JSON

The x in Ajax

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YAHOO IS HIRING DEVELOPERS

Ajax, PHP, DHTML/XHTML, Javascript, CSS, Actionscript / Flash

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Data Interchange

- The key idea in Ajax.
- An alternative to page replacement.
- Applications delivered as pages.
- How should the data be delivered?

History of Data Formats

- Ad Hoc
- Database Model
- Document Model
- Programming Language Model

JSON

- JavaScript Object Notation
- Minimal
- Textual
- Subset of JavaScript

JSON

- A Subset of ECMA-262 Third Edition.
- Language Independent.
- Text-based.
- Light-weight.
- Easy to parse.

JSON Is Not...

- JSON is not a document format.
- JSON is not a markup language.
- JSON is not a general serialization format.
  - No cyclical/recurring structures.
  - No invisible structures.
  - No functions.

History

- 1999 ECMAScript Third Edition
- 2001 State Software, Inc.
- 2002 JSON.org
- 2005 Ajax
- 2006 **RFC** 4627

Languages

- Chinese
- English
- French
- German
- Italian
- Japanese
- Korean

Languages

- ActionScript
- C / C++
- C#
- Cold Fusion
- Delphi
- E
- Erlang
- Java
- Lisp
- Perl
- Objective-C
- Objective CAML
- PHP
- Python
- Rebol
- Ruby
- Scheme
- Squeak

