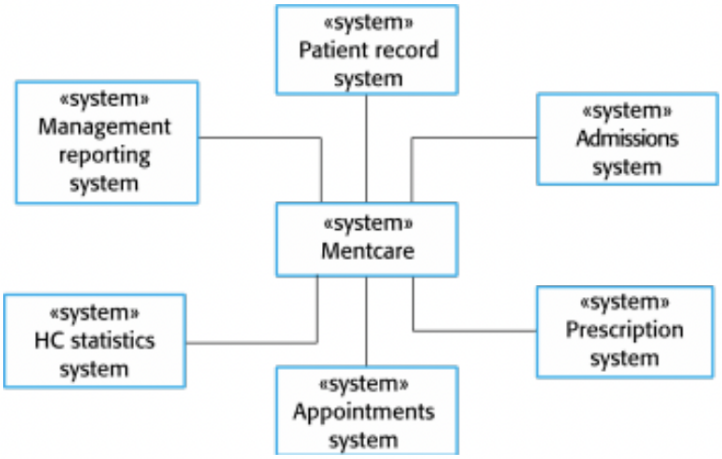
CAS CS 411
Lec 8

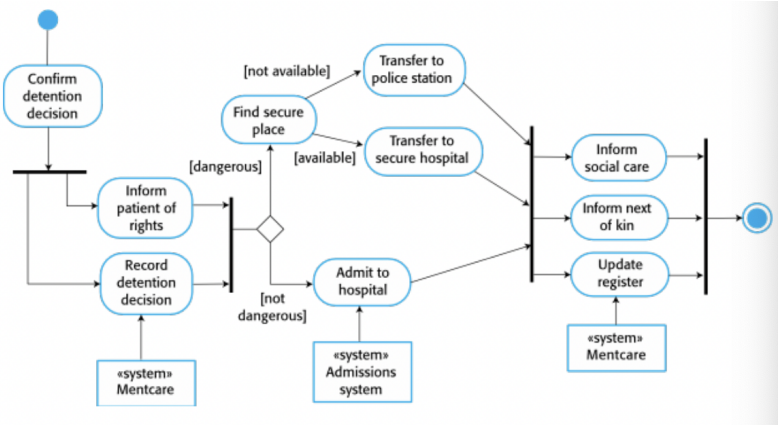
System Modeling

1. System Modeling
    a. System modeling is the process of developing abstract models of a system, with each model presenting a different view or perspective of that system.
    b. System modeling has now come to mean representing a system using some kind of graphical notation, which is now almost always based on notations in the Unified Modeling Language (UML).
    c. System modeling helps the analyst to understand the functionality of the system and models are used to communicate with customers.
2. System perspectives
    a. An external perspective, where you model the context or environment of the system.
    b. An interaction perspective, where you model the interactions between a system and its environment, or between the components of a system.
    c. A structural perspective, where you model the organization of a system or the structure of the data that is processed by the system.
    d. A behavioral perspective, where you model the dynamic behavior of the system and how it responds to events.
3. UML diagram types
    a. Activity diagrams, which show the activities involved in a process or in data processing .
    b. Use case diagrams, which show the interactions between a system and its environment.
    c. Sequence diagrams, which show interactions between actors and the system and between system components.
    d. Class diagrams, which show the object classes in the system and the associations between these classes.
    e. State diagrams, which show how the system reacts to internal and external events.
4. Context models
    a. Context models are used to illustrate the operational context of a system - they show what lies outside the system boundaries.
    b. Social and organisational concerns may affect the decision on where to position system boundaries.
    c. Architectural models show the system and its relationship with other systems.

5. System boundaries
    a. System boundaries are established to define what is inside and what is outside the system.
        i. They show other systems that are used or depend on the system being developed.
    b. The position of the system boundary has a profound effect on the system requirements.
    c. Defining a system boundary is a political judgment
        i. There may be pressures to develop system boundaries that increase / decrease the influence or workload of different parts of an organization.
6. The context of the Mentcare System



