Web Technologies

Concepts for building modern web applications

What is this course about?

Situation

- the World Wide Web has become
a major delivery platform for information
resources

- many applications continue
to be developed in an ad-hoc way, contributing to problems of usability,
maintainability, quality and reliability

- required: systematic, disciplined and quantifiable approaches to developing high-
quality, reliable and usable web applications

What is this course about?

Objectives

➡ tools, techniques, concepts that support design and development of web applications

1 Introduction

- Web-Site
- Web-Application
- Characteristics of Web Applications
- Web Technologies
- Web Engineering

2 Course organization

- Topics
- Practical course

CAI Web Technologies | WS23/24 | Prof. Dr. A. Hagerer

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Introduction

Introduction

Definitions

- Website

  - collection of related web pages that contains images, text, audio, video, etc.

  - provides visual and text content that users can view and read

    - statically oriented

- Web Application

  - piece of software that can be accessed by the browser

    - some mechanism to realize dynamics

  - uses a combination of server-side scripts and client-side scripts to present and process information

Website Development

Static Websites

➥ also known as flat or stationary websites

➥ loaded on the client's browser as exactly they are stored on the web server

➥ contain only static information, i.e. users can only read the information but can't do any modification or interact with the information
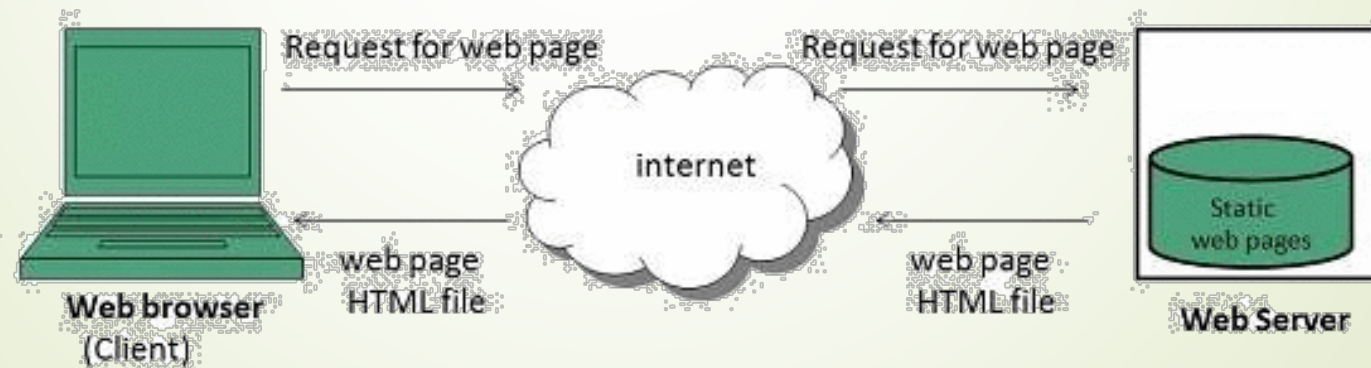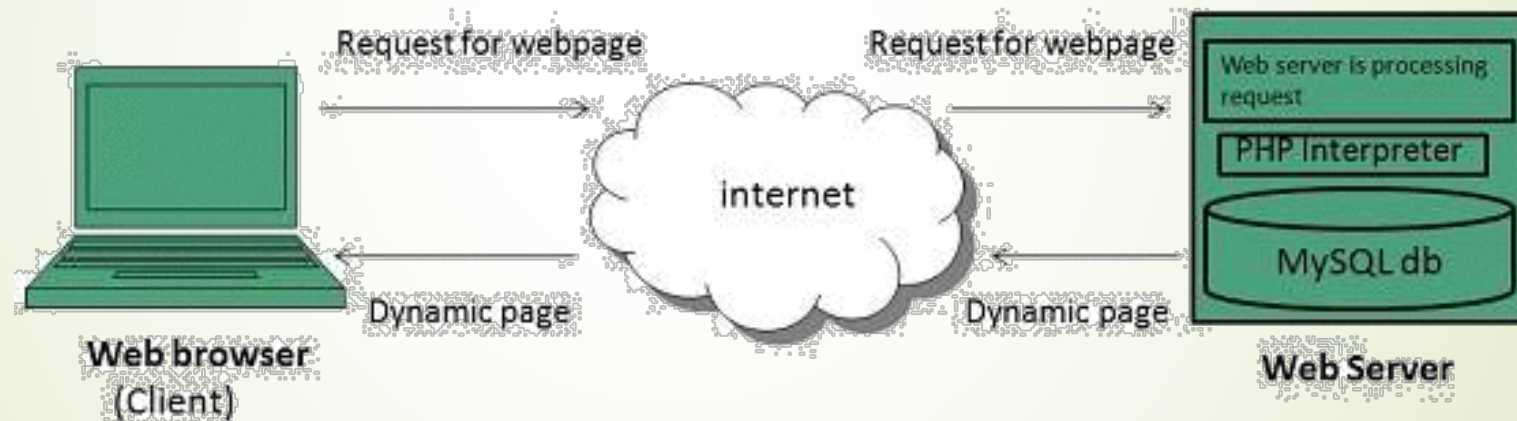
Website Development

Dynamic Websites

➡ shows different information at different point of time

➡ it is possible to change a portion of a web page without loading the entire web page

➢ Server-side dynamic web page

▪ created by using server-side scripting. There are server-side scripting parameters that determine how to assemble a new web page which also include setting up of more client-side processing.