Object Quasi-Literals

- JavaScript
- Python
- NewtonScript

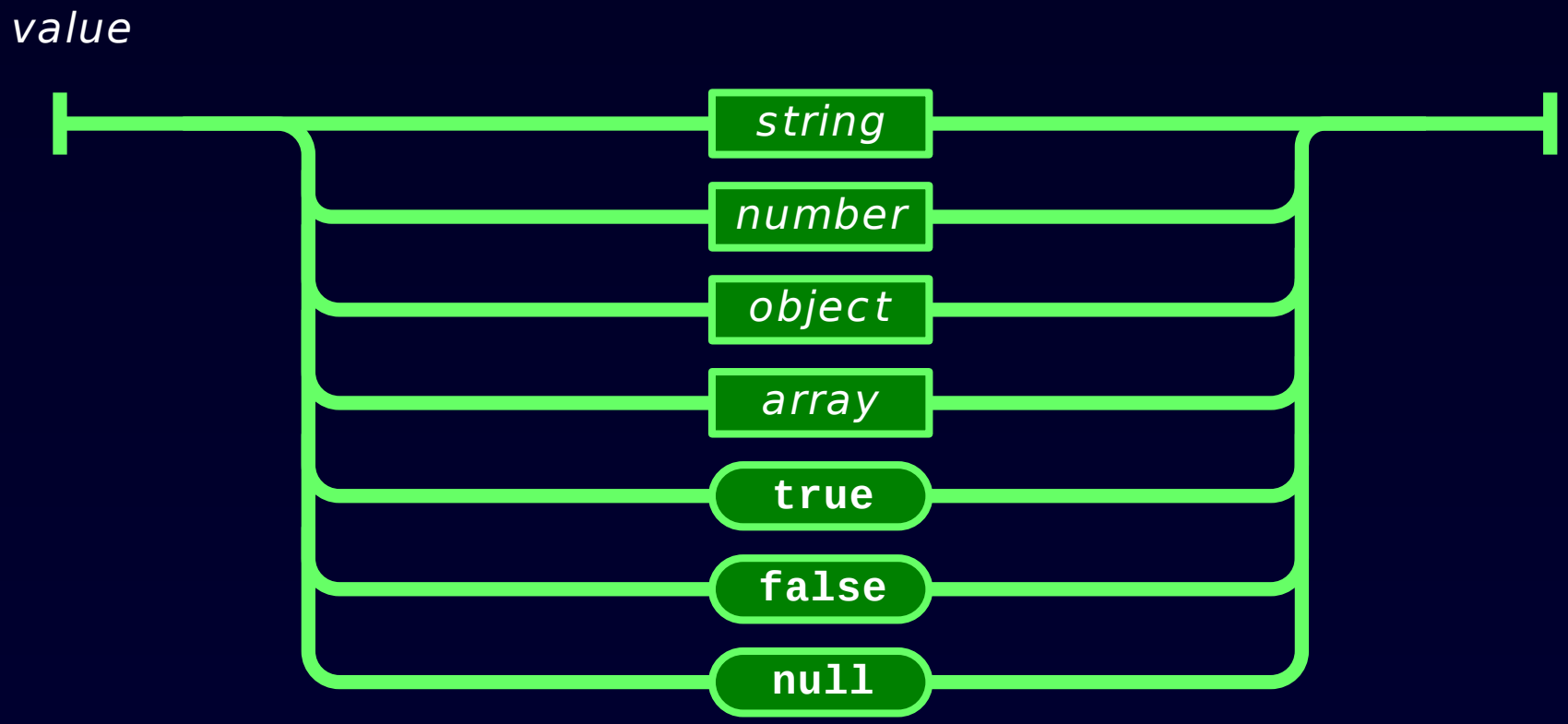
Values

- Strings
- Numbers
- Booleans

- Objects
- Arrays

- **`null`**

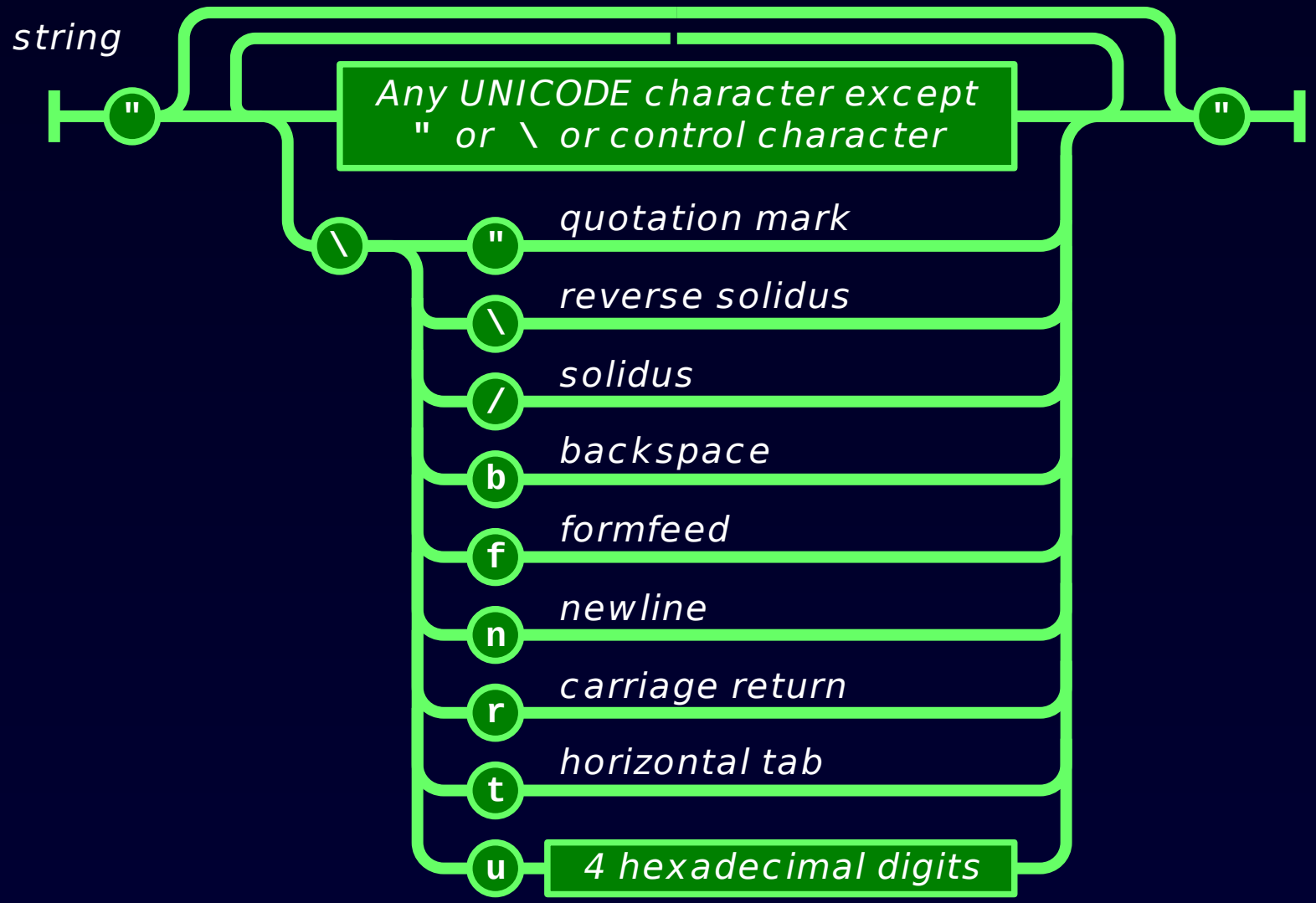
Value



Strings

- Sequence of 0 or more Unicode characters
- No separate character type
  - A character is represented as a string with a length of 1
- Wrapped in "double quotes"
- Backslash escapement

