

Back-end and frontend exams,

Addition: Full-stack open reading list

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Lot of what we already had in backend and frontend exams. But also some completely new topics.

This list is more for tracking the reading than real list of what can be formulated as exam question. So there are less exam question topics than points in these lists.

Not yet divided by front and back exams. As the list follows the Full-stack open course chronologically.

Part 0b. Fundamentals of Web apps

- Not really a lot of totally new stuff for you, don't worry, just recapping.
- Go through this part rather fast
- In Full-stack open you can, but don't have to, visit the offered extra info links. If do so, just spend max 30 seconds or something like that there in the side track link
- It is good to recap at least these concepts
 - http request, GET method
 - looking into http request headers
 - DOM manipulation with (DOM API) JavaScript running in browser
 - POST method, request with headers and body
 - AJAX, <https://en.wikipedia.org/wiki/XMLHttpRequest>, the xhr object given to you by the DOM API JavaScript implementation of the browser
 - SPA idea (Frontend)
 - JavaScript libraries for Web UI and/or datamodels: jQuery, BackboneJS, AngularJS, React, Redux, VueJS
- "JavaScript fatigue" is true. Many new versions of the libraries (e.g. React) utilize all new features that appear in EcmaScript standard. Thus, people need to learn both new version of the library and new version of ECMA Script.
- Do the exercises if have a lot of time. Otherwise you can just learn the theory fast first

Part 1a. Introduction to React

- npx **both** downloads and runs the create-react-app tool
- what kind of React project template is created by it?
- learn/recap the function based React
- JSX, XML-like but not really XML, e.g. this is not valid XML: `<xyz def={abc} />` (attribute values should be inclosed in `" "` or `' '`)
- props as React component function parameter
- start the JSX code on same line as return statement, or wrap it into `()`
- React function should return
 - one root component,
 - or an `[]` array of components
 - or a fragment, empty mother element with other elements inside
- exercises

Part 1b. JavaScript

- babel – transpiler library. From new ECMAScript versions to older versions of JavaScript that the used (browser's or backend server's) JavaScript engine supports
- e.g. Node.js (which uses the V8 JavaScript engine) supports more and more modern ES also without a transpiler: <https://nodejs.org/en/docs/es6/>
- `const t = [1, -1, 3]; const t2 = t.concat(5);` // doesn't change original array, returns the new
- destructuring assignment
- object literals are not JSON, even if they look almost similar. JSON is "text" but object literals are JavaScript code.
- referring to the object members with 'indexer' brackets: `person1['first name'] = "Joe";`
 - works even for illegal member names, like having spaces or starting with digits
- object-oriented JavaScript **was** used in old React, now that is forgotten. Nowadays we use function and Hooks -way React to define React components
- arrow functions, nothing new
- exercises
- old stuff: arrow function doesn't tie the keyword 'this' to itself (to the arrow function object) but refers to outer lexical context. That is, to the React component object.
- method = function that has been attached to an object. When run, the keyword this refers to the object if you have used arrow function notation => please use
- (funny fact, if you take the function=method object out of the object, it loses the this - reference and kind of becomes a non-method function)
`const referenceToGreet = arto.greet`
- setting up timers in JavaScript is easy:
 - `setTimeout (arrowFunctionToBeCalled, 1000)` one shot after 1s
 - `setInterval (arrowFunctionToBeCalled, 5000)` periodically run
- multiple timers are independent of each other
- again class in JavaScript can be skipped, we rarely use nowadays
- Maybe this fast: https://developer.mozilla.org/en-US/docs/Web/JavaScript/A_re-introduction_to_JavaScript

Part 1c. Component state, event handlers

- component helper functions wrapped inside React component functions have access to e.g. props of the React function/component
- destructuring the props with three different ways (so that it's not too simple 😊)

```
o const name = props.name;           // 1.way
o const age = props.age;              // 1.way

o const { name, age } = props         // 2.way

o ({ name, age }) => {                 // 3.way
  // looks like an object created, but no. To vars created and the
  props is destructured to those vars.
```

