# guide # react

# Authentication with NextAuth (Auth.js)

**TCSS 460 — Client/Server Programming**

In Check-Off 5 you stood on the **back-end** side of the OAuth2 line: `requireAuth` accepted an `Authorization: Bearer <token>` header, verified it against Auth²'s JWKS, and either let the request through or returned 401/403. Someone, somewhere, had to actually *acquire* that token — pop a sign-in window, redirect to the IdP, exchange a code for an access token, hold the session, and stick the bearer on every outbound `fetch`. That "someone" is the front end. This guide is the front-end counterpart to JWT verification: how a Next.js consumer app uses **NextAuth (Auth.js v5)** to sign users in against auth-squared, hold the session, and call your partner team's protected backend.

The lecture demo for this guide is `TCSS460-frontend-2` — a Next.js 15 + Auth.js v5 + MUI v7 app that signs in against the deployed auth-squared instance and consumes `backend-3`'s `/v2/messages` API. Every code excerpt below is either lifted from FE-2 or trivially adapted from it; clone the repo and read alongside this guide.

**Lecture demo repo**

TCSS460-frontend-2 on GitHub — Next.js 15 + Auth.js v5 + MUI v7. Clone it and read alongside this guide; inline links throughout point at specific files (`src/lib/auth.ts`, `src/middleware.ts`, `src/lib/api.ts`, etc.).

**Naming: NextAuth.js → Auth.js**

NextAuth.js v5 was renamed **Auth.js**. The npm package is still `next-auth` (it is the Next.js adapter for the broader Auth.js project), but the official docs site is now authjs.dev and the API surface is meaningfully different from v4. Throughout this guide we say "NextAuth" because that is what you will see in the lecture, the install line, and the import paths — but every reference link points at the v5 (Auth.js) docs. **Do not follow v4 tutorials**; the v5 API is a redesign, not a patch.

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## 1 Why NextAuth?

The Week 5 Authentication Concepts reading walked through every moving part of OAuth2 / OIDC: the **authorize** endpoint that hosts the sign-in page, the **token** endpoint that exchanges an authorization code for an access token, the **JWKS** endpoint that publishes the public keys used to verify those tokens, **refresh tokens** that let you stay signed in past the access token's 1-hour expiry, and the **`aud` claim** that pins a token to a specific resource server. Implementing all of that by hand in your front end would be a weekend of work — and most of the bugs would be subtle security holes, not obvious crashes.

NextAuth is the canonical Next.js library for handling that whole dance. You configure it once, and you get:

- A redirect-based OAuth2 flow (browser → your app → IdP → back to your app) implemented correctly, including the PKCE and state-parameter checks that prevent CSRF and code-injection attacks
- An encrypted session cookie keyed to your `NEXTAUTH_SECRET` (so the user stays signed in across page reloads)
- A unified `auth()` helper you can call from any server context — server components, route handlers, server actions, middleware
- A `useSession()` React hook for client components
- A token-refresh hook ( `jwt` callback) where you write the refresh logic once and the rest of the app benefits

What it does *not* do for you: it does not configure auth-squared as a provider (that's §3), it does not decide which routes are protected (that's §8), and it does not attach the bearer token to your outbound fetches (that's §9). You wire those three pieces; NextAuth handles everything in between.

> **Reference**
>
> The back-end counterpart to this guide is JWT Verification with Auth² — the same pieces (issuer, audience, JWKS) appear in both, but viewed from opposite sides of the wire. If you have built `requireAuth` you already understand half of this guide.

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## 2 Installing NextAuth (v5)

NextAuth v5 (Auth.js) is, as of 2026, still distributed under the `@beta` tag while the team finishes the stable release. That sounds scary; in practice the v5 API has been frozen for over a year and is what every new Next.js auth tutorial teaches. The `@beta` tag is a release-engineering technicality.

```
npm install next-auth@beta
```

The library wants four files. You will create them in §3–§7; the inventory is here as a forward map.

| File | Purpose | Lives at |
|---|---|---|
| `auth.ts` | Provider configuration, callbacks, exported helpers | Project root (next to `app/`) |
| `app/api/auth/[...nextauth]/route.ts` | Route handler that hosts NextAuth's HTTP endpoints (`/api/auth/signin`, `/api/auth/callback/...`, etc.) | App Router |
| `middleware.ts` | Edge-runtime gate for entire URL prefixes | Project root (next to `app/`) |
| `app/layout.tsx` (edit) | Wrap the React tree in `<SessionProvider>` so client components can call `useSession()` | App Router |

> ⚠ **Next.js 16 renames `middleware.ts` to `proxy.ts`**
>
> Next.js 16 (October 2025) renames the middleware file to `proxy.ts` and changes the export name from `middleware` to `proxy`. Auth.js v5 supports both. This guide uses the `middleware.ts` name because it remains the most common convention in 2026 and matches every existing tutorial. If your project is on Next.js 16 specifically, swap `middleware.ts` for `proxy.ts` and `as middleware` for `as proxy` in §8 — nothing else changes.

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## 3 Configuring auth-squared as an OAuth2 Provider

NextAuth ships with built-in providers for GitHub, Google, Apple, Microsoft, and a few dozen others — but auth-squared is a **custom OIDC provider**, so you write the provider object yourself. The good news: because auth-squared is OIDC-compliant (it publishes a `/.well-known/openid-configuration` document — see Week 5 reading §7), you only need to give NextAuth the **issuer URL** and your **client credentials**. NextAuth will auto-discover the authorize, token, userinfo, and JWKS endpoints from the discovery document.

## 3.1 The discovery shortcut

Open https://tcss-460-iam.onrender.com/.well-known/openid-configuration in a browser. You will see a JSON document with `authorization_endpoint`, `token_endpoint`, `userinfo_endpoint`, and `jwks_uri` fields. NextAuth fetches this document on first sign-in and caches each endpoint — so you write the issuer once and never touch the others.

## 3.2 Where the credentials come from

Each group has a **pre-issued consumer client** in the `tcss460-sp26` tenant. The client has a `client_id` (public, identifies your app to auth-squared) and a `client_secret` (confidential, proves your app is who it says it is when exchanging the authorization code for tokens).

