



中山大學

SUN YAT-SEN UNIVERSITY

Lecture 05. Basic JavaScript for Client Side Programming

Modern Web Programming

(<http://my.ss.sysu.edu.cn/wiki/display/WEB/> supported by Deep Focus)

School of Data and Computer Science, Sun Yat-sen University

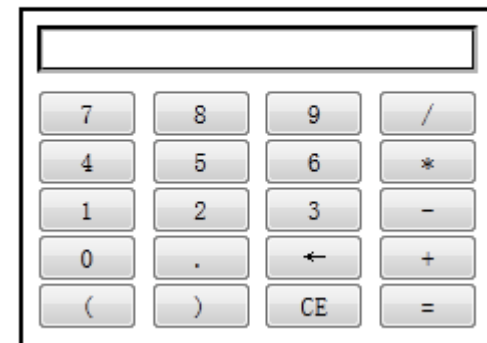
Outline

- **Client Side Basics**
- Introduction to JavaScript
- JavaScript Basic Syntax

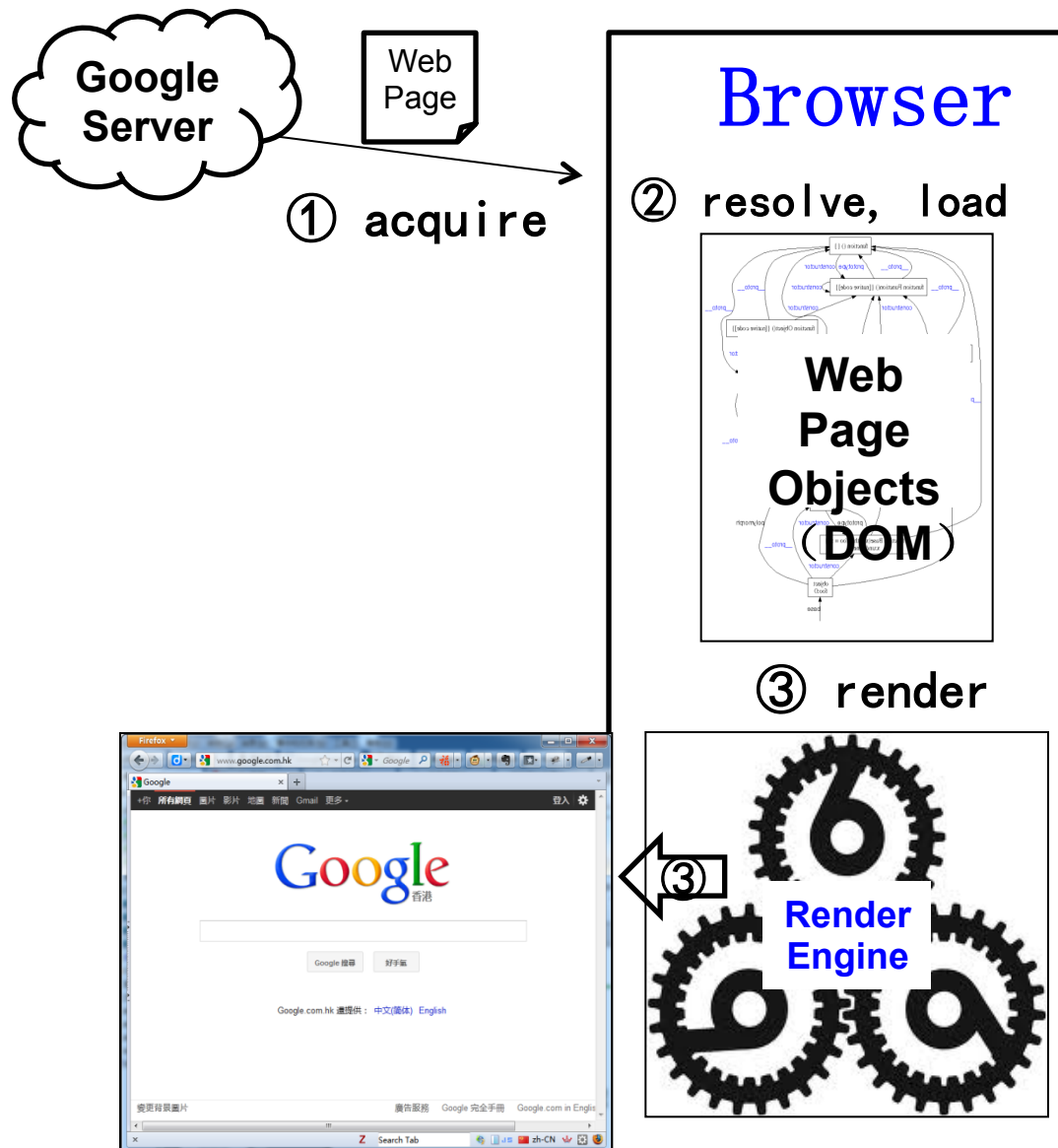
Front-end Dynamics

- Static Web pages → Dynamic Web pages
 - But, all dynamics happen on Web servers
- Not all dynamics should be on server
 - Validate data format
 - Eye-candies
 -
- Client (browser) dynamics is indispensable for Web apps.
 - **Dynamic HTML**
 - **A calculator example**

