

CORE - A PRIMER

The core system explained.

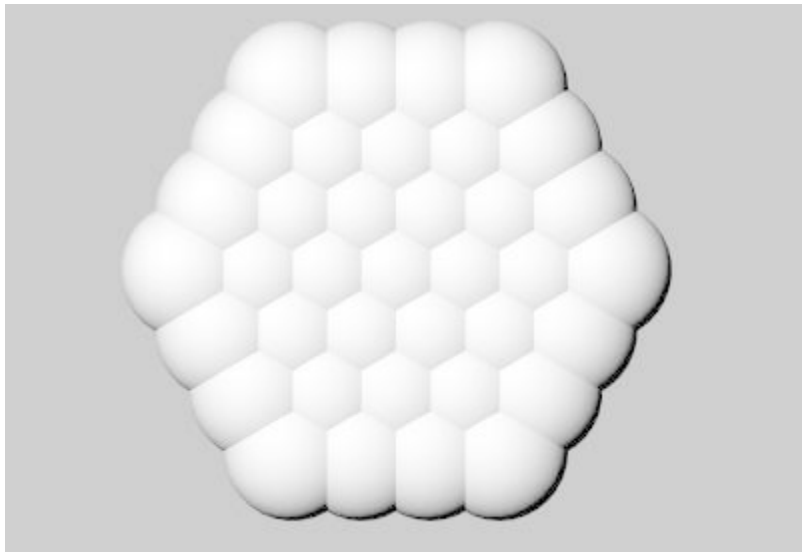


image: Circle of Life

http://i98.photobucket.com/albums/l280/kachina2012/circleoflife3d_1.jpg

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CORE

1. CLIENT SIDE

1. User Interface (UI)

Follows the ExtJS¹ javascript architecture and uses its libraries to request services (i.e. data) from the server.

...

Folder hierarchy:

core			
	app		
		controller	
		model	
		store	
		view	
			organisation
			party
			person

The core / **app** / **embed.js** file (example):

```
Ext.Loader.setConfig({ enabled: true });
Ext.application({
    name: 'core',
    appFolder: 'core/components/core/apps/core/app',
    autoCreateViewport: true,
    models: ['Station', 'Song'],
    stores: ['Stations', 'RecentSongs', 'SearchResults'],
    controllers: [
        // 'Parties',
        // 'Organisations',
        // 'Persons',
        'Station',
        'Song'
    ],
});
```

The core / app / view / **Viewport.js** file (example):

```
Ext.define('core.view.Viewport', {
    extend: 'Ext.container.Viewport',
    requires: [
        'core.view.NewStation',
    ],
});
```

¹ <http://docs.sencha.com/ext-js>

```

        'core.view.SongControls',
        'core.view.StationsList',
        'core.view.RecentlyPlayedScroller',
        'core.view.SongInfo'
    ],
    // By not defining properties like flex, width, height in the views,
    // we can easily adjust the application's overall layout in one single place (this
    Viewport),
    // adding to the maintainability and flexibility of our architecture.
    initComponents: function() {
        var panel = new Ext.Panel({
            renderTo: 'content',
            layout: 'fit',
            dockedItems: [{
                dock: 'top',
                xtype: 'toolbar',
                height: 80,
                items: [{
                    xtype: 'newstation',
                    width: 150
                }, {
                    xtype: 'songcontrols',
                    flex: 1
                }, {
                    xtype: 'component',
                    html: 'Core<br>Internet Radio'
                }
            ]
        }, {
            layout: {
                type: 'hbox',
                align: 'stretch'
            },
            items: [{
                width: 250,
                xtype: 'panel',
                layout: {
                    type: 'vbox',
                    align: 'stretch'
                },
                items: [{
                    xtype: 'stationslist',
                    flex: 1
                }, {
                    html: 'Ad',
                    height: 50,
                    xtype: 'panel'
                }
            ]
        }, {
            xtype: 'container',
            flex: 1,
            layout: {
                type: 'vbox',
                align: 'stretch'
            },
            items: [{
                xtype: 'recentlyplayedscroller',
                height: 250
            }, {
                xtype: 'songinfo',
                height: 250
            }
        ]
    }
    });

    //pass along browser window resize events to the panel
    Ext.EventManager.onWindowResize(panel.doLayout, panel);

    this.callParent();
}
});

```


MQL - The Query Language for AJAX like web application

OK, here it is... I have a change of heart with regards ORMs and such like. Instead the presentation about MQL (*Metaweb Query Language*)² gave a good insight in using this for its benefits over other solutions.

Here is the summary of the presentation³ on MQL-to-SQL by its creator, Roland Bouman:

Presentation:

[MQL-to-SQL_a JSON-based Query Language for RDBMS Access from AJAX Applications Presentation](#) [ODP]

Past year, I got interested in [Freebase](#) and its query language, [MQL](#). In my opinion, MQL is an interesting database query language in general, and a number of features make it downright excellent for implementing secure but flexible access to relational databases over the web, especially for modern (AJAX) web applications – better than SQL.

I created an implementation dubbed **MQL-to-SQL**, which is available at <http://code.google.com/p/mql-to-sql/> under the terms of the LGPL. It's basically a PHP script that supports the the protocol of [the freebase MQL-read webservice](#). MQL-to-SQL itself uses PDO (PHP Data Objects – a standard database access abstraction layer built into PHP) for database access and is thus to some extent RDBMS independent. I currently have examples based on [the sakila sample database](#) working on SQLite, MySQL, Postgres (pagila) and Oracle. For sample queries, see [the project wiki](#) To kickstart it without downloading and installing, try them in [the online demo](#)

In this 45-minute session, I want to explain how MQL works and why it is a great solution to solve the RDBMS access problem for modern (AJAX) web applications. In addition, I will explain how I implemented MQL-to-SQL, and how it translates MQL queries to SQL queries, executes them and returns the result document. Time permitting I will show what the advantage is for the web-client (as compared to being limited to tabular results returned by SQL queries)

The outline for the talk follows below:

Solving the data access problem in Web vs client-server applications:

- How web applications typically use a purpose-built REST or RPC style webservice and a data format like XML or JSON to access and manipulate data over HTTP
- How by contrast, client-server applications typically use a query language like SQL instead of a purpose-built service protocol
- How this relates to so-called document-based queries and results in NoSQL solutions like CouchDB and MongoDB

The problem with SQL from the perspective of a web applications

- Why you don't very often see a webservice that accepts SQL queries
- How to integrate SQL with your application language, and how ORMs make it even worse (yes!)

² <http://mql.freebaseapps.com/>

³ <http://en.oreilly.com/mysql2011/public/schedule/detail/17134>

The MQL query language

- Some background on freebase, for which MQL was designed
- Syntax of MQL queries and results, with examples (hello world and beyond)
- SQL vs MQL: what is similar, what is not; what are the respective strengths and weaknesses and how does that translate to particular use-cases

Why MQL is a great solution for modern (AJAX) web applications:

- accessible through a webservice, but because it is a query language, it is inherently flexible, and you don't need an application-specific purpose-built webservice.
- Application language integration: both queries and results are JSON-based, which is easily processed and generated by JavaScript, which is the de-facto client side and emerging server-side scripting language for web applications
- Query by example and Query/Result symmetry: in MQL, generating new queries from previously returned results is trivial. This is very unlike the SQL case, where the language is an algebra, but the result is pure data.
- Gain performance by saving roundtrips: MQL queries and results are objects and their structure can in principle be arbitrarily complex. With a typical RPC or REST protocol one would need multiple requests to obtain the same information.
- Overcome the "object-relational impedance mismatch": since MQL queries and results are objects there is no need for a separate layer to translate relational results to object structures. In addition, MQL queries are like "fill in the blanks" templates for the result, and unlike some popular ORM dialects (like hibernate or doctrine), MQL queries do not look like "algebras-gone-objectpipelines"
- without compromising flexibility, MQL is much easier to secure than SQL

MQL-to-SQL: an open source MQL implementation for your RDBMS

- concepts: mapping MQL to SQL and relational results to result documents
- implementation: PHP, PDO
- how to get started with MQL-to-SQL using your favorite RDBMS

The slides of this presentation can be found here:

<http://www.slideshare.net/rpbouman/mql-tosql-a-jsonbased-rdbms-query-language>

Here is an example of a query (in JSON format) and the results (in JSON format) returned from mql-to-sql:

Query:	Results:
<pre>{ "type": "/sakila/film", "film_id": 1, "title": null, "language": { "language_id": null, "name": null }, }</pre>	<pre>{ "type": "/sakila/film", "film_id": 1, "title": "ACADEMY DINOSAUR", "language": { "language_id": 1, "name": "English" }, }</pre>

<code>"category": [] }</code>	<code>"category": ["Action", "Adventure"] }</code>
-----------------------------------	--

MQL-to-SQL example with the sakila movie database⁴

Notice how the result is a matter of filling in the blanks. It returns both the query arguments and the **requested** information.

Data model

The freebase database is powered by a proprietary database management system powered by [Metaweb](#). This DBMS is not a relational, but a so-called graph database. Even though the data model is very different from that of relational database systems, the MQL query language can be applied to relational database systems using a fairly straight forward mapping.

Mapping MQL to SQL

To understand the mapping from MQL to SQL used in this project, it is necessary to be familiar with a few fundamental freebase concepts. To this end, please read the excellent online [guide to freebase](#) (start here, and follow all links in the inner left sidebar - it's a 10 minute read altogether).

Although the exact details of the mapping are stored in a schema file, the default mapping is as follows:

- MQL Domains map to SQL schemas (for example: 'core')
- MQL Types map to SQL tables (for example: 'person')
- MQL properties can map to two things:
 - columns, in case the property type implies a value
 - foreign keys, which implement a relationship to a table

Here is a first draft of the schema (**schema-core.json**) for the 'core' database with support of (only) table 'person': NOTE: replace "core" with the real database name in case a prefix is used (for example: "vanheems_core").

{									
	"domains": {								
		"core": {							
			"types": {						
				"person": {					
					"properties": {				
						"kp_Per sonID": {			
							"column_nam e": "kp_Per sonID",		

⁴ <http://dev.mysql.com/doc/sakila/en/sakila.html>

							"nullable": false,		
							"type": "/" type/int"		
						},			
						"Person FirstNa me": {			
							"column_nam e": "Person FirstName",		
							"nullable": false,		
							"type": "/" type/text"		
						},			
						"Person LastNam e": {			
							"column_nam e": "Person LastName",		
							"nullable": false,		
							"type": "/" type/text"		
						}			
					},				
					"keys": {				
						"PRIMAR Y": {			
							"type": "PR IMARY KEY",		
							"columns": ["kp_Person ID"]		
						}			
					}				
				}					
			}						

		}							
	}								
}									

schema-core.json

NOTE: `properties` and `keys` are at the same level of indentation.

In addition, we store our connection from the MQLRead and MQLWrite to MySQL in the **connection-mysql-core.json** file:

```
{
  "pdo": {
    "dsn": "mysql:dbname=core;host=localhost;port=3306;charset=utf8",
    "username": "json",
    "password": "json",
    "driver_options": {
    }
  },
  "explicit_type_conversion": true
}
```

connection-mysql-core.json

NOTE: We use a special database user by the name of 'json' who has access rights in the 'core' database to query the information. Therewith we can limit its authorisation (for example, not allowed to drop a table).

NOTE: If the database is on a hosted server, and the host requires databases to be prefixed with the client name (such as 'vanheems_core'), we need to correct the connection-mysql-core.json file for these prefixes. That means dbname=vanheems_core and "username": "vanheems_json".

NOTE: the dsn includes **charset=utf8**, otherwise data with special characters (such as 'josé') would cause the MQL queries to fail.

The 'schema-core.json' as well as the 'connection-mysql-core.json' will reside in the folder '**schemas**' shown below within the directory structure (starting from the web root i.e. public_html or www):

assets				
	templates			
		core		
			schemas	
				connection-mysql-core.json
				schema-core.json

As the mql-to-sql scripts are php scripts, we integrate them with the MODx content management system used by core.

Hence, under the tab 'Resources' inside the context (here: web), within the site (here: van heemstra pictures), we add a new container document 'api'.

Resources	Elements	Files	Document	
web			Title: API	Use Template: <empty>
	van heemstra pictures		Long Title: Application Programming Interface	Resource Alias: api
		API		Menu Title: API

MODx manager interface: Resources tab

NOTE: The resource alias is in lowercase !!!

A child container from API is '**Services**', shown here:

Resources	Elements	Files		Document	
web				Title: Services	Use Template: <empty>
	van heemstra pictures			Long Title: Services	Resource Alias: services
		API			Menu Title: Services
			Services		

MODx manager interface: Resources tab

NOTE: The resource alias is in lowercase !!!

A child container from Services is '**MQLRead**', shown here:

Resources	Elements	Files			Document	
web					Title: MQLRead	Use Template: core.MQLReadTpl
	van heemstra pictures				Long Title: Metaweb Query Language Read	Resource Alias: mqlread
		API				Menu Title: MQLRead
			Services			

				MQLRead		
--	--	--	--	----------------	--	--

MODx manager interface: Resources tab

NOTE: The resource alias is in lowercase !!!

Likewise, a child container from Services is '**MQLWrite**', shown here:

Resources	Elements	Files			Document	
web					Title: MQLWrite	Use Template: core.MQLWriteTpl
	van heemstra pictures				Long Title: Metaweb Query Language Write	Resource Alias: mqlwrite
		API				Menu Title: MQLWrite
			Services			
				MQLWrite		

MODx manager interface: Resources tab

NOTE: The resource alias is in lowercase !!!

In addition, a child container from Services is '**MQLQueryEditor**', shown here:

Resources	Elements	Files			Document	
web					Title: MQL Query Editor	Use Template: core.MQLQueryEditorTpl
	van heemstra pictures				Long Title: Metaweb Query Language Query Editor	Resource Alias: mql- query-editor
		API				Menu Title: MQL Query Editor
			Services			

				SQL Query Editor		
--	--	--	--	---------------------------------	--	--

MODx manager interface: Resources tab

NOTE: The resource alias is in lowercase !!!

Next, the 'core.MQLReadTpl' template file is stored under the Templates (see Elements tab):

Resources	Elements	Files	Document	
Templates			Name: core.MQLReadTpl	Category: Core
	Core		Description: Core MQL Read Template	
		core.MQLRe adTpl	Template code (html): [[\$core.MQLReadTpl]]	

MODx manager interface: Elements tab > Templates

Likewise, the 'core.MQLWriteTpl' template file is stored under the Templates (see Elements tab):

Resources	Elements	Files	Document	
Templates			Name: core.MQLWriteTpl	Category: Core
	Core		Description: Core MQL Write Template	
		core.MQLWr iteTpl	Template code (html): [[\$core.MQLWriteTpl]]	

MODx manager interface: Elements tab > Templates

In addition, the 'core.MQLQueryEditorTpl' template file is stored under the Templates (see Elements tab):

Resources	Elements	Files	Document	
Templates			Name: core.MQLWriteTpl	Category: Core
	Core		Description: Core MQL Write Template	

		core.MQLQueryEditorTpl	Template code (html): [[\$core.MQLQueryEditorTpl]]	
--	--	-------------------------------	---	--

MODx manager interface: Elements tab > Templates

As you can see from the Template code in above overview, the template **core.MQLReadTpl** makes use of the chunk '**core.MQLReadTpl**', which is stored as shown below:

Resources	Elements	Files	Create/edit chunk	
Chunks			Name: core.MQLReadTpl	Category: Core
	Core		Description: Core MQL Read Chunk	
		core.MQLReadTpl	Chunk code (html): [[!coreMQLRead]]	

MODx manager interface: Elements tab > Chunks

Likewise, the template **core.MQLWriteTpl** makes use of the chunk '**core.MQLWriteTpl**', which is stored as shown below:

Resources	Elements	Files	Create/edit chunk	
Chunks			Name: core.MQLWriteTpl	Category: Core
	Core		Description: Core MQL Write Chunk	
		core.MQLWriteTpl	Chunk code (html): [[!coreMQLWrite]]	

MODx manager interface: Elements tab > Chunks

In addition, the template **core.MQLQueryEditorTpl** makes use of the chunk '**core.MQLQueryEditorTpl**', which is stored as shown below:

Resources	Elements	Files	Create/edit chunk	
Chunks			Name: core.MQLWriteTpl	Category: Core
	Core		Description: Core MQL Write Chunk	

		core.MQLQueryEditorTpl	Chunk code (html): <shown further on>	
--	--	-------------------------------	--	--

MODx manager interface: Elements tab > Chunks

Here is the code contained in core.MQLQueryEditorTpl:

```
<!DOCTYPE html>
<html>
  <head>
    <meta http-equiv="Content-Type" content="text/html; charset=utf-8">
    <title>MQL to SQL Query Editor - Core</title>
    <style type="text/css">
      * {
        font-family: arial;
        font-size: 10pt;
      }
      body {
      }
      table {
        height: 100%;
        position: absolute;
        top: 0px;
        bottom: 0px;
        left: 0px;
        right: 0px;
        width: 100%;
      }
      td {
        vertical-align: top;
        align: left;
      }
      textarea {
        border-style: solid;
        border-width: 1px;
        color: blue;
        background-color: rgb(255, 255, 170);
        font-family: monospace;
        width: 100%;
        height: 100%;
        top: 0px;
        bottom: 0px;
      }

      .header {
        height: 12px;
      }
      .top {
        height: 35px;
      }
      .left {
        width: 75px;
        height: 30%;
      }
      .right {
        height: 30%;
      }
      button {
      }
    </style>
  </head>
  <body>
    <table cellpadding="0" cellspacing="0">
      <tr>
        <td class="top" colspan="2">
          <a href="http://code.google.com/p/mql-to-sql/"
```



```

        target="mql-to-sql"
        title="mql-to-sql project homepage hosted at google code."
    >Project: mql-to-sql</a>
    |
    <a
    href="http://www.freebase.com/docs/data"
    target="freebase"
    title="Homepage of Freebase, the open collaborative data project that
uses MQL as its native query language, and main source of inspiration for this project."
    >Freebase</a>
    |
    <a
    href="http://www.freebase.com/docs/mql"
    target="freebase"
    title="MQL reference. This is the most complete description of the MQL
query language today. Note that mql-to-sql currently implements a subset of the MQL grammar,
with some extensions."
    >MQL Reference</a>
    |
    <a
    href="https://docs.google.com/viewer?url=http://download.freebase.com/
MQLcheatsheet-081208.pdf"
    target="freebase"
    title="MQL Cheatsheet provides a concise overview of MQL language
features"
    >MQL Cheatsheet</a>
    |
    <a
    href="http://dev.mysql.com/doc/sakila/en/sakila.html"
    target="mql-to-sql"
    title="Documentation to the Sakila sample database. This query editor
allows you to query this sample database using MQL."
    >Sakila Sample Database</a>
</td>
</tr>
<tr>
<td class="left" rowspan="2">
        <button
        type="button"
        id="btnExecute"
        title="Hit this button to execute your MQL query against the Sakila
sample database"
        >Execute</button>
</td>
<td class="header">
        Debug: <input id="debug" type="checkbox"/>
        No Execute: <input id="noexecute" type="checkbox"/>
</td>
</tr>
<tr>
<td class="right">
        <textarea
        id="txtQuery"
        rows="5"
        title="Type your MQL query here."
        ></textarea>
</td>
</tr>
<tr><td></td><td class="header">Result:</td></tr>
<tr style="height:70%">
<td>
</td>
<td class="right">
        <textarea
        id="txtResult"
        rows="20"
        title="This is where the JSON result of your MQL query will be returned."
        ></textarea>
</td>
</tr>

```

```

</table>
<!-- Script for the query editor -->
<script type="text/javascript">
    (function () {

        function validateJSON(txt){
            var o = JSON.parse(txt);
            var t = JSON.stringify(o, null, 2);
            return t;
        }
        function setResult(v){
            document.getElementById("txtResult").value = v;
        }

        function doMQLReadRequest(query){
            var queryEnvelope = "{" +
                "\"query\": " + query +
                (document.getElementById("debug").checked ? ", \"debug_info\": " +
true" : "") +
                (document.getElementById("noexecute").checked ? ", \"noexecute\": " +
true" : "") +
                "}";
            var url = "/api/services/mqlread/?query=" +
encodeURIComponent(queryEnvelope);
            var xhr = new XMLHttpRequest();
            xhr.open("GET", url, true);
            xhr.setRequestHeader("Accept", "application/json");
            xhr.onreadystatechange = function(){
                switch (this.readyState) {
                    case 4:
                        switch (this.status) {
                            case 200:
                                handleMQLReadResponse(this);
                                break;
                            default:
                                handleMQLReadFailure(this);
                        }
                        break;
                    default:
                }
            };
            xhr.send(null);
        }
        function handleMQLReadFailure(response){
            alert("Snap, something went wrong :(" +
                "\n" + "http status code: " + response.status +
                "\n" + "http status text: " + response.statusText
            );
        }
        function handleMQLReadResponse(response){
            var t, rt = response.responseText;
            try {
                t = validateJSON(rt);
            } catch(e) {
                t = "Error in response:\n" + e +
                    "\nRaw responseText:\n\n" + rt;
            }
            setResult(t);
        }

        var rst = document.getElementById("txtResult");
        document.getElementById("btnExecute").onclick = function(){
            try {
                setResult("");
                var txtQuery = document.getElementById("txtQuery");
                var query = txtQuery.value;
                var o = eval("(" + query + ")");
                doMQLReadRequest(JSON.stringify(o, null, 0));
            } catch (e) {
                setResult(e);
            }
        }
    })();

```

```

        txtQuery.value = query;
    }
    }) ();
</script>
</body>
</html>

```

core.MQLQueryEditorTpl

Since MODx keeps all php code in what it calls ‘Snippets’ we embed the MQL code in two snippets: core.MQLRead snippet and core.MQLWrite snippet.

