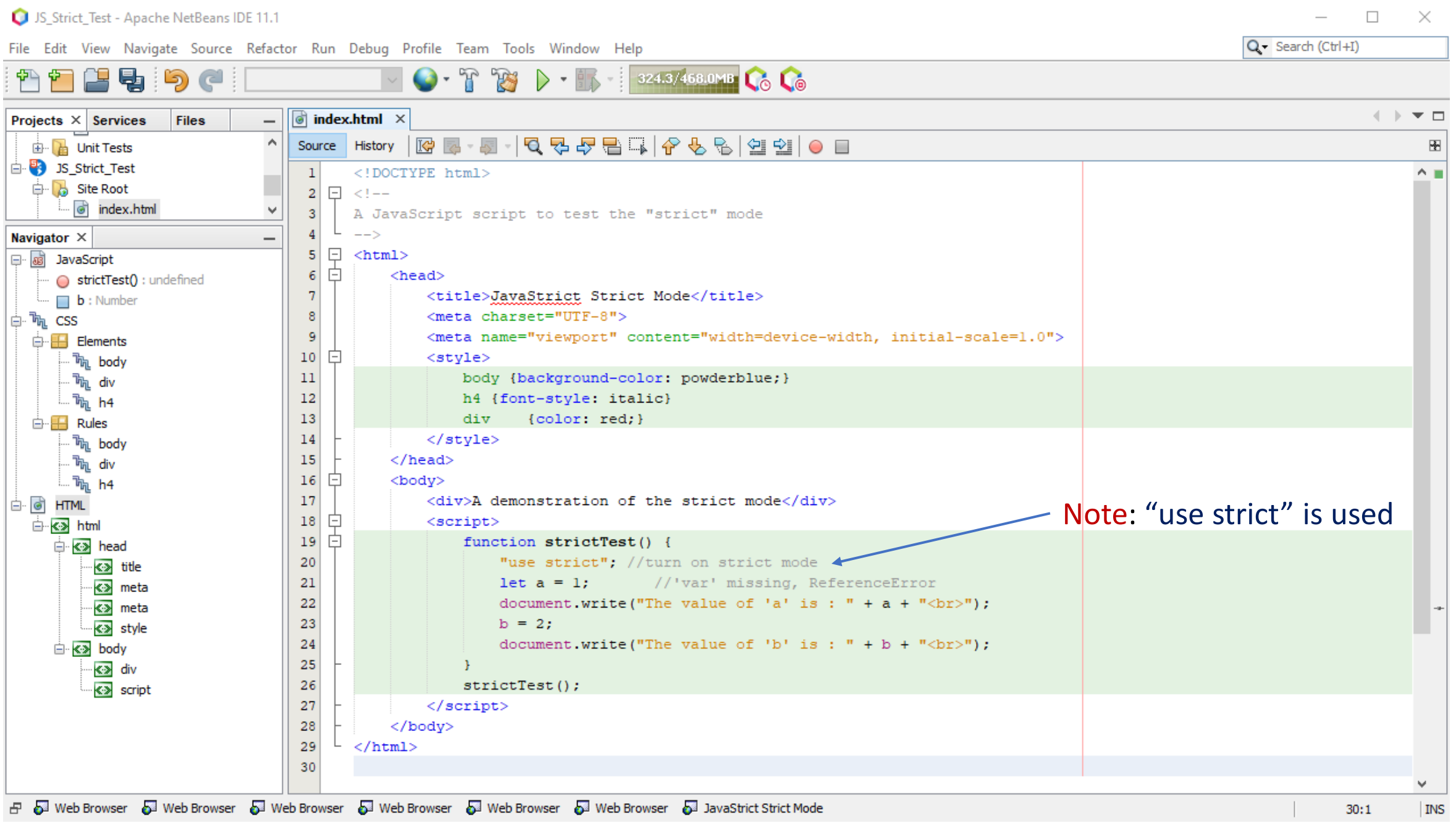
21 let a = 1; //'var' missing, ReferenceError
When "strict" is NOT used if var or let is NOT used the 'a' variable becomes global and returns the value
JavaStrict Strict Mode
http://localhost:8383/JS_Strict_Test/index.html
100%
A demonstration of the strict mode
The value of 'a' is : 1
The value of 'b' is : 2
Note: "use strict" not used
Web Browser Web Browser Web Browser Web Browser Web Browser Web Browser
30:1
INS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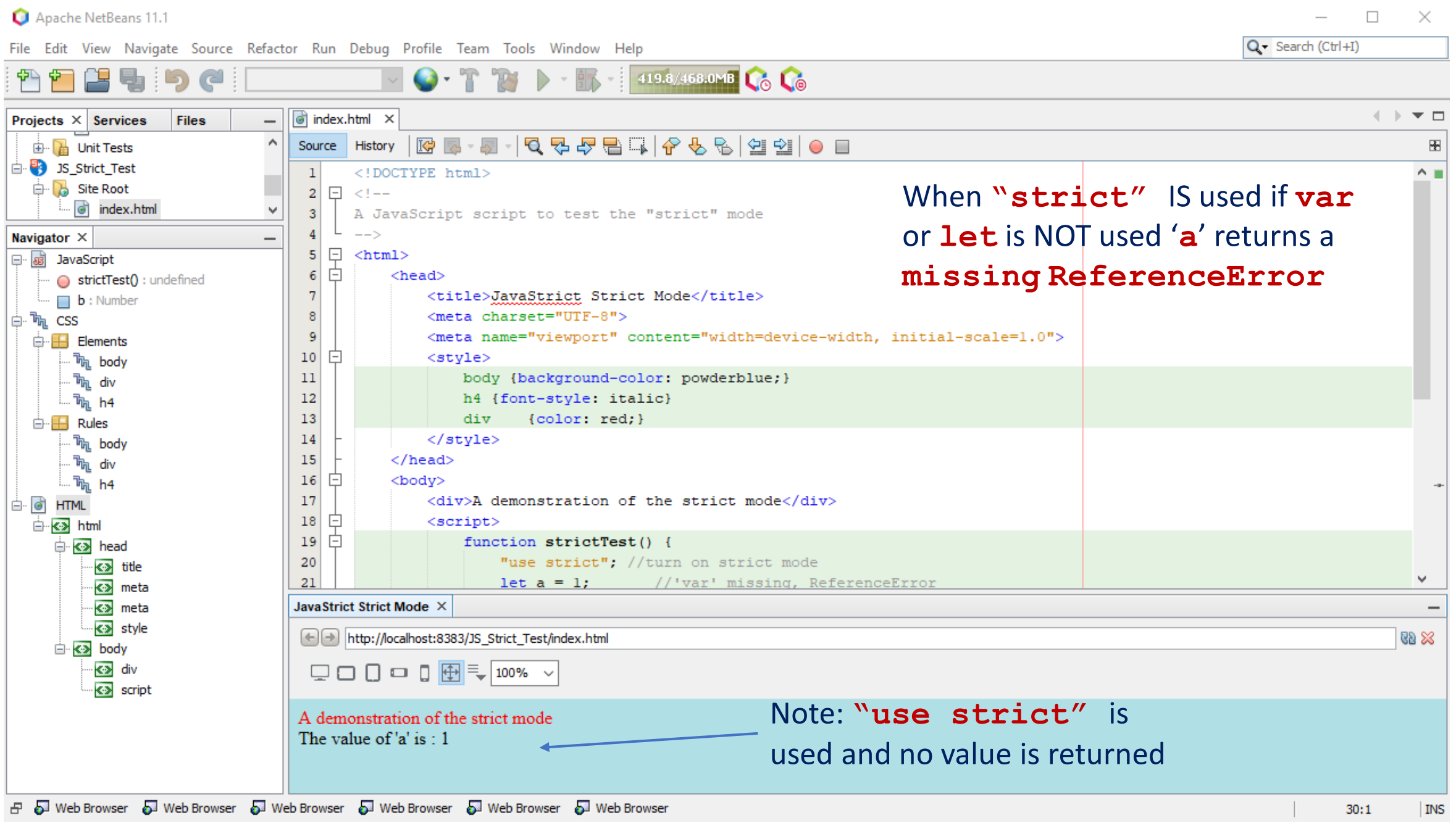
");
23 b = 2;
24 document.write("The value of 'b' is : " + b + "
");
25 }
26 strictTest();
27 </script>
28 </body>
29 </html>
30
Note: “use strict” is used
Web Browser
Web Browser
Web Browser
Web Browser
Web Browser
Web Browser
JavaStrict Strict Mode
30:1
INS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Projects Services Files
Unit Tests
JS_Strict_Test
Site Root
index.html
Navigator
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21 let a = 1; //'var' missing, ReferenceError