➢ Client-side dynamic web page

▪ processed using client side scripting such as javascript and then passed in to Document Object Model (DOM)
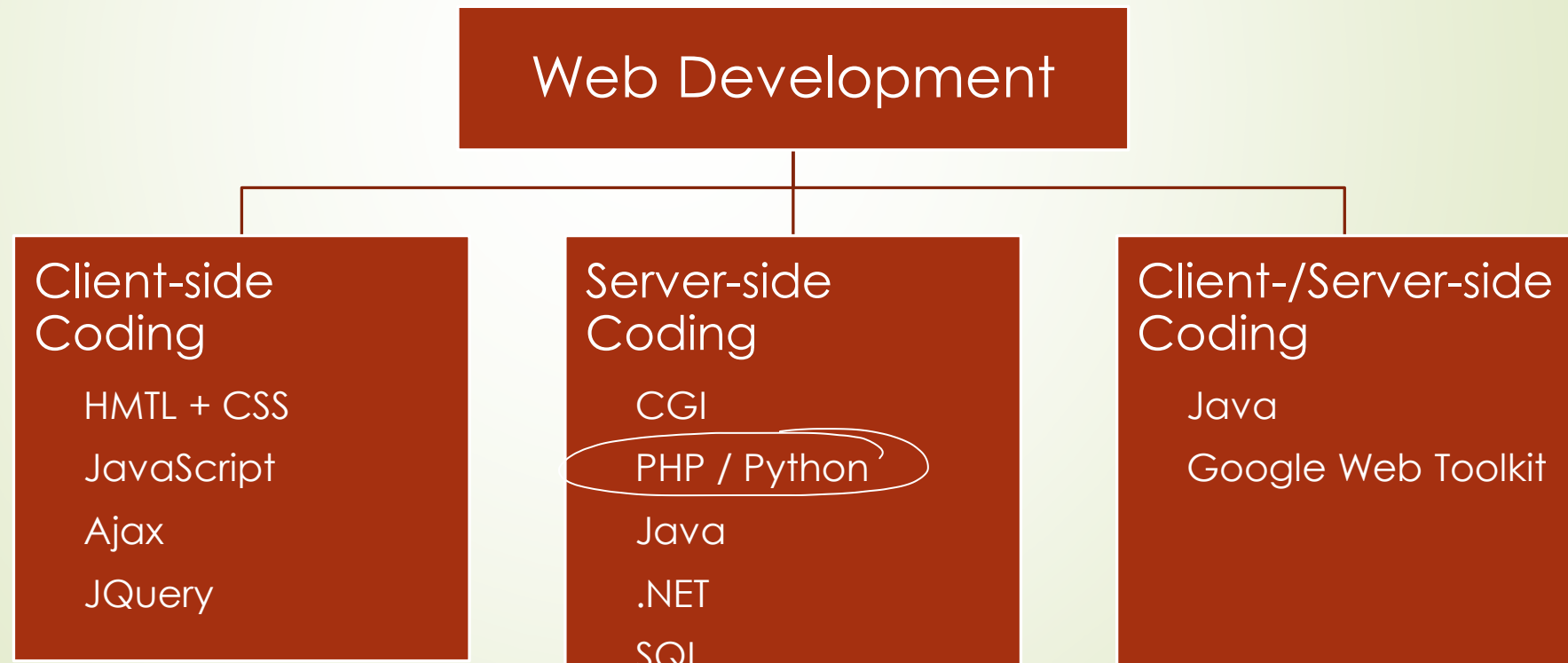
Website Development

Dynamic Websites

➡ shows different information at different point of time

Website Development

Website Development

➡ refers to building website and deploying on the web

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                    ┌─────────────────────────┐
                    │     Web Development      │
                    └─────────────────────────┘
                                 │
          ┌──────────────────────┼──────────────────────┐
┌───────────────────┐  ┌───────────────────┐  ┌───────────────────┐
│ Client-side       │  │ Server-side       │  │ Client-/Server-side│
│ Coding            │  │ Coding            │  │ Coding            │
│                   │  │                   │  │                   │
│   HMTL + CSS      │  │   CGI             │  │   Java            │
│                   │  │   PHP / Python    │  │                   │
│   JavaScript      │  │                   │  │   Google Web Toolkit│
│                   │  │   Java            │  │                   │
│   Ajax            │  │   .NET            │  │                   │
│                   │  │                   │  │                   │
│   JQuery          │  │   SQl             │  │                   │
└───────────────────┘  └───────────────────┘  └───────────────────┘
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Website Development

Website Development - Skills Required

➡ understanding of client and server side scripting

➡ creating, editing and modifying templates for a CMS or web development framework

➡ testing cross browser inconsistencies

➡ conducting observational user testing

➡ testing for compliance to specified standards such as accessibility standards in the client region

➡ programming interaction with JavaScript, PHP, and Jquery etc.

Web Applications

Web Applications

➡ a distributed application that accomplishes a certain business need based on the technologies of WWW and that consists of a set of Web-specific resources

➡ Web System
an infrastructure or system enabling the operation of a Web application, e.g. the entire backend support for Websites, including logistics, security, transactions, failure-safe operation etc.

Web Applications

Categories of Web Applications
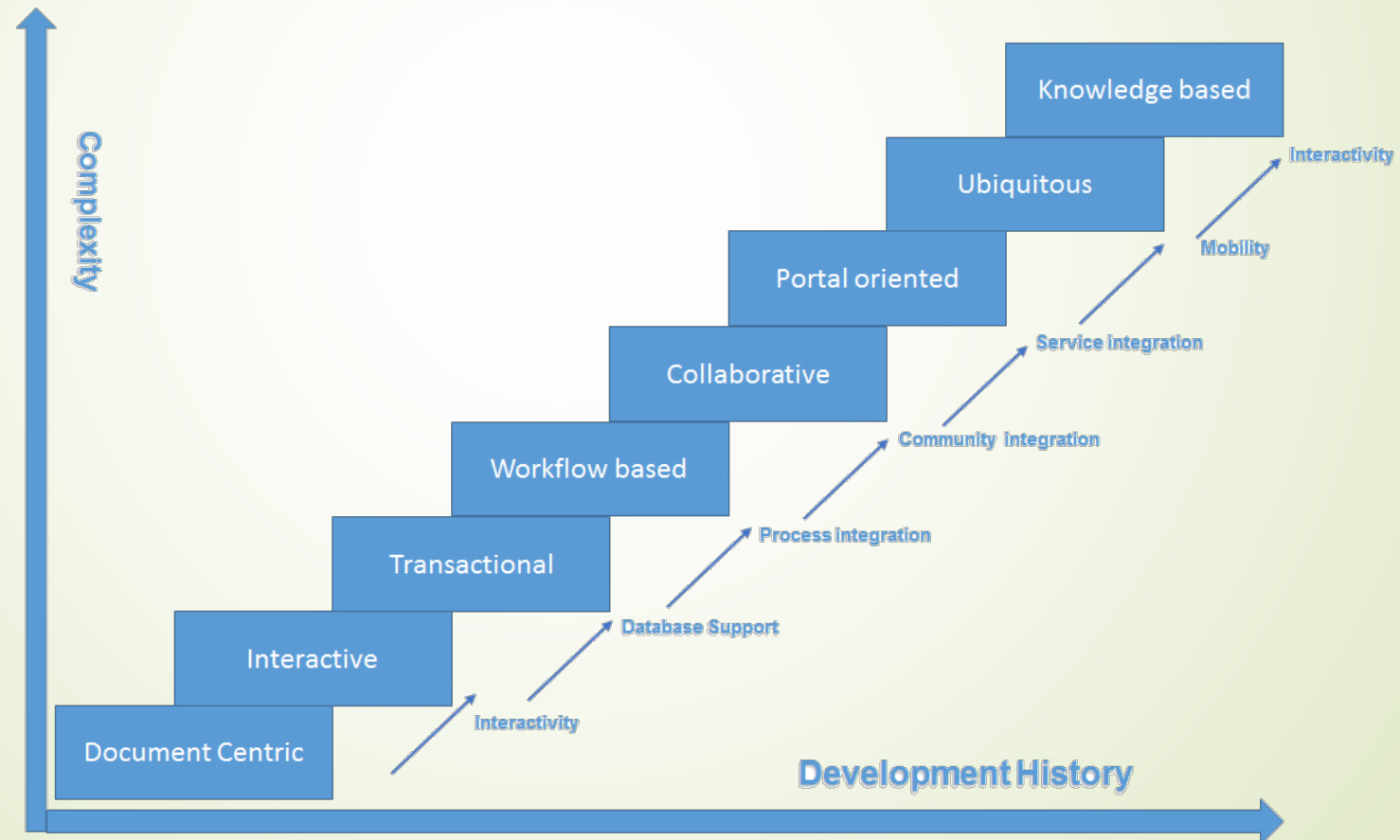
Categories of Web Applications