- relax and try to see how the three ways above lead to almost same (the last one is almost same even if two vars are created).
- why last one leads to vars and not consts? It happens in the parameter list of the React function. Like you know for the variables introduced in parameter list (=parameters) we cannot define var/let/const at all and the parameters become function-scoped vars automatically.
- useState -hook => Stateful component the modern way (Forget the old object-oriented React and setState)
- useState is used to map 1. one state value holder and 2. its setter function and 3. provide the initial value
- don't be fooled by it being const - React will handle the really running of the components, we just attach hooks to certain events
- passing event-handler arrow function objects to components in their props
- if you need e.g. button click to call function foo(), do not call there immediately foo(), but create an arrow function which would, when later called, call the foo() inside its function body. = you are not doing something, you are giving the system chance to do something later, right?
- passing data (e.g. pieces of parent state) to child components via props
- the concept of different kind of React components. Some e.g. only show data and provide buttons for doing something to just that data item. Some are parent components that have several child components. Those typically fetched all the data.
- (re-)rendering at least in these cases: 1. state changes, 2. props change, (~~3. render method called~~) I need to think what are the other real cases in modern function + hooks way.
- we want to have the React components follow SRP, single-responsibility principle. Doing just one thing and if not, then refactoring, e.g. splitting it potentially to sub-components. Sub-components defined outside of the parent component, so that you can reuse them possibly in another view too.

Part 1d. A more complex state, debugging React apps

- several pieces forming the state OR one more complex object forming the state
- initial value kind of gives the format of the state, and methods that update or read the state need to follow the same format, e.g. member names.
- methods updating the state might **first** utilize the ... spread notation to take a copy of the current state as basis, and **then** change the wanted parts in it.
- we will thus create a new object that will replace the old state object. We cannot mutate the old state object. (this was the same in the traditional class-based React)
- array.concat (from earlier) will be handy when the model is an array. As it will not mutate original array, but will return a totally new array to be used as the state value. (unlike e.g. array.push() that would mutate the original object)
- in conditional rendering the authors have used if return return -structure (two returns in row). If true, return something. If was true, the method will end. Otherwise return what the second return returns. You like that or not? To me if-else would be more elegant. A bit nerdy solution. Even the block for the if is left out. Well it's JSX+JS combo so...
- Old React, read but skip mostly
- console.log('props value is', props) // For better debugging messages, try it out
- React developer tools
- rules of Hooks we have also in the Frontend exam reading list already, but good to read also here
- Once again the idea of passing a function object (defined with arrow function syntax) to the onClick, not executing code, but passing executable code
- all in all, read the code examples here, and ask if don't understand everything out of it.
- in addition to reuse, components should be defined outside of other components so that the system can treat and optimize them as separate, but possibly together orchestrated components.
- Useful reading for React, two links to learning sites. Certainly good, now just think do you want to advance fast to tasks, or make a deeper dive into React. Up to you and depends on your situation
- exercises: nice recap of the topics. Recommended if not in hurry to next chapter.

Part 2a. Rendering a collection, modules

- About the debugging and debugging tools again. Never emphasized too much!
- (Snippets maybe come more handy in daily work than in learning. I like to type all myself when learning)
- Higher order functions (functions that are passed functions, functions that return functions to be executed, map/foreach/filter/find/reduce. Interesting topics, we have seen a lot of that topic, but not all)
- (again event-handler arrow functions returned from another arrow function that is passed some needed id:s or other config)
- (BTW. All in all, you might want to use only arrow function syntax with modern React!)
- Rendering collections involves: 1. outer mother element (finally e.g. ol, ul, table, div), 2. map/foreach/... creating child elements (finally e.g. li, tr, div) **and** 3. the unique attribute 'key' to the child element
- Nowadays, when a React component can return an array of elements, the map-function is the most used.
- Never use array index for the key values in real cases. Use instead the UID or id that the item has in database. Or a encrypted hash based on that id. Those id:s work.
 - whereas the one from array gets ruined when an item in the collection is removed. '
- Visiting prop destructuring again, React component refactoring and splitting all views into single-responsibility principle components with child components further inside.
- And again, remember not to define Component inside the mother component's code.
- How the root React component (Start of the SPA application) gets 'injected' to the web page = to the DOM? What libraries and templates and components are involved? Just study it fast. index.js, App.js, index.html, react-dom, react
- node modules referred to without the folder path, own react components etc. JS files with ./and_so_on
- exercises