The snippet ‘**core.MQLRead**’ is stored as shown below:

Resources	Elements	Files	Create/edit snippet	
Snippets			Name: core.MQLRead	Category: Core
	Core		Description: Core MQL Read Snippet	
		core.MQLRead	Snippet code (php): <?php echo ‘I am the MQLRead Snippet’;	

MODx manager interface: Elements tab > Snippets

Access to this resource is by requesting this URL:

<http://vanheemstrapictures.com/vhp/api/services/mqlread/>

In the case of the example Snippet code, this request would be replying with:

```
I am the MQLRead Snippet
```

The snippet ‘**core.MQLWrite**’ is stored as shown below:

Resources	Elements	Files	Create/edit snippet	
Snippets			Name: core.MQLWrite	Category: Core
	Core		Description: Core MQL Write Snippet	
		core.MQLWrite	Snippet code (php): <?php echo ‘I am the MQLWrite Snippet’;	

MODx manager interface: Elements tab > Snippets

Access to this resource is by requesting this URL:

<http://vanheemstrapictures.com/vhp/api/services/mqlwrite/>

In the case of the example Snippet code, this request would be replying with:

```
I am the MQLWrite Snippet
```

Following is the insertion of the proper code into the core.MQLRead snippet:

```
<?php
/**
 * core.MQLRead Snippet
 *
 * NOTE: Set two parameter value below:
 * 1) $metadata_file_name inside function init_metadata()
 * 2) $connection_file_name inside function init_pdo()
 */

/**
 * Benchmarking
 */
$callstack = array();
function callstack_push($name){
    global $callstack;
    $callstack[] = array(
        'name' => $name
        , 'microtime' => microtime()
    );
}
/*****
 * General Functions
 *****/
function get_last_json_error(){
    if (function_exists('json_last_error')){
        $error = json_last_error();
        $message = $error.': ';
        switch($error){
            case JSON_ERROR_NONE:
                $message .= 'No error has occurred';
                break;
            case JSON_ERROR_DEPTH:
                $message .= 'The maximum stack depth has been exceeded';
                break;
            case JSON_ERROR_CTRL_CHAR :
                $message .= 'Control character error, possibly incorrectly encoded';
                break;
            case JSON_ERROR_SYNTAX:
                $message .= 'Syntax error';
                break;
            case JSON_ERROR_UTF8:
                $message .= 'Malformed UTF-8 characters, possibly incorrectly encoded';
                break;
        }
    }
    else {
        $message = 'function json_last_error() does not exist - no error information available.
PHP version: '.phpversion();
    }
    return $message;
}
/*****
 * MQL processing Functions
 *****/
function analyze_type($type) {
    $type_pattern = '/^\/(\w+)\.\/(\w+)$/';
    $matches = array();
    if (preg_match($type_pattern, $type, $matches)){
        return array(
            'domain' => $matches[1]
            , 'type' => $matches[2]
        );
    }
}
```



```

        exit('The parent type "/"
        . $parent_schema_type_domain.'/'.' $parent_schema_type_type
        ." was not found in the schema.'
        .' This indicates a logical error in the schema.'
        );
    }
    $types[$parent_schema_type_name] = $parent_schema_type;
}

//helper for process_mql_object
function check_types($types) {
    switch (count($types)) {
        case 0:
            exit('Could not find a type. Currently we rely on a known type');
            break;
        case 1:
            //assigning the contents of the array to the $type variable.
            //php gurus, any better way to do this?
            foreach ($types as $type_name => $type){}
            break;
        default:
            exit('Found more than one type. Currently we can handle only one type.');
```

```

    }
}

//helper for process_mql_object
function expand_star($source_properties, &$target_properties) {
    unset($target_properties['*']);
    foreach ($source_properties as $property_name => $property) {
        if (isset($target_properties[$property_name])){
            continue;
        }
        if (isset($property['column_name'])) {
            $target_properties[$property_name] = array(
                'is_directive' => FALSE,
                'qualifier'    => '',
                'name'         => $property_name,
                'value'        => NULL,
                'is_filter'    => FALSE,
                'operator'     => NULL
            );
        }
    }
}

//helper for process_mql_object
function pre_process_properties($object_vars, &$properties, &$types, &$star_property){
    foreach ($object_vars as $property_key => $property_value) {
        if (!$property = analyze_property($property_key, $property_value)){
            exit('Property "'.$property_key.'" is not valid.');
```

```

        }
        $operator = $property['operator'];
        if ($operator) {
            $operator_in = ($operator==='|=')||($operator==='!=');
            if ($property_value === NULL
            || is_object($property_value)
            || ($operator_in && is_array($property_value) && count($property_value)===0)
            ){
                exit("Operator ".$operator.' '
                . (($operator==='|=' || $operator==='!=')
                ? 'takes a non-empty list of values'
                : 'takes a single value (not an object or an array)')
                );
            }
        }
        $property_qualifier = $property['qualifier'];
        $property_name      = $property['name'];

        switch ($property_name) {
```

```

        case 'type':
        case 'creator':
        case 'guid':
        case 'id':
        case 'key':
        case 'name':
        case 'permission':
        case 'timestamp':
        if ($property_qualifier=== '') {
            $property['qualifier'] = '/type/object';
        }
        break;
        case 'limit':
        case 'optional':
        case 'return':
        case 'sort':
        case '*':
        if ($property_qualifier=== '' ) {
            $property['is_directive'] = TRUE;
            switch ($property_name) {
                case 'optional':
                    $parent['optional'] = ($property_value===TRUE ||
$property_value=== 'optional');
                    break;
                case '*':
                    $star_property = TRUE;
                    break;
            }
        }
        default:
        if ($property_qualifier === '/type/object') {
            exit('"' . $property_name . '" is not a universal property, and may not have
the qualifier "' . $property_qualifier . '"');
        }
    }

    if ($property['qualifier'] === '/type/object'
&& $property_name === 'type'
&& isset($property_value)
&& !isset($types[$property_value])
) {
        $type = analyze_type($property_value);
        if (!$type) {
            exit('"' . $property_value . '" is not a valid type identifier. ');
        }
        $domain = $type['domain'];
        $domain_type = $type['type'];
        $type = get_type_from_schema($domain, $domain_type);
        if (!$type) {
            exit('Type "' . $domain . '/' . $domain_type . '" not found in schema. ');
        }
        $types[$property_value] = $type;
    }
    $properties[$property_key] = $property;
}

}

//helper for process_mql_object
function process_properties(&$properties, $type_name, $type) {
    foreach ($properties as $property_name => &$property){
        if ($property['is_directive']===TRUE) {
            continue;
        }
        switch ($property['qualifier']) {
            case '/type/object':
                continue;
            case '*':
                $schema_property = $type['properties'][$property['name']];
                if ($schema_property) {
                    $property['qualifier'] = $type_name;
                }
            }
        }
    }
}

```

```

        $property['schema'] = $schema_property;
        if (isset($schema_property['join_condition'])) {
            $property['types'][] = $schema_property['type'];
            $property_value = &$amp;$property['value'];
            if (is_object($property_value) || is_array($property_value)) {
                process_mql($property_value, $property);
            }
        }
    }
    else {
        exit('No property "'. $property['name'] .'" in type "'. $type_name .'"');
    }
    break;
    default:
        if ($property['qualifier']!=$type_name) {
            exit('Property "'. $property['qualifier'] ."/". $property['name']
                .'" does not belong to the type "'. $type_name .'" . This feature is not
supported yet.');
```

```

        }
    }
}

function process_mql_object(&$mql_object, &$parent){
    $object_vars = get_object_vars($mql_object);
    $properties = array();
    $type = NULL;
    $types = array();
    $star_property = FALSE;
    $parent['properties'] = &$properties;

    get_parent_type($parent, $types);
    pre_process_properties($object_vars, $properties, $types, $star_property);
    check_types($types);
    foreach($types as $type_name => $type){} //extract the type name
    $parent['types'] = array_keys($types);
    if ($star_property==TRUE) {
        expand_star($type['properties'], $properties);
    }
    process_properties($properties, $type_name, $type);
}

function process_mql_array($mql_array, &$parent){
    $count = count($mql_array);
    switch ($count) {
        case 0:
            break;
        case 1:
            $parent['entries'] = array();
            if (array_key_exists('schema', $parent)) {
                $parent['entries']['schema'] = $parent['schema'];
            }
            process_mql($mql_array[0], $parent['entries']);
            break;
        default:
            exit('Expected a dictionary or a list with one element in a read (were you
trying to write?)');
```

```

    }
}

function process_mql($mql, &$parent){
    if ($mql===NULL) {
    }
    else
        if (is_object($mql)){
            process_mql_object($mql, $parent);
        }
        else
            if (is_array($mql)){

```



```

        process_mql_array($mql, $parent);
    }
    else {
        exit('mql query must be an object or an array, not "'.gettype($mql).'"');
    }
}
/*****
*   SQL generation Functions
*****/
$t_alias_id = 0;
$c_alias_id = 0;
$p_id = 0;

function reset_ids(){
    global $t_alias_id, $c_alias_id, $p_id;
    $t_alias_id = 0;
    $c_alias_id = 0;
    $p_id = 0;
}

function get_t_alias(){
    global $t_alias_id;
    return 't'.(++$t_alias_id);
}

function get_c_alias($new=TRUE){
    global $c_alias_id;
    if ($new){
        $c_alias_id++;
    }
    return 'c'.$c_alias_id;
}

function get_p_name(){
    global $p_id;
    return 'p'.(++$p_id);
}

function is_optional($mql_node){
    $optional = FALSE;
    if (is_array($mql_node)) {
        if (array_key_exists('properties', $mql_node)){
            $properties = $mql_node['properties'];
            if (count($properties)==0){
                $optional = TRUE;
            }
            else
                if (isset($properties['optional'])) {
                    $optional_property = $properties['optional'];
                    $value = $optional_property['value'];
                    switch ($value) {
                        case TRUE:
                        case 'optional':
                            $optional = TRUE;
                    }
                }
        }
        else
            if (array_key_exists('entries', $mql_node)){
                $entries = $mql_node['entries'];
                if (count($entries)==NULL){
                    $optional = TRUE;
                }
            }
        else
            if (array_key_exists('value', $mql_node)) {
                $value = $mql_node['value'];
                if ($value==NULL) {
                    $optional = TRUE;
                }
            }
    }
}

```

```

    }
    }
    else {
        print_r("\ntype is ".gettype($mql_node)."\n");
    }
    return $optional;
}

function get_from_clause(&$mql_node, $t_alias, $child_t_alias, $schema_name, $table_name,
&$query){
    $schema = isset($mql_node['schema'])?&$mql_node['schema']:NULL;
    $from = &$query['from'];
    $count_from = count($from);
    $from_line = array();
    $join_condition = '';
    if (isset($schema['direction'])) {
        $direction = $schema['direction'];
    }
    if (($optional = is_optional($mql_node))===TRUE){
        $mql_node['outer_join'] = TRUE;
        $outer_join = TRUE;
    }
    else
        if (isset($mql_node['outer_join'])) {
            $outer_join = $mql_node['outer_join'];
        }
        else {
            $outer_join = FALSE;
        }

    $from_line['join_type'] = ($outer_join===TRUE) ? 'LEFT' : 'INNER';

    switch ($direction) {
        case 'referencing->referenced': //lookup (n:1 relationship)
            break;
        case 'referenced<-referencing': //lookdown (1:n relationship) - starts a
separate query.
            $select = &$query['select'];
            $order_by = &$query['order_by'];
            $merge_into = &$query['merge_into'];
            $merge_into_columns = &$merge_into['columns'];
            break;
    }

    foreach ($schema['join_condition'] as $columns) {
        $join_condition .= ($join_condition==='')? 'ON':"\nAND";
        switch ($direction){
            case 'referencing->referenced':
                $referenced_column = $t_alias.'.'.$columns['referenced_column'];

                if ($outer_join===TRUE && $join_condition === 'ON'){
                    if ($optional===TRUE) {
                        $from_line['optionality_group'] = $t_alias;
                    }
                    else {
                        if ($count_from) {
                            $from_line['optionality_group'] = $from[$child_t_alias]
['optionality_group'];
                        }
                        else {
                            $from_line['optionality_group'] = $child_t_alias;
                        }
                    }
                }
                $from_line['optionality_group_column'] = $referenced_column;
            }

            $join_condition .= ' '
.$child_t_alias.'.'.$columns['referencing_column']
. ' ' = '.$referenced_column;

            break;

```

```

        case 'referenced<-referencing':
            $column_ref = $t_alias.'.'.$columns['referencing_column'];
            $alias = $t_alias.get_c_alias();
            $merge_into_columns[] = $alias;
            $select[$column_ref] = $alias;
            $order_by .= ($order_by==''? 'ORDER BY ' : "\n, ");
            $order_by .= $alias;
            break;
    }
}
}
$from_line['table'] = ($schema_name? $schema_name.'.' : '').$table_name;
$from_line['alias'] = $t_alias;
if ($join_condition) {
    $from_line['join_condition'] = $join_condition;
}
$from[$t_alias] = $from_line;
}

function map_mysql_to_pdo_type($mysql_type){
    switch ($mysql_type){
        case '/type/boolean':
            $pdo_type = PDO::PARAM_BOOL;
            break;
        case '/type/content':
            $pdo_type = PDO::PARAM_LOB;
            break;
        case '/type/datetime':
        case '/type/text':
        case '/type/float': //this feels so wrong, but PDO doesn't seem to support any decimal/
float type :(
            $pdo_type = PDO::PARAM_STR;
            break;
        case '/type/int':
            $pdo_type = PDO::PARAM_INT;
            break;
        case '/type/rawstring':
            $pdo_type = PDO::PARAM_STR;
            break;
    }
    return $pdo_type;
}

function add_parameter(&$where, &$params, $value, $pdo_type){
    $where .= ':'.$param_name = get_p_name();
    $params[] = array(
        'name' => $param_name
        , 'value' => $value
        , 'type' => $pdo_type
    );
}

function add_parameter_for_property(&$where, &$params, $property){
    $property_value = $property['value'];
    $mysql_type = $property['schema']['type'];
    $pdo_type = map_mysql_to_pdo_type($mysql_type);
    if (is_array($property_value)) {
        $num_entries = count($property_value);
        for ($i=0; $i<$num_entries; $i++) {
            if ($i){
                $where .= ', ';
            }
            add_parameter($where, $params, $property_value[$i], $pdo_type);
        }
    }
    else {
        add_parameter($where, $params, $property_value, $pdo_type);
    }
}
}

```

```

function handle_filter_property(&$queries, $query_index, $t_alias, $column_name, $property){
    $query = &$queries[$query_index];
    $from = &$query['from'];
    $params = &$query['params'];
    $where = &$query['where'];

    $num_from_lines = count($from);
    if ($num_from_lines > 1){
        $from_line = &$from[$num_from_lines - 1];
        $from_or_where = &$from_line['join_condition'];
        $from_or_where .= "\n". 'AND ' . $t_alias . ' . ' . $column_name;
    }
    else {
        $from_or_where = &$query['where'];
        $from_or_where .= ($from_or_where? "\n". 'AND' : 'WHERE')
            . ' ' . $t_alias . ' . ' . $column_name;
    }

    //prepare right hand side of the filter expression
    $add_closing_parenthesis = FALSE;
    $add_closing_escape_clause = FALSE;
    if ($operator = $property['operator']) {
        //If an operator is specified,
        //the expression is used in the WHERE clause.
        switch ($operator) {
            case '~=': //funky mql pattern matcher
                //not implemented yet.
                //most likely it will be very hard
                //to implement this in a rdms-independent way
                //let alone efficiency
                break;
            case '<': case '>': case '<=': case '>=': case '!=':
            case '=': //note that = is an extension. Silly it's not standard.
                $from_or_where .= ' ' . $operator . ' ';
                break;
            case '!=|=':
                $from_or_where .= ' NOT';
                //fall through is intentional, keep the != and |= together please, in order.
            case '|=':
                $from_or_where .= ' IN (';
                $add_closing_parenthesis = TRUE;
                break;
            case '!=?': //extension. Ordinary database NOT LIKE
                $from_or_where .= ' NOT';
                //fall through is intentional, keep the != and ?= together please, in order.
            case '?=': //extension. Ordinary database LIKE
                $from_or_where .= ' LIKE ';
                $add_closing_escape_clause = TRUE;
                break;
        }
    }
    else {
        //If no operator is specified,
        //the comparison is automatically with equals.
        $from_or_where .= ' = ';
    }
    //prepare the right hand side of the comparison expression
    add_parameter_for_property($from_or_where, $params, $property);
    if ($add_closing_parenthesis) {
        $from_or_where .= ')';
    }
    else
    if ($add_closing_escape_clause) {
        $from_or_where .= " ESCAPE '\\\"";
    }
}

function handle_non_filter_property($t_alias, $column_name, &$select, &$property){

```

```

        $c_alias = $t_alias.get_c_alias();
        $column_ref = $t_alias.'.'. $column_name;
        $select[$column_ref] = $c_alias;
        $property['alias'] = $c_alias;
    }

function generate_sql(&$mql_node, &$queries, $query_index, $child_t_alias=NULL,
&$merge_into=NULL){
    global $metadata;
    if (isset($mql_node['entries'])) {
        generate_sql($mql_node['entries'], $queries, $query_index, $child_t_alias, $merge_into);
        return;
    }

    if (!isset($mql_node['query_index'])){
        $mql_node['query_index'] = $query_index;
    }

    $query = &$queries[$query_index];
    if (!$query){
        $query = array(
            'select'           => array()
            , 'from'           => array()
            , 'where'          => ''
            , 'order_by'       => ''
            , 'limit'          => ''
            , 'params'         => array()
            , 'mql_node'       => &$mql_node
            , 'indexes'        => array()
            , 'merge_into'     => $merge_into
            , 'results'        => array()
        );
        $queries[$query_index] = &$query;
    }
    $select = &$query['select'];
    $from   = &$query['from'];
    $where  = &$query['where'];
    $params = &$query['params'];
    $indexes = &$query['indexes'];

    $type = analyze_type($mql_node['types'][0]);
    $domain_name = $type['domain'];
    $domains = $metadata['domains'];
    $schema_domain = $domains[$domain_name];
    $type_name = $type['type'];
    $schema_type = $schema_domain['types'][$type_name];

    //table_name is either explicitly specified, or we take the type name
    if (isset($schema_type['table_name'])){
        $table_name = $schema_type['table_name'];
    }
    else {
        $table_name = $type_name;
    }

    //schema_name is either explicitly specified, or we take the domain name
    if (isset($schema_type['schema_name'])) { //schema_name is defined at the type level
        $schema_name = $schema_type['schema_name'];
    }
    else //schema_name is defined at the domain
level
        if (isset($schema_domain['schema_name'])){
            $schema_name = $schema_domain['schema_name'];
        }
        else { //schema_name not defined, settle for the
domain name
            $schema_name = $domain_name;
        }

    $t_alias = get_t_alias();

```

```

get_from_clause($mql_node, $t_alias, $child_t_alias, $schema_name, $table_name, $query);
if (array_key_exists('properties', $mql_node)) {
$properties = &$mql_node['properties'];
foreach ($properties as $property_name => &$property) {

    if ($property['is_directive']) {
    switch ($property_name) {
        case 'limit':
            $limit = intval($property['value']);
            if ($limit < 0) {
                exit('Limit must not be less than zero.');
            }
            $query['limit'] = $limit;
            break;
        }
    }
    else
        if (isset($mql_node['outer_join'])) {
            $property['outer_join'] = $mql_node['outer_join'];
        }

    $schema = $property['schema'];
    if (isset($schema['direction'])) {
        $direction = $schema['direction'];
    }
    if ($direction === 'referenced<-referencing') {
        $index_columns = array();
        $index_columns_string = '';
        foreach ($schema['join_condition'] as $columns) {
            $column_ref = $t_alias.'.'.$columns['referenced_column'];
            if (isset($select[$column_ref])) {
                $c_alias = $select[$column_ref];
            }
            else {
                $c_alias = $t_alias.get_c_alias();
                $select[$column_ref] = $c_alias;
            }
            $index_columns_string .= $c_alias;
            $index_columns[] = $c_alias;
        }
        if (!isset($indexes[$index_columns_string])) {
            $indexes[$index_columns_string] = array(
                'columns' => $index_columns
                , 'entries' => array()
            );
        }
        $merge_into = array(
            'query_index' => $query_index
            , 'index' => $index_columns_string
            , 'columns' => array()
        );
        $new_query_index = count($queries);
    }
    else
        if ($direction === 'referencing->referenced') {
            $merge_into = NULL;
            $new_query_index = $query_index;
        }
        $property['query_index'] = $new_query_index;
        generate_sql($property, $queries, $new_query_index, $t_alias, $merge_into);
    }
    else
        if ($column_name = $schema['column_name']) {
            if ($property['is_filter']) {
                handle_filter_property($queries, $query_index, $t_alias, $column_name,
$property);
            }
            else {
                handle_non_filter_property($t_alias, $column_name, $select, $property);
            }
        }
    }
}

```

```

    }
}
else
if (array_key_exists('default_property', $schema_type)) {
$default_property_name = $schema_type['default_property'];
$properties = $schema_type['properties'];
if (!array_key_exists($default_property_name, $properties)) {
exit('Default property "'. $default_property_name.'" specified but not found
in "'. $domain_name.'" / "'. $type_name.'"');
}
$default_property = $properties[$default_property_name];
$column_name = $default_property['column_name'];
$property = &$mysql_node;
$schema = &$property['schema'];
$schema['type'] = $default_property['type'];
if ($property['is_filter']) {
handle_filter_property($where, $params, $t_alias, $column_name, $property);
}
else {
handle_non_filter_property($t_alias, $column_name, $select, $property);
}
}
}

/*****
* Execute query / render result
*****/
function map_mysql_to_php_type($mysql_type) {
switch ($mysql_type) {
case '/type/boolean':
$php_type = 'bool';
break;
case '/type/content':
case '/type/datetime':
case '/type/text':
case '/type/rawstring':
$php_type = 'string';
break;
case '/type/float':
$php_type = 'float';
break;
case '/type/int':
$php_type = 'integer';
break;
default:
throw new Exception('No php type defined for mysql type: '.$mysql_type);
}
return $php_type;
}

$statement_cache = array();

function prepare_sql_statement($statement_text) {
global $pdo, $statement_cache;
if (isset($statement_cache[$statement_text])) {
$statement_handle = $statement_cache[$statement_text];
} else {
$statement_handle = $pdo->prepare($statement_text);
$statement_cache[$statement_text] = $statement_handle;
}
return $statement_handle;
}

function &execute_sql($statement_text, $params, $limit) {
global $pdo, $noexecute;
if ($noexecute) {
return array();
}
try {

```

```

        $statement_handle = prepare_sql_statement($statement_text);
        foreach($params as $param_key => $param){
            $statement_handle->bindValue(
                $param['name']
                ,   $param['value']
                ,   $param['type']
            );
        }
        $statement_handle->execute();
        if ($limit === -1) {
            $result = $statement_handle->fetchAll(PDO::FETCH_ASSOC);
        }
        else {
            $result = array();
            while ($limit-- && $row = $statement_handle->fetch(PDO::FETCH_ASSOC)) {
                $result[] = $row;
            }
        }
        $statement_handle->closeCursor();
    } catch (Exception $exception) {
        throw new Exception(
            $exception->getMessage().
            ' Offending statement: '.$statement_text
        );
    }
    return $result;
}

function get_query_sql($query){
    global $sql_dialect;

    $identifier_quote_start = $sql_dialect['identifier_quote_start'];
    $identifier_quote_end = $sql_dialect['identifier_quote_end'];

    $sql = 'SELECT';
    if ($select_columns = $query['select']) {
        foreach ($select_columns as $column_ref => $column_alias) {
            $sql .= ($sql==='SELECT'? ' ' : "\n, ").$column_ref.' AS '.$column_alias;
        }
    }
    else {
        $sql .= ' NULL';
    }
    $optionality_groups = array();
    foreach ($query['from'] as $index => $from_line) {
        if (isset($from_line['optionality_group'])) {
            $optionality_group_name = $from_line['optionality_group'];
            if (!array_key_exists ($optionality_group_name, $optionality_groups)) {
                $optionality_groups[$optionality_group_name] = array();
            }
            $optionality_group = &$optionality_groups[$optionality_group_name];
            $optionality_group[] = $from_line['optionality_group_column'];
        }
        $from_or_join = $index && (isset($from_line['join_type']));
        if ($from_or_join) {
            $sql .= "\n".$from_line['join_type'].' JOIN '
                . $from_line['table'].' ' . $from_line['alias']
                . "\n".$from_line['join_condition']
            ;
        }
        else
        if (array_key_exists('table', $from_line)) {
            $sql .= "\nFROM ".$from_line['table'].' ' . $from_line['alias'];
        }
        else
        if ($from_line['join_condition']){
            //these are filter condition but we write them in the join
            //this is required to handle outer joins.
            $sql .= "\n".$from_line['join_condition'];
        }
    }
}

