THE JSCRIPT LANGUAGE SPECIFICATION

Version 0.1

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DOCUMENTATION NOTATION

Throughout this document, comments in *italic and colored in red* indicate differences with Java language conventions.

FEEDBACK

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CONTENTS

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NOTATIONAL CONVENTIONS

This specification organizes sections into five categories: syntax, constraints, description, semantics, and discussion.

Category	Description
Syntax	Describes the syntax of some language entity
Constraints	Adds textual constraints to the syntax description. These constraints normally cannot be described using formal syntax.
Description	A textual description of the entity.
Semantics	The semantics of the language entity. This and the syntax category are normally the most rigorous section of the section.
Discussion	A textual discussion of the language entity being described. This section is to give greater insight through examples and non-formal text.

The syntax notation is similar to that used in the ANSI C Language Specification[1]. Syntactic categories are represented by *italic* type. Literals are specified in **`fixed-font`** bold type. Syntactic productions are specified by the rule name followed by a colon followed by one or more definitions. Definitions are placed on separate lines. Alternately, definitions can be space separated if the definitions are prefaced by the words "one of". Appending the subscript "opt" to the symbol specifies that the construct is optional. The basic syntax of this descriptive form is as follows:

Entity	Syntax	Definition
Production	*ProductionSymbol* **`:`** *LineSeparatedDefinitions* OR *ProductionSymbol* **`: one of`** *SpaceSeparatedDefinitions*	Syntax rules (productions) are specified by a name (RuleName) and a rule body (RuleBody) separated by a ':'. If the words "one of" are placed after the colon then the production definitions are space separated.
LineSeparatedDefinitions	One or more of: *Definition* <newline>	Alternate definitions are placed on separate lines.
SpaceSeparatedDefinitions	One or more of: *Definition* <space>	Alternate defintions are placed on the same line and separated by white space. This convention is normally used to specify lexical categories.
Definition	One or more of: *SyntacticElement*	A rule statement consists of one or more syntactic elements.
SyntacticElement	*Literal* *ProductionSymbol* $Literal_{opt}$ $ProductionSymbol_{opt}$	A syntactic element can either be a literal or a production symbol that specifies a production rule. If the syntactic element is optional then literals or production symbols are subscripted with "opt".
Literal	Text in fixed-spaced bold font. Examples: one of **`while ( ) { }`**	Literals specify text as it must appear in the source text. Literals are specified in a **`fixed-spaced bold font`**.
ProductionSymbol	An *italic* identifier. Eaxmple: one of *WhileStatement* *ArithmeticExpression*	A production symbol is a symbol that specifies a production. Production symbols are in *italic font*.

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UNICODE

JScript source text is represented as Unicode version 2.0. To support ASCII based systems, it is possible to represent any Unicode value as a sequence of ASCII values within a source document. Within an ASCII based source document, non-escaped values are translated to their Unicode equivalents. Escaped values are represented in the source text as a "\u" followed by four hex digits:

UnicodeEscapeSequence:
\u *HexDigit HexDigit HexDigit HexDigit*

HexDigit: one of
0 1 2 3 4 5 6 7 8 9
a b c d e f
A B C D E F

A 16-bit Unicode value is derived from the hex digits. The leftmost digits constitute the high order bits of the Unicode value. A Unicode escape sequence can occur anywhere in the source text and will be translated into its Unicode equivalent.

Non-ASCII Unicode values are limited to string constants and comment text. All other occurrences are in error. *Unlike Java, Unicode characters are not allowed in identifiers.*

3 LEXICAL CONVENTIONS

The source text to a JScript program is first converted into a sequence of tokens and white space. A token is a sequence of characters from the source text that constitutes a lexical element. The source text is scanned from left to right, repeatedly taking the longest possible sequence of characters as the next token.

White space is a sequence of whitespace characters and comments. White space may occur between any two tokens, but it is not required.

3.1 WHITE SPACE

White space characters are used to separate tokens from one another. White space can also be used to format the source text. Because white space characters are used to delineate lexical units they cannot be used within a lexical unit. The following characters are considered white space:

Unicode Value	Name
\u000A	Tab
\u000D	Newline
\u0010	Line feed
\u0019	End of medium (^Z)
\u0020	Space

3.2 COMMENTS

Like white space, comments separate tokens.

Syntax

Comment:
MultiLineComment
SingleLineComment

MultiLineComment:
/* *MultiLineCommentChars* ***/**

MultiLineCommentChars:
<any Unicode character except asterisk ***** *>* *MultiLineCommentChars*$_{opt}$
***** *PostAsteriskCommentChars*$_{opt}$

PostAsteriskCommentChars
<any Unicode character except forward-slash **/** *>* *MultiLineCommentChars*$_{opt}$

SingleLineComment:
// *SingleLineCommentChars*$_{opt}$ *<newline>*

SingleLineCommentChars
<any Unicode character except newline> *SingleLineCommentChars*$_{opt}$

Description
Comments can be either single or multi-line. Multi-line comments cannot nest.

The Java documentation comment (`/** text */`) convention is not explicitly endorsed.

3.3 TOKENS

Syntax
Token:
Keyword
Identifier
Punctuator
Operator
Literal

3.3.1 Keywords

Syntax
Keyword*: one of*

abstract	**else**	**int**	**switch**
arguments	**extends**	**interface**	**synchronized**
boolean	**false**	**long**	**this**
break	**final**	**native**	**throw**
byte	**finally**	**new**	**throws**
case	**float**	**null**	**transient**
catch	**for**	**package**	**true**
char	**function**	**private**	**try**
class	**goto**	**protected**	**typeof**
const	**if**	**public**	**var**
continue	**implements**	**return**	**void**
default	**import**	**short**	**while**
do	**in**	**static**	**with**
double	**instanceof**	**super**	

Description
Keyword tokens are reserved and cannot be used as identifiers. Keywords are case-sensitive; for example, **`double`** is a keyword, but **`Double`** is an identifier.

Discussion
True, false, and null are, semantically speaking, actually literal constants.

Many of these keywords are not used by the JScript language and a reserved for future use. The keywords currently in use by JScript are:

KeywordsInUse: one of

arguments	**else**	**in**	**true**
break	**false**	**new**	**typeof**
case	**for**	**null**	**var**
continue	**function**	**return**	**void**
default	**goto**	**switch**	**while**
do	**if**	**this**	**with**

ISSUE: What is the rationale for reserving Java specific keywords?

3.3.2 Identifiers

Syntax

Identifier:
IdentifierPreface IdentifierBody

IdentifierPreface: one of
Letter
_ $

IdentifierBody:
BodyCharacter
IdentifierBody BodyCharacter

BodyCharacter: one of
Letter
0 1 2 3 4 5 6 7 8 9
_ $

Letter: one of
a b c d e f g h i j k l m n o p q r s t u v w x y z
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Description

An identifier is a sequence of letters, digits, and extended alphabetic characters that must begin with a character from a distinguished set of characters called the *identifier preface*. JScript is a case sensitive language; that is, identifiers that differ only in the case of one or more of their constituent characters are considered to be unique. So, for example, the identifier **xxx** is different from the identifier **Xxx.** There is no defined limit on the length of identifiers.