Document-centric

- are provided in the form of static HTML that are sent as a reply to a request from the client are sent as a reply to a request from the client

- Pros

  ➢ simple, stable, short response times

- Cons

  ➢ high management costs for frequent updates & large collections

  ➢ more prone to inconsistent/redundant info

① difficult to update for large collections

Categories of Web Applications

Interactive

➨ CGI (Common Gateway Interface)

➢ standard for interfacing
external applications
with information servers,
such as HTTP or Web servers

➨ simple interactivity

➨ dynamic page creation

Web Browser — HTTP — Web Server — CGI — Common Gateway Interface

Document in File System — Disk Files — Database

Categories of Web Applications

Transactional

➡ concurrent access to distributed data shared amongst multiple components, to perform operations on data

➡ applications should maintain integrity of data (as defined by the business rules of the application)
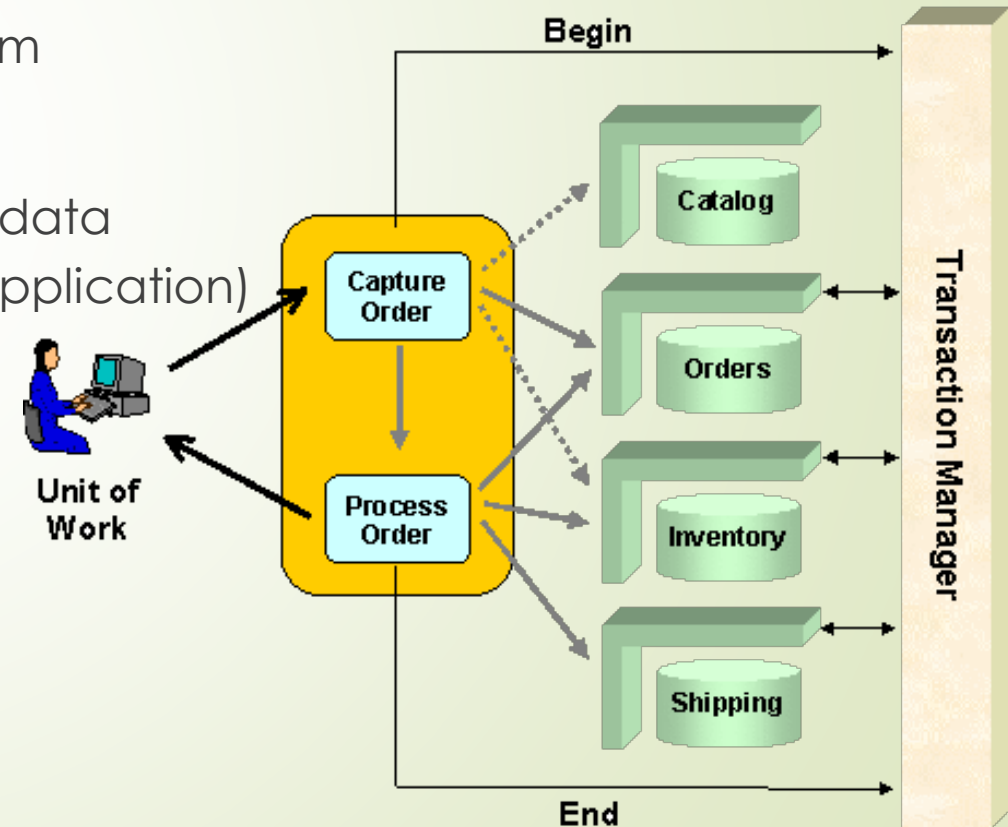
Categories of Web Applications

Workflow-based

- designed to handle business processes across departments, organizations & enterprises

- Web-services provide interoperability

- requirement: processes must be structured!

- challenges:

  - complexity of all services

  - autonomy of participating parties

  - robustness and flexibility of business processes

  - business logic defines the structure

Categories of Web Applications
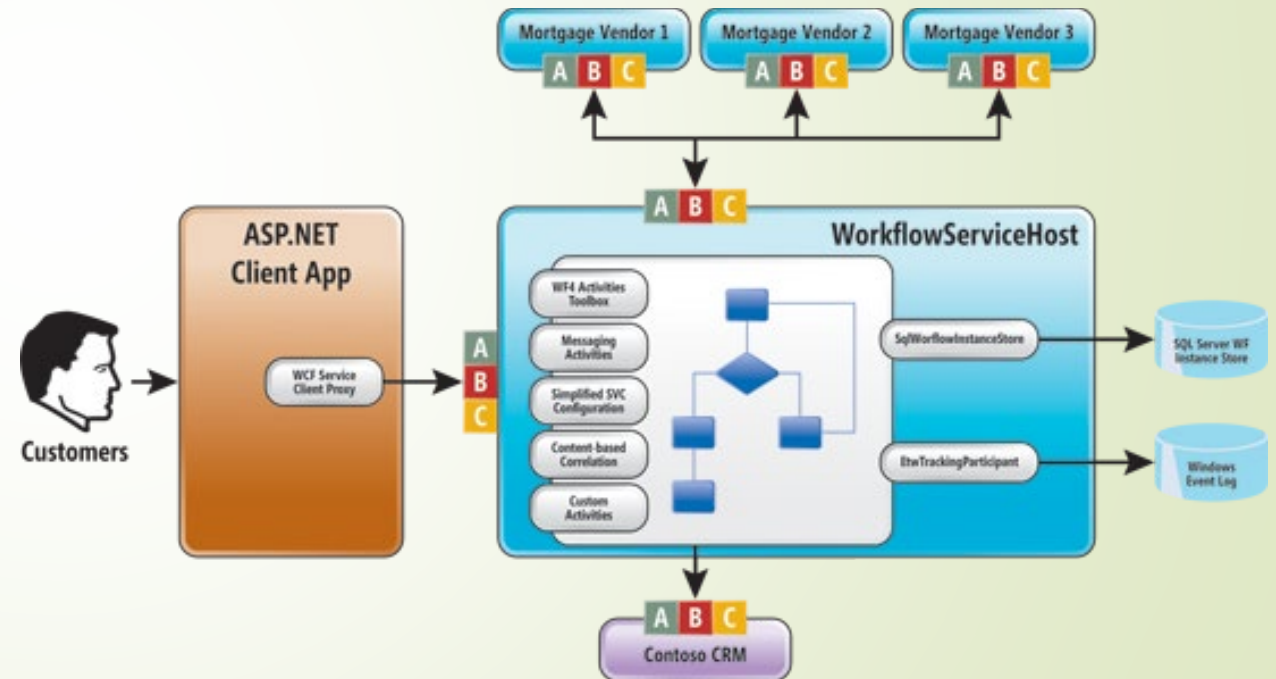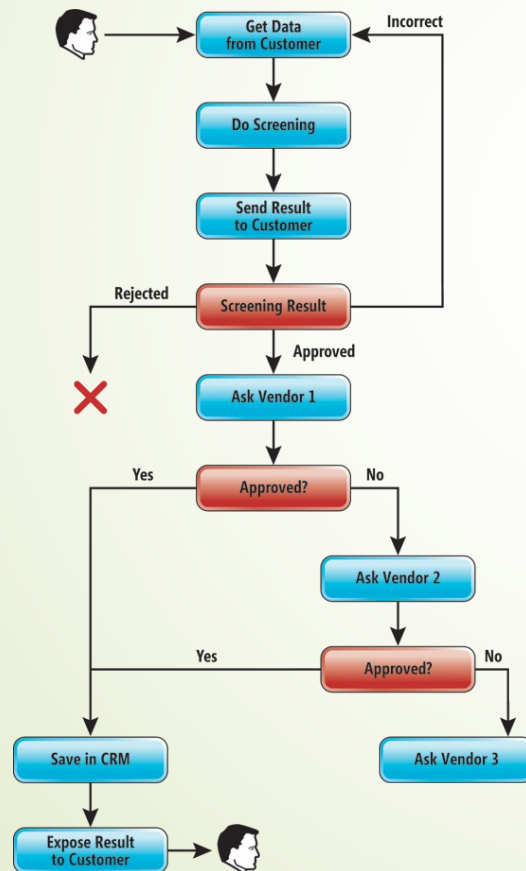
Workflow-based

