

Express introduction

Our first server application

Our goals

- ▶ **What is express and why do we need it?**
- ▶ **Understand Express architecture**
- ▶ **Understand the patterns we use with express**
- ▶ **Using those patterns solve common server problems like**
 - **request body**
 - **session**
 - **Authentication / Authorization**
- ▶ **We will also learn how to split our server files and arrange them properly for a well structured application**

What is Express

- ▶ **Express is a framework for creating web server**
- ▶ **It will get a request and send a proper response**
- ▶ **Minimalistic**
- ▶ **Unopinionated**
- ▶ **Fast**
- ▶ **Very easy learning curve**
- ▶ **Large community that develops a lot of plugins**

Express architecture - App - EX

- ▶ **Building an express app starts with creating an express app**
- ▶ **An app contains methods to run on each request**
- ▶ **Usually we will have one app**
- ▶ **The app listens to a certain port for requests**
- ▶ **Let's start by installing express and starting to listen on a port**
- ▶ **The app will listen for request and activate certain methods on certain requests**

Express architecture - Middleware - EX

- ▶ **A middleware is a function that will be called on certain requests**
- ▶ **That function have access to the request, response, next**
 - **request - object containing information about the current request**
 - **response - used to send the response back**
 - **next - used to pass to the next middleware**
- ▶ **Add your first middleware, on all get requests, send a response of hello world**

Express architecture - Attaching a middleware

- ▶ **Attaching a middleware is used with app.[METHOD] where method can be one of the following:**
- ▶ **The middleware will work based on the request type**
 - **use**
 - **used for added behaviour and usually not to deal with routes**
 - usually placed at the top**
 - **optional path and will match path prefix as well**
 - **all**
 - **get**
 - **post**
 - **put**
 - **delete**
 - **patch**
 - **options**
 - **head**

Express architecture - middleware path

- ▶ The first argument of the middleware is the path
- ▶ With **use** the default value of the path is “/” which means it will work on all the requests
- ▶ The match on the not use route methods should match exactly
- ▶ The path can be: regular expression or string, or array of strings / regex
- ▶ path can transfer params in the route (query or fragment do not effect the match)
- ▶ Express use a library called path-to-regexp
 - <https://www.npmjs.com/package/path-to-regexp>
- ▶ Let's examine some path examples

Express architecture - middleware path

- ▶ **app.use('/user', ...)**
 - will match /user or /user/foo/bar/hello/wold
 - Will not match / or /userhello
- ▶ **app.all('/user', ...)**
 - Will match /user
 - Will not match /user/foo/bar/...
- ▶ **app.get('/user/:id')**
 - will match /user/30
 - req.params.id === '30'
- ▶ **app.get('/user/:id(\\d+)', ...)**
 - will match /user/30 and req.params.id === '30'
 - will not match /user/foo

Express architecture - middleware path

- ▶ **`app.get(/^user/)`**
 - **will match `/user` or `/sdfasdf/user/sdfsdf` or `/sdf/userfasdf`**
- ▶ **`app.all('/user/*', ...)`**
 - **will match `/user/` or `/user/foo/bar`**
 - **will not match `/user`**

Express architecture - EX

- ▶ **Create a server that will get a number param on the url and print that param**

Express architecture - middleware function

- ▶ The middleware function has the following signature
 - `function(req, res, next)`
- ▶ `req` is the request object
- ▶ `res` represents the response
- ▶ `next` will pass to the next middleware
- ▶ your choice is to either call `next` or to return the response
- ▶ when passing to `next` we can change the request response object
- ▶ You can use async functions as well
- ▶ You can place one function, list of functions, array of function

Express architecture - middleware function - req

- ▶ **An object representing the request**
- ▶ **common properties:**
 - **req.params**
 - **req.headers**
 - **req.query**
 - **req.url**
 - **req.method**
- ▶ **It is common to add key values to the response**

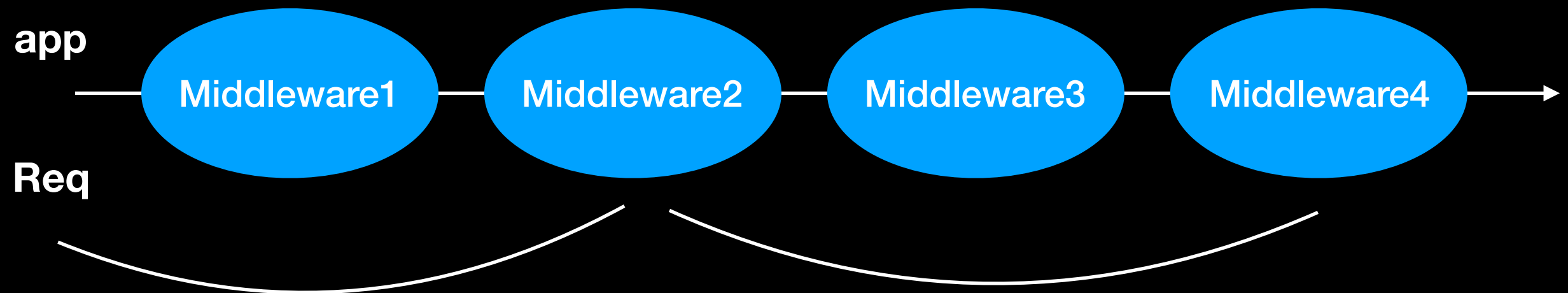
Express architecture - middleware function - res