```



```

    }
    $where = $query['where'];
    foreach ($optionality_groups as $k => $v) {
        $condition_null = '';
        $condition_not_null = '';
        foreach ($v as $optionality_group_column) {
            if ($condition_null !== '') {
                $condition_null .= ' AND ';
            }
            $condition_null .= $optionality_group_column.' IS NULL';
            if ($condition_not_null !== '') {
                $condition_not_null .= ' AND ';
            }
            $condition_not_null .= $optionality_group_column.' IS NOT NULL';
        }
        if ($where) {
            $where .= "\nAND";
        }
        else {
            $where .= "\nWHERE";
        }
        $where .= ' (('.$condition_null.') OR ( '.$condition_not_null.' ))';
    }

    $sql .= ($where? "\n".$where : '')
        . ($query['order_by']? "\n".$query['order_by'] : '');
    ;
    //TODO: this implementation of limit is buggy!
    //It works fine if applied to a top-level mql node,
    //When used for a nested mql node, it does not take into
    //account that the limit should be applied only to the nested node
    if ($query['limit']) {
        if ($sql_dialect['supports_limit']) {
            $sql .= "\nLIMIT ".$query['limit'];
        }
    }
    return $sql;
}

function execute_sql_query(&$sql_query){
    global $sql_dialect;
    if ($sql_query['limit'] && !$sql_dialect['supports_limit']) {
        //TODO: this implementation of limit is buggy!
        //It works fine if applied to a top-level mql node,
        //When used for a nested mql node, it does not take into
        //account that the limit should be applied only to the nested node
        $limit = $sql_query['limit'];
    }
    else {
        //limit has been implemented directly in SQL
        $limit = -1;
    }
    $sql = get_query_sql($sql_query);
    $sql_query['sql'] = $sql;
    return execute_sql($sql, $sql_query['params'], $limit);
}

function get_result_object(&$mql_node, $query_index, &$result_object=NULL, $key=NULL){
    if ($mql_node['query_index']!=$query_index){
        return;
    }
    $object = array();

    if (is_array($result_object)) {
        $result_object[$key] = &$object;
    }
    else {
        $result_object = &$object;
    }
}

```

```

        if (isset($mql_node['entries'])) {
            get_result_object($mql_node['entries'], $query_index, $object, 0);
        }
        else
        if (isset($mql_node['properties'])) {
            foreach ($mql_node['properties'] as $property_key => $property) {
                if ($property['operator'] || $property['is_directive']) {
                    continue;
                }
                $value = $property['value'];
                if (is_object($value) || is_array($value)){
                    get_result_object($property, $query_index, $object, $property_key);
                }
                else {
                    $object[$property_key] = $value;
                }
            }
        }
        $mql_node['result_object'] = $object;
        return $object;
    }

function fill_result_object(&$mql_node, $query_index, $data, &$result_object){
    global $explicit_type_conversion;
    if($mql_node['query_index']!=$query_index){
        return;
    }

    if ($entries = &$mql_node['entries']) {
        fill_result_object($entries, $query_index, $data, $result_object[0]);
    }
    else
    if ($properties = &$mql_node['properties']) {
        foreach ($result_object as $key => $value) {
            $property = $properties[$key];
            if (is_object($value) || is_array($value)){
                fill_result_object($property, $query_index, $data, $result_object[$key]);
            }
            else
            if (isset($property['alias'])) {
                $alias = $property['alias'];
                if ($explicit_type_conversion) {
                    if (!is_null($data[$alias])) {
                        settype($data[$alias], map_mql_to_php_type($property['schema']['type']));
                    }
                }
                $result_object[$key] = $data[$alias];
            }
        }
    }
}

function add_entry_to_indexes(&$indexes, $row_index, &$row) {
    foreach($indexes as $index_name => &$index) {
        $entries = &$index['entries'];
        $cols = $index['columns'];
        $colcount = count($cols) - 1;
        for ($i=0; $i<$colcount; $i++){
            $col = $cols[$i];
            $sub_entries = &$entries[$row[$col]];
            if (!$sub_entries) {
                $sub_entries = array();
                $entries[$row[$col]] = &$sub_entries;
            }
            $sub_entries = &$sub_entries;
        }
        $entries[$row[$cols[$i]]] = $row_index;
    }
}

```

```

}

function &get_entry_from_index(&$query, $index_name, $key){
    $index = $query['indexes'][$index_name]['entries'];
    foreach ($key as $k) {
        $index = $index[$k];
    }
    $results = &$query['results'];
    return $results[$index];
}

function merge_result_object(&$mql_node, &$result_object, $query_index, &$data, $from, $to){
    if (isset($mql_node['entries'])) {
        merge_result_object($mql_node['entries'], $result_object[0], $query_index, $data,
$from, $to);
    }
    else
    if (isset($mql_node['properties'])) {
        $properties = $mql_node['properties'];
        foreach ($properties as $property_key => $property) {
            if ($property['operator']) {
                continue;
            }
            if (isset($property['query_index']) && ($property['query_index']===$query_index)
) {
                $result_object[$property_key] = array();
                $target = &$result_object[$property_key];
                for ($i=$from; $i<=$to; $i++){
                    $target[] = &$data[$i];
                }
            }
            else {
                $value = $property['value'];
                if (is_object($value) || is_array($value)){
                    merge_result_object($property, $result_object[$property_key],
$query_index, $data, $from, $to);
                }
            }
        }
    }
}

function merge_results(&$queries, $query_index, $key, $from, $to){
    if ($from===-1){
        return;
    }
    $query = &$queries[$query_index];
    $merge_into = $query['merge_into'];
    $target_query_index = $merge_into['query_index'];
    $target_query = &$queries[$target_query_index];
    $index_name = $merge_into['index'];
    $merge_target = &get_entry_from_index($target_query, $index_name, $key);
    merge_result_object($target_query['mql_node'], $merge_target, $query_index,
$query['results'], $from, $to);
}

function create_inline_table_for_index_entry(&$entries, $columns, $column_index, &$statement,
&$row){
    global $pdo, $sql_dialect;
    $single_row_from_clause = $sql_dialect['single_row_from_clause'];
    foreach ($entries as $key => $value) {
        $row .= ($row === '' ? 'SELECT ' : ', ');
        $row .= (is_string($key) ? $pdo->quote($key) : $key)
        . ($statement === '' ? ' AS ' : '. $columns[$column_index] : ');
    }

    if (is_array($value)){
        create_inline_table_for_index_entry($value, $columns, $column_index+1,
$statement, $row);
    }
}

```

```

        else
        if (is_int($value)) {
            $statement .= ($statement===' ' ? ' ' : "\nUNION
ALL\n").$row.$single_row_from_clause;
            $row = '';
        }
    }
}

function create_inline_table_for_index(&$index){
    $statement = '';
    $row = '';
    create_inline_table_for_index_entry($index['entries'], $index['columns'], 0,
$statement, $row);
    $statement = "(\n".$statement."\n)";
    $index['inline_table'] = $statement;
}

function create_inline_tables_for_indexes(&$indexes){
    foreach ($indexes as &$index) {
        create_inline_table_for_index($index);
    }
}

/**
 * execute_sql_queries(&$sql_queries)
 * Executes multiple SQL queries
 *
 * arguments:
 * sql_queries:      an array
 *
 * return:
 */
function execute_sql_queries(&$sql_queries) {
    foreach($sql_queries as $sql_query_index => &$sql_query){

        $indexes = &$sql_query['indexes'];

        $mql_node = $sql_query['mql_node'];
        get_result_object($mql_node, $sql_query_index);
        $result_object = $mql_node['result_object'];

        if ($merge_into = $sql_query['merge_into']) {
            $merge_into_columns = $merge_into['columns'];
            $select_columns = $sql_query['select'];
            $merge_into_values_new = array();
            $merge_into_values_old = array();
            $offset = -1;

            $index_name = $merge_into['index'];
            $index = $sql_queries[$merge_into['query_index']]['indexes'][$index_name];
            $index_columns = $index['columns'];
            $extra_from_line = array(
                'table' => $index['inline_table']
                ,   'alias' => $index_name
            );
            $join_condition = '';
            foreach ($index_columns as $position => $index_column) {
                $join_condition .= ($join_condition===' ' ? 'ON' : "\nAND").' '
                    . $index_name.'.'.$index_column.' = '
                    . array_search($merge_into_columns[$position],
$select_columns, TRUE)
                    ;
            }
            $from = &$sql_query['from'];
            //php guru's, isn't the a func to get the first element of an array?
            foreach ($from as &$first_from_line) { break; }
            $first_from_line['join_condition'] = $join_condition;
            $first_from_line['join_type'] = 'INNER';
            array_unshift($from, $extra_from_line);

```



```

        $return_value['timing'] = $callstack;
    }
    return $return_value;
}

/**
 * handle_queries($queries)
 * Executes multiple MQL queries.
 *
 * arguments:
 * queries:   an associative array of mql query objects (decoded from JSON)
 *
 * return:    an associative array of result envelopes
 */
function handle_queries($queries){
    $queries = get_object_vars($queries);
    $results = array(
        'code' =>  '/api/status/ok'
    );
    foreach ($queries as $query_key => $query){
        $result = handle_query($query, $query_key);
        $results[$query_key] = $result;
    }
    return $results;
}

/*****
 * Schema
 *****/
// $metadata_file_name is defined in config.php
$metadata = NULL;

function init_metadata(){

    global $metadata_file_name, $metadata;

    // We have to redefine the schema file location again here, because it is out-of-scope.
    $metadata_file_name = MODX_ASSETS_PATH . 'templates/core/schemas/schema-core.json';

    if (!file_exists($metadata_file_name)){
        exit('Cannot find schema file "' . $metadata_file_name . '".');
    }

    $metadata_file_contents = file_get_contents($metadata_file_name);

    if (!$metadata = json_decode($metadata_file_contents, TRUE)) {
        exit('schema is not valid json ('.get_last_json_error().').');
    }
}

/*****
 * Database (PDO)
 *****/
// $connection_file_name is defined in config.php
$pdo = NULL;
$explicit_type_conversion = NULL;

$sql_dialect = NULL;
function init_dialect($pdo_config){
    global $sql_dialect;
    $pdo_dsn = $pdo_config['dsn'];
    $db_type = substr($pdo_dsn, 0, strpos($pdo_dsn, ':'));
    include($db_type.'-dialect.php');
}

function init_pdo(){
    global $connection_file_name, $pdo,
        $explicit_type_conversion, $sql_dialect
    ;

    // We have to redefine the connection file location again here, because it is out-of-

```

```

scope.
    $connection_file_name = MODX_ASSETS_PATH . 'templates/core/schemas/connection-mysql-core.json';

    if (!file_exists($connection_file_name)){
        exit('Cannot find connection file "'. $connection_file_name. '".');
    }

    $connection_file_contents = file_get_contents($connection_file_name);

    if (!$connection = json_decode($connection_file_contents, TRUE)) {
        exit('connection is not valid json ('.get_last_json_error().'.');
    }

    $pdo_config = $connection['pdo'];

    if (!is_array($pdo_config)) {
        exit('schema does not specify a valid pdo configuration. ');
    }
    init_dialect($pdo_config);

    $pdo = new PDO(
        $pdo_config['dsn']
        , $pdo_config['username']
        , $pdo_config['password']
        , $pdo_config['driver_options']
    );
    $pdo->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);
    $pdo->setAttribute(PDO::ATTR_STRINGIFY_FETCHES, FALSE);
    $pdo->setAttribute(PDO::ATTR_CASE, PDO::CASE_LOWER);
    $explicit_type_conversion = $connection['explicit_type_conversion'];
}
/*****
*   misc
*****/
$args = NULL;
function init_args() {
    global $args;
    switch ($_SERVER['REQUEST_METHOD']){
        case 'GET':
            $args = $_GET;
            break;
        case 'POST':
            $args = $_POST;
            break;
        default:
            exit('Must use either GET or POST');
    }
}
/*****
*   Queries
*****/
$query_or_queries = NULL;
$query = NULL;
$queries = NULL;
$debug_info = NULL;
function init_queries(){
    global $args,
        $query,
        $queries,
        $query_decode,
        $debug_info,
        $noexecute
    ;
    if (isset($args['query'])) {
        $query = $args['query'];
    }
    if (isset($args['queries'])){
        $queries = $args['queries'];
    }
}

```

```

//check if the query parameter is present
if ((!isset($query) && !isset($queries))
|| (isset($query) && isset($queries))) {
exit('Either query or queries must be specified');
}

$query_or_queries = $query? $query : $queries;

//immunize against magic quoting
if (get_magic_quotes_gpc() === 1) {
$query_or_queries = stripslashes($query_or_queries);
}

//check if the query parameter is valid JSON
$query_decode = json_decode($query_or_queries);
if ($query_decode===NULL) {
exit('query or queries not valid JSON ('.get_last_json_error().')');
}

//testing if the envelope is an object (not some other random JSON value)
if (!is_object($query_decode)) {
exit('Envelope must be an object');
}

$debug_info = property_exists($query_decode,'debug_info')? $query_decode->debug_info :
FALSE;
$noexecute = property_exists($query_decode,'noexecute')? $query_decode->noexecute :
FALSE;
}

/**
 *
 */
function handle_request(){
    global $args,
    $queries,
    $query_decode;

    if (isset($queries)) {
$result = handle_queries($query_decode);
    }
    else {
$result = handle_query($query_decode);
    }
    $result['status'] = '200 OK';
    $result['transaction_id'] = 'not implemented';
    $json_result = json_encode($result);

    if (isset($args['callback'])) {
$content_type = 'text/javascript';
$response = $args['callback'].'( '.$json_result.' )';
    }
    else {
$content_type = 'application/json';
$response = $json_result;
    }
    header('Content-Type: '.$content_type);
    echo $response;
}
/*****
 *
 * run
 *****/
function run() {
    init_metadata();
    init_pdo();
    init_args();
    init_queries();
    handle_request();
}

```



```
/******  
*   main  
*****/  
run();
```

core.MQLRead snippet

With all these files in place, we can now open the MQL Query Editor web page in our web browser like so:

```
http://localhost/api/services/mql-query-editor/
```

NOTE: If the MODx content management system is on a remote server, change localhost to the domain name or IP address of that server (e.g. <http://vanheemstrapictures.com/vhp/api/services/mql-query-editor/>)

... to do: explain how to query with the query editor ...

A sample query in the MQL Query Editor window would be:

```
{
  "type": "/core/person",
  "kp_PersonID": 1,
  "PersonFirstName": null,
  "PersonLastName": null
}
```

NOTE: replace core with the real name of the database to query, for example if it uses a prefix (e.g. vanheems_core).

NOTE: 'person' in the above query is the name of the table (in fact the view on the table) that we are querying.

All fields that we list with the value 'null' are going to be 'filled' with their found values in the response from the server.

A sample found set from above query is (provided we choose not to show debug info):

```
{
  "code": "/api/status/ok",
  "result": [
    {
      "type": "/core/person",
      "kp_PersonID": 1,
      "PersonFirstName": "Zenaida",
      "PersonLastName": "Rodarte"
    }
  ],
  "status": "200 OK",
  "transaction_id": "not implemented"
}
```

... more

Write-Store - Making the ExtJS Store transaction enabled

The **write-store**⁵ is an extension to the excellent [ExtJS](#) library by Jack Slocum. It answers several shortcomings of ExtJS data Stores, which are used to present data:

- ExtJS stores are primarily read-only with respect to the server, rather than read-write. You can change data in the Store, but cannot transmit it back to the server.
- ExtJS stores do not have a full transaction support. If you make several changes and then decide you want to undo them, modern RDBMS systems will let you reject or roll back the transaction; ExtJS stores do not support this.
- ExtJS stores cannot use other Stores as their data source. This becomes important to reduce round-trip requests to/from the server in a time-sensitive Ajax environment. For example, if a single query returns a list of persons, and each person has several telephone numbers, it makes sense from a presentation to the user perspective to have the persons in one Store, perhaps displayed by one grid, and the telephone numbers in another Store, perhaps displayed by a separate grid. ExtJS currently requires you to retrieve the persons in one request and each set of telephone numbers, when desired, in separate requests.

write-store extends ExtJS to resolve these shortcomings.

It is **strongly** recommended that you understand how to use [ExtJS](#) before using write-store.

JSormDB - Database at the client with support of the Server

jsormdb⁶ is a full-featured stand-alone database written entirely in JavaScript. jsormdb can be used to store data within a client-side or server-side JavaScript application. jsormdb supports full transaction semantics including commit and partial/full rollback, and queries.

jsormdb also supports loading information from and sending information to a remote data source. In this, jsormdb acts as a local representation of remote data, and can fully interact with the data. Commits are sent to the remote data source in one of multiple methods, and the returned data can be entered in the jsormdb in one of multiple methods.

jsormdb was inspired by the [write-store](#) extension to [ExtJS](#). The author of [write-store](#) saw a general need for a proper data store and built jsormdb from scratch to meet that need.

jsormdb currently supports only one table per instance. A direct result of this limitation is that a join query is not possible. Multi-table is scheduled for a future release.

WARNING: An error will be raised if the following has not been fixed:

Inside the javascript file **jsormdb.js** and **jsormdb-src.js** one has to put quotes around the version number, like so: `var JSORM={version:"1.3b"}`

⁵ <http://jsorm.com/wiki/Write-store>

⁶ <http://jsorm.com/wiki/Jsormdb>

1. Persistence ---- NO LONGER REQUIRED, WE NOW USE JSormDB !!!

Persistence⁷ is a JavaScript framework to persist (i.e. temporarily store) objects in a browser and/or server environment. We use it to store objects in the browser in its database or local storage.

persistence.js utilizes the browser's SQLite database to store and query data.

Browser support

- Modern webkit browsers (Google Chrome and Safari)
- Firefox (through [Google Gears](#)) NOTE: Google Gears is deprecated.
- Opera (10+)
- Android browser (tested on 1.6 and 2.x)
- iPhone browser (iPhone OS 3+)
- Palm WebOS (tested on 1.4.0)

The [in-memory store](#) can be used in other browser (such as Firefox) as a fall-back option. The in-memory store has the ability to write and load the entire database to the browser's window.localStorage.

So, we will detect the web browser and if the web browser does not support Web SQL Database (for example, Firefox and IE), we fall back to using the in-memory store.

See <http://persistencejs.org/stores/memory>

```
if (/Firefox[\\\/s] (\d+\.\d+)/.test(navigator.userAgent)) {  
    // FireFox detected  
  
}  
else if (/MSIE (\d+\.\d+)/.test(navigator.userAgent)) {  
    // IE detected  
  
}  
else {  
    // a WebSQL database compatible browser  
  
}
```

HTML 5 Client-side DatabaseStorage API demo

See <http://www.webkit.org/demos/sticky-notes/index.html>

To 'play' with all features of the browser Web SQL Database, go here:

http://playground.html5rocks.com/#async_transactions

//////////////////// STAY WITH PERSISTENCE.JS //////////////////////

-- NO NEED TO DIVERT TO OTHER SOLUTIONS AS PERSISTENCE.JS HAS FALL BACK --

⁷ <http://persistencejs.org>

For compatibility reasons, we should abstract from the Web SQL Database (as neither IE nor FireFox support it) and use an abstraction layer, such as **JStore**⁸ (i.e. JQuery Store).

Or stick with **HTML 5 Local Storage** as it supported in almost all browsers natively:
See here for more info on the use of HTML 5 Local Storage (which uses key/value pairs):
<http://diveintohtml5.info/storage.html>

Or use **PersistJS**⁹, which handles client-side storage seamlessly and transparently to your code. You use a single API and get support for the following backends:

- flash: Flash 8 persistent storage.
- gears: Google Gears-based persistent storage.
- localStorage: HTML5 draft storage.
- whatwg_db: HTML5 draft database storage.
- globalstorage: HTML5 draft storage (old spec).
- ie: Internet Explorer userdata behaviors.
- cookie: Cookie-based persistent storage.

Any of those can be disabled—if, for example, you don't want to use cookies. With this library, you'll get native client-side storage support in IE 5.5+, Firefox 2.0+, Safari 3.1+, and Chrome; and plugin-assisted support if the browser has Flash or Gears. If you enable cookies, it will work in everything (but will be limited to 4 kB).

Each backend exposes the exact same interface, which means you don't have to know or care which backend is being used.

////////////////////////////////////
///

Folder Hierarchy for Persistence for Client (i.e. web pages) usage:

assets					
	templates				
		core			
			javascripts		
				persistence	
					<the persistence javascript files>

Addition to all web pages that use persistence:

```
<html>
...

<script src="assets/templates/core/javascripts/persistence/persistence.js" type="application/
javascript"></script>
<script src="assets/templates/core/javascripts/persistence/persistence.store.sql.js"
type="application/javascript"></script>
```

⁸ <http://code.google.com/p/jquery-jstore/>

⁹ <http://pablotron.org/?cid=1557>

```

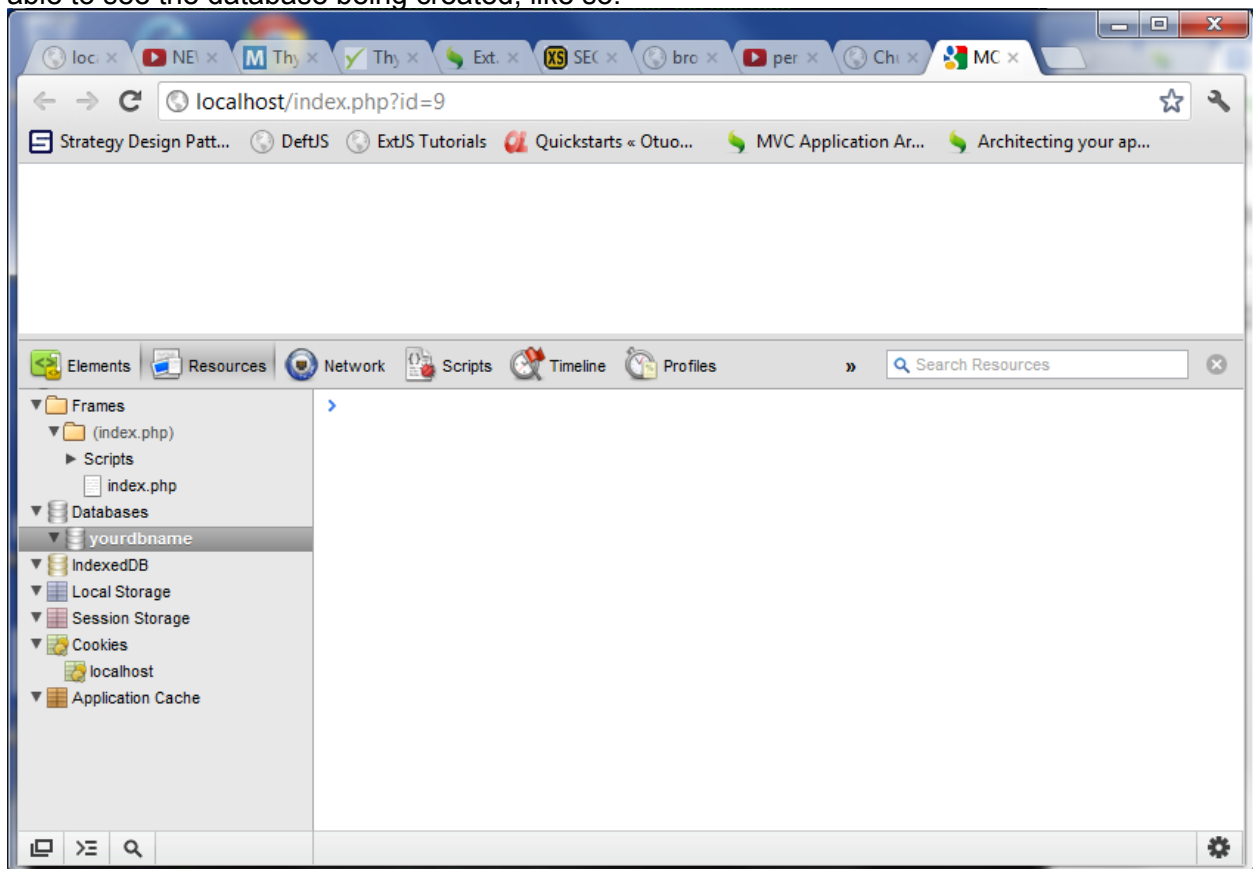
<script src="assets/templates/core/javascripts/persistence/persistence.store.websql.js"
type="application/javascript"></script>
<script type="application/javascript">
    persistence.store.websql.config(persistence, 'yourdbname', 'A database description', 5 * 1024
    * 1024);
</script>

...
</html>

```

NOTE: The above example includes a WebSQL store (which includes Google Gears support). The first argument is always supposed to be persistence. The second in your database name (it will create it if it does not already exist, the third is a description for your database, the last argument is the maximum size of your database in bytes (5MB in this example).