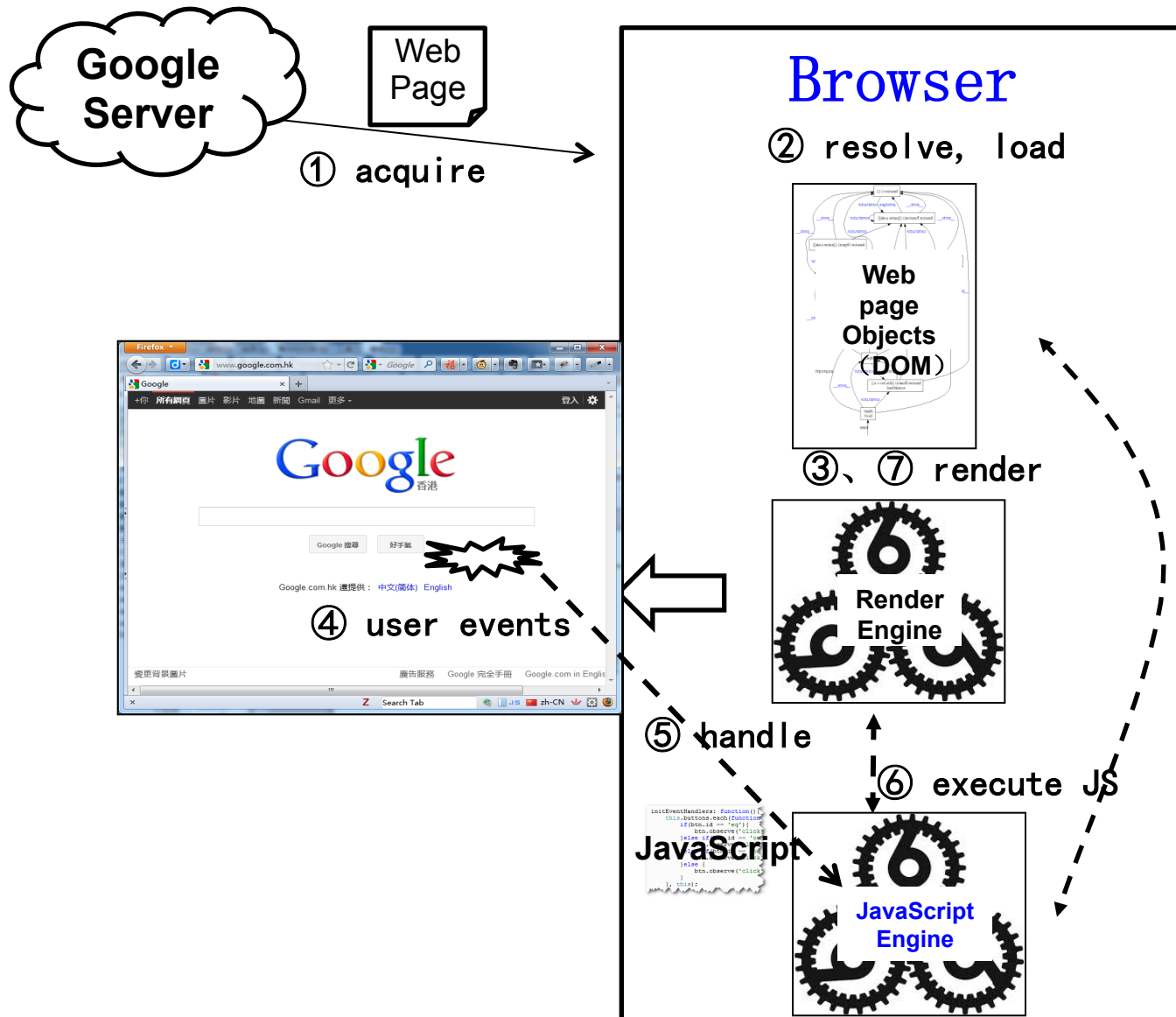
简单计算器



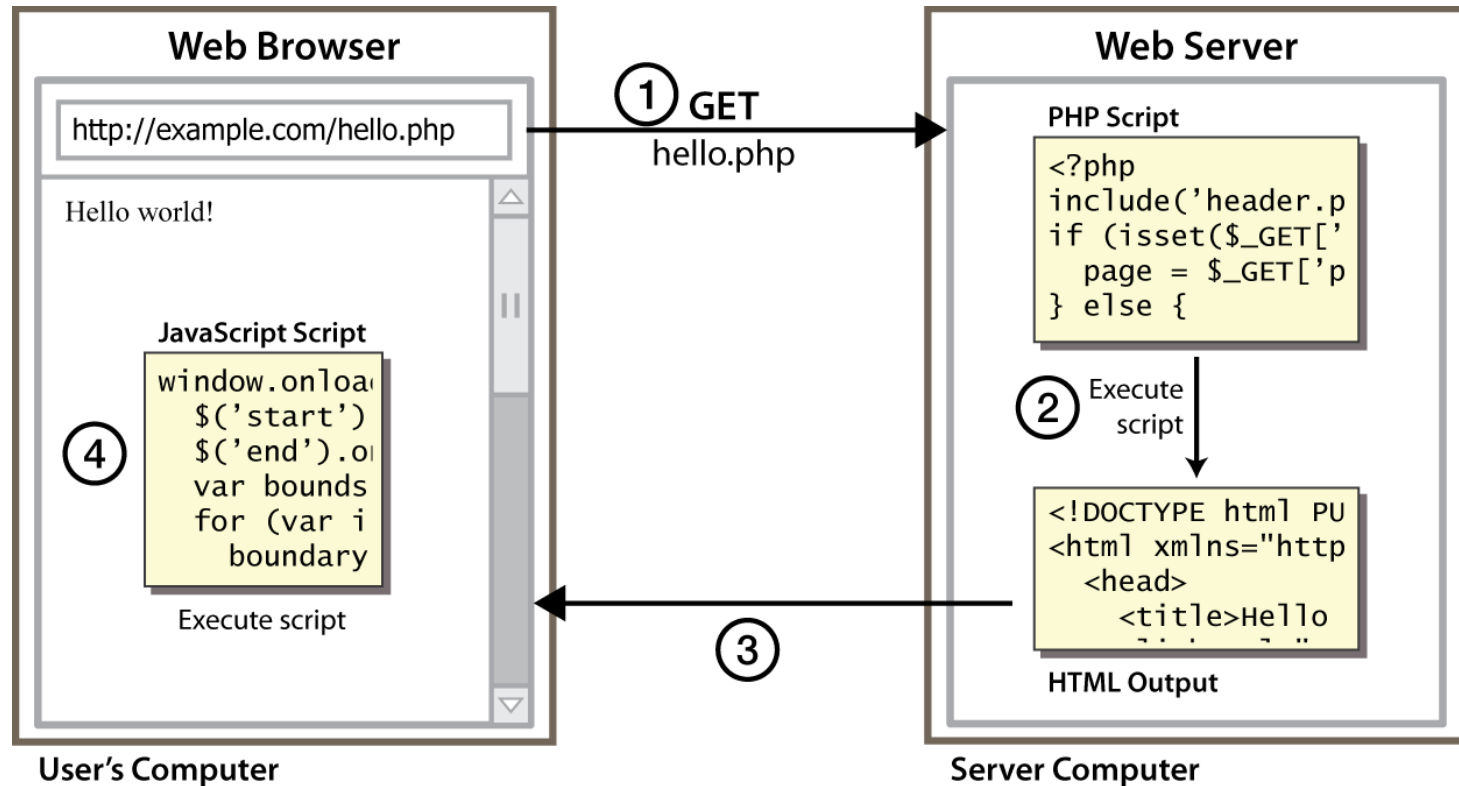
Working mechanism of browsers



Working mechanism of browsers

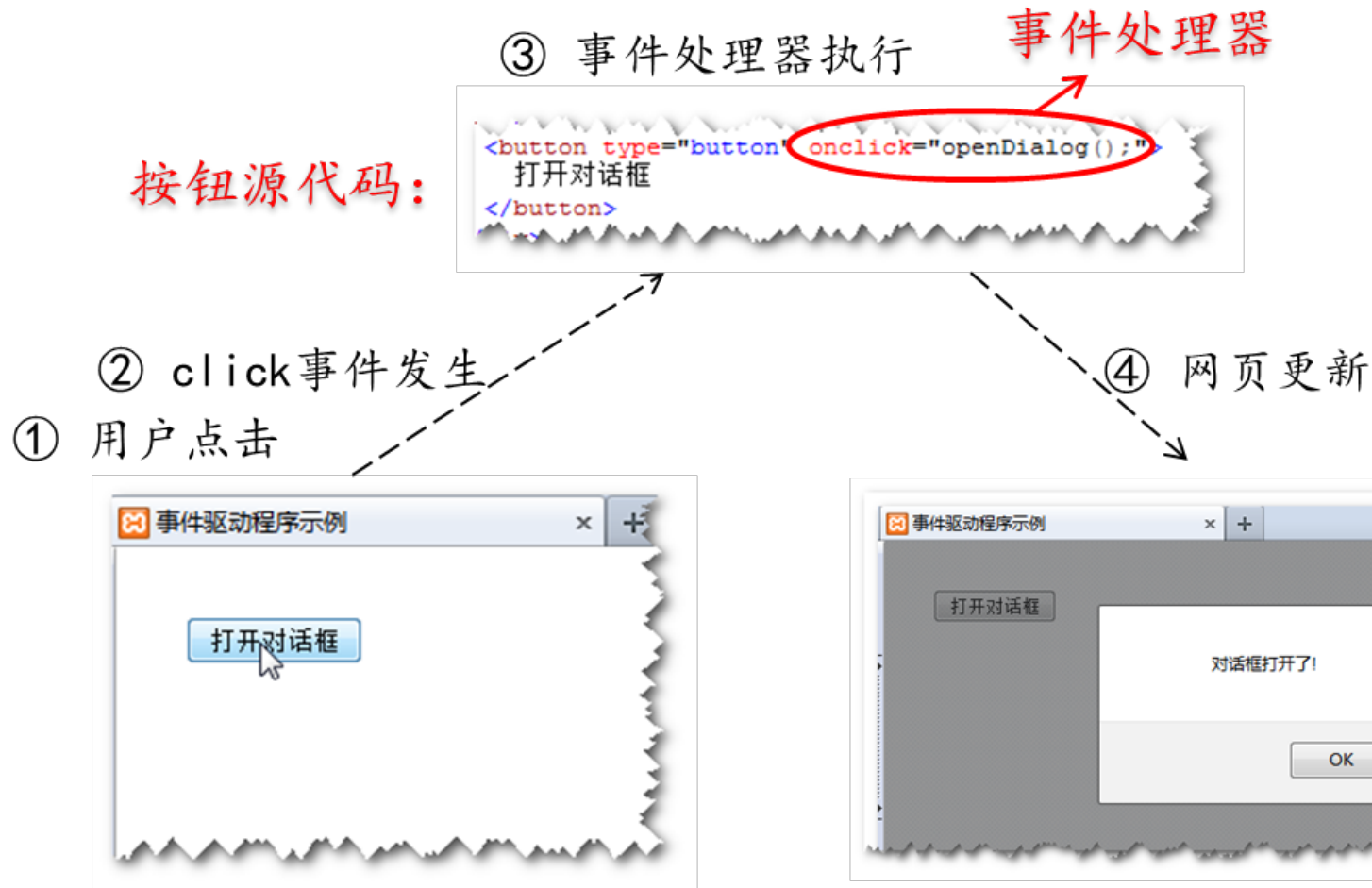


Client-side scripting



- client-side script: code **runs in browser** after page is sent back from server
 - often this code manipulates the page or responds to user actions

Event-driven programming

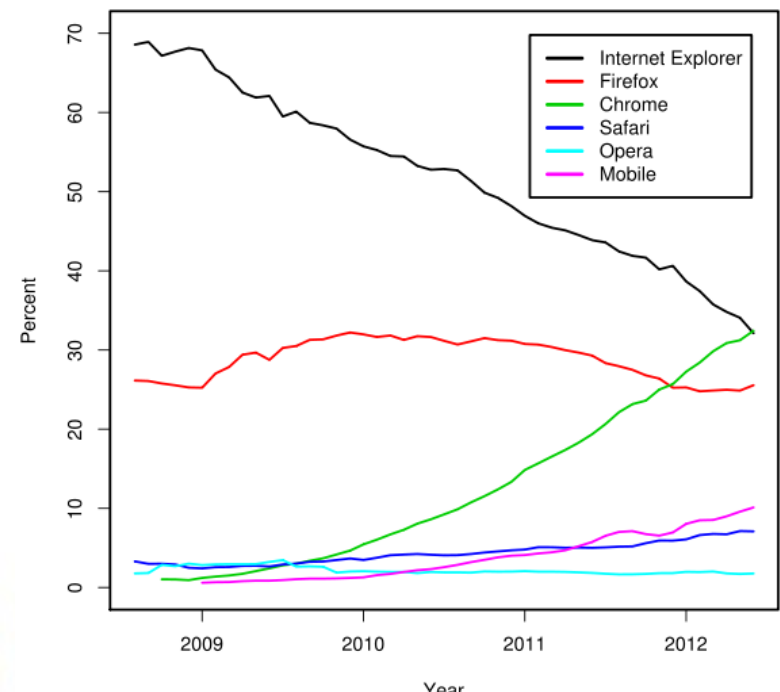


Browser wars

- Mosaic war
 - the winner: Netscape
- The first browser war (1995.12.7 ~ 1997.12.7)
 - Netscape Navigator 90%, IE 0%
 - The battle at IE 4.0 party, San Francisco
 - IE 96%
 - Netscape was purchased by AOL
 - Consequence: → Web Standardization
- The second browser war (1998 ~ 2003)



Usage share of web browsers



Client-side vs. server-side programming

- PHP already allows us to create dynamic web pages. Why also use client-side scripting?
- client-side scripting (JavaScript) benefits:
 - **usability**: can modify a page without having to post back to the server (faster UI)
 - **efficiency**: can make small, quick changes to page without waiting for server
 - **event-driven**: can respond to user actions like clicks and key presses
- server-side programming (PHP) benefits:
 - **security**: has access to server's private data; client can't see source code
 - **compatibility**: not subject to browser compatibility issues
 - **power**: can write files, open connections to servers, connect to databases, ...