String

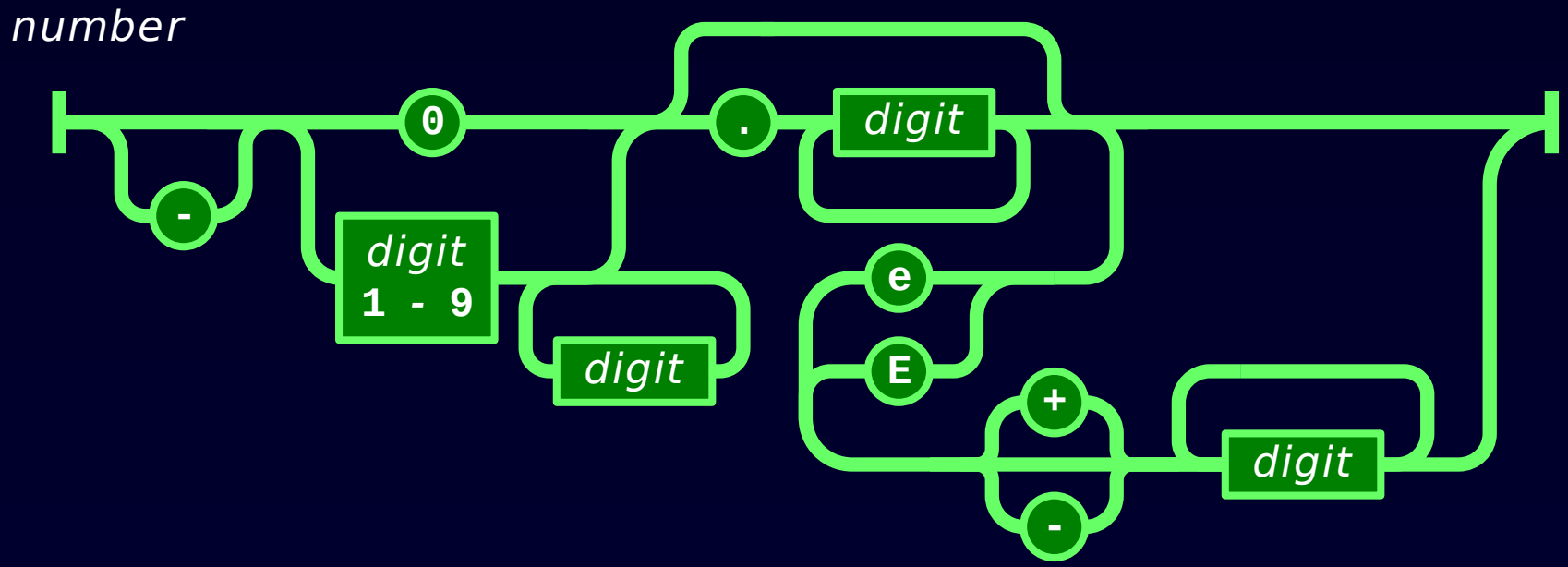

string
"
Any UNICODE character except
" or \ or control character
"
\
"
quotation mark
\
reverse solidus
/
solidus
b
backspace
f
formfeed
n
newline
r
carriage return
t
horizontal tab
u
4 hexadecimal digits

Numbers

- Integer
- Real
- Scientific

- No octal or hex
- No **`NaN`** or **`Infinity`**
  - Use **`null`** instead

Number



Booleans

- `true`
- `false`

`null`

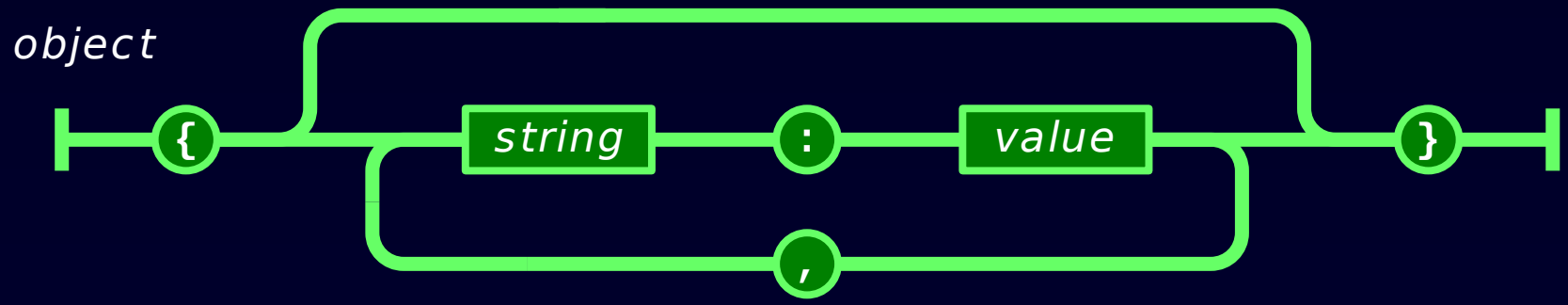
- A value that isn't anything

Object

- Objects are unordered containers of key/value pairs
- Objects are wrapped in `{ }`
- `,` separates key/value pairs
- `:` separates keys and values
- Keys are strings
- Values are JSON values

struct, record, hashtable, object

Object



Object


```
{"name":"Jack B. Nimble","at large":
true,"grade":"A","level":3, "format":
{"type":"rect","width":1920,
"height":1080,"interlace":false,
"framerate":24}}
```

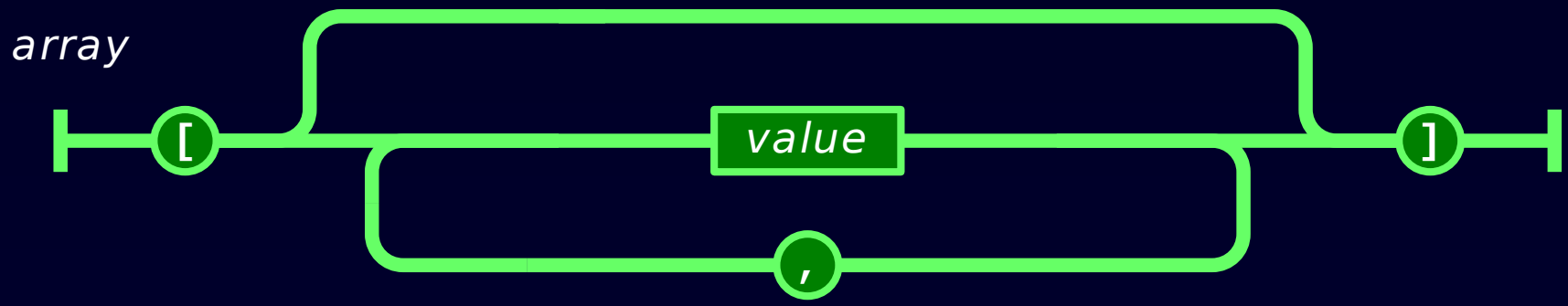
Object

```
{
    "name":      "Jack B. Nimble",
    "at large": true,
    "grade":     "A",
    "format": {
        "type":       "rect",
        "width":      1920,
        "height":     1080,
        "interlace": false,
        "framerate": 24
    }
}
```