- ▶ **An object representing the response**
- ▶ **Useful properties and methods**
 - **res.send**
 - **res.json**
 - **res.status**
 - **res.redirect**
 - **res.sendFile**

Express architecture - middleware function - next

- ▶ **next is in charge to pass the req and response to the next middleware function in line**
- ▶ **the next middleware function can belong to the same app.[method] or a different one**
- ▶ **To skip the rest of the functions in this app.[method] and jump to the next app.[method] you can pass next('route')**
 - **will not work with use**
- ▶ **To pass an error we do next(new Error(...))**

Express architecture



Express pattern - middleware creator -EX

- ▶ **This pattern is used to send options to our middleware**
- ▶ **We use closure to place variable configuration values above the middleware function.**
- ▶ **Let's exercise this pattern by creating a configurable middleware which we pass a name string to it**
- ▶ **That middleware should print 'hello <name>'**

Express pattern - community middleware

- ▶ **Express is a very popular node framework**
- ▶ **large community develops a lot of 3rd party middleware**
- ▶ **Almost all of those middleware we attach with the create middleware pattern we learned before**
- ▶ **Each middleware we have to supply it's own configurations.**
- ▶ **Let's go over the popular middlewares**

Express - community middleware - static

- ▶ **express.static** - The static middleware is used to serve static files
- ▶ We need to give it the path to the folder where our static files are located
- ▶ When requesting a static file we will not need to
- ▶ We can give create a virtual folder by providing the path.
- ▶ As an ex:
 - create a static assets directory with an image
 - install the static middleware
 - activate the server and make sure you can request the image and see it in the browser
- ▶ Do you think it's a good idea to let express serve static files?

Express pattern - adding to the request - EX

- ▶ **Another pattern commonly used in express is modifying the request object**
- ▶ **The request object is passed between middlewares so it can be used to transfer data from middleware to middleware**
- ▶ **if we will add a key to the request object with data, the same request object with the same key and data is passed to the next middleware**
- ▶ **Let's create the following middleware**
 - **Check if we have an Authorization header**
 - **if so create a req.user with the data that was passed in that header**
 - **Otherwise pass a status 401 with an unauthorized message**

Express pattern - adding to the request

- ▶ **Let's examine popular common community middlewares that use this pattern to help us solve problems**

Express pattern - adding to the request

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Express pattern - request body - EX

- ▶ **Some requests like post and put are sent with data from the user in the request body**
- ▶ **That data can be sent in different format : form-data, json, etc.**
- ▶ **We would like to grab the data sent in our express middleware functions**
- ▶ **body-parser is a middleware that will populate req.body with the data the user sent in the body of the request**
- ▶ **That data needs to be validated**
- ▶ **EX: add this middleware to parse json data sent in the request body**

Express pattern - Strategy pattern

- ▶ In the strategy pattern the different strategies need to implement a certain interface
- ▶ Our middleware can use different strategy to perform a certain action.
- ▶ In express this pattern usually look like this

```
app.use(middlewareCreator({  
  strategy: new SomeCommunityStrategy(...)  
}))
```

```
middlewareCreator.attachStrategy(new SomeStrategy(...));  
app.use(middlewareCreator.initialize())
```

- ▶ Let's examine some middlewares that use this pattern

Express pattern - sessions

- ▶ The session information is usually stored on the server
- ▶ the server sends a cookie to the client with a hashed encrypted session id
- ▶ The client will send his cookies with the encrypted session id
- ▶ the server will decrypt the session id and use it to retrieve the user session data
- ▶ Where we save the session data can vary
 - Memory (dev only)
 - Database
 - Memory database (Redis, Memcached)
 - Cookies

Express pattern - express-session middleware

- ▶ **With express-session we can use sessions in our express app**
- ▶ **The session will be added to the request object**
 - **req.session**
- ▶ **req.session is a regular js object which you can retrieve keys and set key values**
- ▶ **express-session can store the session data in all the common available options we just need to set the appropriate store**
- ▶ **The default store is memory and is not recommended**
- ▶ **EX:**
 - **create 2 pages**
 - **the first one the user enters text in a text input and when he submits the form we save what he typed in the session**
 - **the second page displays that data from the session**

