Full Stack Application Development- SE ZG503

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Lecture No: 1 - Introduction to the Various Application Landscape

Introduction

This course aims to provide a comprehensive introduction to modern Web application architecture approaches, frontend and backend technologies, and suitable web application frameworks required for developing modern web apps.

Learning Outcomes
Understand the underlying architecture used for Web applications and identify the various components of the Web Application
Demonstrate the creation of API to accomplish various backend functionalities of an application like database interaction, handling user requests
Design and develop user-friendly and interactive web frontends.
Implement a functional end-to-end web application using client-side and server-side web technologies.

Modular Structure

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Module 1: Application Development

Introduction to the Various Application Landscape

Module 2: Understanding the Web Basics

Structure of web applications, Client – Server Communication

Module 3: Web Protocols

HTTP, HTTPS, WebSockets

Module 4: Server Side: Implementing Web Services

REST, gRPC, GraphQL

Module 5: Securing Application

JWT, OAuth

Modular Structure

Module 6: Understanding Frontend Development

Implementing Single Page Applications using JavaScript Tech stack

Module 7: Testing

API Testing, Unit Testing

Module 8: Accessibility and Performance

Inclusive Design , Assistive Technologies, Tools and Metrics for Measuring Performance

Module 9: Latest Advancements

Progressive Web Apps

Web Assembly

Development Environment

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Tools/Technologies

- Visual Studio Code
- Browser(Chrome)
- Frontend: ReactJS, Node Ecosystem
- Backend: NodeJS, Express, Django
- Database: MongoDB/Postgresql
- Postman for Testing
- GitHub and GIT

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Module 1: Application Introduction

Activity 1

Open Makemytrip in a browser

Open the BITS Website in a browser

Observe the difference in the address bar!!

Repeat in a different browser

Install the app from one browser and observe

Website-What & Why?

A group of interlinked web pages having a single domain name

- Hosted on a web server
- Accessible over the web with an internet connection
- Easily accessible through browsers
- Can be developed and maintained by individuals/teams for personal or business usage

Use Cases for Static Websites

- portfolios
- personal blogs
- informational websites and
- small business websites with minimal content updates.

- They are also suitable for landing pages or temporary promotions where the content doesn’t change frequently.

Web Application

A web application is an application program stored on a remote server and delivered over the internet.

Users can access a web application through a web browser, such as Google Chrome, Mozilla Firefox or Safari.

Common web applications include e-commerce shops, webmail, and social networking sites.

Application Types

There are three basic types of mobile apps based on the technology used to develop the:

Native apps are created for one specific platform or operating system.

Web apps are responsive versions of websites that can work on any mobile device or OS because they're delivered using a browser.

Hybrid apps are combinations of both native and web apps, but wrapped within a native app, giving it the ability to have its icon or be downloaded from an app store.

Native Apps

Developed specifically for a particular mobile device

Installed directly onto the device itself

Needs to be downloaded via app stores such as

- Apple App Store
- Google Play store, etc.

Built for specific mobile operating system such as

- Apple iOS
- Android OS

An app made for Apple iOS will not work on Android OS or Windows OS

Need to target all major mobile operating systems

- require more money and more effort

Native Apps-Pros and Cons

Pros

- Can be Used offline - faster to open and access anytime
- Allow direct access to device hardware that is either more difficult or impossible with web apps
- Allow the user to use device-specific hand gestures
- Full access to all device features and APIs.
- Gets the approval of the app store they are intended for
- User can be assured of improved safety and security of the app

Native Apps-Pros and Cons

Cons

- More expensive to develop - separate app for each target platform
- The cost of app maintenance is higher - especially if this app supports more than one mobile platform
- Getting the app approved for the various app stores can prove to be a long and tedious process
- Needs to download and install the updates to the apps ontouser’ss mobile device

Native Apps

Native apps are built specifically for one platform using its native programming language and tools.

iOS:

- **Language**: Swift, Objective-C
- **Frameworks**: UIKit, SwiftUI
- **Tools**: Xcode
- **Example App**: Instagram (iOS)

Android:

- **Language**: Java, Kotlin
- **Frameworks**: Android SDK
- **Tools**: Android Studio
- **Example App**: WhatsApp (Android)

Web Apps

Internet-enabled applications

- Accessible via the device's Web browser

Don't need to be downloaded and installed onto a mobile device

Written as web pages in HTML and CSS with interactive parts in JQuery, JavaScript, etc.