Characteristics of Web Applications

Web application as a product

1. content

   ➢ document-centric character and multimedia

      ▪ presentation in the form of tables, text, graphics, animations, video, audio

      ▪ communication of contents

      ▪ didactive presentation of contents

   ➢ high quality demands

      ▪ actuality, preciseness, correctness, reliability, size

Characteristics of Web Applications

Web application as a product

2. navigation / hypertext

   ➢ non-linearity

     ▪ difference to traditional software: possibility of systematic reading (e.g. guided tour)

     ▪ moving in information space depending on various factors, such as interests

     ▪ challenge for authors!

   ➢ disorientation and cognitive overload

     ▪ disorientation: loss of sense of direction and location in a non-linear document

     ▪ cognitive overload: higher effort and concentration to maintain overview of various paths

Characteristics of Web Applications

Web application as a product

3. presentation – user interface

   ➢ aesthetics

      ▪ look and feel

      ▪ trends

   ➢ self-explanatory design

      ▪ usage without documentation

      ▪ consistent user logic

Characteristics of Web Applications

Web application as a product

4. usage

   ➢ much greater diversity compared to traditional applications

   ➢ spontaneity
      ▪ users come and go
      ▪ unknown number of users
      ▪ scalability important issue

   ➢ multiculturality
      ▪ anonymous type of user
      ▪ limited knowledge about previous knowledge, handicaps, preferences of users
      ▪ desired adaptation of content and presentation

Characteristics of Web Applications

Web application as a product

4. usage

- ➤ technical context
  - ▪ quality of service: unknown network characteristics (e.g., bandwidth, reliability)
  - ▪ multi platform delivery
    - different types of devices (PC, tablet, mobile phone)
    - different versions of browsers
    - different degree of functionality, performance, display size
- ➤ place and time of access

Characteristics of Web Applications

Web application as a product

4. usage

- ➢ globality
  - ▪ internationalization of web applications
    - • regional, cultural, linguistic differences have to be taken into account
  - ▪ demands on security
    - • prevent access to private or confidential data
- ➢ availability
  - ▪ instant delivery mechanism (also in case of partial realizations)
  - ▪ permanent (24/7)
  - ▪ time-dependent services

Characteristics of Web Applications

Web application as a product

5. quality
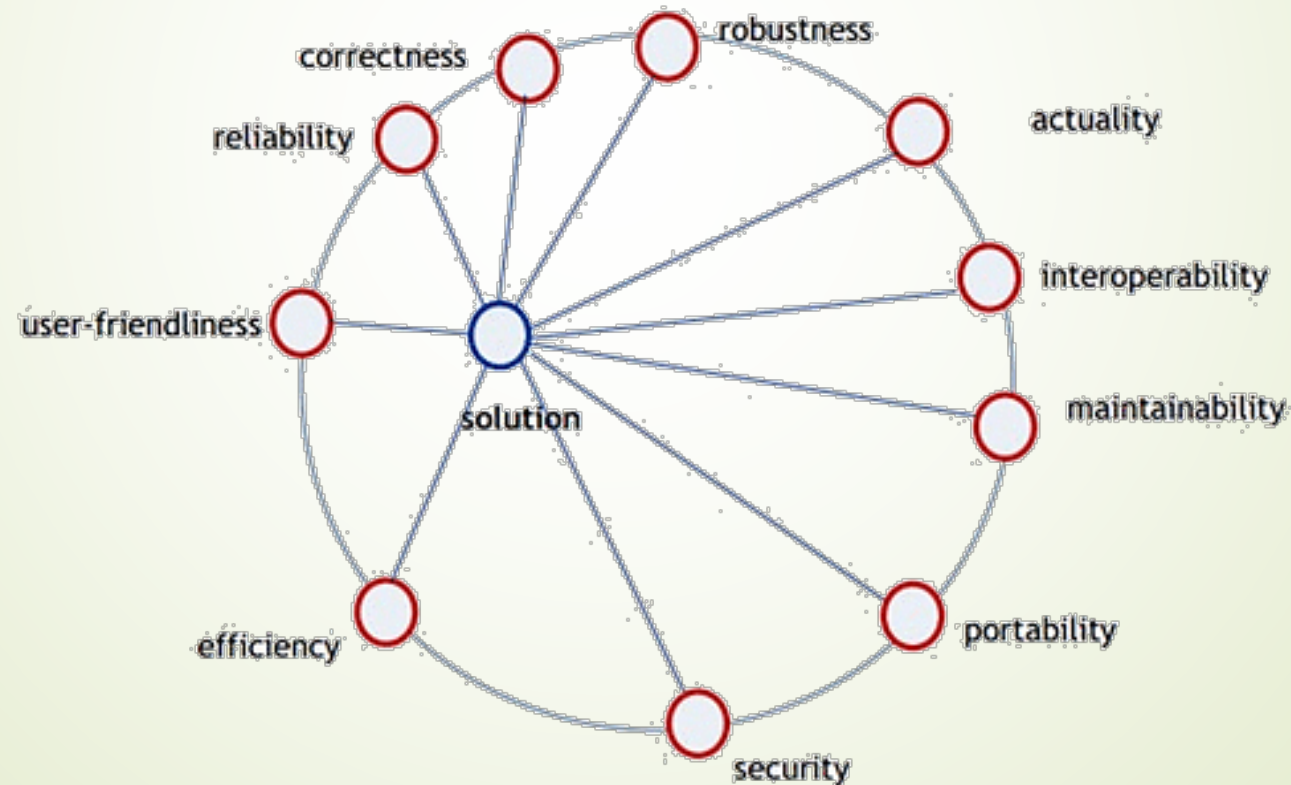
Web Technologies

The big picture: Full Stack Web Development

- refers to the development of both front end and back end of a web application

- common layering in web applications (abstraction)

