

INF 354: Advanced Programming



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Make today matter

www.up.ac.za

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular 1

Learning Outcome:

- ❖ Understand, develop, and deploy web applications using the Angular framework and TypeScript.

Learning Objectives:

- ❖ To understand the purpose of using Angular
- ❖ To develop an Angular project



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Make today matter
www.up.ac.za

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Outline

- ❖ Introduction
- ❖ Features of Angular
- ❖ Angular Architecture
- ❖ Data Binding
- ❖ Practical



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

ANGULAR 1

Introduction



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Angular

- Angular is a framework for frontend web development
- With the aid of the Angular framework, you may develop sophisticated HTML web apps.
- It can be used on other frameworks such as Ionic to make native mobile application
- Responsive, user-friendly, scalable
- Developed by Google
- Angular CLI enables you to create things faster

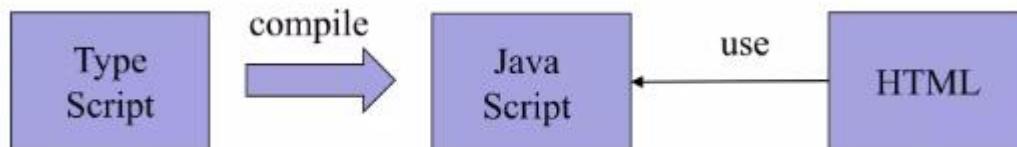


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular

- Angular enhances the UI experience for users
- Angular uses the concept of single page application (SPA)
- Angular code is written in TypeScript language



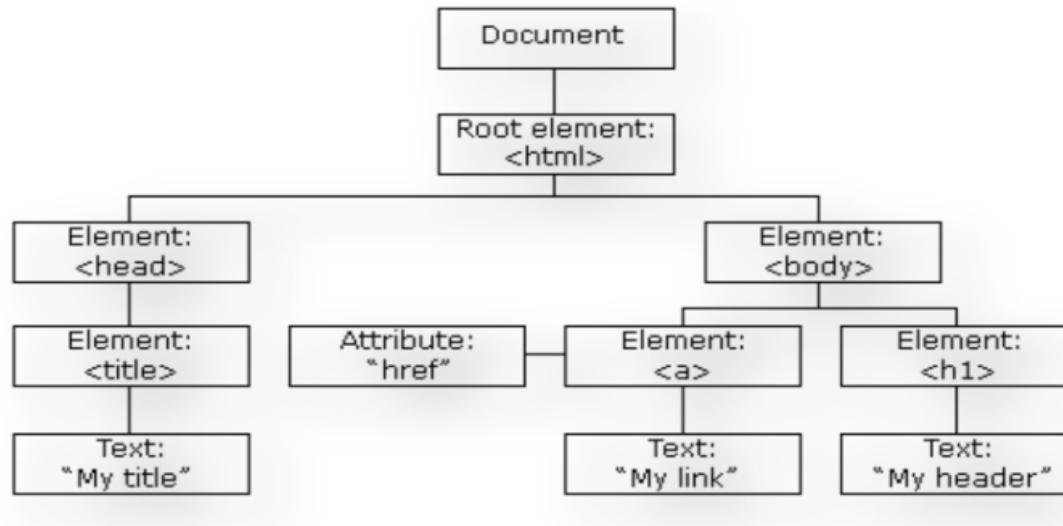
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Features

- An XML or HTML page is treated by the **document object model** (DOM) as a tree structure, with each node denoting a distinct section of the content.



- TypeScript - JavaScript users can write more understandable code by using TypeScript, which specifies a set of types. Any platform can easily support the smooth operation of the TypeScript code thanks to JavaScript compilation.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Features

- The Angular framework provides a robust set of tools and components that allow developers to create scalable, maintainable, and efficient web applications.
- It includes features like
 - two-way data binding,
 - templating,
 - RESTful API handling,
 - modularization,
 - AJAX handling,
 - dependency injection,
 - the use of directives to create reusable components.



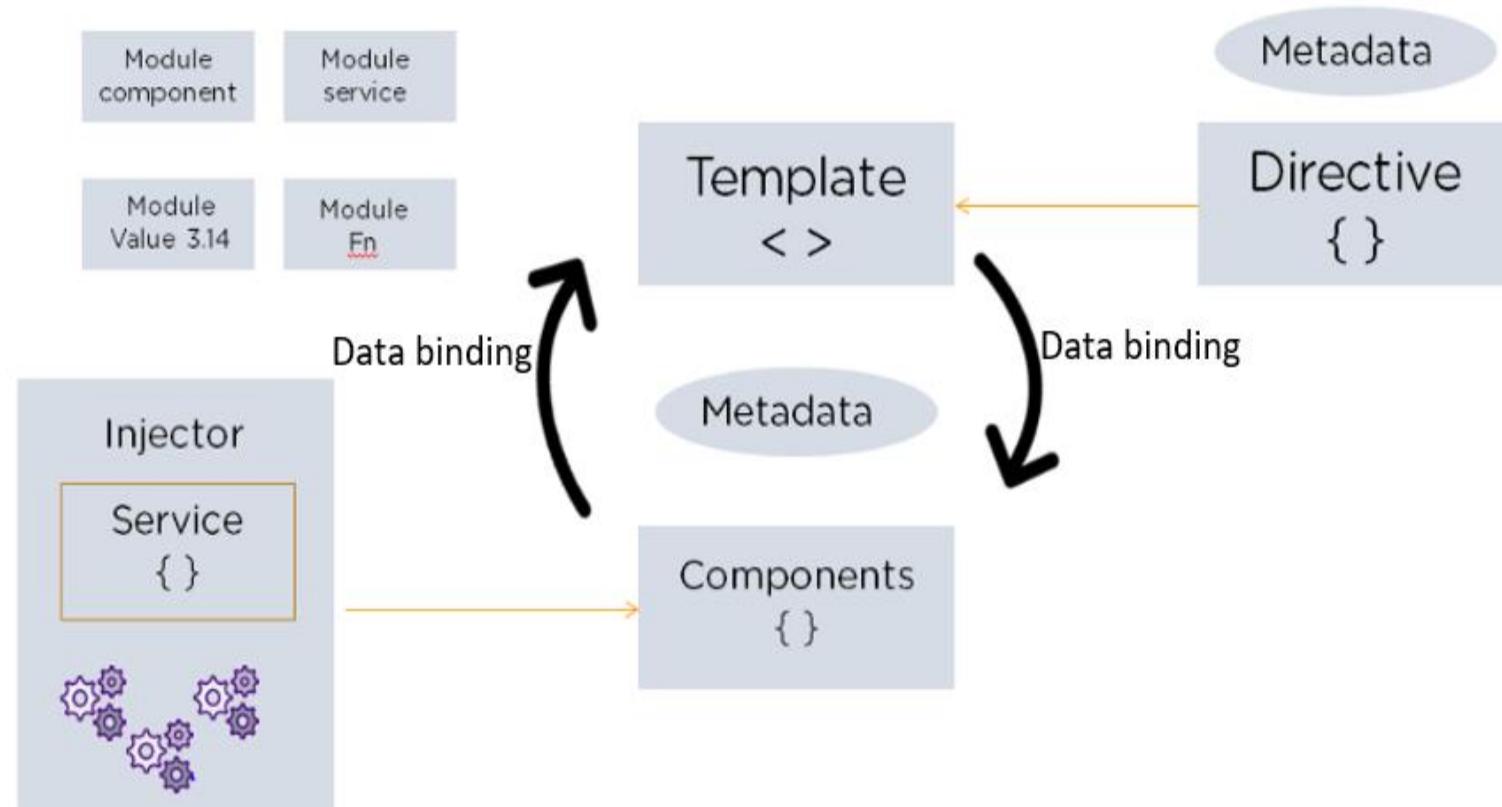
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Architecture

The architecture diagram identifies the eight main building blocks of an Angular application:

1. Module
2. Components
3. Templates
4. Metadata
5. Data binding
6. Directives
7. Services
8. Dependency injection



Architecture

1. Module - A root module called AppModule serves as the application's bootstrap mechanism in an Angular application.
2. Components:

A view is a portion of the screen that is controlled by a component.

The application logic of a component—what it does to assist the view—is specified in a class.

Using a set of attributes and methods on the API, the class communicates with the view.

3. Templates: is a form of HTML that tells Angular how to render the component
The Angular template combines the Angular markup with HTML to modify HTML elements before they are displayed



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Architecture

4. Metadata: Metadata tells Angular how to process a class. It is used to decorate the class to configure the expected behavior of a class.
In Typescript, you attach metadata by using a decorator
5. Data binding: supported by Angular is a method for coordinating parts of a template with parts of a component. It plays an important role in communication between a template and its component
6. Directives are easily distinguished since they begin with the prefix "-ng." Consider their markers on the DOM element that tell Angular to alter the element entirely or to attach a specific behavior to it.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Architecture

7. Services: Any value, feature, or function that your application requires falls under the wide category of service. A service can be almost anything. A service might be a function or value as well as a TypeScript class having a specific, well-defined purpose.
8. Dependency injection: A method for providing a new instance of a class with the dependencies it needs is called dependency injection. Dependencies are typically services. Dependency injection is a technique used by Angular to supply new components with the services they require. By examining the kinds of a component's constructor parameters, Angular may determine which services the component requires.

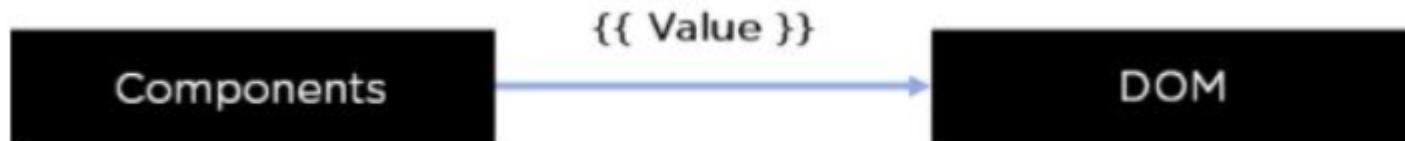


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Data Binding

- Interpolation Binding
 - Interpolation is a procedure that allows the user to bind a value to the user interface element. Interpolation binds the data one way, which means that data moves in one direction from the components to HTML elements. It uses the “{{ }}” syntax for data binding.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Data Binding

- Property Binding
 - Property binding is a one-way data binding mechanism that allows you to set the properties for HTML elements. It uses the "[]" syntax for data binding.
- Event Binding
 - Event binding type is when information flows from the view to the component when an event is triggered. The event could be a mouse click or keypress. It uses the "()" syntax for data binding.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Data Binding

- Two-way Data Binding
 - is a mechanism where data flows from the component to the view and back. This binding ensures that the component and view are always in sync. It uses the “[()]” syntax for data binding.



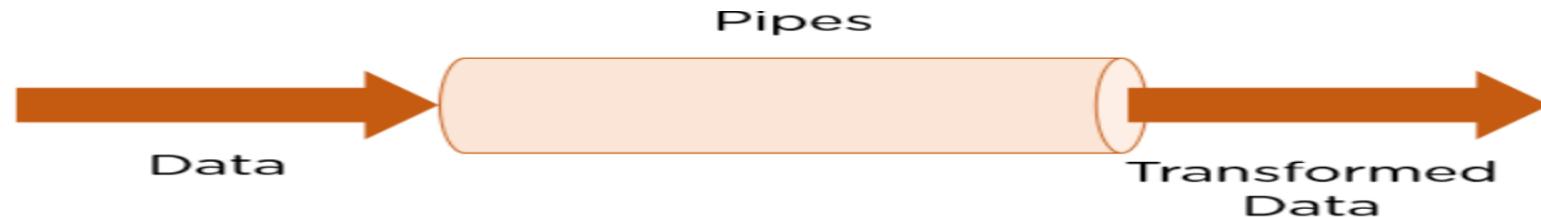
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Pipes

- Angular Pipes transform the output. You can think of them as makeup rooms where they beautify the data into a more desirable format. They do not alter the data but change how they appear to the user.



- Pipes are defined using the pipe “|” symbol.
- Some commonly used predefined Angular pipes are:
 - DatePipe: Formats a date value.
 - UpperCasePipe: Transforms text to uppercase.
 - LowerCasePipe: Transforms text to lowercase.
 - CurrencyPipe: Transforms a number to the currency string.
 - PercentPipe: Transforms a number to the percentage string.
 - DecimalPipe: Transforms a number into a decimal point string.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Practical

- **Prerequisites:**
 - NodeJS
 - npm install @angular/cli -g or npm install -g @angular/cli
 - Visual Studio 2022
 - Visual Studio Code
 - SQL Server Management Studio (SSMS),

To confirm installation

- node –version
- ng version



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Create New Project

cmd npm install

```
C:\Users\U05215804>md c:\angular  
C:\Users\U05215804>cd c:\angular  
c:\angular>ng new TaskManager --style=scss --routing
```

For Bootstrap:

npm install jquery --save

npm install popper.js --save

npm install bootstrap --save

npm install font-awesome --save



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

The End



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za



ENGINEERING 4.0
UNIVERSITY OF PRETORIA



INF 354: Advanced Programming



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

LP 02:

Architecture with TypeScript



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Outline

- ❖ Visual Studio 2022
- ❖ .Net 6 API
- ❖ SQL Server 2022
- ❖ Visual Studio Code
- ❖ Node.js
- ❖ Angular
- ❖ TypeScript
- ❖ Integration
- ❖ Conclusion



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Visual Studio 2022



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Visual Studio 2022

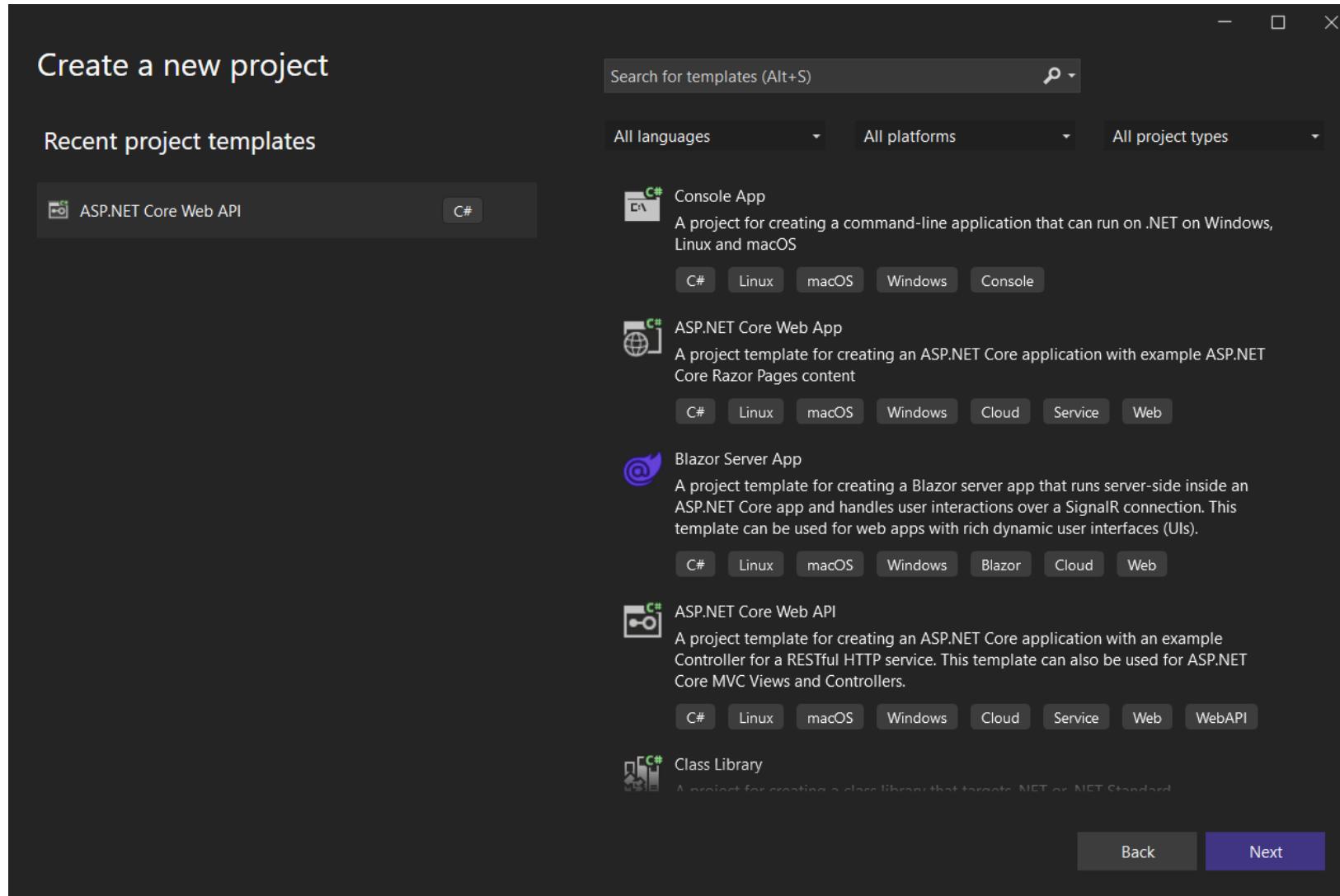


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Visual Studio 2022 continued...



The screenshot shows the 'Create a new project' dialog in Visual Studio 2022. At the top left, it says 'Create a new project'. Below that is a 'Recent project templates' section with 'ASP.NET Core Web API' selected. A search bar at the top right contains 'Search for templates (Alt+S)'. Underneath are filters for 'All languages', 'All platforms', and 'All project types'. The main area lists several project templates:

- Console App**: A project for creating a command-line application that can run on .NET on Windows, Linux and macOS. It supports C#, Linux, macOS, Windows, and Console.
- ASP.NET Core Web App**: A project template for creating an ASP.NET Core application with example ASP.NET Core Razor Pages content. It supports C#, Linux, macOS, Windows, Cloud, Service, and Web.
- Blazor Server App**: A project template for creating a Blazor server app that runs server-side inside an ASP.NET Core app and handles user interactions over a SignalR connection. This template can be used for web apps with rich dynamic user interfaces (UIs). It supports C#, Linux, macOS, Windows, Blazor, Cloud, and Web.
- ASP.NET Core Web API**: A project template for creating an ASP.NET Core application with an example Controller for a RESTful HTTP service. This template can also be used for ASP.NET Core MVC Views and Controllers. It supports C#, Linux, macOS, Windows, Cloud, Service, Web, and WebAPI.
- Class Library**: A project for creating a class library that targets .NET or .NET Standard. It supports C#, Linux, macOS, Windows, Cloud, Service, Web, and WebAPI.

At the bottom are 'Back' and 'Next' buttons.



**Faculty of Engineering,
Built Environment and
Information Technology**
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Visual Studio 2022 continued...