Part 2b. Forms

- `event.preventDefault()` used to stop the normal behavior of HTML forms, with submission to backend etc. We want to stay in the same SPA and let SPA do the routing of the views. And React code to handle the “submit” button behavior too.
- The ‘event’ refers to the Web browser UI event object. Has information about e.g. event target, how long was some button pressed. Etc. etc. Think e.g. all things related to what you can do with mouse in UI.
- `onSubmit={addNote}` //When user presses the submit, what event-handler function should be called (`addNote`).
- ‘controlled components’ having own mapping between html input fields and the state of the component. When value in input field value changes, change event-handlers also update the components state, and thus also update any components showing the state.
- used the model where in the state there are all the items, plus the ‘temp’ for just in-read input value(s) before they/it go/goes to the all items collection
- nice example, but need to read the final/full version below
- ternary operator (conditional operator) `a ? b : c` used in conditional rendering in JS or JSX code
- always use `===` in JavaScript, unless know exactly some rare special case, and have tested all possible probs out.
- quite nice example continues. Not a bad idea to write all of it to a pristine create-react-app project template?
- exercises

Part 2c. Getting data from server

- Using tool json-server (Instead of Node.js server with e.g. Express) in this first example.
- fast output API generated based on the JSON file in the folder
- (possibly JSONView plugin needed for Browser if the browser doesn't show the results nicely)
- use AJAX via some promises-based library, e.g. Axios, no need to learn those old directly-using-the-DOM-api-ajax-objects -ways used here
- JavaScript engines are single-threaded, even the one behind the Node.js server. (But Node.js simulates multi-threading as well as it can. Browser JavaScript on the otherhand is eager to hang or become non-responsive.)
- Web workers are for running multiple threads in Browser JavaScript. You might see one in the create-react-app
- npm, the **node package/module manager**, that should not be called node package manager...
- npm used also to start / build / clean the project
- package.json (file you don't want to use. package-lock.json etc. can be removed and generated again. But this is the place where the dependencies and some other tooling/scripting are defined)
- development dependency = only included in the development version of the product, not to the build version!
- npm run server (read this script from the package.json and understand how it works)
- like always, just the last version of Axios usage starts to be what we would use.
- Even there the request object could be maybe configured first and then sent. (URL, parameters, body data)
- useEffect -hooks // do something else too, than the React component state/props <-> render cycle. =side effects. E.g. run the AJAX call to backend.
- the nice example starts to expand, but of course in real create-react-app projects we would have a lot of folders and files. E.g. one for views, one for SPA routing files, one for other components, ...
- the create-react-app project is, by default, development environment with e.g. auto-refresh of the running code after changes you make
- the real build version of the project does not run dynamic code in Node.js server, and doesn't have all your folders and files separately. The built version runs only in the browser JavaScript environment after it has downloaded the few generated and bundled/packed HTML and JS and CSS files. Just running then JavaScript in browser and of course also making AJAX calls to backend.

