

Comp 324/424 - Client-side Web Design - Slides

Fall Semester 2017 - Week 10

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Contents

- AJAX, JSON, and jQuery
- ES6 Generators & Promises

Ajax, JSON & jQuery - part I

jQuery Deferred

- jQuery provides a useful solution to the escalation of code for asynchronous development
- known as the `$.Deferred` object
 - *effectively acts as a central despatch and scheduler for our events*
- with the **deferred** object created
 - *parts of the code indicate they need to know when an event completes*
 - *whilst other parts of the code signal an event's status*
- **deferred** coordinates different activities
 - *enables us to separate how we trigger and manage events*
 - *from having to deal with their consequences*

Ajax, JSON & jQuery - part 2

using deferred objects

- now update our AJAX request with **deferred** objects
- separate the asynchronous request
 - *into the initiation of the event, the AJAX request*
 - *from having to deal with its consequences, essentially processing the response*
- separation in logic
 - *no longer need a success function acting as a callback parameter to the request itself*
- now rely on `.getJSON()` call returning a **deferred** object
- function returns a restricted form of this **deferred** object
 - *known as a **promise***

```
deferredRequest = $.getJSON (
    "file.json",
    {format: "json"}
);
```

Ajax, JSON & jQuery - part 3

using deferred objects

- indicate our interest in knowing when the AJAX request is complete and ready for use

```
deferredRequest.done(function(response) {  
    //do something useful...  
});
```

- key part of this logic is the `done ()` function
- specifying a new function to execute
 - *each and every time the event is successful and returns complete*
 - *our AJAX request in this example*
- **deferred** object is able to handle the abstraction within the logic
- if the event is already complete by the time we register the callback via the `done ()` function
 - *our **deferred** object will execute that callback immediately*
- if the event is not complete
 - *it will simply wait until the request is complete*

Ajax, JSON & jQuery - part 4

handling errors with deferred objects

- also signify interest in knowing if the AJAX request fails
- instead of simply calling `done()`, we can use the `fail()` function
- still works with JSONP
 - *the request itself could fail and be the reason for the error or failure*

```
deferredRequest.fail(function() {  
    //report and handle the error...  
});
```

Ajax, JSON & jQuery - part 5

example

- add the option to read and write from a JSON file
- we'll use AJAX for these requests
- initially we can consider our application as follows
 - *read data from JSON file*
 - *load initial data to application*
- no edit features for now
- add edit features with DB

Ajax, JSON & jQuery - part 6

example - JSON

- test reading and loading JSON file and data
- ignore standard AJAX pattern
 - *passing two callbacks, success and error*
- use deferred and promise
- initial JSON for Travel Notes app

```
{
  "travelNotes": [{
    "created": "2015-10-12T00:00:00Z",
    "note": "a note from Cannes..."
  }, {
    "created": "2015-10-13T00:00:00Z",
    "note": "a holiday note from Nice..."
  }, {
    "created": "2015-10-14T00:00:00Z",
    "note": "an autumn note from Antibes..."
  }]
}
```


Ajax, JSON & jQuery - part 7

example - deferred

- start by submitting a query for the required JSON file
- then retain the deferred object we're using for tracking
- then indicate interest in knowing when AJAX request is complete

```
//load main app logic
function loadApp() {
  "use strict";

  var $deferredNotesRequest = $.getJSON (
    "docs/json/notes.json",
    {format: "json"}
  );

  $deferredNotesRequest.done(function(response) {
    console.log("tracking json...");
  });
};
$(document).ready(loadApp);
```

Ajax, JSON & jQuery - part 8

example - deferred

- `done ()` method is the key part
- helps us specify the required logic to execute
 - *when the request is complete*
- if the given event has already completed as callback is registered via `done ()`
 - *deferred object will execute required callback immediately*
- if not, it will simply wait until request is complete
- respond to an error
 - *add `fail ()` method for errors handling and reporting*

Ajax, JSON & jQuery - part 9

example - work with data

- returned data
 - our response returns an object containing an array with notes
- we could simply extract the required notes
 - then append them to the DOM

```
$deferredNotesRequest.done(function(response) {  
    //get travelNotes  
    var $travelNotes = response.travelNotes  
    //process travelNotes array  
    $travelNotes.forEach(function(item) {  
        if (item !== null) {  
            var note = item.note;  
            //create each note's <p>  
            var p = $("<p>");  
            //add note text  
            p.html(note);  
            //append to DOM  
            $(".note-output").append(p);  
        }  
    });  
});
```

- DEMO - ajax & json basic loader

Image - HTML5, CSS, & JS - AJAX & JSON

AJAX and JSON

a note from Cannes...

a holiday note from Nice...

an autumn note from Antibes...

app's copyright information, additional links...

