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IT3180 – Introduction to Software Engineering

13 – System architecture (2)

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Three popular architectural styles

- Three tier Architecture
- Master File Update
- Model/View/Control

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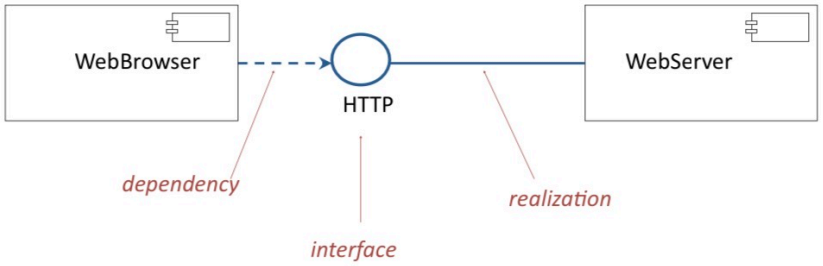
Three Tier Architecture

- This architecture is an extension of the client/server model
- It is the standard architecture for small and medium sized web sites
- The basic web system has a client / server architecture



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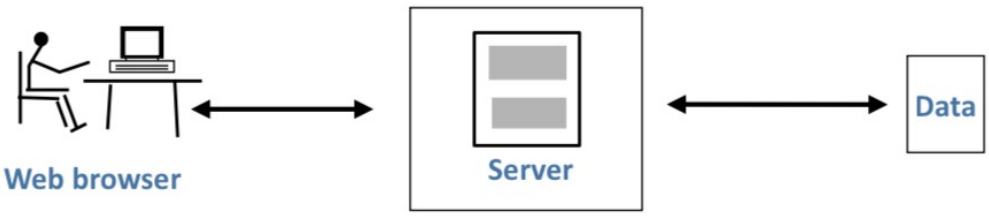
Web Server with Data Store

The basic client/server web site returns only fixed HTML pages

- Attach the server to a data store, so that it can respond to requests from the client and return suitable content



- Advantage: Server-side code can respond to user requests by accessing data, configuring pages, validating information, etc.

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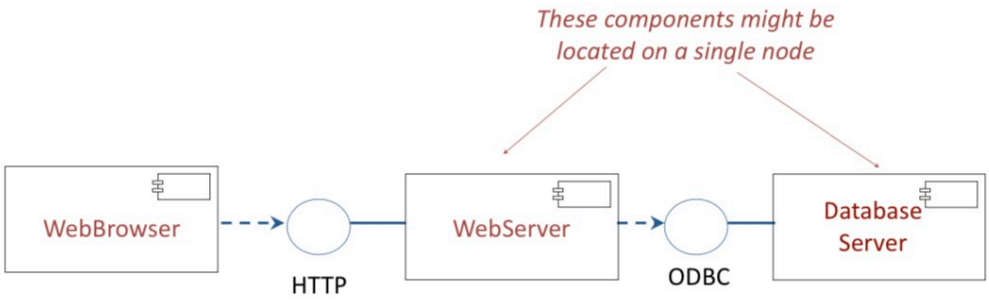
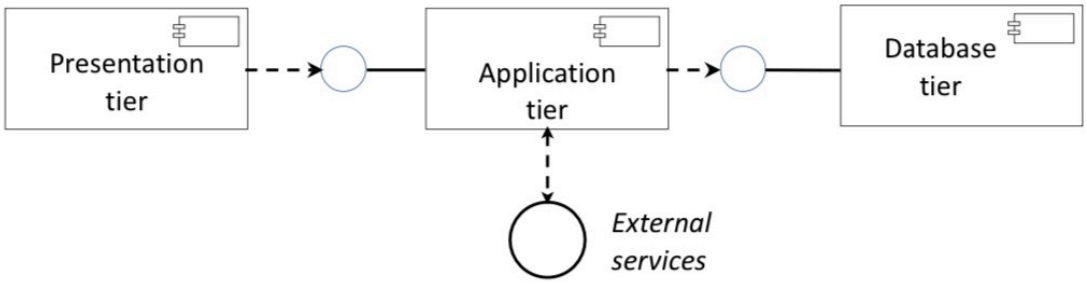
Web Server with Data Store – Component Diagram