Single web app can be used on most devices capable of surfing the web irrespective of the operating system

Web Apps- Pros and Cons

Pros

- Instantly accessible to users via a browser
- Easier to update or maintain
- Easily discoverable through search engines
- Development is considerably more time and cost-effective than development of a native app
- common programming languages and technologies
- It has a much larger developer base.

Cons

- Only have limited scope as far as accessing a mobile device's features is concerned such as device-specific hand gestures, sensors, etc.
- Many variations between web browsers and browser versions and phones
- Challenging to develop a stable web app that runs on all devices without any issues
- Not listed in 'App Stores'
- Unavailable when offline, even as a basic version

Web Apps

Web apps run in web browsers and are built using standard web technologies.

Languages: HTML, CSS, JavaScript

Frameworks: React, Angular, Vue.js

Tools: Web browsers, developer tools

Example App: Google Docs

Progressive Web Application

A **progressive web app** (PWA) is an app that's built using web platform technologies

Like a platform-specific app, it can be installed on the device.

Offline and background operation

Progressive web apps combine the best features of traditional websites and platform-specific apps

Progressive Web Application

PWAs offer a native app-like experience on the web, including offline capabilities and installation.

Languages: HTML, CSS, JavaScript

Frameworks: Workbox, Lighthouse (for auditing)

Tools: Service Workers, Web App Manifests

Hybrid Apps

Hybrid apps combine elements of both native and web applications. They are built using web technologies but run inside a native container.

Languages: HTML, CSS, JavaScript

Frameworks: Ionic, Apache Cordova, PhoneGap

Tools: Web technologies wrapped in native code

Hybrid Apps

Part native apps, part web apps

Like native apps,

- available in an app store
- can take advantage of some device features available

Like web apps,

- Rely on HTML, CSS , JS for browser rendering

The heart of a hybrid mobile application is an application that is written with HTML, CSS, and JavaScript!

Run from within a native application and its own embedded browser, which is essentially invisible to the user

- iOS application would use the WKWebView to display the application
- Android app would use the WebView element to do the same function.

Hybrid Apps- Pros and Cons

Pros

- Don’t need a web browser like web apps
- Can access to a device’s internal APIs and device hardware
- Only one codebase is needed for hybrid apps

Cons

- Much slower than native apps
- With hybrid app development, dependent on a third-party platform to deploy the app’s wrapper
- Customization support is limited.

Cross-platform Application

Cross-platform app development refers to developing software that can run on multiple devices.

Multi-platform compatibility is a pervasively desirable trait.

Product to be available to as many consumers as possible.

Cross-platform Application

Cross-platform native apps use frameworks that allow development for multiple platforms from a single codebase, providing near-native performance.

Frameworks: React Native, Flutter, Xamarin

Tools: IDEs like Visual Studio, Android Studio

Example App:

- **React Native**: Facebook
- **Flutter**: Google Ads
- **Xamarin**: Microsoft Outlook

Native App vs Cross Platform

Native App Development	Cross Platform App Development
Native App Development is costly.	It is cost-effective.
Code cannot be reused	It supports code reusability. Same codebase is used across multiple platforms
Native apps are faster.	Cross Platform apps are slower than native apps

Cloud Native Application

Cloud-native is an approach to developing, deploying, and running applications using modern methods and tools.