When "strict" IS used if var or let is NOT used 'a' returns a missing ReferenceError
JavaStrict Strict Mode
http://localhost:8383/JS_Strict_Test/index.html
100%
A demonstration of the strict mode
The value of 'a' is : 1
Note: "use strict" is used and no value is returned
Web Browser Web Browser Web Browser Web Browser Web Browser Web Browser
30:1
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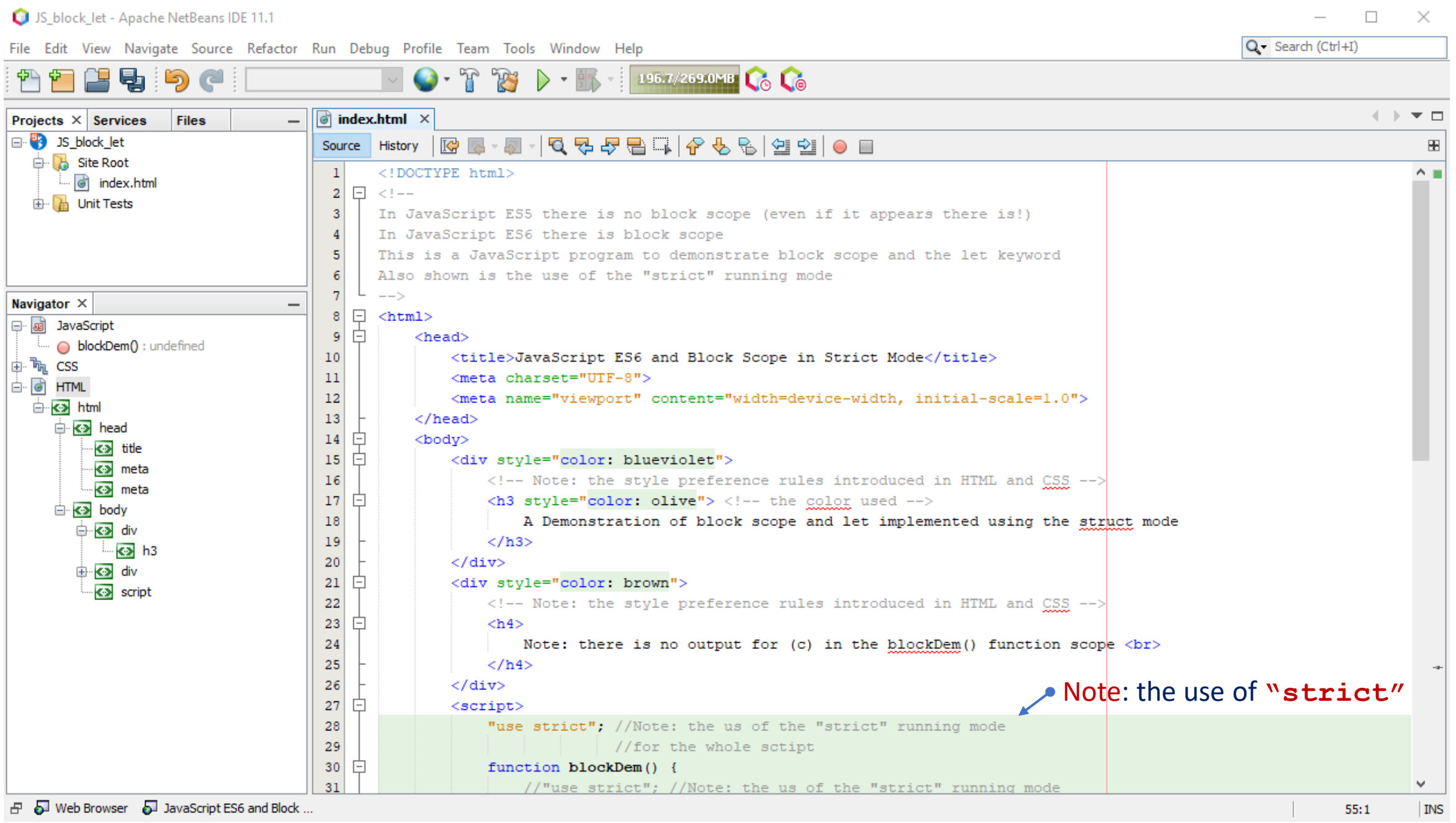
JS_block_let - Apache NetBeans IDE 11.1
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Projects
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Files
JS_block_let
Site Root
index.html
Unit Tests
Navigator
JavaScript
blockDem() : undefined
CSS
HTML
html
head
title
meta
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body
div
h3
div
script
index.html
Source
History
1 <!DOCTYPE html>
2 <!--
3 In JavaScript ES5 there is no block scope (even if it appears there is!)
4 In JavaScript ES6 there is block scope
5 This is a JavaScript program to demonstrate block scope and the let keyword