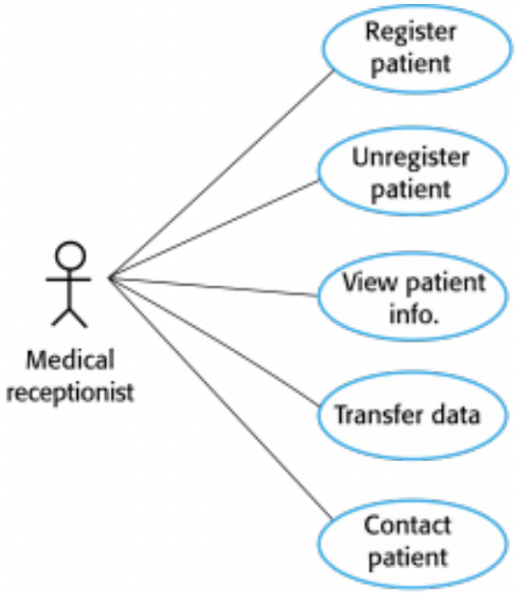
    a.
7. Process perspective
    a. Context models simply show the other systems in the environment, not how the system being developed is used in that environment.
    b. Process models reveal how the system being developed is used in broader business processes.
    c. UML activity diagrams may be used to define business process models.
8. Process model of involuntary detention



    a.

9. Use case modeling
    a. Use cases were developed originally to support requirements elicitation and now incorporated into the UML.
    b. Each use case represents a discrete task that involves external interaction with a system.
    c. Actors in a use case may be people or other systems.
    d. Represented diagramatically to provide an overview of the use case and in a more detailed textual form.
10. Transfer-data use case
    a. A use case in the Mentcare system
    b.

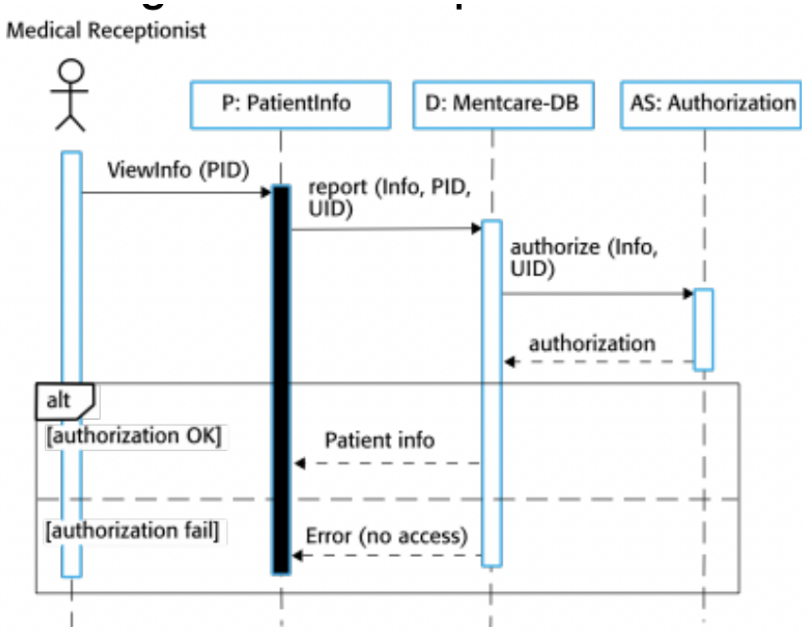
11. Use cases in the Mentcare system involving



    a.
12. Sequence diagrams
    a. Sequence diagrams are part of the UML and are used to model the interactions between the actors and the objects within a system.
    b. A sequence diagram shows the sequence of interactions that take place during a particular use case or use case instance.
    c. The objects and actors involved are listed along the top of the diagram, with a dotted line drawn vertically from these.
    d. Interactions between objects are indicated by annotated arrows.

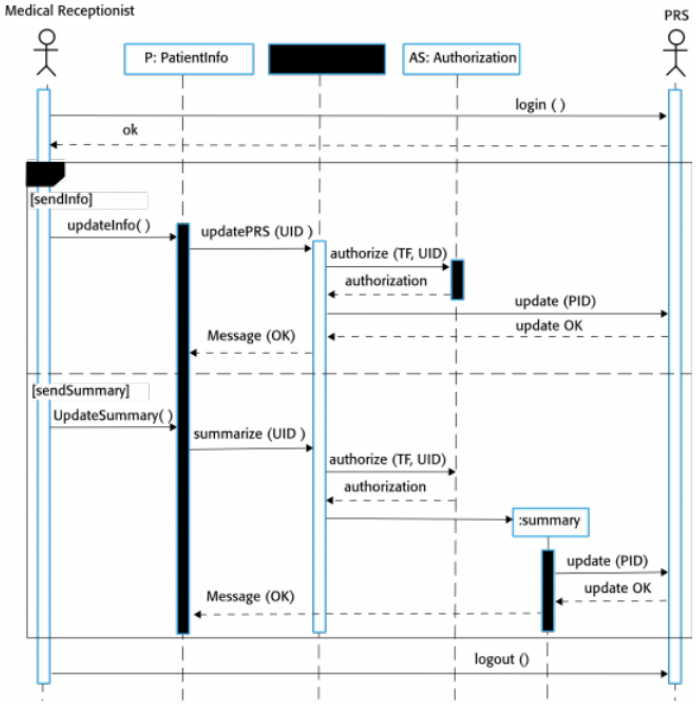
13. Sequence diagrams for View patient information

a.