The Cloud Native Computing Foundation(CNCF) defines

> *Cloud-native technologies empower organizations to build and run scalable applications in modern, dynamic environments such as public, private, and hybrid clouds. Containers, service meshes, microservices, immutable infrastructure, and declarative APIs exemplify this approach.*

Why Cloud Native

Monolithic Application

- A monolithic architecture refers to a traditional software design approach where an entire application is built as a single, self-contained unit.

Key characteristics of monolithic architecture include:

- ❑ Single Codebase
- ❑ Tight Coupling
- ❑ Single Deployment Unit
- ❑ Centralized Database
- ❑ Development and Scaling Challenges
- ❑ Longer Development Cycles
- ❑ Limited Fault Isolation

Cloud-Enabled Solutions

What happens when you move a monolithic app from on-premises to cloud?

A cloud-based application is an existing app shifted to a cloud ecosystem.

They are not able to utilize the full potential of the cloud

- Not scalable
- Less automation
- Longer Time to Market

Cloud-Native Applications are designed to run on the cloud computing architecture.

With cloud-native applications, you can take advantage of the automation and scalability that the cloud provides.

Cloud native vs. Cloud enabled

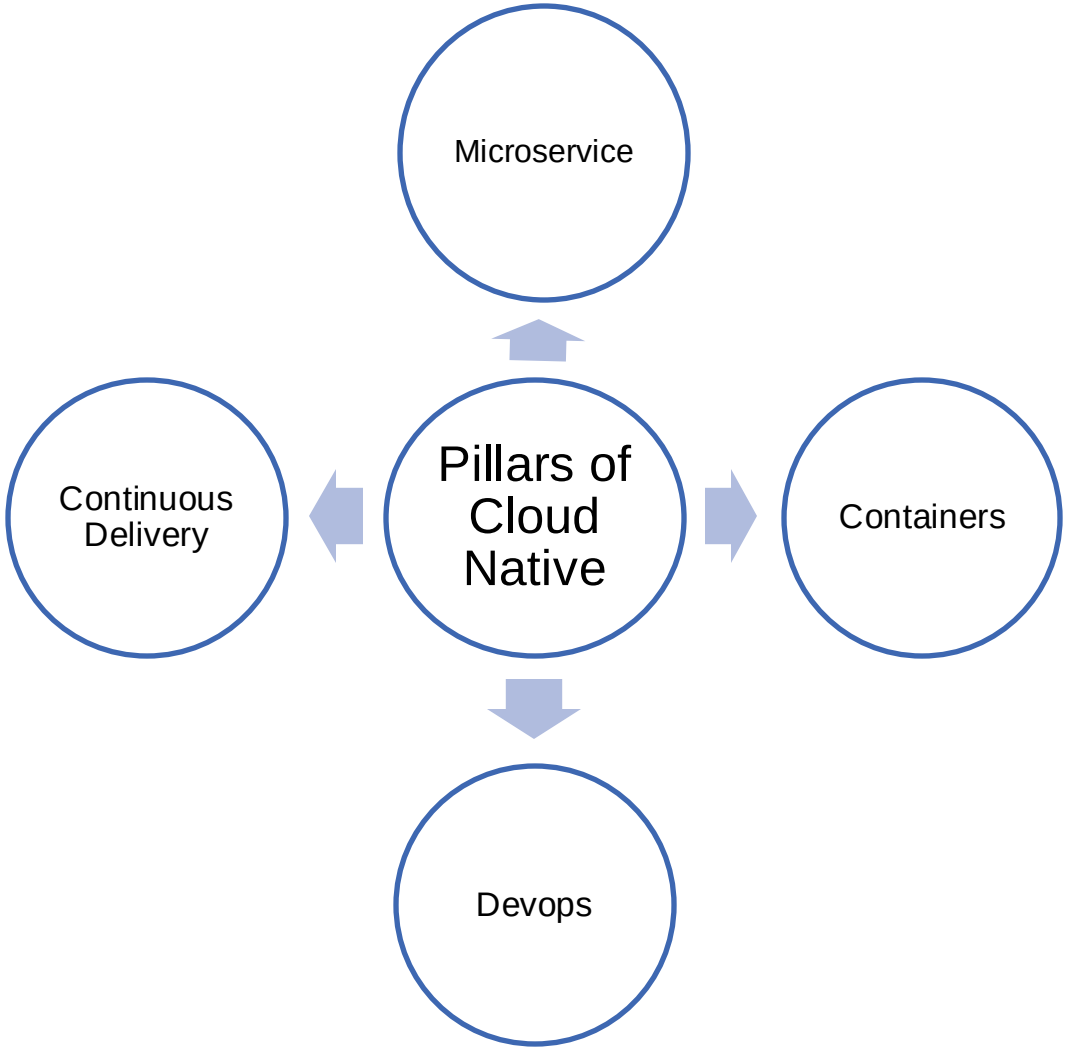
A cloud-enabled application is an application that was developed for deployment in a traditional data center but was later changed so that it could also run in a cloud environment