Semantics

An identifier denotes a variable, a function argument, a function, an object property, or an object method.

3.3.3 Operators

Syntax

Operator: one of

=	**|=**	**^**	**<<**	**~**
+=	**<<=**	**&**	**>>**	**!**
-=	**>>=**	**==**	**>>>**	**++**
***=**	**>>>=**	**!=**	**+**	**--**
/=	**?:**	**<**	**-**	**[]**
%=	**||**	**<=**	*****	**.**
&=	**&&**	**>**	**/**	**()**
^=	**|**	**>=**	**%**	**?:**

Semantics
An operator specifies an operation to be performed that produces a value. Operators are applied to one or more operands.

3.4 LITERALS

Syntax

Literal:
NullLiteral
BooleanLiteral
NumericLiteral
StringLiteral

Constraints
Literal must specify values that are in the range of values for their corresponding type.

3.4.1 The Null Literal

Syntax

NullLiteral:
`null`

Semantics
The null type consists of a single unique value called "null". The **`null`** literal specifies this immutable value.

3.4.2 Boolean Literals

Syntax

BooleanLiteral: one of
`true false`

Semantics
The boolean type consists of two values: **`true`** and **`false`**. These elements can be directly specified using the **`true`** and **`false`** keywords:

3.4.3 Numeric Literals

Syntax

NumericLiteral:
DecimalLiteral
HexLiteral
OctalLiteral

DecimalLiteral:
IntegralLiteral
RealLiteral Exponent

IntegralLiteral:
NonzeroDecimalDigit DecimalDigits

NonzeroDecimalDigit: one of
`1 2 3 4 5 6 7 8 9`

DecimalDigits:
DecimalDigit
DecimalDigits DecimalDigit

Digit: one of
0 1 2 3 4 5 6 7 8 9

RealLiteral:
DecimalDigits$_{opt}$ **.** *DecimalDigits*
DecimalDigits **.**

Exponent:
e *Sign*$_{opt}$ *DecimalDigits*
E *Sign*$_{opt}$ *DecimalDigits*

Sign: one of
+ -

HexLiteral:
0x *HexDigits*
0X *HexDigits*

HexDigits:
HexDigit
HexDigits HexDigit

HexDigit: one of
0 1 2 3 4 5 6 7 8 9
a b c d e f
A B C D E F

OctalLiteral:
0 *OctalDigits*

OctalDigits: one of
0 1 2 3 4 5 6 7

Description
Number literals can be specified in hexadecimal, octal, and decimal. The hexadecimal and octal representations can only be used to represent integers. The decimal representation can be used to specify either integers or real numbers (possibly in scientific notation).

Semantics
Numeric literals cannot exceed the precision of the number type. The number type is capable of representing at least 64 bit IEEE floating point numbers.

3.4.4 String Literals

Syntax
StringLiteral:
" *NotDoubleQuoteStringCharacters* **"**
' *NotSingleQuoteStringCharacters* **'**

NotDoubleQuoteStringCharacters:
Any Unicode character except double-quote **"**, *backslash* **** *and the newline character*
EscapeSequence

NotSingleQuoteStringCharacters:
Any Unicode character except single-quote **'**, *backslash* **** *and the newline character*
EscapeSequence

EscapeSequence:
    CharacterEscapeSequence
    HexEscapeSequence
    UnicodeEscapeSequence

CharacterEscapeSequence: one of
    \' \" \\ \b \f \n \r \t

HexEscapeSequence:
    \x *HexDigits*

Description
Strings can contain any Unicode characters. The maximum string constant supported must be at least 32,000 characters long.

4 TYPES

There are seven types of entities in JScript: Undefined, Null, Boolean, Number, String, Object, and Array.

4.1 THE UNDEFINED TYPE

The undefined type consists of a single unique value, called **undefined**.

4.2 THE NULL TYPE

The null type consists of a single unique value called **null**.

4.3 THE BOOLEAN TYPE

The Boolean type consists of two unique values, called **true** and **false**.

4.4 THE NUMBER TYPE

The Number type consists of integer and real values. The Number type has at least the precision and range of 64 bit IEEE floating point numbers.

4.5 THE STRING TYPE

Elements of the String type are arrays of Unicode characters. Strings are immutable: once created, the length and contents of a string cannot be changed.

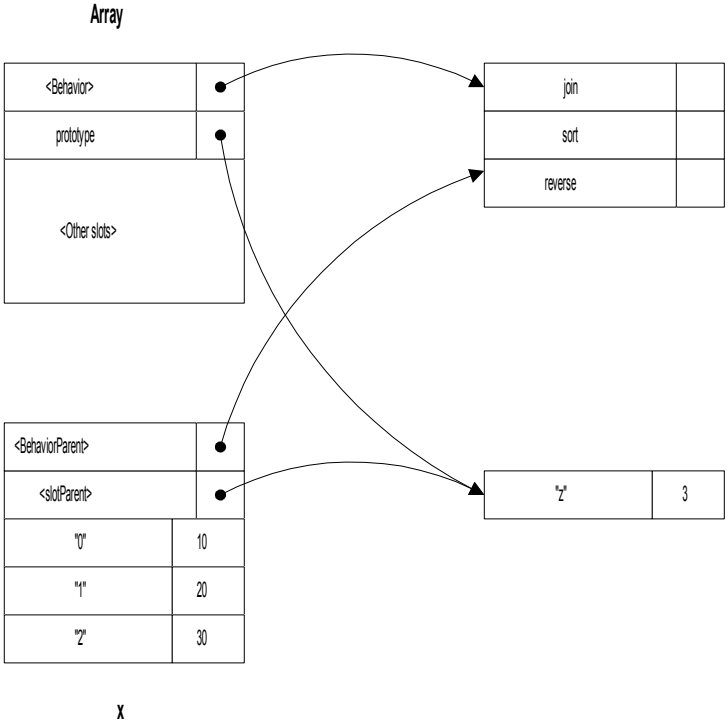
4.6 THE OBJECT TYPE

Objects are unordered collections of name-value pairs called “slots”. In each pair, the name is a string, and the value can be of any type. Objects are mutable: values may be changed, and slots may be added and removed at any time.

4.7 THE ARRAY SUBTYPE OF OBJECT

An array is an object with a property called `length` whose value is always one greater than the largest integral slot name in the object. Assignment to the `length` property is a run-time error.

```
Array.prototype.z = 3;
x = new Array(10, 20, 30);
```



5 PROPERTIES

Objects and non-reference values may have "properties". A property is a value associated with a name string.

5.1 OBJECT PROPERTIES

Every slot of an object has a corresponding property with the same name and value as the slot.