[AJAX & JSON - basic loader](#)

Ajax, JSON & jQuery - part 10

example - work with data

- we can use simple deferred requests with our local JSON data
- with staggered API calls to data, need to use slightly modified approach
 - *digging through data layer by layer*
 - *submitting a request as one layer returns*
- we could now create a second deferred object
 - *use to track additional processing requests*
 - *stagger our requests to the API*
 - *ensuring we only request certain data as needed or available*
- also create multiple deferred objects to handle our requests and returned data
 - *allows us to respond accordingly within the application*

Ajax, JSON & jQuery - part II

example - work with data

resolve()

- use this method with the deferred object to change its state, effectively to complete
- as we resolve a deferred object
 - any **doneCallbacks** added with *then()* or *done()* methods will be called
 - these callbacks will then be executed in the order added to the object
 - arguments supplied to *resolve()* method will be passed to these callbacks

promise()

- useful for limiting or restricting what can be done to the deferred object

```
function returnPromise() {  
    return $.Deferred().promise();  
}
```

- method returns an object with a similar interface to a standard deferred object
 - only has methods to allow us to attach callbacks
 - does not have the methods required to resolve or reject deferred object
- restricting the usage and manipulation of the deferred object
 - eg: offer an API or other request the option to subscribe to the deferred object
 - **NB:** they won't be able to resolve or reject it as standard

Ajax, JSON & jQuery - part 12

example - work with data

- still use the `done ()` and `fail ()` methods as normal
- use additional methods with these callbacks including the `then ()` method
- use this method to return a new promise
 - *use to update the status and values of the deferred object*
 - *use this method to modify or update a deferred object as it is resolved, rejected, or still in use*
- can also combine promises with the `when ()` method
 - *method allows us to accept many promises, then return a sort of master deferred*
- updated deferred object will now be resolved when all of the promises are resolved
 - *it will likewise be rejected if any of these promises fail*
- use standard `done ()` method to work with results from all of the promises
 - *eg: could use this pattern to combine results from multiple JSON files*
 - *multiple layers within an API*
 - *staggered calls to paged results in a API...*

Ajax, JSON & jQuery - part 13

example - work with data

- now start to update our test AJAX and JSON application
 - *begin by simply abstracting our code a little*

```
function buildNote(data) {  
    //create each note's <p>  
    var p = $("<p>");  
    //add note text  
    p.html(data);  
    //append to DOM  
    $(".note-output").append(p);  
}  
  
//get the notes JSON  
function getNotes() {  
    //$.get returns an object derived from a Deferred object - do not need explicit deferred object  
    var $deferredNotesRequest = $.getJSON (  
        "docs/json/notes.json",  
        {format: "json"}  
    );  
    return $deferredNotesRequest;  
}
```

- DEMO - ajax & json abstract loader

Ajax, JSON & jQuery - part 14

example - work with data

- requesting our JSON file using `.getJSON()`
 - we get a returned **promise** for the data
- with a **promise** we can only use the following
 - *deferred object's method required to attach any additional handlers*
 - *or determine its state*
- our **promise** can work with
 - *then, done, fail, always...*
- our **promise** can't work with
 - *resolve, reject, notify...*

Ajax, JSON & jQuery - part 15

example - work with data

- one of the benefits of using **promises** is the ability to load one JSON file
 - *then wait for the results*
 - *then issue a follow-on request to another file*
 - ...
- a simple example of chained `then ()` methods

```
getNotes().then(function(response1) {  
    console.log("response1="+response1.travelNotes[2].note);  
    $(".note-output").append(response1.travelNotes[2].note);  
    return getPlaces();  
}).then(function(response2) {  
    console.log("response2="+response2.travelPlaces[2].place);  
    $(".note-output").append(response2.travelPlaces[2].place);  
});
```

- outputting a limited test result to the DOM and the console
- as we chain our `then ()` methods
 - *pass returned results to next chained `then ()` method...*
- DEMO - ajax & json deferred `.then()`