14. Sequence diagram for Transfer Data

a.



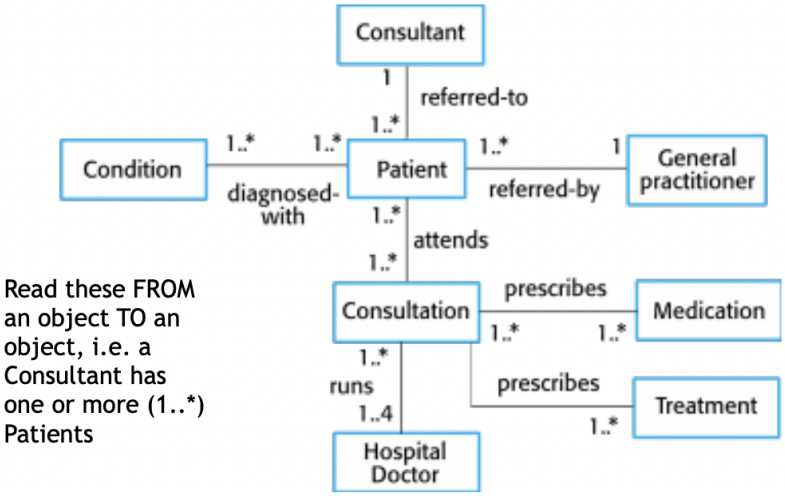
15. Structural models

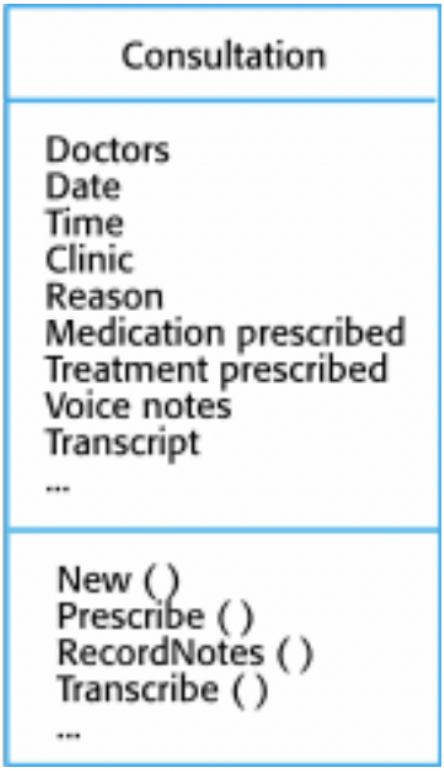
a. Structural models of software display the organization of a system in terms of the components that make up that system and their relationships.
b. Structural models may be static models, which show the structure of the system design, or dynamic models, which show the organization of the system when it is executing.

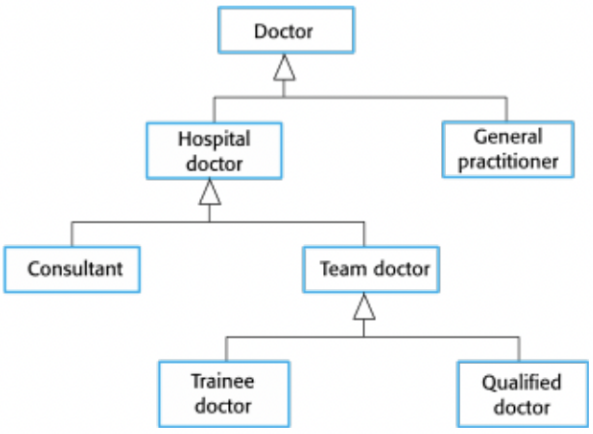
c. You create structural models of a system when you are discussing and designing the system architecture.

16. Class diagrams
    a. Class diagrams are used when developing an object-oriented system model to show the classes in a system and the associations between these classes.
    b. An object class can be thought of as a general definition of one kind of system object.
    c. An association is a link between classes that indicates that there is some relationship between these classes.
    d. When you are developing models during the early stages of the software engineering process, objects represent something in the real world, such as a patient, a prescription, doctor, etc.
17. General Object Characteristics
    a. Objects have two basic characteristics:
        i. Attributes, which are the data that an object contains
            1. These are typically private to the object
        ii. Behaviors, which are the ways that the object manipulates its data and communicates with other objects
            1. The behaviors that are publicly available are also called the object's interface
    b. The values of an object at a given moment of time are known as its state
18. UML classes and association
    a.