5.2 PROPERTY INHERITANCE

All entities contain two properties <BehaviorParent> and <SlotParent> whose names are undefined. The slots in these objects are accessible as properties of the entity. A property named *X* is retrieved as follows:

1. If the entity has a property called *X*, its value is retrieved.
2. Otherwise, if the <SlotParent> of the entity has a slot called *X*, its value is retrieved.
3. Otherwise, if the <BehaviorParent> of the entity has a slot called *X*, its value is retrieved.
4. Otherwise, the value **undefined** is retrieved.

Refer to the description of the **`new`** operator for a description of how <BehaviorParent> and <SlotParent> are initialized.

6 BUILT-IN OBJECTS

There are a number of predefined objects in JScript.

6.1 CONSTRUCTORS

Some types have an associated constructor function that can be used with the **`new`** operator. The Object and Array constructors return objects and arrays. The Number and String constructors construct objects that

wrap entities of those types. A wrapper object has a valueOf method that returns the original entity, and a toString method that returns the string representation of the original entity. The constructor functions also may have properties and methods useful for all members of the type. Entities may be coerced to objects by converting them to their types' corresponding constructors.

References to the constructor functions are contained in global variables named for the types.

6.1.1 Boolean

The Boolean constructor has two modes.

- With no arguments, it returns an object whose valueOf method returns false.
- With one argument, which must be a boolean, it returns an object whose valueOf method returns the argument.

6.1.2 Number

The Number constructor has two modes.

- With no arguments, it returns an object whose valueOf method returns 0.
- With one argument, which must be a number, it returns an object whose valueOf method returns the argument.

6.1.3 String

The String constructor takes one argument, a string.

6.1.4 Object

The Object constructor takes no arguments and returns an empty object.

6.1.5 Array

The **`Array`** constructor has three modes:

- With no arguments, it creates an array with a length property of 0.
- With one argument *X*, if *X* is a Number, it creates an array with a length property of *X*. Otherwise, it creates an array with a length property of 1 whose "0" slot contains *X*.
- With more than one argument, it creates an array with the arguments as the values of its numbered slots, numbered from zero left-to-right. The length property of the array is the number of arguments.

6.2 BEHAVIOR PARENTS

Each type has an associated <BehaviorParent> object, which contains the standard built-in behaviors for the type. Each type's <BehaviorParent> includes a valueOf method that returns the object itself, and a toString method that returns the string representation of the object. Some have more properties, as follows.

6.2.1 Number

Aside from valueOf and toString, the properties of Number's <BehaviorParent> are as follows:

6.2.1.1 NaN

A property with a constant value that is equivalent to the IEEE "Not-a-Number" value.

6.2.2 String

Aside from valueOf and toString, the properties of String's <BehaviorParent> are as follows.

6.2.2.1 Length

An integer giving the total number of characters in the string. This property cannot be altered by assignment.

6.2.2.2 IndexOf

A function object.

With one argument, *searchString,* which is coerced to a string, returns the index in **`this`** of the first occurrence of *searchString*, or –1 if not found.

With two arguments, *searchString* and *startIndex*, begins the search at *startIndex*.

6.2.2.3 lastIndexOf

A function object.

With one argument, *searchString,* which is coerced to a string, returns the index in **`this`** of the last occurrence of *searchString*, or –1 if not found.

With two arguments, *searchString* and *startIndex*, begins the (backwards) search at *startIndex*.

6.2.2.4 Substring

A function object taking two arguments, *first* and *limit*, which are coerced to integers. If *first* is less than *limit*, returns a string containing the characters of **`this`** starting with index *first* and extending to index *limit* – 1. If *first* is greater than *limit*, returns a string containing the characters of **`this`** starting with index *limit* and extending to index *first* – 1. If *first* is equal to *limit*, returns an empty string.

6.2.2.5 charAt

A function object taking one argument, *index*, which is coerced to an integer. If index is less than zero or greater than **`this.length`** – 1, an empty string is returned. Otherwise, a string containing the character at index *index* in **`this`** is returned.

6.2.2.6 toLowerCase

A function object taking no arguments. Returns a string containing the contents of **`this`** converted to lower case.

6.2.2.7 toUpperCase

A function object taking no arguments. Returns a string containing the contents of **`this`** converted to upper case.

6.2.2.8 split

A function object taking one argument, *separator*, which is coerced to a string. Returns an array of strings generated by separating **`this`** into substrings based on separator.

6.2.3 Array

Aside from valueOf and toString, the properties of Array's <BehaviorParent> are as follows:

6.2.3.1 join

A function object taking no arguments, or one argument, *separator*, which is coerced to a string. Returns a string consisting of the elements of **`this`**, coerced to strings, concatenated with *separator* in between each pair of elements. The no-argument form is the same as passing "," as *separator*.

6.2.3.2 reverse

A function object taking no arguments. Reverses the order of the elements of **`this`**.

6.2.3.3 sort

A function object taking no arguments, or one argument, *compareFunc*, a function of two arguments. Sorts the elements of this according to the comparisons done by compareFunc. The no-argument form uses dictionary order of the string conversions of the elements.

6.3 MATH

The Math object has properties that are functions and constants useful for mathematical computation. The value of the global variable "Math" is a reference to the Math object.

6.3.1 The abs Method

Description

Determines the absolute value of its numeric argument.

Syntax

Math.abs(number)
The number argument is a numeric expression for which the absolute value is sought.

Remarks

The return value is the absolute value of the number argument.

6.3.2 The acos Method

Description

Computes the arccosine of its numeric argument.

Syntax

Math.acos(number)
The number argument is a numeric expression for which the arccosine is sought.

Remarks

The return value is the arccosine of the number argument.

6.3.3 The asin Method

Description

Computes the arcsine of its numeric argument.

Syntax

Math.asin(number)
The number argument is a numeric expression for which the arcsine is sought.

Remarks

The return value is the arcsine of its numeric argument.

6.3.4 The atan Method

Description

Computes the arctangent of its numeric argument.

Syntax

Math.atan(number)
The number argument is a numeric expression for which the arctangent is sought.

Remarks

The return value is the arctangent of its numeric argument.

6.3.5 The ceil Method

Description

Determines the smallest integer greater than or equal to its numeric argument.

Syntax

Math.ceil(number)
The number argument is a numeric expression.

Remarks

The return value is an integer value equal to the smallest integer greater than or equal to its numeric argument.

6.3.6 The cos Method

Description

Computes the cosine of its numeric argument.

Syntax

Math.cos(number)
The number argument is a numeric expression for which the cosine is sought.

Remarks

The return value is the cosine of its numeric argument.

6.3.7 The E Property

Description

Euler's constant, the base of natural algorithms. The E property is approximately equal to 2.718.

Syntax

var numVar
numVar = Math.E

6.3.8 The exp Method

Description

Computes **Error! Bookmark not defined.** to the power of the supplied numeric argument.

Syntax

Math.exp(number)
The number argument is a numeric expression representing the power of e.

Remarks

The return value is enumber The constant e is Euler's constantm, approximately equal to 2.178 and number is the supplied argument.

6.3.9 The floor Method

Description

Computes the greatest integer less than or equal to its numeric argument.