6 Also shown is the use of the "strict" running mode
7 -->
8 <html>
9 <head>
10 <title>JavaScript ES6 and Block Scope in Strict Mode</title>
11 <meta charset="UTF-8">
12 <meta name="viewport" content="width=device-width, initial-scale=1.0">
13 </head>
14 <body>
15
16 <!-- Note: the style preference rules introduced in HTML and CSS -->
17 <h3 style="color: olive"> <!-- the color used -->
18 A Demonstration of block scope and let implemented using the struct mode
19 </h3>
20
21
22 <!-- Note: the style preference rules introduced in HTML and CSS -->
23 <h4>
24 Note: there is no output for (c) in the blockDem() function scope
25 </h4>
26
27 <script>
28 "use strict"; //Note: the us of the "strict" running mode
29 //for the whole sctipt
30 function blockDem() {
31 //"use strict"; //Note: the us of the "strict" running mode
Note: the use of "strict"
Web Browser
JavaScript ES6 and Block ...
55:1
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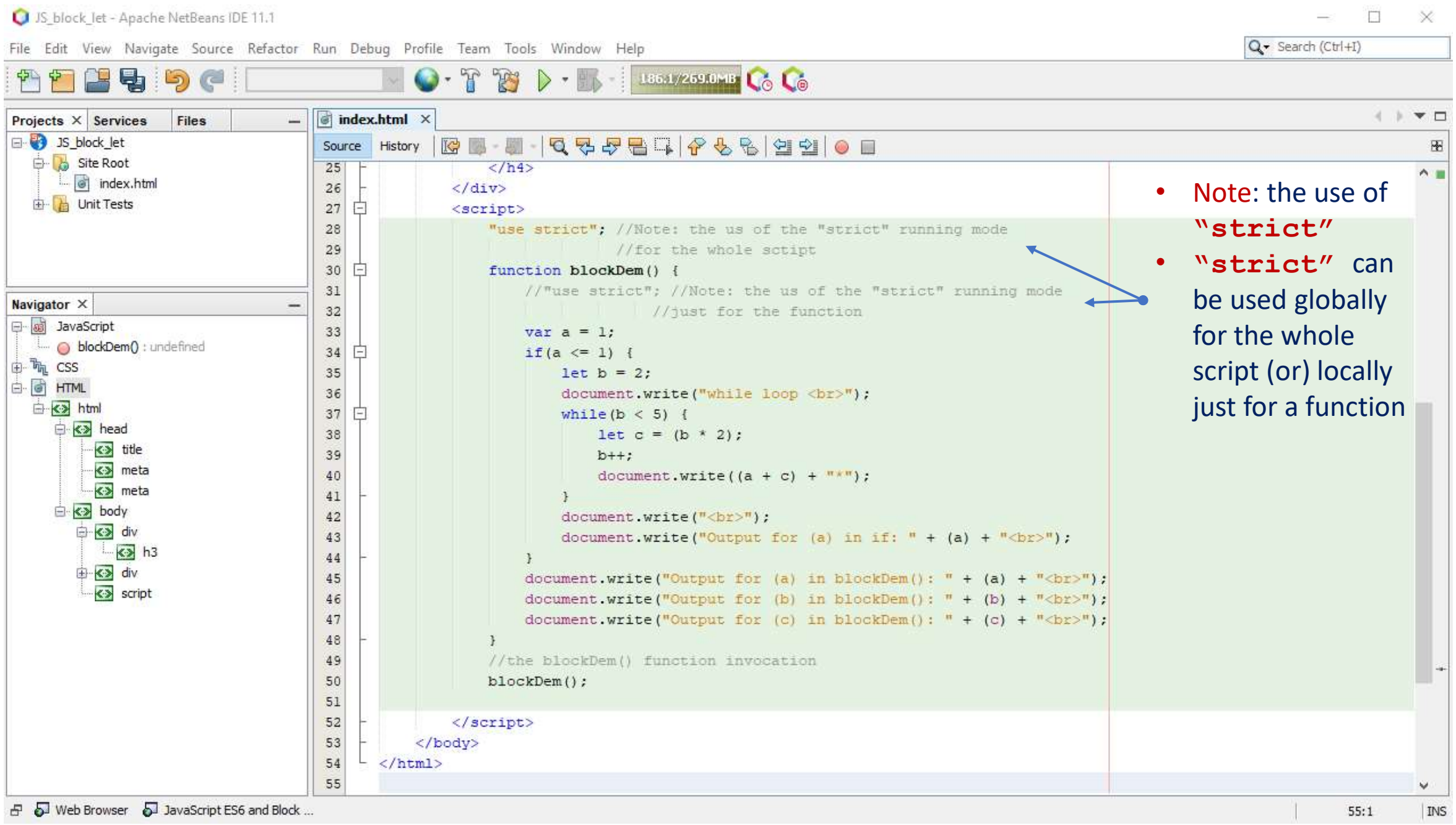
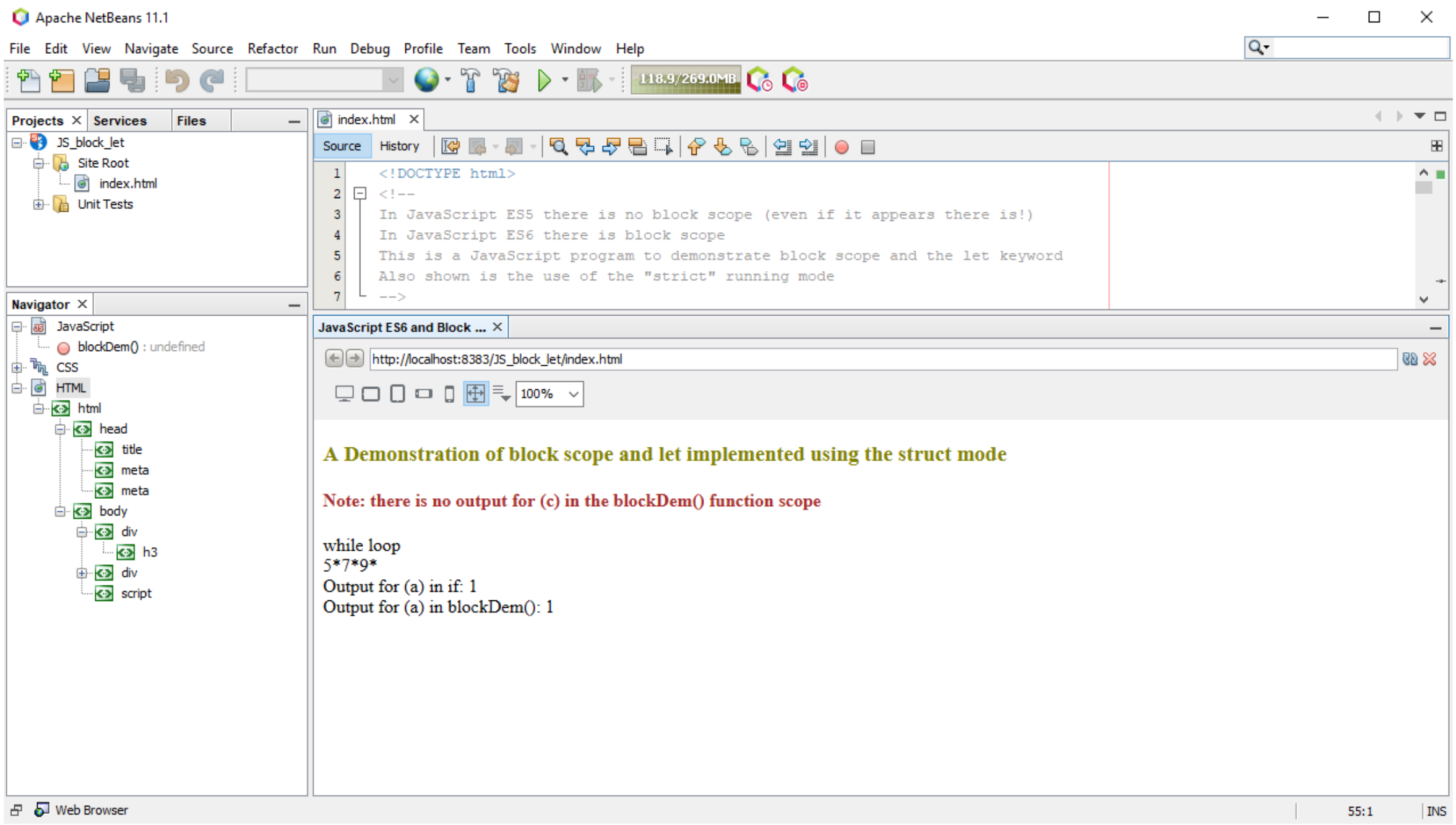