Students do **not** have access to the auth-squared admin portal. Charles distributes the `client_id` and `client_secret` to each group out-of-band when you begin your Sprint 7+ consumer app. If you lose the secret, ask for a rotation — do not commit it, and never paste it in a chat that other groups can see.

For the lecture demo, FE-2 uses the shared `tcss460-dev-shared` client and the `backend-3-messages` audience — see `.env.example`. Credentials for the shared client are posted in the course Canvas page.

## 3.3 Why `audience` matters

By default an OAuth2 token is bound to *the IdP*. To bind it to a specific **resource server** (your partner team's backend) you pass the `audience` parameter on the authorize request. auth-squared puts that value in the token's `aud` claim, and your partner's `requireAuth` rejects any token whose `aud` does not match.

This is the same audience you saw in Check-Off 5 Outcome C: a cryptographically valid token *for the wrong audience* gets a 401, not a 200. The whole point is that **your front end has to ask for a token scoped to your partner's API audience.** If you forget the `audience` param, you will get a default-audience token, your partner's backend will reject it, and you will spend an evening confused.

For Sprint 7+ each group's audience is `group-N-api` (replace `N` with your partner team's group number). The lecture demo (FE-2 against `backend-3`) uses `backend-3-messages`. Use whichever matches the backend you are calling.

## 3.4 The provider object

This is the inline provider definition FE-2 uses, lightly annotated. It lives inside the `NextAuth({...})` call in `src/lib/auth.ts` — the full file is in §5.

**The TCSS 460 provider (lifted from FE-2's auth.ts)**

```
{
  id: 'tcss460',                                // becomes
/api/auth/callback/tcss460
  name: 'TCSS 460 Auth',                        // shown on the default sign-
in page
  type: 'oidc',
  issuer: process.env.AUTH_TCSS460_ISSUER,      // https://tcss-460-
iam.onrender.com
  clientId: process.env.AUTH_TCSS460_CLIENT_ID,
  clientSecret: process.env.AUTH_TCSS460_CLIENT_SECRET,
  authorization: {
    params: {
      scope: 'openid profile email',            // OIDC scopes for sub, name,
email
      audience: process.env.AUTH_TCSS460_AUDIENCE, // backend-3-messages —
pins the token's aud claim
    },
  },
  checks: ['pkce', 'state'],                    // PKCE + state — recommended
defaults
  client: {
    token_endpoint_auth_method: 'client_secret_post',
  },
}
```

A few things worth highlighting. The `id` field becomes part of the callback URL — FE-2 registers its provider as `tcss460`, so its redirect URI is `/api/auth/callback/tcss460` *exactly*; that exact path must be whitelisted in the auth-squared admin portal. The `audience` is nested under `authorization.params` because the OAuth2 spec only defines it on the authorize request, not as a top-level provider field. And `client.token_endpoint_auth_method: 'client_secret_post'` tells the OAuth client to send the `client_secret` in the request *body* on the code-for-tokens exchange (rather than as Basic auth in the header) — which is what auth-squared accepts.

**Env var prefix**

FE-2 uses the `AUTH_TCSS460_*` prefix on its provider env vars. Auth.js v5's convention is `AUTH_<PROVIDER>_<FIELD>` — pick a prefix that matches your provider `id` and stay consistent across `.env.local` and your hosting environment.

## 4 Environment Variables

Auth.js v5 reads several env vars by convention. Some are required, some are required-only-in-prod, and a few are required-only-for-this-provider. **The v5 names are `AUTH_*`, not `NEXTAUTH_*`** — that change is one of the things v4 tutorials get wrong.

| Variable | Required? | What it does |
|---|---|---|
| `AUTH_SECRET` | **Always** | Signs the session cookie and the JWT inside it. Must be a high-entropy random string. Generate with `openssl rand -base64 32`. |
| `AUTH_URL` | **Production only** | The base URL of *your* app (`https://my-app.vercel.app`). Vercel sets this automatically; on Render and most other hosts you set it manually. Auth.js uses it to build callback URLs. |
| `AUTH_TCSS460_ISSUER` | This provider | The auth-squared issuer (no trailing slash). |
| `AUTH_TCSS460_CLIENT_ID` | This provider | Your group's pre-issued client ID. |
| `AUTH_TCSS460_CLIENT_SECRET` | This provider | Your group's pre-issued client secret. **Never** prefix with `NEXT_PUBLIC_`. |
| `AUTH_TCSS460_AUDIENCE` | This provider | Your partner backend's audience (`group-N-api`, or `backend-3-messages` for the lecture demo). |
| `NEXT_PUBLIC_API_BASE_URL` | This app | The base URL of the partner backend your app talks to (no trailing slash). Public — used by client-side fetches. |

The `.env.local` template, distilled from FE-2's `.env.example`:

.env.local

```
# Required by Auth.js v5
AUTH_SECRET=<run: openssl rand -base64 32>
AUTH_URL=http://localhost:3000               # only needed in prod, but
harmless in dev
```

```
# auth-squared (TCSS 460 IdP) connection
AUTH_TCSS460_ISSUER=https://tcss-460-iam.onrender.com
AUTH_TCSS460_CLIENT_ID=<from your tenant's Clients page in the admin portal>
AUTH_TCSS460_CLIENT_SECRET=<rotated once on the Client Detail page; copy immediately>
AUTH_TCSS460_AUDIENCE=backend-3-messages     # the partner backend you call

# Backend you are consuming (no trailing slash)
NEXT_PUBLIC_API_BASE_URL=http://localhost:3001
```

**Never put `AUTH_TCSS460_CLIENT_SECRET` in a `NEXT_PUBLIC_*` variable**

Anything prefixed `NEXT_PUBLIC_` is **inlined into the JavaScript bundle that ships to every browser**. A leaked client secret means anyone can mint tokens as your app. Server-only env vars (no `NEXT_PUBLIC_` prefix) are read in `auth.ts` on the server and never reach the client. The only place the secret lives is your `.env.local` (gitignored) and your hosting provider's environment-variable dashboard.

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## 5 The `auth.ts` Config in Full

This is the file Auth.js orbits around. It exports four things — `handlers`, `auth`, `signIn`, `signOut` — which the rest of your app consumes. FE-2 puts it at `src/lib/auth.ts`; the project root next to `app/` is also a common location.