Syntax

Math.floor(number)
The number argument is a numeric expression.

6.3.10 The LN10 Property

Remarks

The return value is an integer value equal to the greatest integer less than or equal to its numeric argument.

Description

The natural logarithm of 10.

Syntax

var numVar
numVar = Math.LN10

Remarks

The LN10 property is approximately equal to 2.302.

6.3.11 The LN2 Property

Description

The natural logarithm of 2.

Syntax

var numVar
numVar = Math.LN2

Syntax

The LN2 property is approximately equal to 0.693.

6.3.12 The LOG10E Property

Description

The base 10 logarithm of e, Euler's constant.

Syntax

var varName
varName = objName.LOG10E

Remarks

The LOG10E property, a constant, is approximately equal to 0.434.

6.3.13 The PI Property

Description

The ratio of the circumference of a circle to its diameter.

Syntax

var numVar
numVar = Math.PI

Syntax

The pi property, a constant, is approximately equal to 3.14159.

6.3.14 The SQRT1_2 Property

Description

The square root of 0.5, or one divided by the square root of 2.

Syntax

var numVar
numVar = Math.SQRT1_2

Remarks

The SQRT1_2 property, a constant, is approximately equal to 0.707.

6.3.15 The SQRT2 Property

Description

The square root of 2.

Syntax

var numVar
numVar = Math.SQRT2

Syntax

The SQRT2 property, a constant, is approximately equal to 1.414.

7 VARIABLE SCOPING

7.1.1 The Scope of Variables

The visibility of an variable is called its scope. In JScript, scopes can be nested such that an *inner* scope is completely contained by an *outer* scope. If an identifier of the same name is defined by both the inner and outer scopes then the identifier resolves to the entity defined by the inner scope. This is generally termed lexical scoping. JScript has five lexically nested scoping levels: global, host-defined, function arguments, function locals, and with.

Context	Description
Global	Global variables are visible from any point in the source text so long as the name used to specify the variable is not masked by a nested scope.
Host-defined	The host system may define variables that are available anywhere in the source text and hide global variables defined in JScript source. (The definition mechanism is beyond the scope of the JScript specification.)
Function Arguments	A caller passes argument values to functions. These values are bound to argument variables that can be accessed within the body of a function or method.
Function Locals	Local variables can be defined within a function body and are visible from within that function body. (Note that nested statement blocks within a function do *not* constitute separate scopes.)
With Block	A with block can be used to associate a scope with a particular object. Identifiers specified within the with block first try to resolve to the properties on the object specified by the with expression.

7.1.2 Implicit Global Variables

If a variable assignment statement is executed whose variable identifier is not found in any scope, a global variable is created.

8 COERCION

Coercion are performed to convert a value of one type into a value of another type. Coercion is used to implement the core unary and binary operators. The following tables detail the coercions performed for the different operators.

The following table details the conversions performed on different types of arguments for the + and += operators:

+ +=	**Object**	**non-numeric string**	**Numeric String**	**number**	**Bool**	**undefined**	**null**
Object	String	String	String	String	String	String	String
non-numeric string	String	String	String	String	String	String	String
Numeric String	String	String	String	String	String	String	String
Number	String	String	String	Numeric	Numeric	Error	Error
Bool	String	String	String	Numeric	Numeric	Error	Error
Undefined	String	String	String	Error	Error	Error	Error
Null	String	String	String	Error	Error	Error	Error

The following table details the coercions for the equality operators:

== !=	**Object**	**non-numeric string**	**numeric string**	**number**	**bool**	**undefined**	**null**
Object	**true false**	**false**	**False**	**false**	**false**	**false**	**false**
Non-numeric string	**false**	String	String	Error	Error	Error	**false**
Numeric String	**false**	String	String	Numeric	Numeric	Error	**false**
Number	**false**	Error	Numeric	Numeric	Numeric	Error	**true**
Bool	**false**	Error	Numeric	Numeric	Numeric	Error	**true**
Undefined	**false**	Error	Error	Error	Error	Error	**true**
Null	**false**	**False**	**False**	**true**	**true**	**true**	**true**

The following table details the coercions for the relational operators:

< <= > >=	**Object**	**non-numeric**	**Numeric String**	**number**	**bool**	**undefined**	**null**

		string					
Object	String	String	String	Numeric	Numeric	Error	Error
Non-numeric string	String	String	String	Error	Error	Error	Error
Numeric String	String	String	String	Numeric	Numeric	Error	Error
Number	Numeric	Error	Numeric	Numeric	Numeric	Error	Error
Bool	Numeric	Error	Numeric	Numeric	Numeric	Error	Error
Undefined	Error	Error	Error	Error	Error	Error	Error
Null	Error	Error	Error	Error	Error	Error	Error

The following table details the coercions for the rest of the binary operators:

	Object	**non-numeric string**	**numeric string**	**number**	**bool**	**Undefined**	**null**
Object	Numeric	Error	Numeric	Numeric	Numeric	Error	Error
non-numeric string	Error	Error	Error	Error	Error	Error	Error
Numeric String	Numeric	Error	Numeric	Numeric	Numeric	Error	Error
Number	Numeric	Error	Numeric	Numeric	Numeric	Error	Error
Bool	Numeric	Error	Numeric	Numeric	Numeric	Error	Error
Undefined	Error	Error	Error	Error	Error	Error	Error
Null	Error	Error	Error	Error	Error	Error	Error

8.1 REFERENCE COMPARISONS

Objects compare by reference, so

```
(Math == Math) === true
(Math == Date) === false
```

8.2 OPERATORS: `&&, ||, !`

The following are the rules for converting to a boolean:

- All objects are true.
- Strings are false if and only if they are empty.
- Null and undefined are false.
- Numbers are false if and only if they are 0.

8.3 UNARY OPERATORS: ++, --, -, ~

These work as follows:

- Applied to undefined or null signals a runtime error.
- Objects are converted to strings (toString function), then the string is converted to a numbers.
- Strings are converted to numbers (error if not possible), then the operator applied to the number.
- Booleans are treated as numbers (false is 0 and true is 1).

8.4 STRING CONVERSIONS

Conversion from number from string uses the same rules as parseFloat, except that in cases their behavior differs. Error cases involving conversion (rather than parsing) result in runtime errors.

8.5 BITWISE OPERATORS AND NUMBERS

Numbers are truncated as necessary to produce the 32-bit integers used by the bitwise operators.

9 EXPRESSIONS

9.1 PRIMARY EXPRESSIONS

Syntax

PrimaryExpression:
this
arguments
Identifier
Literal
(*Expression* **)**

9.1.1 The **this** Keyword

The **this** keyword has meaning in two contexts:

1. When a function is called as a method of an object; in this case the **this** pointer refers to the calling object.
2. When a function is being called as a constructor; that is, in the context of a new expression. In this case, the **this** pointer refers to the object being constructed.

In all other cases the **this** pointer is undefined.