When this web page is loaded in a web browser, using Chrome's Developer Tools you will be able to see the database being created, like so:



We can add tables and relationships to the database on the client like so:

```

<html>
...

<script src="assets/templates/core/javascripts/persistence/persistence.js" type="application/
javascript"></script>
<script src="assets/templates/core/javascripts/persistence/persistence.store.sql.js"
type="application/javascript"></script>
<script src="assets/templates/core/javascripts/persistence/persistence.store.websql.js"
type="application/javascript"></script>
<script type="application/javascript">

```

```

    persistence.store.websql.config(persistence, 'yourdbname', 'A database description', 5 * 1024
    * 1024);

    var Task = persistence.define('Task', {
        name: "TEXT",
        description: "TEXT",
        done: "BOOL"
    });

    var Category = persistence.define('Category', {
        name: "TEXT"
    });

    Category.hasMany('tasks', Task, 'category');

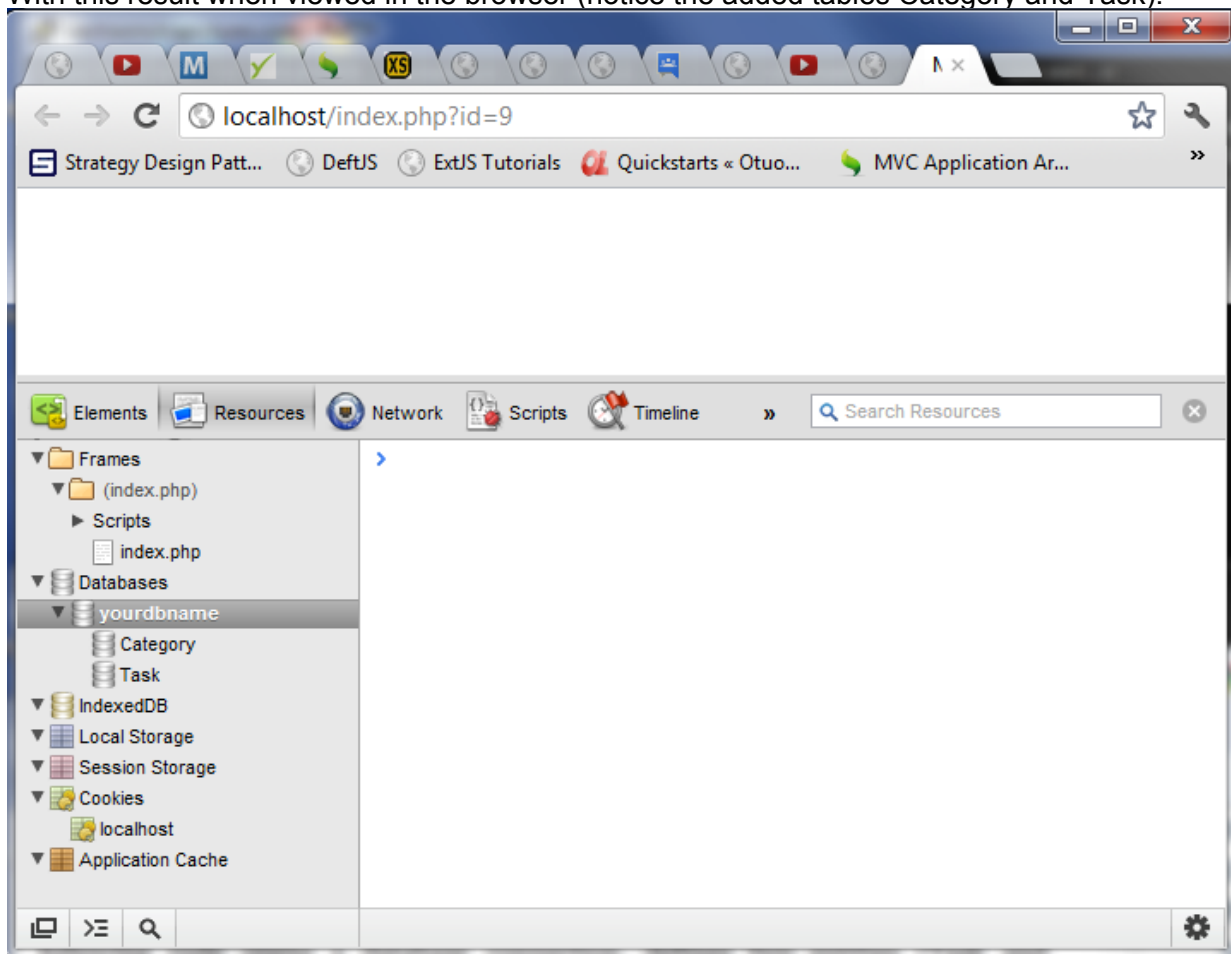
    persistence.schemaSync(null, function(tx) {
        alert('Successfully synchronized the schema!');
    });
</script>

...
</html>

```

NOTE: Schema property types are based on **SQLite** types. Options are: TEXT, INT, BOOL, DATE and JSON.

With this result when viewed in the browser (notice the added tables Category and Task):



Instances of the defined entities can then be created in a natural way, and subsequently marked to be persisted (note: below is javascript in the web page):

```
var task = new Task();
task.name = "My new task";
var category =
    new Category({name: "My category"});
persistence.add(task);
persistence.add(category);
```

NOTE: "Important: Changes and new objects will not be persisted until you explicitly call flush()"

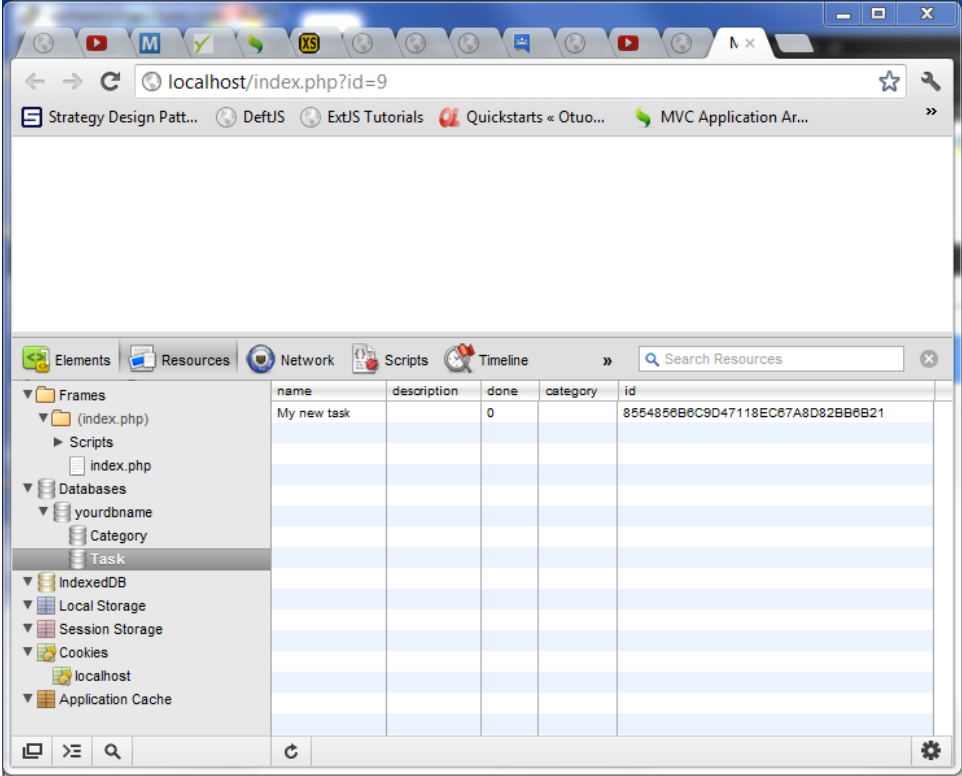
One-to-many and many-to-many relationships can be used as collections (note: below is javascript in the web page):

```
category.tasks.add(task);
```

When modifications to objects have been made, these have to be **flushed** to the database:

```
persistence.flush(null, function() {
    alert('All objects flushed!');
});
```

This is the result of the flushing... records in the tables !!



A nice feature of [persistence.js](#) is QueryCollections, which are virtual collections that can prefetch relations, can easily be filtered and sorted (and in the future paginated):

```
Task.all().filter("done", '=', true)
    .prefetch("category")
    .order("name", false)
    .list(null, function (results) {
        results.forEach(function (t) {
            console.log('[' + t.category.name + ']' +
                + t.name);
        });
    });
```



```
});  
});
```

The creator (Zef Hemel) has add synchronization support to it so that the local database can transparently be synchronized with a (view on) a remote database, which is a typical use case of applications like these.

The Client side of sync-ing using persistence.js

Persistence.js is not limited to the client side, and this is one of its true strengths. On the server side, in a node.js environment, Persistence.js can make use of the node-mysql module to store and retrieve data from a MySQL database. The persistence.sync module allows for synchronization of tables between a browser database and server side MySQL.

See here: <http://persistencejs.org/plugin/sync>

Adding sync capability, requires the web page to contain these script tags:

```
<html>  
...  
<script src="assets/templates/core/javascripts/persistence/persistence.js" type="application/  
javascript"/></script>  
<script src="assets/templates/core/javascripts/persistence/persistence.sync.js"  
type="application/javascript"/></script>  
...  
</html>
```

After including both persistence.js and persistence.sync.js in your page, you can enable syncing on entities individually:

```
var Task = persistence.define("Task", {  
  name: "TEXT",  
  done: "BOOL"  
});  
  
Task.enableSync('/taskChanges');
```

The argument passed to enableSync is the URI of the sync server component.

To initiate a sync, the EntityName.**syncAll(..)** method is used (e.g. Task.syncAll(..)):

```
function conflictHandler(conflicts, updatesToPush, callback) {  
  // Decide what to do with the conflicts here, possibly add to updatesToPush  
  callback();  
}  
  
EntityName.syncAll(conflictHandler, function() {  
  alert('Done!');  
});
```

There are two sample conflict handlers:

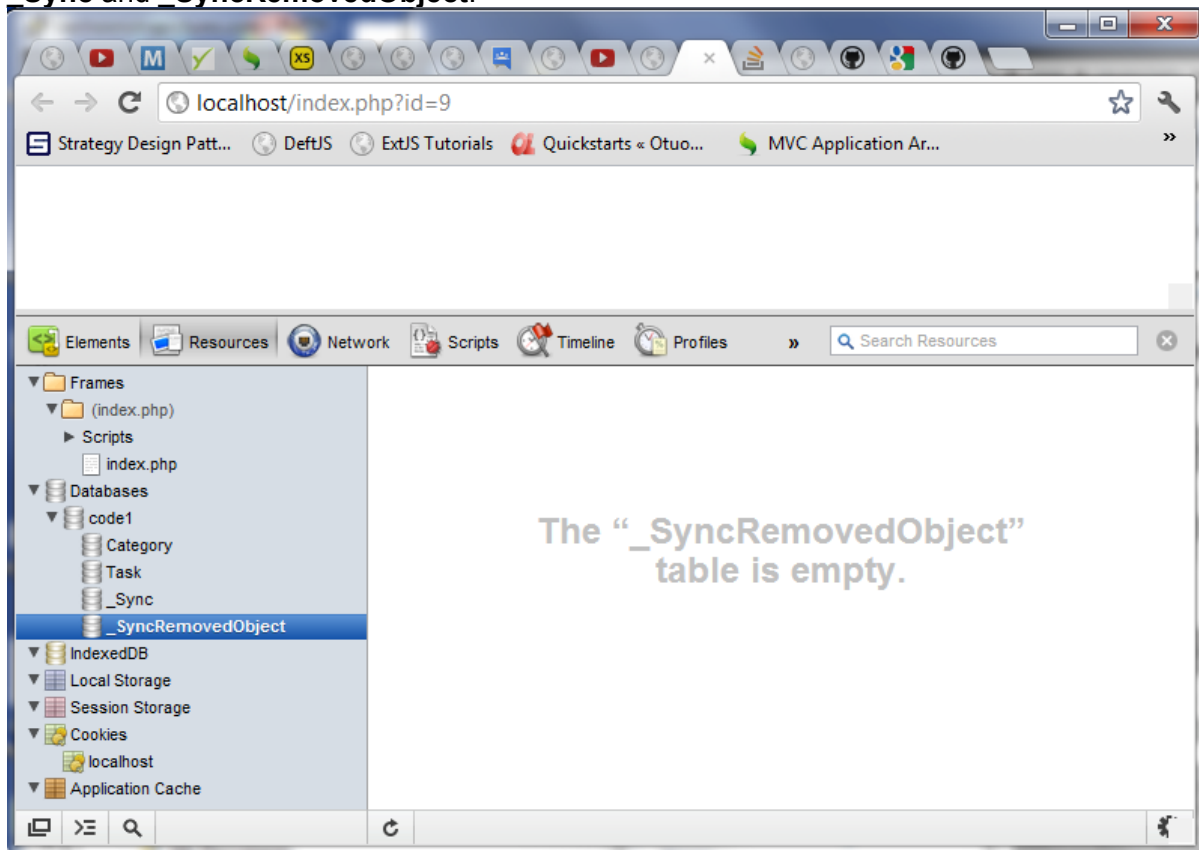
1. persistence.sync.preferLocalConflictHandler, which in case of a data conflict will always pick the local changes.
2. persistence.sync.preferRemoteConflictHandler, which in case of a data conflict will always pick the remote changes.

For instance:

```
EntityName.syncAll(persistence.sync.preferLocalConflictHandler, function() {  
    alert('Done!');  
});
```

Note that you are responsible for syncing all entities and that there are no database consistencies after a sync, e.g. if you only sync Tasks that refer to a Project object and that Project object has not (yet) been synced, the database will be (temporarily) inconsistent.

The addition of the **persistence.sync.js** code to the **persistence.store.websql.js** code in the web page will automatically create two more tables inside the database in the browser, called **_Sync** and **_SyncRemovedObject**:



NOTE: We have renamed the database to 'code1' in above example.

This is the WebSQL that is executed by `persistence.store.websql.js:78`:

```
CREATE TABLE IF NOT EXISTS `Category` (`name` TEXT, `id` VARCHAR(32) PRIMARY KEY) null  
  
CREATE TABLE IF NOT EXISTS `Task` (`name` TEXT, `description` TEXT, `done` INT, `category`  
VARCHAR(32), `id` VARCHAR(32) PRIMARY KEY) null  
  
CREATE INDEX IF NOT EXISTS `Task__category` ON `Task` (`category`) null  
  
CREATE TABLE IF NOT EXISTS `_SyncRemovedObject` (`entity` VARCHAR(255), `objectId` VARCHAR(32),  
`id` VARCHAR(32) PRIMARY KEY) null  
  
CREATE TABLE IF NOT EXISTS `_Sync` (`entity` VARCHAR(255), `localDate` BIGINT, `serverDate`  
BIGINT, `serverPushDate` BIGINT, `id` VARCHAR(32) PRIMARY KEY) null
```

```
INSERT INTO `Task` (`name`, `description`, `done`, id) VALUES (?, ?, ?, ?) ["My new task", "", 0, "6A38B884845E43B8B15D447D1F468023"]

INSERT INTO `Category` (`name`, id) VALUES (?, ?) ["My category", "C88CFB677D404FC185301770160EFDD4"]
```

NOTE: It creates an 'id' field by default and creates unique values for each record for this field (e.g. 6A38B884845E43B8B15D447D1F468023).

Here is another code example (with a database called code2), which shows the **creation** (Task 1 through Task 10), **retrieval** (All Tasks), **updating** (by randomly setting 'done' from '0' to '1') and **deletion** of records (whose done field was set to '1' where 1 means true):

```
<script type="application/javascript">
//establish local database
persistence.store.websql.config(persistence, 'code2', 'A database description', 5 * 1024 * 1024);

//define Entity
var Task = persistence.define('Task', {
  name: "TEXT",
  done: "BOOL"
});

//wipe local database clean
persistence.reset(function() {

  //write schema
  persistence.schemaSync(function() {

    //create ten dummy tasks
    for(var i=1;i<=10;i++){
      var task = new Task();
      task.name = "Task " + i;
      task.done = false;
      persistence.add(task);
    }

    //commit dummy tasks to database
    persistence.flush(function() {

      //retrieve all tasks from database
      Task.all().list(function(tasks){
        //callback counter
        var taskCounter = tasks.length;

        //asynchronously loop through items
        tasks.forEach(function(task){
          //randomly set items to done
          task.done = Math.round(Math.random());

          //decrement callback counter
          //check if this is last run
          if(--taskCounter == 0){

            //write all changes back to database
            persistence.flush(function() {

              //call destroyAll on a collection with the filter done=true
              Task.all().filter('done', '=', true).destroyAll();
            });
          }
        });
      });
    });
  });
});
});
```

```
});  
});  
</script>
```

Note: example taken from <http://jacobmumm.com/demos/persistencetask/index.html>

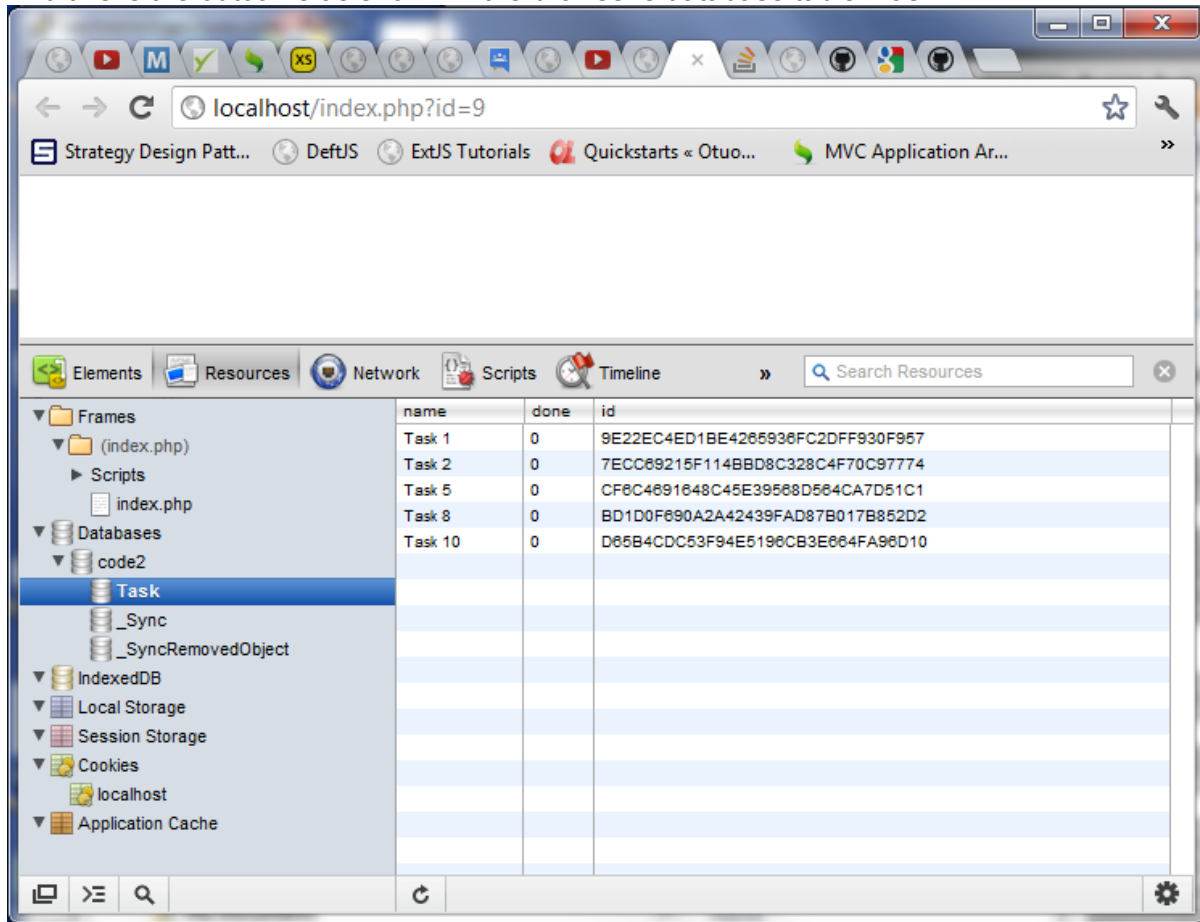
This is the executed WebSQL in the browser by [persistence.store.websql.js:78](#):

```
DROP TABLE IF EXISTS `Task` null  
DROP TABLE IF EXISTS `_SyncRemovedObject` null  
DROP TABLE IF EXISTS `_Sync` null  
CREATE TABLE IF NOT EXISTS `Task` (`name` TEXT, `done` INT, `id` VARCHAR(32) PRIMARY  
KEY) null  
CREATE TABLE IF NOT EXISTS `_SyncRemovedObject` (`entity` VARCHAR(255), `objectId`  
VARCHAR(32), `id` VARCHAR(32) PRIMARY KEY) null  
CREATE TABLE IF NOT EXISTS `_Sync` (`entity` VARCHAR(255), `localDate` BIGINT,  
`serverDate` BIGINT, `serverPushDate` BIGINT, `id` VARCHAR(32) PRIMARY KEY) null  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 1",  
0, "9E22EC4ED1BE4265936FC2DFF930F957"]  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 2",  
0, "7ECC69215F114BBD8C328C4F70C97774"]  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 3",  
0, "A1C34523D1CF4CB5AB4429B60210A463"]  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 4",  
0, "B981EF0315BF480290E6A1A52F0C8E01"]  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 5",  
0, "CF6C4691648C45E39568D564CA7D51C1"]  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 6",  
0, "D34FDB5497C74412ABCD03D87EC42AB4"]  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 7",  
0, "B78A3C7F491A45569471F8AB056AFBCC"]  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 8",  
0, "BD1D0F690A2A42439FAD87B017B852D2"]  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 9",  
0, "639574F31E86496EA022C95A8FA69DCD"]  
INSERT INTO `Task` (`name`, `done`, id) VALUES (?, ?, ?) ["Task 10",  
0, "D65B4CDC53F94E5196CB3E664FA96D10"]  
SELECT `root`.id AS Task_id, `root`.`name` AS `Task_name`, `root`.`done` AS `Task_done`  
FROM `Task` AS `root` WHERE 1=1 []  
UPDATE `Task` SET `done` = ? WHERE id = '9E22EC4ED1BE4265936FC2DFF930F957' [0]  
UPDATE `Task` SET `done` = ? WHERE id = '7ECC69215F114BBD8C328C4F70C97774' [0]  
UPDATE `Task` SET `done` = ? WHERE id = 'A1C34523D1CF4CB5AB4429B60210A463' [1]  
UPDATE `Task` SET `done` = ? WHERE id = 'B981EF0315BF480290E6A1A52F0C8E01' [1] UPDATE  
`Task` SET `done` = ? WHERE id = 'CF6C4691648C45E39568D564CA7D51C1' [0]  
UPDATE `Task` SET `done` = ? WHERE id = 'D34FDB5497C74412ABCD03D87EC42AB4' [1]  
UPDATE `Task` SET `done` = ? WHERE id = 'B78A3C7F491A45569471F8AB056AFBCC' [1]  
UPDATE `Task` SET `done` = ? WHERE id = 'BD1D0F690A2A42439FAD87B017B852D2' [0]  
UPDATE `Task` SET `done` = ? WHERE id = '639574F31E86496EA022C95A8FA69DCD' [1]  
UPDATE `Task` SET `done` = ? WHERE id = 'D65B4CDC53F94E5196CB3E664FA96D10' [0]  
SELECT id FROM `Task` WHERE (1=1 AND `done` = ?) [1]  
DELETE FROM `Task` WHERE (1=1 AND `done` = ?) [1]
```

See above WebSQL making use of **prepared statements**, where the ? is set through the value in the index [0].