- Since components are replaceable binary elements:
  - Any web browser can access the web site
  - The database server can be replaced by another database that supports the same interface

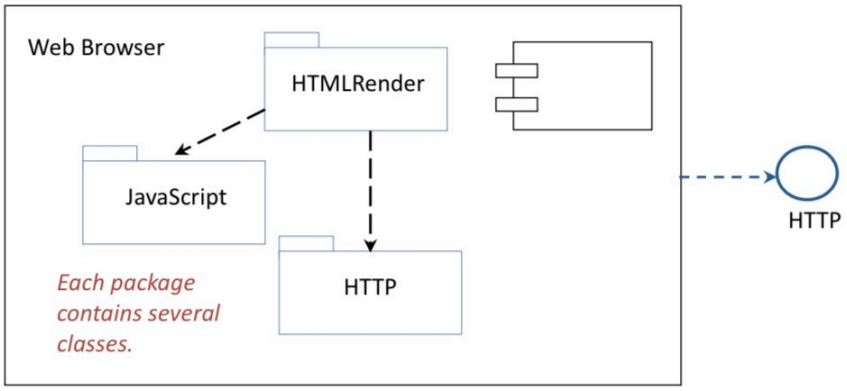
Architectural Style: Three tier architecture



Each of the tiers can be replaced by other components that implement the same interfaces

Web Browser with JavaScript

The Presentation Tier has become more complex. Since it still supports the same interface it is still a replaceable binary component.



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Tier vs. Layer

- A 'layer' refers to a functional division of the software
  - Presentation Layer
  - Business Logic Layer
- A 'tier' refers to a functional division of the software too, but a tier runs on infrastructure separate from the other divisions
- For example:
  - The Contacts app on your phone is a three-layer application but a single-tier application because all three layers run on your phone

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Benefits of three-tier architecture

A separation of logical functionality and physical functionality

- Each tier can run on a separate operating system and server platform
- Presentation tier, Application tier, Database tier – that best fits its functional requirements
- Each tier runs on at least one dedicated server hardware or virtual server
- Services of each tier can be customized and optimized without impact the other tiers

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Master File Update

- This architecture is an alternative to the repository model
- Information is kept on files needing to be modified as changes. The process is called **updating** and the files that are being updated are called **master files**
- It is very widely used in data processing systems
  - Inputs
  - Processing
  - Outputs

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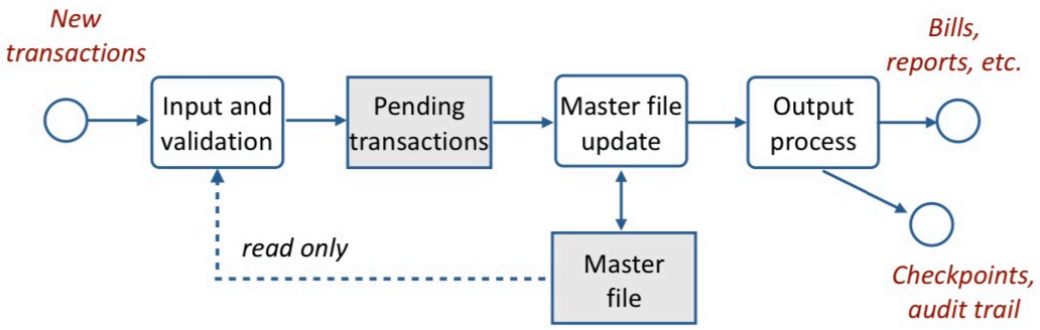
Updating