9.1.2 The **arguments** Keyword

The **arguments** keyword refers to an array that represents the arguments of current activation frame. The **arguments** keyword is generally used when a function takes a variable number of arguments. The arguments array holds the argument values in the same order as they are evaluated, that is, the 0^{th} array element contains the 0^{th} (leftmost) argument, the 1^{st} array element contains the 1^{st} argument and so on.

This interpretation of the "arguments" within a function body differs from existing practice but has two important advantages of the current mechanism:

1. It can be much more efficiently implemented, especially in the case of recursive functions.
2. It eliminates some complex and confusing semantic issues that arise as a result of the arguments to an activation frame being accessible from a function object.

9.1.3 Variable reference

An identifier resolves itself using the scoping rules stated in section 7.

9.2 POSTFIX OPERATORS

Syntax

MemberExpression:
PostfixExpression **[** *Expression* **]**
PostfixExpression **.** *Identifier*

FunctionCallExpression:

PostfixExpression **(** *ArgumentList* **)**

PostfixExpression:
PrimaryExpression
MemberExpression
FunctionCallExpression
PostfixExpression **++**
PostfixExpression **--**

9.2.1 Property Accessors

Properties are accessed by name, using either the dot notation *PostfixExpression* . *Identifier* or the bracket notation *PostfixExpression* **[** *Expression* **]**.

The dot notation is transformed using the following syntactic conversion:

PostfixExpression **.** *Identifier*

is exactly equivalent to:

PostfixExpression **[** <identifier-string> **]**

Where <identifier-string> is a string literal containing the same characters as the identifier.

The bracket notation is transformed using the following syntactic conversion:

PostfixExpression **[** *Expression* **]**

is exactly equivalent to:

PostfixExpression **["" + (** *Expression* **)]**

9.2.2 Function Calls

Function calls are evaluated as follows:
1. *PostfixExpression* must evaluate to a function object.
2. *ArgumentList* is evaluated from left to right.
3. An activation frame is created to hold the arguments.
4. A special **this** reference in the activation frame is set to **undefined**. This reference is used to resolve references resulting from use of the **this** keyword.
5. If a reference in the function body is made to the **arguments** keyword, then a special arguments reference must be initialized to point to the array of arguments as specified by the **arguments** keyword. Note that this step is only required if the function body refers to the **arguments** keyword.
6. The function body is evaluated using the activation frame as the execution context.
7. Any return value is captured for the caller and the activation frame is discarded.
8. Control is returned to the caller.

9.2.3 Object Method Calls

Object method calls are evaluated as follows:
1. The*PostfixExpression* preceeding the (ArgumentList) must be a *MemberExpression*. The *MemberExpression* is evaluated and must yield a property that evaluates to a function object. Otherwise, a runtime error is signalled.
2. The argument list is evaluated from left to right.
3. An activation frame is created to hold the arguments.

4. A special **this** reference in the activation frame is bound to the target entity mentioned in step 1. This reference is used to resolve references resulting from the use of the **this** keyword.
5. If a reference in the function body is made to the **arguments** keyword, then a special arguments reference must be initialized to point to the array of arguments as specified by the **arguments** keyword. Note that this step is only required if the function body refers to the **arguments** keyword.
6. Any return value is captured for the caller and the activation frame is discarded.
7. Control is returned to the caller.

9.2.4 Postfix Increment and Decrement Operators

These operators are evaluated as follows:
1. PostfixExpression is evaluated and must yield an lvalue.
2. The lvalue from step 1 is dereferenced and an attempt is made to coerce it to a number. If this fails then a runtime error is signaled.
3. The value from step 1 is increased or decreased by one as necessary.
4. The lvalue is assigned the value from step 3.
5. The value from step 1 is the expression result.

9.3 UNARY OPERATORS

Syntax

UnaryExpression:
PostfixExpression
new *FunctionCallExpression*
delete *MemberExpression*
void *UnaryExpression*
typeof *UnaryExpression*
++ *UnaryExpression*
-- *UnaryExpression*
- *UnaryExpression*
~ *UnaryExpression*
! *UnaryExpression*

9.3.1 The **new** Expression

The **new** operator creates new entities using constructor functions. A **new** expression performs the following steps:

1. A new, empty object is created.
2. The <BehaviorParent> property is initialized in an implementation-dependent manner to support the type-specific operations on the entity.
3. The <SlotParent> property is initialized with a reference to the constructor function's **prototype** slot.
4. The constructor function is executed with **this** bound to the new object.
5. The value of the **new** expression is a reference to the object created in step 1.

9.3.2 The **delete** Expression

The delete expression removes a property from an entity, if found. Delete is implemented as follows:
1. The delete *MemberExpression* is evaluated.
2. If the *MemberExpression* does not resolve to a valid entity property then **false** is returned as the expression result.
3. Otherwise, the referred to property is removed from the entity and **true** is returned as the expression result.
4. Attempting to removing built-in properties may result in a runtime error being signaled.

9.3.3 The `void` Expression

The void expression discards the value *UnaryExpression* and returns **`undefined`**.

9.3.4 The `typeof` Expression

Typeof returns a string representation of the type of the given *UnaryExpression*. The strings returned for the various types are as follows:

Type	Result
Undefined	"undefined"
Null	"object"
Boolean	"boolean"
Number	"number"
String	"string"
Object	"object"
Array	"object"

9.3.5 Prefix Increment and Decrement Operators

These operators are evaluated as follows:

1. *UnaryExpression* is evaluated and must yield an lvalue.
2. The lvalue from step 1 is dereferenced and an attempt is made to coerce it to a number. If this fails then a runtime error is signaled.
3. The value from step 1 is increased or decreased by one as necessary.
4. The lvalue is assigned the value from step 3.
5. The value from step 3 is the expression result.

9.3.6 Unary `+-` Operators

The UnaryExpression is evaluated and must be coercible to a number. If the coercion fails then a runtime error is signalled. Otherwise, if the operator specified is the negation operator then the number is negated and returned as the result of the expression.

9.3.7 The Bitwise NOT Operator (`~`)

The UnaryExpression is evaluated and must be coercible to a number. If the coercion fails then a runtime error is signaled. Otherwise, the number is converted into a 32-bit integer and a bitwise NOT is applied to the value and the result returned as the result of the expression.

9.3.8 Logical NOT Operator (`!`)

The UnaryExpression is evaluated and must be coercible to a boolean. If the coercion fails then a runtime error is signaled. Otherwise, the logical not is applied to the boolean value and returned.

9.4 MULTIPLICATIVE OPERATORS

Syntax

MultiplicativeExpression:
UnaryExpression
MultiplicativeExpression **`*`** *UnaryExpression*
MultiplicativeExpression **`/`** *UnaryExpression*
MultiplicativeExpression **`%`** *UnaryExpression*

9.4.1 The Division Operator (/)

The *MultiplicativeExpression* and the *UnaryExpressions* are evaluated (in that order) and must be coercible to numbers. If the coercion fails on either argument then a runtime error is signaled. If *MultiplicativeExpression* fails to coerce then *UnaryExpression* is not evaluated at all.