**src/lib/auth.ts (lifted from FE-2)**

```
import NextAuth from 'next-auth';

export const { handlers, signIn, signOut, auth } = NextAuth({
  providers: [
    {
      id: 'tcss460',
      name: 'TCSS 460 Auth',
      type: 'oidc',
      issuer: process.env.AUTH_TCSS460_ISSUER,
      clientId: process.env.AUTH_TCSS460_CLIENT_ID,
      clientSecret: process.env.AUTH_TCSS460_CLIENT_SECRET,
      authorization: {
        params: {
          scope: 'openid profile email',
          audience: process.env.AUTH_TCSS460_AUDIENCE,
        },
      },
      checks: ['pkce', 'state'],
      client: {
```

```
        token_endpoint_auth_method: 'client_secret_post',
      },
    },
  ],
  callbacks: {
    // Runs on every request that touches the session. Receives `account` only
on
    // the very first sign-in callback (the redirect from auth-squared back to
us).
    async jwt({ token, account }) {
      if (account) {
        // Initial sign-in: stash both tokens + the access token's expiry on
the
        // server-side JWT so subsequent requests can read them.
        token.accessToken = account.access_token;
        token.idToken = account.id_token;
        token.accessTokenExpires = account.expires_at ? account.expires_at *
1000 : undefined;
      }
      return token;
    },

    // Runs whenever a server or client component asks for the session.
    // Anything you put on `session` here is visible to the rest of the app.
    async session({ session, token }) {
      session.accessToken = token.accessToken;
      session.idToken = token.idToken;
      session.accessTokenExpires = token.accessTokenExpires;
      if (session.user && token.sub) {
        session.user.id = token.sub;
      }
      return session;
    },
  },
  session: { strategy: 'jwt' },
});
```

The session/token type augmentation lives in a separate file so TypeScript can pick it up across the project. This is FE-2's `src/types/next-auth.d.ts`:

**src/types/next-auth.d.ts**

```
import 'next-auth';
import 'next-auth/jwt';

declare module 'next-auth' {
  interface Session {
    accessToken?: string;
    idToken?: string;
    accessTokenExpires?: number;
    user?: {
      id?: string;
      name?: string | null;
      email?: string | null;
      image?: string | null;
    };
```

```
    }
  }

  declare module 'next-auth/jwt' {
    interface JWT {
      accessToken?: string;
      idToken?: string;
      accessTokenExpires?: number;
    }
  }
```

A few things to internalize:

- **`session: { strategy: 'jwt' }`** — this is the v5 default but worth pinning explicitly. The "JWT" here is *Auth.js's own* session JWT (signed with `AUTH_SECRET`, stored in an httpOnly cookie). It is not the auth-squared access token; it is the envelope that *carries* the access token across requests.
- **Two callbacks, two purposes.** `jwt` decides what data lives on the server-side session token. `session` decides what data is exposed to the client when something calls `auth()` or `useSession()`. By default `session` does not include `accessToken` — you have to forward it explicitly, as shown.
- **`session.user.id` is the `id_token`'s `sub` claim**, copied from `token.sub`. FE-2's `auth.ts` notes a footgun here: this is **not** necessarily the same as the access token's `sub` claim, and `backend-3` keys local user rows off the access token's sub. For "is this resource mine?" checks against the backend, decode `session.accessToken` directly rather than trusting `session.user.id`.
- **The `declare module` blocks** are TypeScript module augmentation. They extend Auth.js's built-in `Session` and `JWT` interfaces with the fields *we* added. Without them, `session.accessToken` would be a type error.

> **FE-2 doesn't implement token refresh**
>
> The `jwt` callback above stops at "stash the tokens on initial sign-in." When the access token expires (one hour after sign-in), FE-2 lets it expire silently and the user re-signs in. The canonical refresh-token rotation pattern lives in §10 — read it once even though FE-2 skips it, because Sprint 7+ apps that want a longer session lifetime need it.

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## 6 The Route Handler and Session Provider

Two more files and you have a working sign-in flow.

`app/api/auth/[...nextauth]/route.ts` — this is the catch-all route that hosts `/api/auth/signin`, `/api/auth/callback/tcss460`, `/api/auth/signout`, `/api/auth/session`, and friends. In v5 it is a two-liner. FE-2: `src/app/api/auth/[...nextauth]/route.ts`.

**src/app/api/auth/[...nextauth]/route.ts**

```
import { handlers } from '@/lib/auth';

export const { GET, POST } = handlers;
```

**Layout + Providers** — wrap the React tree in `<SessionProvider>` so client components can call `useSession()`. The provider is `'use client'`, so you can't drop it directly into a server-rendered `app/layout.tsx`; FE-2's pattern is to extract a small client wrapper and import that.

**src/components/Providers.tsx (FE-2)**

```
'use client';

import { SessionProvider } from 'next-auth/react';
import type { ReactNode } from 'react';

export default function Providers({ children }: { children: ReactNode }) {
  return <SessionProvider>{children}</SessionProvider>;
}
```

**src/app/layout.tsx**

```
import type { ReactNode } from 'react';

import Providers from '@/components/Providers';

export default function RootLayout({ children }: { children: ReactNode }) {
  return (
    <html lang="en">
      <body>
        <Providers>{children}</Providers>
      </body>
    </html>
  );
}
```

You do *not* need to pass the session as a prop to `<SessionProvider>` — v5 fetches it on demand from the `/api/auth/session` endpoint that the route handler above exposes.

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## 7 Sign-In, Sign-Out, and the Redirect Dance