- Note: the use of **"strict"**
- **"strict"** can be used globally for the whole script (or) locally just for a function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Projects Services Files
JS_block_let
Site Root
index.html
Unit Tests
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JavaScript
blockDem() : undefined
CSS
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2 <!--
3 In JavaScript ES5 there is no block scope (even if it appears there is!)
4 In JavaScript ES6 there is block scope
5 This is a JavaScript program to demonstrate block scope and the let keyword
6 Also shown is the use of the "strict" running mode
7 -->
JavaScript ES6 and Block ...
http://localhost:8383/JS_block_let/index.html
100%
A Demonstration of block scope and let implemented using the struct mode
Note: there is no output for (c) in the blockDem() function scope
while loop
5*7*9*
Output for (a) in if: 1
Output for (a) in blockDem(): 1
Web Browser
55:1
INS

Documenting JavaScript

Debugging JavaScript

JavaScript Debugging

- Writing and debugging JavaScript
  - Comment the program file and the code as it is written
  - Add regular test output test statements (they can be commented out) to track variable values and types
  - Keep a careful track of the variables and the variable assignments
  - Know the required output and test it against the actual output
- There are many debugging tools for all programming languages
  - Web browsers may include a debugging tool which can be used to debug a JavaScript script
- The starting point is to design the program and related algorithm
  - It is simpler to avoid bugs than it is to rectify errors

JavaScript Comments

- The following examples show the methods of inserting comments (documenting) JavaScript code

```
/*
 * This is a block multi-line Java, C, and C++ style comment
 * With a second line
 */

/* Another comment*/

// This is a single line Java, C, and C++ style comment
```

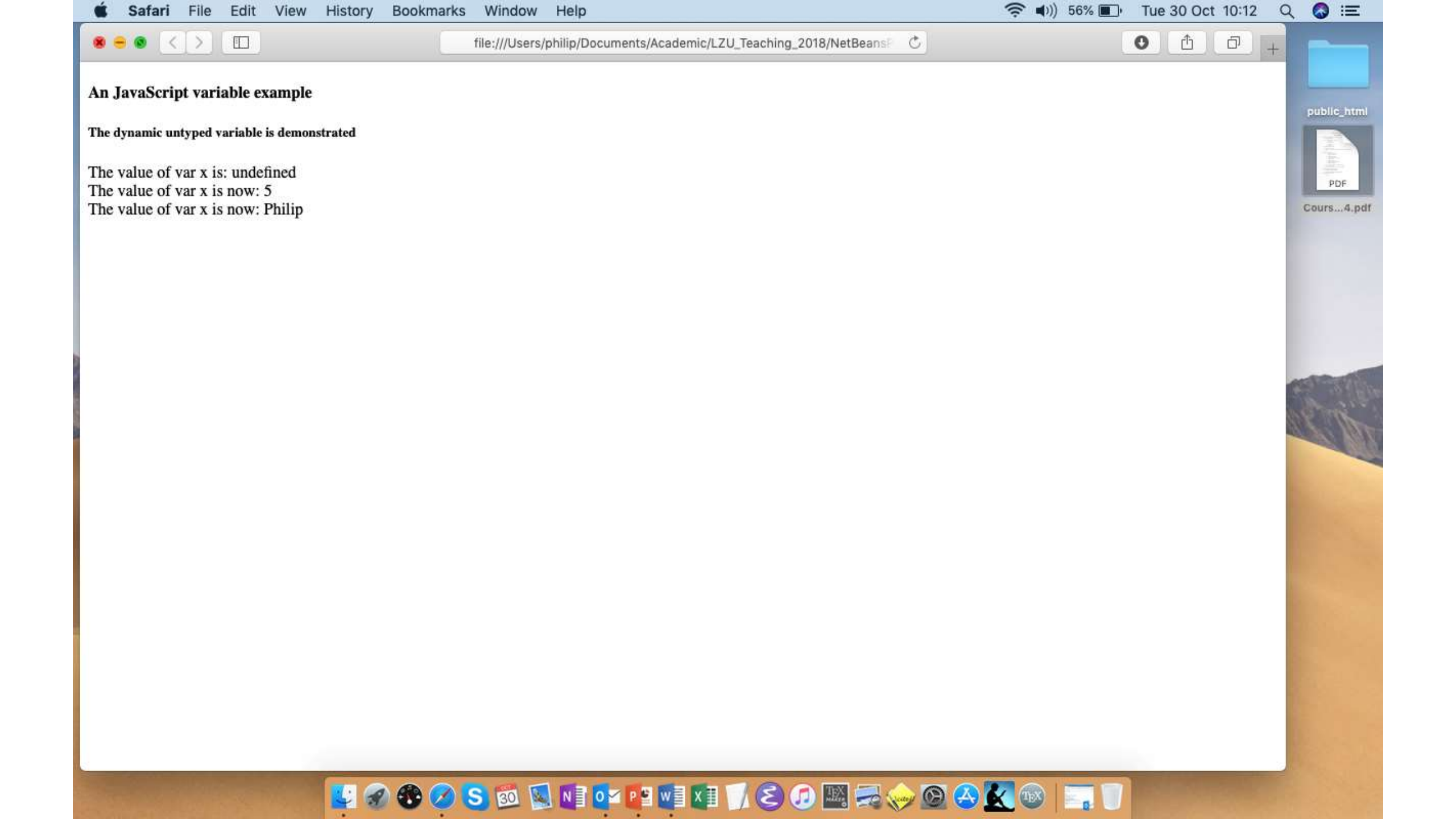
Testing Variable Typing with Test Statements

```
<script>
var x;
document.write("The value of var x is: " + x + "<br>" );  // test the value of x
var x = 5;
document.write("The value of var x is now: " + x + "<br>" );  // test the value
of x
var x = "Philip";
document.write("The value of var x is now: " + x + "<br>" );  // test the value
of x
</script>
```

