

# **Comp 324/424 - Client-side Web Design**

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Fall Semester 2018 - Week 12

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# Ajax, JSON & jQuery - part I

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## 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

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### *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

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### 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

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## **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

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### **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

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### 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

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### **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

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### **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

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### 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

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## **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

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## **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

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## 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

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### **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

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## 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 = $("

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


```

- DEMO - ajax & json abstract loader

# Ajax, JSON & jQuery - part 14

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## 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

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## 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

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- 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

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- 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 - promises - intro

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- 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

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```
// 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

## ES6 Generators & Promises - promises - executor

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- 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 - example

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## explicit use of resolve

```
/*  
 * promisel.js  
 * wrap Array in Promise using resolve()...  
 */  
  
let testArray = Promise.resolve(['one', 'two', 'three']);  
  
testArray.then(value => {  
  console.log(value[0]);  
  // remove first item from array  
  value.shift();  
  // pass value to chained `then`  
  return value;  
})  
.then(value => console.log(value[0]));
```

- Demo - Promise.resolve

# ES6 Generators & Promises - promises - callbacks & async

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- 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

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- 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

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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 - callbacks & async - example

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## promise from scratch

```
/*
 * promisefromscratch-delay.js
 * create a Promise object from scratch...use delay to check usage
 * promise may only be called once per execution due to delay and timeout...
 */

// check promise usage relative to timer...either timeout will cause the Promise to call a
function resolveWithDelay(delay) {
  return new Promise(function(resolve, reject) {
    // log Promise creation...
    console.log('promise created...waiting');
    // resolve promise if delay value is less than 3000
    setTimeout(function() {
      resolve(`promise resolved in ${delay} ms`);
    }, delay);
    // resolve promise if delay is greater than 3000
    setTimeout(function() {
      resolve(`promise resolved in 3000ms`);
    }, 3000);
  })
}

// fulfilled with delay of 2000 ms
resolveWithDelay(2000).then(function(value) {
  console.log(value);
});

// fulfilled with default timeout of 3000 ms
// resolveWithDelay(6000).then(function(value) {
//   console.log(value);
// });
```

- Demo - Promise from scratch

# 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 - example

---

## promise error handling

```
/*
 * promise-basic-error1.js
 * basic example usage of promise error handling and order...
 */

Promise
  .resolve(1)
  .then(x => {
    if (x === 2) {
      console.log('val resolved as', x);
    } else {
      throw new Error('test failed...')
    }
  })
  .catch(err => console.error(err));
```

- Demo - Promise error handling with catch

# 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 fl.
});
```



## ES6 Generators & Promises - promises - chain

---

- calling `then` on the returned promise creates a new *promise*
- if this promise is now resolved successfully
  - *we can then register an additional callback*
- we may now chain as many `then` methods as necessary
- create a sequence of promises
  - *each resolved &c. one after another*
- instead of creating deeply nested callbacks
  - *simply chain such methods to our initial resolved promise*
- to catch an error we may chain a final `catch` call
- to catch an error for the overall chain
  - *use the `catch` method for the overall chain*

```
getJSON().then()  
.then()  
.then()  
.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 fl.  
});
```

- if a failure occurs in any of the previous promises
  - *the `catch` method will be called*

# ES6 Generators & Promises - promises - wait for multiple promises

---

- promises also make it easy to wait for multiple, independent asynchronous tasks
- with `Promise.all`, we may wait for a number of promises

```
// wait for a number of promises - all
Promise.all([
// call getJSON with required URL, `then` method for resolve object, and `catch` for error
getJSON("notes.json"),
getJSON("metadata.json")]).then(response => {
  // check return value from promise...response[0] = notes.json, response[1] = metadata.js
  if (response[0] !== null) {
    console.log("response obtained");
    console.log("notes = ", JSON.stringify(response[0]));
    console.log("metadata = ", JSON.stringify(response[1]));
  }
}).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 fl
});
```

- order of execution for tasks doesn't matter for `Promise.all`
- by using the `Promise.all` method
  - we are simply stating that we want to wait...
- `Promise.all` accepts an array of promises
  - then creates a new promise
  - promise will resolve successfully when all passed promises resolve
- it will reject if a single one of the passed promises fails
- return promise is an array of succeed values as responses
  - i.e. one succeed value for each passed in promise