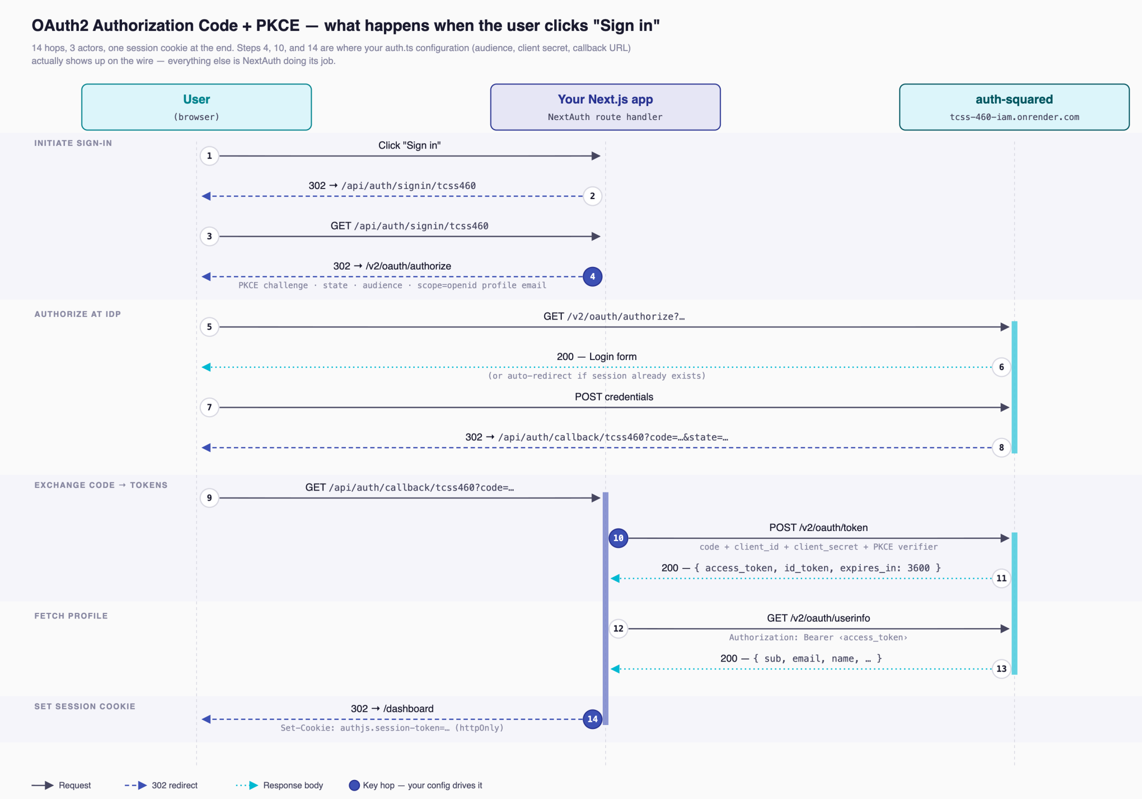
A minimum viable sign-in / sign-out pair, distilled from FE-2's `SignInButton` and `SignOutButton` (MUI styling stripped here so you can see the auth bits):

**components/AuthButtons.tsx**

```tsx
'use client';

import { signIn, signOut, useSession } from 'next-auth/react';

export function SignInButton({ callbackUrl = '/dashboard' }: { callbackUrl?:
string }) {
  return (
    <button onClick={() => signIn('tcss460', { callbackUrl })}>
      Sign in
    </button>
  );
}

export function SignOutButton() {
  return <button onClick={() => signOut({ callbackUrl: '/' })}>Sign
out</button>;
}

export function UserBadge() {
  const { data: session, status } = useSession();
  if (status === 'loading') return <span>...</span>;
  if (status === 'unauthenticated') return <SignInButton />;
  return (
    <span>
      Signed in as {session?.user?.email} <SignOutButton />
    </span>
  );
}
```

Note that `signIn('tcss460')` matches the `id: 'tcss460'` from §3.4. If you change the provider id, you change every `signIn` call. The second argument is an options object; both `callbackUrl` (the page Auth.js redirects to *after* a successful sign-in) and the older `redirectTo` work in v5, but FE-2 uses `callbackUrl` for consistency with the underlying `/api/auth/signin?callbackUrl=...` query param.

What actually happens when the user clicks "Sign in"? The OAuth2 redirect dance — eight hops, one cookie at the end:




NextAuth handles every step in this diagram for you. The pieces *you* configured — `clientId`, `clientSecret`, `audience`, `scope`, `issuer` — feed into the highlighted hops (steps 4 and 9). Everything else is the library doing its job.

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# 8 Reading the Session and Protecting Routes

NextAuth gives you three ways to check "is this user signed in?", each appropriate to a different rendering context.

## 8.1 Server components and route handlers — `await auth()`

In a server component you can `await auth()` directly. No props, no context, no hook. The function reads the session cookie from the incoming request, verifies it against `AUTH_SECRET`, and returns the session object (or `null` if unauthenticated).

FE-2's [`/profile` page](#) is the canonical example:

**src/app/profile/page.tsx**

```
import { redirect } from 'next/navigation';
import { auth } from '@/lib/auth';

export default async function ProfilePage() {
  const session = await auth();
  if (!session) {
    redirect('/api/auth/signin?callbackUrl=/profile');
  }
  return <h1>Hello {session.user?.email}</h1>;
}
```

This is the right pattern for one-off protected pages — the session check runs on the server, the unauthenticated user is redirected before any HTML reaches their browser, and the protected content is never sent over the wire to anonymous callers. The redirect's `callbackUrl` query param is what bounces the user back here after sign-in.

## 8.2 Middleware — gate URL prefixes

If you have many protected pages, repeating the `auth()` check in every page file is tedious. `middleware.ts` lets you gate URLs once at the edge. FE-2 uses this for everything in its `(dashboard)` route group: see `src/middleware.ts`.

**src/middleware.ts (FE-2)**

```
import { NextResponse } from 'next/server';
import { auth } from '@/lib/auth';

export default auth((request) => {
  if (!request.auth) {
    const signInUrl = new URL('/api/auth/signin', request.url);
    signInUrl.searchParams.set('callbackUrl', request.nextUrl.pathname);
    return NextResponse.redirect(signInUrl);
  }
  return NextResponse.next();
});

export const config = {
  matcher: ['/dashboard', '/messages/view', '/messages/send', '/debug'],
};
```

A few things to notice. `auth()` here is a **wrapper**: passed a request handler, it returns a function that populates `request.auth` from the session cookie before calling your handler. Wrapping it lets you decide *what to do* on missing auth — FE-2 redirects to `/api/auth/signin` with a `callbackUrl` query param so the user lands back where they were trying to go.

The matcher is an **explicit URL list, not a prefix wildcard**. FE-2's protected pages live inside the `(dashboard)` route group — but route groups are a routing-only convention; the parenthesized segment never appears in the URL. So we can't match `/(dashboard)/:path*`;

we have to enumerate the actual URLs ( `/dashboard` , `/messages/view` , `/messages/send` , `/debug` ). Add a new dashboard page → add it to the matcher.