Part 2d. Altering data in server

- json-server at least claims to be really good for creating fast mockup REST API server, before getting the real backend created. Frontend developers can create their counter part for testing and development
- just remember to define the backend server URL or any such changing configuration only once and only in one gitignored file = easy to change later and details not going to github etc. remote git repo
- (even better would be reading that from environment variables = not part of the tested and github submitted project at all)
- REST is explained in other materials. But read these texts here and remember e.g. statelessness of each call. Not related to previous call. All calls=requests must include all info needed to serve that call.
- POST request with body = data
- browser tools for checking the requests and responses are important
- so are also the PostMan or e.g. VS Code request test sender, saving few successful and purposefully unsuccessful requests for future repeat of the tests.
- tests could be saved in a second repo OR in the same repo (if you can define which parts of the demo are monitored for code changes and which ones are not. As we do want to develop more and more, better and better test cases, but also differentiate between real code changing or not)
- The 'bang' operator, or the exclamation point ! is like Trump, turns true to false, and false to true.
- shallow copy term we have studied used here too. In this example fine, as the Note objects do not refer to further objects.
- (rest of the example is actually based on already learned stuff, repeating the concepts learned in parts 0,1, and 2a-c)
- template literal used, with the backticks ` ` and placeholders
- alert dialog is one of the other good old (used in debugging but mainly nowhere else) -tools.
- exercises definitely good thing to do so that you remember all issues recapped here

Part 2e. Adding styles to React app

- (These style examples in part 2e are mainly for very basic styling. Fully-fledged styling would involve Theme injection to the React-dom tree root and e.g. style files written in their own .js code files)
- based on CSS basics of styling HTML elements produced based on the JSX code(s).
- and the fact that the index.css was (was it not?) added to the create-react-app project template
- and using HTML attribute class first, later JSX attribute className, which will dynamically produce the class attribute to the output when JSX rendered to final HTML
- notice again how HTML elements with all small letters, and in JSX use exactly given casing, e.g. className
- having a state 'piece' for errorMessage too, updated like state before. Used to show the possible error message
- notice the differences between .css files and .js style files (or style definitions) that define style objects. Difference in use and also syntax
- What is here called inline styles can be also kept in external style files and so on. Maybe better coding style if ask me.
- exercises

Part 3a. Node.js and Express

- “NodeJS, which is a JavaScript runtime based on Google's Chrome V8 JavaScript engine”.
- Notice: can be and normally used to create backend, but also used also e.g. in create-react-app generated development time frontend environment for fast development
- Node ECMAScript support has recently evolved, so could we use e.g. ES6 import/export (instead of the require and module.exports from older CommonJS) without transpiling with babel? “we can use the latest features without having to transpile our code”
- npm init, package.json (dependency definitions and scripts, plus more), node_modules folder
- `const app` // Usually/later refers to the Express object we use to define more and more features to the Node (w. Express) backend. Like configurations, security settings, routing, starting the server,...
- Now first the `const app` refers to a different object from the Node's own npm module 'http', a bit cumbersome way to do things, but later again to Express.
- remember that if running front and back in same machine, they might both have Node server and thus eager to use port 3000 => clash. Thus we use e.g. 8686 for front and 8787 for backend Node. Thus 3000/3001 are free for your other Node projects too.
- “At the time of writing this material, Node does not support ES6 modules, but support for them is coming somewhere down the road” Hmm. is the material up-to-date for this part?
- `npm install somemodule` // adds the dependency to the package.json and also downloads the needed file(s) to the node_modules folder tree
- `"express": "^4.17.1"` // caret ^ means at least, 4=major, 17=minor, 1=patch version numbers. Major has to stay at 4, unless you explicitly update it
- `npm update`
- `npm install` // this you need to run e.g. after cloning a project from git. As you get package.json from git repo, but not the node_modules. So you have the dependency definitions, but not the physical module files. One dependency might depend on other modules, so you will get more than one file downloaded.
- `app.get`, `app.listen`,
- `response.send (200, text/html)`, `response.json (200, application/json)`
- nodemon (node-mon(itor), not: no-demon ☺): *nodemon will watch the files in the directory in which nodemon was started, and if any files change, nodemon will automatically restart your node application*
- `node index.js` vs. `nodemon index.js`
- look at the very few aspects about REST services presented on the course. Core stuff
- HTTP verbs = HTTP methods <https://developer.mozilla.org/en-US/docs/Web/HTTP/Methods> Some systems only use(d) GET and POST (a new resource posted to the backend) to do everything (instead of including e.g. the useful DELETE, PUT (replace) and PATCH (modify). You could use these five or four of these, skipping patch.
- the nature of `app.get` we have already discussed (see the asynchronous code examples, the code might be executed in three different times / phases, the `app.get` being executed at server setup, others later if the service called, and last after some async resource like database responds)
- `app.get('/api/notes/:id', (request, response) => {`
... `const id = request.params.id`