Outline

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- **Introduction to JavaScript**
- JavaScript Basic Syntax

Essential of JavaScript

- **JavaScript** is an object-oriented scripting language used to enable programmatic access to objects within both the client application and other applications. It is primarily used in the form of client-side JavaScript, implemented as an integrated component of the web browser, allowing the development of enhanced user interfaces and dynamic websites.
- JavaScript is a dialect of the **ECMAScript** standard and is characterized as a dynamic, weakly typed, prototype-based language with first-class functions. JavaScript was influenced by many languages and was designed to look like Java, but to be easier for non-programmers to work with.

1995

/ FAST SLIM CORRECT

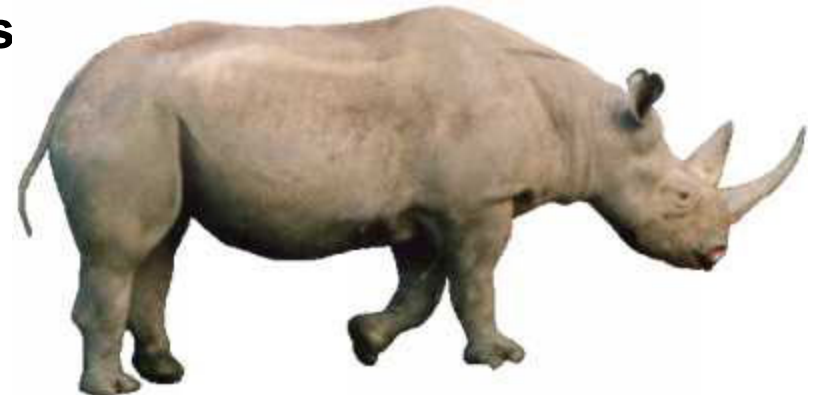
BRENDAN EICH DESIGNS MOCHA JAVASCRIPT ...IN 10 DAYS



Joins NETSCAPE in April 1995.

Essential of JavaScript

- JavaScript is a script language
- JavaScript programs are evaluated and executed by JavaScript interpreters / engines
 - [Rhino](#), [SpiderMonkey](#), [V8](#), [Squirrelfish](#), [TraceMonkey](#)
- The mainstream purpose and usage: Exposing objects of an application at runtime, for customizing / embedding user logics
 - OS, **browsers**, **flashes**, **pdf apps**, etc.
 - that implies two sections of learning JavaScript, **the language itself** and **objects** exposed in corresponding host applications



JavaScript Engine Competition

- Google Chrome → Webkit's Squirrelfish, Firefox's TraceMonkey
- An incredible JavaScript Engine Google V8, which is as fast as binary code!
- 2009 Node.js, JavaScript for server side
- Beat apache, Nginx, IIS up!
 - Especially in high concurrence
- A new technical revolution emerges in Web front-end
- CoffeScript, Sass, Less, HamI,
- The legend goes on
 - Safari's Nitro, Mozilla's JägerMonkey,

JavaScript is the language for the Web era.

JavaScript vs. Java

- **interpreted**, not compiled
 - more relaxed syntax and rules
 - **fewer** and "**looser**" data types
 - variables **DON'T** need to be declared
 - **errors often silent** (few exceptions)
- key construct is the **function** rather than the class
 - "first-class" functions are used in many situations
- contained within a web page and integrates with its HTML /CSS content
 - **comparability**: browsers may behave differently upon a JavaScript program
 - different dialects/implementations of the standard (ECMAScript)
 - different objects exposed



JavaScript vs. PHP

- similarities:

- both are **interpreted**, not compiled
- both are **relaxed** about syntax, rules, and types
- both are **case-sensitive**
- both have **built-in regular expressions** for powerful text processing



- differences:

- JS is **more object-oriented**: `noun.verb()`, less procedural: `verb(noun)`
- JS focuses on user interfaces and interacting with a document; PHP is geared toward HTML output and file/form processing
- JS code runs on the **client's browser**; PHP code runs on the **web server**

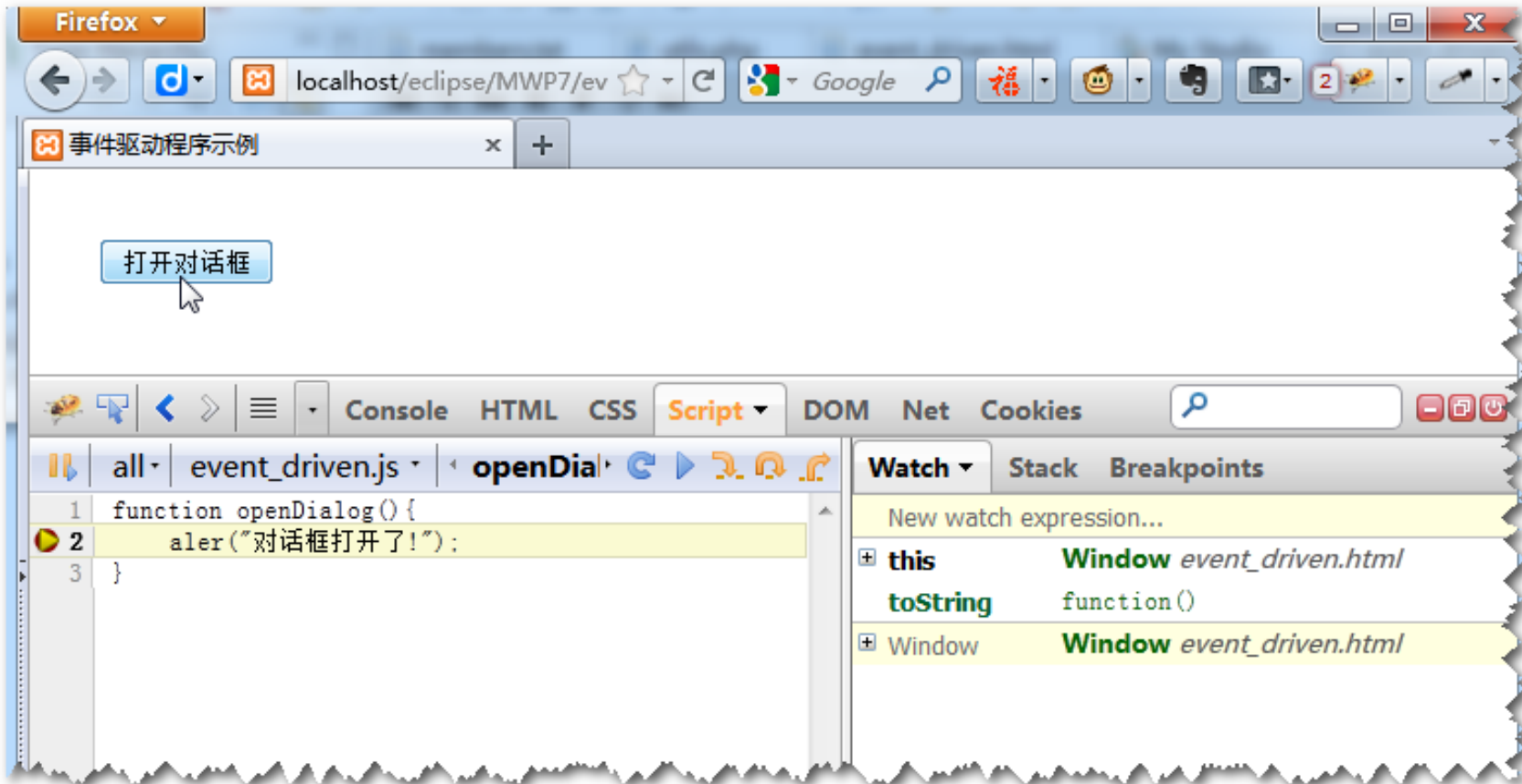
Linking to a JavaScript file: script

```
<script src="filename" type="text/javascript"></script> HTML
```

```
<script src="example.js" type="text/javascript"></script> HTML
```