Pages inside the matcher's reach can render naively: they have no `await auth()` calls, no `useSession` checks, no inline sign-in CTA, because by the time they render the user is known to be signed in. Compare this with the per-page pattern in §8.1 — same outcome, different gate location.

## 8.3 Client components — `useSession()`

For UI that depends on session state (showing the user's name, hiding admin buttons, displaying a loading spinner), use the `useSession()` hook from `next-auth/react` .

**app/components/Greeting.tsx**

```
"use client";
import { useSession } from "next-auth/react";

export function Greeting() {
  const { data: session, status } = useSession();
  if (status === "loading") return <span>Loading…</span>;
  if (status === "unauthenticated") return <span>Please sign in</span>;
  return <span>Hello {session?.user?.email}</span>;
}
```

`status` cycles `"loading" → "authenticated" | "unauthenticated"` . **Always handle the loading state** — if you only check `status === "authenticated"` , your page flashes "Please sign in" for a few hundred milliseconds on every reload before the session resolves. Users notice. (See §13.)

## 8.4 Decision rubric

| Where | Use | Why |
|---|---|---|
| Server component (page or layout) | `await auth()` + `redirect()` | Runs server-side, never ships protected HTML to anonymous users |
| Many pages under one prefix | `middleware.ts` matcher | One gate covers a whole subtree, edge-runtime fast |
| Client component (interactive UI) | `useSession()` hook | Reactive — re-renders on sign-in/sign-out without a full page reload |

| Where | Use | Why |
|---|---|---|
| Route handler (`app/api/.../route.ts`) | `await auth()` | Same as server component — works inside any HTTP handler |

You will use **all three** in a real Next.js app. They are not alternatives; they are tools for different jobs.

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## 9 Calling the Partner Backend with the Access Token

This is the whole point. Your partner team's backend has `requireAuth` on its protected routes, expecting an `Authorization: Bearer <access_token>` header with a token whose `aud` claim matches their API audience. You configured `AUTH_TCSS460_AUDIENCE` for that exact value (§4), so the token Auth.js holds in `session.accessToken` is already the right one. You just need to attach it to the outbound `fetch`.

> **Reference**
>
> The mechanics of `fetch`, parsing JSON responses, error handling, and the `NEXT_PUBLIC_API_BASE_URL` convention are covered in Consuming a Web API from the Browser. This section adds *only* the bearer-token overlay — the surrounding fetch shape is identical.

FE-2 wraps the bearer attachment in two helpers in `src/lib/api.ts` — `apiGet` for public reads and `apiAuthed` for anything that needs a token. Read those once before you write your own.

### 9.1 A reusable `apiAuthed` helper (FE-2's pattern)

The interesting trick here: `apiAuthed` is called from **client components** (a form's submit handler, a button's `onClick`), so it can't read `process.env.AUTH_SECRET` to verify the cookie itself. Instead, it asks Auth.js's React client for the session — which performs an internal fetch to `/api/auth/session`, returning the `accessToken` you forwarded in the `session` callback (§5).

**src/lib/api.ts (FE-2 — abridged)**

```
import { getSession } from 'next-auth/react';

const API_BASE = process.env.NEXT_PUBLIC_API_BASE_URL ??
'http://localhost:3001';

export class ApiError extends Error {
  constructor(public status: number, public statusText: string, public body:
string) {
    super(`${status} ${statusText}: ${body}`);
    this.name = 'ApiError';
  }
}

export async function apiAuthed<T = unknown>(
  method: 'POST' | 'PUT' | 'PATCH' | 'DELETE',
  path: string,
  body?: unknown,
  options?: { signal?: AbortSignal }
): Promise<T> {
  const session = await getSession();
  if (!session?.accessToken) throw new Error('Not signed in');

  const response = await fetch(`${API_BASE}${path}`, {
    method,
    headers: {
      'Content-Type': 'application/json',
      Authorization: `Bearer ${session.accessToken}`,
    },
    body: body ? JSON.stringify(body) : undefined,
    signal: options?.signal,
  });

  if (!response.ok) {
    throw new ApiError(response.status, response.statusText, await
response.text());
  }
  if (response.status === 204) return undefined as T;
  return response.json() as Promise<T>;
}
```

Now any client component can call the protected backend with one line:

```
import { apiAuthed } from '@/lib/api';

await apiAuthed('POST', '/v2/messages', { content, priority: 1 });
```

Use it from a form (FE-2's `MessageSendForm` is the canonical example).

## 9.2 Pattern A — server component

When the protected request is needed to render the page — i.e. on a page-load read, not a user click — you can fetch on the server instead and skip the round-trip through

`/api/auth/session`:

**app/dashboard/page.tsx (server component)**

```
import { redirect } from 'next/navigation';
import { auth } from '@/lib/auth';

interface Message { id: number; content: string; }

export default async function DashboardPage() {
  const session = await auth();
  if (!session?.accessToken) redirect('/api/auth/signin?
callbackUrl=/dashboard');

  const response = await
fetch(`${process.env.NEXT_PUBLIC_API_BASE_URL}/v2/messages`, {
    headers: { Authorization: `Bearer ${session.accessToken}` },
    cache: 'no-store', // session-bound data should not be statically cached
  });

  if (response.status === 401) redirect('/api/auth/signin?
callbackUrl=/dashboard');
  if (!response.ok) throw new Error(`Backend failed: ${response.status}`);

  const { data: messages }: { data: Message[] } = await response.json();
  return <ul>{messages.map((m) => <li key={m.id}>{m.content}</li>)}</ul>;
}
```

Why server-fetch when you can: the access token never reaches the browser, the fetch executes server-to-server (no CORS), and the response body is rendered into HTML. A malicious extension running in the user's browser cannot steal the token from a server component.