Array

- Arrays are ordered sequences of values
- Arrays are wrapped in `[]`
- `,` separates values
- JSON does not talk about indexing.
  - An implementation can start array indexing at 0 or 1.

Array



Array

```
["Sunday", "Monday", "Tuesday",
  "Wednesday", "Thursday",
  "Friday", "Saturday"]


[
    [0, -1, 0],
    [1, 0, 0],
    [0, 0, 1]
]
```

Arrays vs Objects

- Use objects when the key names are arbitrary strings.
- Use arrays when the key names are sequential integers.
- Don't get confused by the term Associative Array.

MIME Media Type

application/json

Character Encoding

- Strictly UNICODE.
- Default: UTF-8.
- UTF-16 and UTF-32 are allowed.

Versionless

- JSON has no version number.
- No revisions to the JSON grammar are anticipated.
- JSON is very stable.

Rules

- A JSON decoder must accept all well-formed JSON text.
- A JSON decoder may also accept non-JSON text.
- A JSON encoder must only produce well-formed JSON text.
- *Be conservative in what you do, be liberal in what you accept from others.*

Supersets

- YAML is a superset of JSON.
  - A YAML decoder is a JSON decoder.
- JavaScript is a superset of JSON.
  - A JavaScript compiler is a JSON decoder.
- New programming languages based on JSON.

JSON is the X in Ajax

JSON in Ajax

- HTML Delivery.

- JSON data is built into the page.

```
<html>...
<script>
var data = { ... JSONdata ... };
</script>...
</html>
```

JSON in Ajax

- XMLHttpRequest
  - Obtain **`responseText`**
  - Parse the **`responseText`**

```
responseData = eval(
    '(' + responseText + ')');

responseData =
    responseText.parseJSON();
```

JSON in Ajax

- Is it safe to use **`eval`** with XMLHttpRequest?
- The JSON data comes from the same server that vended the page. **`eval`** of the data is no less secure than the original html.
- If in doubt, use ***`string`*`.parseJSON`** instead of **`eval`**.

JSON in Ajax

- Secret **<iframe>**
- Request data using **form.submit** to the **<iframe>** target.
- The server sends the JSON text embedded in a script in a document.

```
<html><head><script>
document.domain = 'penzance.com';
parent.deliver({ ... JSONtext ... });
</script></head></html>
```

- The function **deliver** is passed the value.

JSON in Ajax

- Dynamic script tag hack.
- Create a script node. The **`src`** url makes the request.
- The server sends the JSON text embedded in a script.

```
deliver({ ... JSONtext ... });
```

- The function **`deliver`** is passed the value.
- The dynamic script tag hack is insecure.

JSONRequest

- A new facility.
- Two way data interchange between any page and any server.
- Exempt from the Same Origin Policy.
- Campaign to make a standard feature of all browsers.

JSONRequest

```
function done(requestNr, value, exception) {
    …
}

var request =
    JSONRequest.post(url, data, done);

var request =
    JSONRequest.get(url, done);
```

- No messing with headers.
- No cookies.
- No implied authentication.