- `notes.find ...` // refers to the array/collection method `find` that is the sibling of `filter/map/foreach/reduce` methods. Returns the first item in collection for which the provided arrow function returns `true`
- `notes` is so far just hard-coded JS array object `let notes = [...something here...]`
- `response.end()` // from Node itself, just ends the response processing, you need to set the status code and response type etc.
- `response.send()` // from Express, sets /sniffs some stuff for you automatically (sometimes/usually the one you need to use), uses internally the `response.end()` from Node. *"res.send() implements res.write, res.setHeaders and res.end"*
- deleting is again done just funny way of filtering out from the local object, no database yet.
- **Postman** or **VS Code REST client** add-on.
- `const note = request.body;` // handling POST. Remember before **`request.params.id`** for GET
- (GET method can also have a `body = data`, but not all implementations support it like they **should support** based on the HTTP standards. So if use `body` for GET, make sure to test it well before! Or don't use `body` for GET)
- remember how `array.concat(newObject)` did not modify the existing array, but returned a copy with the `newObject` added to it
- `Math.max(...notes.map(n => n.id))` // interesting pile-up of executions. 1. `map` 2. arrow function used inside of `map` for each item, returns an array, 3. spread notation called for the array
- `{ important: body.important || false, }` // test this with simple example of yours to understand
- exercises
- safe and idempotent
- "middleware". For e.g. schema validation, centralized error handling, routing management, json parsing, ...
- exercises

Part 3b. Deploying app to internet

- look at the `baseUrl` as an example of “define only once and in one place”. Later on
- CORS, or Cross-Origin Resource Sharing. By default the CORS mode is restrictive and may forbid AJAX calls, as our AJAX in full-stack apps is naturally calling the backend, which we have on a different server than the frontend.
- Here note that dev time frontend might have some code running against the React-dev Node server, but in final stage, the frontend is running totally on end-user’s web browser. But the web browser has got the HTML and JS from some web server, and then the AJAX code wants to connect to a backend server.
- Thus you can see, that later we need to change the CORS config so that the browser will accept calls and content from the backend to be in the frontend.
- `npm install cors`, `const cors = require('cors');` `app.use(cors());`
The last step creates CORS configuration with no restrictions. Ok for helloworld, but for real environments we should only allow the domain URL of the backend.
- When you look at the “*The setup of our app looks now as follows:*” picture you can see how in the full-stack course example the frontend and backend are in the same computer (student’s PC). Usually that is not the case, we e.g. want to separate the backend and frontend servers, thus we could separate the storage symbol at the bottom into two storage symbols. `app.js` and `index.js` on one frontend server computer and the `index.js` of the backend server in another.
- Heroku – When **learning any cloud environment** try to see the difference between Heroku-specific learning and common learning of any cloud infrastructure. Not spending too much on details, but more with what exactly are we doing, the big picture. That kind of understanding can be moved to e.g. Google cloud, or Azure, or AWS. But the details and exact commands usually not!
- `const PORT = process.env.PORT || 3001;`
https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Operators/Logical_OR
“if this operator is used with non-Boolean values, it will return a non-Boolean value”. Thus you can use it in conditional assignments.
- Notice the “template literal” with backticks:
 - ``Server running on port ${PORT}``
- “Frontend production build” we have already been talking about this. Finally the React-dev Node disappears, and the produced mashed up HTML+JS code could be served by a static server even, like `myy.haaga-helia.fi` even. No dynamic server needed, no node, no apache tomcat.
- we will not put the frontend deployment files to the backend server. We want to be ‘kosher’, keep front and back totally separate project and server. Why? because later we could have e.g. native mobile app that uses the same backend, but has no relationship with the frontend whatsoever.
- bad bad bad, though this is kind of beginners’ course to full-stack. But think about this problem too: You want to monitor if something has changed in the server. If both front and back are on the same server, you lose the knowledge which one has changes. Testability (e.g. regression testing) and so on complicated unnecessarily!
- “*The setup that is ready for product deployment looks as follows:*” picture. Looks confusing, front and back mixed up to the same server. Otherwise nice picture of course.