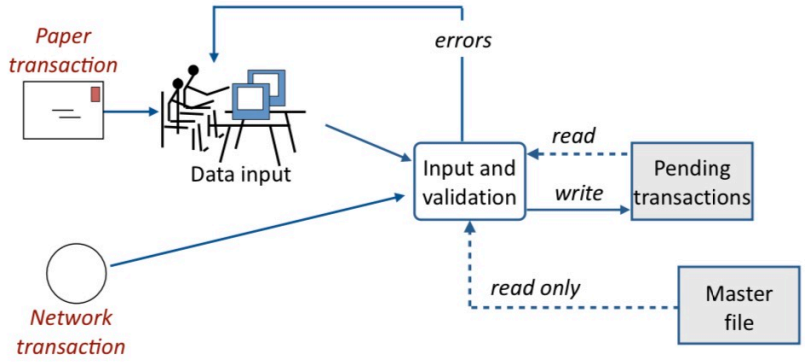
- Updating a file can involve the following:
  - **Adding** records to the file
  - **Changing** records on the file
  - **Deleting** records from the file
- Actions: add, change, delete transactions that will be used to update the master file are saved on a **transaction file**
- Transaction file will be processed with the master file to update the file
- 2 kinds of business updating:
  - **Maintenance** updating
  - **Production** updating

Master File with Batch Processing: Dataflow Model



- **Input** and **validation process** runs throughout the day
  - It processes transactions when they arrive
- **Master file update** program runs once per day (usually at night)
- **Output process** is run after the master file update finishes

Batch Processing: Input and Validation



- Because the input and validation process is able to read the master file, it can check that the transaction is compatible with the master file
  - Example: whether or not the file has a record for the customer

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Benefits of Batch processing with Master File Update

Advantages:

- Backup and recovery has fixed checkpoints
- Better management control of operations
- Efficient use of staff and hardware
- Error detection and correction is simplified

Disadvantages:

- Information in master file is **not** updated **immediately**
- No good way to answer customer inquiries

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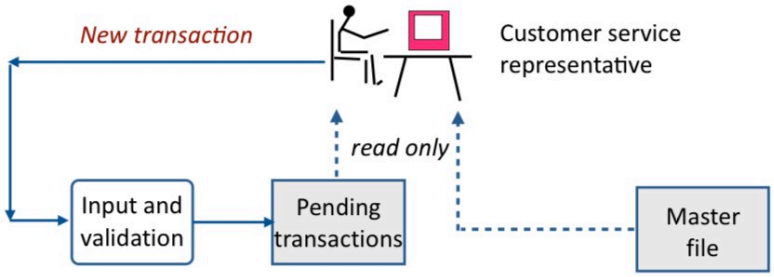
Online Inquiry



- Customer calls the organization and speaks to a customer service representative
- The representative can read the master file and the pending file, but cannot change them
- If the representative wishes to change information in the master file, a new transaction is created and sent to the input and validation process

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Model/View/Control (MVC) Architecture

- This architecture is used to control a **complex user interface**
- It is the standard architecture for web/mobile apps and widely used in robotics
- The definition of MVC is in a **state of flux** – The term is used to describe a range of architectures and designs
  - Some are **system architectures**, where the model, view and controller are **separate components**
  - Some are **program design**, with **classes** called model, view and controller

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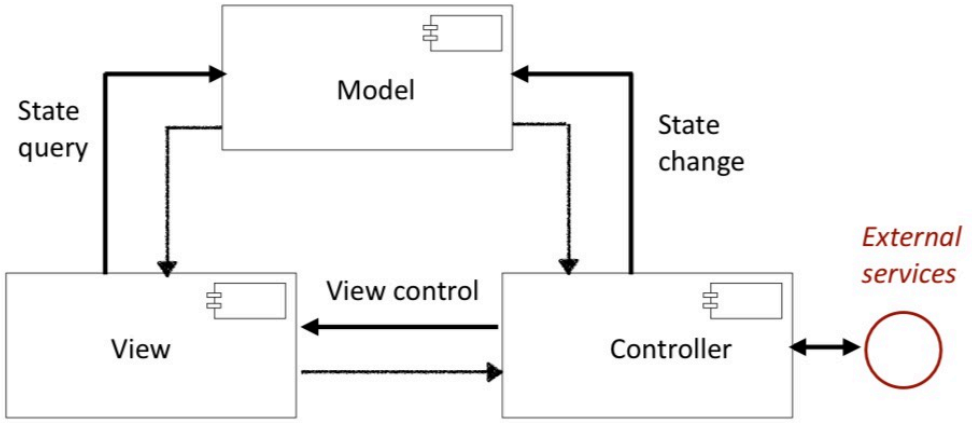
Model/View/Controller as a System Architecture