# ES6 Generators & Promises - promises - racing promises

---

- we may also setup competing promises
  - with an effective prize to the first promise to resolve or reject
  - might be useful for querying multiple APIs, databases, &c.

```
Promise.race([
  // call getJSON with required URL, `then` method for resolve object, and `catch` for error
  getJSON("notes.json"),
  getJSON("metadata.json")]).then(response => {
  if (response !== null) {
    console.log(`response obtained - ${response} won...`);
  }
}).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 fl.
});
```

- method accepts an array of promises
  - returns a completely new resolved or rejected promise
  - returns for the first resolved or rejected promise

# ES6 Generators & Promises - promises - Fetch API

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- [MDN - Fetch API](#)

# ES6 Generators & Promises - promises - Fetch API - Example

---

## basic usage

```
/*
 * fetch-basic1.js
 * basic example usage of Fetch API...
 */

fetch('./assets/notes.json')
  .then(response => {
    return response.json();
  })
  .then(myJSON => {
    console.log(myJSON);
  });
```

- Demo - Fetch API - basic usage

# ES6 Generators & Promises - promises - Fetch API - Example

---

## catching errors

```
/*
 * fetch-basic-error1.js
 * basic example usage of Fetch API...chain `catch` to `then` for error handling
 */

fetch('./assets/item.json')
  .then(response => {
    // reactions passed to `then` used to handle fulfillment of a promise
    return response.json();
  })
  .then(myJSON => {
    console.log(myJSON);
  })
  .catch(err => {
    // reactions passed to `catch` executed with a rejection reason...
    console.log(`error detected - ${err}`);
  });
```

- Demo - Fetch API - catching errors

# ES6 Generators & Promises - promises - Fetch API - Example

---

## Fetch with Promise all

```
/*
 * fetch-promise-all.js
 * basic example usage of Promise.all...using Fetch API
 */

Promise
  .all([
    fetch('./assets/items.json'),
    fetch('./assets/notes.json')
  ])
  .then(responses =>
    Promise.all(responses.map(res => res.json()))
  ).then(json => {
    console.log(json);
  });
```

- Demo - Fetch API - Promise all

# ES6 Generators & Promises - promises - Fetch API - Example

---

## Fetch with Promise race

```
/*  
 * fetch-promise-race.js  
 * basic example usage of Promise.race...using Fetch API  
 */  
  
Promise  
  .race([  
    fetch('./assets/items.json'),  
    fetch('./assets/notes.json')  
  ])  
  .then(responses => {  
    return responses.json()  
  })  
  .then(res => console.log(res));
```

- Demo - Fetch API - Promise race



## 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*

# 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*

# 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);
  }
}
```

# 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 - generators

---

## example - pass generator to function

```
function getRandomNote(gen) {
  console.log(`getRandomNote called...`);
  const g = gen();
  fetch('./assets/input/notes.json', {
    headers: new Headers({
      Accept: 'application/json'
    })
  })
  .then(res => res.json())
  .then(json => {
    return g.next(json);
  })
  .catch(err => g.throw(err))
}

getRandomNote(function* printRandomNote() {
  console.log(`generator function executes...`);
  const json = yield;
})
```

- Demo - Generators - pass generator to function

# 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*



# ES6 Generators & Promises - traversal with generators

---

- traversed using depth-first search
- algorithm tries to go deeper into tree structure
  - *when it can't it moves to the next child in the list*
- e.g. define a class to create a Node
  - *creates with value and arbitrary amount of child nodes*

```
// Node class - holds a value and arbitrary amount of child nodes...
class Node {
  constructor(value, ...children) {
    this.value = value;
    this.children = children;
  }
}
```

Then, we create a basic node tree,

```
// define basic node tree - instantiate nodes from
const root = new Node(1,
  new Node(2),
  new Node(3,
    new Node(4,
      new Node(5,
        new Node(6)
      ),
      new Node(7)
    )
  ),
  new Node(8,
    new Node(9),
    new Node(10)
  )
)
```

- various implementations we might create for a traversal generator...

# ES6 Generators & Promises - generator function

---

- e.g. depth first generator function for traversing the tree

```
// FN: depthFirst generator
function* depthFirst(node) {
  yield node.value;
  for (const child of node.children) {
    yield* depthFirst(child);
  }
}

// log tree recursion
console.log([...depthFirst(root)]);
```

## 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

# 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 - generators & iterables

---

## fibonacci number generator

- example generator for Fibonacci sequence
- generator will output an infinite sequence of numbers
- we may also call individual iterations of the sequence
  - e.g.