  - presentation layer

  - business logic layer

  - data (management/resource) layer
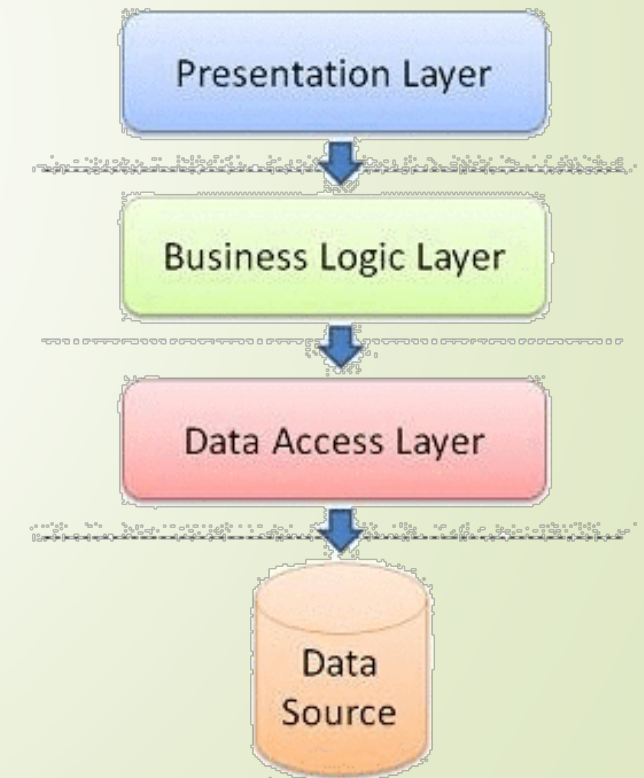
Web Technologies

The big picture: Full Stack Web Development

➡ presentation Layer

➢ displays information (processing output) which are get from the business logic layer *(get)*

➢ gets user's requests and pass them (with required data) to the business logic layer *(send)*

➡ business Logic Layer

➢ receives requests from presentation layer, fetches required data from data layer, process the request & data *(get)*
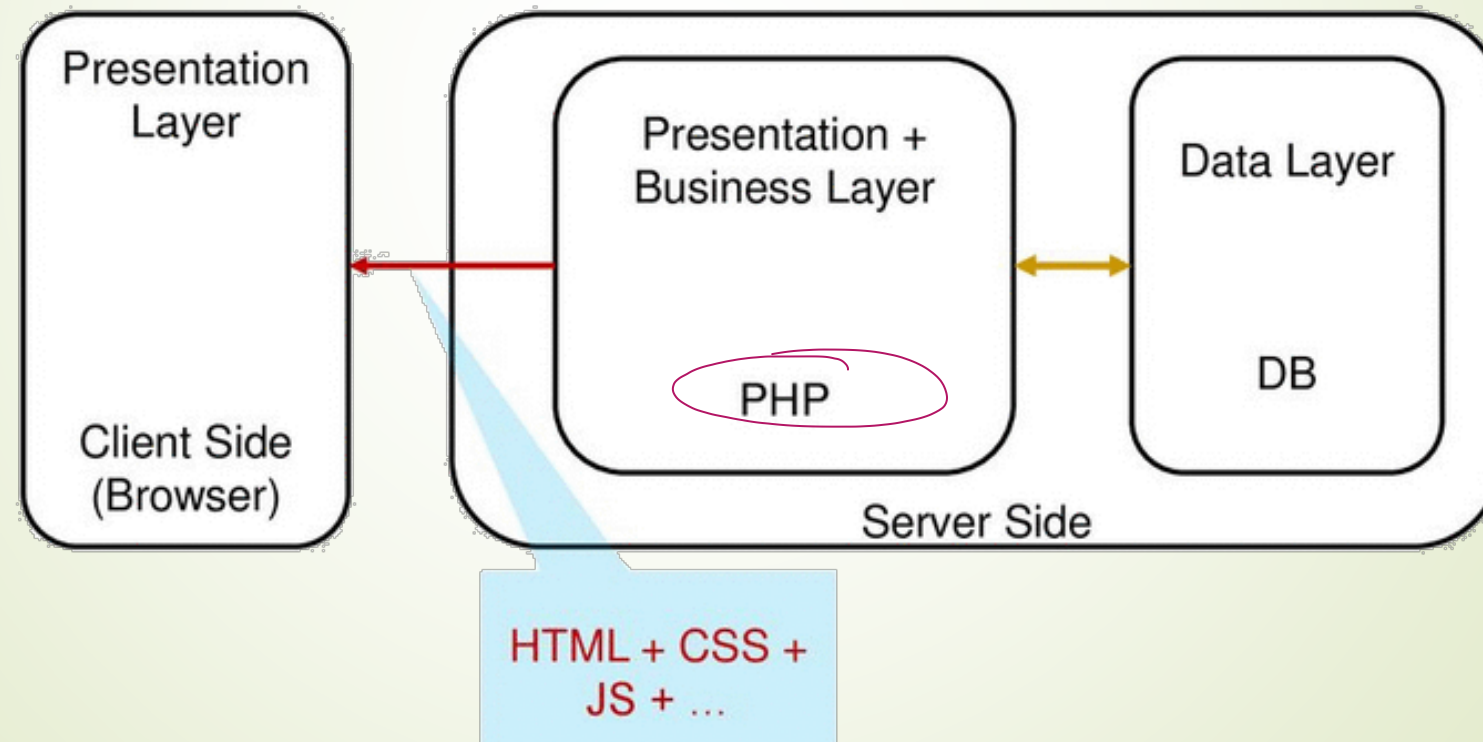
➢ output is sent back to the presentation layer *(send)*