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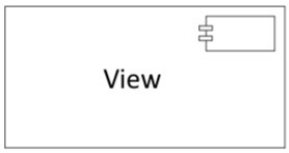
View



The **view** presents the state of the interface to the user. It subscribes to the model, which notifies it of events that change the state

- Renders data from the model for the user interface
- Provides editors for properties, such as text fields, etc.
- Receives updates from the model
- Sends user input to the controller
- A given model may support a choice of alternative views

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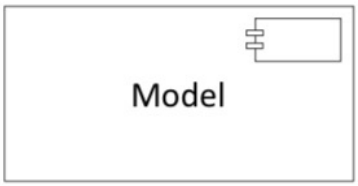
Model



The model records the state of the application and notifies subscribers. It does not depend on the controller or the view

- Stores the state of the application in suitable data structures or databases
- Responds to instructions to change the state information
- Notifies subscribers of events that change the state
- May be responsible for validation of information

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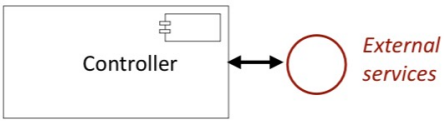
Controller



The **controller** is the part of the system that manages user input and navigation within the application

- Defines the application behavior
- Maps user actions to changes in the state of the model
- Interacts with external services via APIs
- May be responsible for validation of information
- Different frameworks handle controllers in different ways. In particular, there are several ways to divide responsibilities between the model and the controller, e.g., data validation, external APIs

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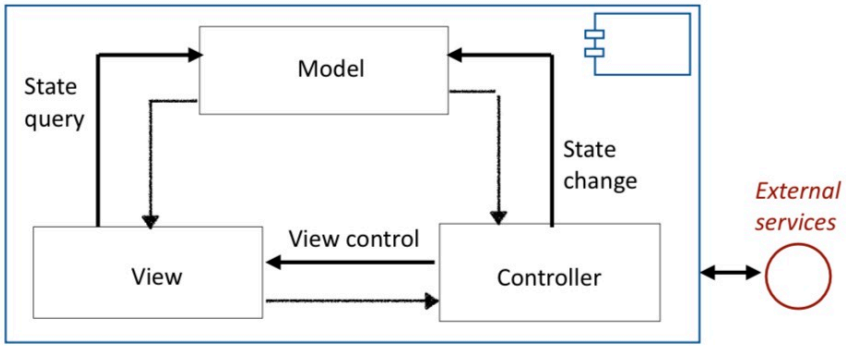
Model/View/Controller as a Program Design

- For mobile apps, the MVC is a single component. The model, view, controller are classes
- The programs often use cloud-based external services, each with an API (e.g., location, validation). These are usually managed by the controller



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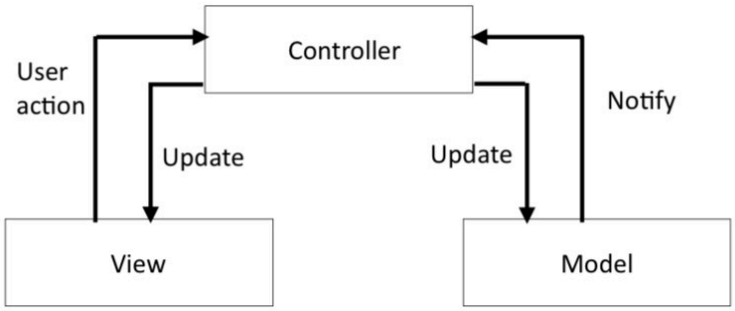
Web's Version of Model/View/Controller



- The MVC is a program design (not a system architecture)
- The model, view, controller are classes (not components)
- All messages pass through the controller
- A multi-screen app will have several views and controllers sharing the same model

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Architectural Styles and Design Patterns

- There are many variants of the common architectural styles
- We distinguish carefully between architectural styles and design patterns
  - Architectural styles are part of system design. They are defined in terms of subsystems, components and deployment
  - Design pattern are part of program design. They are defined in terms of classes

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13. System Architecture (2)

(end of lecture)

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