Express pattern - express-session strategy

- ▶ **The express-session middleware uses the strategy pattern to decide how to store the session data**
- ▶ **By default it is stored in the memory**
- ▶ **EX:**
 - **Switch the strategy to store the data in the file system**
 - **The strategy to do that is called session-file-store**
 - **the option to specify a new storing strategy is called store**

Session Security

- ▶ **secure** - set to true, ensure the browser only sends the cookie over https
- ▶ **httpOnly** - ensure the cookie is sent only over http(s) and not via javascript
- ▶ **Set the domain and the path of the cookie**

CSRF

- ▶ **The browser will automatically send cookies when requesting our site**
- ▶ **Malicious site can take advantage of this fact and send a request on behalf of the user from a different site**
- ▶ **If the user has persistent login via a session our server will consider the request as if the user has sent it.**
- ▶ **This vulnerability is easily closed since the malicious site cannot read the content of the cookies which means in our forms we can place a hidden token and send the same token in the cookies**
- ▶ **We will then compare the two and only request from our site will pass this protection**

CSRF - EX

- ▶ **Install CSURF middleware that is used to block this vulnerability**
- ▶ **Create a form and place a hidden `_csrf` field using `req.csrfToken()`**
- ▶ **process the post response from the form and make sure the `csrf` is now required**

Express pattern - Authentication

- ▶ **Dealing with authentication in express is also done via the pattern of adding data to the request object combined with the strategy pattern**
- ▶ **After the user is authenticated we are adding the user property to the request**
 - **req.user**
- ▶ **We attach the strategy of how we want to authenticate where a strategy can be**
 - **username and password**
 - **facebook**
 - **twitter**
 - **etc.**
- ▶ **The middleware we want to use for authentication is called passport**

Express pattern - passport

- ▶ **Passport is an authentication middleware**
- ▶ **You connect an authentication strategy to passport**
- ▶ **That strategy can be something that you write but usually you will use community strategies**
- ▶ **Passport will take care of placing req.user**
- ▶ **Passport will take care of persistent login session (needs to be disabled when not needed)**
- ▶ **To connect passport we need the following**

Express - passport - 1. Strategy

- ▶ **Strategy determines the way we will authenticate the user**
 - **username + password**
 - **JWT**
 - **Facebook**
- ▶ **We attach it via `passport.use(new OurStrategy(...))`**

Express - passport - 2. Verify Callback

- ▶ **The verify callback will get the authentication data and will need to**
 - **find the user that match the authentication data**
 - **if not finding a user return false**
 - **If error we can return an error**
- ▶ **For example for the username password strategy we can do the following**
 - **Look for a user with that username (if not return false)**
 - **found a user then verify that the password match and if so return the user**
- ▶ **The verify callback will get a done method as last argument and will need to call with error as first argument and the user as the second (or false if authentication failed)**

Express - passport - 3. Session?

- ▶ **When adding our authentication we need to decide if we want to persist the user login with a session**
 - **Can you give example where we would like to persist with a session and an example where we wouldn't?**
- ▶ **To persist to session we have to do the following**
 - **Add express-session middleware**
 - **Add passport.session() middleware after passport.initialize()**
 - **implement passport.serializeUser(function(user, done) { ...})**
 - **implement passport.deserializeUser(function(id, done) { ... })**

Express passport - EX

- ▶ **For our first ex. we will use passport to authenticate with credentials**
- ▶ **the user will provide a username and a password and we will need to authenticate him**
- ▶ **We will create an object containing the usernames and password of our users (usually this will reside in the database)**
- ▶ **We will connect the proper strategy for the job which is called passport-local and requires a verify callback**
- ▶ **We will persist the login to the session**
- ▶ **passport-local also required bodyParser installed**

Express passport - Authentication in REST server

- ▶ **For REST server it is common to authenticate using some sort of token authentication**
- ▶ **The user will enter his username and password and upon successful login he will get a token**
- ▶ **The token will have to be attached to any subsequent requests the user makes**
 - **The token is usually attach to the request as a header usually the header is called Authorization**
- ▶ **This authentication does not require sessions**

Express passport - JWT

- ▶ **JWT is a popular token authentication standard**
- ▶ **After user logs in he will receive a JWT token which he needs to pass in the Authorization header**
 - **Authorization: Bearer <token>**
- ▶ **The token is encrypted using a secret, only the one that holds the secret can decrypt the token (the server holds the secret)**
- ▶ **The token contains data that can only be viewed by the one who holds the secret**
- ▶ **Although it is protected we do not store sensitive information in the token data**
- ▶ **We can store information in the token like the user primary key that we can use to grab the user from the database**
- ▶ **Let's examine the JWT structure: jwt.io**