DEMO...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

.Net 6 API



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

.NET 6 API



6.0



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

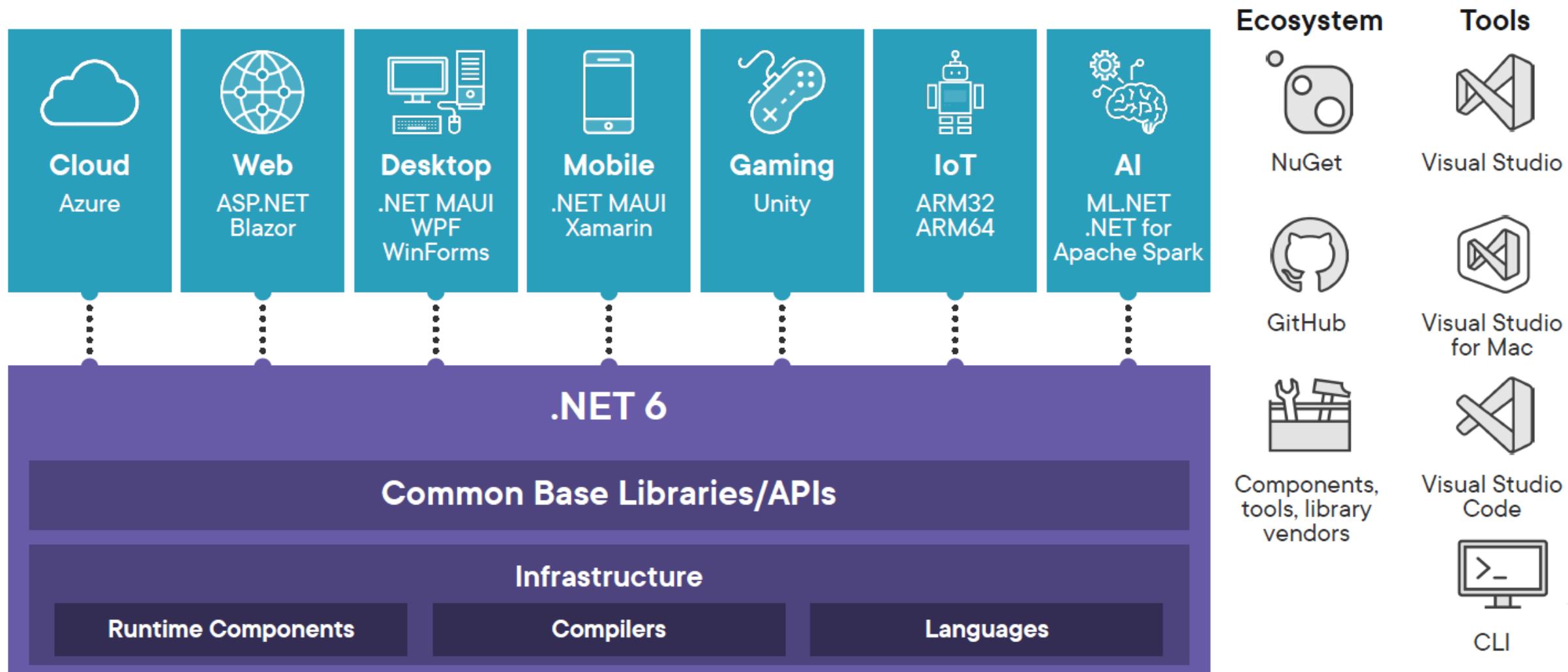
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

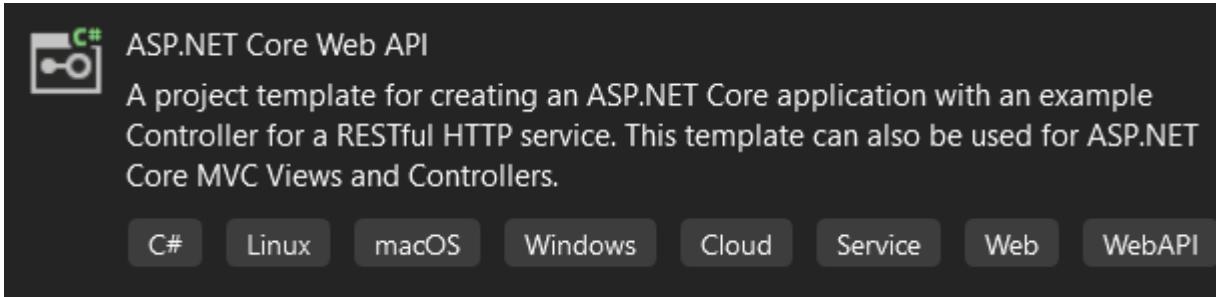
www.up.ac.za

.NET 6 API continued...

.NET Architecture



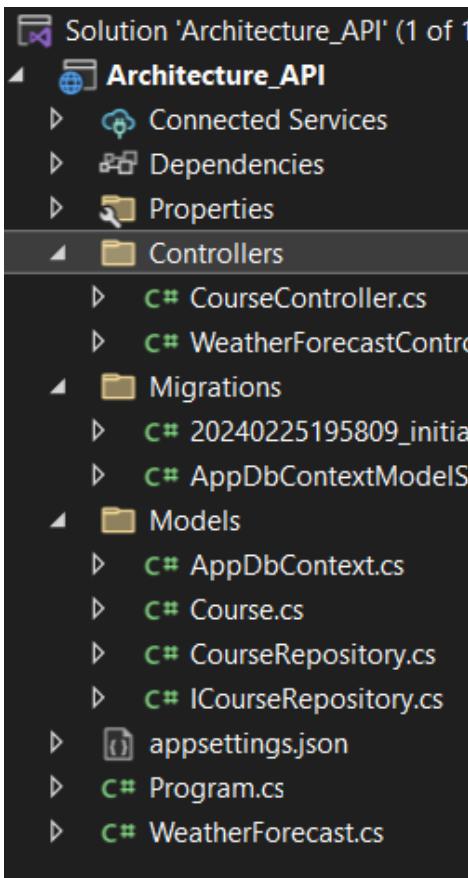
.NET 6 API continued...



A screenshot showing the details of the 'ASP.NET Core Web API' project template. It includes a description, supported platforms, and a file tree view.

ASP.NET Core Web API
A project template for creating an ASP.NET Core application with an example Controller for a RESTful HTTP service. This template can also be used for ASP.NET Core MVC Views and Controllers.

C# Linux macOS Windows Cloud Service Web WebAPI



A screenshot showing the file structure of the 'Architecture_API' solution. It includes files for Connected Services, Dependencies, Properties, Controllers, Migrations, Models, and various C# code files.

- Solution 'Architecture_API' (1 of 1)
 - Architecture_API
 - Connected Services
 - Dependencies
 - Properties
 - Controllers
 - CourseController.cs
 - WeatherForecastController.cs
 - Migrations
 - 20240225195809_initia...
AppDbContextModelS...
 - Models
 - AppDbContext.cs
 - Course.cs
 - CourseRepository.cs
 - ICourseRepository.cs
 - appsettings.json
 - Program.cs
 - WeatherForecast.cs



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

.NET 6 API continued...

DEMO...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

SQL Server 2022



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

SQL Server 2022



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

SQL Server 2022 continued...

Microsoft
SQL Server Management Studio

v19.0

© 2023 Microsoft.
All rights reserved.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

SQL Server 2022 continued...

DEMO...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Visual Studio Code



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Visual Studio Code



Visual Studio Code



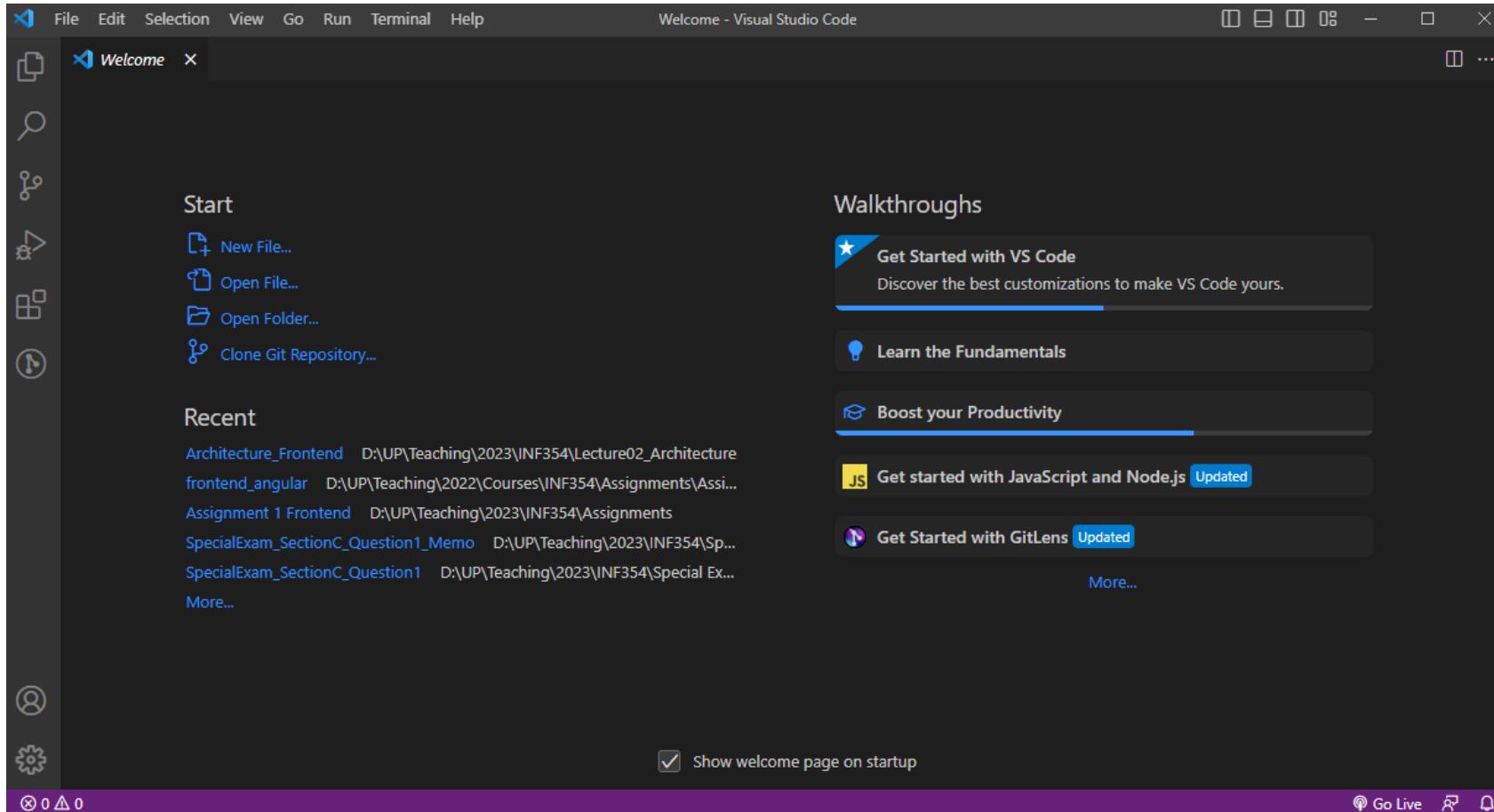
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Visual Studio Code continued...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Visual Studio Code continued...

DEMO...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Node.js



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Node.js

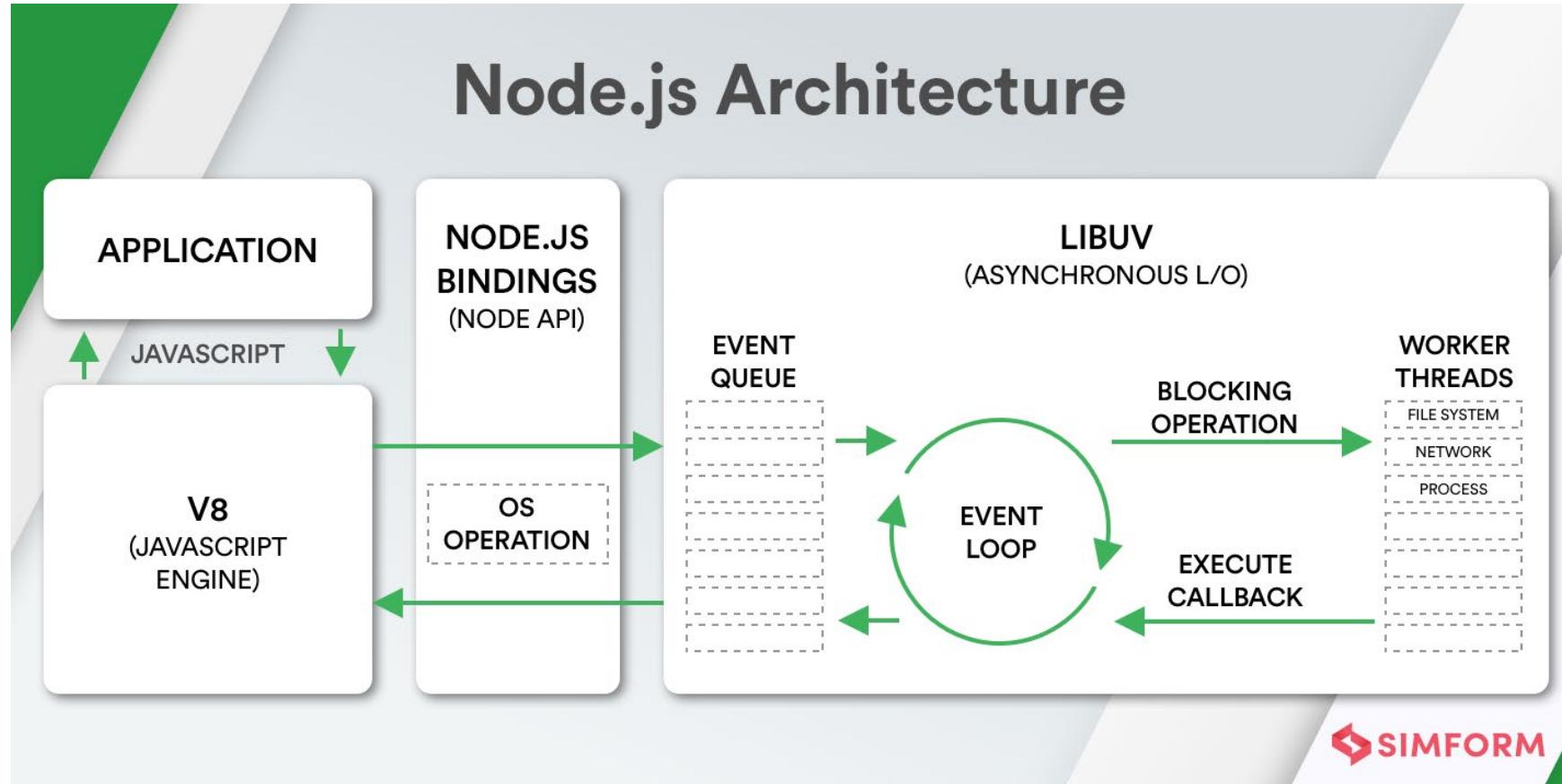


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Node.js continued...