## 9.3 Pattern B — client component

For interactive writes (a button click, a form submit) you have no choice — the action originates in the browser. FE-2's `apiAuthed` from §9.1 is the canonical wrapper. Inline, the shape looks like this:

**components/CloseIssueButton.tsx**

```
'use client';

import { useSession } from 'next-auth/react';

export function CloseIssueButton({ id }: { id: number }) {
  const { data: session } = useSession();

  async function close() {
    if (!session?.accessToken) return;
    const response = await fetch(
```

```
        `${process.env.NEXT_PUBLIC_API_BASE_URL}/issues/${id}/close`,
        {
          method: 'POST',
          headers: { Authorization: `Bearer ${session.accessToken}` },
        },
      );
      if (!response.ok) alert(`Failed: ${response.status}`);
    }

    return <button onClick={close}>Close</button>;
  }
```

Note the `NEXT_PUBLIC_` prefix on the API URL — client-side fetches need a value the browser can read. The token still flows through the user's browser (it lives in their session cookie); the *API URL* needed to be inlined in the bundle. The token itself is *not* in the bundle — `useSession()` (and `getSession()`, used by `apiAuthed`) fetches it at runtime from `/api/auth/session`.

### 9.4 Which pattern when

For protected reads on page load, prefer the server-component pattern (§9.2): the token stays on your server and the response renders into HTML for free. For anything triggered by a user interaction — a form submit, a button click, an autocomplete keystroke — use the client-component pattern (§9.1 or §9.3); the action originates in the browser, so the fetch has to too. FE-2 demonstrates both: the public `/messages` list uses a client-side `useMessages` hook against the unauthenticated `apiGet`, and the dashboard's `/messages/send` submits via `apiAuthed` from a client component. Pick the one that fits where the work needs to happen.

---

## 10 Token Refresh

**FE-2 deliberately doesn't implement this**

The `jwt` callback in FE-2's `auth.ts` only stashes tokens on initial sign-in — there's no refresh branch. When the access token expires (~1 hour), every authenticated fetch returns 401, and the user is expected to sign out and back in. That's a deliberate teaching simplification, not a recommendation. Read this section once even though FE-2 skips it; if your Sprint 7+ app needs sessions longer than an hour, you'll wire it up here.

auth-squared issues access tokens with `expires_in: 3600` — one hour. After that, your partner's backend will start returning 401 with a "jwt expired" message (Check-Off 5 Outcome

B). Without refresh, the user gets unceremoniously bounced back to sign-in every 60 minutes — which is a terrible experience for anyone using your app for more than an hour.

The fix is **refresh-token rotation**: alongside the access token, auth-squared also issues a longer-lived refresh token. When the access token expires, you POST the refresh token to `/v2/oauth/token` and receive a fresh pair. This logic belongs in the `jwt` callback, which runs on every session lookup — perfect place to detect expiry and rotate.

## 10.1 The canonical pattern

This expands the `jwt` callback from §5. The `account` branch (initial sign-in) now also stashes the `refreshToken`; the post-`account` branch is new. Field names on the token use the same `camelCase` you saw in §5 (`accessToken`, `refreshToken`, `accessTokenExpires`) so a single `next-auth.d.ts` augmentation covers both — add `refreshToken?: string` to the `JWT` interface from §5 if you adopt this.

**src/lib/auth.ts (jwt callback, expanded)**

```
async jwt({ token, account }) {
  if (account) {
    // Initial sign-in
    return {
      ...token,
      accessToken: account.access_token,
      refreshToken: account.refresh_token,
      accessTokenExpires: account.expires_at ? account.expires_at * 1000 :
undefined, // ms since epoch
    };
  }

  // Subsequent calls — check if the access token has expired.
  if (token.accessTokenExpires && Date.now() < token.accessTokenExpires) {
    return token; // still valid
  }

  // Expired — try to refresh.
  if (!token.refreshToken) {
    token.error = 'RefreshTokenError';
    return token;
  }

  try {
    const response = await
fetch(`${process.env.AUTH_TCSS460_ISSUER}/v2/oauth/token`, {
      method: 'POST',
      headers: { 'Content-Type': 'application/x-www-form-urlencoded' },
      body: new URLSearchParams({
        grant_type: 'refresh_token',
        refresh_token: token.refreshToken,
        client_id: process.env.AUTH_TCSS460_CLIENT_ID!,
        client_secret: process.env.AUTH_TCSS460_CLIENT_SECRET!,
```

```
      }),
    });

    const newTokens = await response.json();
    if (!response.ok) throw newTokens;

    return {
      ...token,
      accessToken: newTokens.access_token,
      accessTokenExpires: Date.now() + newTokens.expires_in * 1000,
      // Some IdPs rotate the refresh token, some don't. Keep the new one if
present.
      refreshToken: newTokens.refresh_token ?? token.refreshToken,
      error: undefined,
    };
  } catch (error) {
    console.error('Refresh failed:', error);
    token.error = 'RefreshTokenError';
    return token;
  }
},
```

The wire format (the JSON auth-squared returns from `/v2/oauth/token`) still uses `snake_case` — `access_token`, `refresh_token`, `expires_in` — which is why the assignments above destructure those names from `account` and `newTokens` before storing them as `camelCase` on the token.

## 10.2 Forwarding the error to the client

The `session` callback already forwards `token.error` to `session.error` (§5). Use it on the client to force re-login when refresh fails:

**app/components/SessionWatchdog.tsx**

```
"use client";
import { useSession, signIn } from "next-auth/react";
import { useEffect } from "react";

export function SessionWatchdog() {
  const { data: session } = useSession();
  useEffect(() => {
    if (session?.error === "RefreshTokenError") {
      signIn('tcss460'); // forces a fresh sign-in flow
    }
  }, [session?.error]);
  return null;
}
```

Mount this somewhere persistent (e.g. inside `app/layout.tsx`) and refresh failures are handled automatically.

**Auth.js refresh-token rotation guide**

The pattern above mirrors the Auth.js v5 refresh-token rotation guide. Read it before customising — the docs cover edge cases (race conditions on parallel session lookups, single-use refresh tokens, IdPs that rotate refresh tokens on every use) that the snippet above handles by being conservative.

---

## 11 Roles and Authorization (Beyond Authentication)

**FE-2 doesn't gate UI on roles**

FE-2's pages don't branch on the user's auth-squared role — every signed-in user sees the same dashboard, can post messages, etc. The patterns below are what you'd add when an app legitimately needs role-aware UI. Adapt the type augmentation in your `next-auth.d.ts` to expose `user.role` if you adopt them.