MultiplicativeExpression is then divided by the *UnaryExpression*. If *UnaryExpression* is zero then a runtime error is signaled. The division is performed as if both arguments where represented as floating point.

9.4.2 The Multiplication Operator (*)

The *MultiplicativeExpression* and the *UnaryExpressions* are evaluated (in that order) and must be coercible to numbers. If the coercion fails on either argument then a runtime error is signaled. If *MultiplicativeExpression* fails to coerce then *UnaryExpression* is not evaluated at all.

The product of MultiplicativeExpression and UnaryExpression is computed. The multiplication is performed as if both arguments where represented as floating point.

9.4.3 The Modulus Operator (%)

The *MultiplicativeExpression* and the *UnaryExpression* are evaluated (in that order) and must be coercible to numbers. If the coercion fails on either argument then a runtime error is signaled. If *MultiplicativeExpression* fails to coerce then *UnaryExpression* is not evaluated at all.

Returns the value *MultiplicativeExpression - i * UnaryExpression,* for some integer i such that, if *UnaryExpression* != 0 then the result has the same sign as *MultiplicativeExpression* and magnitude less than the magnitude of *UnaryExpression*. If *UnaryExpression* is zero then the result is undefined.

9.5 ADDITIVE OPERATORS

Syntax

AdditiveExpression:
MultiplicativeExpression
AdditiveExpression **+** *MultiplicativeExpression*
AdditiveExpression **–** *MultiplicativeExpression*

9.5.1 The Addition Operator (+)

The addition operator either performs string concatenation or numeric addition. If either argument can only be coerced to a string then string concatenation is performed. This occurs when one of the arguments is a string, function, or object entity.

9.5.2 The Subtraction Operator (–)

The subtraction operator performs numeric subtraction. Both arguments must be coercible to numbers. Otherwise a runtime error is signalled.

9.6 BITWISE SHIFT OPERATORS

Syntax

ShiftExpression:
ShiftExpression **<<** *AdditiveExpression*
ShiftExpression **>>** *AdditiveExpression*
ShiftExpression **>>>** *AdditiveExpression*

9.6.1 The Left Shift Operator (<<)

Performs a left shift operation on the left argument by the amount specified by the right argument. The left argument is coerced to a 32 bit value and only the bottom 5 bits of the right argument are used to specify the shift amount.

9.6.2 The Signed Right Shift Operator (>>)

Performs a sign-filling right shift operation on the left argument by the amount specified by the right argument. The left argument is coerced to a 32 bit value and only the bottom 5 bits of the right argument are used to specify the shift amount.

9.6.3 The Unsigned Right Shift Operator (>>>)

Performs a zero-filling right shift operation on the left argument by the amount specified by the right argument. The left argument is coerced to a 32 bit value and only the bottom 5 bits of the right argument are used to specify the shift amount.

9.7 RELATIONAL OPERATORS

Syntax

RelationalExpression:
ShiftExpression
RelationalExpression **<** *ShiftExpression*
RelationalExpression **>** *ShiftExpression*
RelationalExpression **<=** *ShiftExpression*
RelationalExpression **>=** *ShiftExpression*

Semantics

The relational operators perform either string magnitude comparisons or numeric magnitude comparisons. If both can be coerced to either form then string comparisons are used. If one or neither of the arguments can be coerced to strings or numbers then a runtime error is generated.

9.8 EQUALITY OPERATORS

Syntax

EqualityExpression:
RelationalExpression
EqualityExpression **==** *RelationalExxpression*
EqualityExpression **!=** *RelationalExxpression*

Semantics

Compares the two entites for equality or inequality. There are three possible comparisons that can be performed:

- Identity comparisons - this comparison is performed on objects (including null) and functions.
- String comparisons - this is performed is both arguments can be coerced to strings.
- Numeric comparisons - this is performed if both arguments can be converted to numbers.

9.9 BINARY BITWISE OPERATORS

Syntax

BitwiseANDExpression:
EqualityExpression
BitwiseANDExpression **&** *EqualityExpression*

BitwiseXORExpression:
BitwiseANDExpression
BitwiseXORExpression **^** *BitwiseANDExpression*

BitwiseORExpression:
BitwiseXORExpression
BitwiseORExpression **|** *BitwiseXORExpression*

Semantics
Performs bitwise operations on the left and right arguments. Both arguments are coerced to 32-bit integer values and the expression result is computed by applying the appropriate bitwise operator (**&, ^, or |**).

9.10 BINARY LOGICAL OPERATORS

Syntax
LogicalANDExpression:
BitwiseORExpression
LogicalANDExpression **&&** *BitwiseORExpression*

LogicalORExpression:
LogicalANDExpression
LogicalORExpression **||** *LogicalANDExpression*

Semantics
Performs logical operations on the left and right arguments. Both arguments are coerced to boolean values and the expression result is computed by applying the appropriate logical operator (**&&** or **||**).

9.11 CONDITIONAL OPERATOR (?:)

Syntax
ConditionalExpression:
LogicalORExpression
LogicalORExpression **?** *Expression* **:** *ConditionalExpression*

Semantics
The LogicalORExpression is coerced to a boolean. If the result is true then Expression is evaluated; otherwise ConditionalExpression is evaluated.

9.11.1 Conditional Expressions

9.12 ASSIGNMENT OPERATORS

Syntax
AssignmentExpression:
ConditionalExpression
UnaryExpression AssignmentOperator AssignmentExpression

AssignmentOperator: one of
= *= /= %= += -= <<= >>= >>>= &= ^= |=

9.12.1 Simple Assignment (=)

The *UnaryExpression* is evaluated and must evaluate to an lvalue. The *AssignmentExpression* is then evaluated and the result is used to set the lvalue. A runtime error is generated if *AssignmentExpression* is undefined.

9.12.2 Compound Assignment (op=)

A compound expression E1 **op=** E2 is identical to E1 **=** E1 op E2 except E1 is evaluated only once.

9.13 COMMA OPERATOR (,)

Syntax

Expression:
AssignmentExpression
Expression **,** *AssignmentExpression*

Semantics

The sequence of expressions is evaluated from left to right and the last expression is returned as the expression result.

10 STATEMENTS

Syntax

Statement:
Block
VariableStatement
ExpressionStatement
IfStatement
IterationStatement
ControlFlowStatements
SwitchStatement
WithStatement

10.1 BLOCK

Syntax

Block:
{ $Statements_{opt}$ **}**

Statements:
Statement
Statements Statement

Semantics

The statements in a block are executed in sequence.

10.2 VARIABLE STATEMENT

Syntax

VariableStatement::
var *VariableDeclarationList* **;**

VariableDeclarationList:
VariableDeclaration
VariableDeclarationList **,** *VariableDeclaration*

VariableDeclaration:
Identifier $Initializer_{opt}$

Initializer:
= *AssignmentExpression*

Semantics

If the variable statement occurs inside a *FunctionDeclaration*, they are defined with function-local scope in that function. Otherwise, they are defined with global scope. Variables with no *Initializer* are initialized to the **undefined** value. Variables with *Initializers* are initialized to the values of their *AssignmentExpressions*, which are executed in order of appearance.