**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Node.js continued...

DEMO...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Angular



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular continued...

```
> .angular
> .vscode
> node_modules
< src
  > app
    < assets
      .gitkeep
    > environments
    ★ favicon.ico
    < index.html
    TS main.ts
    TS polyfills.ts
    SCSS styles.scss
    TS test.ts
    .browserslistrc
    .editorconfig
    .gitignore
    { angular.json
    K karma.conf.js
    { package-lock.json
    { package.json
    i README.md
    { tsconfig.app.json
    TS tsconfig.json
    { tsconfig.spec.json
```

```
< app
  > course
  < services
    TS data.service.ts
  < shared
    TS course.ts
    TS app-routing.module.ts
    < app.component.html
    SCSS app.component.scss
    TS app.component.spec.ts
    TS app.component.ts
    TS app.module.ts
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Angular continued...

DEMO...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

TypeScript



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

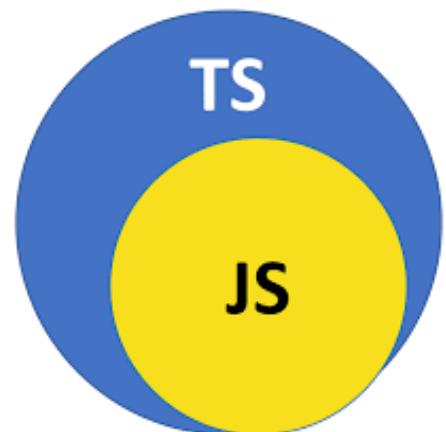
**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

TypeScript



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

TypeScript continued

- JavaScript was not made for large scale development.
- TypeScript compiles to JavaScript. (Transpile/TransCompile still refers to Compile).
- TypeScript is a compiled language.
- TypeScript can compile all the way down to ES3 (ECMAScript 3 1999)
- ECMAScript2015 did add Classes and the Class keyword.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

TypeScript continued

- TypeScript makes it easier to manage a large codebase. Contains classes, namespaces, modules, interfaces
- Benefit of TypeScript is when you are making non trivial applications (Larger applications)
- Functions are building blocks of TypeScript and JavaScript applications
- NB: Superset of JavaScript. Write more maintainable code with fewer bugs. Valid JavaScript is also valid TypeScript
- NB: Inheritance is arguably the most important aspect of TypeScript OOP



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

TypeScript continued

- Try to avoid the any type, as the more info you give typescript the better!
- NB: The more explicit you are the better. ANY - is basically just saying let's continue as if we are using JavaScript
- TypeScript is JavaScript with syntax for types. TypeScript is a strongly typed programming language that builds on JavaScript, giving you better tooling at any scale
- NB: The more information you can give typescript the better typescript will be at finding errors early on
- Transpiled version when you convert a ts [typescript] file to js [javascript]



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

TypeScript continued

TypeScript Types

<https://www.typescriptlang.org/docs/handbook/2/everyday-types.html>

- number
- string
- boolean
- **any**
- null
- arrays
- enums
- literal types
- bigint
- type



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

TypeScript continued

Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Integration



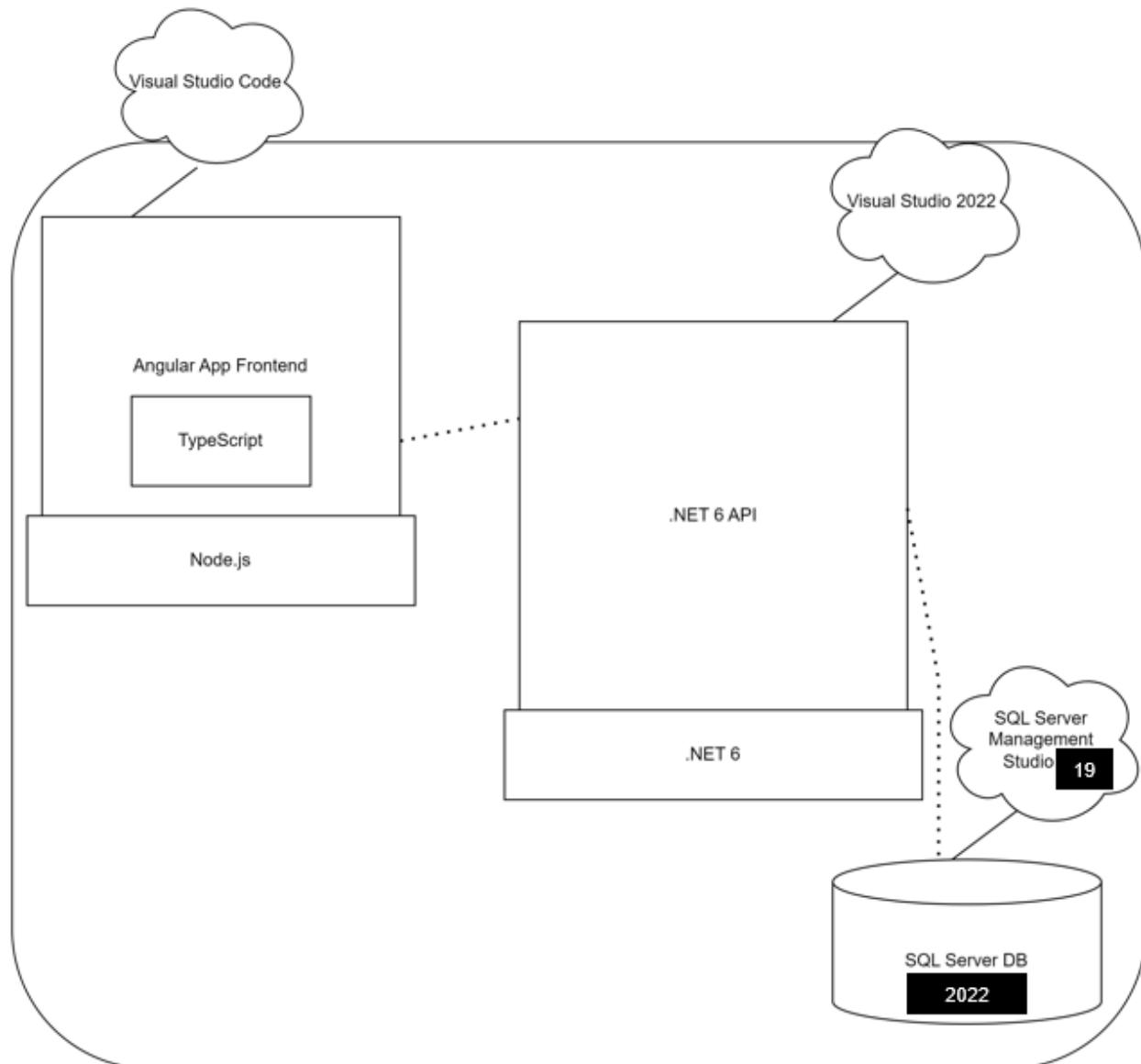
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Integration



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Integration continued...

Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Conclusion



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

INF 354: Advanced Programming



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Make today matter

www.up.ac.za

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

API 1

Learning Outcome:

- ❖ Understand, develop, and deploy Application Programming Interfaces (APIs) using .NET Core cross-platform framework and the C# programming language to connect to repositories and data sources such as databases.

Learning Objectives:

- ❖ To understand the purpose of creating an API
- ❖ Develop a WebAPI



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Outline

- ❖ Introduction
- ❖ REST
- ❖ HTTP Verbs
- ❖ Routing
- ❖ Database
- ❖ Practical



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

API 1

Introduction



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

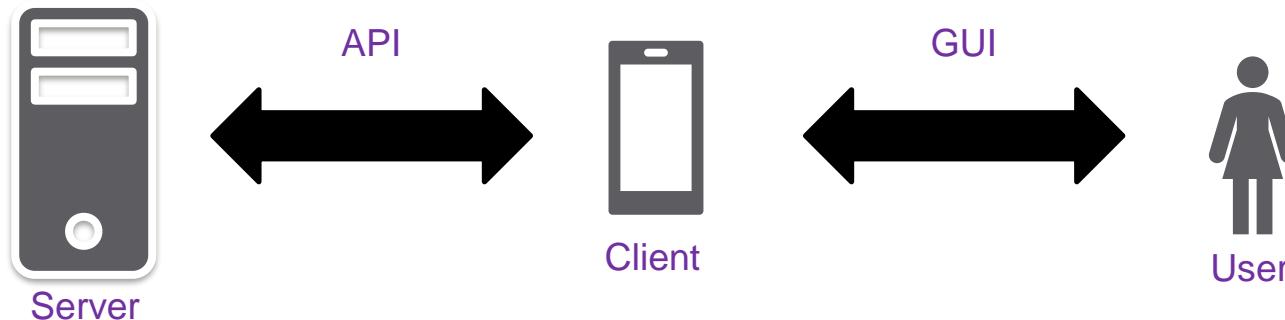
Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

API

- An API (Application Programming Interface) connects two or more applications. It allows two applications to communicate with one another.



- An API making use of HTTP is called a *Web API*.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Different types of Web APIs

Remote Procedure Call, RPC.

- Clients can call functions on the server.

Remote Method Invocation, RMI.

- Clients can call methods on objects on the server.

Representational State Transfer, REST.

- Clients can apply CRUD operations on resources on the server.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Representational State Transfer (REST)

- A style of software architecture for distributed hypermedia systems such as the World Wide Web.
- Introduced in the doctoral dissertation of Roy Fielding
 - One of the principal authors of the HTTP specification.
- Rest is a set of principles that define how web services should be designed and interact with each other.
- A collection of network architecture principles that outline how resources are defined and addressed



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Representational State Transfer (REST)

- Rest, emphasizes a stateless client-server architecture.
- This principle means that the server does not store any state about the client session on the server side.
- Instead, each request from the client to the server must contain all the information necessary to understand and complete the request.
- Adhering to a stateless communication model, RESTful services aim to enhance performance, reliability, and scalability while ensuring a uniform and standardized web services architecture.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Representational State Transfer (REST)

- Implication of having REST as a stateless client-server
 - Self-contained Requests
 - Session State
 - Scalability
 - Caching
 - Simplicity and Uniform Interface



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

REST - not a Standard

REST is not a standard

- JSR 311: JAX-RS: The Java™ API for RESTful Web Services

But it uses several standards:

- HTTP
- URL
- XML/HTML/GIF/JPEG/etc (Resource Representations)
- text/xml, text/html, image/gif, image/jpeg, etc (Resource Types, MIME Types)



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

ASP.NET Core

ASP.NET Core provides a powerful and flexible platform for building restful APIs with its support for

- HTTP verbs
- Routing
- Model binding,
- Response types.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

HTTP Verbs

- GET – (Read) Get information. GET requests must be safe and idempotent, which means that no matter how many times they are repeated with the same parameters, the results must be the same.
- POST – (Create) Instruct the resource at the URI to perform an action on the provided entity.
- PUT – (Update) Add an entity to a URI. PUT can be used to create a new entity or to update an existing one.
- PATCH - Update only the specified fields of a URI entity.
- DELETE - Request the removal of a resource; however, the resource does not have to be removed right away..



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

HTTP Verbs

Get: <https://myapi.com/api/employees> (Get all Employees)

Get: <https://myapi.com/api/employees/{id}> (Get single Employees by id)

POST: <https://myapi.com/api/employees> (Create an Employee)

PUT: <https://myapi.com/api/employees/{id}> (Update an Employees by id)

Delete: <https://myapi.com/api/employees/{id}> (Delete an Employee by id)



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Web API Routing

- It routes incoming HTTP requests to a specific action method on a Web API controller.
- Attribute routing uses [Route()] attribute to define routes. The Route attribute can be applied on any controller or action method.

```
public class StudentController : ApiController
{
    [Route("api/student/names")]
    public IEnumerable<string> Get()
    {
        return new string[] { "student1", "student2" };
    }
}
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Practical – (Creating a new WebAPI)

Search for templates (Alt+S)  Clear all

C# All platforms Web

 ASP.NET Core Web App
A project template for creating an ASP.NET Core application with example ASP.NET Core Razor Pages content
C# Linux macOS Windows Cloud Service Web

 Blazor Server App
A project template for creating a Blazor server app that runs server-side inside an ASP.NET Core app and handles user interactions over a SignalR connection. This template can be used for web apps with rich dynamic user interfaces (UIs).
C# Linux macOS Windows Blazor Cloud Web

 ASP.NET Core Web API
A project template for creating an ASP.NET Core application with an example Controller for a RESTful HTTP service. This template can also be used for ASP.NET Core MVC Views and Controllers.
C# Linux macOS Windows Cloud Service Web WebAPI

 ASP.NET Core Empty
An empty project template for creating an ASP.NET Core application. This template does not have any content in it.
C# Linux macOS Windows Cloud Service Web

 ASP.NET Core Web App (Model-View-Controller)
A project template for creating an ASP.NET Core application with dynamic ASP.NET

[Back](#) [Next](#)

Get started



Clone a repository

Get code from an online repository like GitHub or Azure DevOps



Open a project or solution

Open a local Visual Studio project or .sln file



Open a local folder

Navigate and edit code within any folder



Create a new project

Choose a project template with code scaffolding to get started

[Continue without code →](#)



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Practical – (Creating a new WebAPI)

Configure your new project

ASP.NET Core Web API C# Linux macOS Windows Cloud Service Web WebAPI

Project name

ZAHike.API

Location

C:\Users\U05215804\Documents\Semester1_2023\INF 354\ZAHike\

Solution name ⓘ

ZAHike

Place solution and project in the same directory

Back

Next

Additional information

ASP.NET Core Web API C# Linux macOS Windows Cloud Service Web WebAPI

Framework ⓘ

.NET 6.0 (Long Term Support)

Authentication type ⓘ

None

Configure for HTTPS ⓘ

Enable Docker ⓘ

Docker OS ⓘ

Linux

Use controllers (uncheck to use minimal APIs) ⓘ

Enable OpenAPI support ⓘ

Do not use top-level statements ⓘ



Back

Create

Practical – (Creating a new WebAPI)

The screenshot shows the Microsoft Visual Studio IDE interface with the following details:

- Top Bar:** File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, Help, Search (Ctrl+Q), ZAHike (highlighted), Sign in, Live Share.
- Solution Explorer:** Shows the Solution 'ZAHike' (1 of 1 project) with the following items:
 - ZAHike.API
 - Connected Services
 - Dependencies
 - Properties
 - Controllers
 - appsettings.json
 - Program.cs
 - WeatherForecast.cs
- Output Window:** Shows output from Service Dependencies.
- Central Area:** ASP.NET Core Overview page for the ZAHike API project. It features:
 - Build Your App:** Icon of curly braces {}, link to ASP.NET Core documentation and .NET application architecture.
 - Connect To The Cloud:** Icon of a cloud with an upward arrow, link to Publish your app to Azure and Get started with ASP.NET on Azure.
 - Learn Your IDE:** Icon of two interlocking tools, link to See our productivity guide and Write code faster.

ZAHikes

Hikes

Name	Type
ID	Unique Identifier (GUID)
Name	String
Description	String
LengthInKm	Double
HikeImageUrl	String
ProvinceId	Unique Identifier (GUID)
DifficultyId	Unique Identifier (GUID)

Province

Name	Type
ID	Unique Identifier (GUID)
Code	String
Name	String
RegionImageUrl	String

Difficulty

Name	Type
ID	Unique Identifier (GUID)
Name	String



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

The End



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za



ENGINEERING 4.0
UNIVERSITY OF PRETORIA



INF 354: Advanced Programming



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

LP 04: API II



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Outline

- ❖ Theory
- ❖ Create API .NET 6 blank solution
- ❖ Configure API solution
- ❖ Create the Entities/Models
- ❖ Configure the DbContext
- ❖ Setup & Configure Repository
- ❖ Create CRUD endpoints
- ❖ Entity Framework Relationship Examples
- ❖ Simulate DB-First Approach
- ❖ In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

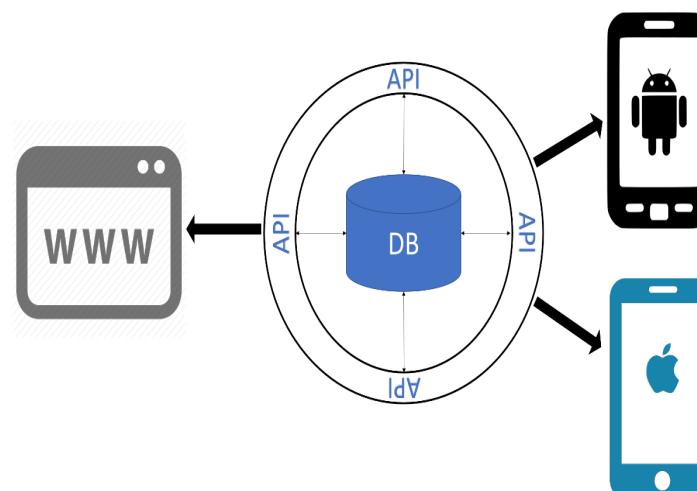
**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Theory

- API – “*A set of routines, protocols, and tools for building software applications*”
- In SOAP and REST services, an API is simply a specification of remote calls exposed to the API consumers.
- **A major benefit is that common business logic can be defined inside the API and is only coded once.**



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Theory continued...

- APIs typically return JSON or XML.
- JSON is preferred.
- APIs can be written in most backend languages (C#, Java, PHP, C++, Python, etc.)
- *APIs can be used to separate concerns, for example, you do not need to develop 3 backends for 3 apps. In other words, the single API can be shared across multiple apps.*
- APIs can be used to integrate software.

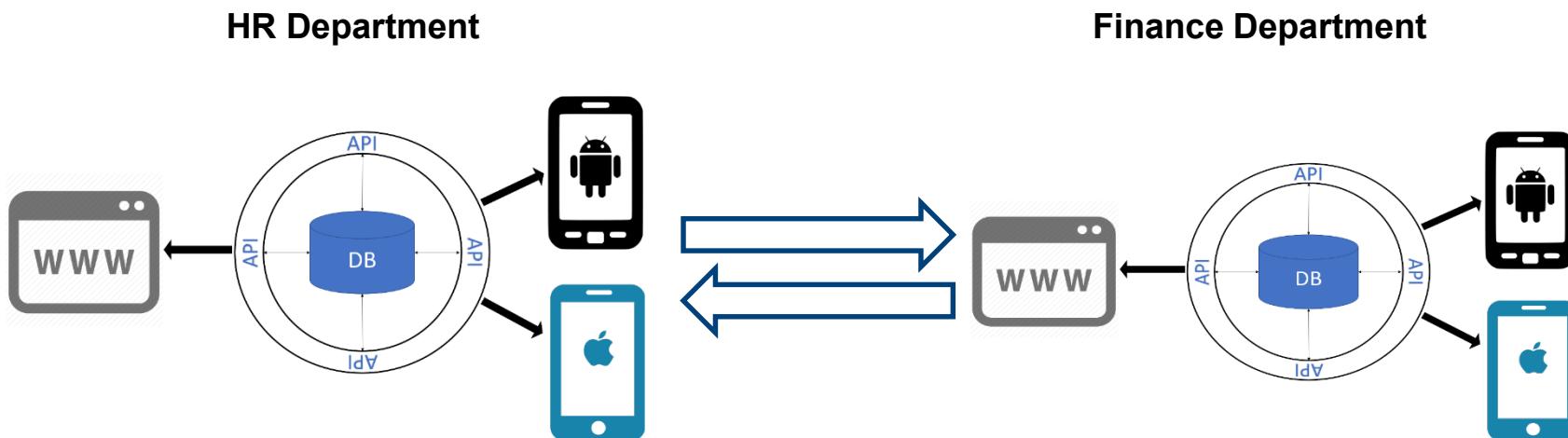


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory continued...

- In business, APIs allow different businesses and business departments to easily exchange data.
- Typically, this is done by sending JSON or XML objects between APIs or other applications.
- Databases are often accessed through APIs and not directly by client-facing applications.
- **Desktop, mobile and web applications can then access this API and a lot of logic is written in the API, the other applications interpret data received from the API.**



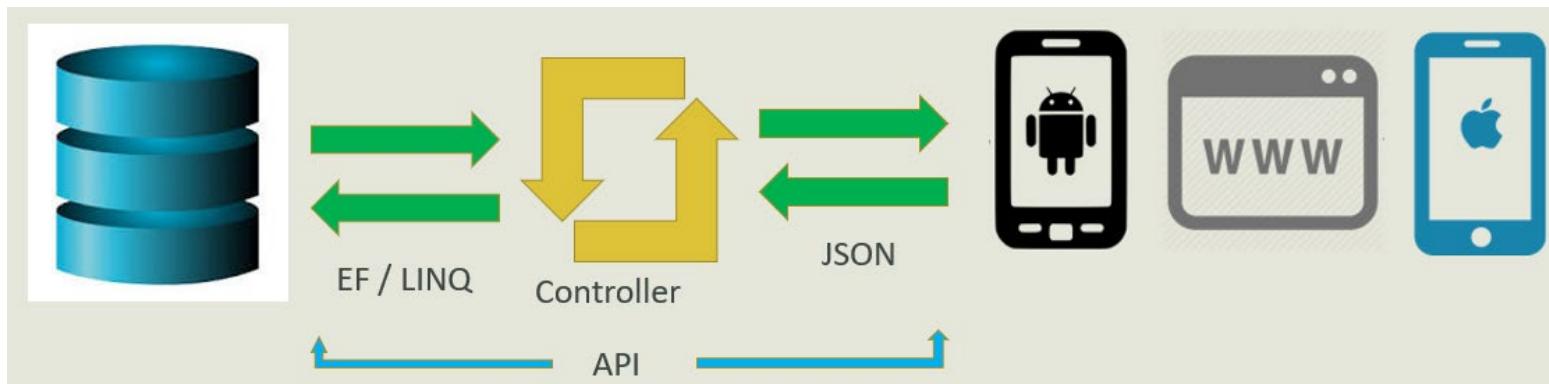
UNIVERSITÄT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory continued...

- Create a new ASP.NET web application and select Web API .NET 6.
- Create an Entity Framework (EF) model of your database.
- Write controllers that manipulate data from the database via EF, applying additional business logic where required.
- Return results in JSON.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Create API .NET 6 blank solution



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

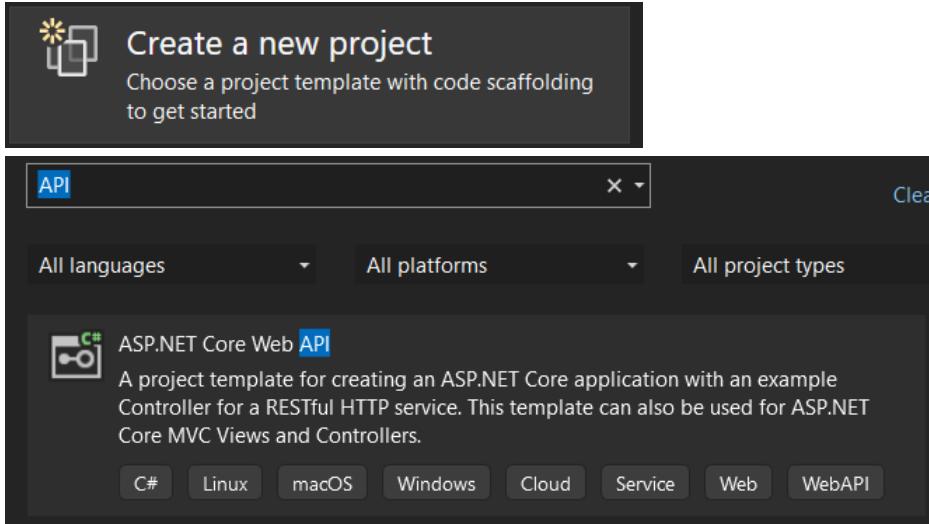
**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Create API .NET 6 blank solution



The screenshot shows the 'Create a new project' dialog in Visual Studio. The search bar at the top contains the text 'API'. Below the search bar, there are filters for 'All languages', 'All platforms', and 'All project types'. The results list shows the 'ASP.NET Core Web API' template, which is highlighted. This template is described as 'A project template for creating an ASP.NET Core application with an example Controller for a RESTful HTTP service. This template can also be used for ASP.NET Core MVC Views and Controllers.' Below the description are buttons for selecting the programming language (C#) and platform (Linux, macOS, Windows, Cloud, Service, Web, WebAPI).