JSONRequest

- Requests are transmitted in order.
- Requests can have timeouts.
- Requests can be cancelled.
- Connections are in addition to the browser's ordinary two connections per host.
- Support for asynchronous, full duplex connections.

JSONRequest

- Tell your favorite browser maker

I want JSONRequest!

http://www.JSON.org/JSONRequest.html

ECMAScript Fourth Ed.

- New Methods:

  `Object.prototype.toJSONString`

  `String.prototype.parseJSON`

- Available now: **`JSON.org/json.js`**

supplant

```
var template = '<table border="{border}">' +
    '<tr><th>Last</th><td>{last}</td></tr>' +
    '<tr><th>First</th><td>{first}</td></tr>' +
    '</table>';

var data = {
    "first":  "Carl",
    "last":   "Hollywood",
    "border": 2
};

mydiv.innerHTML = template.supplant(data);
```

supplant

```
String.prototype.supplant = function (o) {
    return this.replace(/{([^{}]*)}/g,
        function (a, b) {
            var r = o[b];
            return typeof r === 'string' ?
                r : a;
        }
    );
};
```

JSONT

```
var rules = {
    self:
'<svg><{closed} stroke="{color}" points="{points}" /></svg>',
    closed: function (x) {return x ? 'polygon' : 'polyline';},
    'points[*][*]': '{$} '
};

var data = {
    "color":  "blue",
    "closed": true,
    "points": [[10,10], [20,10], [20,20], [10,20]]
};

jsonT(data, rules)

<svg><polygon stroke="blue"
     points="10 10 20 10 20 20 10 20 " /></svg>
```

http://goessner.net/articles/jsont/

```
function jsonT(self, rules) {
    var T = {
        output: false,
        init: function () {
            for (var rule in rules) if (rule.substr(0,4) != "self") rules["self." + rule] = rules[rule];
            return this;
        },
        apply: function(expr) {
            var trf = function (s) {
                return s.replace(/{([A-Za-z0-9_\$\.\[\]\'@\(\)]+)}/g, function ($0, $1){
                    return T.processArg($1, expr);
                })
            },  x = expr.replace(/\[[0-9]+\]/g, "[*]"),  res;
            if (x in rules) {
                if (typeof(rules[x]) == "string") res = trf(rules[x]);
                else if (typeof(rules[x]) == "function") res = trf(rules[x](eval(expr)).toString());
            } else res = T.eval(expr);
            return res;
        },
        processArg: function (arg, parentExpr) {
            var expand = function (a, e) {
                return (e = a.replace(/^\$/,e)).substr(0, 4) != "self" ? ("self." + e) : e;
            },  res = "";
            T.output = true;
            if (arg.charAt(0) == "@") res = eval(arg.replace(/@([A-za-z0-9_]+)\(([A-Za-z0-9_\$\.\[\]\']+)\)/, function($0, $1, $2){
                return "rules['self." + $1 + "'](" + expand($2,parentExpr) + ")";
            }));
            else if (arg != "$") res = T.apply(expand(arg, parentExpr));
            else res = T.eval(parentExpr);
            T.output = false;
            return res;
        },
        eval: function (expr) {
            var v = eval(expr), res = "";
            if (typeof(v) != "undefined") {
                if (v instanceof Array) {
                    for (var i = 0; i < v.length; i++) if (typeof(v[i]) != "undefined") res += T.apply(expr + "[" + i + "]");
                    } else if (typeof(v) == "object") {
                        for (var m in v) if (typeof(v[m]) != "undefined") res += T.apply(expr+"."+m);
                    } else if (T.output) res += v;
                }
                return res;
            }
        };
        return T.init().apply("self");
}
```

Some features that make *it* well-suited for data transfer

- It's simultaneously human- and machine-readable format;
- It has support for Unicode, allowing almost any information in any human language to be communicated;
- The self-documenting format that describes structure and field names as well as specific values;
- The strict syntax and parsing requirements that allow the necessary parsing algorithms to remain simple, efficient, and consistent;
- The ability to represent the most general computer science data structures: records, lists and trees.