ES6 Generators & Promises - intro

- generators and promises are new to plain JavaScript
 - *introduced with ES6 (ES2015)*
- **Generators** are a special type of function
 - *produce multiple values per request*
 - *suspend execution between these requests*
- generators are useful to help simplify convoluted loops
- suspend and resume code execution, &c.
 - *helps write simple, elegant async code*
- **Promises** are a new, built-in object
 - *help development of async code*
- promise becomes a placeholder for a value not currently available
 - *but one that will be available later*

ES6 Generators & Promises - async code and execution

- JS relies on a single-threaded execution model
- query a remote server using standard code execution
 - *block the UI until a response is received and various operations completed*
- we may modify our code to use callbacks
 - *invoked as a task completes*
 - *should help resolve blocking the UI*
- callbacks can quickly create a *spaghetti* mess of code, error handling, logic...
- *Generators and Promises*
 - *elegant solution to this mess and proliferation of code*

ES6 Generators & Promises - generators

- a *generator* function generates a sequence of values
 - *commonly not all at once but on a request basis*
- generator is explicitly asked for a new value
 - *returns either a value or a response of no more values*
- after producing a requested value
 - *a generator will then suspend instead of ending its execution*
 - *generator will then resume when a new value is requested*

ES6 Generators & Promises - generators - example

```
//generator function
function* nameGenerator() {
  yield "emma";
  yield "daisy";
  yield "rosemary";
}
```

- define a generator function by appending an *asterisk* after the keyword
 - *function* ()*
- use the `yield` keyword within the body of the generator
 - *to request and retrieve individual values*
- then consume these generated values using a standard loop
 - *or perhaps the new `for-of` loop*
- Demo - Generators - Basic

ES6 Generators & Promises - generators - iterator object

- if we make a call to the body of the generator
 - *an iterator object will be created*
- we may now communicate with and control the generator using the iterator object

```
//generator function
function* NameGenerator() {
  yield "emma";
}
// create an iterator object
const nameIterator = NameGenerator();
```

- iterator object, nameIterator, exposes various methods including the next method

ES6 Generators & Promises - generators - iterator object - next()

- use `next` to control the iterator, and request its next value

```
// get a new value from the generator with the 'next' method  
const name1 = nameIterator.next();
```

- `next` method executes the generator's code to the next `yield` expression
- it then returns an object with the value of the `yield` expression
 - and a property *done* set to *false* if a value is still available
- `done` boolean will switch to *true* if no value for next requested `yield`
- `done` is set to *true*
 - the iterator for the generator has now finished
- Demo - Generators - Basic Iterator

ES6 Generators & Promises - generators - iterate over iterator object

- iterate over the iterator object
 - *return each value per available yield expression*
 - *e.g. use the `for-of` loop*

```
// iterate over iterator object
for(let iteratorItem of NameGenerator()) {
  if (iteratorItem !== null) {
    console.log("iterator item = "+iteratorItem+index);
  }
}
```

- Demo - Generators - Basic Iterator Over

ES6 Generators & Promises - generators - call generator within a generator

- we may also call a generator from within another generator

```
//generator function
function* NameGenerator() {
  yield "emma";
  yield "rose";
  yield "celine";
  yield* UsernameGenerator();
  yield "yvaine";
}

function* UsernameGenerator() {
  yield "frisby67";
  yield "trilby72";
}
```

- we may then use the initial generator, NameGenerator, as normal

ES6 Generators & Promises - generator - recursive traversal of DOM

- document object model, or DOM, is tree-like structure of HTML nodes
- every node, except the root, has exactly one parent
 - *and the potential for zero or more child nodes*
- we may now use generators to help iterate over the DOM tree

```
// generator function - traverse the DOM
function* DomTraverseGenerator(htmlElem) {
  yield htmlElem;
  htmlElem = htmlElem.firstChild;
  // transfer iteration control to another instance of the
  // current generator - enables sub iteration...
  while (htmlElem) {
    yield* DomTraverseGenerator(htmlElem);
    htmlElem = htmlElem.nextElementSibling;
  }
}
```

- benefit to this generator-based approach for DOM traversal
 - *callbacks are not required*
- able to consume the generated sequence of nodes with a simple loop
 - *and without using callbacks*
- able to use generators to separate our code
 - *code that is producing values - e.g. HTML nodes*
 - *code consuming the sequence of generated values*
- Demo - Generators - Basic DOM Traversal