Note how by setting '**WHERE 1=1**' all records are retrieved.

And this is the outcome as shown in the browser's database table 'Task':



NOTE: We have renamed the database to 'code2' in above example.

Date handling can be deceptive. Make sure that any fields defined as date objects are being sent as an epoch rather than any other format. This can silently fail, or succeed in certain Web SQL implementations and not others.

- This synchronization library synchronizes on a per-object granularity. It does not keep exact changes on a per-property basis, therefore conflicts may be introduced that need to be resolved.
- It does not synchronize many-to-many relationships at this point
- Error handling is not really implemented, e.g. there's no way to deal with a return from the server other than "status: ok" at this point.

Querying with persistence

Here is an example of an efficient way to query for a Person object and its related Person object (i.e. the father). It will print the person's name and the name of his/her father from 1 query !!!

```
Person.all().prefetch("father").each(tx, function(p) {  
    println(p.name);  
    println(p.father.name);  
});
```

Adding full text search capability, requires the web page to contain these script tags:

```
<html>  
...  
<script src="assets/templates/core/javascripts/persistence/persistence.js" type="application/  
javascript"/></script>  
<script src="assets/templates/core/javascripts/persistence/persistence.search.js"  
type="application/javascript"/></script>  
...  
</html>
```

Declare the data model (example):

```
var Task = persistence.define('Task', {  
    name: "TEXT",  
    description: "TEXT",  
    done: "BOOL"  
});  
  
var Category = persistence.define('Category', {  
    name: "TEXT"  
});
```

Define which columns should be indexed:

```
Task.textIndex('name');  
Task.textIndex('description');  
Category.textIndex('name');
```

Indexing will be enabled and any new entity instances and changes to them will automatically be (re)indexed. You can then search as follows:

```
Task.search('important').list(null, function(results) {  
    console.log("All tasks including the word 'important'");  
    console.log(results);  
});
```

Note that `Task.search(...)` returns a query collection, so the usual things such as `filter`, `limit` and `skip` (but not `order`, because results are always sorted by number of occurrences) can be used, e.g.:

```
Task.search('important')
  .limit(10)
  .skip(currentPage * 10)
  .list(null, function(results) {
    ...
  });
```

ORDER in PERSISTENCE: `schemaSync()` first, then add entities, then `persistence.flush()`;

2. SERVER SIDE

2. Content Management System (CMS)

Uses the MODx¹⁰ content management system.

2. Request Handling (NodeJS)

Introduction

Follows the NodeJS¹¹ javascript architecture and uses its libraries for handling requests from the client.

Installing on Windows

Download the binary from nodejs.org and follow the installation instructions.

- Windows (64 bit) will install Node.exe in C:\Program Files (x86) and in C:\Users\{user_name}\AppData\Roaming\ it will place npm (within which the node_modules are stored) and npm-cache.
- Make sure to run all commands from the Console as root/Administrator by starting the Console with CTRL+SHIFT

Installing on Mac OS

Download the binary from nodejs.org and follow the installation instructions.

- Mac OS X will install in /usr/local/bin/node and /usr/local/bin/npm
- Make sure that /usr/local/bin is in your \$PATH
- Make sure to run all command from the Terminal as root/Administrator by starting them with (you will be asked to provide the root password the first time):

```
sudo
```

Installing on Linux (e.g. BlueHost)

NOTE: to be able to access the port that is set by the NodeJS server(s), when using a hosted solution like Bluehost you will have to have extended your subscription to a **Dedicated IP Address**. See the Control Panel on the Bluehost site to order a Dedicated IP Address (ca \$2.50 per month extra).

<http://www.vanheemstrapictures.com> Dedicated IP address is:

```
http://69.195.104.126
```

Inside the \$HOME/downloads/git directory type:

```
git clone http://github.com/joyent/node.git
```

A new directory will be created by git called 'node'.

Inside this node directory type (so it installs it in the node directory of our home directory):

¹⁰ <http://www.modxcms.com>

¹¹ <http://nodejs.org>


```
./configure --prefix=$HOME/node
```

Next, type:

```
make
```

Followed by:

```
make install
```

Now we need to make the node command usable so do the following commands:

Go back to the HOME directory like so:

```
cd $HOME
```

Followed by:

```
nano .bashrc
```

Now add the following line to the bottom of the file.

```
export PATH=$HOME/node/bin:$PATH
```

Save the edited file, by using this combination of keys:

```
ctrl+x
```

and confirm by Y, then ENTER and ENTER again.

You will need to reload bash, like so:

```
source .bashrc
```

Enter into the directory where nodejs has been installed and then into the bin directory to type:

```
node --version
```

This should echo the version of the newly installed nodejs (here v0.8.2).

It is recommended to also **update** NodeJS with all its dependencies, by going into the directory where nodejs has been installed and type:

```
npm update
```

Nodejs Files Location within our Core

Folder hierarchy within our MODx installation under `public_html/core/components/core/apps/`

core				
	app			

		controller	< all entity controller js files >	
		model	< all entity model js files >	
		store	< all entity store js files >	
		view		
			< all entity sub-folders >	
				< all entity view js files >
			< all viewport js files >	
	data	< all static JSON files >		
	lib			
		Ext	< all Ext src files for server use, see N-Ext >	
	persistence			
		< all the persistence javascript files >		
< all app_embed.js, app.js, server.js, database.js, etc files >				

The core / **server3.js** file (example):

```
// see http://www.youtube.com/watch?v=qws6LOvDQRE
var sys = require('sys'),
    http = require('http');

/* call this file as a URL
/with adding the options below.
/e.g. localhost:3000/add/2/2
/will return 4
/add/2/2 => 4
/sub/103/42 => 61
/mul/3/2 => 6
/div/100/25 =>4
*/
var operations = {
  add: function(a,b){return a + b},
  sub: function(a,b){return a - b},
  mul: function(a,b){return a * b},
  div: function(a,b){return a / b}
}
```

```
http.createServer(function(req, res) {
  var parts = req.url.split("/"),
      op = operations[parts[1]],
      a = parseInt(parts[2], 10),
      b = parseInt(parts[3], 10);
  //sys.puts(sys.inspect(parts));
  var result = op ? op(a,b) : "Error";
  res.writeHead(200, {
    'Content-type': 'text/plain'
  });
  res.end("" + result);
}).listen(3000, "127.0.0.1");

sys.puts('Server running at http://127.0.0.1:3000/');
```

To start this server, type the command from within its directory:

```
node server3.js
```

Opening a browser and following the following URL should allow you to interact with this server:

```
http://localhost:3000
```

To stop (i.e. kill) the server, push this combination of keys in the active console window from where you started the server:

```
CTRL+C
```

Uses Node-MySQL¹² for connecting to the MySQL database. Use Node Package Manager (NPM)¹³ to install, which comes with NodeJS.

NOTE: On Windows you want to be running the console as Administrator. To do so, type this into the Run box from the Start menu:

```
cmd -d
```

Now instead of hitting the Enter key, use **Ctrl+Shift + Enter**. You will be prompted with the obnoxious User Account Control dialog... but it will then open up a command prompt in Administrator mode.

NOTE: On Windows npm by default places the node_modules folder in C:\Users\<myname>\AppData\Roaming\npm\node_modules

On Windows this means adding the mysql folder to the node_modules folder. If the module(s) cannot be found, add this to the Environment Variables:

```
NODE_PATH=/path/to/node_modules
```

e.g.

```
NODE_PATH=C:\Users\Willem van Heemstra\AppData\Roaming\npm\node_modules
```

A quick check to see which modules have been installed for nodejs is by executing this command within the nodejs program folder:

¹² <https://github.com/felixge/node-mysql>

¹³ <http://npmjs.org>

```
npm ls
```

For node-mysql this should list:

```
...mysql (followed by its version, e.g. @2.0.0-alpha3)
```

To install modules (e.g. forever) using the g for global reference, type this:

```
npm install forever -g
```

To update npm use this command from within the specific module dir inside the node_modules:

```
npm -g update npm
```

To find outdated modules use this command from within the specific module dir inside the node_modules:

```
npm outdated
```

See <http://npmjs.org/doc/install.html> for its use.

To install the latest version of mysql type:

```
npm install mysql@2.0.0-alpha3 -g
```

The core / **database1.js** file (example)

```
var mysql      = require('mysql');
var connection = mysql.createConnection({
  host  : 'localhost',
  user  : 'root',
  password : '',
  database : 'core'
});

connection.connect();

connection.query('SELECT * from PERSON', function(err, rows, fields) {
  if (err) throw err;

  console.log('Query result: ', rows);
});

connection.end();

// Output is returned in JSON by default.
```

This requires that you have installed the mysql for node.

```
npm install mysql@ -g
```

To do a general test after having installed mysql for node, from within the 'test' directory under node_modules / mysql type this command (note: mysql should be running):

```
npm run.js
```

Connection options

When establishing a connection, you can set the following options:

host: The hostname of the database you are connecting to. (Default: localhost)
port: The port number to connect to. (Default: 3306)
socketPath: The path to a unix domain socket to connect to. When used host and port are ignored.
user: The MySQL user to authenticate as.
password: The password of that MySQL user.
database: Name of the database to use for this connection (Optional).
charset: The charset for the connection. (Default: 'UTF8_GENERAL_CI')
insecureAuth: Allow connecting to MySQL instances that ask for the old (insecure) authentication method. (Default: false)
typeCast: Determines if column values should be converted to native JavaScript types. (Default: true)
debug: Prints protocol details to stdout. (Default: false)
multipleStatements: Allow multiple mysql statements per query. Be careful with this, it exposes you to SQL injection attacks. (Default: `false`)

JSormDB - Object Relational Mapper for JavaScript & Database

Install JSormDB:

Get a clone from the repository:

```
git://github.com/deitch/jsormdb.git
```

Or by typing inside the directory where you want the clone (e.g \$HOME/downloads/git/):

```
git clone https://github.com/deitch/jsormdb.git
```

Inside the downloaded project directory (here: jsormdb) type:

```
npm install -g
```

Install JSorm Utilities:

Get a clone from the repository:

```
git://github.com/deitch/jsorm-utilities.git
```

Or by typing inside the directory where you want the clone (e.g \$HOME/downloads/git/):

```
git clone https://github.com/deitch/jsorm-utilities.git
```

Inside the downloaded project directory (here: jsorm-utilities) type:

```
npm install -g
```

Sample HTML page code:

```
<?xml version="1.0" encoding="utf-8" standalone="yes"?>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 TRANSITIONAL//EN">
<html>
  <!-- Copyright (c) Atomic Inc. 2009 http://jsorm.com -->
  <head>
    <title>jsormdb Sample</title>
    <style>
      #content {
        position: absolute;
        left: 5%;
        top: 10%;
        width: 75%;
        height: 300px;
      }
      .grid-cell {
        float: left;
        width: 45%;
```

```

        height: 100%;
        border: 1px solid;
        margin: 5px;
        padding: 5px;
    }
    .output {
        padding: 5px;
    }
    .output-data {
        display:inline;
    }

</style>
<script type="text/javascript" src="assets/templates/core/javascripts/jquery/
jquery-1.3.2.min.js"></script>
<script type="text/javascript" src="assets/templates/core/javascripts/json2/
json2.js"></script>
<script type="text/javascript" src="assets/templates/core/javascripts/jsorm-
utilities/jsorm.js"></script>
<script type="text/javascript" src="assets/templates/core/javascripts/jsormdb/
jsormdb-src.js"></script>
<script type="text/javascript" src="assets/templates/core/javascripts/jsormdb/
jsormdb-sample.js"></script>
<script type="text/javascript">
    $(document).ready(function(){
        var buttons = ['load', 'change', 'commit', 'reject'];
        var i,len;
        var enable = function(db,enabled) {
            var i,len;
            for (i=0,len=buttons.length;i<len;i++) {
                if (enabled[buttons[i]]) {
                    $('#'+buttons[i]
+db).removeAttr('disabled');

                    $('#'+buttons[i]+db).show();
                } else {
                    $('#'+buttons[i]
+db).attr('disabled',true);

                    $('#'+buttons[i]+db).hide();
                }
            }
        };
        var display = function(id) {
            var db = SAMPLE["getDb"+id]();
            $("#db"+id+ " .output-
data").html(JSON.stringify(db.find()));
        };

        for (i=1;i<=2;i++) {
            (function(db){
                // handlers for the buttons
                $("#load"+db).click(function(event)
{SAMPLE["loadDb"+db]();event.preventDefault();});

```

```

        $("#change"+db).click(function(event){
            SAMPLE["changeDb"+db]();
            enable(db,{ 'commit':true, 'reject':true});
            display(db);
            event.preventDefault();
        });
        $("#commit"+db).click(function(event){
            SAMPLE["commitDb"+db]();
            enable(db,{ 'load':true});
            display(db);
            event.preventDefault();
        });
        $("#reject"+db).click(function(event){
            SAMPLE["rejectDb"+db]();
            enable(db,{ 'change':true});
            display(db);
            event.preventDefault();
        });

        // handlers for load functions
        SAMPLE["getDb"+db]().on('load',function(){
            enable(db,{ 'change':true});
            display(db);
        });

        // start with only Load
        enable(db,{load: true});
    })(i);
}

});
</script>
</head>
<body>
    <div id="content">
        <div id="instructions">
            This is the sample page for jsormdb. Be sure to examine the
            source code, which is unminified. All JavaScript is in
            <a href="jsormdb-sample.js">jsormdb-sample.js</a>, except for
            UI controls, which are in this file. <p/>

            Note that this sample page includes jquery. This is needed for
            manipulating this sample page <u>only</u>
            and has nothing to do with jsormdb itself. jsormdb has <b>no</b>
            dependencies (other than JavaScript, of
            course).<p/>

            In this sample page, two databases are created. The first is
            loaded from raw data.

            The second is loaded from a remote server,
            using http, and processed via a JsonParser.
            To each database, data is then added, removed and changed, and

```


a

```
        commit or reject can be performed.
    </div>
    <div id="db1" class="grid-cell">
        <h2>Raw database</h2>
        <div class="controls">
            <input type="button" id="load1" value="Load"></
input><br/>
            <input type="button" id="change1" value="Change"></
input><br/>
            <input type="button" id="commit1" value="Commit"></
input>
            <input type="button" id="reject1" value="Reject"></
input>
        </div>
        <div class="output">
            <h4>Database Contents</h4>
            <div class="output-data"></div>
        </div>
    </div>
    <div id="db2" class="grid-cell">
        <h2>Remote database</h2>
        <div class="controls">
            <input type="button" id="load2" value="Load"></
input><br/>
            <input type="button" id="change2" value="Change"></
input><br/>
            <input type="button" id="commit2" value="Commit"></
input>
            <input type="button" id="reject2" value="Reject"></
input>
        </div>
        <div class="output">
            <h4>Database Contents</h4>
            <div class="output-data"></div>
        </div>
    </div>
</div>
<div>
</body>
</html>
```

***Persistence* A storage solution for Node.JS----** NO LONGER REQUIRED, WE NOW USE **JSormDB !!!**

Install **Persistence**¹⁴ by running this command (**TIP**: install from GIT as this prevents a deprecated node-waf dependency):

```
npm install https://github.com/zefhemel/persistencejs.git -g
```

On Linux (e.g. Bluehost):

Inside the \$HOME/downloads/git directory type:

```
git clone https://github.com/zefhemel/persistencejs.git
```

Inside the \$HOME/downloads/git/persistencejs directory type:

```
npm install -g
```

Now you will find that npm has successfully installed persistencejs in the following directory: \$HOME/node/lib/node_modules/persistencejs as it shows you this response.

```
persistencejs@0.2.5 /home2/vanheems/node/lib/node_modules/persistencejs
```

Here 0.2.5 is the version of persistence that it has installed. And /home2/vanheems is the equivalent of \$HOME.

To use the **latest version** of any modules, from now on you just go inside the specific git sub-directory (e.g. \$HOME/downloads/git/persistencejs/) and type:

```
git pull
```

Followed by this:

```
npm install -g
```

That's all there is to it!!

NOTE: Persistence requires that MySQL (or if used SQLite) for Node.JS has is installed.

SQLite¹⁵ should thus be asynchronous to work with Persistence. Hence - if you will be needing SQLite - install SQLite for Node.JS like so:

```
npm install node-sqlite -g
```

NOTE: This is different from the default sqlite, which is synchronous.

The Server side of sync-ing with persistence using Node.JS

Persistence will try to create tables in the database that it synchronizes to on the server (i.e. MySQL):

Sync table:

```
CREATE TABLE IF NOT EXISTS `_Sync` (`entity` VARCHAR(255), `localDate` BIGINT, `serverDate`
```

¹⁴ <http://persistencejs.org>

¹⁵ <https://github.com/orlandov/node-sqlite>

```
BIGINT, `serverPushDate` BIGINT ENGINE=InnoDB DEFAULT CHARSET=utf8
```

This above SQL is related to the below code from `persistence.sync.js`:

```
...
  persistence.sync.Sync = persistence.define('_Sync', {
    entity: "VARCHAR(255)",
    localDate: "BIGINT",
    serverDate: "BIGINT",
    serverPushDate: "BIGINT"
  });
...
```

SyncRemovedObject table:

```
CREATE TABLE IF NOT EXISTS `SyncRemovedObject` (`entity` VARCHAR(255), `objectId` VARCHAR(32),
`date` BIGINT, `id` VARCHAR(32) PRIMARY KEY) ENGINE=InnoDB DEFAULT CHARSET=utf8
```

This above SQL is related to the below code from `persistence.sync.js`:

```
...
  persistence.sync.RemovedObject = persistence.define('_SyncRemovedObject', {
    entity: "VARCHAR(255)",
    objectId: "VARCHAR(32)"
  });
...
```

The way persistence sync's objects (`persistence.sync.js`) at the web browser end:

Step 1: Look at local versions of remotely updated entities.

Step 2: Remove all remotely removed objects.

Step 3: Store new remote items locally.

Step 4: Find local new/updated/removed items (not part of the remote change set).

Task table (per example, not part of the default tables):

```
CREATE TABLE IF NOT EXISTS 'Task' ('name' TEXT, 'done' INT, 'id' VARCHAR(32) PRIMARY KEY)
ENGINE=InnoDB DEFAULT CHARSET=utf8
```

The server must expose a resource located at the given URI that responds to:

GET	<p>requests with a <code>since=<UNIX MS TIMESTAMP></code> GET parameter that will return a JSON object with two properties:</p> <ul style="list-style-type: none">• <code>now</code>, the timestamp of the current time at the server (in ms since 1/1/1970)• <code>updates</code>, an array of objects updated since the timestamp <code>since</code>. Each object has at least an <code>id</code> and <code>_lastChange</code> field (in the same timestamp format). <p>For instance: <code>/taskChanges?since=1279888110373</code></p> <p>Which returns:</p>
-----	--

	<pre>{ "now": 1279888110421, "updates": [{ "id": "F89F99F7B887423FB4B9C961C3883C0A", "name": "Main project", "_lastChange": 1279888110370 }] }</pre>
POST	<p>requests with as its body a JSON array of new/updated objects. Every object needs to have at least an id property.</p> <p>Example, posting to: /taskChanges</p> <p>with body: [{"id": "BDDF85807155497490C12D6DA3A833F1", "name": "Locally created project"}]</p> <p>The server is supposed to persist these changes (if valid). Internally the items must be assigned a _lastChange timestamp TS. If OK, the server will return a JSON object with "ok" as status and TS as now.</p> <p><i>Note:</i> it is important that the timestamp of all items and the one returned are the same.</p> <pre>{ "status": "ok", "now": 1279888110797 }</pre>

Sequelize A multi-dialect Object-Relational-Mapper for Node.JS

The Sequelize¹⁶ library provides easy access to a MySQL database by mapping database entries to objects and vice versa. To put it in a nutshell... it's an ORM (Object-Relational-Mapper). The library is written entirely in JavaScript and can be used in the Node.JS environment.

Keeping NodeJS servers running with Forever

The purpose of **Forever**¹⁷ is to keep a child process (such as your node.js web server) running continuously and automatically restart it when it exits unexpectedly.

Install Forever by running this command:

```
npm install forever -g
```

See for an explanation of setting up Forever with NodeJS:

<http://www.exratione.com/2011/07/running-a-nodejs-server-as-a-service-using-forever/>

On Windows, make sure that there is a directory C:\root and that this directory is writeable. Forever uses this directory to write its log files to.

To **start** a server through forever (so it stays alive at all times), type this command in the directory of the server file (e.g. server4.js):

```
forever start server4.js
```

¹⁶ <http://sequelizejs.com/>

¹⁷ <http://blog.nodejitsu.com/keep-a-nodejs-server-up-with-forever>

You will notice that now when you open a browser window, the server can be contacted on its port. It has been started implicitly through forever.

To **list** all processes (i.e. node files) that forever is keeping alive, type this command:

```
forever list
```

This should return a list of each node files that is running prepended with an index number (e.g. 0 server4.js [24611, 24596])

To **stop** a server through forever, type this command (using the process index number, here 0):

```
forever stop 0
```

For **help** with forever, simply type this command:

```
forever --help
```

See for all commands with forever, <http://blog.nodejitsu.com/keep-a-nodejs-server-up-with-forever>

To see the **logs** of forever, on Windows look inside C:\root\forever directory.

Also in the C:\root\forever\pids directory you find the process identifier (pid) of each node file that is running.

To **kill** a process/processes on Windows (using the pid, for example 6568 and 5759) type:

```
Taskkill /PID 6568 5759 /F
```

Forever and Apache

The way it's usually setup is setting up a proxy in apache to redirect traffic to whatever port node is running on. There are tons of examples online. It's useful when you are running other apps (rails for example) on the same box.

Connect: the Middleware that works with Node

[Connect](#) adds one new unique aspect to node's HTTP server and that's the idea of layers. An app is structured like an onion. Every request enters the onion at the outside and traverses layer by layer till it hits something that handles it and generates a response. In [Connect](#) terms, these are called filters and providers. Once a layer provides a response, the path happens in reverse.

The [Connect](#) framework simply takes the initial request and response objects that come from node's http callback and pass them layer by layer to the configured middleware modules in an application.

Install Connect by running this command from the Node program directory:

```
npm install connect -g
```

The core / `connect-http.js` file

```
var Connect = require('connect');

Connect.createServer(function (req, res, next) {
  // Every request gets the same "Hello Connect" response.
  res.simpleBody(200, "Hello Connect");
}).listen(8080);
```

Express: built on top of Connect

Express¹⁸ contains Connect and has added features to it.

A tip for Express: when you create a project, you may be shown some errors about missing folders, re-execute the command again to create the project successfully.

Install a clone from the Github for express like so:

```
git clone https://github.com/visionmedia/express.git
```

Enter into the newly created directory 'express' and type following command:

```
npm install -g
```

TIP: To switch between releases of (here as an example, express) type:

```
$ npm uninstall express  
$ npm install express@3.0.0beta4
```

This will have installed express for Node.js. Check it with the following command:

```
express --version
```

This should return the version of the newly installed module.