10.3 EXPRESSION STATEMENT

Syntax

ExpressionStatement:
Expression$_{opt}$ **;**

Semantics

The expression in an *ExpressionStatement* is executed for side effects; its value is ignored. An *ExpressionStatement* with no *Expression* performs no operations.

10.4 THE `if` STATEMENT

Syntax

IfStatement:
`if (` *Expression* **`)`** *Statement*
`if (` *Expression* **`)`** *Statement* **`else`** *Statement*

An **`else`** is associated with the lexically immediately preceding **`else`**-less **`if`** that is in the same block (but not in an enclosed block).

Semantics

The *Expression's* value is coerced to a Boolean entity (the "condition"). In both forms, the first *Statement* is executed if and only if the condition is **true**. In the second form, the second Statement is executed if and only if the condition is **false**.

10.5 ITERATION STATEMENTS

Syntax

IterationStatement:
`while (` *Expression* **`)`** *Statement*
`for (` *Expression*$_{opt}$ **`;`** *Expression*$_{opt}$ **`;`** *Expression*$_{opt}$ **`)`** *Statement*
`for ( var`$_{opt}$ *Identifier* **`in`** *Expression* **`)`** *Statement*

Semantics

10.5.1 The `while` Statement

Statement is executed repeatedly. Before each execution of *Statement*, the *Expression* is evaluated and the result is coerced to a Boolean entity (the "condition"). If the condition is **false**, execution of the **`while`** statement ceases.

10.5.2 The `for` Statement

The first *Expression* is executed, if present. Then *Statement* is executed repeatedly. Before each execution of *Statement*, the second *Expression* is evaluated and the result is coerced to a Boolean entity (the "condition"). If the condition is **false**, execution of the **`for`** statement ceases. After each execution of *Statement*, the third *Expression* is evaluated, if present.

If the second *Expression* is not present, the condition is always **false**.

10.5.3 The `for..in` Statement

Expression is evaluated (call its value the "subject"). *Statement* is executed repeatedly; before each execution, the name of a slot in the subject is assigned to the variable named by *Identifier*. Slots are chosen in no defined order, but each slot is chosen exactly once. When the slots are exhausted, execution of the **`for`** statement ceases.

10.6 CONTROL FLOW STATEMENTS

Syntax

ControlFlowStatement:
    `continue ;`
    `break ;`
    `return` *Expression*$_{opt}$ **`;`**

10.6.1 The `continue` Statement

The **`continue`** statement can only be used inside a **while**, **for**, or **for..in** loop. Executing the **`continue`** statement stops the current iteration of the loop and continues program flow with the beginning of the loop. This has the following effects on the different types of loops:

- **while** loops test their condition, and if true, execute the loop again.
- **for** loops execute their increment expression, and if the test expression is true, execute the loop again.
- **for..in** loops proceed to the next slot and execute the loop again.

10.6.2 The `break` Statement

The **`break`** statement can only be used inside a **while**, **for**, or **for..in** loop. Executing the **`break`** statement causes execution of the enclosing loop to cease.

10.6.3 The `return` Statement

The **`return`** statement can only be used inside a *FunctionDeclaration*. It causes a function to return a value to the caller. If *Expression* is omitted, the return value is the **undefined** value. Otherwise, the return value is the value of *Expression*.

10.7 THE `with` STATEMENT

Syntax

WithStatement:
    `with (` *Expression* **`)`** *Statement*

Semantics

Expression is evaluated (call its value the "subject"). *Statement* is executed in a nested dynamic scope defined by the properties of the subject: variable reference and assignment expressions using variable names that are property names of the subject access and assign those properties. (See the section "Variable Scoping".)

11 FUNCTION DEFINITION

Syntax

FunctionDeclaration:
    `function` *Identifier* **`(`** *FormalParameterList*$_{opt}$ **`)`** *Block*

FormalParameterList:
    Identifier
    FormalParameterList **`,`** *Identifier*

Semantics

Defines a global variable whose name is the *Identifier* and whose value is a function object with the given parameter list and statements.

12 PROGRAM

Syntax

Program:
SourceElements

SourceElements:
SourceElement
SourceElements SourceElement

SourceElement:
Statement
FunctionDefinition

1.1.1

13 LANGUAGE SYNTAX SUMMARY

13.1 UNICODE

UnicodeEscapeSequence:
\u *HexDigit HexDigit HexDigit HexDigit*

HexDigit: one of
0 1 2 3 4 5 6 7 8 9
a b c d e f
A B C D E F

13.2 LEXICAL GRAMMAR

Any amount of *Whitespace* and *Comments* may appear between any two *Tokens*. For clarity, this is not explicitly stated in the grammar.

13.2.1 Whitespace

Whitespace:
<tab>
<linefeed>
<newline>
<end-of-medium>
<space>

13.2.2 Comments

Comment:
MultiLineComment
SingleLineComment

MultiLineComment:
/* *MultiLineCommentChars* ***/**

MultiLineCommentChars:
<any Unicode character except asterisk ***** *>* $MultiLineCommentChars_{opt}$
***** $PostAsteriskCommentChars_{opt}$

PostAsteriskCommentChars
<*any Unicode character except forward-slash* **/** > *MultiLineCommentChars*$_{opt}$

SingleLineComment:
// *SingleLineCommentChars*$_{opt}$ <*newline*>

SingleLineCommentChars
<*any Unicode character except newline*> *SingleLineCommentChars*$_{opt}$

13.2.3 Tokens

Token:
Keyword
Identifier
Punctuator
Operator
Literal

13.2.3.1 Keywords

Keyword*: one of*

abstract	**else**	**int**	**switch**
arguments	**extends**	**interface**	**synchronized**
boolean	**false**	**long**	**this**
break	**final**	**native**	**throw**
byte	**finally**	**new**	**throws**
case	**float**	**null**	**transient**
catch	**for**	**package**	**true**
char	**function**	**private**	**try**
class	**goto**	**protected**	**typeof**
const	**if**	**public**	**var**
continue	**implements**	**return**	**void**
default	**import**	**short**	**while**
do	**in**	**static**	**with**
double	**instanceof**	**super**	

KeywordsInUse: one of

arguments	**else**	**in**	**true**
break	**false**	**new**	**typeof**
case	**for**	**null**	**var**
continue	**function**	**return**	**void**
default	**goto**	**switch**	**while**
do	**if**	**this**	**with**

13.2.3.2 Identifiers

Identifier:
IdentifierPreface IdentifierBody

IdentifierPreface: one of
Letter
_ $

IdentifierBody:
BodyCharacter
IdentifierBody BodyCharacter

BodyCharacter: one of
Letter
0 1 2 3 4 5 6 7 8 9
_ $

Letter: one of
a b c d e f g h i j k l m n o p q r s t u v w x y z
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