JSON Looks Like Data

- JSON's simple values are the same as used in programming languages.
- No restructuring is required: JSON's structures look like conventional programming language structures.
- JSON's object is record, struct, object, dictionary, hash, associate array...
- JSON's array is array, vector, sequence, list...

Arguments against JSON

- JSON Doesn't Have Namespaces.
- JSON Has No Validator.
- JSON Is Not Extensible.
- JSON Is Not XML.

JSON Doesn't Have Namespaces

- Every object is a namespace. Its set of keys is independent of all other objects, even exclusive of nesting.

- JSON uses context to avoid ambiguity, just as programming languages do.

Namespace

- **http://www.w3c.org/TR/REC-xml-names/**

- In this example, there are three occurrences of the name title within the markup, and the name alone clearly provides insufficient information to allow correct processing by a software module.

```
<section>
    <title>Book-Signing Event</title>
    <signing>
        <author title="Mr" name="Vikram Seth" />
        <book title="A Suitable Boy" price="$22.95" />
    </signing>
    <signing>
        <author title="Dr" name="Oliver Sacks" />
        <book title="The Island of the Color-Blind"
              price="$12.95" />
    </signing>
</section>
```

Namespace

```
{"section":
    "title": "Book-Signing Event",
    "signing": [
        {
            "author": { "title": "Mr", "name": "Vikram Seth" },
            "book": { "title": "A Suitable Boy",
                      "price": "$22.95" }
        }, {
            "author": { "title": "Dr", "name": "Oliver Sacks" },
            "book": { "title": "The Island of the Color-Blind",
                      "price": "$12.95" }
        }
    ]
}}
```

- section.title
- section.signing[0].author.title
- section.signing[1].book.title

JSON Has No Validator

- Being well-formed and valid is not the same as being correct and relevant.
- Ultimately, every application is responsible for validating its inputs. This cannot be delegated.
- A YAML validator can be used.

JSON is Not Extensible

- It does not need to be.
- It can represent any non-recurrent data structure as is.
- JSON is flexible. New fields can be added to existing structures without obsoleting existing programs.

JSON Is Not XML

- objects
- arrays
- strings
- numbers
- booleans
- **`null`**

- element
- attribute
- attribute string
- content
- **`<![CDATA[ ]]>`**
- entities
- declarations
- schema
- stylesheets
- comments
- version
- namespace

Data Interchange

- JSON is a simple, common representation of data.
- Communication between servers and browser clients.
- Communication between peers.
- Language independent data interchange.

Why the Name?

- XML is not a good data interchange format, but it is a document standard.
- Having a standard to refer to eliminates a lot of squabbling.

Going Meta

- By adding one level of meta-encoding, JSON can be made to do the things that JSON can't do.
- Recurrent and recursive structures.
- Values beyond the ordinary base values.

Going Meta

- Simply replace the troublesome structures and values with an object which describes them.

```
{
    "$META$": meta-type,
    "value": meta-value
}
```

Going Meta

- Possible meta-types:

"label"	Label a structure for reuse.
"ref"	Reuse a structure.
"class"	Associate a class with a structure.
"type"	Associate a special type, such as Date, with a structure.

Browser Innovation

- During the Browser War, innovation was driven by the browser makers.
- In the Ajax Age, innovation is being driven by application developers.
- The browser makers are falling behind.

The Mashup Security Problem

- Mashups are an interesting new way to build applications.
- Mashups do not work when any of the modules or widgets contains information that is private or represents a connection which is private.

The Mashup Security Problem

- JavaScript and the DOM provide completely inadequate levels of security.
- Mashups require a security model that provides cooperation under mutual suspicion.

The Mashup Security Solution

```
<module id="NAME" href="URL"
  style="STYLE" />
```

- A module is like a restricted iframe. The parent script is not allowed access to the module's window object. The module's script is not allowed access to the parent's window object.