The main workspace below the dialog shows the 'ASP.NET Core Web API' project details. It includes the project name 'WebApplication1' in the Solution Explorer on the left, the 'WeatherForecast' controller in the code editor, and the Swagger UI interface on the right displaying the 'WeatherForecast' endpoint with a 'GET /WeatherForecast' button.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Configure API solution



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

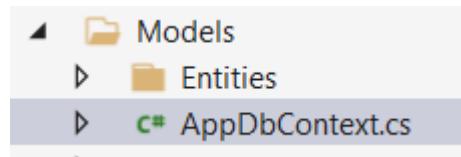
**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

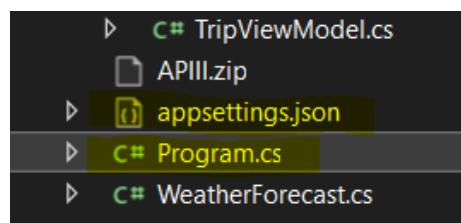
www.up.ac.za

Configure API solution

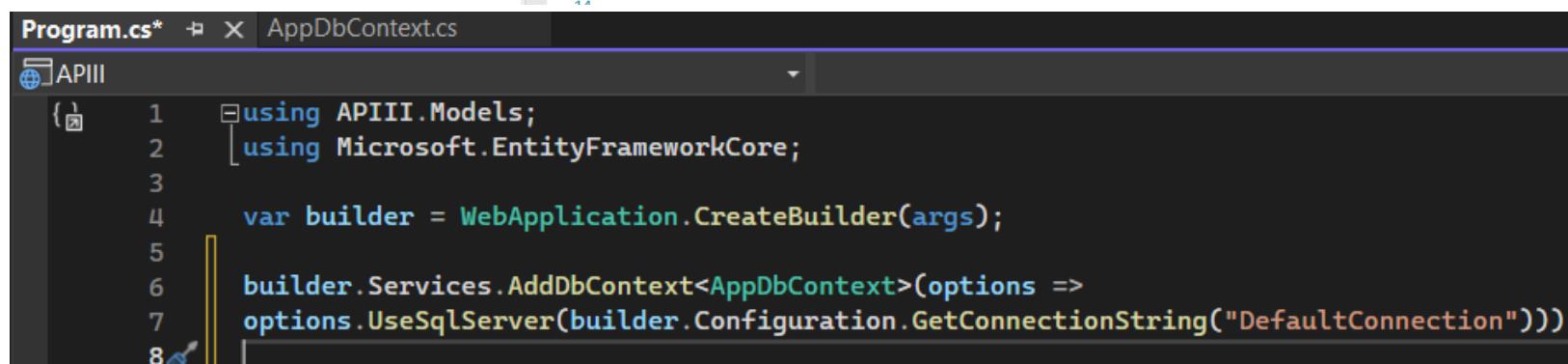


```
public AppDbContext(DbContextOptions<AppDbContext> options) : base(options)
{
}

0 references
protected override void OnModelCreating(ModelBuilder modelBuilder)
{
    base.OnModelCreating(modelBuilder);
}
```



```
appsettings.json ✎ X AppDbContext.cs*
Schema: https://json.schemastore.org/appsettings.json
1  {
2   "Logging": {
3     "LogLevel": {
4       "Default": "Information",
5       "Microsoft": "Warning",
6       "Microsoft.Hosting.Lifetime": "Information"
7     }
8   },
9   "AllowedHosts": "*",
10  "ConnectionStrings": {
11    "DefaultConnection": "Server=.;Database=API_II;Trusted_Connection=True;MultipleActiveResultSets=True"
12  }
13 }
```



```
Program.cs* ✎ X AppDbContext.cs
APIII
1  using APIII.Models;
2  using Microsoft.EntityFrameworkCore;
3
4  var builder = WebApplication.CreateBuilder(args);
5
6  builder.Services.AddDbContext<AppDbContext>(options =>
7    options.UseSqlServer(builder.Configuration.GetConnectionString("DefaultConnection")));
8
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Create the Entities/Models



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

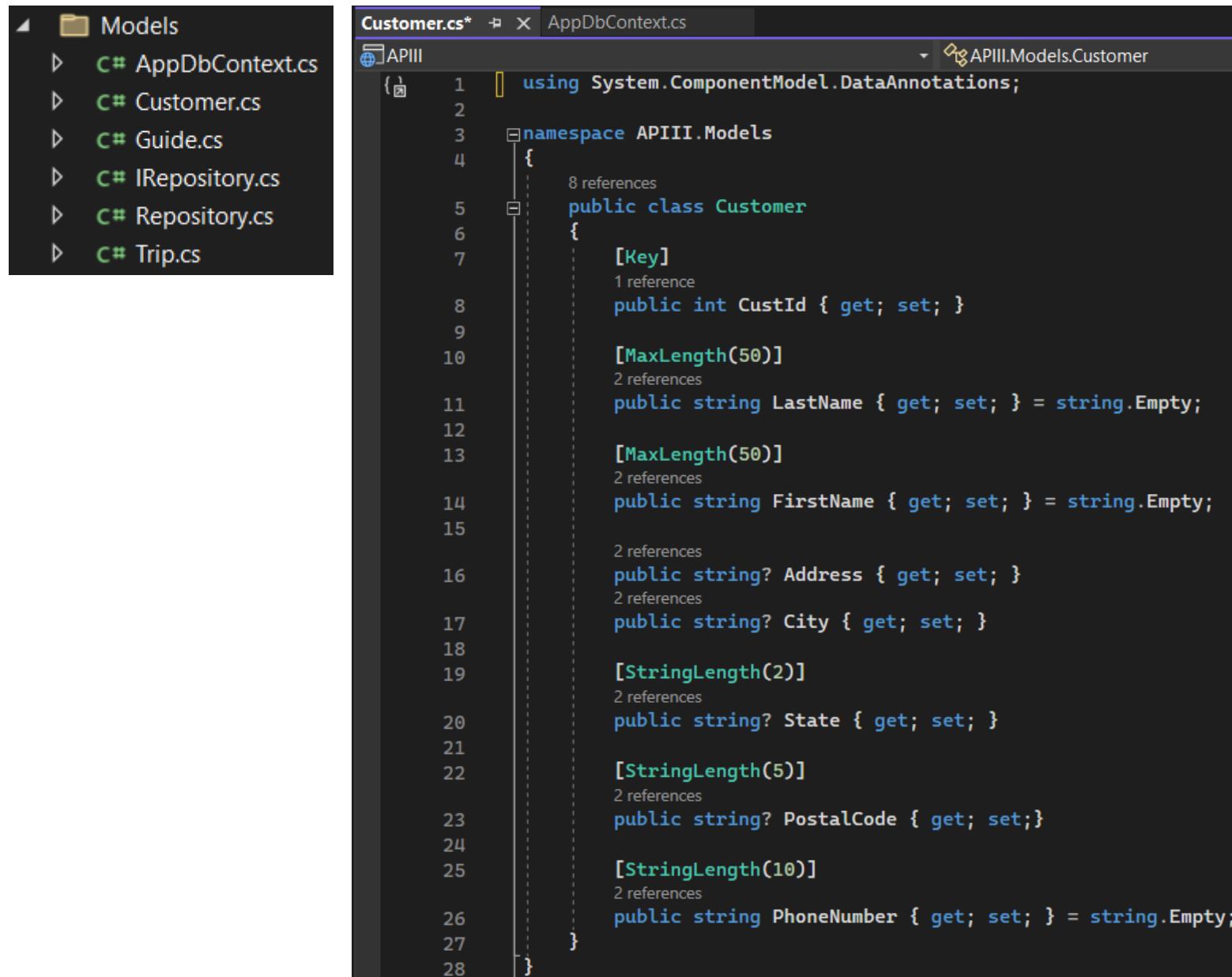
**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Create the Entities/Models



The screenshot shows a code editor with two files open:

- Customer.cs***: This is the active file, showing the definition of the `Customer` entity. It includes properties for `CustId`, `LastName`, `FirstName`, `Address`, `City`, `State`, `PostalCode`, and `PhoneNumber`. Each property is annotated with `[Key]`, `[MaxLength]`, or `[StringLength]` attributes.
- AppDbContext.cs**: This file is visible in the background, part of the `APIII` project.

```
Customer.cs*
namespace APIII.Models
{
    public class Customer
    {
        [Key]
        public int CustId { get; set; }

        [MaxLength(50)]
        public string LastName { get; set; } = string.Empty;

        [MaxLength(50)]
        public string? FirstName { get; set; } = string.Empty;

        public string? Address { get; set; }

        public string? City { get; set; }

        [StringLength(2)]
        public string? State { get; set; }

        [StringLength(5)]
        public string? PostalCode { get; set; }

        [StringLength(10)]
        public string PhoneNumber { get; set; } = string.Empty;
    }
}
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Configure the DbContext



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

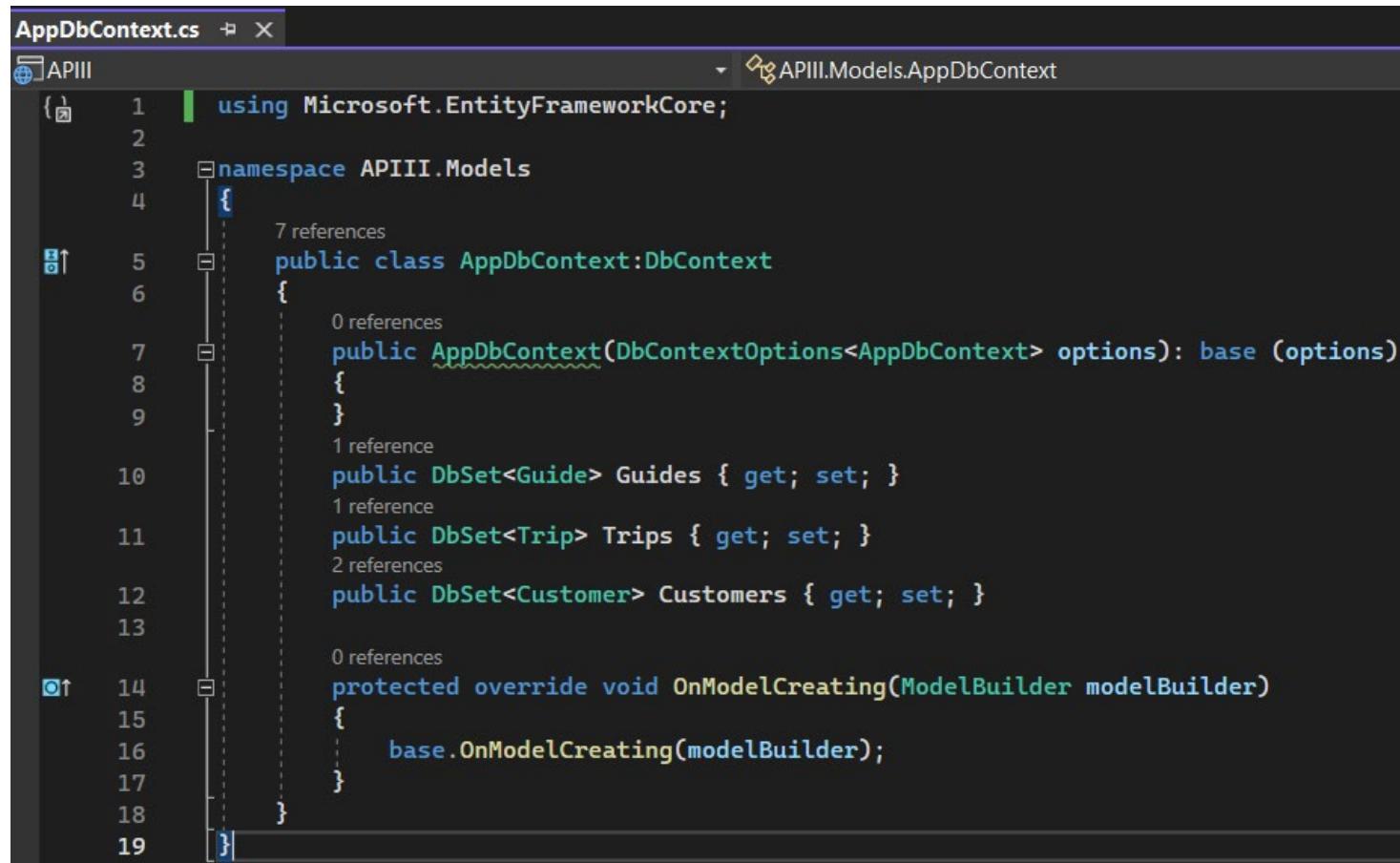
**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

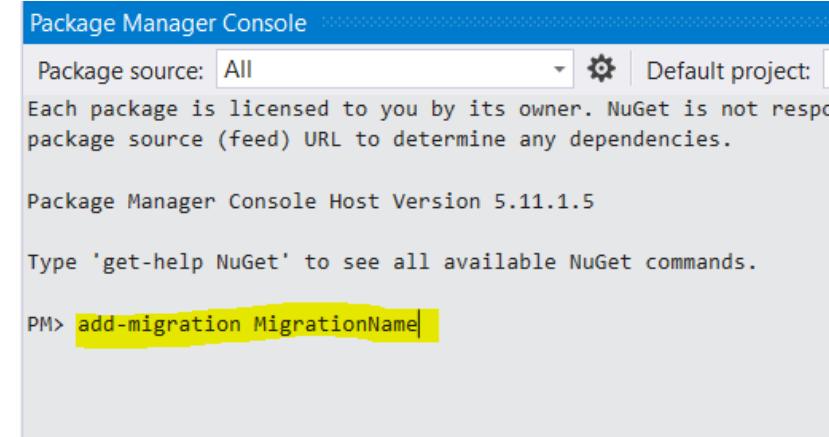
Make today matter

www.up.ac.za

Configure the DbContext



```
AppDbContext.cs X
APIII
AppDbContext.cs APIII.Models.AppDbContext
1  using Microsoft.EntityFrameworkCore;
2
3  namespace APIII.Models
4  {
5      public class AppDbContext:DbContext
6      {
7          public AppDbContext(DbContextOptions<AppDbContext> options): base (options)
8          {
9          }
10         public DbSet<Guide> Guides { get; set; }
11         public DbSet<Trip> Trips { get; set; }
12         public DbSet<Customer> Customers { get; set; }
13
14         protected override void OnModelCreating(ModelBuilder modelBuilder)
15         {
16             base.OnModelCreating(modelBuilder);
17         }
18     }
19 }
```

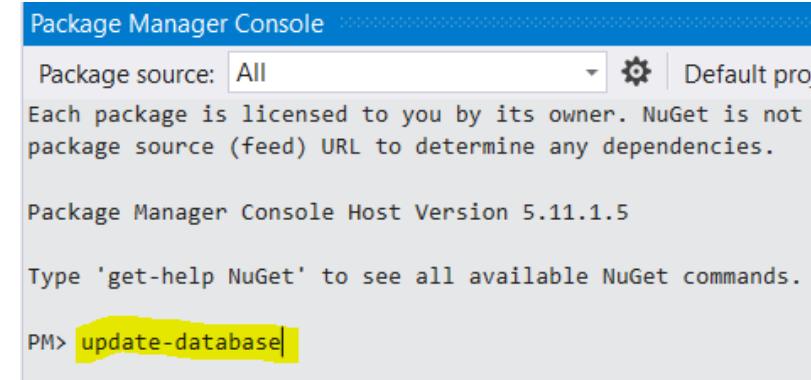


```
Package Manager Console
Package source: All
Each package is licensed to you by its owner. NuGet is not responsible for the packages it contains. Consider using NuGet Package Source instead of a package source (feed) URL to determine any dependencies.

Package Manager Console Host Version 5.11.1.5

Type 'get-help NuGet' to see all available NuGet commands.

PM> add-migration MigrationName
```



```
Package Manager Console
Package source: All
Each package is licensed to you by its owner. NuGet is not responsible for the packages it contains. Consider using NuGet Package Source instead of a package source (feed) URL to determine any dependencies.

Package Manager Console Host Version 5.11.1.5

Type 'get-help NuGet' to see all available NuGet commands.

PM> update-database
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Setup & Configure Repository



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Setup & Configure Repository

The image shows a .NET development environment with four code editors:

- Models**: A folder containing `DbContext.cs`, `Customer.cs`, `Guide.cs`, `IRepository.cs` (highlighted in yellow), `Repository.cs` (highlighted in green), and `Trip.cs`. Two red arrows point from the `IRepository.cs` and `Repository.cs` files towards the `IRepository.cs` interface definition below.
- IRepository.cs**: A code editor showing the `IRepository` interface definition. It includes methods like `Add<T>(T entity)`, `Delete<T>(T entity)`, `SaveChangesAsync()`, `GetAllCustomersAsync()`, `GetCustomerAsync(int custId)`, `GetTripAsync(int tripId)`, and `GetGuideAsync(string guideNum)`.
- Repository.cs**: A code editor showing the `Repository` class implementation. It uses `Microsoft.EntityFrameworkCore` and defines a constructor `Repository(DbContext dbContext)` and methods `Add<T>(T entity)`, `Delete<T>(T entity)`, `SaveChangesAsync()`, `GetAllCustomersAsync()`, `GetCustomerAsync(int custId)`, `GetTripAsync(int tripId)`, and `GetGuideAsync(string guideNum)`.
- Program.cs***: A code editor showing the `Program` class which sets up the application builder to add the `Repository` service.