- The following slide shows the JavaScript in a worked example in EMACS

```
<!DOCTYPE html>
<!--
An example of the dynamic nature
The untyped issue for global variables is shown
-->
<html>
    <head>
        <title>JavaSript Variable Example</title>
        <meta charset="UTF-8">
        <meta name="viewport" content="width=device-width, initial-scale=1.0">
    </head>
    <body>
        <div>
            <h4>An JavaScript variable example</h4>
            <h5>The dynamic untyped variable is demonstrated</h5>

            <script>
                var x;
                document.write("The value of var x is: " + x + "<br>" );
                var x = 5;
                document.write("The value of var x is now: " + x + "<br>" );
                var x = "Philip";
                document.write("The value of var x is now: " + x + "<br>" );
            </script>
        </div>
    </body>
</html>
```


Safari File Edit View History Bookmarks Window Help
56% Tue 30 Oct 10:12
file:///Users/philip/Documents/Academic/LZU_Teaching_2018/NetBeans
An JavaScript variable example
The dynamic untyped variable is demonstrated
The value of var x is: undefined
The value of var x is now: 5
The value of var x is now: Philip
public_html
PDF
Cours...4.pdf

Practical Examples

Design a Testing Strategy

- A typical approach the test computer programs is to:
  1. Develop a suitable testing strategy
  2. Develop and document test scenarios
  3. Develop tests to evaluate all true and false values
  4. Develop a randomly generated test dataset
  5. Run tests and evaluate the results against the test scenarios
- When the evaluation has been completed and any ‘bugs’ in the program have been eliminated:
  - Run the program with actual datasets
- The following example demonstrates the process

Control Context Processing Scenario: C_CP_8

Context Properties	Data Type	Functional Property	Literal Value	Validity
#event_Type	Integer	True	[2]	True
#action_Type	Integer	True	[1]	True
#user_Id	String	True		True
#user_Policy	Integer	True	[2]	False
#res_Type	Integer	True	[1, 2]	True

Exceptions Caught:	Invalid: #user_Policy
Anticipated (design) result:	False: in this scenario the user policy only permits a collaboration query input therefore the system terminates the context processing
Actual (experimental) result:	False: the anticipated design result is validated
Scenario testing result:	Correct
Design action:	Terminate context processing + error message
Actual action:	Terminate context processing + error message
Action result:	Correct

Notes:

- #event_Type [2] == a user input such as a resource or a collaboration query
- #action_Type [1] == a resource (file) input
- #user_Policy [1, 2] == an academic policy. [1] allows both a resource or collaboration input, [2] is a restricted level of rights and only allows collaboration queries
- The #user_Policy property is derived using a Sparql query using the #user_Id
- #res_Type [1, 2] == a type of resource input. [1] relates to a file input while [2] relates to a link input. Different context properties are used for a file and a link.

Generate Random Test Sets

Random Test Set: 1

property	test value [1]/[0]	true / false
coSub	1	true
modSub	1	true
acadQual	0	false
vocQual	1	true
acadExp	1	true
vocExp	1	true
acadInt	0	false
vocInt	1	true
resFHEQ	1	true

Random Test Set: 6

property	test value [1]/[0]	true / false
coSub	1	true
modSub	0	true
acadQual	1	false
vocQual	1	true
acadExp	1	true
vocExp	0	true
acadInt	0	false
vocInt	0	true
resFHEQ	1	true

Test set all True Literal Values

```
run:
Begin Program Run
 INFO [main] (SetupTDB.java:678) - Statistics-based BGP optimizer
Error: null
InData.inResType: 2
*loginAction: 2
cp_R4: 2
*begin context matching
*eval_CoSub(iCS): cpg1 (oCS): cpg1
*(e): 1 *(W): 0.9 *(av): 0.9 *(sv): 0.9 *(mv): 0.9
*eval_MoSub(iMS): m1cpg1 (oMS): m1cpg1
*(e): 1 *(W): 0.8 *(av): 0.8 *(sv): 1.7 *(mv): 1.7
*eval_AcadQual(iAQ): aq1 (oAQ): aq1
*(e): 1 *(W): 0.8 *(av): 0.8 *(sv): 2.5 *(mv): 2.5
*eval_VocQual(iVQ): vq1 (oVQ): vq1
*(e): 1 *(W): 0.5 *(av): 0.5 *(sv): 3.0 *(mv): 3.0
*eval_AcadExp(iAE): ae1 (oAE): ae1
*(e): 1 *(W): 0.7 *(av): 0.7 *(sv): 3.7 *(mv): 3.7
*eval_VocExp(iVE): ve1 (oVE): ve1
*(e): 1 *(W): 0.6 *(av): 0.6 *(sv): 4.3 *(mv): 4.3
*eval_AcadInt(iAI): ai1 (oAI): ai1
*(e): 1 *(W): 0.7 *(av): 0.7 *(sv): 5.0 *(mv): 5.0
*eval_VocInt(iVI): vi1 (oVI): vi1
*(e): 1 *(W): 0.4 *(av): 0.4 *(sv): 5.4 *(mv): 5.4
*eval_FHEQ(resFHEQ): 7 (outFHEQ): 7
*(e): 1 *(W): 1.0 *(av): 1.0 *(sv): 6.4 *(mv): 6.4
*getResultantValue (sv / mv): 1.0
*semanticMatch.outPrecision: GQ
*semanticMatch: 1.0
*semanticMatch (q): 0.01
*semanticMatch: HQ
*applyPrecision(semPrec)(outPrec): HQ : GQ
*CM result: true
BUILD SUCCESSFUL (total time: 3 seconds)
```