➡ data Layer

➢ provides data access interface to business logic *(send)*

➢ hide data storage details *(process)*

Web Technologies

The big picture: Full Stack Web Development

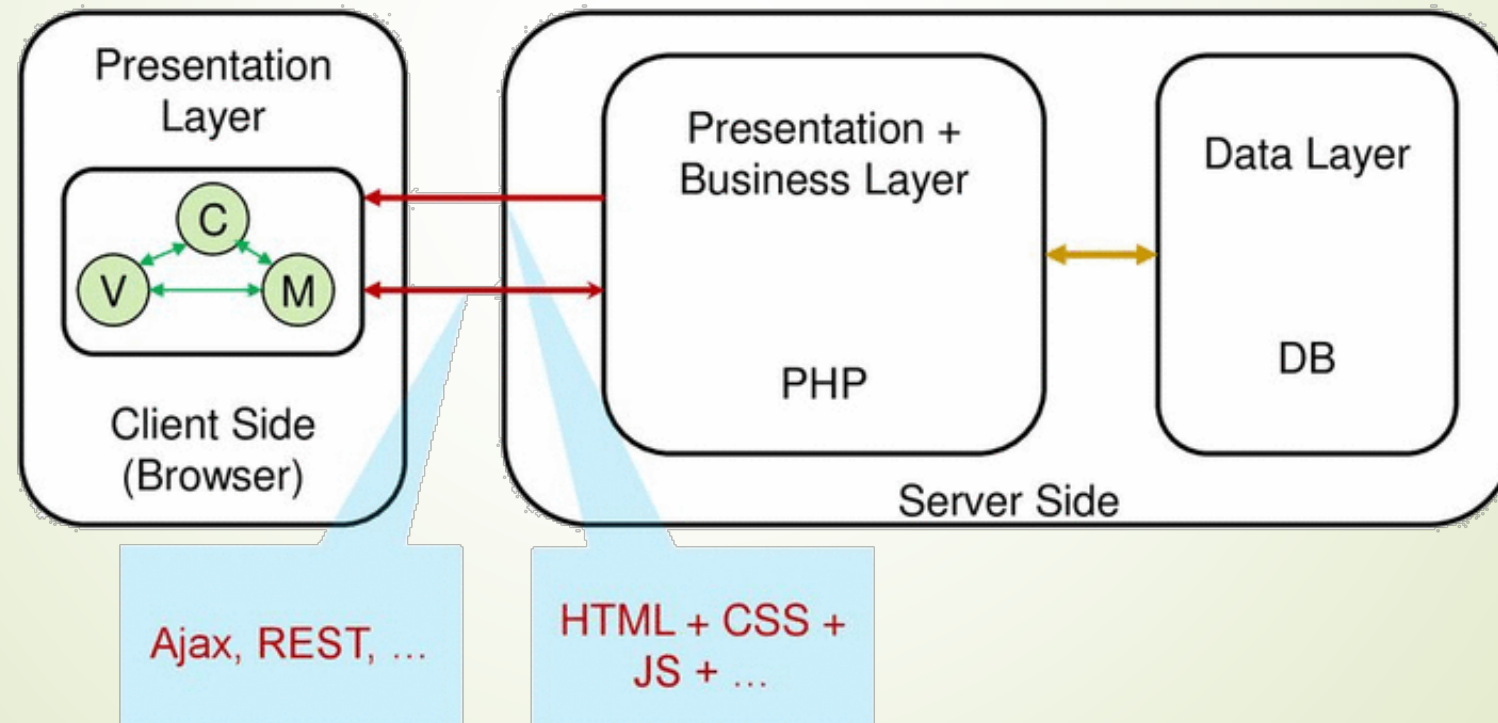- concept "Server-Side Rendering"

Web Technologies

The big picture: Full Stack Web Development

➤ concept "Client-Side Rendering"

Web Technologies

The big picture: Full Stack Web Development

➡ Technologies and Concepts

- ➢ Browser environment
  - ▪ HTML/CSS/JavaScript - markup, separation of content & style, reuse, scripting
  - ▪ Document object Model (DOM) - document structure

- ➢ Browser software
  - ▪ Model View Controller, single page applications, responsive design - React.js

- ➢ Backend communication
  - ▪ API design - HTTP/AJAX/REST/GraphQL
  - ▪ Cookies/sessions/state management - storage/trust

- ➢ Backend implementation
  - ▪ Web Server - HTTP request processing - Node.js
  - ▪ DBMS - Schema, Objects, CRUD, indexes, transactions - MongoDB
  - ▪ End-to-End - Scale and Security

Web Technologies

The big picture: Full Stack Web Development
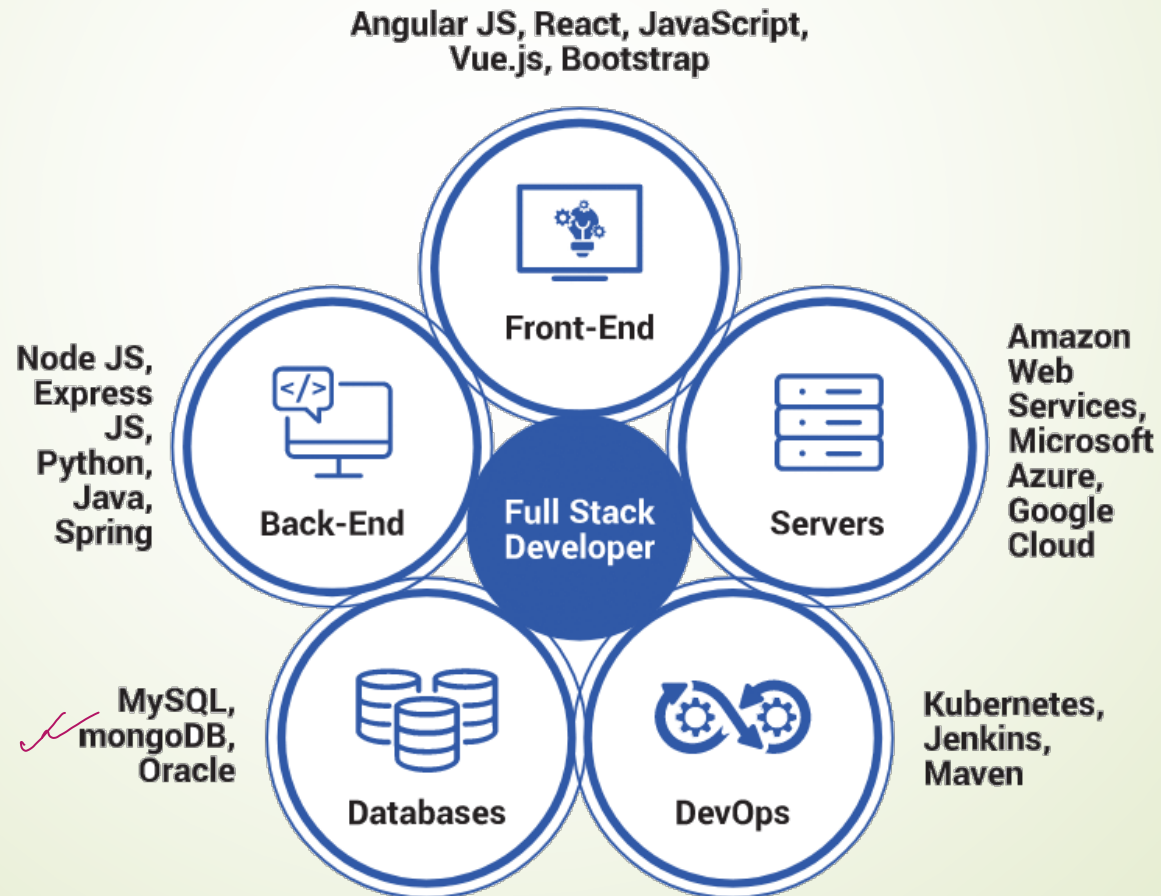
Web Engineering

The Problem

➥ complexity increases

The Solution

➥ Web engineering

➢ is basically all about designing and promoting web based systems

➢ the application of systematic and quantifiable approaches to cost-effective analysis, design, implementation, testing, operation, and maintenance of high-quality Web applications

Web Engineering

Web engineering

➡ developing Web-based systems is significantly different from traditional software development and cause many additional challenges

➡ there are slight differences in the nature and life cycle of Web-based and software systems.