```
Repository.cs  IRepository.cs
APIII          APIII.Models.Repository
{             {
1      using Microsoft.EntityFrameworkCore;
2
3      namespace APIII.Models
4      {
5          public class Repository : IRepository
6          {
7              private readonly DbContext _dbContext;
8
9              public Repository(DbContext dbContext)
10             {
11                 _dbContext = dbContext;
12             }
13
14             public void Add<T>(T entity) where T : class
15             {
16                 _dbContext.Add(entity);
17             }
18
19             public void Delete<T>(T entity) where T : class
20             {
21                 _dbContext.Delete(entity);
22             }
23
24             public Task SaveChangesAsync()
25             {
26                 return _dbContext.SaveChangesAsync();
27             }
28
29             public Task<Customer[]> GetAllCustomersAsync()
30             {
31                 return _dbContext.Customers.ToListAsync();
32             }
33
34             public Customer GetCustomerAsync(int custId)
35             {
36                 return _dbContext.Customers.Find(custId);
37             }
38
39             public Task<Trip> GetTripAsync(int tripId)
40             {
41                 return _dbContext.Trips.FindAsync(tripId);
42             }
43
44             public Task<Guide> GetGuideAsync(string guideNum)
45             {
46                 return _dbContext.Guides.FindAsync(guideNum);
47             }
48         }
49     }
50 }

Program.cs*  Repository.cs  IRepository.cs
APIII
1  using APIII.Models;
2
3  var builder = WebApplication.CreateBuilder(args);
4  builder.Services.AddScoped<IRepository, Repository>();
5
6  var app = builder.Build();
7
```

Create **CRUD** endpoints



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

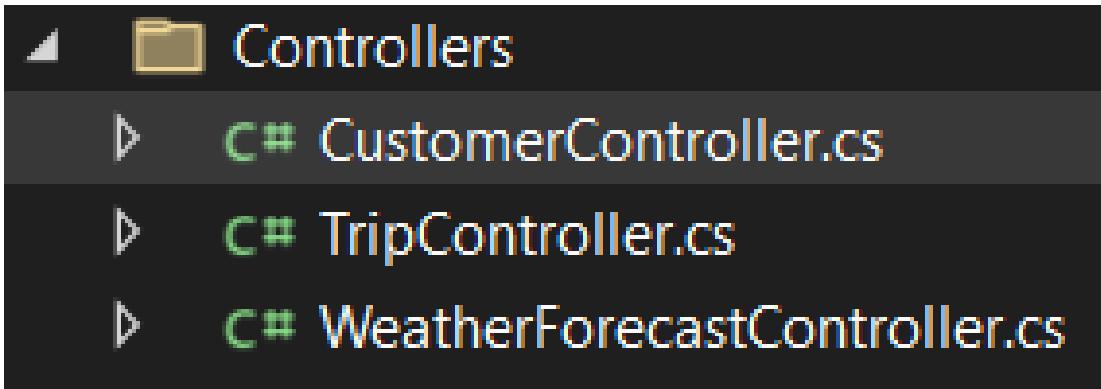
**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Create a CRUD endpoints



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Create a CRUD endpoints continued...

GET Request

```
[HttpGet]
[Route("GetAllCustomers")]
0 references
public async Task<IActionResult> GetAllCustomers()
{
    try
    {
        var results = await _repository.GetAllCustomersAsync();
        return Ok(results);
    }
    catch (Exception)
    {
        return StatusCode(500, "Internal Server Error. Please contact support.");
    }
}
```

```
[HttpGet]
[Route("GetCustomer/{custId}")]
0 references
public async Task<IActionResult> GetCustomerAsync(int custId)
{
    try
    {
        var result = await _repository.GetCustomerAsync(custId);

        if (result == null) return NotFound("Customer does not exist");

        return Ok(result);
    }
    catch (Exception)
    {
        return StatusCode(500, "Internal Server Error. Please contact support");
    }
}
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Create a CRUD endpoints continued...

POST Request

```
[HttpPost]
[Route("AddCustomer")]
0 references
public async Task<IActionResult> AddCustomer(CustomerViewModel cvm)
{
    var customer = new Customer { LastName = cvm.LastName,
        FirstName = cvm.FirstName,
        Address = cvm.Address,
        City = cvm.City,
        State = cvm.State,
        PostalCode = cvm.PostalCode,
        PhoneNumber = cvm.PhoneNumber };

    try
    {
        _repository.Add(customer);
        await _repository.SaveChangesAsync();
    }
    catch (Exception)
    {
        return BadRequest("Invalid transaction");
    }

    return Ok(customer);
}
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Create a CRUD endpoints continued...

PUT Request

```
[HttpPut]
[Route("EditCustomer/{custId}")]
0 references
public async Task<ActionResult<CustomerViewModel>> EditCustomer(int custId,
    CustomerViewModel customerModel)
{
    try
    {
        var existingCustomer = await _repository.GetCustomerAsync(custId);
        if (existingCustomer == null) return NotFound($"The customer does not exist");

        existingCustomer.LastName = customerModel.LastName;
        existingCustomer.FirstName = customerModel.FirstName;
        existingCustomer.Address = customerModel.Address;
        existingCustomer.City = customerModel.City;
        existingCustomer.State = customerModel.State;
        existingCustomer.PostalCode = customerModel.PostalCode;
        existingCustomer.PhoneNumber = customerModel.PhoneNumber;

        if (await _repository.SaveChangesAsync())
        {
            return Ok(existingCustomer);
        }
    }
    catch (Exception)
    {
        return StatusCode(500, "Internal Server Error. Please contact support.");
    }
    return BadRequest("Your request is invalid.");
}
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Create a CRUD endpoints continued...

DELETE Request

```
[HttpDelete]
[Route("DeleteCustomer/{custId}")]
0 references
public async Task<IActionResult> DeleteCustomer(int custId)
{
    try
    {
        var existingCustomer = await _repository.GetCustomerAsync(custId);

        if (existingCustomer == null) return NotFound($"The customer does not exist");

        _repository.Delete(existingCustomer);

        if (await _repository.SaveChangesAsync()) return Ok(existingCustomer);

    }
    catch (Exception)
    {
        return StatusCode(500, "Internal Server Error. Please contact support.");
    }
    return BadRequest("Your request is invalid.");
}
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Create a CRUD endpoints continued...

DEMO...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Entity Framework Relationship Examples



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Entity Framework Relationship Examples

The image shows two side-by-side code editors, both titled "APIII". The left editor displays the `Guide.cs` file and the right editor displays the `Trip.cs` file.

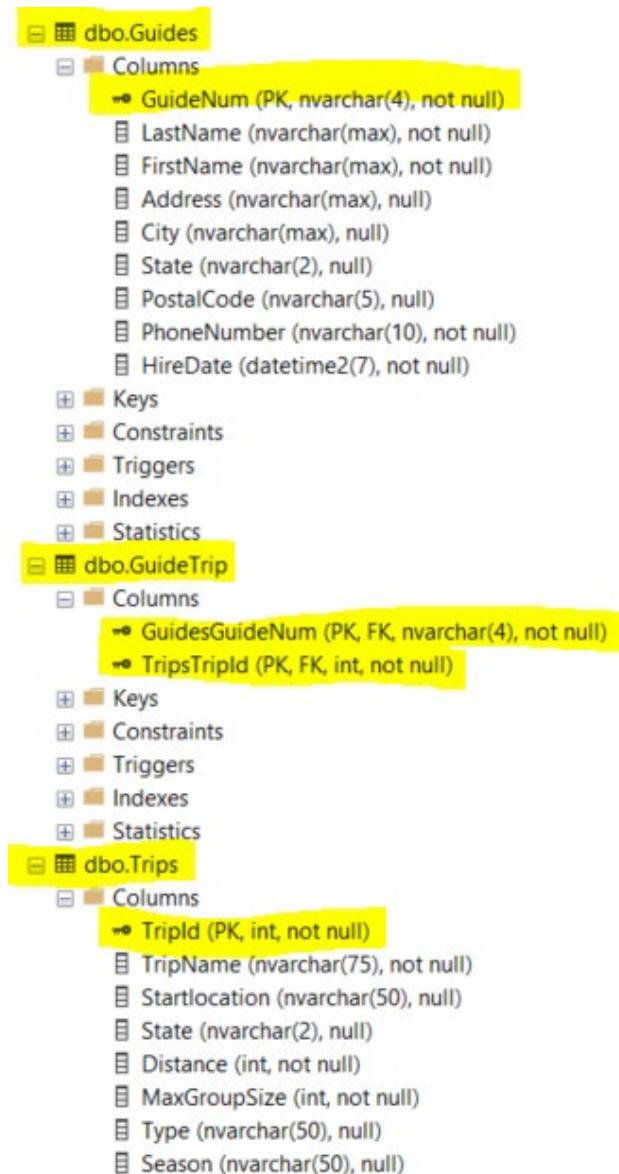
Guide.cs

```
4  namespace APIII.Models
5  {
6      public class Guide
7      {
8          [StringLength(4)]
9          [DatabaseGenerated(DatabaseGeneratedOption.None)]
10         [Key]
11         public string GuideNum { get; set; }
12         public string LastName { get; set; } = string.Empty;
13         public string FirstName { get; set; } = string.Empty;
14         public string? Address { get; set; }
15         public string? City { get; set; }
16
17         [StringLength(2)]
18         public string? State { get; set; }
19
20         [StringLength(5)]
21         [RegularExpression(@"^\d+$")]
22         public string? PostalCode { get; set; }
23
24         [StringLength(10)]
25         public string PhoneNumber { get; set; } = string.Empty;
26         public DateTime HireDate { get; set; }
27
28         public List<Trip> Trips { get; set; } = new List<Trip>();
29     }
30 }
```

Trip.cs

```
1  using System.ComponentModel.DataAnnotations;
2  namespace APIII.Models
3  {
4      public class Trip
5      {
6          [Key]
7          public int TripId { get; set; }
8          [MaxLength(75)]
9          public string TripName { get; set; } = string.Empty;
10         [MaxLength(50)]
11         public string? Startlocation { get; set; }
12         [StringLength(2)]
13         public string? State { get; set; }
14         [Range(0, 500)]
15         public int Distance { get; set; }
16         [Range(1, 100)]
17         public int MaxGroupSize { get; set; }
18         [MaxLength(50)]
19         public string? Type { get; set; }
20         [MaxLength(50)]
21         public string? Season { get; set; }
22         public List<Guide> Guides { get; set; } = new List<Guide>();
23     }
24 }
```

Entity Framework Relationship Examples continued...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Entity Framework Relationship Examples continued...

DEMO...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Simulate DB-First Approach



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Simulate DB-First Approach

Package Manager Console

Package source: All | Default project: APIII

Each package is licensed to you by its owner. NuGet is not responsible for, nor does it grant any licenses to, third-party packages. Some packages may include dependencies which are governed by additional licenses. Follow the package source (feed) URL to determine any dependencies.

Package Manager Console Host Version 6.4.0.111

Type 'get-help NuGet' to see all available NuGet commands.

PM> Scaffold-DbContext "Server=YourServerLocation;Database=YourDatabaseLocation;Trusted_Connection=True;MultipleActiveResultSets=true" Microsoft.EntityFrameworkCore.SqlServer -OutputDir Models -Context AppDbContext -DataAnnotations -f



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za



ENGINEERING 4.0
UNIVERSITY OF PRETORIA



INF 354: Advanced Programming



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

LP 06: Angular II



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Outline

- ❖ Angular Architecture
- ❖ Install & Configuration
- ❖ Angular CLI
- ❖ Angular Material
- ❖ Components & Templates
- ❖ Angular Services
- ❖ Routing & Navigation with Pages
- ❖ @Input & @Output decorators
- ❖ Additional Mentions
- ❖ In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular Architecture



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

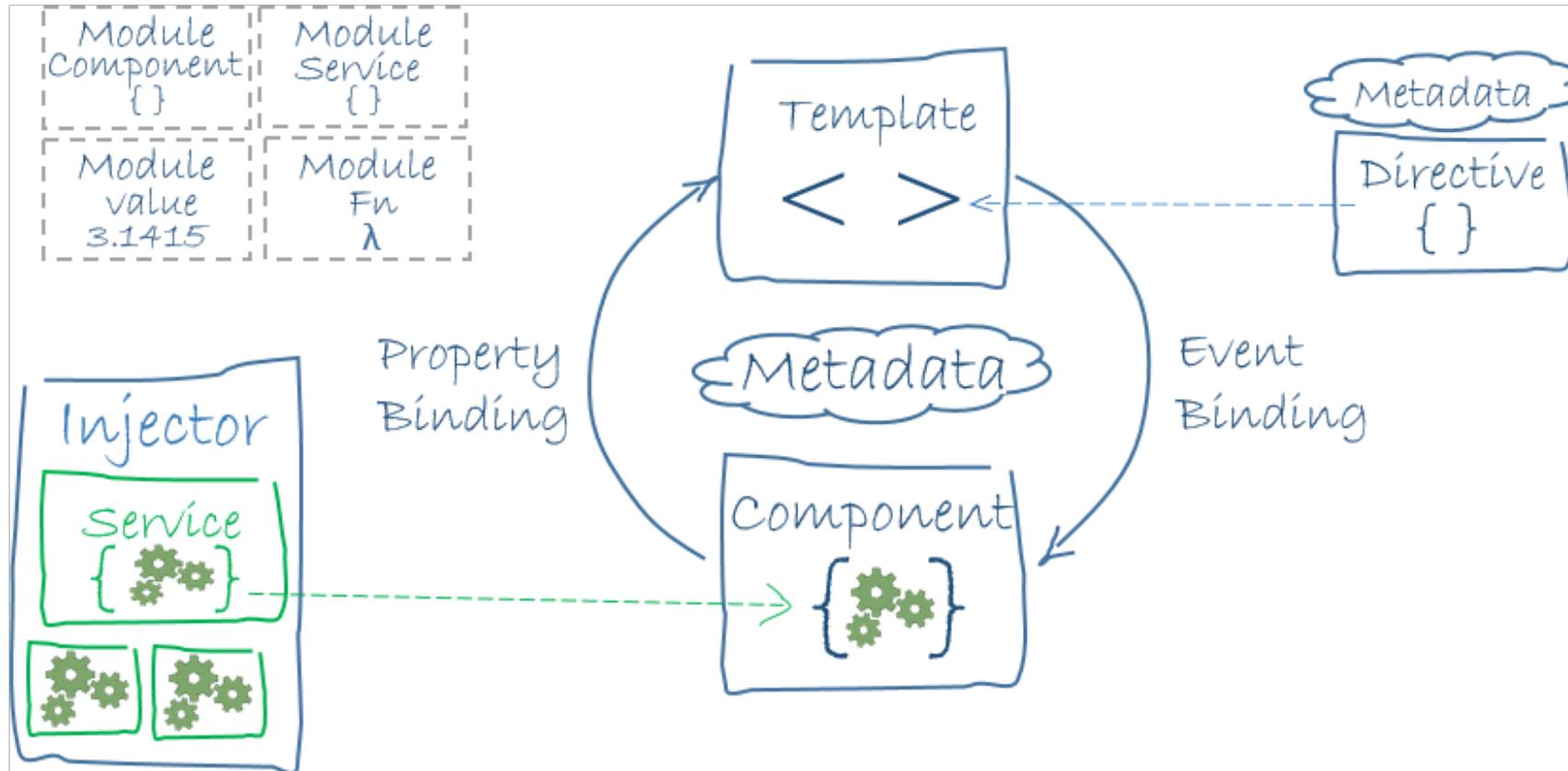
**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Angular Architecture

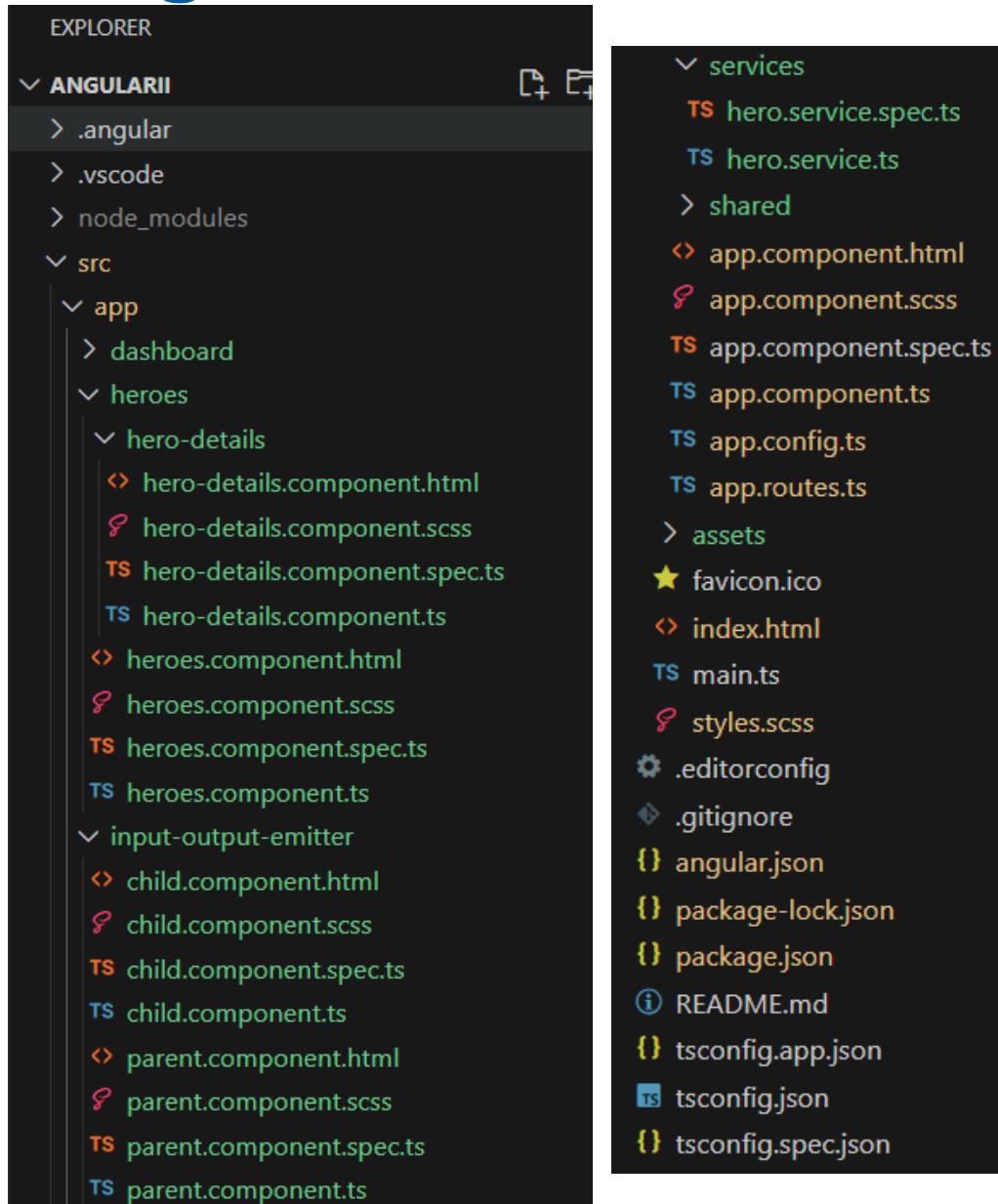


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular Architecture continued...



The screenshot shows the VS Code interface with the 'EXPLORER' view open. The project structure is as follows:

- ANGULARII
 - .angular
 - .vscode
 - node_modules
 - src
 - app
 - dashboard
 - heroes
 - hero-details
 - hero-details.component.html
 - hero-details.component.scss
 - hero-details.component.spec.ts
 - hero-details.component.ts
 - heroes.component.html
 - heroes.component.scss
 - heroes.component.spec.ts
 - heroes.component.ts
 - input-output-emitter
 - child.component.html
 - child.component.scss
 - child.component.spec.ts
 - child.component.ts
 - parent.component.html
 - parent.component.scss
 - parent.component.spec.ts
 - parent.component.ts
 - services
 - hero.service.spec.ts
 - hero.service.ts
 - shared
 - app.component.html
 - app.component.scss
 - app.component.spec.ts
 - app.component.ts
 - app.config.ts
 - app.routes.ts
 - assets
 - favicon.ico
 - index.html
 - main.ts
 - styles.scss
 - .editorconfig
 - .gitignore
 - angular.json
 - package-lock.json
 - package.json
 - README.md
 - tsconfig.app.json
 - tsconfig.json
 - tsconfig.spec.json

Faculty of Engineering,
Built Environment and
Information Technology



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Make today matter

www.up.ac.za

Install & Configuration



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Install & Configuration

- Node.js (website)
- npm install -g typescript
- npm install -g @angular/cli
- ng add @angular/material
- npm install
- ng build
- npm start
- ng serve --o
- ng new myapp



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular CLI



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Angular CLI

- <https://angular.io/cli>
- ng new testapp
- ng generate something [options]
- ng g component favourite-component
- ng g c favourites/favourite-component --flat
- ng g c favourite-component --flat -it -is --skip-Tests
- ng g [interface or module or service] etc...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular CLI continued...

- Demo



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Angular Material



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

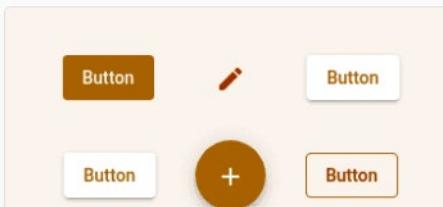
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

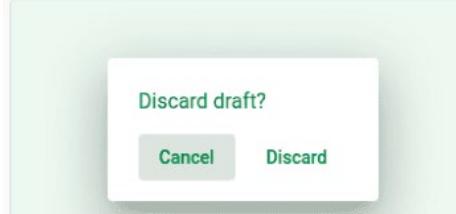
www.up.ac.za

Angular Material

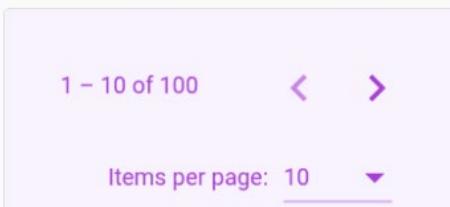
- <https://material.angular.io/>
- Components & CDK (Components Dev Kit)
- Angular Material offers a wide variety of UI components based on the Material Design specification



Button
An interactive button with a range of presentation options.



Dialog
A configurable modal that displays dynamic content.



Paginator
Controls for displaying paged data.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Angular Material continued...