```
// generator function - value per iteration & done will not return true...
function* fibonacci() {
  // define start values for fibonacci sequence
  let previous = 0;
  let current = 1;
  // loop will continue to iterate fibonacci sequence
  while(true) {
    // return current value in fibonacci sequence
    yield current;
    // compute next value for sequence...
    const next = current + previous;
    // update values for next iteration of loop in fibonacci sequence
    previous = current;
    current = next;
  }
}

// instantiate iterator object using fibonacci generator
const g = fibonacci();

// call iterator
console.log(g.next());
```

- to improve performance, and prevent memory and execution timeout
  - add **memoisation** to script
  - a type of local cache for the execution of the algorithm...

# ES6 Generators & Promises - async I/O using generators

---

- use generators and generator helpers to create simple async input and output
  - *use with saving data &c.*
  - *a consistent and abstracted usage design for a custom generator*

```
// called with passed generator function
function saveItems(itemList) {
  const items = [];
  const g = itemList();
  return more(g.next());
  function more(item) {
    if (item.done) {
      return save(item.value);
    }
    return details(item.value);
  }
  function details(endpoint) {
    // check inputs are called & location...
    console.log(`details called - ${endpoint}`);
    return fetch(endpoint)
      .then(res => res.json())
      .then(item => {
        items.push(item);
        return more(g.next(item));
      })
  }
  function save(endpoint) {
    // check output is called & location...
    console.log(`save endpoint - ${endpoint}`);
    /*return fetch(endpoint, {
      method: 'POST',
      body: JSON.stringify({ items })
    })
    .then(res => res.json());*/
  }
}

saveProducts(function* () {
  yield './assets/input/items.json';
  yield './assets/input/notes.json';
  return './assets/output/journal.json';
})
```

# ES6 Generators & Promises - promises - combine generators and promises

---

an example usage for generators and promises,

- *async* function takes a generator, calls it, and creates the required *iterator*
  - *use iterator to resume generator execution as needed*
  - *declare a handle function - handles one return value from generator*
  - *one iteration of iterator*
  - *if generator result is a promise & resolves successfully - use iterator's `next` method*
  - *promise value sent back to generator*
  - *generator resumes execution*
  - *if error, promise gets rejected*
  - *error thrown to generator using iterator's `throw` method*
  - *continue generator execution until it returns `done`*
- *generator* - executes up to each `yield` `getJSON( )`
  - *promise created for each `getJSON( )` call*
  - *value is fetched async - generator is paused whilst fetching value...*
  - *control flow is returned to current invocation point in `handle` function whilst paused*
- *handle function*
  - *yielded value to `handle` function is a promise*
  - *able to use `then` and `catch` methods with promise object*
  - *registers success and error callback*
  - *execution is able to continue*



# ES6 Generators & Promises - lots of examples

---

e.g.

- generator
  - *basic*
  - *basic-iterator*
  - *basic-iterator-over*
  - *basic-loop*
  - *basic-dom*
  - *basic-send-data*
  - *basic-send-data-2*
- promises
  - *basic*
  - *basic-cors-flickr*
  - *basic-xhr-local*
  - *basic-promise-all*
  - *basic-promise-race*
- generator & promise - async
  - *basic*

# Demos

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## ***AJAX and JSON - jQuery***

- abstract code for load a JSON file
- load a JSON file
- test deferred .then()

## ***Fetch API***

- basic usage
- catching errors
- Fetch API & Promise.all
- Fetch API & Promise.race

## ***Generators - plain JS***

- Basic
- Basic Iterator
- Basic Iterator Over
- Basic DOM Traversal
- Basic Send Data
- Basic Send Data 2
- Pass generator to function

## ***Promises - plain JS***

- Basic
- Basic CORS Flickr
- Basic Promise All
- Basic Race
- Basic XHR Local
- Promise error handling with catch
- Promise from scratch
- Promise.resolve



# Resources

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## ***jQuery***

- [jQuery](#)
- [jQuery API](#)
- [jQuery - deferred](#)
- [jQuery - .getJSON\(\)](#)
- [jQuery - JSONP](#)
- [jQuery - promise](#)

## ***MDN - plain JS***

- [MDN - Fetch API](#)
- [MDN - JS](#)
- [MDN - JS Const](#)
- [MDN - JS - Iterators and Generators](#)
- [MDN - JS Objects](#)
- [MDN - JS - Using Promises](#)