ES6 Generators & Promises - generator - exchange data with a generator

- also send data to a generator
- enables bi-directional communication
- a pattern might include
 - *request data*
 - *then process the data*
 - *then return an updated value when necessary to a generator*

ES6 Generators & Promises - generator - exchange data with a generator - example

```
// generator function - send data to generator - receive standard argument
function* MessageGenerator(data) {
  // yield a value - generator returns an intermediary calculation
  const message = yield(data);
  yield("Greetings, " + message);
}

const messageIterator = MessageGenerator("Hello World");
const message1 = messageIterator.next();
console.log("message = " + message1.value);

const message2 = messageIterator.next("Hello again");
console.log("message = " + message2.value);
```

- first call with the `next ()` method requests a new value from the generator
 - *returns initial passed argument*
 - *generator is then suspended*
- second call using `next ()` will resume the generator, again requesting a new value
- second call also sends a new argument into the generator using the `next ()` method
- newly passed argument value becomes the complete value for this `yield`
 - *replacing the previous value `Hello World`*
- we can achieve the required bi-directional communication with a generator
- use `yield` to return data from a generator
- then use iterator's `next ()` method to pass data back to the generator
- Demo - Generators - Basic Send Data
- Demo - Generators - Basic Send Data 2

ES6 Generators & Promises - generator - detailed structure

Generators work in a detailed manner as follows,

- **suspended start**

- *none of the generator code is executed when it first starts*

- **executing**

- *execution either starts at the beginning or resumes where it was last suspended*
- *state is created when the iterator's `next ()` method is called*
- *code must exist in generator for execution*

- **suspended yield**

- *whilst executing, a generator may reach `yield`*
- *it will then create a new object carrying the return value*
- *it will yield this object*
- *then suspends execution at the point of the `yield...`*

- **completed**

- *a `return` statement or lack of code to execute*
- *this will cause the generator to move to a complete state*

ES6 Generators & Promises - promises - intro

- a *promise* is similar to a placeholder for a value we currently do not have
 - *but we would like later*
- it's a guarantee of sorts
 - *eventually receive a result to an asynchronous request, computation, &c.*
- a result will be returned
 - *either a value or an error*
- we commonly use *promises* to fetch data from a server
 - *fetch local and remote data*
 - *fetch data from APIs*

ES6 Generators & Promises - promises - example

```
// use built-in Promise constructor - pass callback function with two parameters (resolve & reject)
const testPromise = new Promise((resolve, reject) => {
  resolve("test return");
  // reject("an error has occurred trying to resolve this promise...");
});

// use `then` method on promise - pass two callbacks for success and failure
testPromise.then(data => {
  // output value for promise success
  console.log("promise value = "+data);
}, err => {
  // output message for promise failure
  console.log("an error has been encountered...");
});
```

- use the built-in *Promise* constructor to create a new promise object
- then pass a function
 - a standard arrow function in the above example
- Demo - Promises - Basic

ES6 Generators & Promises - promises - executor

- function for a Promise is commonly known as an *executor* function
 - *includes two parameters, `resolve` and `reject`*
- *executor* function is called immediately
 - *as the Promise object is being constructed*
- `resolve` argument is called manually
 - *when we need the promise to resolve successfully*
- second argument, `reject`, will be called if an error occurs
- uses the *promise* by calling the built-in `then` method
 - *available on the promise object*
- `then` method accepts two callback functions
 - *success and failure*
- *success* is called if the *promise* resolves successfully
- the *failure* callback is available if there is an error

ES6 Generators & Promises - promises - callbacks & async

- async code is useful to prevent execution blocking
 - *potential delays in the browser*
 - *e.g. as we execute long-running tasks*
- issue is often solved using *callbacks*
 - *i.e. provide a callback that's invoked when the task is completed*
- such long running tasks may result in errors
- issue with callbacks
 - *e.g. we can't use built-in constructs such as `try-catch` statements*

ES6 Generators & Promises - promises - callbacks & async - example

```
try {
  getJSON("data.json", function() {
    // handle return results...
  });
} catch (e) {
  // handle errors...
}
```

- this won't work as expected due to the code executing the callback
 - *not usually executed in the same step of the event loop*
 - *may not be in sync with the code running the long task*
- errors will usually get lost as part of this long running task
- another issue with callbacks is nesting
- a third issue is trying to run parallel callbacks
- performing a number of parallel steps becomes inherently tricky and error prone