- **script** tag should be placed in HTML page's **head**
- script code is stored in a separate **.js** file
- JS code can be placed directly in the HTML file's body or head (like CSS)
 - but this is **BAD** style (should separate content, presentation, and behavior)

Run and debug JavaScript



Outline

- Client Side Basics
- Introduction to JavaScript
- **JavaScript Basic Syntax**

Comments (same as Java)

```
// single-line comment
```

```
/* multi-line comment */
```

JS

- identical to Java's comment syntax
- recall: 4 comment syntaxes
 - HTML: `<!--comment-->`
 - CSS/JS/PHP: `/* comment */`
 - Java/JS/PHP: `// comment`
 - PHP: `# comment`

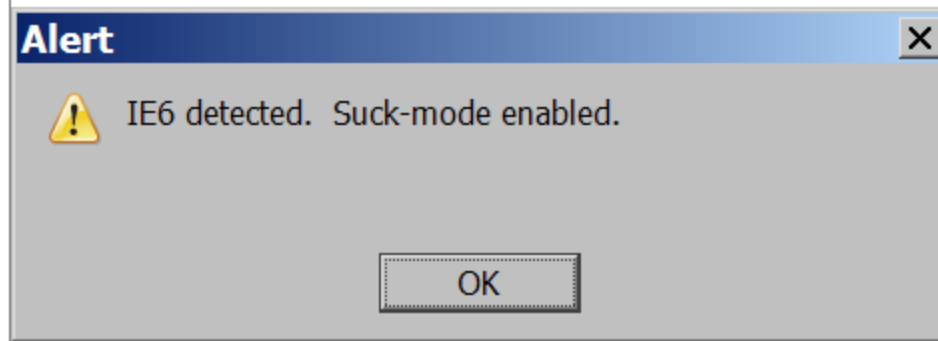
A JavaScript statement: alert

```
alert("message");
```

JS

```
alert("IE6 detected. Suck-mode enabled.");
```

JS

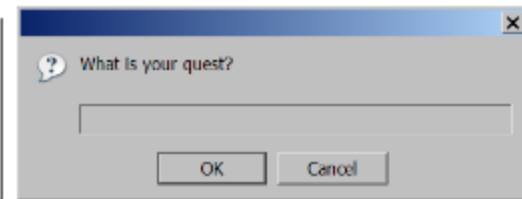
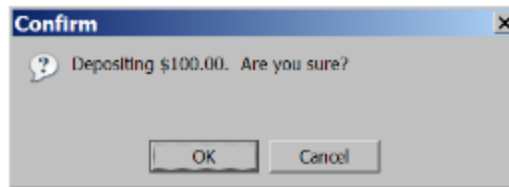
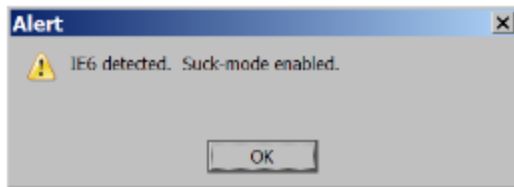


output

- a JS command that pops up a dialog box with a message

Popup boxes

```
alert("message");           // message  
confirm("message");         // returns true or false  
prompt("message");          // returns user input string
```

JS

Variables and types

```
var name = expression;
```

JS

```
var clientName = "Connie Client";  
var age = 32;  
var weight = 127.4;
```

JS

- variables are declared with the var keyword (case sensitive)
- types are not specified, but JS does have types ("loosely typed")
 - number, boolean, string, array, object, **function**, null, undefined
 - can find out a variable's type by calling typeof

Built-in types

表 7-1 JavaScript 内置数据类型

类型	描述	示例
number	数字，整数或者浮点数	42、-17、0、3.14、2.4e-6、NaN
boolean	布尔值	true、false
string	文本、字符串	"hello world"、'你好'
array	数组，一组可通过自然数下标索引访问的数据	[12, 17, '你好', 0]
object	对象，包含属性和行为的实体	{name: "张三", age: 24}
function	函数，一组可以执行的语句	function openDialog(){ alert("对话框打开了"); }
null	空	null
undefined	未定义	undefined

number type

```
var enrollment = 99;
var medianGrade = 2.8;
var credits = 5 + 4 + (2 * 3);
```

JS

- integers and real numbers are the **same** type (no **int** vs. **double**)
- same operators: **+** **-** ***** **/** **%** **++** **--** **+=** **-=** ***=** **/=** **%=**
- similar precedence to Java
- many operators **auto-convert types**: "2"* 3 is 6