```
import { MatAutocompleteModule } from '@angular/material/autocomplete';
import { MatCheckboxModule } from '@angular/material/checkbox';
import { MatDatepickerModule } from '@angular/material/datepicker';
import { MatNativeDateModule } from '@angular/material/core'
import { MatFormFieldModule } from '@angular/material/form-field';
import { MatInputModule } from '@angular/material/input';
import { MatRadioModule } from '@angular/material/radio'.
```

```
@NgModule({
  declarations: [],
  exports: [
    MatAutocompleteModule,
    MatCheckboxModule,
    MatDatepickerModule,
    MatNativeDateModule,
    MatFormFieldModule,
    MatInputModule,
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular Material continued...

- Demo



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Components & Templates



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

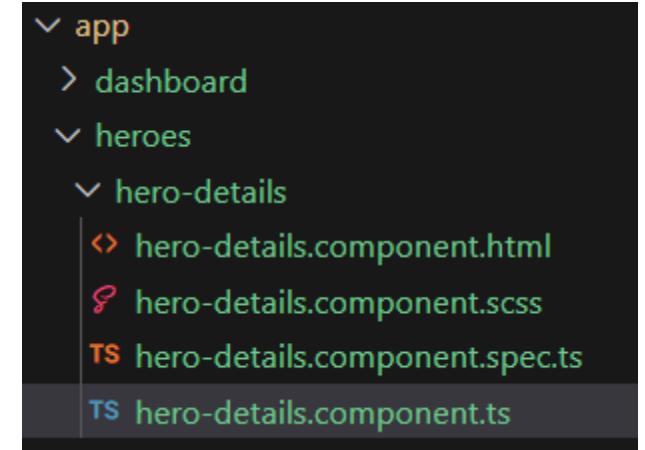
Make today matter
www.up.ac.za

Components & Templates [Component]

- `ng g c heroes/hero-details --skip-Tests`

```
ts hero-details.component.ts ×

src > app > heroes > hero-details > ts hero-details.component.ts > ...
1 import { Component, OnInit } from '@angular/core';
2 import { HeroService } from '../../../../../services/hero.service';
3 import { ActivatedRoute, RouterModule } from '@angular/router';
4 import { MaterialModule } from '../../../../../shared/material.module';
5
6 @Component({
7   selector: 'app-hero-details',
8   standalone: true,
9   imports: [MaterialModule, RouterModule],
10  templateUrl: './hero-details.component.html',
11  styleUrls: ['./hero-details.component.scss'
12 })
13 export class HeroDetailsComponent implements OnInit {
14   hero:any
15   constructor(private heroService: HeroService, private route: ActivatedRoute) { }
16
17   ngOnInit(): void {
18     this.heroService.getHero(+this.route.snapshot.params['id']).subscribe(hero: any) => {this.hero = hero}
19   }
20 }
21 }
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Components & Templates [Template]

```
(hero-details.component.html) ● |  
src > app > heroes > hero-details > hero-details.component.html > ...  
    Go to component  
1   <div class="flex-container" fxLayout.xs="column">  
2     <div class="flex-item">Age: {{hero?.age}}</div>  
3     <div class="flex-item">Birthday: {{hero?.birthday}}</div>  
4     <div class="flex-item"></div>  
5     <div class="flex-item">Height: {{hero?.height}}</div>  
6     <div class="flex-item">Alive: {{hero?.alive}}</div>  
7     <div class="flex-item"></div>  
8  
9   </div>  
10  <button mat-button [routerLink]="/heroes">  
11    <mat-icon>home</mat-icon>  
12    return  
13  </button>  
14
```

```
app  
  dashboard  
  heroes  
    hero-details  
      hero-details.component.html  
      hero-details.component.scss  
      hero-details.component.spec.ts  
      hero-details.component.ts
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Components & Templates continued...

- Demo



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular Services



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Angular Services

- `ng g s services/hero --skip-Tests --flat`
- Provides functionality that can be shared across multiple components, directives, or other services within an application.

```
import { Injectable } from '@angular/core';
import { Subject } from 'rxjs';
import { Hero } from '../shared/hero';

@Injectable({
  providedIn: 'root'
})
export class HeroService {

  constructor() {
    if(!localStorage.getItem('heroes')) {
      let heroes = [ ... ]
      localStorage.setItem('heroes', JSON.stringify(heroes))
    }
  }

  getHeroes() { ... }

  getHero(id:number) ...
}

deleteHero(id: any){ ...}
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Angular Services continued...

- Demo



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Routing & Navigation with Pages



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Routing & Navigation with Pages

- app.routes.ts (*Angular 17*) or app-routing.module.ts (*others*) → where you setup/configure your application routing.

```
ts app.routes.ts M X
src > app > ts app.routes.ts > ...
You, 12 hours ago | 1 author (You)
1 import { Routes } from '@angular/router';
2 import { DashboardComponent } from './dashboard/dashboard.component';
3 import { HeroesComponent } from './heroes/heroes.component';
4 import { HeroDetailsComponent } from './heroes/hero-details/hero-details.component';
5 import { ChildComponent } from './input-output-emitter/child.component';
6 import { ParentComponent } from './input-output-emitter/parent.component';
7
8 export const routes: Routes = [
9   {path: 'parent', component:ParentComponent},
10  {path: 'dashboard', component:DashboardComponent},
11  {path: 'heroes', component:HeroesComponent},
12  {path: 'hero/:id', component:HeroDetailsComponent },
13  {path: '', redirectTo: '/dashboard', pathMatch:'full'}
14];
```

```
:> app > ts app-routing.module.ts > ...
You, 44 seconds ago | 1 author (You)
1 import { NgModule } from '@angular/core';
2 import { RouterModule, Routes } from '@angular/router';
3 import { DashboardComponent } from './dashboard/dashboard.component';
4 import { HeroDetailsComponent } from './heroes/hero-details/hero-details.component';
5 import { HeroesComponent } from './heroes/heroes.component';
6
7 const routes: Routes = [
8   {path: 'dashboard', component:DashboardComponent},
9   {path: 'heroes', component:HeroesComponent},
10  {path: 'hero/:id', component:HeroDetailsComponent },
11  {path: '', redirectTo: '/dashboard', pathMatch:'full'}
12];
13
You, 2 days ago | 1 author (You)
14 @NgModule({
15   imports: [RouterModule.forRoot(routes)],
16   exports: [RouterModule]
17 })
18 export class AppRoutingModule { }
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Routing & Navigation with Pages continued...

```
app.component.html M X
> app > < app.component.html > mat-toolbar
0
1   </mat-toolbar>
2   <mat-sidenav-container>
3     <mat-sidenav #sidenav mode="side" opened="true" class="side-container">
4       <mat-nav-list>
5
6         → <a mat-list-item [routerLink]="/dashboard"> Dashboard </a>
7         → <a mat-list-item [routerLink]="/heroes"> Heroes </a>
8
9       </mat-nav-list>
10      </mat-sidenav>
11      <mat-sidenav-content class="content-container">
12        <div style="height: 88vh;">
13          <router-outlet></router-outlet>
14        </div>
15      </mat-sidenav-content>
16    </mat-sidenav-container>
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Routing & Navigation with Pages continued...

```
<td mat-cell *matCellDef="let element"> <button mat-button [routerLink]="['/hero', element.id]"> ←  
| | <mat-icon>face</mat-icon>  
ts hero-details.component.ts ×  
src > app > heroes > hero-details > ts hero-details.component.ts > ...  
1 import { Component, OnInit } from '@angular/core';  
2 import { HeroService } from '../../../../../services/hero.service';  
3 import { ActivatedRoute, RouterModule } from '@angular/router';  
4 import { MaterialModule } from '../../../../../shared/material.module';  
5  
6 @Component({  
7   selector: 'app-hero-details',  
8   standalone: true,  
9   imports: [MaterialModule, RouterModule],  
10  templateUrl: './hero-details.component.html',  
11  styleUrls: ['./hero-details.component.scss'  
12 })  
13 export class HeroDetailsComponent implements OnInit {  
14   hero:any  
15   constructor(private heroService: HeroService, private route: ActivatedRoute) { } ←  
16  
17   ngOnInit(): void {  
18     this.heroService.getHero(+this.route.snapshot.params['id']).subscribe(hero: any) => {this.hero = hero} ←  
19   }  
20 }  
21 }  
22 }
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Routing & Navigation with Pages continued...

- Demo



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

@Input & @Output Decorators



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

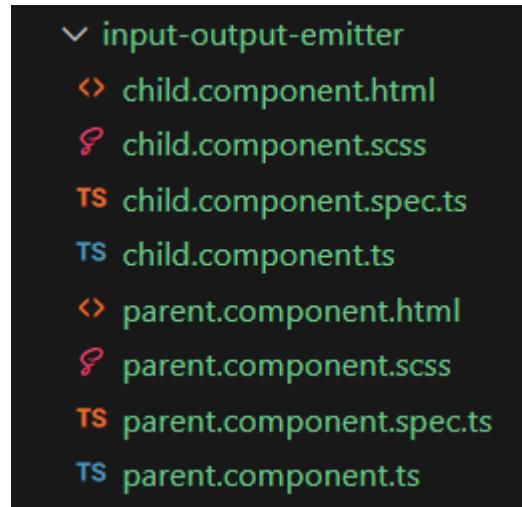
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

@Input & @Output Decorators

- **@Input** and **@Output** are fundamental to creating dynamic and interactive component relationships in Angular applications.
- **@Input** controls data flow from *parent to child*, and **@Output** handles data flow from *child to parent*.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

@Input & @Output Decorators continued ...

■ Parent Component & Template

```
ts parent.component.ts U X
src > app > input-output-emitter > ts parent.component.ts > ...
1 import { Component } from '@angular/core';
2 import { ChildComponent } from './child.component';
3
4 @Component({
5   selector: 'app-parent',
6   standalone: true,
7   imports: [ChildComponent],
8   templateUrl: './parent.component.html',
9   styleUrls: ['./parent.component.scss'
10 })
11 export class ParentComponent {
12   parentCount: number = 5;
13
14   handleCountChange(newCount: number) {
15     this.parentCount = newCount;
16   }
17 }
```

```
↳ parent.component.html U X
src > app > input-output-emitter > ↳ parent.component.html > ...
Go to component
1 <div style="text-align: center">
2   <h1>Parent Component Count: {{ parentCount }}</h1>
3   <app-child [initialCount]="parentCount" (countChange)="handleCountChange($event)"></app-child>
4 </div>
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

@Input & @Output Decorators continued...

■ Child Component & Template

```
ts child.component.ts U X
src > app > input-output-emitter > ts child.component.ts > ...
1 import { Component, EventEmitter, Input, Output } from '@angular/core';
2
3 @Component({
4   selector: 'app-child',
5   standalone: true,
6   imports: [],
7   templateUrl: './child.component.html',
8   styleUrls: ['./child.component.scss'
9 })
10 export class ChildComponent {
11   @Input() initialCount: any;
12   @Output() countChange = new EventEmitter<number>();
13
14   currentCount: number = 0;
15
16   incrementCount() {
17     this.currentCount++;
18     this.countChange.emit(this.calculateTotal());
19   }
20
21   calculateTotal(){
22     if (this.currentCount <=1)
23       return this.currentCount = this.initialCount + this.currentCount;
24     else
25       return this.currentCount;
26   }
27 }
```

```
▷ child.component.html U X
src > app > input-output-emitter > ▷ child.component.html > ...
Go to component
1 <button mat-raised-button (click)="incrementCount()">
2   Increment Counter (Current: {{ calculateTotal() }})
3 </button>
4
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

@Input & @Output Decorators continued...

- Demo



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Additional Mentions



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

INF 354: Advanced Programming



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Make today matter

www.up.ac.za

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic 1

Learning Outcome:

- ❖ Understand, develop, and deploy mobile applications using the Ionic framework and TypeScript.

Learning Objectives:

- ❖ To understand the purpose of using Ionic
- ❖ To develop an Ionic project



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Make today matter
www.up.ac.za

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Outline

- ❖ Introduction
- ❖ Architecture
- ❖ Setup
- ❖ CLI
- ❖ Practical



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

IONIC 1

Introduction



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Make today matter

www.up.ac.za

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic

- Ionic 6 is an open-source UI toolkit that includes over 100 components.
- It works with Angular, React, Vue, and other frameworks.
- It's cross-platform and has an adaptable user interface.
- The stunning open-source platform for creating hybrid mobile apps



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Key Features of Ionic Framework

- Cross-Platform Development
- Integration with Angular
- Component Library
- Capacitor
- Performance
- Development Efficiency
- Community and Support



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Native vs Hybrid App

Native App

- Proficiency in each platform required
- Entirely separate code bases
- Timely & expensive development

Hybrid App

- HTML5 that acts like native
- Web wrapped in the native layer
- Direct access to native APIs



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Native vs Hybrid App

Native App	Hybrid App
Native apps are platform specific	Hybrid apps are platform independent
Respective development tools	It employs HTML5, CSS3, and JavaScript
Good performance	It has restricted performance
Time consuming apps	it can be produced more quickly than native apps..
Expensive app development	Using Capacitor, we can directly access native APIs



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Prerequisite

To get started with Ionic Framework, the only requirement is

- Node
- npm environment.
- Visual Studio Code



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic I - CLI

- To install the CLI: **npm install -g @ionic/cli**
- To create a project: **ionic start projectname template**
- To create an angular ionic app: **ionic start projectname tabs --type=angular**
- To test in a browser: **ionic serve**
- To see all templates available: **ionic start --list**



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

The End



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za



ENGINEERING 4.0
UNIVERSITY OF PRETORIA



INF 354: Advanced Programming



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

LP 09: Ionic II



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Outline

- ❖ Install & Configure
- ❖ Ionic CLI
- ❖ Ionic Framework Components
- ❖ Ionic Service API Integration
- ❖ Ionic Tabs & Routing
- ❖ Ionic Framework Components Implementation
- ❖ Additional Mentions
- ❖ In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Install & Configure



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Install & Configure

- Node.js (website)
- npm install -g @ionic/cli
- ionic start **yourprojectname** tabs --type=angular
- ionic serve -o



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic CLI



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Ionic CLI

- <https://ionicframework.com/docs/intro/cli>
- ionic generate

```
PS D:\UP\Teaching\2023\INF354\Lecture09_Ionic_II\Ionic_II_app\hero> ionic generate
? What would you like to generate? (Use arrow keys)
> page
  component
  service
  module
  class
  directive
  guard
(Move up and down to reveal more choices)
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Framework Components



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Ionic Framework Components

- <https://ionicframework.com/docs/components>



Button

Buttons let your users take action. They're an essential way to interact with and navigate through an app.



Card

Cards are a great way to display an important piece of content, and can contain images, buttons, text, and more.



Chip

Chips are a compact way to display data or actions.



Modal

Modals slide in and off screen to display a temporary UI and are often used for login or sign-up pages.



Toast

Toast is used to show a notification over the top of an app's content. It can be temporary or dismissable.



Refresher

Refresher provides pull-to-refresh functionality on a content component.



Icons

Beautifully designed icons for use in web, iOS, Android, and desktop apps.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Service API Integration



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Ionic Service API Integration

■ ionic g s yourservicename

```
import { Injectable } from '@angular/core';
import { HttpClient, HttpHeaders } from '@angular/common/http';
import { map, Observable, Subject } from 'rxjs';
import { Hero } from '../shared/hero';

@Injectable({
  providedIn: 'root'
})
export class HeroService {

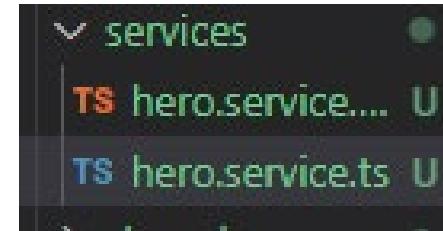
  apiUrl = 'http://localhost:5116/api/'

  httpOptions ={
    headers: new HttpHeaders({
      'Content-Type': 'application/json'
    })
  }

  constructor(private _httpClient: HttpClient) { }

  getHeroes(): Observable<Hero[]>{
    return this._httpClient.get<Hero[]>(`${this.apiUrl}Hero GetAllHeroes`)
      .pipe(map(result => result))
  }

  getHero(heroId: number) {
    return this._httpClient.get(` ${this.apiUrl}Hero GetHero` + "/" + heroId)
      .pipe(map(result => result))
  }
}
```

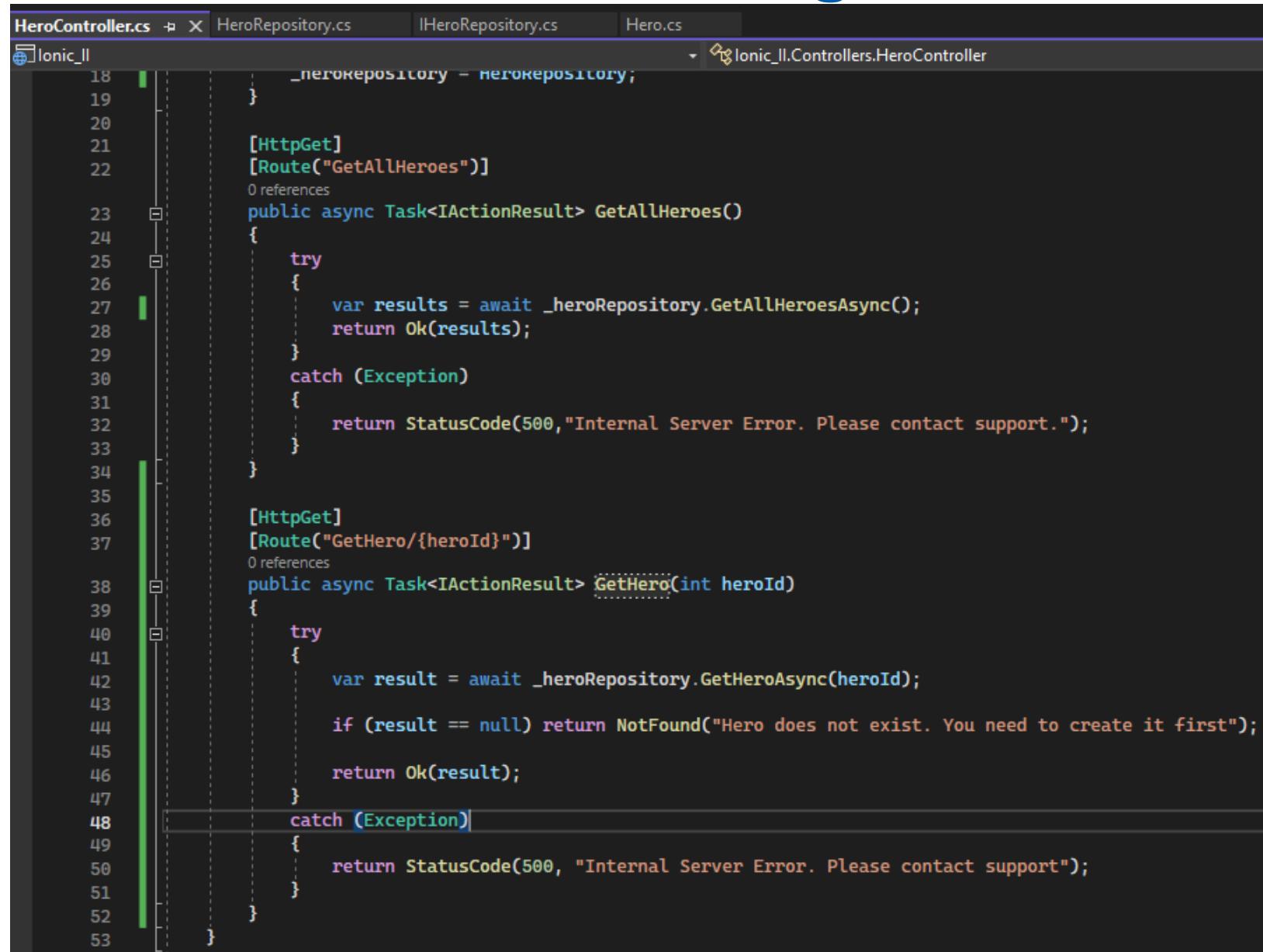


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Service API Integration continued...



The screenshot shows a code editor with several tabs at the top: HeroController.cs, X, HeroRepository.cs, IHeroRepository.cs, and Hero.cs. The Hero.cs tab is active, showing the following C# code:

```
18     _heroRepository = heroRepository;
19 }
20
21 [HttpGet]
22 [Route("GetAllHeroes")]
23 public async Task<IActionResult> GetAllHeroes()
24 {
25     try
26     {
27         var results = await _heroRepository.GetAllHeroesAsync();
28         return Ok(results);
29     }
30     catch (Exception)
31     {
32         return StatusCode(500, "Internal Server Error. Please contact support.");
33     }
34 }
35
36 [HttpGet]
37 [Route("GetHero/{heroId}")]
38 public async Task<IActionResult> GetHero(int heroId)
39 {
40     try
41     {
42         var result = await _heroRepository.GetHeroAsync(heroId);
43
44         if (result == null) return NotFound("Hero does not exist. You need to create it first");
45
46         return Ok(result);
47     }
48     catch (Exception)
49     {
50         return StatusCode(500, "Internal Server Error. Please contact support");
51     }
52 }
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Ionic Service API Integration continued...

```
HeroRepository.cs | IHeroRepository.cs | Hero.cs + X
using System.ComponentModel.DataAnnotations;

namespace Ionic_II.Models
{
    19 references
    public class Hero
    {
        [Key]
        1 reference
        public int HeroId { get; set; }
        0 references
        public string Name { get; set; }
        0 references
        public int Age { get; set; }
        0 references
        public string Birthday { get; set; }
        0 references
        public string Height { get; set; }
        0 references
        public bool isAlive { get; set; }
        0 references
        public string FileName { get; set; }
        0 references
        public string ImageBase64 { get; set; }
    }
}
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Service API Integration continued...

Herold	Name	Age	Birthday	Height	isAlive	FileName	ImageBase64
1	Samuel Thomas 'Sam' Wilson (Falcon/Captain Ameri...	40	September 23	178cm	1	Anthony-Mackie-Captain-America-4.webp	data:image/webp;base64,UkIGRvhAAABXRUJQVIA4IOxuAAD...
2	Scott Lang (Ant-Man)	34		178cm	1	antman-and-the-wasp-marvel-4.webp	data:image/webp;base64,UkIGRmbqAABXRUJQVIA4IFrqAAD...
3	Natasha Romanoff (Black Widow)	39	December 3	164cm	1	black-widow-1.webp	data:image/webp;base64,UkIGrvRWAABXRUJQVIA4IohWAA...
4	Colonel James 'Rhodey' Rhodes (War Machine)	55	October 6	173cm	1	Don-cheadle-as-rhodey-Cropped.webp	data:image/webp;base64,UkIGRgqCAABXRUJQVIA4IP6BAA...
5	Clint Barton (Hawkeye)	53	June 18	173cm	1	hawkeye.webp	data:image/webp;base64,UkIGRtKEAABXRUJQVIA4IMaEAA...
6	Peter Parker (Spider-Man)	19	August 10	170cm	1	peter-parker-Cropped.webp	data:image/webp;base64,UkIGRjI9AABXRUJQVIA4ICY9AACw...
7	Steve Rogers (Captain America)	34	July 4	185cm	0	steve-rogers.webp	data:image/webp;base64,UkIGRpQ4AABXRUJQVIA4Ilg4AAB...
8	Bruce Banner (The Hulk)	54	December 18	250cm	1	The-Incredible-Hulk.webp	data:image/webp;base64,UkIGRI50AABXRUJQVIA4IFJ0AAD...
9	Thor	1059		192cm	1	thor-lightning.webp	data:image/webp;base64,UkIGRjhKAABXRUJQVIA4ICxKAAD...
10	Tony Stark (Iron Man)	53	May 29	185cm	0	tony-stark-iron-man.webp	data:image/webp;base64,UkIGRjiPAABXRUJQVIA4ICyPAAD...
11	Vision	3	May 29	178cm	1	Vision-Civil-War-Cropped.webp	data:image/webp;base64,UkIGriRTAABXRUJQVIA4IBhTAAB...
12	Wanda Maximoff (Scarlet Witch)	30	February 10	168cm	1	Wanda-Scarlet-Witch-Cropped.webp	data:image/webp;base64,UkIGRs5XAABXRUJQVIA4IMJXAA...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Service API Integration continued...

ionic_II 1.0 OAS3

<http://localhost:5116/swagger/v1/swagger.json>

Hero

^

GET /api/Hero GetAllHeroes

GET /api/Hero/GetHero/{heroId}



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Ionic Service API Integration continued...

```
Heroes: Observable<Hero[]>;  
constructor(private _toastController: ToastController, private _heroService: HeroService) {  
  this.Heroes = this._heroService.getHeroes();  
}  
}
```

```
<ion-card button *ngFor="let hero of (Heroes | async)" [routerLink]="['hero-detail', hero.heroId]">  
  <ion-img [src]="hero.imageBase64"></ion-img>  
</ion-card>
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Ionic Service API Integration continued...

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Tabs & Routing



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

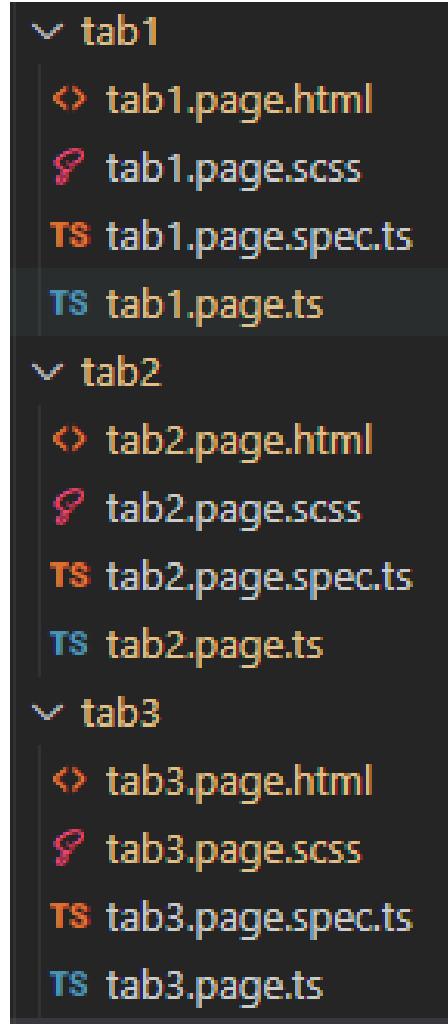
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Ionic Tabs & Routing

- 3 default tabs created with ionic start --tabs app.



```
ts tab3.page.ts ×

src > app > tab3 > ts tab3.page.ts > ...
    You, 4 days ago | 1 author (You)
1 < import { Component } from '@angular/core';
2 import { IonicModule } from '@ionic/angular';
3 import { ExploreContainerComponent } from '../explore-container/explore-container.component';
4
    You, 4 days ago | 1 author (You)
5 < @Component({
6   selector: 'app-tab3',
7   templateUrl: 'tab3.page.html',
8   styleUrls: ['tab3.page.scss'],
9   standalone: true,
10  imports: [IonicModule, ExploreContainerComponent],
11 })
12 < export class Tab3Page {
13   constructor() {}
14 }
```



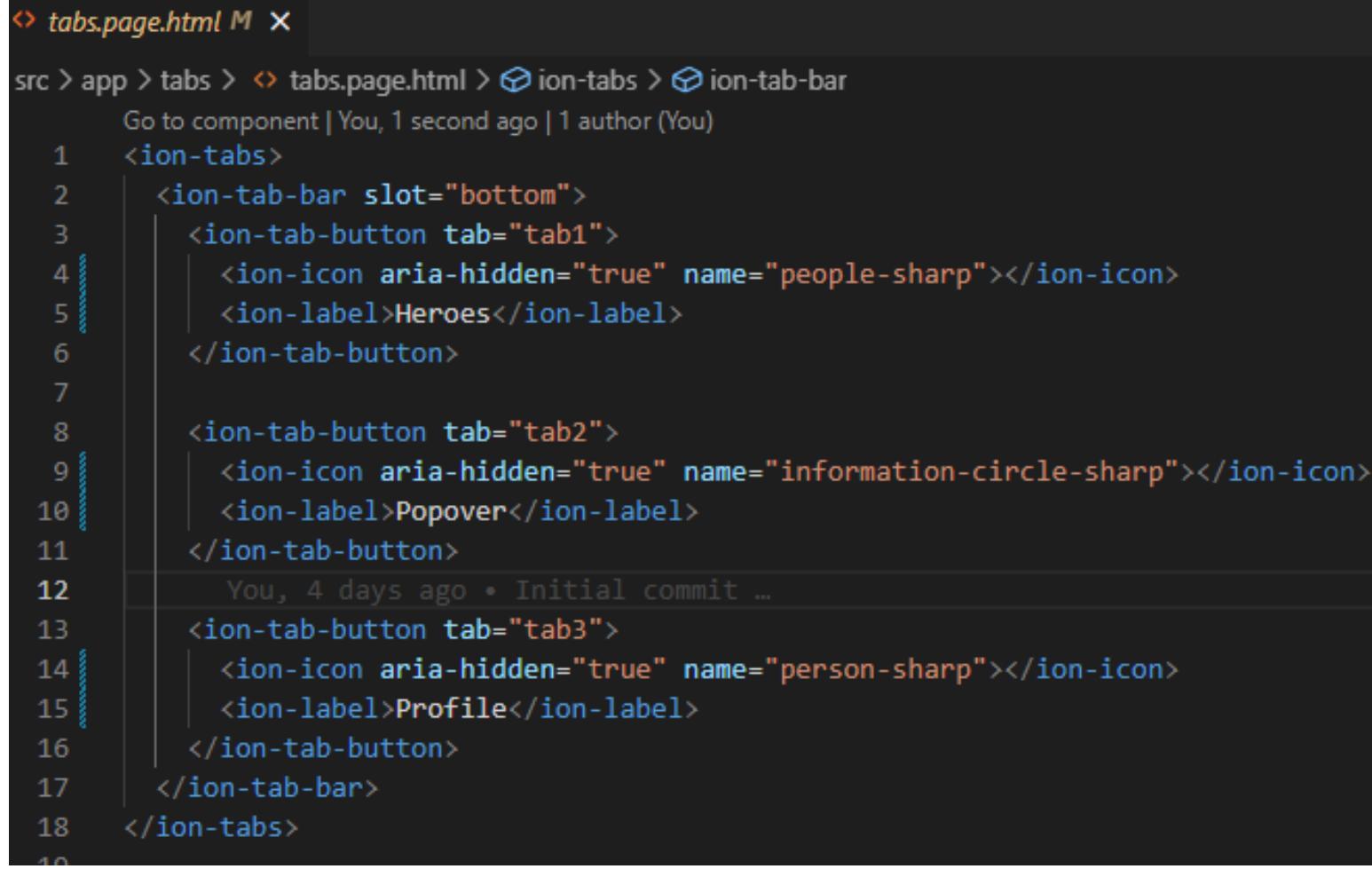
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Tabs & Routing continued...

- default tabs folder created as well. **Location for the tabs Routes.**

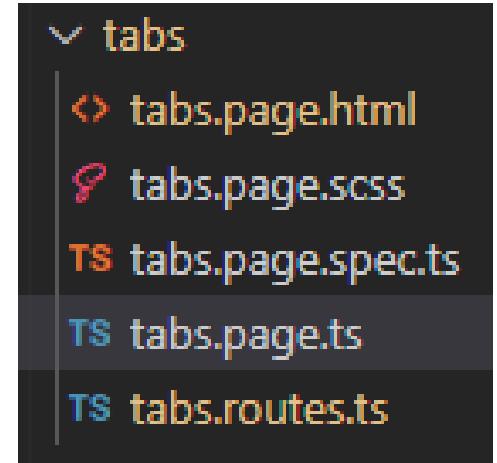


tabs.page.html M

src > app > tabs > tabs.page.html > ion-tabs > ion-tab-bar

Go to component | You, 1 second ago | 1 author (You)

```
1 <ion-tabs>
2   <ion-tab-bar slot="bottom">
3     <ion-tab-button tab="tab1">
4       <ion-icon aria-hidden="true" name="people-sharp"></ion-icon>
5       <ion-label>Heroes</ion-label>
6     </ion-tab-button>
7
8     <ion-tab-button tab="tab2">
9       <ion-icon aria-hidden="true" name="information-circle-sharp"></ion-icon>
10      <ion-label>Popover</ion-label>
11    </ion-tab-button>
12
13    <ion-tab-button tab="tab3">
14      <ion-icon aria-hidden="true" name="person-sharp"></ion-icon>
15      <ion-label>Profile</ion-label>
16    </ion-tab-button>
17
18 </ion-tab-bar>
19 </ion-tabs>
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Tabs & Routing continued...

■ tabs Routes

```
tabs.routes.ts M X
: > app > tabs > ts tabs.routes.ts > [?] routes
    You, 2 minutes ago | 1 author (You)
1  import { Routes } from '@angular/router';
2  import { TabsPage } from './tabs.page';

3
4  export const routes: Routes = [
5    {
6      path: 'tabs',
7      component: TabsPage,
8      children: [
9        {
10          path: 'tab1',
11          loadChildren: () => [
12            {
13              path: '',
14              loadComponent: () =>
15                import('../tab1/tab1.page').then((m) => m.Tab1Page),
16            },
17            {
18              path: 'hero-detail/:heroId',
19              loadComponent: () => import('../hero-detail/hero-detail.page').t
20            },
21          ],
22        },
23        {
24          path: 'tab2',
25          loadComponent: () =>
26            import('../tab2/tab2.page').then((m) => m.Tab2Page),
27        },
28        {
29          path: 'tab3',
30          loadComponent: () =>
31            import('../tab3/tab3.page').then((m) => m.Tab3Page),
32        }
33      ]
34    }
35  ]
36 }
```

```
  path: '',
  redirectTo: '/tabs/tab1',
  pathMatch: 'full',
},
],
},
{
  path: '',
  redirectTo: '/tabs/tab1',
  pathMatch: 'full',
},
]
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Ionic Tabs & Routing continued...

■ app Routes

```
$ app.routes.ts M X
rc > app > TS app.routes.ts > ...
You, 31 seconds ago | 1 author (You)
1 import { Routes } from '@angular/router';
2
3 export const routes: Routes = [
4   {
5     path: '',
6     loadChildren: () => import('./tabs/tabs.routes').then((m) => m.routes),
7   },
8   // {
9   //   path: 'herostatus',
10  //   loadComponent: () => import('./herostatus/herostatus.page').then( m => m.HerostatusPage)
11  // },
12  // {
13  //   path: 'hero-detail',
14  //   loadComponent: () => import('./hero-detail/hero-detail.page').then( m => m.HeroDetailPage)
15  // },
16];
.
```



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Tabs & Routing continued...

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Framework Components Implementation



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Ionic Framework Components Implementation

- ion-avatar
- ion-card
- ion-button | ion-fab-button
- ion-list
- ion-skeleton-text
- ion-refresher
- Modal
- Popover



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Ionic Framework Components Implementation

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Additional Mentions



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za



ENGINEERING 4.0
UNIVERSITY OF PRETORIA



INF 354: Advanced Programming



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

LP 10: Application Security



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Outline

- ❖ Theory
- ❖ .NET Identity Installations
- ❖ Setup & Configuration
- ❖ Create Register functionality
- ❖ Create Login functionality
- ❖ Create API Bearer JWT
- ❖ Configure Swagger (Enable Headers)
- ❖ Endpoint to Accept JWT Token
- ❖ Additional Mentions
- ❖ In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Theory

- Authenticate (check to see if the person exist)
- Authorize (check what authorization (e.g. role) the user has)
- Audit (log what the user did) user access to the things he/she was limited to by, e.g. Administrator.