- nice scripting help in this part! including how to make Windows use bash console to run the scripts nicer
- “for example placing both backend and frontend code to the same repository” For the love of a dog, Nooooouuuuu! 😞 Full-stack means that the architecture consists of front, back and storage, but in no way should they be mixed as one entity.
- I have seen people do a hack where the REST API backend and the frontend run in the same runtime. Not React/Node, but was it Ruby on rails or something. Even if it’s interesting technically, it’s against any sensible principles.

Part 3c. Saving data to MongoDB

- I sometimes counted the possible windows you could get open and monitor while running a full stack app with React, Node and database. I got to 8 different windows to monitor, that of course includes the web page itself, but then the browser console etc. Eight screens where some error or info message could tell what is happening or what is the problem!
- This of course depends on the tools you are using, e.g. React dev tools and Redux dev tools where two of the eight windows!
- The eight windows provided a view inside the full-stack “black box”.
- VS Code debugging for Node.js, launch.json
- (Interesting, using Chrome dev tools to debug Node.js code. Though, why not, Chrome and Node both utilize the same V8 JavaScript engine)
- Old good advice, stay lean, test, add more, test. Test as soon as anything is testable. = test even just SQL if RDBMS. Write test and test even an empty API end point. = be in control of the code rather than code takes control of you.
- Document database is official and better name than noSQL. MongoDB, Google/Amazon/ etc. have their own and also offer MongoDB service, (ElasticSearch is behind of many very fast applications)
- Remember that document databases are not replacing relational databases, but complementing the spectrum. Document databases are fast in bulk output, bulk reports and summaries. Relational databases guard the integrity of data model and more complex business rules better. And are, actually, faster in more complicated searches.
- So certainly needed, but not replacing. Many information systems use both. Relational database for input to the normalized, guarded, high-integrity data model. And then document database for bulk output. Data flowing from RDBMS => document database.
- Database - * Collections - * Documents -* key:value pairs
- BSON, Binary JSON, <https://docs.mongodb.com/manual/reference/bson-types/>
- BSON fully supports JSON datatypes and then adds more specific definition possibilities that JSON cannot “enforce” or relay, but they go through as JSON data fine.
- Heroku/Azure/Google/Amazon/IBM/mLab/DigitalOcean would provide MongoDB as service, this full-stack course used: <https://www.mongodb.com/atlas/database> Atlas MongoDB
- Mongoose. Schema + model (Model is like the ‘ORM’ programming side object. At the same time kind of our access to and from the database, enforcing the schema on the way)
- Document databases on their own are schemaless, so we put the schema validation “at the gate”
- **note** (document), **notes** (collection of documents). Though with capital letter **Note** refers to the model and the model able to fetch both single and multiple items.
- exercises
- a student told (2021-10-26) that mongoose has to be ‘required’, ‘import’ not supported yet

UNDER CONSTRUCTION

UNDER CONSTRUCTION

Part . Aaaaa

- Beee
- Ceee

Part . Aaaaa

- Beee
- Ceee

Part . Aaaaa

- Beee
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Part . Aaaaa

- Beee
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