Cloud-native applications, however, are built to operate only in the cloud.

Developers design cloud-native applications to be

- Scalable
- platform agnostic
- and comprised of microservices

Cloud Native Applications



Building Blocks

Microservices

- ✓ is an architectural approach to developing an application as a collection of small services
- ✓ each service implements business capabilities, runs in its own process and communicates via HTTP APIs or messaging

Containers

- ✓ offer both efficiency and speed compared with standard virtual machines (VMs)
- ✓ Using operating system (OS)-level virtualization, a single OS instance is dynamically divided among one or more isolated containers, each with a unique writable file system and resource quota
- ✓ Low overhead of creating and destroying containers combined with the high packing density in a single VM makes containers an ideal compute vehicle for deploying individual microservices

Building Blocks

DevOps

- ✓ Collaboration between software developers and IT operations to constantly deliver high-quality software that solves customer challenges
- ✓ Creates a culture and an environment where building, testing, and releasing software happens rapidly, frequently, and more consistently

Continuous Delivery

- ✓ is about shipping small batches of software to production constantly through automation
- ✓ makes the act of releasing reliable, so organizations can deliver frequently, at less risk, and get feedback faster from end users

Advantages

Reduced Time to Market

Ease of Management

Scalability and Flexibility

Reduced Cost

Serverless Application

Serverless architecture is an approach to software design that allows developers to build and run services without managing the underlying infrastructure.

- Cloud service providers automatically provision, scale, and manage the infrastructure required to run the code.

Function as a Service

One of the most popular serverless architectures is Function as a Service (FaaS)

Developers write their application code as a set of discrete functions.

Each function will perform a specific task when triggered by an event

When a function is invoked, the cloud provider executes the function

The execution process is abstracted away from the view of developers.

Examples:

- AWS: AWS Lambda
- Microsoft Azure: Azure Functions
- Google Cloud: Cloud Functions

Serverless

Benefits

- Reduced operational cost
- Easier operational management
- Scalability

Drawbacks

- Loss of control
- Vendor lock-in
- Multitenancy problems
- Security concerns

AWS Serverless- Serverless Offering

AWS provides a set of fully managed services that can be used to build and run serverless applications