To have Express as a service for our core app, we have to step inside the core app's directory:

```
cd $HOME/public_html/core/components/core/apps/core
```

or if we are on Windows and use wamp server do this:

```
cd C:\wamp\www\core\components\core\apps\core
```

Now that we are in the core app's directory use the call for express, here with support of sessions and using *less* for styling:

```
express --sessions --css less
```

It will ask for confirmation if (and as) the directory is not empty. You can accept with Y for yes as the directories and files it will create are not effecting our directories and files already in there.

apps			
	core		
		app	
		data	
		lib	
		persistence	

¹⁸ <http://expressjs.com>

		app1_embed.js	
		public	
		routes	
		views	
		app.js	
		package.json	

NOTE: the directories and files newly created by express are in **bold**

After express has created its directories and files in this directory, it will request that you install dependencies, as follows:

```
cd . && npm install
```

That will install a bunch of modules used by the app, which are stored in the newly created directory *node_modules*:

node_modules	
	.bin
	express
	jade
	less-middleware

With that the base of the app is ready. It is already a working app. Let's see what it outputs.

Start the app:

```
node app
```

It will prompt you with something like:

```
Express server listening on port 3000 in development mode
```

Stop the app with the combined keys: CTRL +C

To assist in not having to restart this server every time we edit the file(s), this is a good moment to install **nodemon**, which will reload our application each time it changes so you don't need to restart it:

```
npm install nodemon -g
```

From now on we will be using nodemon instead of node as a command.

Start the app again using nodemon:

```
nodemon app
```

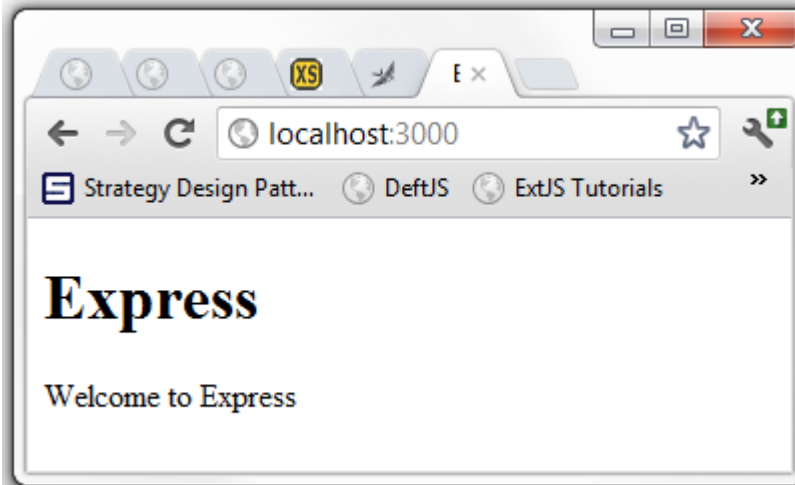

NOTE: you may be better off typing the file's full name, like so: `nodemon app.js`

It will prompt you with something like:

```
16 Jul 21:20:25 - [nodemon] v0.6.23
16 Jul 21:20:25 - [nodemon] watching: C:\wamp\www\core\components\core\apps\core
16 Jul 21:20:25 - [nodemon] starting 'node app'
Express server listening on port 3000 in development mode
```

Great!!

Then load <http://localhost:3000/> in your browser. You will see a simple webpage with the title "Express", and the webpage says:



NOTE: This page is being loaded and a reference to the stylesheet '**style.css**' is made which resides in the folder:

`public\stylesheets`

You will find a '**style.less**' file there as well, as we had indicated to prefer less as our style code language.

So looks like the app is working. Time to find out how it works.

Request flow in Express

This is how a request to an Express server flows:

Route → Route Handler → Template → HTML

The route defines the URL schema. It captures the matching request and passed on control to the corresponding route handler.

The route handler processes the request and passes the control to a template. The template constructs the HTML for the response and sends it to the browser.

The route handler need not always pass the control to a template, it can optionally send the response to a request directly.

Templates here are made with the use of **jade**. These jade files are inside the *views* folder:

core		
	routes	index.js
	views	index.jade layout.jade

NOTE: To quickly convert HTML to Jade use this tool:

<http://html2jade.aaron-powell.com/>

Routes are URL schema for a website. In Express you define them using `app.get()`, `app.post()`, `app.delete()` etc. The get, post, delete methods are derived from their corresponding **HTTP verbs**.

The **routes** directory is a convention, not a compulsion. In the **routes** directory we create appropriately named files which will handle the routes we define in the `app.js` file. We will import these files into our app and assign the functions defined in them to handle various routes. The imported file becomes sort of like an instance of the class of the route handler file.

Again as a recommended convention, we create an appropriately named variable for the imported file from the **routes** directory (here: `index`). Then we pass one of its functions as the second parameter for the route (here: `index`) from the **views** directory.

For example:

```
app.get('/', index.index);
```

Rendering Views

You have seen `res.render()` and `res.send()` in action already and probably have a fair idea about what they do. `res.send()` will directly send a string of text to the browser and `res.render()` will render a **Jade template**.

While it is possible to create a website entirely using `res.send()`, it is certainly not recommended to do so, because you will only end up with a complex and dirty looking codebase. Jade is the default templating engine for Express. Let's find out the basics of `res.render()` and the Jade templates.

Open the file named `layout.jade` in the **views** directory. Let's examine its content:

```
!!!
html
  head
    title= title
    link(rel='stylesheet', href='/stylesheets/style.css')
  body!= body
```

This is Jade code.

The very basics of Jade is this:

i. HTML tag names to create tags, but without the angular brackets

- ii. Spaces or tabs for indentation, but **don't mix them**
- iii. `#` to assign an id to a tag
- iv. `.` to assign a class to a tag, or create a div with a class if not already created
- v. `(property='value')` to create attributes and assign values to a tag

The `!!!` you see in `layout.jade` is doing a doctype declaration of HTML5. Also notice the relatively 'cryptic' `title= title` and `body!= body`. This is what they are doing:

The following is an explanation of two pieces of code that might intrigue you.

`title= title`: The template expects a variable called `title` from the route handler. The variable will be set as the content of the `title` tag AFTER escaping special characters.

`body!= body`: The template expects a variable called `body` from the route handler which called the `res.render()` method. The variable will be set as the content of the `body` tag WITHOUT escaping special characters. If special characters like `<` and `>` are escaped, we won't have any HTML code within the `body` tag, hence we don't want the contents of the `body` variable to be escaped.

Our renderer code looks for a Jade template named `index.jade` in the `views` folder and passes an object to it. In our case it is `{ title: 'Express' }`. The properties of the object will be available as variable names in the template with their respective name. In our case, we will have a variable named `title` in `index.jade`.

Invisible to the naked eye, another property is 'sent' to the template - `layout` with a default value of `layout.jade`. So the 'actual' renderer code can be understood as `res.render('index', { layout: 'layout', title: 'Express' })`.

When a template gets the `layout` variable. It makes all its variables available to the layout with their respective names, and itself in a variable named `body`.

Since `layout` has a default value, probably it might make you wonder if you could specify a layout of your own choice, or maybe even not use one. Your guesses are right.

To specify a custom layout do this:

```
{ layout: 'layout-ie', title: 'Express' }
```

If you don't want to use a layout do this:

```
{ layout: false, title: 'Express' }
```

By default `res.send()` and `res.render()` send the HTTP status code of 200. You can specify your own HTTP status code.

Custom status code example for `res.send()`:

```
res.send('File not Found', 404);
```

Custom status code example for `res.render()` (make sure you have created a file named `404.jade` in the `views` directory):

```
res.render('404', { title: 'File not Found', status: 404 });
```

Open the file named **404.jade** in the **views** directory. Let's examine its content:

```
!!!
html
  head
    title= title
    link(rel='stylesheet', href='/stylesheets/style.css')
  body!= body
```

This is Jade code.

Stylesheets

Even though we code our CSS in the **.less** file, we always include the **.css** file in the Jade template:

```
link(rel='stylesheet', href='/stylesheets/style.css')
```

Changes made to the **views** and everything in the **public** directory will be updated immediately when you refresh the browser. Refresh the browser and see what you get. In rare cases, the view may not be update - feel free to restart the server.

HTTP 403 Forbidden Error

Occasionally, you might see that (for example when trying to load images) you get a HTTP 403 Forbidden error message.

The HTTP 403 Forbidden error is caused by limited access to a web domain or directory. Administrators can limit access to a web domain's directory by removing the anonymous user or requiring a password to view the content of the location. To remove or fix the error requires added permissions on the Windows host machine using the Internet Information Services (IIS) console. Once permissions are set, browsers to the domain will be able to access and read files normally again.

Read more: [How to Fix the HTTP 403 Forbidden Error | eHow.com http://www.ehow.com/how_5180610_fix-http-forbidden-error.html#ixzz21XLYw2fj](http://www.ehow.com/how_5180610_fix-http-forbidden-error.html#ixzz21XLYw2fj)

..... MORE HERE TO FOLLOW ...

Locomotive: brings additional MVC-based structure, for architecting larger applications, while leveraging the power of Express and Connect middleware.

Locomotive¹⁹ is a web framework for [Node](#) that makes building web applications easier and more efficient. This is accomplished by architecting an application around REST principles, the familiar MVC design pattern, and establishing a set of conventions for organizing the source code of an application.

Locomotive closely follows the expectations popularized by [Ruby on Rails](#), so developers familiar with that environment can adapt quickly, while enjoying the benefits of idiomatic [JavaScript](#) and the power of Node's asynchronous I/O.

Locomotive is built entirely on top of [Express](#), a minimalist and high-performance web framework. Locomotive brings additional MVC-based structure, for architecting larger applications, while leveraging the power of Express and [Connect](#) middleware.

While adopting the best ideas from existing web frameworks, Locomotive has its own set of opinions about the needs of modern applications in the era of big data and real-time events. In particular, these challenges demand [polyglot persistence](#). As such, Locomotive places no restrictions on the model layer, allowing developers to choose the database (or databases) and object mapping layer that best fits their needs.

The end result is an application comprised of beautifully written code, that is both familiar, yet able to meet the demands of the modern web.

In order to follow Locomotive's directory structure, we have to extend ours as follows:

apps				
	core			
		app		
			controllers	
				<namespace> e.g. admin
			models	
			views	
		config		
			environments	
				all.js
			initializers	
			routes.js	

¹⁹ <http://locomotivejs.org>

		data		
		lib		
		persistence		
		app1_embed.js		
		public		
		routes		
		views		
		app.js		
		package.json		

NOTE: The directories and files in **bold** are the added directories and files for Locomotive.

Directory Structure

Locomotive favors convention over configuration. Part of these conventions is a well defined directory structure.

app/controllers

Contains the controllers that handle requests sent to an application.

app/models

Contains the models for accessing and storing data in a database.

app/views

Contains the views and layouts that are rendered by an application and sent as a response to the client.

config

Configuration for the application, including routes, databases, etc.

config/environments

Environment-specific configuration. For example, *development* and *production* are two environments that require different configuration.

config/initializers

Initialization code that is `require()`'d before the applications starts.

public

Static files and compiled assets served by the application.

Routing

Locomotive's router is responsible for receiving requests to your application and dispatching each request to a controller's action. Dispatching is based on the request's URL and HTTP method.

The router also dynamically generates routing helper functions that build paths and URLs.

These helpers are available in controllers and views, eliminating the need to hardcode strings in views.

Routes are configured in `config/routes.js`

Resource Routing

Resource routing declares routes to a resourceful controller. These routes map HTTP methods to controller's actions, according to REST conventions. Resource routing is the preferred routing mechanism in a Locomotive application.

For example, declaring this route:

```
this.resources('photos');
```

will result in the following routes being mapped to **PhotosController**:

Method	Path	Action
GET	/photos	index
GET	/photos/new	new
POST	/photos	create
GET	/photos/:id	show
GET	/photos/:id/edit	edit
PUT	/photos/:id	update
DELETE	/photos/:id	destroy

Additionally, the following routing helpers will be declared and available in controllers and views:

Helper	Returns
photosPath	/photos
photoPath(id)	/photos/123
newPhotoPath	/photos/new
editPhotoPath(id)	/photos/123/edit

Each of these path routing helpers has a corresponding URL routing helper (such as **photosURL**), that returns an absolute URL, including scheme and host. Using these helpers, as opposed to hard-coding paths, makes an application easier to maintain as routes change.

Singleton Resources

An application may contain singleton resources that are not referenced using an ID. For example, **/account** is often used to show account details for the logged in user (rather than **/account/:id**).

In this case, a singleton resource route can be declared:

```
this.resource('account');
```

resulting in the following routes being mapped to **AccountController**:

Method	Path	Action
GET	/account/new	new
POST	/account	create

GET	/account	show
GET	/account/edit	edit
PUT	/account	update
DELETE	/account	destroy

Additionally, the following routing helpers will be declared and available in controllers and views:

Helper	Returns
accountPath	/account
newAccountPath	/account/new
editAccountPath	/account/edit

Each of these path routing helpers has a corresponding URL routing helper.

Namespaces

You may want to organize an application by grouping controllers under a namespace. Most commonly, administrative functionality is grouped under an `Admin::` namespace by placing controllers in the `app/controllers/admin` directory.

This namespace is reflected in the routes:

```
this.namespace('admin', function() {
  this.resources('posts');
});
```

resulting in the following URLs and routing helpers being mapped to `Admin::PostsController`:

Method	Path	Action	Helper
GET	/admin/posts	index	adminPostsPath
GET	/admin/posts/new	new	newAdminPostPath
POST	/admin/posts	create	
GET	/admin/posts/:id	show	adminPostPath(id)
GET	/admin/posts/:id/edit	edit	editAdminPostPath(id)
PUT	/admin/posts/:id	update	
DELETE	/admin/posts/:id	destroy	

Each of the above path routing helpers has a corresponding URL routing helper.

Nested Routes

It is common to have resources that are logically children of other resources. These relationships can be captured in your routing:


```
this.resources('bands', function() {
  this.resources('albums');
});
```

In addition to the routes for bands, the following URLs and routing helpers are mapped to **AlbumsController**

Method	Path	Action	Helper
GET	/bands/:band_id/albums	index	bandAlbumsPath (bandId)
GET	/bands/:band_id/albums/new	new	newBandAlbumPath (bandId)
POST	/bands/:band_id/albums	create	
GET	/bands/:band_id/albums/:id	show	bandAlbumPath (bandId, id)
GET	/bands/:band_id/albums/:id/edit	edit	editBandAlbumPath (bandId, id)
PUT	/bands/:band_id/albums/:id	update	
DELETE	/bands/:band_id/albums/:id	destroy	

Each of the above path routing helpers has a corresponding URL routing helper.

While no limit is placed on the number of levels to which resources can be nested, applications are encouraged not to nest more than one level deep, as doing otherwise quickly becomes cumbersome.

Match Routes

In addition to resource routing, Locomotive can match arbitrary URL patterns to a controller's action.

For example, declaring this match route:

```
this.match('songs/:title', { controller: 'songs', action: 'show' });
```

will cause **SongsController's show()** action to handle requests for URLs which match the pattern.

```
/songs/like-a-rolling-stone
/songs/all-along-the-watchtower
```

Shorthand notation, in the form of *controller#action* is also available to target a controller's action.

For example, the following route is equivalent to the one declared above:

```
this.match('songs/:title', 'songs#show');
```

The values associated with named placeholders, in this case **:title**, will be available in the controller via the **param()** function.

```
this.param('title'); // returns 'like-a-rolling-stone'
```

Routing to Middleware

Instead of routing to a controller, you can route directly to any [Connect](#)-compatible middleware.

For example, the following will route login requests to [Passport](#) for authentication.

```
this.match('login', passport.authenticate('local', { successRedirect: '/',  
                                                    failureRedirect: '/login' }))  
  
    { via: 'post' } );
```

Routes can be sent to a middleware chain by specifying each function as an element within an array.

```
this.match('somewhere', [ middlewareOne(),  
                          middlewareTwo() ] );
```

Root Route

The root route, `/`, can be declared with the `root()` function:

```
this.root('pages#main');
```

Controllers

Controllers consist of a set of functions known as *actions*. Routing will dispatch a request to a controller's action, which does the work of loading data and rendering views. The rendered view will be sent in the response to the client.

Defining Controllers

In Locomotive, controllers are instances of `Controller`. Defining a new controller is as simple as creating an instance and exporting it via the module.

```
var PhotosController = new Controller();  
  
module.exports = PhotosController;
```

Action Functions

Any functions attached to the controller are available as actions. When Locomotive receives a request, it will create a new instance of the controller and call the appropriate action function.

For example, if a request is received for `/photos/123`, Locomotive will call the `show()` action of `PhotosController`.

```
PhotosController.show = function() {  
    this.render();  
}
```

Controllers are responsible for sending a response to the request. This is typically accomplished by `render()`ing a view or issuing a `redirect()`.

Parameters

A controller will often inspect data sent in the request, in order to construct an appropriate response. Use the `param()` function to access data contained in route, query, or body parameters.

```
PhotosController.show = function() {  
  this.title = this.param('title');  
  this.render();  
}
```

The value returned by `param()` will be found by checking parameters in the following order:

- Checks route params (`req.params`), ex: `/photos/:id`
- Checks query string params (`req.query`), ex: `?id=12`
- Checks urlencoded body params (`req.body`), ex: `id=12`

Rendering Views

Rendering a view is accomplished by calling `render()`. Any instance variables attached to the controller will be made available to the view. By convention, variables named with a leading underscore are considered private and will not be made available to the view.

```
PhotosController.show = function() {  
  // this._photo is "private", and not available in the view  
  this.title = this._photo.title;  
  this.description = this._photo.description;  
  this.render();  
}
```

The view found in `views/photos/show.html.ejs` will be rendered.

```
<h2><%= title %></h2>  
<p><%= description %></p>
```

NOTE: This is EJS code

Alternatively:

The view found in `views/photos/show.jade` will be rendered.

```
extends layout  
  
block content  
  h1= title  
  p #{description}
```

NOTE: This is Jade code

Render an Action's View

By default, the view corresponding to the invoked action will be rendered, in this case `show`. A different action's view can be rendered by specifying it (here for example `'index'`):

```
this.render('index');
```

Render a Controller's View

If you want to render a template corresponding to a different *controller's* action, that can be accomplished as follows (so here instead of using the photos controller's action `'show'`, we use the albums controller's action `'show'`):

```
this.render('albums/show');
```

Options

Options can be used to render a different format (here: xml) or use a different template engine (here: jade).

```
this.render({ format: 'xml' });
```

```
this.render({ engine: 'jade' });
```

Redirecting

In some situations, instead of rendering a view, a controller may want to redirect the request.

```
this.redirect('/login');
```

Filters

Filters are functions that are run before or after the action function. Each function is executed sequentially, one after the other, when each filter calls `next`. This is especially useful for loading data from a database and avoiding nested blocks of async code.

```
PhotosController.before('show', function(next) {  
  var self = this;  
  Photo.findOne(this.param('id'), function(err, photo) {  
    if (err) { return next(err) }  
    self._photo = photo;  
    next();  
  });  
});
```

[Connect](#)-compatible middleware can also be used directly as a filter.

```
PhotosController.before('create', connect.limit('10mb'));
```

After filters are identical to *before* filters, with the exception that they are executed after the action has completed.

```
PhotosController.after('show', function(next) {  
  // update view counter  
  next();  
});
```

Request and Response

If an application needs access to the raw request and response, each is available as instance variable within the controller.

```
PhotosController.show = function() {  
  var req = this.req; // aka this.request  
  var res = this.res; // aka this.response  
  this.render();  
}
```

Views

Loomotive inherits its view layer from [Express](#), so any compatible template engine can be used, including [EJS](#), [Jade](#), [Haml](#), and [others](#).

Configuration

By default, Locomotive uses [EJS](#) as its template engine. That is easily changed by setting the option in `config/environments/all.js`:

```
this.set('view engine', 'jade');
```

Selecting an Engine at Render Time

Controllers can selectively override the application's default template engine in the call to `render`:

```
PhotosController.show = function() {  
  this.render({ engine: 'haml' });  
}
```

Datastores

Locomotive recognizes that the demands of modern web applications entail the use of a variety of datastores. Choosing the correct datastore is an important decision, and Locomotive does not impose on that choice. Locomotive is fully functional, independent of the choice of database or object mapping layer used by an application.

Model Object Introspection

Locomotive includes a `urlFor` helper that can be used to build URLs to a controller's action. For example:

```
urlFor({ controller: 'animals', action: 'show', id: '123' });  
// => http://www.example.com/animals/123
```

This helper is also model aware. It can be handed a model object (here: `Animal`), which will be introspected in order to determine the type of record and build the corresponding URL.

```
var animal = new Animal();  
animal.id = '123';  
urlFor(animal);  
// => http://www.example.com/animals/123
```

By default, model awareness works for any datastore that represent each distinct type of record with a unique class. In cases where this does not apply, other datastores can be made model aware through the use of adapters.

QUESTION: how would this apply to MySQL ???

Mongoose

To use the Mongoose adapter, register it in `config/environments/all.js`:

```
this.datastore(require('locomotive-mongoose'));
```

Mongoose documents can then be passed directly to `urlFor()`:

```
Animal.findById(this.param('id'), function(err, animal) {  
  if (err) { return next(err); }  
  self.url = self.urlFor(animal);  
  next();  
});
```

THIS COMPLETES THE GUIDE ON LOCOMOTIVE (<http://locomotivejs.org/guide/>).

Sequelize: *a well-documented ORM project that supports MySQL*

The **Sequelize**²⁰ project is a well documented ORM project that supports MySQL. It supports a variety of ORM features that includes models, validation and relationship handling.²¹

The Sequelize library provides easy access to a MySQL database by mapping database entries to objects and vice versa. To put it in a nutshell... it's an ORM (Object-Relational-Mapper). The library is written entirely in JavaScript and can be used in the Node.JS environment.

Installation

You can install Sequelize via NPM:

```
npm install sequelize -g
```

Or just download the code from the git repository DIRECTLY INTO THE LIB FOLDER so with a simple 'git pull' we will have the latest release (!):

NOTE: Use this approach for ALL MODULES !!

```
cd %HOME/public_html/core/components/core/apps/core/lib
git clone git://github.com/sdepolo/sequelize.git
```

Enter the newly created directory, install globally, and automatically get the latest dependencies:

```
cd sequelize
npm install -g
```

And require its entry file index.js in your Node file (for example: app.js):

```
var Sequelize = require(__dirname + "/lib/sequelize/index")
```

This will make the class **Sequelize** available.

Usage

.. see <http://sequelizejs.com/>

We follow advice coming from this tutorial:

<http://www.ziggytech.net/technology/web-development/experiences-with-node-js-porting-a-restful-service-written-in-java/>

A more advanced app.js

The app.js file contains the core instructions for the application. It defines the application, sets global variables, initializes the ORM, routes files, and starts our HTTP server. There are many good resources available on the web for creating this core file. This example uses a combination of many different techniques from multiple sources. It also includes added support for pulling in command line parameters. There are modules available that add helper methods

²⁰ <http://sequelizejs.com/>

²¹ <http://www.ziggytech.net/technology/web-development/experiences-with-nodejs-researching-node/>

for this, but it is pretty simple to handle without them.