➡ building a complex Web-based system calls for knowledge and expertise from many different disciplines
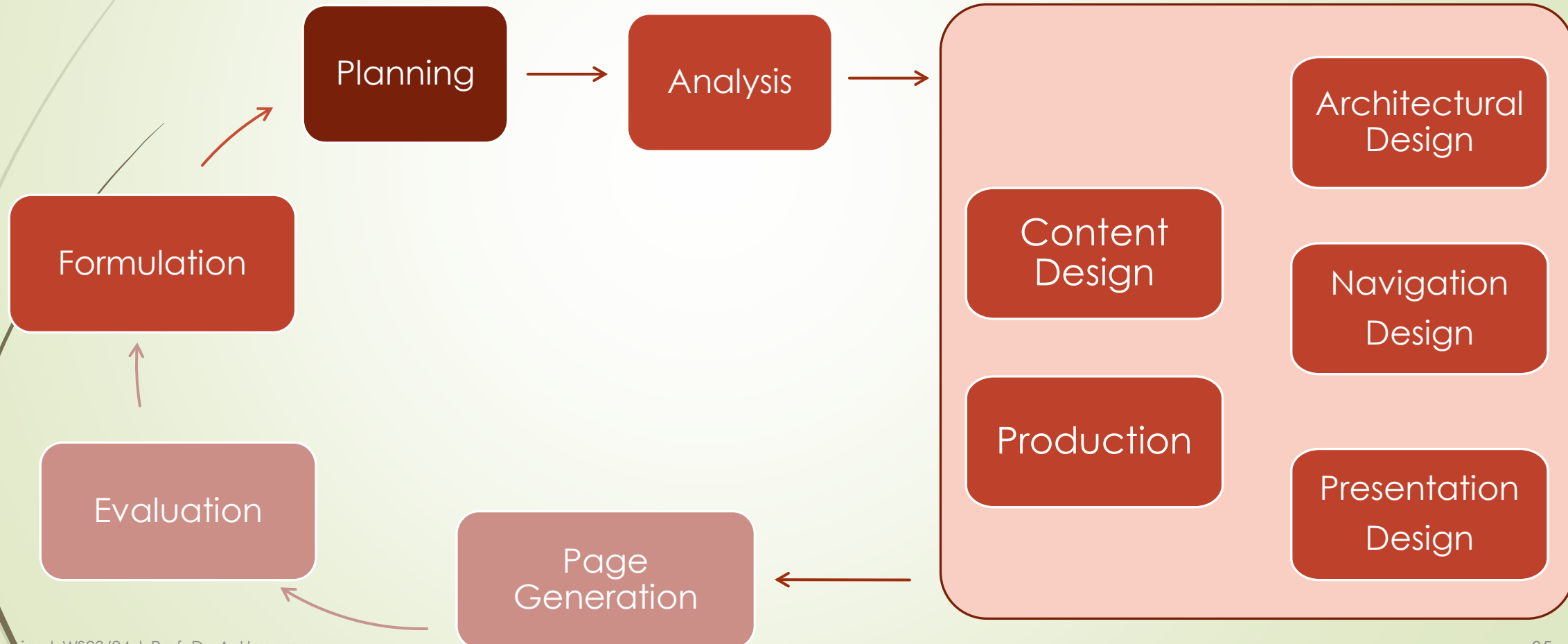
Web Engineering

Web engineering

➥ deals with all aspects of Web-based systems development

  ➢ starting from conception and development to implementation

  ➢ performance evaluation

  ➢ continual maintenance

  ➢ building and deploying a Web-based system involves multiple, iterative steps.
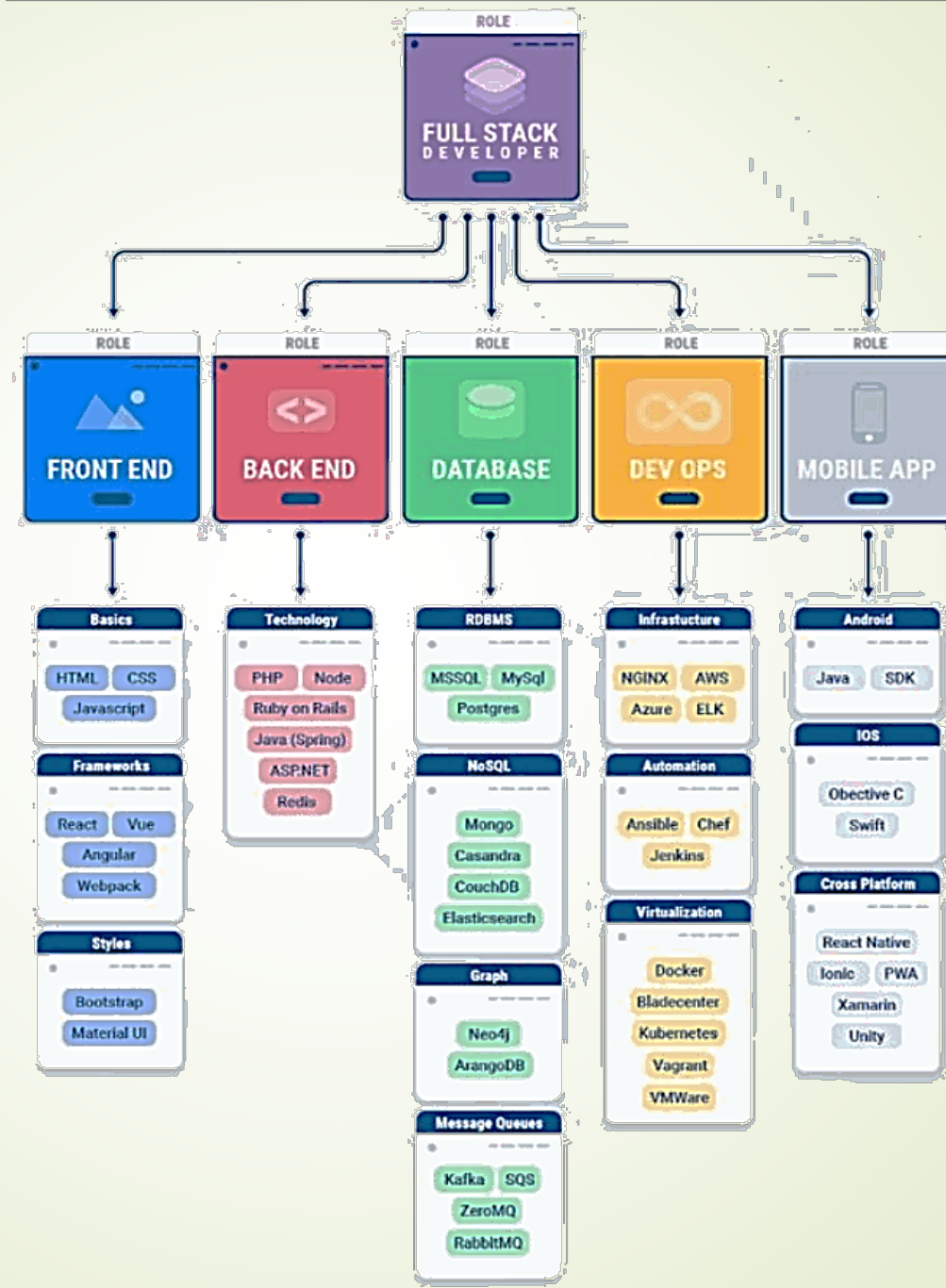
Web Engineering