Test set all False Literal Values

```
run:
Begin Program Run
 INFO [main] (SetupTDB.java:678) - Statistics-based BGP optimizer
Error: null
InData.inResType: 2
*loginAction: 2
cp_R4: 2
*begin context matching
*eval_CoSub(iCS): cpg2 (oCS): cpg1
*(e): 0 *(W): 0.9 *(av): 0.0 *(sv): 0.0 *(mv): 0.9
*eval_MoSub(iMS): m1cpg2 (oMS): m1cpg1
*(e): 0 *(W): 0.8 *(av): 0.0 *(sv): 0.0 *(mv): 1.7
*eval_AcadQual(iAQ): aq2 (oAQ): aq1
*(e): 0 *(W): 0.8 *(av): 0.0 *(sv): 0.0 *(mv): 2.5
*eval_VocQual(iVQ): vq2 (oVQ): vq1
*(e): 0 *(W): 0.5 *(av): 0.0 *(sv): 0.0 *(mv): 3.0
*eval_AcadExp(iAE): ae2 (oAE): ae1
*(e): 0 *(W): 0.7 *(av): 0.0 *(sv): 0.0 *(mv): 3.7
*eval_VocExp(iVE): ve2 (oVE): ve1
*(e): 0 *(W): 0.6 *(av): 0.0 *(sv): 0.0 *(mv): 4.3
*eval_AcadInt(iAI): ai2 (oAI): ai1
*(e): 0 *(W): 0.7 *(av): 0.0 *(sv): 0.0 *(mv): 5.0
*eval_VocInt(iVI): vi2 (oVI): vi1
*(e): 0 *(W): 0.4 *(av): 0.0 *(sv): 0.0 *(mv): 5.4
*eval_FHEQ(resFHEQ): 8 (outFHEQ): 7
*(e): 0 *(W): 1.0 *(av): 0.0 *(sv): 0.0 *(mv): 6.4
*getResultantValue (sv / mv): 0.0
*semanticMatch.outPrecision: GQ
*semanticMatch: 0.0
*semanticMatch (q): 0.01
*semanticMatch: LQ
*applyPrecision(semPrec)(outPrec): LQ : GQ
*CM result: false
BUILD SUCCESSFUL (total time: 3 seconds)
```

Random Test Set: 1

```
run:
INFO [main] (SetupTDB.java:678) - Statistics-based BGP optimizer
Error: null
InData.inResType: 2
*loginAction: 2
cp_R4: 2
*begin context matching
*eval_CoSub(iCS): cug1 (oCS): cug1
*(e): 1 *(W): 0.9 *(av): 0.9 *(sv): 0.9 *(mv): 0.9
*eval_MoSub(iMS): m1cug1 (oMS): m1cug1
*(e): 1 *(W): 0.8 *(av): 0.8 *(sv): 1.7 *(mv): 1.7
*eval_AcadQual(iAQ): aq2 (oAQ): aq1
*(e): 0 *(W): 0.8 *(av): 0.0 *(sv): 1.7 *(mv): 2.5
*eval_VocQual(iVQ): vq1 (oVQ): vq1
*(e): 1 *(W): 0.5 *(av): 0.5 *(sv): 2.2 *(mv): 3.0
*eval_AcadExp(iAE): ae1 (oAE): ae1
*(e): 1 *(W): 0.7 *(av): 0.7 *(sv): 2.9 *(mv): 3.7
*eval_VocExp(iVE): ve1 (oVE): ve1
*(e): 1 *(W): 0.6 *(av): 0.6 *(sv): 3.5 *(mv): 4.3
*eval_AcadInt(iAI): ai2 (oAI): ai1
*(e): 0 *(W): 0.7 *(av): 0.0 *(sv): 3.5 *(mv): 5.0
*eval_VocInt(iVI): vi1 (oVI): vi1
*(e): 1 *(W): 0.4 *(av): 0.4 *(sv): 3.9 *(mv): 5.4
*eval_FHEQ(resFHEQ): 6 (outFHEQ): 6
*(e): 1 *(W): 1.0 *(av): 1.0 *(sv): 4.9 *(mv): 6.4
*getResultantValue (sv / mv): 0.765625
*semanticMatch.outPrecision: GQ
*semanticMatch: 0.765625
*semanticMatch (q): 0.01
*semanticMatch: GQ
*applyPrecision(semPrec)(outPrec): GQ : GQ
*CM result: true
BUILD SUCCESSFUL (total time: 3 seconds)
```

Test Set (1/1)