The Week 5 reading insists on the distinction: **authentication** is "who are you?" — handled by Auth.js and auth-squared. **Authorization** is "what can you do?" — handled by your app's gate code, informed by the user's role.

auth-squared puts a `role` claim in the userinfo response. Forward it through the `jwt` and `session` callbacks (§5) so it surfaces as `session.user.role`. Then you can gate rendering on the client:

**components/AdminPanel.tsx**

```
'use client';

import { useSession } from 'next-auth/react';

export function AdminPanel() {
  const { data: session } = useSession();
  if (session?.user?.role !== 'Admin') return null;
  return <button>Delete everything</button>;
}
```

…and you can gate route handlers and server components on the server:

**app/admin/page.tsx**

```
import { redirect } from 'next/navigation';
import { auth } from '@/lib/auth';
```

```
export default async function AdminPage() {
  const session = await auth();
  if (session?.user?.role !== 'Admin') redirect('/');
  return <h1>Admin dashboard</h1>;
}
```

> **The FE hides; the BE enforces**
>
> A client-side `role !== "Admin"` check **only hides the button.** A user who knows the API endpoint can still call it directly with `curl` — and if your partner's backend does not enforce the same role check server-side, your "admin only" feature is open to anyone with a valid token. The `requireRole` middleware students wrote in Check-Off 5 Requirement 5 is the *real* gate; the front-end check is purely UX. Hide the button so users do not get confused, but do not rely on it for security.

The `role` claim arrives as a string from auth-squared's hierarchy: `"User"`, `"Moderator"`, `"Admin"`, `"SuperAdmin"`, `"Owner"`. Note the PascalCase — exact-string comparisons are case-sensitive.

---

## 12 Try It Yourself — Login → Protected Page → Authenticated API Call

Walk through the full flow end-to-end. The fastest path is to clone FE-2 and run it locally — you'll need a backend (the deployed reference instance, or your own running locally on port 3001) and a copy of `.env.local` with credentials filled in.

**Try It Yourself**

1. **Clone** — `git clone https://github.com/UWT-SET-TCSS460-LECTURE-MATERIALS/TCSS460-frontend-2.git && cd TCSS460-frontend-2 && npm install`.
2. **Create `.env.local`** — copy `.env.example` and fill in `AUTH_SECRET`, `AUTH_TCSS460_CLIENT_ID`, `AUTH_TCSS460_CLIENT_SECRET`. Run `openssl rand -base64 32` for the secret. Leave the issuer, audience, and `NEXT_PUBLIC_API_BASE_URL` at their defaults.
3. **The `localhost:3000` callback is already whitelisted** for the shared `tcss460-dev-shared` client — you don't need to do anything. (Production deploys are different; see §13.)
4. **Run `npm run dev`**, open `http://localhost:3000`, click "Sign in", complete the auth-squared login, and confirm the redirect lands you on `/dashboard`.
5. **Open DevTools → Network**, refresh, and watch the redirect chain — you should see every hop from the §7 sequence diagram.
6. **Visit `/messages/view`** — that's a public read against `apiGet`. Then visit `/messages/send` — that's an authenticated POST through `apiAuthed`. Submit a message; confirm it appears in the list.
7. **Verify the bearer** — open the POST request in DevTools and confirm the `Authorization: Bearer ...` header is present. Decode the token at jwt.io and verify the `aud` claim matches `backend-3-messages`.
8. **Check `/debug`** — FE-2 ships a debug panel that decodes both tokens and runs JWKS verification on the access token. Use it to convince yourself the token is the same shape backend-3 verifies.

Once that loop works, swap `AUTH_TCSS460_AUDIENCE` and `NEXT_PUBLIC_API_BASE_URL` to point at your partner team's audience and deployed backend, and the same code drives your Sprint 7+ consumer.

If step 7's `aud` claim is wrong, re-read §3.3 and §13 — that is the Check-Off 5 Outcome C scenario, which means your `AUTH_TCSS460_AUDIENCE` is set to the wrong string for the backend you are calling.

---

# 13 Common Mistakes

The order here is rough frequency-of-occurrence, most common first.

## 13.1 Production redirect URI does not match — byte-exactly

auth-squared's client config stores a list of allowed redirect URIs and rejects any inbound auth code whose redirect does not match one of them, character for character. The default callback path Auth.js uses is `/api/auth/callback/<providerId>` — FE-2's provider id is `tcss460`, so its callback path is `/api/auth/callback/tcss460`. The `localhost:3000` callback is already whitelisted on the shared client, but production callbacks are not.

When you deploy your Sprint 7+ FE to a public URL, **send Charles your full production callback URL** ( `https://your-prod-host.example.com/api/auth/callback/tcss460` — exact, no trailing slash, no missing `s` in `https`, no missing `/tcss460` suffix). Charles adds it to your client's allowed redirect URIs in the admin portal. Do this *before* you deploy, not after — sign-in will fail with a redirect error from auth-squared until the URL is whitelisted. **Charles personally hit this on the auth-sq deploy.**

### 13.2 Wrong `audience` — the partner backend returns 401

You configured `AUTH_TCSS460_AUDIENCE` to a string that does not match what your partner backend's `requireAuth` expects. The token is cryptographically valid, Auth.js sees it as a successful sign-in, but every `fetch` to the partner returns 401. This is exactly Check-Off 5 Outcome C — verify by decoding `session.accessToken` at jwt.io and reading the `aud` claim.

### 13.3 `AUTH_TCSS460_CLIENT_SECRET` accidentally in a `NEXT_PUBLIC_*` variable

This is a security disaster — the secret ships in the JS bundle and is harvestable by anyone who views your site. Audit your `.env.local`: the only `NEXT_PUBLIC_*` vars should be public-by-design things like `NEXT_PUBLIC_API_BASE_URL`. Never `NEXT_PUBLIC_AUTH_*`.

### 13.4 `useSession()` outside `<SessionProvider>` returns loading forever

`useSession()` outside `<SessionProvider>` returns `{ data: undefined, status: 'loading' }` forever. The hook reads from React context, and if there is no provider in the tree, the context is empty. The fix is always the same: ensure your root layout renders the `Providers` wrapper from §6 around `{children}`.

### 13.5 Mixing `useSession()` (client) with `auth()` (server) in the same component

`useSession()` only works in components marked `'use client'`; `auth()` only works in server components and route handlers. Pick one based on whether the component is

interactive. If a server component needs to pass the session to a client child, fetch it server-side and pass it as a prop.