The Mashup Security Solution

```
<module id="NAME" href="URL" style="STYLE" />
```

- The module node presents a **`send`** method which allows for sending a JSON string to the module script.

- The module node can accept a **`receive`** method which allows for receiving a JSON string from the module script.

The Mashup Security Solution

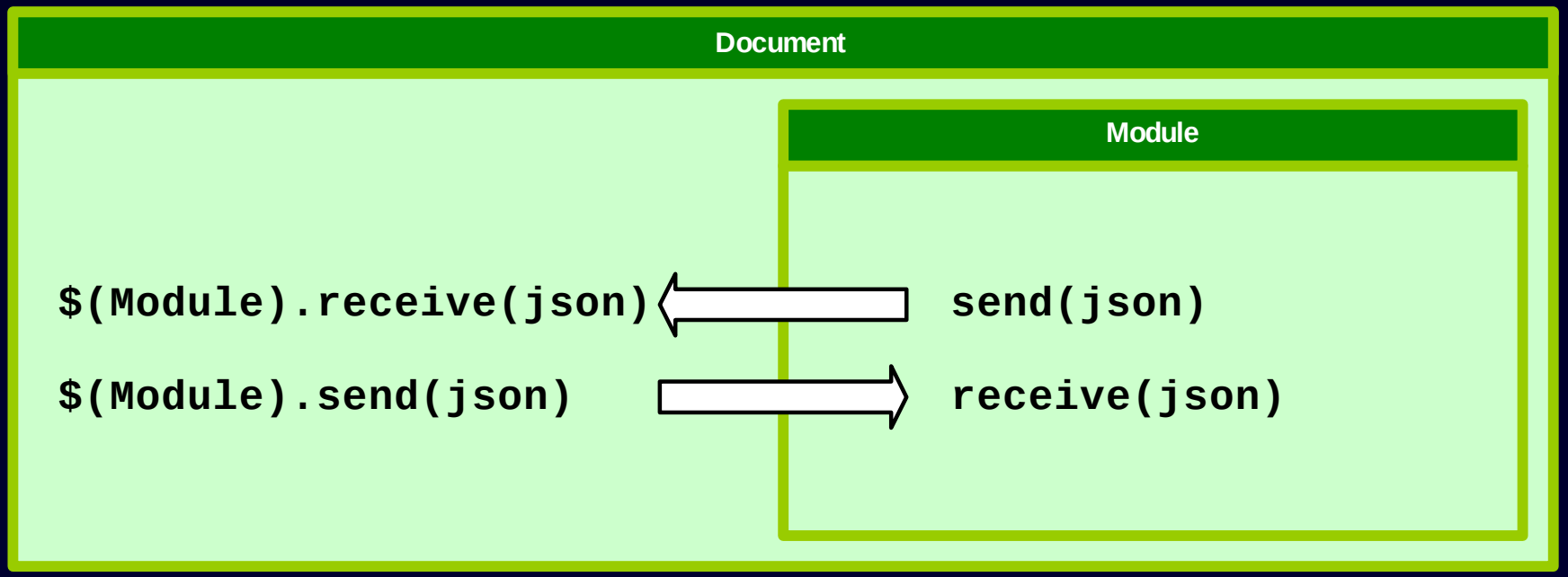
```
<module id="NAME" href="URL" style="STYLE" />
```

- Inside the module, there is a global **`send`** function which allows for sending a JSON string to the outer document's script.

- Inside the module, you can define a **`receive`** method which allows for receiving a JSON string from the outer document's script.

The Mashup Security Solution

```
<module id="NAME" href="URL" style="STYLE" />
```



The Mashup Security Solution

```
<module id="NAME" href="URL" style="STYLE" />
```

- Communiciation is permitted only through cooperating **`send`** and **`receive`** functions.
- The module is exempt from the Same Origin Policy.

The Mashup Security Solution

```
<module id="NAME" href="URL" style="STYLE" />
```

- Ask your favorite browser maker for the **<module>** tag.

www.JSON.org