13.2.3.3 Operators

Operator: one of

=	**|=**	**^**	**<<**	**~**
+=	**<<=**	**&**	**>>**	**!**
-=	**>>=**	**==**	**>>>**	**++**
***=**	**>>>=**	**!=**	**+**	**--**
/=	**?:**	**<**	**-**	**[]**
%=	**||**	**<=**	*****	**.**
&=	**&&**	**>**	**/**	**()**
^=	**|**	**>=**	**%**	**?:**

13.2.3.4 Literals

Literal:
NullLiteral
BooleanLiteral
NumericLiteral
StringLiteral

NullLiteral:
null

BooleanLiteral: one of
true false

NumericLiteral:
DecimalLiteral
HexLiteral
OctalLiteral

DecimalLiteral:
IntegralLiteral
RealLiteral Exponent

IntegralLiteral:
NonzeroDecimalDigit DecimalDigits

NonzeroDecimalDigit: one of
1 2 3 4 5 6 7 8 9

DecimalDigits:
    DecimalDigit
    DecimalDigits DecimalDigit

Digit: one of
    0 1 2 3 4 5 6 7 8 9

RealLiteral:
    DecimalDigits$_{opt}$ **.** *DecimalDigits*
    DecimalDigits **.**

Exponent:
    e *Sign*$_{opt}$ *DecimalDigits*
    E *Sign*$_{opt}$ *DecimalDigits*

Sign: one of
    + -

HexLiteral:
    0x *HexDigits*
    0X *HexDigits*

HexDigits:
    HexDigit
    HexDigits HexDigit

HexDigit: one of
    0 1 2 3 4 5 6 7 8 9
    a b c d e f
    A B C D E F

OctalLiteral:
    0 *OctalDigits*

OctalDigits: one of
    0 1 2 3 4 5 6 7

StringLiteral:
    " *NotDoubleQuoteStringCharacters* **"**
    ' *NotSingleQuoteStringCharacters* **'**

NotDoubleQuoteStringCharacters:
    Any Unicode character except double-quote **"**, *backslash* **** *and the newline character*
    EscapeSequence

NotSingleQuoteStringCharacters:
    Any Unicode character except single-quote **'**, *backslash* **** *and the newline character*
    EscapeSequence

EscapeSequence:
    CharacterEscapeSequence
    HexEscapeSequence
    UnicodeEscapeSequence

CharacterEscapeSequence: one of

\' \" \\ \b \f \n \r \t

HexEscapeSequence:
\x *HexDigits*

13.3 PHRASE STRUCTURE GRAMMAR

13.3.1 Expressions

PrimaryExpression:
this
arguments
Identifier
Literal
(*Expression* **)**

MemberExpression:
PostfixExpression **[** *Expression* **]**
PostfixExpression . *Identifier*

FunctionCallExpression:
PostfixExpression **(** *ArgumentList* **)**

PostfixExpression:
PrimaryExpression
MemberExpression
FunctionCallExpression
PostfixExpression **++**
PostfixExpression **--**

UnaryExpression:
PostfixExpression
new *FunctionCallExpression*
delete *MemberExpression*
void *UnaryExpression*
typeof *UnaryExpression*
++ *UnaryExpression*
-- *UnaryExpression*
+ *UnaryExpression*
- *UnaryExpression*
~ *UnaryExpression*
! *UnaryExpression*

MultiplicativeExpression:
UnaryExpression
MultiplicativeExpression ***** *UnaryExpression*
MultiplicativeExpression **/** *UnaryExpression*
MultiplicativeExpression **%** *UnaryExpression*

AdditiveExpression:
MultiplicativeExpression
AdditiveExpression **+** *MultiplicativeExpression*
AdditiveExpression **-** *MultiplicativeExpression*

ShiftExpression:
AdditiveExpression
ShiftExpression **<<** *AdditiveExpression*
ShiftExpression **>>** *AdditiveExpression*
ShiftExpression **>>>** *AdditiveExpression*

RelationalExpression:
ShiftExpression
RelationalExpression **<** *ShiftExpression*
RelationalExpression **>** *ShiftExpression*
RelationalExpression **<=** *ShiftExpression*
RelationalExpression **>=** *ShiftExpression*

EqualityExpression:
RelationalExpression
EqualityExpression **==** *RelationalExpression*
EqualityExpression **!=** *RelationalExpression*

BitwiseANDExpression:
EqualityExpression
BitwiseANDExpression **&** *EqualityExpression*

BitwiseXORExpression:
BitwiseANDExpression
BitwiseXORExpression **^** *BitwiseANDExpression*

BitwiseORExpression:
BitwiseXORExpression
BitwiseORExpression **|** *BitwiseXORExpression*

LogicalANDExpression:
BitwiseORExpression
LogicalANDExpression **&&** *BitwiseORExpression*

LogicalORExpression:
LogicalANDExpression
LogicalORExpression **||** *LogicalANDExpression*

ConditionalExpression:
LogicalORExpression
LogicalORExpression **?** *Expression* **:** *ConditionalExpression*

AssignmentExpression:
ConditionalExpression
UnaryExpression AssignmentOperator AssignmentExpression

AssignmentOperator: one of
= *= /= %= += -= <<= >>= >>>= &= ^= |=

Expression:
AssignmentExpression
Expression **,** *AssignmentExpression*

13.3.2 Statements

Statement:
Block
VariableStatement
ExpressionStatement
IfStatement
IterationStatement
ControlFlowStatements
SwitchStatement
WithStatement

Block:
{ *Statements*$_{opt}$ **}**

Statements:
Statement
Statements Statement

VariableStatement::
var *VariableDeclarationList* **;**

VariableDeclarationList:
VariableDeclaration
VariableDeclarationList **,** *VariableDeclaration*

VariableDeclaration:
Identifier Initializer$_{opt}$

Initializer:
= *AssignmentExpression*

ExpressionStatement:
Expression$_{opt}$ **;**

IfStatement:
if (*Expression* **)** *Statement*
if (*Expression* **)** *Statement* **else** *Statement*

IterationStatement:
while (*Expression* **)** *Statement*
for (*Expression*$_{opt}$ **;** *Expression*$_{opt}$ **;** *Expression*$_{opt}$ **)** *Statement*
for (var *Identifier* **in** *Expression* **)** *Statement*

ControlFlowStatement:
continue ;
break ;
return *Expression*$_{opt}$ **;**

SwitchStatement:
switch (*Expression* **)** *CaseStatements*

CaseStatements:
CaseStatement
CaseStatements CaseStatement

CaseStatement:
case *Literal* **:** *Statement*
default : *Statement*

WithStatement:
with (*Expression* **)** *Statement*

13.3.3 Function Definition

FunctionDeclaration:
function *Identifier* **(** *FormalParameterList*$_{opt}$ **)** *Block*

FormalParameterList:
Identifier
FormalParameterList **,** *Identifier*

13.3.4 Program

Program:
SourceElements

SourceElements:
SourceElement
SourceElements SourceElement

SourceElement:
Statement
FunctionDefinition

14 REFERENCES

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