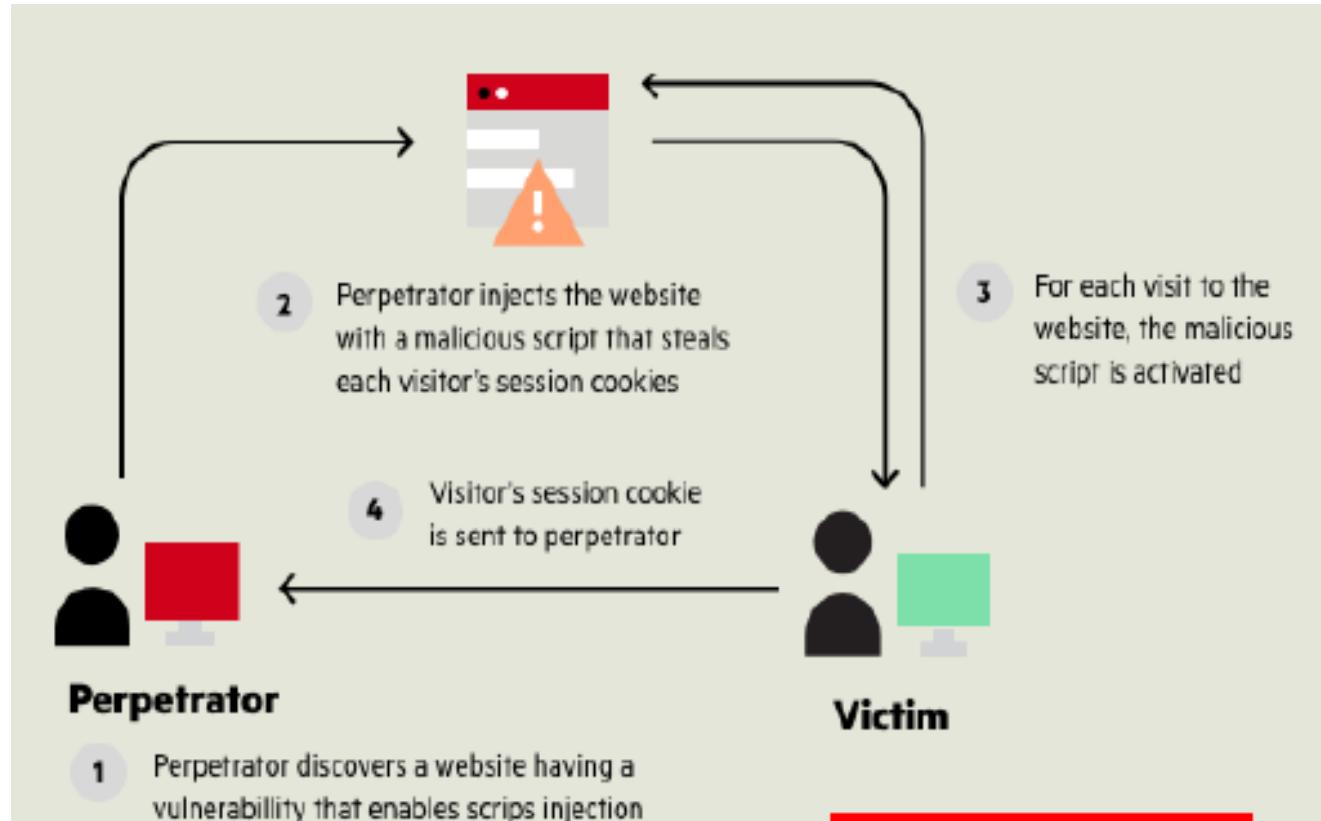


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory continued...

- Without any sort of authentication and authorization, anyone with the link to the API can access the data and get private company information like customer details and can cause a lot of problems.
- This is not only to protect your own resources, but the confidentiality of your end users as well.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory continued...

The most common response codes:

- 200 OK (Means everything is successful and the resources can be fetched)
- 404 Not Found (The server can not find the requested resources)
- 403 Forbidden (This means you don't have the access right to the content)
- 401 Unauthorized (Means you are not authenticated to request the resource)
- 400 Bad Request (Client Issue – server cannot/will not process the request)
- 500 Internal Server Error (Something has gone wrong on the server)

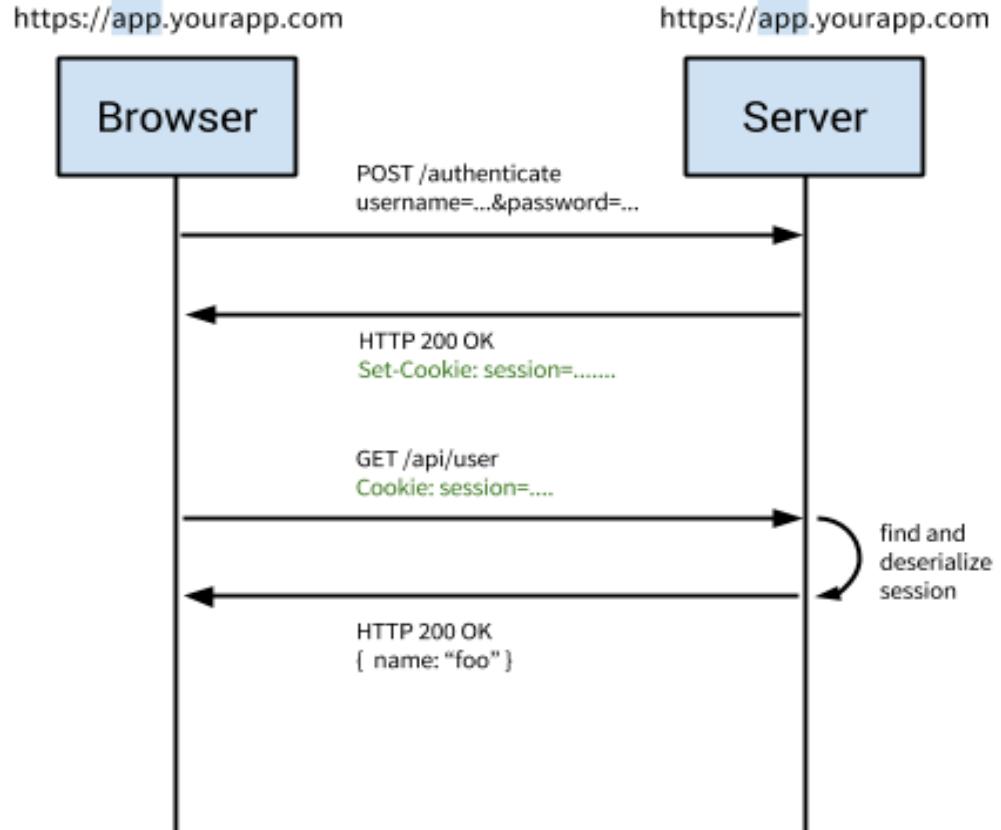


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

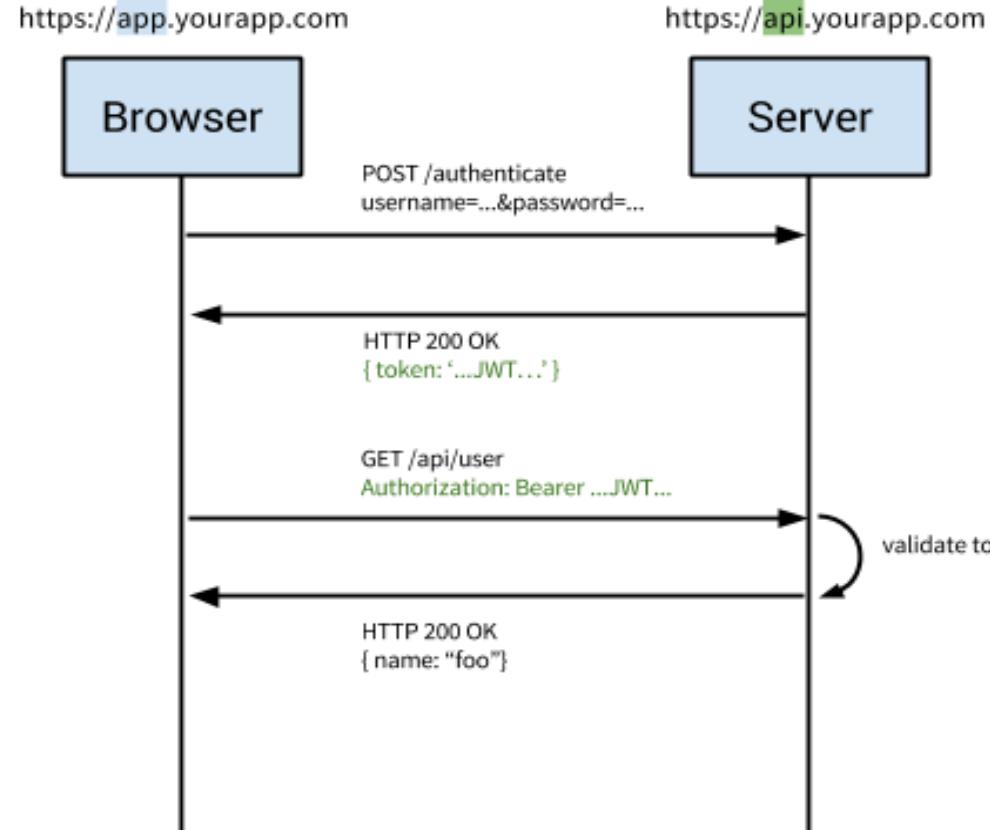
Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory continued...

Traditional Cookie-Based Auth



Modern Token-Based Auth



Theory continued...

Encoded

```
eyJhbGciOiJIUzI1NiIsInR5cCI6  
IkpxVCJ9.eyJzdWIiOiIxMjM0NTY  
3ODkwIiwibmFtZSI6IkpvG4gRG9  
lIiwiYWRtaW4iOnRydWV9.TJVA95  
OrM7E2cBab30RMHrHDcEfjoYZge  
FONFh7HgQ
```

Decoded

HEADER:

```
{  
  "alg": "HS256",  
  "typ": "JWT"  
}
```

PAYOUT:

```
{  
  "sub": "1234567890",  
  "name": "John Doe",  
  "admin": true  
}
```

VERIFY SIGNATURE

```
HMACSHA256(  
  base64UrlEncode(header) + "." +  
  base64UrlEncode(payload),  
  secret  
)  secret base64 encoded
```



Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

matter

www.up.ac.za

.NET Identity Installations



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

.NET Identity Installations

	Microsoft.AspNetCore.Identity.EntityFrameworkCore by Microsoft	5.0.17
	ASP.NET Core Identity provider that uses Entity Framework Core.	6.0.5
	Microsoft.Extensions.Identity.Core by Microsoft	5.0.17
	ASP.NET Core Identity is the membership system for building ASP.NET Core web applications, including membership, login, and user data. ASP.NET Core Identity allows you to add login features to your applic...	6.0.5
	Microsoft.Extensions.Identity.Stores by Microsoft	5.0.17
	ASP.NET Core Identity is the membership system for building ASP.NET Core web applications, including membership, login, and user data. ASP.NET Core Identity allows you to add login features to your applic...	6.0.5
	Microsoft.AspNetCore.Authentication.JwtBearer by Microsoft	5.0.17
	ASP.NET Core middleware that enables an application to receive an OpenID Connect bearer token.	6.0.5



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Setup & Configuration



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Setup & Configuration

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Create Register functionality



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Create Register functionality

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Create Login functionality



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Create Login functionality

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Create API Bearer JWT



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Create API Bearer JWT

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Configure Swagger (Enable Headers)



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Configure Swagger (Enable Headers)

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Create Roles functionality



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Create Roles functionality

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Endpoint to Accept JWT Token



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Endpoint to Accept JWT Token

- Demo...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Additional Mentions



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za



ENGINEERING 4.0
UNIVERSITY OF PRETORIA



INF 354: Advanced Programming



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

LP 13: Advanced Concepts II



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Outline

- ❖ Theory
- ❖ Creating the ChatBot
- ❖ Training and Testing the Model
- ❖ Incorporate into Web app
- ❖ Additional Mentions
- ❖ In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

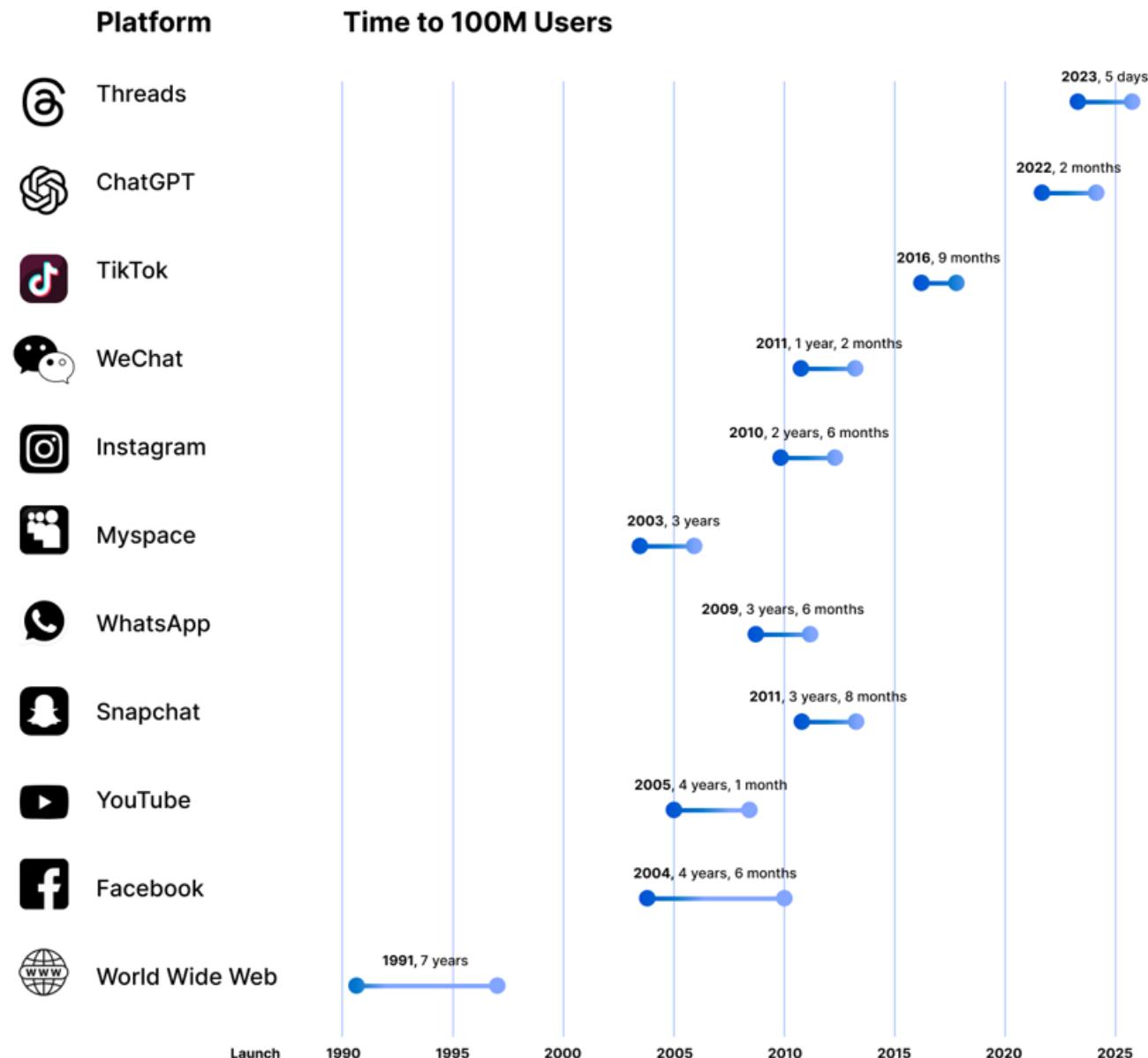
**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

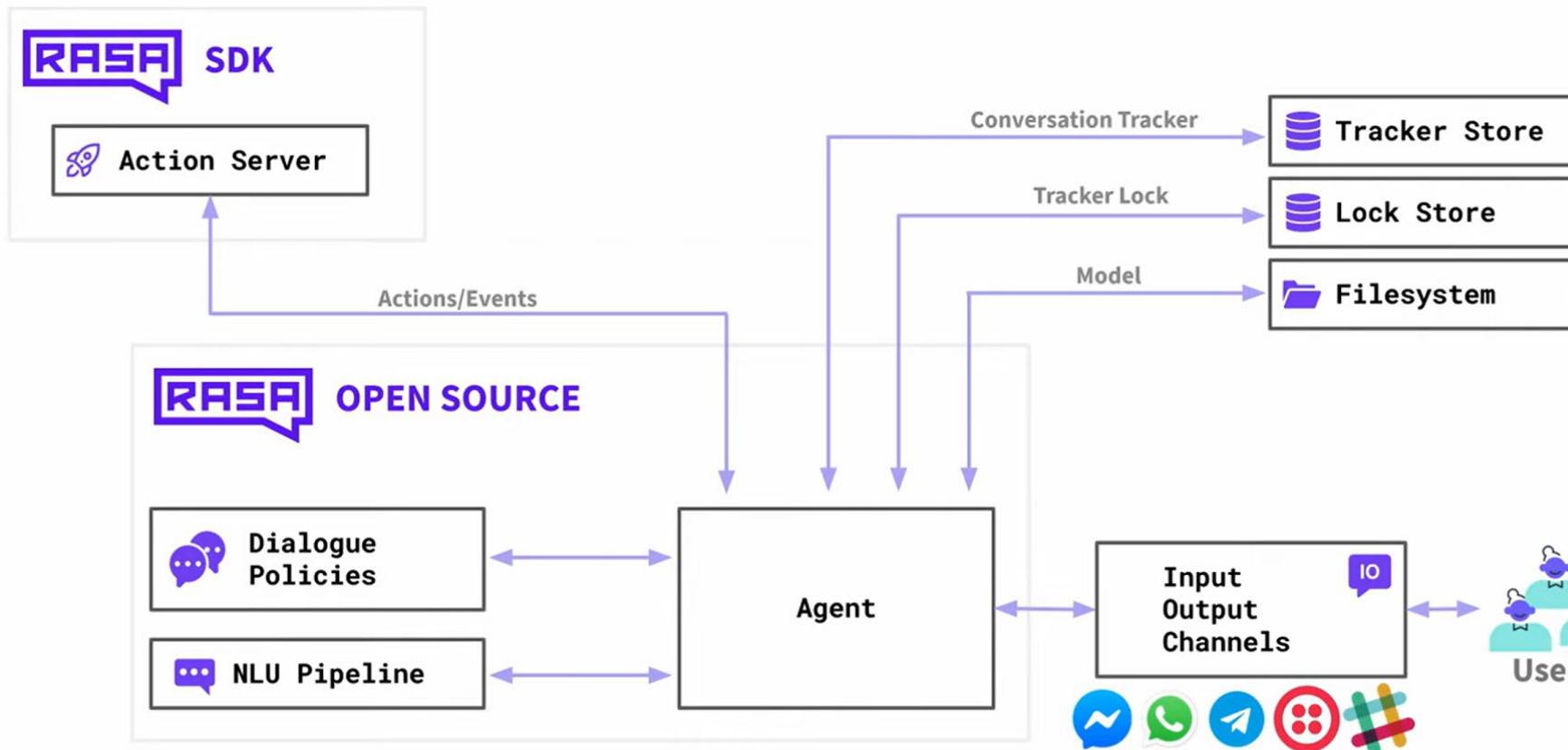
Make today matter
www.up.ac.za

Theory

- NLP: Natural Language Processing
- NLU: Natural Language Understanding
- NLG: Natural Language Generation



Theory continued...



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory continued...

Terminology:

- Narrow assistant – defined skill-set
- Intents - are the goals or meaning the user is trying to convey
- Entities – are important keywords, that you want to capture, that the models extract from users message
- Custom Action - getting the assistant to do something for you. E.g., connect to a database, posting data to an API, send data to a spreadsheet
- Forms – uses slots to store values



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Theory continued...

Key Files:

- NLU.yml – create intents
- Domain.yml – Register intents and Write response templates
- Stories.yml – Write stories using new intents and responses



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Creating the ChatBot



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Creating the ChatBot

Install requirements:

- Visual studio for C++ dependencies (via VS)
- Python 3.10
- Rasa



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Creating the ChatBot continued...

Key commands:

- pip install rasa (install rasa)
- rasa init (start new project)
- rasa shell (command line)
- rasa interactive (interactive learning session)
- rasa run --enable-api (enable api)
- rasa run -m model --enable-api --cors "*" -p 5005 (run on specific port with cors)



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Creating the ChatBot continued...

Demo



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Training and Testing the Model



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Training and Testing the Model

Demo



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Incorporate into Web app



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za

Incorporate into Web app

Demo



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

Additional Mentions



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter
www.up.ac.za

In-Class Practice



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and
Information Technology**

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

www.up.ac.za