JavaScript 没有真正的整形数: JavaScript 使用 Number 类型同时表示整数和浮点数。实际上, JavaScript 中并没有真正意义上的整型数, 所有的数字都表示为 64 位浮点数。只是在输出时, 当浮点数没有小数部分时, 省略了小数点和零。

number type

JavaScript 的 Number 类型还包括了几个特殊的常量用来表示一些特殊的数值，参见表 7-2。

表 7-2 Number 类型常数

常数	描述
<code>Number.MAX_VALUE</code>	系统可表示的最大正有理数
<code>Number.MIN_VALUE</code>	系统可表示的最小小数
<code>Number.NaN</code> (或者 NaN)	不是数字
<code>Number.NEGATIVE_INFINITY</code>	表示数值已经超出系统能表示的最大负数
<code>Number.POSITIVE_INFINITY</code>	表示数值已经超出系统能表示的最大正数

number type

表 7-3 JavaScript 算术运算符

运算符	解释
+	加法
-	减法
*	乘法
/	除法
%	取余

number type

表 7-4 JavaScript 数学常数

常量	值
Math.PI	3.14159……, 圆周率 π
Math.E	2.71828……, 自然对数底 e
Math.LN2	0.69314……, 2 的自然对数

表 7-5 JavaScript 数学函数

函数	解释
<u>Math.abs(x)</u>	绝对值
Math.ceil(x)、Math.floor(x)	天花板（向上取整）、地板（向下取整）
Math.cos(x)、Math.sin(x)、Math.tan(x)	相应的三角函数
<u>Math.log(x)</u>	自然对数（也可给出底，计算任意底的对数）、10 为 3 的对数
Math.min(x, y, ...)、Math.max(x, y, ...)	最小值、最大值
<u>Math.pow(base, exponent)</u>	幂函数
<u>Math.random()</u>	随机数
<u>Math.round(x)</u>	四舍五入
<u>Math.sqrt(x)</u>	平方根

string type

```
var s = "Connie Client";
var fName = s.substring(0, s.indexOf(" "));    // "Connie"
var len = s.length;                           // 13
var s2 = 'Melvin Merchant';                    JS
```

- methods: charAt, charCodeAt, fromCharCode, indexOf, lastIndexOf, replace, split, substring, toLowerCase, toUpperCase
 - charAt returns a one-letter String (there is no char type)
- length property (not a method as in Java)
- Strings can be specified with "" or "
- concatenation with + :
 - 1 + 1 is 2, but "1" + 1 is "11"

表 7-8 JavaScript 字符串运算示例

表达式	值
1 + "2"	"12"
1 + "3 个和尚"	"13 个和尚"
(1+3) + "5"	"45"

More about string

- escape sequences behave as in Java: `' \" \& \n \t \`
- converting between numbers and Strings:

```
var count = 10;  
var s1 = "" + count;           // "10"  
var s2 = count + " bananas, ah ah ah!"; // "10 bananas, ah ah ah!"  
var n1 = parseInt("42 is the answer"); // 42  
var n2 = parseFloat("booyah");        // NaN
```

- accessing the letters of a string:

```
var firstLetter = s[0];           // fails in IE  
var firstLetter = s.charAt(0);    // does work in IE  
var lastLetter = s.charAt(s.length - 1);
```

More about string

表 7-9 JavaScript 解析数字示例

表达式	值
<code>parseInt("2")</code>	2
<code>parseInt("2.8")</code>	2
<code>parseInt("2.8 个和尚")</code>	2
<code>parseInt(" 2.8 个和尚")</code>	2
<code>parseInt("")</code>	NaN
<code>parseInt("有 2.8 个和尚")</code>	NaN
<code>parseFloat("2.8")</code>	2.8
<code>parseFloat("2.8 个和尚")</code>	2.8

More about string

表 7-10 JavaScript 字符串常用方法

方法	用途
<code>charAt(index)</code>	在 <code>index</code> 处的字符，等于 <code>str[index]</code>
<code>charCodeAt(index)</code>	给出 <code>index</code> 处字符的编码（数字）
<code>String.fromCharCode(code)</code>	静态方法，将 <code>code</code> （数字）转换为对应的字符
<code>indexOf(searchStr)</code> <code>indexOf(searchStr, fromIndex)</code>	在 <code>str</code> 中从 <code>fromIndex</code> （缺省为 0）开始查找 <code>searchStr</code> ，找到则返回其第一次出现的位置；未找到返回 -1
<code>split(delimiter)</code> <code>split(delimiter, howMany)</code>	将 <code>str</code> 以 <code>delimiter</code> 为分隔符，截断为多个字符串，将这些字符串前 <code>howMany</code> 个组成一个数组返回；无 <code>howMany</code> 参数，则返回所有
<code>substring(start)</code> <code>substring(start, stop)</code>	返回 <code>str</code> 从 <code>start</code> 到 <code>stop</code> 的部分， <code>stop</code> 缺省为 <code>str</code> 结束
<code>toLowerCase()</code>	将 <code>str</code> 转换为全小写字符
<code>toUpperCase()</code>	将 <code>str</code> 转换为全大写字符

Immutable vs. mutable



JavaScript 字符串不可改变!: 字符串在 JavaScript 和许多高级语言一样, 例如: Java、C#等等, 是不可改变的 (immutable)。也就是说, 一经产生, 字符串本身的值就再也不会发生改变。变量赋值为字符串后, 除非重新赋值, 其值不变, 参考源代码 7-11。PHP、C、C++等语言则不同, 字符串本身的值是可以改变的, 参考源代码 7-12。↵

■ 源代码 7-11 JavaScript 字符串 immutable 示例↵

```
var str = "Hello";↵  
str[0] = "W";↵  
alert(str);    // "Hello"↵
```

■ 源代码 7-12 PHP 字符串 mutable 示例↵

```
<?php↵  
$str = "Hello";↵  
$str[0] = "W";↵  
echo $str;    // "Wello"↵  
?>↵
```

boolean type

```
var iLike190M = true;  
var ieIsGood = "IE6" > 0;    // false  
if ("web dev is great") {    /* true */ }  
if (0) { /* false */ }
```

JS

- any value can be used as a **Boolean**
 - "falsey" values: 0, 0.0, NaN, "", null, and undefined
 - "truthy" values: anything else
 - "0" and empty array are "truthy", which are "falsey" in PHP
- converting a value into a Boolean explicitly:
 - var boolValue = Boolean(otherValue);
 - var boolValue = !(otherValue);

Special values: **null**, **NaN**, **undefined**

```
var ned = null;  
var benson = 9;  
  
// at this point in the code,  
//   ned is null  
//   benson's 9  
//   caroline is undefined
```

JS

- **NaN**: not a number (only returned by the **isNaN()** function)
- **undefined** : has not been declared, does not exist
- **null** : exists, but was specifically assigned an null value