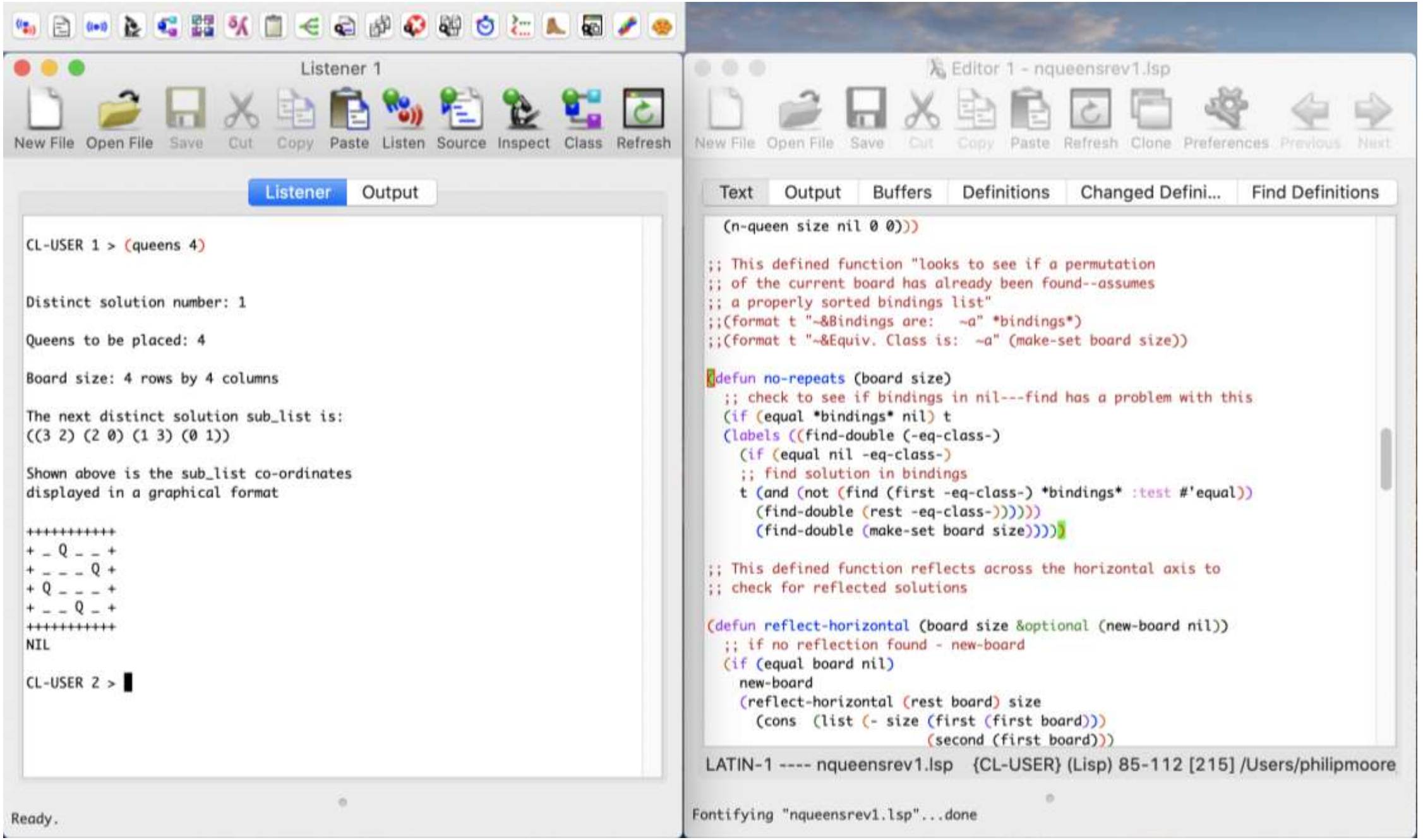
```
run:
Begin Program Run
 INFO [main] (SetupTDB.java:678) - Statistics-based BGP
optimizer
Error: null
InData.inResType: 2
*loginAction: 2
cp_R4: 2
*begin context matching
*eval_CoSub(iCS): cug1 (oCS): cug1
*(e): 1 *(W): 0.9 *(av): 0.9 *(sv): 0.9 *(mv): 0.9
*eval_MoSub(iMS): m1cug1 (oMS): m1cug1
*(e): 1 *(W): 0.8 *(av): 0.8 *(sv): 1.7 *(mv): 1.7
*eval_AcadQual(iAQ): aq1 (oAQ): aq1
*(e): 1 *(W): 0.8 *(av): 0.8 *(sv): 2.5 *(mv): 2.5
*eval_VocQual(iVQ): vq1 (oVQ): vq1
*(e): 1 *(W): 0.5 *(av): 0.5 *(sv): 3.0 *(mv): 3.0
*eval_AcadExp(iAE): ae1 (oAE): ae1
*(e): 1 *(W): 0.7 *(av): 0.7 *(sv): 3.7 *(mv): 3.7
*eval_VocExp(iVE): ve1 (oVE): ve1
*(e): 1 *(W): 0.6 *(av): 0.6 *(sv): 4.3 *(mv): 4.3
*eval_AcadInt(iAI): ai2 (oAI): ai1
*(e): 0 *(W): 0.7 *(av): 0.0 *(sv): 4.3 *(mv): 5.0
*eval_VocInt(iVI): vi2 (oVI): vi1
*(e): 0 *(W): 0.4 *(av): 0.0 *(sv): 4.3 *(mv): 5.4
*eval_FHEQ(resFHEQ): 8 (outFHEQ): 6
*(e): 0 *(W): 1.0 *(av): 0.0 *(sv): 4.3 *(mv): 6.4
*getResultantValue (sv / mv): 0.6718749999999999
*semanticMatch.outPrecision: GQ
*semanticMatch: 0.6718749999999999
*semanticMatch (q): 0.01
*semanticMatch: GQ
*applyPrecision(semPrec)(outPrec): GQ : GQ
*CM result: true
BUILD SUCCESSFUL (total time: 3 seconds)
```

Test Set (8/1/1)

```
run:
Begin Program Run
 INFO [main] (SetupTDB.java:678) - Statistics-based BGP
optimizer
Error: null
InData.inResType: 2
*loginAction: 2
cp_R4: 2
*begin context matching
*eval_CoSub(iCS): cug1 (oCS): cug1
*(e): 1 *(W): 0.9 *(av): 0.9 *(sv): 0.9 *(mv): 0.9
*eval_MoSub(iMS): m1cug1 (oMS): m1cug1
*(e): 1 *(W): 0.8 *(av): 0.8 *(sv): 1.7 *(mv): 1.7
*eval_AcadQual(iAQ): aq1 (oAQ): aq1
*(e): 1 *(W): 0.8 *(av): 0.8 *(sv): 2.5 *(mv): 2.5
*eval_VocQual(iVQ): vq1 (oVQ): vq1
*(e): 1 *(W): 0.5 *(av): 0.5 *(sv): 3.0 *(mv): 3.0
*eval_AcadExp(iAE): ae1 (oAE): ae1
*(e): 1 *(W): 0.7 *(av): 0.7 *(sv): 3.7 *(mv): 3.7
*eval_VocExp(iVE): ve1 (oVE): ve1
*(e): 1 *(W): 0.6 *(av): 0.6 *(sv): 4.3 *(mv): 4.3
*eval_AcadInt(iAI): ai1 (oAI): ai1
*(e): 1 *(W): 0.7 *(av): 0.7 *(sv): 5.0 *(mv): 5.0
*eval_VocInt(iVI): vi1 (oVI): vi1
*(e): 1 *(W): 0.4 *(av): 0.4 *(sv): 5.4 *(mv): 5.4
*eval_FHEQ(resFHEQ): 8 (outFHEQ): 6
*(e): 0 *(W): 1.0 *(av): 0.0 *(sv): 5.4 *(mv): 6.4
*getResultantValue (sv / mv): 0.84375
*semanticMatch.outPrecision: GQ
*semanticMatch: 0.84375
*semanticMatch (q): 0.01
*semanticMatch: HQ
*applyPrecision(semPrec)(outPrec): HQ : GQ
*CM result: true
BUILD SUCCESSFUL (total time: 2 seconds)
```