ES6 Generators & Promises - promises - further details

- a *promise* starts in a pending state
 - *we know nothing about the return value*
 - *promise is often known as an unresolved promise*
- during execution
 - *if the promise's resolve function is called*
 - *the promise will move into its fulfilled state*
 - *the return value is now available*
- if there is an error or *reject* method is explicitly called
 - *the promise will simply move into a rejected state*
 - *return value is no longer available*
 - *an error now becomes available*
- either of these states
 - *the promise can now no longer switch state*
 - *i.e from rejected to fulfilled and vice-versa...*

ES6 Generators & Promises - promises - concept example

an example of working with a promise may be as follows

- code starts (execution is ready)
- promise is now executed and starts to run
- promise object is created
- promise continues until it resolves
 - *successful return, artificial timeout &c.*
- code for the current promise is now at an end
- promise is now resolved
 - *value is available in the promise*
- then work with resolved promise and value
 - *call `then` method on promise and returned value...*
 - *this callback is scheduled for successful resolve of the promise*
 - *this callback will always be asynchronous regardless of state of promise...*

ES6 Generators & Promises - promises - explicitly reject

- two standard ways to reject a promise
- e.g. explicit rejection of promise

```
const promise = new Promise((resolve, reject) => {  
  reject("explicit rejection of promise");  
});
```

- once the promise has been rejected
 - *an error callback will always be invoked*
 - *e.g. through the calling of the `then` method*

```
promise.then(  
  () => fail("won't be called..."),  
  error => pass("promise was explicitly rejected...");  
);
```

- also chain a `catch` method to the `then` method
- as an alternative to the error callback. e.g.

```
promise.then(  
  () => fail("won't be called..."))  
  .catch(error => pass("promise was explicitly rejected..."));
```

ES6 Generators & Promises - promises - real-world promise - getJSON

```
// create a custom get json function
function getJSON(url) {
  // create and return a new promise
  return new Promise((resolve, reject) => {
    // create the required XMLHttpRequest object
    const request = new XMLHttpRequest();
    // initialise this new request - open
    request.open("GET", url);
    // register onload handler - called if server responds
    request.onload = function() {
      try {
        // make sure response is OK - server needs to return status 200 code...
        if (this.status === 200) {
          // try to parse json string - if success, resolve promise successfully with value
          resolve(JSON.parse(this.response));
        } else {
          // different status code, exception parsing JSON &c. - reject the promise...
          reject(this.status + " " + this.statusText);
        }
      } catch(e) {
        reject(e.message);
      }
    };

    // if error with server communication - reject the promise...
    request.onerror = function() {
      reject(this.status + " " + this.statusText);
    };

    // send the constructed request to get the JSON
    request.send();
  });
}
```

ES6 Generators & Promises - promises - real-world promise - usage

```
// call getJSON with required URL, then method for resolve object, and catch for error
getJSON("test.json").then(response => {
  // check return value from promise...
  response !== null ? "response obtained" : "no response";
}).catch((err) => {
  // Handle any error that occurred in any of the previous promises in the chain.
  console.log('error found = ', err); // not much to show due to return of jsonp from flickr...
});
```

- Demo - Promises - Basic XHR Local
- Demo - Promises - Basic CORS Flickr

Demos

AJAX and JSON

- AJAX-JSON 1 - load a JSON file
- AJAX-JSON 2 - abstract code for load a JSON file
- AJAX-JSON 3 - test deferred .then()
- AJAX-JSON 4 - Flickr API

Generators

- Basic
- Basic Iterator
- Basic Iterator Over
- Basic DOM Traversal
- Basic Send Data
- Basic Send Data 2

Promises

- Basic
- Basic XHR Local
- Basic CORS Flickr

References - JS & Libraries

- Flickr API
 - *Public feeds*
 - *Public feed - public photos & video*
- jQuery
 - *jQuery*
 - *jQuery API*
 - *jQuery - deferred*
 - *jQuery - .getJSON()*
 - *jQuery - JSONP*
 - *jQuery :parent selector*
 - *jQuery - promise*
- MDN
 - *MDN - JS*
 - *MDN - JS Const*
 - *MDN - JS Data Types and Data Structures*
 - *MDN - JS Grammar and Types*
 - *MDN - JS - Iterators and Generators*
 - *MDN - JS Objects*
 - *MDN - JS - Using Promises*