## 13.6 Not handling the `'loading'` state

`useSession()` starts as `{ status: 'loading' }`, then resolves. If your gate is `if (status === 'unauthenticated') return <SignInButton />`, the page flashes the sign-in button on every reload before settling. Always handle `'loading'` explicitly (return a spinner, return `null`, anything that is not "wrong").

## 13.7 Trying to read `session.accessToken` before exposing it via the `session` callback

By default, Auth.js does **not** put the access token on the session — the OAuth provider's tokens stay server-side, on the JWT, and never reach `session`. You have to forward them explicitly in the `session` callback (§5). If `session.accessToken` is `undefined` and you swear you are signed in, this is why.

## 13.8 Forgetting `AUTH_SECRET` in production

In dev, Auth.js helpfully picks a random secret on each restart. In prod (or with `NODE_ENV=production`) it refuses to start without one. The error message is reasonably clear — but the *silent* version of this failure is when you set the secret to an empty string by mistake. Double-check.

## 13.9 Letting the access token expire and not implementing refresh

Without §10's refresh logic — which FE-2 deliberately skips — every 60 minutes the user's session token contains an expired access token and every fetch to the partner backend returns 401. The fix is to implement the refresh dance; the workaround is to require the user to sign out and back in.

## 13.10 `AUTH_URL` mismatch in production

On Vercel this is auto-set; everywhere else (Render, Railway, fly.io) you set it manually. If it does not match the URL the browser is actually visiting, Auth.js builds wrong callback URLs and the redirect from auth-squared lands somewhere unexpected.

### 13.11 Using `NEXTAUTH_*` env-var names instead of `AUTH_*`

v4's vars were `NEXTAUTH_SECRET`, `NEXTAUTH_URL`. v5 renamed them to `AUTH_SECRET`, `AUTH_URL`. Most v4 tutorials still rank highly on Google. Symptoms range from "secret missing" startup errors to silent fall-back behavior. Always check `authjs.dev`, not `next-auth.js.org`.

---

## 14 Summary

| Concept | Key Point |
| --- | --- |
| Auth.js v5 (NextAuth) | Renamed library, npm package still `next-auth@beta`. Use the v5 docs at authjs.dev — v4 docs are wrong. |
| Env vars | `AUTH_SECRET`, `AUTH_URL`, plus provider-specific `AUTH_<PROVIDER>_*` (FE-2: `AUTH_TCSS460_*`). The `NEXTAUTH_*` names are v4. |
| Four pieces | `lib/auth.ts` (config), `app/api/auth/[...nextauth]/route.ts` (handlers), `middleware.ts` (gate), `Providers` wrapper in `app/layout.tsx`. |
| Custom OIDC provider | `type: 'oidc'` + `issuer` auto-discovers endpoints. Pass `audience` under `authorization.params` to scope the token. |
| Two callbacks | `jwt` decides what's on the server-side token; `session` decides what reaches client/server consumers. Forward `accessToken` (and `idToken`, role, etc.) explicitly. |
| Three ways to read | `await auth()` server-side, `useSession()` client-side, `middleware.ts` for URL-list gates. |
| Bearer token | Server-side `await auth()` for page-load reads (token stays on server); `apiAuthed` / `useSession()` for client-side writes. |
| Refresh | 1-hour expiry from auth-squared. FE-2 doesn't implement it; if you need a longer session, the canonical pattern lives in §10. |

| Concept | Key Point |
| --- | --- |
| Roles | `session.user.role` is for hiding UI. The BE's `requireRole` is for actual security. FE-2 doesn't gate on roles. |
| Redirect URI | Must match byte-exactly in the auth-squared client config — for FE-2, `/api/auth/callback/tcss460`. |

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## 15 References

**Use the Auth.js v5 docs, not v4 NextAuth.js**

NextAuth.js v4 docs still rank highly on Google for "next-auth" searches. The API is meaningfully different from v5. **Always check the URL** — `authjs.dev` is v5, `next-auth.js.org` is v4. Every link in this section points at v5.

**Official Auth.js v5 documentation:**

- Auth.js — Installation — the canonical install line and project setup
- Auth.js — Configuring OAuth Providers — custom OIDC provider patterns, `wellKnown` discovery, `audience` and `scope`
- Auth.js — Refresh Token Rotation — the canonical `jwt` callback refresh pattern (basis of §10)
- Auth.js — Next.js Reference — `auth()`, `signIn()`, `signOut()`, `handlers`, middleware
- Auth.js — Migrating to v5 — useful even if you never wrote v4, because it documents *what changed* and helps disambiguate v4 tutorials

**OAuth2 and OIDC standards:**

- RFC 6749 — The OAuth 2.0 Authorization Framework — the original OAuth2 spec; §1.3.1 (authorization code flow) and §6 (refresh tokens) are most relevant
- OpenID Connect Core 1.0 — the OIDC layer on top of OAuth2 (id tokens, userinfo)
- RFC 7636 — Proof Key for Code Exchange (PKCE) — the `checks: ["pkce", "state"]` from §3.4

**Course materials:**

- Week 5 — Authentication & Authorization Concepts — theory behind every choice in this guide
- Week 8 — OAuth2 & Federated Identity — the federated-identity story this guide implements
- JWT Verification with Auth² (back-end guide) — the `requireAuth` counterpart students built in Sprint 3
- Check-Off 5: Auth-Squared — Outcomes A/B/C/D mental model (especially Outcome C for wrong-audience debugging)
- Next.js (front-end guide) — file-based routing, server vs. client components, layouts (prerequisite)
- Consuming a Web API from the Browser — `fetch` mechanics this guide builds on
- TCSS460-frontend-2 — The lecture demo every code excerpt above is drawn from. Next.js 15 + Auth.js v5 + MUI v7. Read the `src/lib/auth.ts`, `src/middleware.ts`, and `src/lib/api.ts` files alongside §5, §8, and §9.

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## 16 Further Reading

**External Resources**

- The OAuth 2.0 Authorization Code Flow with PKCE — Okta Developer — animated walkthrough of the redirect dance from §7
- Auth.js Discussions — JWT refresh edge cases — community-curated answers to refresh-token race conditions and parallel-request issues
- Vercel — Authentication patterns for Next.js — production-deployment guidance for NextAuth on Vercel
- OWASP — OAuth 2.0 Cheat Sheet — security checklist worth scanning before you deploy

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