AWS Lambda

- Allows to run code without provisioning or managing servers

AWS Fargate

- Purpose-built serverless compute engine for containers

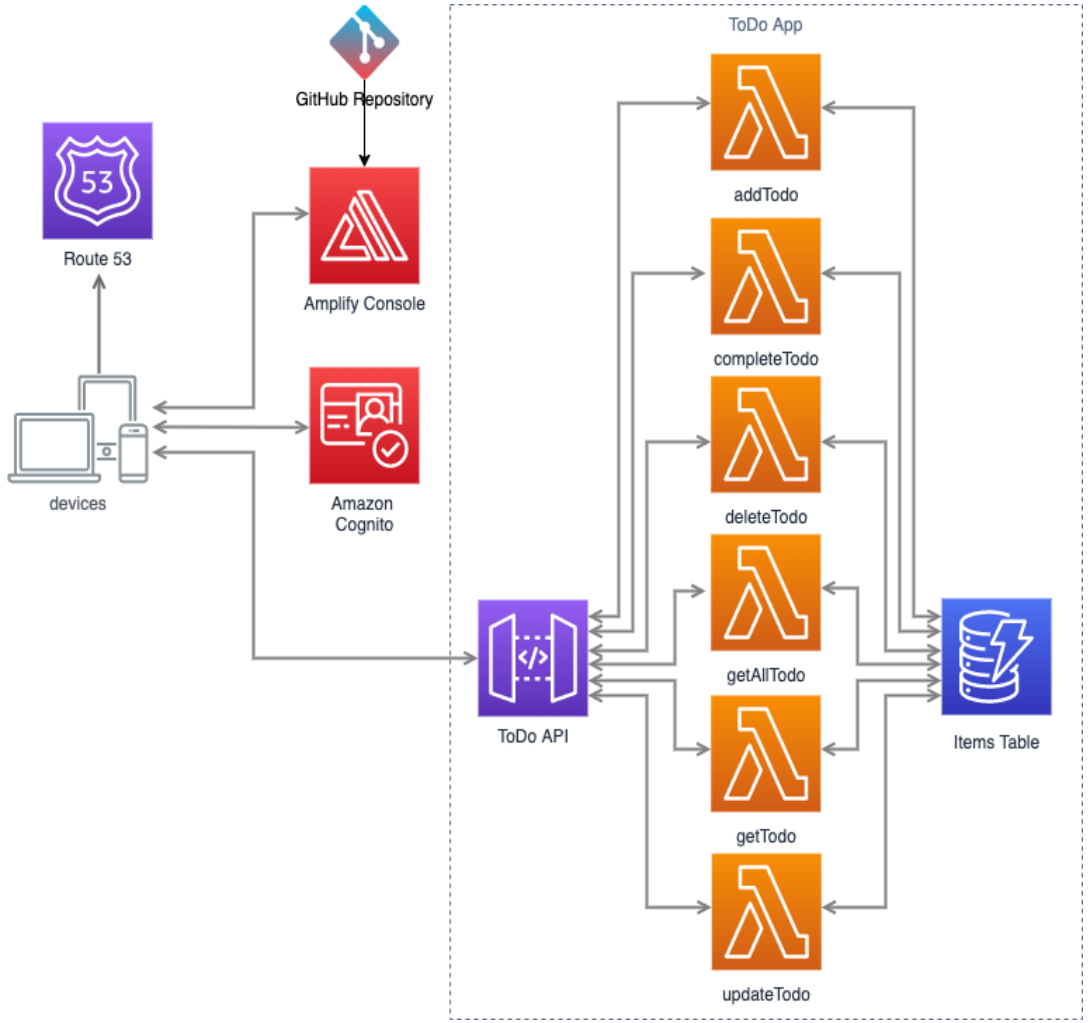
Amazon API Gateway

- Fully managed service that makes it easy for developers to create, publish, maintain, monitor, and secure APIs at any scale

Source : AWS Serverless

Example: AWS Serverless Architecture

- General-purpose, event-driven, web application back-end that uses
- AWS Lambda, Amazon API Gateway for its business logic
- Uses Amazon DynamoDB as its database
- Uses Amazon Cognito for user management
- All static content is hosted using AWS Amplify Console



Source : AWS

Self Reading

Recommendation 1:https://railsware.com/blog/native-vs-hybrid-vs-cross-platform/

Recommendation 2: https://litslink.com/blog/mobile-applications-development-native-web-cross-platform

References

1. https://developer.mozilla.org/en-US/
2. Full Stack Web Development: The Comprehensive Guide by Philip Ackermann Shroff/Rheinwerk Computing; First Edition (2 August 2023)

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Thank you