Logical operators

- `> < >= <= && || !== != === !==`
- most logical operators automatically convert types:
 - `5 < "7"` is **true**
 - `42 == 42.0` is **true**
 - `"5.0" == 5` is **true**
- `===` and `!==` are **strict equality** tests; checks both type and value
 - `"5.0" === 5` is **false**

<code>10 < "42"</code>	<code>true</code>
<code>10 < "42 人"</code>	<code>false</code>
<code>10 > "42 人"</code>	<code>false</code>
<code>10 == "42 人"</code>	<code>false</code>
<code>42 == "42"</code>	<code>true</code>
<code>42 == "42.0"</code>	<code>true</code>
<code>42 === 42.0</code>	<code>true</code>
<code>42 === "42"</code>	<code>false</code>

- **`NaN == NaN`, `NaN === NaN` are all false!**

Operators precedence

表 7-13 JavaScript 运算优先级（降序）

类别	操作符
括号	()
成员、索引操作符	. []
方法（函数）调用、对象创建	() new
逻辑非、负号、自增、自减、类型	! - ++ -- typeof delete void
乘、除、取模	* / %
加、减	+ -
关系比较、实例、包含	< > <= >= instanceof in
相等、不等比较	== != === !==
逻辑与	&&
逻辑非	
赋值	= += -= *= /= %=

if/else statement

```
if (condition) {  
    statements;  
} else if (condition) {  
    statements;  
} else {  
    statements;  
}
```

JS

- identical structure to Java's **if/else** statement
- JavaScript allows almost anything as a *condition*

for loop (same as Java)

```
for (initialization; condition; update) {  
    statements;  
}
```

JS

```
var sum = 0;  
for (var i = 0; i < 100; i++) {  
    sum = sum + i;  
}
```

JS

```
var s1 = "hello";  
var s2 = "";  
for (var i = 0; i < s.length; i++) {  
    s2 += s1.charAt(i) + s1.charAt(i);  
}  
// s2 stores "hheelllloo"
```

JS

while loops (same as Java)

```
while (condition) {  
    statements;  
}
```

JS

```
do {  
    statements;  
} while (condition);
```

JS

- break and continue keywords also behave as in **Java**

Variables scope

- Global and Local, the same as PHP, but without global statement when using global variables within a function

源代码 7-18 变量作用域示例↵

```
var a = 2;           // 全局变量↵
↵
function scopeExample() {↵
    alert(a);        // 弹出2↵
    a = 2 * 2↵
    b = 3;           // 隐式变量声明，b为全局变量！↵
    var c = 5;       // 局部变量↵
    // 这里a为4，b为3，c为5↵
}↵
scopeExample();↵
// 这里a为4，b为3，c为undefined↵
```

Variables scope

- Function scope, not block scope

源代码 7-19 函数作用域示例↵

```
function scopeExample2() {↵  
    for(var i = 0; i < 10; i++) {↵  
        var a = i * i;↵  
    }↵  
    // 这里i和a依然能够被访问↵  
    alert(i);↵  
    alert(a);↵  
}↵  
scopeExample2();↵  
// i 和 a 不能被访问, undefined↵
```

Scope



循环变量不要忘记 var: 循环变量如源代码 7-19 中的变量 `i`，如果忘记使用关键字 `var` 声明，会成为全局变量！这是个常见错误。↵



慎用全局变量: 绝大多数编程语言都认为要慎用全局变量，因为它很容易被某些代码“不注意地”改动。使用全局变量还违反低耦合的原则，使用全局变量的模块间会经由它产生相互依赖。网页前端 JavaScript 代码中更要尽量避免使用全局变量，因为一个网页可能同时使用若干个脚本，包括来源不同的脚本，而所有

这些脚本中的全局变量，都同时可以被其它脚本访问，这非常容易造成名称冲突和变量值被错误修改的问题。↵

Arrays

```
var name = []; // empty array
var name = [value, value, ..., value]; // pre-filled
name[index] = value; // store element JS
```

```
var ducks = ["Huey", "Dewey", "Louie"];

var stooges = []; // stooges.length is 0
stooges[0] = "Larry"; // stooges.length is 1
stooges[1] = "Moe"; // stooges.length is 2
stooges[4] = "Curly"; // stooges.length is 5
stooges[4] = "Shemp"; // stooges.length is 5 JS
```

- auto-increasing size
- different types of elements
- two ways to initialize an array
- **length** property (grows as needed when elements are added)

Arrays

源代码 7-20 数组示例

```
var a = [];           //空数组
a[0] = 23;            //23存储在数组下标为0处

var a2 = ["some", "strings", "in", "an", "array"];
a2.push("Ooh~");      //在数组末尾添加"Ooh~"
alert(a2.length);     //6
a2[100] = "Yeah!"     //将数组大小变为101，并给下标100处赋值"Yeah!"

alert(a2[99]);        //undefined
alert(a2.length);     //101
```

Array methods

```
var a = ["Stef", "Jason"]; // Stef, Jason
a.push("Brian");           // Stef, Jason, Brian
a.unshift("Kelly");        // Kelly, Stef, Jason, Brian
a.pop();                   // Kelly, Stef, Jason
a.shift();                 // Stef, Jason
a.sort();                  // Jason, Stef
```

JS

方法↵	用途↵
concat(array1, ..., arrayN)↵	将多个数组拼接成为一个↵
join()↵ join(separator)↵	将数组元素以 separator 为分隔符拼接成为一个字符串↵
pop()↵	弹出数组最后一个元素↵
push(value)↵ push(value1, ..., valueN)↵	将一个或者多个值压入数组↵
shift()↵	从头部取出一个元素，并依次向前移动其余元素↵
unshift(value)↵ unshift(value1, ..., valueN)↵	向头部添加一个元素，并依次向后移动其余元素↵
reverse()↵	改变当前数组，将其顺序翻转↵
sort()↵	改变当前数组，将其排序↵
slice(startIndex)↵ slice(startIndex, endIndex)↵	返回当前数组的子数组，子数组从 startIndex 开始，到 endIndex 结束，endIndex 缺省为数组长度↵
splice(index, count, value1, ..., valueN)↵	将当前数组从 index 起 count 个元素删除，并更换插入给定的多个值 (value1, ..., valueN) ↵

Splitting strings: split and join

```
var s = "the quick brown fox";  
var a = s.split(" ");           // ["the", "quick", "brown", "fox"]  
a.reverse();                    // ["fox", "brown", "quick", "the"]  
s = a.join("!");                // "fox!brown!quick!the" JS
```