Example of the more advanced **app_sequelize.js**:

```
/**
 * Module dependencies.
 */
var express = require('express');
//NO LONGER IN USE var store = require('./routes/store');
//NO LONGER IN USE var http = require('http');
//NO LONGER IN USE var app = express();

/**
 * Create Application Server.
 */
var app = module.exports = express.createServer();

/**
 * Set Route Init Path.
 */
var routes = "./routes.js";

/**
 * Set Database Init Path.
 */
var database = "./database.js";

/**
 * app
 * @type {Express}
 *
 * The Singleton of Express app instance
 */
GLOBAL.app = app;

/**
 * Retrieve Command Line Arguments
 * [0] process : String 'node'
 * [1] app : void
 * [2] port : Number 3000
 */
var args = process.argv;

/**
 * port
 * @type {Number}
 *
 * HTTP Server Port
 */
var port = args[2] ? args[2]: 3000;

/**
 * Database Connections
 */
var database_options = {
  schema: "core",
  user: "root",
  password: "", // High Security FTW.
  host: "localhost",
  port: "3306"
};
```



```

/**
 * Configuration
 */
app.configure(function(){
//NO LONGER IN USE app.set('port', process.env.PORT || 3000);
  app.set('views', __dirname + '/views');
  app.set('view engine', 'jade');
  app.use(express.favicon());
  app.use(express.logger('dev'));
  app.use(express.bodyParser());
  app.use(express.methodOverride());
  app.use(express.cookieParser('your secret here'));
  app.use(express.session());
  app.use(app.router);
  app.use(require('less-middleware')({ src: __dirname + '/public' }));
  app.use(express.static(__dirname + '/public'));
});

app.configure('development', function(){
  app.use(express.errorHandler({dumpExceptions: true, showStack: true}));
  database_options.logging = true;
});

app.configure('production', function(){
  app.use(express.errorHandler());
  database_options.logging = false;
});

/**
 * db (database)
 * @type {Object}
 * @param Object [database_options] the database options
 */
GLOBAL.db = require(database) (database_options);

/**
 * Routes
 */
var routes = require(routes);

//NO LONGER USED app.get('/', store.home);

/**
 * HTTP Server
 */
app.listen(port);
console.log("Express server listening on port %d in %s mode using Sequelize ORM.",
  app.address().port,
  app.settings.env);
//NO LONGER USED http.createServer(app).listen(app.get('port'), function(){
//NO LONGER USED console.log("Express server listening on port " + app.get('port'));
//NO LONGER USED});

```

Routing file

This is the routing file that defines what URL's will use which resource. Using the express-resource module, simple routes were created for the RESTful resources with very minimal lines of code. In this example, the URL is passed in and the Person resource module to the resource

to define that relationship.

routes.js

```
/**
 * Resource Routes
 */
module.exports = function() {
  var Resource = require('express-resource');
  app.resource('services/persons', require('./resource/Person'));
};
```

Database file

In the database.js file, the database object is created and a utility method for pushing the data from the model to an object is appended. After the ORM has created its database connection, the models can be built.

database.js

```
/**
 * Database Connection
 */
module.exports = function(options) {
  var database = {
    options: options
  };

  var Sequelize = require('sequelize');
  database.module = Sequelize;
  database.client = new Sequelize(options.schema, options.user, options.password, {
    host: options.host,
    port: options.port,
    logging: options.logging,
    dialect: 'mysql',
    maxConcurrentQueries: 100
  });

  /**
   * @type {Object}
   * Map all attributes of the registry
   * (Instance method useful to every sequelize Table)
   * @this {SequelizeRegistry}
   * @return {Object} All attributes in an Object.
   */
  database.map = function() {
    var obj = new Object(),
        ctx = this;
    ctx.attributes.forEach(function(attr) {
      obj[attr] = ctx[attr];
    });

    return obj;
  };

  database.models = require('./models.js')(database);

  return database;
};
```

Models file

Using the Sequelize ORM model structure, the individual model Java classes are converted to a singular JSON object that represent all the database tables with validations, constraints and

relationships. In this models.js example, there is a mapAttributes linked to the db.map function to return only the data in a specific model. For this example, the Person model is shown.

models.js

```
/**
 * Sequelize ORM Models
 */
module.exports = function(db) {
  /**
   * @type {Object}
   * All models we have defined over Sequelize, plus the db instance itself
   */
  var self = {
    Person: db.define('PERSON', {
      KP_PERSONID: { type: Sequelize.INTEGER, allowNull: false, primaryKey: true},
      PERSON_FIRSTNAME: { type: Sequelize.STRING, allowNull: true, validate: { max: 225 } },
      PERSON_LASTNAME: { type: Sequelize.STRING, allowNull: true, validate: { max: 225 } }
    },
    {
      timestamps: false,
      freezeTableName: true,
      instanceMethods: {
        mapAttributes: db.map
      }
    }
  ),
  };
  return self;
};
```

Resources files

A basic set of CRUD functions are constructed for the model and replicated for each resource. The Sequelize ORM made this task very simple and allowed for querying the database with a few very simple function calls and callbacks. After querying the ORM, the success callback will call the mapAttributes function and return a JSON object to the response object. In the case of an error, the error callback function fires returning the error to the response object. For this example, the List and the Show methods are shown. Other methods can be created for a RESTful implementation. Documentation for the Express Resource module can be found on the [project site](#).

resources/Person.js

```
var model = models.Person;

/**
 * List
 * @GET /model/
 * @returns JSON list of records
 */
exports.index = function(request, response) {
  model.findAll()
    .success(function(models) {
      response.json(models.map(function(record) {
        return record.mapAttributes();
      }));
    })
    .failure(function(error) {
      response.send(error);
    });
};
```

```
/*
 * Show by Id
 * @GET /model/:id
 * @returns JSON requested record
 */
exports.show = function(request, response) {
  model.find(request.params.person)
    .success(function(record) {
      response.json(record.mapAttributes());
    })
    .failure(function(error) {
      response.send(error);
    });
};
```

===== OUR OWN APPROACH - BUILDING THE FILES STEP BY STEP =====

STEP 1) Creating the app file, called: *core_server.js*

We start off with the minimalist code, that works (this is in line with ExpressJS as of version 3.0²²):

```
/**
 * Create Application Server.
 */
var express = require('express');
var http = require('http');
var server = http.createServer(express);

/**
 * HTTP Server
 */
server.listen(3000);
console.log("Express server listening on port %d.",
    server.address().port);
```

core_server.js

This file sits here in our directory structure:

core						
	components					
		core				
			apps			
				core		
					core_server.js	

If not already started, start this server from its directory with the use of nodemon, like so:

```
nodemon core_server.js
```

Once the file is saved, nodemon will notice a file change and will restart this server.

This will output:

```
Express server listening on port 3000.
```

TIP: Use the key combination CTRL+C to stop the server from running.

STEP 2) Modify the file *core_server.js* for the express dependency

²² <https://github.com/visionmedia/express/wiki/New-features-in-3.x>

We change the `core_server.js` file to:

```
/**
 * Module dependencies.
 */
var express = require('express');
var http = require('http');

/**
 * Create Application Server.
 */
var server = http.createServer(express);

/**
 * HTTP Server
 */
server.listen(3000);
console.log("Express server listening on port %d.",
    server.address().port);
```

`core_server.js`

Now, the module dependencies are nicely listed on their own.

STEP 3) Modify the file `core_server.js` for the globalization of the Singleton of Express `express` instance.

We change the `core_server.js` file to:

```
/**
 * Module dependencies.
 */
var express = require('express');
var http = require('http');

/**
 * Create Application Server.
 */
var server = http.createServer(express);

/**
 * express
 * @type {Express}
 *
 * The Singleton of Express express instance
 */
GLOBAL.express = express;

/**
 * HTTP Server
 */
server.listen(3000);
console.log("Express server listening on port %d.",
    server.address().port);
```

`core_server.js`

Now the Singleton of Express `express` instance is globally accessible.

STEP 4) Modify the file core_server.js to allow for Command Line Arguments

We change the core_server.js file to:

```
/**
 * Module dependencies.
 */
var express = require('express');
var http = require('http');

/**
 * Create Application Server.
 */
var server = http.createServer(express);

/**
 * express
 * @type {Express}
 *
 * The Singleton of Express express instance
 */
GLOBAL.express = express;

/**
 * Retrieve Command Line Arguments
 * [0] process : String 'node'
 * [1] app : void
 * [2] address : String '127.0.0.1'
 * [3] port : Number 3000
 */
var args = process.argv;

/**
 * HTTP Server
 */
server.listen(3000);
console.log("Express server listening on port %d.",
    server.address().port);
```

core_server.js

Now we have prepared an args variable that can accept command line arguments.

process.argv#

An array containing the command line arguments. The first element will be 'node' (or in our case perhaps 'nodemon'), the second element will be the path & name of the JavaScript file (here: c:\wamp\www\core\components\core\apps\core\core_server.js). The next elements will be any additional command line arguments (here: address & port).

STEP 5) Modify the file core_server.js by adding a port variable that can be set through Command Line Arguments

We change the core_server.js file to:

```
/**
 * Module dependencies.
 */
var express = require('express');
var http = require('http');
```

```

/**
 * Create Application Server.
 */
var server = http.createServer(express);

/**
 * express
 * @type {Express}
 *
 * The Singleton of Express express instance
 */
GLOBAL.express = express;

/**
 * Retrieve Command Line Arguments
 * [0] process : String 'node'
 * [1] app : void
 * [2] address : String '127.0.0.1'
 * [3] port : Number 3000
 */
var args = process.argv;

/**
 * address
 * @type {String}
 *
 * HTTP Server Address (i.e. IP or host)
 */
var address = args[2] ? args[2]: '127.0.0.1';

/**
 * port
 * @type {Number}
 *
 * HTTP Server Port
 */
var port = args[3] ? args[3]: 3000;

/**
 * HTTP Server
 */
server.listen(port, address, function() {
  console.log("Express server listening on " + server.address().address + " at port " +
server.address().port + " in development mode.");
});

```

core_server.js

NOTE: Because of the asynchronous nature when trying to gather the address and port number from its variables, we had to enclose the console.log inside the server.listen().

Now we have added an address (i.e. host ip) and a port variable that can be set through Command Line Arguments. For example if we would like to set the port to a number other than 3000 (the default) we would only need to start the core_server like so (e.g. for port 3010):

```
nodemon core_server.js 127.0.0.1 3010
```

This will output:

```
Express server listening on 127.0.0.1 at port 3010 in development mode.
```


As you can see, we do need to supply an address (here: 127.0.0.1) if we want to supply a port, as the code expects the port to be the fourth argument (i.e. args[3]).

NOTE: If you supply an address that cannot be reached (for example, because it is outside of the computer's list of ip addresses) the server will crash at startup!

STEP 6) Using Configuration Files that distinguish between Deployment Environments.

For this added functionality we make use of a node module called **node-config**²³.

If not already installed, install it like so (on Linux):

```
cd $HOME/public_html/core/components/core/apps/core/lib
git clone git://github.com/lorenwest/node-config.git
cd node-config
npm install config -g
npm test config
```

Likewise install it like so (on Windows):

```
cd C:\wamp\www\core\components\core\apps\core\lib
git clone git://github.com/lorenwest/node-config.git
cd node-config
npm install config -g
npm test config
```

WARNING: Note that you have to explicitly type 'config' on the install line, otherwise some module dependencies will not be installed.

We require a new directory in our directory structure to keep the configuration files, called **config**.

Add this directory - if it does not already exists - as shown here:

core						
	components					
		core				
			apps			
				core		
					config	
					core_server.js	

Add the default configuration file (called **default.yaml**) to the config directory:

```
Customer:
  dbHost: localhost
  dbPort: 3306
```

²³ <https://github.com/lorenwest/node-config#readme>

```
dbSchema: core
dbUser: root
dbPassword: null
dbLogging: console.log
```

default.yaml

NOTE: The logging option should be either a function or false. Default console.log.

Add the production configuration file (called **production.yaml**) to the config directory:

```
Customer:
  dbHost: prod_db_server
  dbPort: 3306
  dbSchema: core
  dbUser: root
  dbPassword: null
  dbLogging: false
```

production.yaml

NOTE: prod_db_server is here purely used as an example, in practise it should be the name or ip address of the production database server (it could as well be localhost). If we leave out any of these settings (for example dbPort), the configuration will use the default of this setting (i.e. dbPort from default.yaml).

To use the configuration file, we change the core_server.js file to:

```
/**
 * Module dependencies.
 */
var express = require('express');
var http = require('http');
var config = require('config').Customer;

/**
 * Create Application Server.
 */
var server = http.createServer(express);

/**
 * express
 * @type {Express}
 *
 * The Singleton of Express express instance
 */
GLOBAL.express = express;

/**
 * Retrieve Command Line Arguments
 * [0] process : String 'node'
 * [1] app : void
 * [2] address : String '127.0.0.1'
 * [3] port : Number 3000
 */
var args = process.argv;

/**
 * address
 * @type {String}
 *
 * HTTP Server Address (i.e. IP or host)
 */
var address = args[2] ? args[2]: '127.0.0.1';

/**
```

```

* port
* @type {Number}
*
* HTTP Server Port
*/
var port = args[3] ? args[3]: 3000;

/**
* HTTP Server
*/
server.listen(port, address, function() {
  console.log("Express server listening on " + server.address().address + " at port " +
server.address().port + " in + " process.env.NODE_ENV " + mode.");
});

```

core_server.js

Now depending with which deployment environment we start our server up, the right configuration will be loaded.

For example, starting the server in the **production** environment goes like this (on Linux):

```

export NODE_ENV=production
nodemon core_server.js

```

Likewise on Windows:

```

set NODE_ENV=production
nodemon core_server.js

```

Node-config reads configuration files stored in the directory specified by the **NODE_CONFIG_DIR** environment variable, which defaults to the **config** directory within your top-level application directory.

Configuration files can be in .js format, .json format, .coffee format, or .yaml format - whichever you prefer.

Configuration files in the config directory are loaded in the following order:

```

default.EXT
hostname.EXT
deployment.EXT
hostname-deployment.EXT
runtime.json

```

Where EXT can be .yaml, .coffee, .json, or .js depending on the format you prefer. NOTE: If you use .yaml or .coffee file extensions, the 'yaml' or 'coffee-script' modules must be available.

These external dependencies are not included from this package.

hostname is the \$HOST environment variable if set, otherwise the hostname found from `require('os').hostname()`

deployment is the deployment type, found in the \$NODE_ENV environment variable. Defaults to 'development'.

The runtime.json file contains configuration changes made at runtime either manually, or by the application setting a configuration value. Node-config monitors this file and loads any new configurations it detects.

In the running application, each configuration parameter is internally monitored for changes, and persisted to runtime.json upon change. This keeps configurations in sync in a multi-node deployment.

STEP 7) Adding support for a database

First of all we need to create a file that defines the database to be used. Call it **core_database.js** and save it in the directory as shown here:

core						
	components					
		core				
			apps			
				core		
					config	
						default.yaml
						production.yaml
					core_database.js	
					core_server.js	

The initial content of the **core_database.js** file is:

```
/**
 * Database Connection
 */
module.exports = function(options) {
  var database = {
    options: options
  };
  return database;
};
```

Now to add a reference to this database inside the core_server.js file, add the text in bold:

```
/**
 * Module dependencies.
 */
var express = require('express');
var http = require('http');
var config = require('config').Customer;

/**
 * Create Application Server.
 */
var server = http.createServer(express);
```

```

/**
 * express
 * @type {Express}
 *
 * The Singleton of Express express instance
 */
GLOBAL.express = express;

/**
 * Retrieve Command Line Arguments
 * [0] process : String 'node'
 * [1] app : void
 * [2] address : String '127.0.0.1'
 * [3] port : Number 3000
 */
var args = process.argv;

/**
 * address
 * @type {String}
 *
 * HTTP Server Address (i.e. IP or host)
 */
var address = args[2] ? args[2]: '127.0.0.1';

/**
 * port
 * @type {Number}
 *
 * HTTP Server Port
 */
var port = args[3] ? args[3]: 3000;

/**
 * Set Database Init Path.
 */
var database = "./core_database.js";

/**
 * Database Connections
 */
var database_options = {
    schema: "core",
    user: "root",
    password: "", // High Security FTW.
    host: "localhost",
    port: "3306",
    logging: "console.log"
};

/**
 * db (database)
 * @type {Object}
 * @param Object [database_options] the database options
 */
GLOBAL.db = require(database) (database_options);

/**
 * HTTP Server
 */
server.listen(port, address, function() {
    console.log("Express server listening on " + server.address().address + " at port " +
server.address().port + " in " + " process.env.NODE_ENV " + mode.);
});

```

```
});
```

core_server.js

TIP: You may want to check if your core_server.js still starts successfully. It should, but if not... fix it ;o)

Let's make the configuration of the database connection part of our configuration files.

Hence, add apply these changes to core_server.js:

```
/**
 * Module dependencies.
 */
var express = require('express');
var http = require('http');
var config = require('config').Customer;

/**
 * Create Application Server.
 */
var server = http.createServer(express);

/**
 * express
 * @type {Express}
 *
 * The Singleton of Express express instance
 */
GLOBAL.express = express;

/**
 * Retrieve Command Line Arguments
 * [0] process : String 'node'
 * [1] app : void
 * [2] address : String '127.0.0.1'
 * [3] port : Number 3000
 */
var args = process.argv;

/**
 * address
 * @type {String}
 *
 * HTTP Server Address (i.e. IP or host)
 */
var address = args[2] ? args[2]: '127.0.0.1';

/**
 * port
 * @type {Number}
 *
 * HTTP Server Port
 */
var port = args[3] ? args[3]: 3000;

/**
 * Set Database Init Path.
 */
var database = "./core_database.js";

/**
 * Database Connections
 */
var database_options = {
    schema: config.dbSchema,
```

```

        user: config.dbUser,
        password: config.dbPassword,
        host: config.dbHost,
        port: config.dbPort,
        logging: config.dbLogging
    };

    /**
     * db (database)
     * @type {Object}
     * @param Object [database_options] the database options
     */
    GLOBAL.db = require(database) (database_options);

    /**
     * HTTP Server
     */
    server.listen(port, address, function() {
        console.log("Express server listening on " + server.address().address + " at port " +
            server.address().port + " in " + process.env.NODE_ENV + " mode.");
    });

```

core_server.js

When re-starting the core_server.js, it should all still go well with these new additions. Try it.

STEP 8) Extending database support with Sequelize

To map relational data from a rdbms (such as MySQL) to Javascript objects, we require the use of an ORM (Object Relational Mapping); here Sequelize.

To extend the core_database.js file for use of Sequelize (here: for MySQL) add the text in bold to this file:

```

    /**
     * Database Connection
     */
    module.exports = function(options) {
        var database = {
            options: options
        };

        var Sequelize = require('sequelize');
        database.module = Sequelize;
        database.client = new Sequelize(options.schema, options.user, options.password, {
            host: options.host,
            port: options.port,
            logging: options.logging,
            dialect: 'mysql',
            maxConcurrentQueries: 100,
            sync: { force: true },
            pool: { maxConnections: 5, maxIdleTime: 30 }
        });

        return database;
    };

```

core_database.js

NOTE: The options for this Sequelize²⁴ module are dynamically passed on from core_server.js, originating from the configuration files in the config directory.

It is of not much use to have access to a database without being able to query tables, so next we will create a model file that holds at least one table to query.

Create a new file called **core_models.js** (if it does not already exist) in the directory as shown here in bold:

core						
	components					
		core				
			apps			
				core		
					config	
						default.yaml
						production.yaml
					core_database.js	
					core_models.js	
					core_server.js	

The file core_models.js for now contains a mapping to one table: person

```
/**
 * Sequelize ORM Models
 */
module.exports = function(db) {
  /**
   * @type {Object}
   * All models we have defined over Sequelize, plus the db instance itself
   * NOTE: as db.client is an instance of Sequelize,
   * use db.client.INTEGER instead of Sequelize.INTEGER etc
   */
  var self = {
    Person: db.client.define('person', {
      kp_PersonID: { type: db.client.INTEGER, allowNull: false, validate: { max: 11 },
primaryKey: true, autoIncrement: true},
      PersonFirstName: { type: db.client.STRING, allowNull: false, validate: { max: 255 }
    },
      PersonLastName: { type: db.client.STRING, allowNull: false, validate: { max: 255 }
    }
  },
    {
      timestamps: false,
      freezeTableName: true,
      instanceMethods: {
        mapAttributes: db.map
      }
    }
  )
}
```

²⁴ <http://sequelizejs.com/>


```

    }},
    };
    return self;
};

```

core_models.js

This model maps an Object 'Person' to the table '**person**' (note: in practise this will be the view of the table 'person') in the MySQL database called 'core' used for our system.

Name	Type	Collation	Attributes	Null	Default
kp_PersonID	int(11)			No	0
PersonFirstName	varchar(255)	utf8_bin		No	None
PersonLastName	varchar(255)	utf8_bin		No	None
... continued					

view of table 'person'

With this mapping established (in practise ALL tables should be added to the core_models.js file), we should add a reference to this file from core_database.js like so (see text in bold):

```

/**
 * Database Connection
 */
module.exports = function(options) {
    var database = {
        options: options
    };
    var Sequelize = require('sequelize');
    database.module = Sequelize;
    database.client = new Sequelize(options.schema, options.user, options.password, {
        host: options.host,
        port: options.port,
        logging: options.logging,
        dialect: 'mysql',
        maxConcurrentQueries: 100,
        sync: { force: true },
        pool: { maxConnections: 5, maxIdleTime: 30 }
    });
}
/**
 * @type {Object}
 * Map all attributes of the registry
 * (Instance method useful to every sequelize Table)
 * @this {SequelizeRegistry}
 * @return {Object} All attributes in a Object.
 */
database.map = function() {
    var obj = new Object(),
        ctx = this;
    ctx.attributes.forEach(function(attr) {
        obj[attr] = ctx[attr];
    });
    return obj;
};
database.models = require('./core_models.js')(database);
return database;

```

```
};
```

core_database.js

NOTE: See how we pass in the database as an argument for database.model.

Sequelize currently supports the following datatypes:

1. Sequelize.STRING ==> VARCHAR(255)
2. Sequelize.TEXT ==> TEXT
3. Sequelize.INTEGER ==> INTEGER
4. Sequelize.DATE ==> DATETIME
5. Sequelize.BOOLEAN ==> TINYINT(1)
6. Sequelize.FLOAT ==> FLOAT

STEP 9) Add CRUD functions for each resource

Resources files

A basic set of CRUD (i.e. CReate, Update, Delete) functions are constructed for the model and replicated for each resource. The Sequelize ORM makes this task very simple and allows for querying the database with a few very simple function calls and callbacks. After querying the ORM, the success callback will call the mapAttributes function and return a JSON object to the response object. In the case of an error, the error callback function fires returning the error to the response object.

For this example, the List and the Show methods are shown. Other methods can be created for a RESTful implementation.

Documentation for the Express Resource module can be found on the [project site](#).

Create a file for each model (here: Person) in the resources directory, like so for resources/Person.js

```
var model = models.Person;

/*
 * List
 * @GET /model/
 * @returns JSON list of records
 */
exports.index = function(request, response) {
  model.findAll()
    .success(function(models) {
      response.json(models.map(function(record) {
        return record.mapAttributes();
      }));
    })
    .failure(function(error) {
      response.send(error);
    });
};

/*
 * Show by Id
 * @GET /model/:id
 * @returns JSON requested record
 */
```

```

exports.show = function(request, response) {
  model.find(request.params.person)
    .success(function(record) {
      response.json(record.mapAttributes());
    })
    .failure(function(error) {
      response.send(error);
    });
};

```

Person.js

NOTE: See how at the top of this file that it refers to models, which is the core_models.js file containing the Person model. The 'models' is defined in the core_database.js file, see database.models.

This is the Person.js file in its resources directory:

core						
	components					
		core				
			apps			
				core		
					config	
						default.yaml
						production.yaml
					core_database.js	
					core_models.js	
					core_server.js	
					resources	
						Person.js

Step 10) Adding Routes to our server to query the resources (e.g. Person)

Now that we have a way to query our resources (e.g. Person), we need routes that handle the different requests for this information.

Create the file routes.js (if it does not already exist) and place it here (text in bold) in the directory structure:

core						
------	--	--	--	--	--	--

	components					
		core				
			apps			
				core		
					config	
						default.yaml
						production.yaml
					core_database.js	
					core_models.js	
					core_server.js	
					resources	
						Person.js
					routes.js	

This is the preliminary content of routes.js:

```
/**
 * Resource Routes
 */
module.exports = function() {
  var Resource = require('express-resource');
  express.resource('services/persons', require('./resources/Person'));
};
```

routes.js

NOTE: We make use of **express-resource**²⁵, a nodes module. See the separate section on express-resource for more information.