Web engineering

Planning → Analysis →

Formulation

Evaluation

Page Generation

Content Design

Production

Architectural Design

Navigation Design

Presentation Design

Course Organisation

Topics

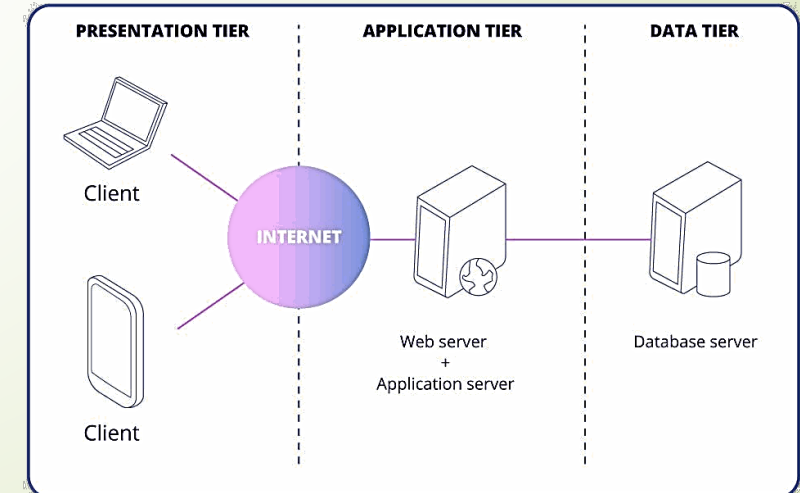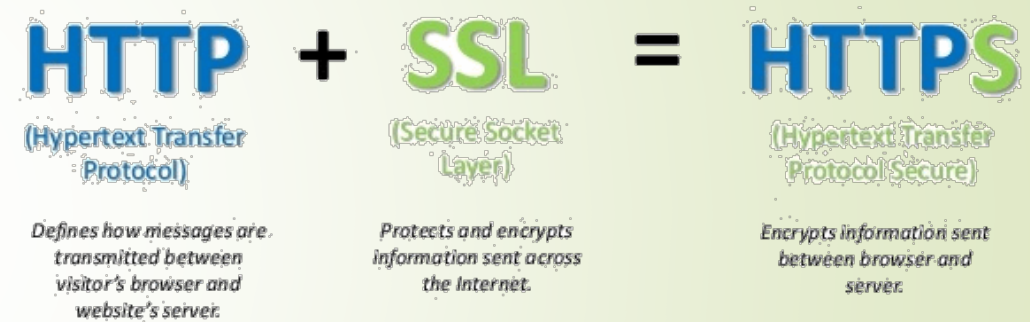*Important for overall idea*

Topics

I. Technological concepts

a) Review: Internet protocol suite

b) Basic services and applications

c) Transport Layer Security (TLS)

d) Hypertext Transfer Protocol (HTTP)

e) Architectures

HTTP (Hypertext Transfer Protocol) Defines how messages are transmitted between visitor's browser and website's server.

+

SSL (Secure Socket Layer) Protects and encrypts information sent across the Internet.

=

HTTPS (Hypertext Transfer Protocol Secure) Encrypts information sent between browser and server.

PRESENTATION TIER — APPLICATION TIER — DATA TIER

Client

Client

INTERNET

Web server + Application server

Database server

Topics

II. Front-end Technologies

a) Hypertext Markup Language

b) Cascading Style Sheet

c) Template-Based Pages
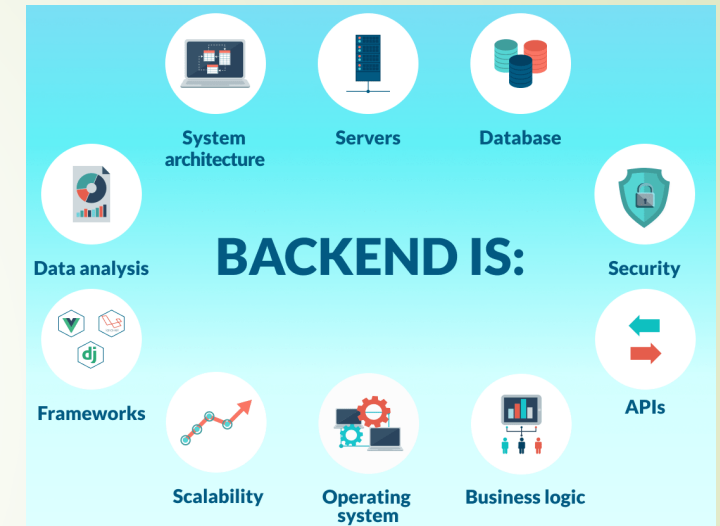
d) JavaScript

e) Interactivity

f) JavaScript Frameworks
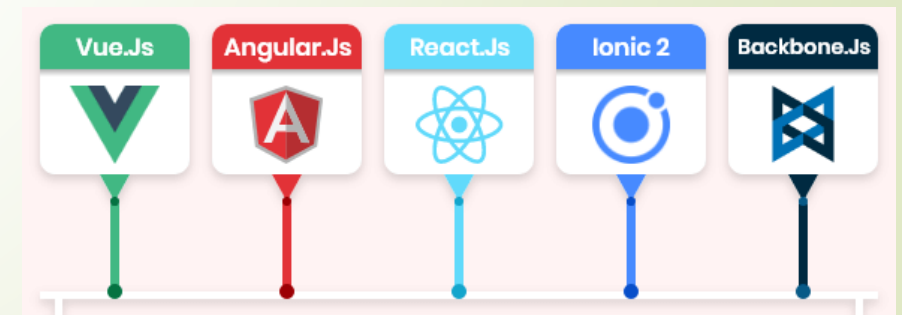
Topics

III. Back-end Technologies

a) Operational concepts of Web-Servers

b) Event-driven Web-Servers: Node.js, Twisted

c) Web Architectures

d) Accessing Databases

e) Server-based Frameworks

Course Organization

Practical Course

➡ applying concepts

➡ submitting solutions to four assignments

➡ evaluating solutions by peer review