A Lisp program

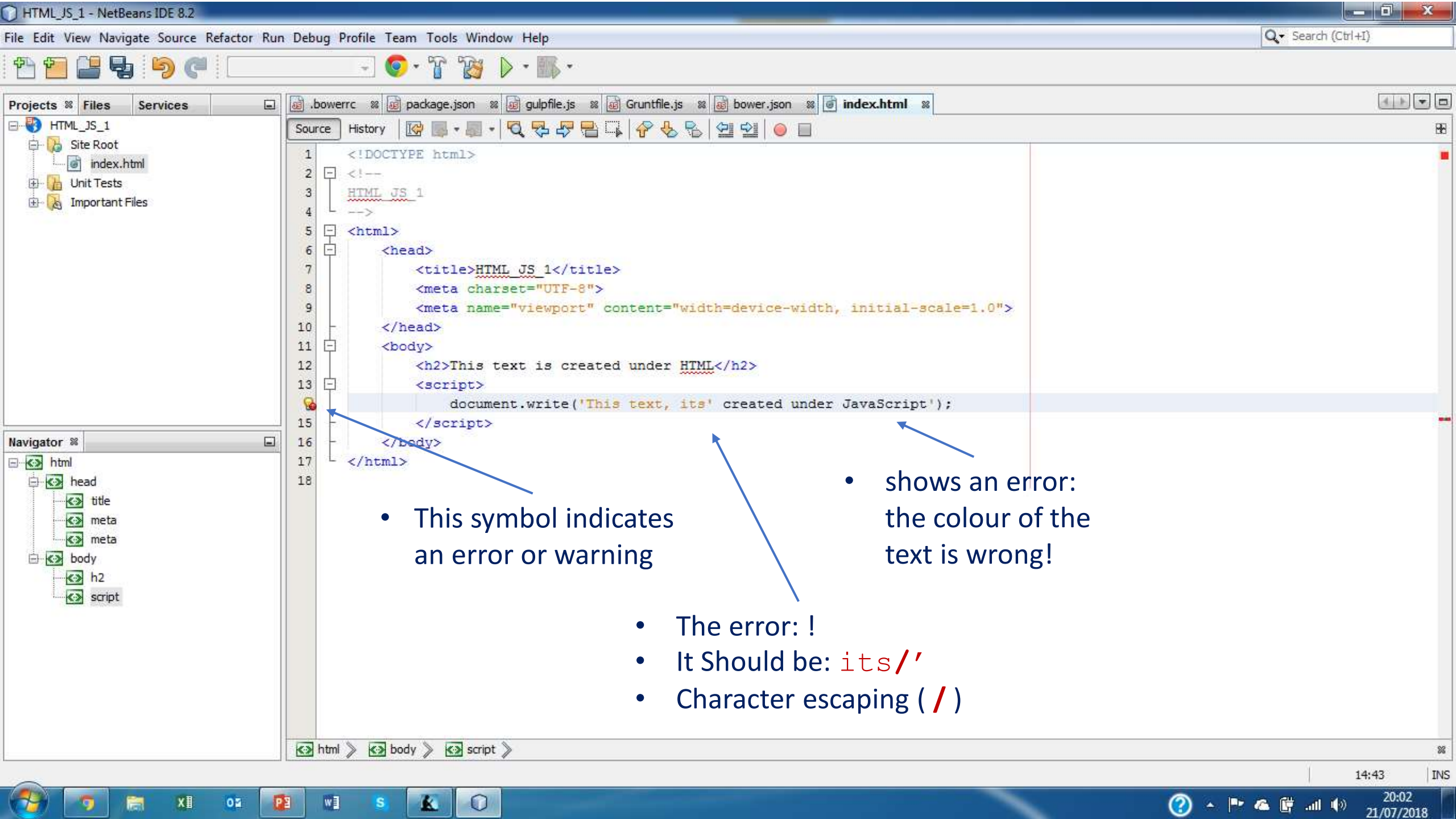
- The following slide shows a Lisp ‘8 queens’ program
- From the program code we can see:
  - The working program code
  - The extensive comments explaining: the purpose of the code, how specific functions operate, and and the output achieved
  - The output is shown for (queens 4) with the explanatory text
- The comments (in Lisp we use (;) are essential to
  - Provide an explanation of the code to remind the programmer (me!) and others! how the program works


Listener 1
New File
Open File
Save
Cut
Copy
Paste
Listen
Source
Inspect
Class
Refresh
Listener
Output
CL-USER 1 > (queens 4)
Distinct solution number: 1
Queens to be placed: 4
Board size: 4 rows by 4 columns
The next distinct solution sub_list is:
((3 2) (2 0) (1 3) (0 1))
Shown above is the sub_list co-ordinates
displayed in a graphical format
++++++++++
+ _ Q _ _ +
+ _ _ _ Q +
+ Q _ _ _ +
+ _ _ Q _ +
++++++++++
NIL
CL-USER 2 >
Ready.
Editor 1 - nqueensrev1.lsp
New File
Open File
Save
Cut
Copy
Paste
Refresh
Clone
Preferences
Previous
Next
Text
Output
Buffers
Definitions
Changed Defini...
Find Definitions
(n-queen size nil 0 0)))
;; This defined function "looks to see if a permutation
;; of the current board has already been found--assumes
;; a properly sorted bindings list"
;;(format t "~&Bindings are: ~a" *bindings*)
;;(format t "~&Equiv. Class is: ~a" (make-set board size))
(defun no-repeats (board size)
;; check to see if bindings in nil---find has a problem with this
(if (equal *bindings* nil) t
(labels ((find-double (-eq-class-)
(if (equal nil -eq-class-)
;; find solution in bindings
t (and (not (find (first -eq-class-) *bindings* :test #'equal))
(find-double (rest -eq-class-))))))
(find-double (make-set board size)))))
;; This defined function reflects across the horizontal axis to
;; check for reflected solutions
(defun reflect-horizontal (board size &optional (new-board nil))
;; if no reflection found - new-board
(if (equal board nil)
new-board
(reflect-horizontal (rest board) size
(cons (list (- size (first (first board)))
(second (first board)))
LATIN-1 ---- nqueensrev1.lsp {CL-USER} (Lisp) 85-112 [215] /Users/philipmoore
Fontifying "nqueensrev1.lsp"...done

Programming Errors

Types of Errors

- There are two types of error (of bug) in any computer program (including JavaScript):
  - *Syntax* errors (mistakes in writing the program code
  - *Logic* errors (where the output is not what is expected or required)
- *Syntax* errors WILL be shown in NetBeans (see the following slide)
  - Identifying such errors is relatively simple (the program will 'crash')
- *Logic* errors will NOT be shown in NetBeans (or any other tool)
  - Identifying such errors can be very difficult and requires extensive testing
  - An effective design and testing plan is required to avoid such errors and find and correct them



- This symbol indicates an error or warning
- shows an error: the colour of the text is wrong!
- The error: !
- It Should be: `its/'`
- Character escaping (/)

Program Design

Program Design (1)

- The design process for a computer program is as follows:
- Identify and document the requirements specification
  - This will set out the required *input* (data) and the required *output* (results)
- Create a block layout showing the program algorithm structure)
  - This will set out the sequence of operations (sequential / selection / iteration)
  - Write pseudo program code describing the algorithm
  - I will have more to say on these topics in another tutorial
- Creating a block layout and pseudo program code will be introduced in another tutorial addressing design principles

Program Design (2)

- Plot the path of the data through the program
- Design a test plan to:
  - Test and verify if the data values throughout the program are correct
  - Test to check if the result is consistent with the required output
- Testing may use both black-box and white-box testing:
  - Black-box testing: a method where the inner workings of the program are not known (only the input and the output)
  - White-box testing: a method where the data-flows within the program are checked and mapped to the output