- **split** breaks apart a string into an array using a delimiter
 - can also be used with **regular expressions** (seen later)
- **join** merges an array into a single string, placing a **delimiter** between them

Array example

源代码 7-21 JavaScript 数组方法使用示例

```
var userInfo = "张三|男|28|13860000660|zhangsan@mail.cn";  
var userInfoArray = userInfo.split("|");  
// [张三, 男, 28, 13860000660, zhangsan@mail.cn]  
  
var nameAndGender = userInfoArray.slice(0,2).join(", ");  
alert(nameAndGender); // 张三, 男  
  
userInfoArray.splice(3, 1, "中山大学", "18509087532");  
// [张三, 男, 28, 中山大学, 18509087532, zhangsan@mail.cn]  
  
alert(userInfoArray.join("|"));  
// 张三|男|28|中山大学|18509087532|zhangsan@mail.cn
```


eval

源代码 7-28 eval 函数用法示例

```
eval("3 + 2 - 5 * 0"); // 5  
var str = "Hello";  
eval("str = str + ' World!'");  
eval(alert(str)); // 弹出'Hello World!'
```



慎用 eval: eval 函数能够动态执行源代码，必须慎用。特别是当执行的源代码直接来自用户的输入，更要格外小心。如果不小心，造成代码注入的安全问题。

Simple Front-end App.

加法器

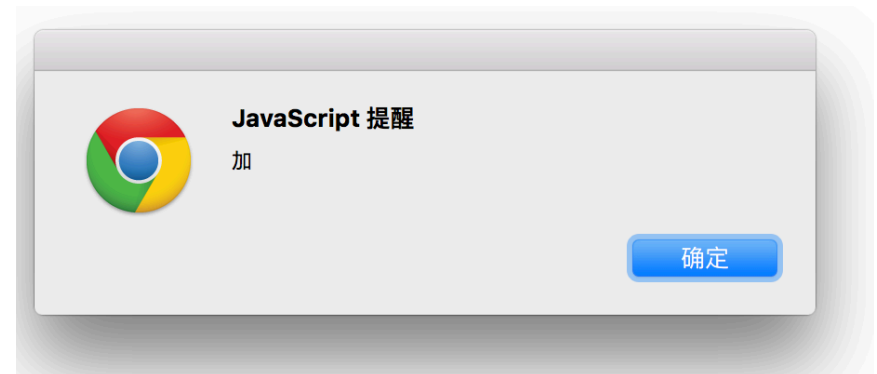
3 + 2 = 5

加

```
<h1>加法器</h1>
<div>
  <input id="left-operand"/> + <input id="right-operand"/>
  = <input id="result" disabled="disabled"/><br />
  <button id="add-button">加</button>
</div>
.....
```

```
1 window.onload = function() {
2   document.getElementById("add-button").onclick = function() {
3     var leftOperand = parseInt(document.getElementById("left-operand").value);
4     var rightOperand = parseInt(document.getElementById("right-operand").value);
5     var result = leftOperand + rightOperand;
6     document.getElementById("result").value = result;
  }
}
```

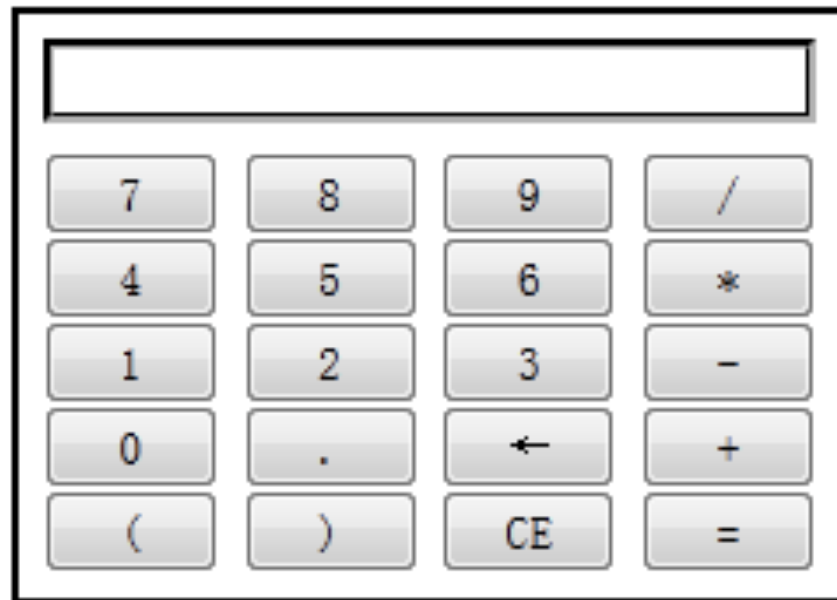
Simple Front-end App.



```
document.getElementById('add-button').onclick = function(event){  
    alert(event.target.textContent); // 加  
}
```

Calculator

简单计算器



Requirement Analysis

计算器通常的用例如下：

1. 响应用户对数字和算术操作符按钮的操作，记录并显示用户通过按钮输入的算术表达式。
2. 响应用户功能按钮的操作。
 - a) 用户按下“←”按钮，删除当前算术表达式最后一个字符，并更新显示。
 - b) 用户按下“CE”按钮，清除当前算术表达式。
 - c) 用户按下“=”按钮，计算当前表达式的结果并显示。
 - i. 如果，算术表达式非法，弹出警告框提醒用户，并终止计算。

Summary

- Client Side Basics
 - client-side vs. server-side
- Introduction to JavaScript
 - standard, language type, purposes & uages
 - language comparisons (Java, PHP)
- JavaScript Basic Syntax
 - comments, alert, confirm, prompt
 - variables and types: Number, Boolean, String (split/join)
 - null, NaN, undefined
 - Math object, logical operators
 - if/else, for, while
 - Array

Exercises

- write JavaScript snippets in Firebug console:
 - create a Fibonacci function, `fabonacci(n)`, which returns the n th element of the Fibonacci sequence
 - create a function `hideVowel(str)`, which returns a string replacing all vowels in the given `str` with “*”
 - create a function `quickSort(array)`, which sorts the given array using the Quick Sort algorithm

Further Readings

- Introduction of JavaScript
<http://en.wikipedia.org/wiki/JavaScript>
- W3Schools JavaScript tutorial
<http://www.w3schools.com/js/default.asp>
- Mozilla Developer Center JavaScript documentation
<https://developer.mozilla.org/en/javascript>

Thank you!