Next we have to place a reference to the routes.js file (text in bold) in the server core_server.js:

```
/**
 * Module dependencies.
 */
var express = require('express');
var http = require('http');
var config = require('config').Customer;

/**
 * Create Application Server.
 */
var server = http.createServer(express);

/**
 * express
```

²⁵ <https://github.com/visionmedia/express-resource>

```

* @type {Express}
*
* The Singleton of Express express instance
*/
GLOBAL.express = express;

/**
* Retrieve Command Line Arguments
* [0] process : String 'node'
* [1] app : void
* [2] address : String '127.0.0.1'
* [3] port : Number 3000
*/
var args = process.argv;

/**
* address
* @type {String}
*
* HTTP Server Address (i.e. IP or host)
*/
var address = args[2] ? args[2]: '127.0.0.1';

/**
* port
* @type {Number}
*
* HTTP Server Port
*/
var port = args[3] ? args[3]: 3000;

/**
* Set Database Init Path.
*/
var database = "./core_database.js";

/**
* Database Connections
*/
var database_options = {
    schema: config.dbSchema,
    user: config.dbUser,
    password: config.dbPassword,
    host: config.dbHost,
    port: config.dbPort,
    logging: config.dbLogging
};

/**
* db (database)
* @type {Object}
* @param Object [database_options] the database options
*/
GLOBAL.db = require(database) (database_options);

/**
* Set Route Init Path.
*/
var routes = "./routes.js";

/**
* Routes
*/
var routes = require(routes);

/**
* HTTP Server
*/

```

```
server.listen(port, address, function() {
  console.log("Express server listening on "
    + server.address().address
    + " at port "
    + server.address().port
    + " in "
    + process.env.NODE_ENV
    + " mode.");
});
```

core_server.js

NOTE: Firstly we have added a reference to the routes.js file, then assigned that reference to a variable routes with require(routes).

Our server is now aware of the routes it should server information for.

Lets restart the server, making sure we start it for a development environment (is the default), so we may see some logging.

On Linux with export:

```
export NODE_ENV=development
nodemon core_server.js 127.0.0.1 3000
```

Likewise on Windows with set:

```
set NODE_ENV=development
nodemon core_server.js 127.0.0.1 3000
```

The output on the console should be:

```
Express server listening on 127.0.0.1 at port 3000 in development mode.
```

Introducing **node-monitor**²⁶

node-monitor²⁷ records and gives you access to vital statistics about your running node.js application.

As a developer, node-monitor gives you a consistent pattern for exposing business events, monitoring exceptions, and managing errors and callbacks in your asynchronous code.

During configuration and deployment, node-monitor lets you configure standard output logging, or customized logging and alerts. Logging and alerts can be defined application-wide, module-wide, or for a specific event or error condition.

The provided loggers let you log to files, to a CouchDB database, to an email distribution list, an SMS gateway, an internal event, or an external program.

When your application exits, node-monitor produces an activity report listing activity for each monitor that fired throughout the lifetime of the application.

... ADD MORE HERE FROM THE GIT HUB README ...

²⁶ <http://lorenwest.github.com/node-monitor/latest/>

²⁷ <https://github.com/lorenwest/node-monitor#readme>

MORE AND NEW APPROACH TO SEQUELIZE²⁸

Sequelize is an object relational mapper (ORM) that takes much of the repetition out of the tasks in the preceding sections.

You can use Sequelize to define objects shared between the database and your program, then pass data to and from the database using those object rather than writing a query for every operation.

This becomes a major time saver when it comes time to perform maintenance or add a new column, and makes overall data management less error-prone.

If a database by the name of 'core' is already created, for user 'root' with password '<blank>' it's time to create a Person entity inside the database. Sequelize handles the creation for you, so you don't have to take care of any manual SQL at this point:

```
var Sequelize = require('sequelize');

var db = new Sequelize('core', 'root', '', {
  host: 'localhost'
});

var Person = db.define('person', {
  kp_PersonID: Sequelize.INTEGER,
  Person_FirstName: Sequelize.STRING,
  Person_LastName: Sequelize.STRING
});

Person.sync().on('success', function() {
  console.log('person table was created.');
```

```
}).on('failure', function(error) {
  console.log('Unable to create person table');
});
```

The output is:

```
Executing: CREATE TABLE IF NOT EXISTS `person` (`kp_PersonID` INT, `Person_FirstName`
VARCHAR(255), `Person_LastName` VARCHAR(255), `id` INT NOT NULL auto_increment ,
`createdAt` DATETIME NOT NULL, `updatedAt` DATETIME NOT NULL, PRIMARY KEY (`id`))
ENGINE=InnoDB;
person table was created.
```

In this example, a Person was defined as an entity containing a first and last name field and a kp (=key primary) id field. As you can see in the output, Sequelize added an auto-incremented primary key column (here: id), a createdAt column, and an updatedAt column. This is typical of many ORM solutions, and provides standard hooks by which Sequelize is able to reference and interact with your data.

Sequelize differs from other libraries in being based on a **listener-driven architecture**, rather than the callback-driven architecture used elsewhere. This means that you have to listen for both success and failure events after each operation, rather than having errors and success indicators returned with the operation's results.

²⁸ http://ofps.oreilly.com/titles/9781449398583/chapter_8.html

The following example creates two tables with a many-to-many relationship. The order of operation is:

1. Set up the entity schemas.
2. Synchronize the schemas with the actual database.
3. Create and save a Book object.
4. Create and save a Person object.
5. Establish a relationship between the Person and the book.

```
var Sequelize = require('sequelize');

var db = new Sequelize('core', 'root', 'dev', {
  host: 'localhost'
});

var Person = db.define('person', {
  kp_PersonId: Sequelize.INTEGER,
  Person_FirstName: Sequelize.STRING,
  Person_LastName: Sequelize.STRING
});

var Book = db.define('book', {
  name: Sequelize.STRING
});

Person.hasMany(Book);
Book.hasMany(Person);

db.sync().on('success', function() {
  Book.build({
    name: 'Through the Storm'
  }).save().on('success', function(book) {
    console.log('Book saved');
    Person.build({
      kp_PersonID: '1',
      Person_FirstName: 'David',
      Person_LastName: 'Beckham'
    }).save().on('success', function(record) {
      console.log('Person saved.');
      record.setBooks([book]);
      record.save().on('success', function() {
        console.log('Person & Book Relation created');
      });
    });
  });
}).on('failure', function(error) {
  console.log('Could not save book');
});
}).on('failure', function(error) {
  console.log('Failed to sync database');
});
```

About Express-Resource

express-resource²⁹ provides resourceful routing to express.

Installation

Download the code from the git repository DIRECTLY INTO THE LIB FOLDER so with a simple 'git pull' we will have the latest release (!):

```
cd %HOME/public_html/core/components/core/apps/core/lib
git clone git://github.com/visionmedia/express-resource.git
```

Enter the newly created directory, install globally, and automatically get the latest dependencies:

```
cd express-resource
npm install -g
```

Usage

To get started simply require('express-resource'), and this module will monkey-patch Express, enabling resourceful routing by providing the app.resource() method. A "resource" (here: person) is simply an object, which defines one or more of the supported "actions" listed below:

```
exports.index = function(req, res){
  res.send('person index');
};

exports.new = function(req, res){
  res.send('new person');
};

exports.create = function(req, res){
  res.send('create person');
};

exports.show = function(req, res){
  res.send('show person ' + req.params.person);
};

exports.edit = function(req, res){
  res.send('edit person ' + req.params.person);
};

exports.update = function(req, res){
  res.send('update person ' + req.params.person);
};

exports.destroy = function(req, res){
  res.send('destroy person ' + req.params.person);
};
```

The app.resource() method returns a new Resource object (here: person), which can be used to further map pathnames, nest resources, and more.

```
var express = require('express')
  , Resource = require('express-resource')
  , app = express.createServer();
```

²⁹ <https://github.com/visionmedia/express-resource#readme>

```
app.resource('persons', require('./person'));
```

Default Action Mapping

Actions are then mapped as follows (by default), providing `req.params.person` which contains the substring where `":person"` is shown below:

GET	/persons	-> index
GET	/persons/new	-> new
POST	/persons	-> create
GET	/persons/:person	-> show
GET	/persons/:person/edit	-> edit
PUT	/persons/:person	-> update
DELETE	/persons/:person	-> destroy

NowJS: Middleware for Real-Time connection between Client and Server

NowJS³⁰ maintains a shared namespace (called “now”) between javascript code on the client (i.e. in the web page) and the server. This allows for direct calling of remote javascript functions (e.g. for a chat application).

On Windows: download the binary from here: <https://github.com/Flotype/now/zipball/windows>
Unzip and place it inside the node_modules directory.

See a nice tutorial here:

<http://nodegames.blogspot.co.uk/2011/12/install-nowjs-in-windows.html>

Others:

NOTE: NowJS requires **Socket.IO**. (get it here <https://github.com/LearnBoost/socket.io>) and **Node-Gyp** and **Node-Proxy** and **Hiredis-Node**.

```
git clone https://github.com/LearnBoost/socket.io.git
```

```
git clone https://github.com/TooTallNate/node-gyp.git
```

```
git clone https://github.com/samshull/node-proxy.git
```

```
git clone https://github.com/pietern/hiredis-node.git
```

If any of the above install give an error on redis, see below warning:

WARNING: Install this version of redis (0.7.1), not the newer one (0.7.2).

```
npm install redis@0.7.1
```

Get a clone from the repository:

```
git://github.com/Flotype/now.git
```

Or by typing inside the directory where you want the clone (e.g \$HOME/downloads/git/):

```
git clone https://github.com/Flotype/now.git
```

Inside the downloaded project directory (here: now) type:

```
npm install -g
```

³⁰ <http://nowjs.com>

N-Ext - Use the non-DOM parts of ExtJS (Ext Core + Ext.data currently) server-side with Node.js

N-Ext³¹ is the compression of [Node](#) and [Ext](#). Its purpose is to allow developers to use the ExtJS 4 Javascript framework in a server-side environment using Node.js.

Install N-Ext:

Get a clone from the repository:

```
git://github.com/xcambar/n-ext.git
```

Or by typing inside the directory where you want the clone (e.g \$HOME/downloads/git/):

```
git clone https://github.com/xcambar/n-ext.git
```

Inside the downloaded project directory (here: n-ext) type:

```
npm install -g
```

Set up N-Ext:

1. Download the latest version of [ExtJS 4](#)
2. Unzip the src folder in %PROJECT_ROOT%/lib/Ext (this can be changed with a single line of code)
3. In the main file (it can be any file) of your application, type the following:
4.

```
var sencha = require('n-ext');  
    sencha.setExtPath('./lib/Ext/');  
    sencha.bootstrapCore();
```

The variable `sencha` above is an instance of the `nExtLoader` prototype, which API can be found here. The 'setExtPath' method can take either an absolute or relative path. Write it as you would declare a path for node modules, as it is Node's `require()` that runs under the hood.

And that's it! You now have the beloved Ext namespace available application-wide.

....

n-ext_server1.js (for example):

```
var sencha = require('n-ext');  
sencha.setExtPath('./lib/Ext/');  
sencha.bootstrapCore();
```

More info in the wiki at <https://github.com/xcambar/n-ext/wiki>

Note on Ext.Loader

All the namespaces which roots are located on the same folder that the Ext namespace are available directly to the Dynamic class loading package of ExtJS 4.

Example: Consider the following file structure

apps				
------	--	--	--	--

³¹ <https://github.com/xcambar/n-ext#readme>

	core			
		app		
		data		
		lib		
			Ext	
			Package1	
			Package2	

If you bootstrap your application as above, you can write the following code without having to configure Ext.Loader:

```
Ext.require('Package1.model.Awesome');
```

Declare another location for custom namespaces ?

ExtJS requires that you declare each and every namespace wherein you want to use the autoloader they provide. So, if you want to use a namespace `Foo`, which contains classes you want to have dynamically loaded in your app, you have to do the following:

```
Ext.Loader.setPath('Foo', './lib/Foo');
```

With *N-Ext*, you can use another mechanism, taking advantages of the capabilities of NodeJS' `require` function. Let's say you have a bunch of namespaces (NS1, NS2 and so on) located in a single folder (a priori another folder than the one containing the Ext library) called `vendor`. Using the line of code below, you won't be required to run `Ext.Loader.setPath(..)` anymore for those namespaces.

```
var sencha = require('n-ext');
sencha.addLibPath('./vendor/'); // <-- This one!
sencha.bootstrapCore();

Ext.require('NS1.model.Foo'); // It Works!
```

Of course, you can add as many paths as you want.

3. Database(s)

Relational Databases

There are still many good reasons to use a traditional database with SQL, and Node interfaces with popular open source choices.³²

3. MySQL

Uses MySQL³³ relational database.

3.1.1 Using **NodeDB**

Installation

The MySQL client development libraries are a prerequisite for the Node database module. On Ubuntu, the libraries can be installed using apt:

```
sudo apt-get install libmysqlclient-dev
```

Using npm, install a package named db-mysql:

```
npm install -g db-mysql
```

In order to run the examples in this section you will need to have a database called 'core' with a user 'root' having password '<blank>'. The following script will create the database table and basic schema:

```
DROP DATABASE IF EXISTS core;

CREATE DATABASE core;

GRANT ALL PRIVILEGES ON core.* TO 'root'@'%' IDENTIFIED BY '';

USE core;

CREATE TABLE person( kp_PersonId int auto_increment primary key, Person_FirstName varchar(255),
Person_LastName varchar(255) );
```

Selection

The following example selects all kp_PersonId and Person_FirstName columns from a person table:

```
var mysql = require( 'db-mysql' );

var connectParams = {
  'hostname': 'localhost',
  'user': 'root',
  'password': '',
  'database': 'core'
}

var db = new mysql.Database( connectParams );

db.connect(function(error) {
  if ( error ) return console.log("Failed to connect");
```

³² http://ofps.oreilly.com/titles/9781449398583/chapter_8.html

³³ <http://www.mysql.com>

```

this.query()
  .select(['kp_PersonId', 'Person_FirstName'])
  .from('person')
  .execute(function(error, rows, columns) {
    if ( error ) {
      console.log("Error on query");
    } else {
      console.log(rows);
    }
  });
});

```

As you can probably guess, this executes the equivalent of the SQL command `SELECT kp_PersonId, Person_FirstName FROM person`.

The output is for example:

```
{ kp_PersonId: 1, Person_FirstName: 'David' }
```

Insertion

Inserting data is very similar to selection because commands are chained in the same way. This is how to generate the equivalent to `INSERT INTO person (Person_FirstName) VALUES ('Victoria');`

```

var mysql = require( 'db-mysql' );

var connectParams = {
  'hostname': 'localhost',
  'user': 'root',
  'password': '',
  'database': 'core'
}

var db = new mysql.Database( connectParams );

db.connect(function(error) {
  if ( error ) return console.log("Failed to connect");

  this.query()
    .insert('person', ['Person_FirstName'], ['Victoria'])
    .execute(function(error, rows, columns) {
      if ( error ) {
        console.log("Error on query");
        console.log(error);
      }
      else console.log(rows);
    });
});

```

The output is:

```
{ id: 2, affected: 1, warning: 0 }
```

The `.insert` command takes 3 parameters:

1. The table name
2. The column names being inserted

3. The values to insert in each column

NOTE: The database drivers take care of escaping and converting the data types in your column values, so you don't have to worry about SQL Injection attacks through code passing through this module.

Updating

Like selection and insertion, updates rely on chained functions to generate equivalent SQL queries. This example demonstrates the use of a query parameter to filter the update, rather than performing it across all records in the database table.

```
var mysql = require( 'db-mysql' );

var connectParams = {
  'hostname': 'localhost',
  'user': 'root',
  'password': '',
  'database': 'core'
}

var db = new mysql.Database( connectParams );

db.connect(function(error) {
  if ( error ) return console.log("Failed to connect");

  this.query()
    .update('person')
    .set({ 'Person_LastName': 'Beckham' })
    .where('Person_FirstName = ?', [ 'Victoria' ])
    .execute(function(error, rows, columns) {
      if ( error ) {
        console.log("Error on query");
        console.log(error);
      }
      else console.log(rows);
    });
});
```

The output is:

```
{ id: 0, affected: 1, warning: 0 }
```

Updating a row consists of three steps:

1. The `.update` command, which takes the table name (*person* in this case) as a parameter.
2. The `.set` command, which uses a key-value object pair to identify the column names to update and their values.
3. The `.where` command, which tells MySQL how to filter the rows that will be updated.

Deletion

Deletion is very similar to updates, except in the case of a delete there are no columns to update. If no where conditions are specified, all records in the table will be deleted.

```
var mysql = require( 'db-mysql' );

var connectParams = {
  'hostname': 'localhost',
```

```

    'user': 'root',
    'password': '',
    'database': 'core'
  }

  var db = new mysql.Database( connectParams );

  db.connect(function(error) {
    if ( error ) return console.log("Failed to connect");

    this.query()
      .delete()
      .from('person')
      .where('Person_FirstName = ?', [ 'David' ])
      .execute(function(error, rows, columns) {
        if ( error ) {
          console.log("Error on query");
          console.log(error);
        }
        else console.log(rows);
      });
  });
});

```

The output is:

```
{ id: 0, affected: 1, warning: 0 }
```

The `.delete` command is similar to the `.update` command, except it does not take any column names or data values. In this example, wildcard parameters are demonstrated in the "where" clause: `'Person_FirstName = ?'`. The question mark is replaced by the `Person_FirstName` parameter in this code before execution. The second parameter is an array, because if multiple question marks are used, the database driver will take the values in order from this parameter.

3.1.2 Using Sequelize

See separate section about Sequelize³⁴.

MySQLDumper - Backup for MySQL Database

MySQLDumper³⁵ is a PHP and Perl based tool for backing up MySQL databases. You can easily dump your data into a backup file and - if needed - restore it. It is especially suited for shared hosting web spaces, where you don't have shell access. MySQLDumper is an open source project and released under the GNU-license.

Notes about MySQLDumper (see also the FAQ here <http://www.mysqldumper.net/faq/>)

- MySQLDumper is running under any operating system. Just start the script in your browser under "http://www.yourDomain.com/path_to_mysqlumper/"
- Your server is running in Safe-Mode and so mysqldumper is not allowed to create directories. You need to create the following directories manually (Don't forget to chmod all directories to 0777.):
 - work
 - work/backup

³⁴ http://ofps.oreilly.com/titles/9781449398583/chapter_8.html

³⁵ <http://www.mysqldumper.net/>

- work/config
- work/log
- work/structure

Folder hierarchy with MySQLDumper:

public_html			
	mysqldumper		
		< all folders other than work >	
		work	
			backup
			config
			log
			structure

3. Filemaker Pro

Uses FileMaker Pro³⁶ relational database.

³⁶ <http://www.filemaker.com>

Background

Asynchronous Programming

In browsers, Javascript and the web page's rendering engine share a single thread. The result of this is that only one thing can happen at a time. If a database query would be performed *synchronously*, like in many other programming environments like Java and PHP the browser would freeze from the moment the query was issued until the results came back. Therefore, many APIs in Javascript are defined as *asynchronous* APIs, which mean that they do not block when an "expensive" computation is performed, but instead provide the call with a function that will be invoked once the result is known. In the meantime, the browser can perform other duties.

(Source: <http://persistencejs.org/async>)

The big thing to be aware of is that much of persistence.js is **async** and you need to handle that. So you want code like:

```
persistence.schemaSync( function( err, tx ) {
  if ( err ){
    console.log( "schemaSync: err:", err );
  }
  else{
    var item = new Item();
    item.ItemId = "123";
    item.Name = "Test";
    persistence.add(item);
    persistence.flush( function( err ) {
      if ( err ){
        console.log( "flush err:", err );
      }
      else{
        //... ok
      }
    });
  }
});
```

NOTE: This snippet uses the code at: <https://github.com/zefhemel/persistencejs/tree/new>

Resources

Ext & ExtJS

- <http://prezi.com/odwelgo7wdue/t3con11-sfo-typo3-and-extdirect/>
- <http://prezi.com/akbjh19yylqy/data-modeling-and-extdirect/>

Node.JS

- NodeManual.org
- <http://nodebits.org/>
- <http://nodejs.org/api/process.html>
- <http://howtonode.org/>
- <http://www.w3resource.com/node.js/installing-node.js-windows-and-linux.php>
- <http://ninjadeveloper.net/blog/2011/12/12/the-road-to-node-setting-up-node-js-on-bluehost/>
- <http://raquelvelez.com/blog/2012/02/basic-functionality-complete/>
- <http://www.nodebeginner.org/>
- <http://net.tutsplus.com/tutorials/javascript-ajax/this-time-youll-learn-node-js/>
- <http://net.tutsplus.com/tutorials/javascript-ajax/node-js-step-by-step-blogging-application/>
- <http://www.ziggytech.net/technology/web-development/experiences-with-nodejs-researching-node/>
- <http://www.ziggytech.net/technology/web-development/experiences-with-node-js-porting-a-restful-service-written-in-java/>
- <http://www.ziggytech.net/technology/web-development/experiences-with-node-js-final-thoughts/>

NVM

- <http://www.backdrifter.com/2011/02/18/using-nvm-and-npm-to-manage-node-js/#more-396>

NPM

- <http://blog.nodejitsu.com/npm-cheatsheet>
- <http://www.backdrifter.com/2011/02/18/using-nvm-and-npm-to-manage-node-js/#more-396>

Jade

- <http://nodejsrocks.blogspot.com/2012/04/need-reasons-to-love-jade-template.html>
- <http://html2jade.aaron-powell.com/>

Connect

- <http://project70.com/nodejs/understanding-connect-and-middleware/>
- http://stephensugden.com/middleware_guide/
- <http://howtonode.org/connect-it>
- <https://github.com/senchalabs/connect>

Express.JS

- <http://expressjs.com/guide.html#Middleware>
- <http://www.hacksparrow.com/express-js-tutorial.html>
- <http://www.hacksparrow.com/running-express-js-in-production-mode.html>
- <https://github.com/visionmedia/express/wiki/New-features-in-3.x>

- <http://fabianosoriani.wordpress.com/2011/08/15/express-api-on-node-js-with-mysql-auth/>

Express-Resource

- <https://github.com/visionmedia/express-resource>

Locomotive

- <http://www.backdrifter.com/>
- <http://locomotivejs.org/>
- <http://jaredhanson.net/>
- <http://www.youtube.com/jaredhanson>
- <http://raquelvelez.com/blog/2012/03/mvc-ftw/>

N-Ext

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MySQL

- <http://cufp.org/videos/functional-programming-freebase-warren-harris-metaweb>
- http://wiki.freebase.com/wiki/MySQL_Manual

Freebase

- http://wiki.freebase.com/wiki/Main_Page
- <http://cuecard.freebaseapps.com/>
- <http://cuecard.freebaseapps.com/about>

Sequelize

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JSormDB

- <http://jsorm.com/wiki/Jsormdb>

Persistence.JS --- NO LONGER REQUIRED, WE USE JSormDB

- <http://zef.me/2774/persistence-js-an-asynchronous-javascript-orm-for-html5gears>
- <http://zef.me/tag/persistence-js>
- <http://jacobmumm.com/2011/09/20/asynchronous-javascript-with-persistencejs/>
- <http://jacobmumm.com/demos/persistencetask/index.html>
- <http://persistencejs.org/objects?do=index>

Persist.JS--- NO LONGER REQUIRED, WE USE JSormDB

- <https://github.com/jeremydurham/persist-js>

MySQL

- <http://nodejsrocks.blogspot.com/2012/04/nodejs-expressjs-mysql.html>

MySQLDumper

- <http://sourceforge.net/projects/mysqldumper/>
- <http://www.mysqldumper.net/>