Express passport - JWT - EX

- ▶ **Let's create a login page that will issue a token on success login**
- ▶ **the user can grab that token and send a request to a restricted route**
- ▶ **We will use Passport for authentication**
- ▶ **We will use passport-jwt strategy**
- ▶ **For the login page you can use the username and password strategy we used before (this time we do not require to use sessions)**
- ▶ **to create the token we will use the package node-jsonwebtoken**
- ▶ **We will add the user id in the payload of the token**

Express - Authorization

- ▶ **The popular way to deal with authorization is by using the roles system**
- ▶ **A role is identified by a string name**
- ▶ **A resource is identified by a route with access to data (data is usually matching our database tables)**
- ▶ **Every resource has a set of actions that we can perform on the data**
 - **read, write, delete, update...**
- ▶ **Each role can perform certain actions on resources**
- ▶ **The roles are usually arranged by parent child hierarchy. for example**
 - **Admin - can do everything**
 - **User - can read all users and update only my user**
 - **Guest - can only login**

Express - Authorization Roles - EX

- ▶ **From the previous ex, add a role to every user**
- ▶ **create a single user with admin role**
- ▶ **only the admin can view all the users**
- ▶ **all the other users will receive a 403 error**

Express - Authorization - ACL Authorization in database

- ▶ **When the authorization get's a bit more complex we will need to save the roles in the database**
- ▶ **acl is a package that can connect to different databases and help us persist the roles in the database.**
- ▶ **It will also help us manage the roles**
- ▶ **create new roles**
- ▶ **create parent child roles**

Express pattern- Router

- ▶ You can use Router to split your server application to chunks
- ▶ each chunk you can use `router.[METHOD]` to attach a middleware
- ▶ Routers help us split our application to different files
- ▶ You connect the Router to the main app with `app.use(router)`
- ▶ It helps to look at the urls of your app to get inspired how to split your app to routers
- ▶ For example if you are creating a REST server with the following api's
 - `/user`
 - `/user/:id`
 - `/task`
 - `/task/:id`
- ▶ If those are your urls then consider having 2 Routers one for user and one for task

Express pattern- Router - EX

- ▶ **Create a new file user.js that will contain a user router**
- ▶ **The user router will define a route to grab list of users and define a route to grab a single user**
- ▶ **Connect that router to the main express app**

Express app configuration

- ▶ **Express app configuration determines how our express app will behave**
- ▶ **When creating express app we have default configurations set for us**
- ▶ **We can change the configuration using:**
 - **`app.set(key, value)`**
- ▶ **We can get the value of a configuration:**
 - **`app.get(key)`**
- ▶ **Few configuration options we will examine**
 - **views - the directory of the application views**
 - **view engine - the view engine to use to render the views**

Express Views - Template engine

- ▶ We create the views using template engine
- ▶ Template engine convert a text syntax + data to html
- ▶ The text syntax will vary between each template engine
- ▶ Think about the middleware as our controller and the template engine as our view so our server application turns into a model view controller architecture
- ▶ express supports all the popular template engines
- ▶ We recommend using
 - 1. Pug
 - 2. Mustache
- ▶ In this lesson we will integrate Mustache with express which is html based and easier to learn
- ▶ Pug has more built in features but is not html based and has a bit harder learning curve

Express Views - configuration views - EX

- ▶ the views configuration need to be set to the directory where you view files will reside
- ▶ the template files will end with **mst** extension
- ▶ **EX:**
 - create a folder called views where our template files will reside
 - point the views configuration to that file.

Express Views - set the view engine

- ▶ you connect a template engine using `app.engine(ext, theEngine)`
- ▶ you set the default engine to use using `app.set('view engine', ext)`
 - this will be used when the extension is omitted or different then what is specified
- ▶ Install **mustache-express** and set it as the template engine

Express Views - Your first template - EX

- ▶ **Create your first template index.mst with an hello message**
- ▶ **Try to pass data between the middleware and the template**

Express pattern - Error handling

- ▶ **Express already has an error handler that will catch error on sync code**
- ▶ **On async code we need to transfer the error to the next handler**
- ▶ **By default express will not catch errors in the async code**
- ▶ **you can place error handler by attaching app.use with a function that contains 4 arguments, the first one is the error and the rest is re, res, next**

Express Generator - arranging the files

- ▶ The express generator helps you bootstrap an express project
- ▶ It will arrange the files in one of the recommended ways to arrange your project files
- ▶ It can connect a template engine
- ▶ the package **express-generator** is usually installed globally
- ▶ Let's try and install this package and bootstrap a new application

Summary

- ▶ **In this lesson we covered the patterns we use on an express application**
- ▶ **We took those patterns and solve common server problems like**
 - **Session**
 - **request body**
 - **Authentication**
 - **Authorization**
- ▶ **We also saw how we create view and attach a view engine to our app.**