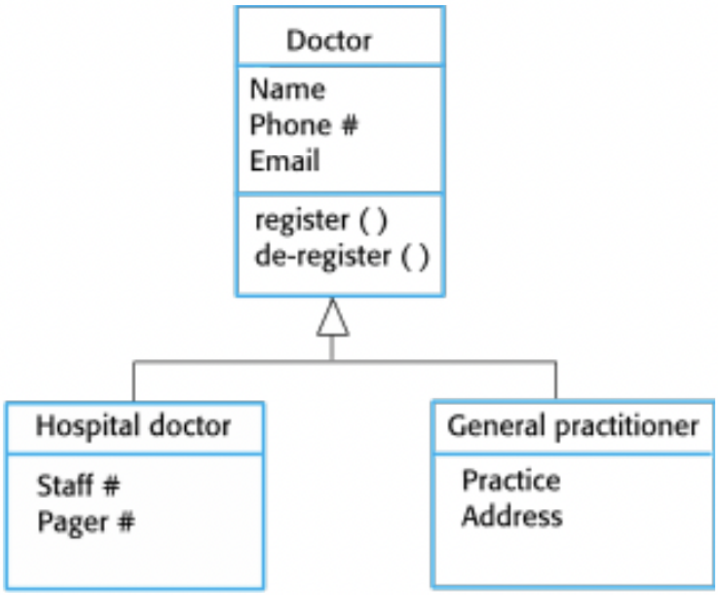
19. Classes and associations in the MHC-PMS
    a.



20. The Consulation class
    a. 

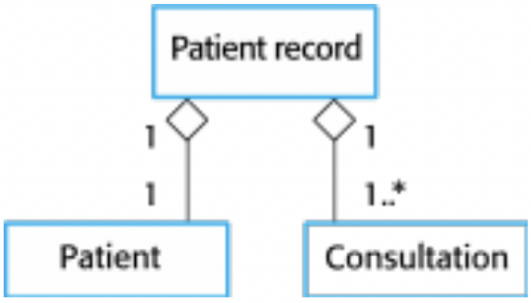
21. Class Relationships
    a. We can describe two broad categories of objects
        i. Objects in an is-a relationship are members of the same family… this is an inheritance relationship
            1. Example: A car is-a vehicle
        ii. Objects in a has-a relationship are composites (your book calls them aggregates)…the container object is made up (composed) of other objects
            1. Example: An egg carton has-an egg in it
22. An abstraction hierarchy
    a. 

23. An abstraction hierarchy with added detail

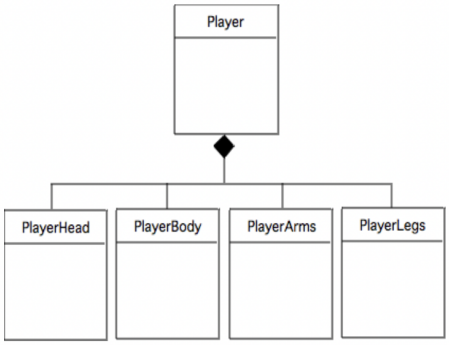
a. 

24. Object class aggregation models
    a. An aggregation model shows how classes that are collections are composed of other classes.
    b. Aggregation models are similar to the part-of relationship in semantic data models.
    c. These are has-a or contains relationships

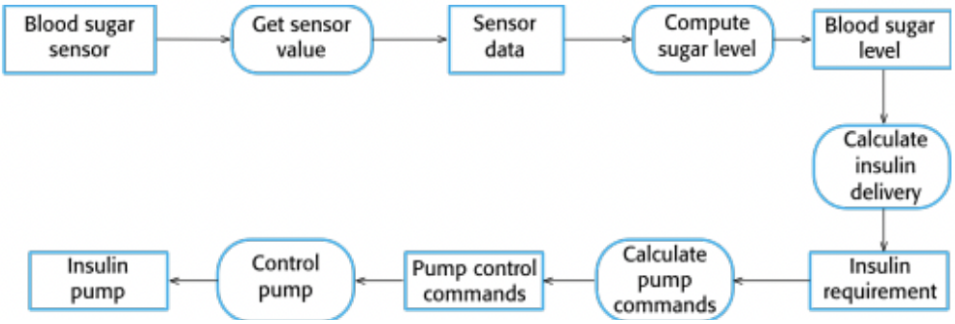
25. The aggregation association

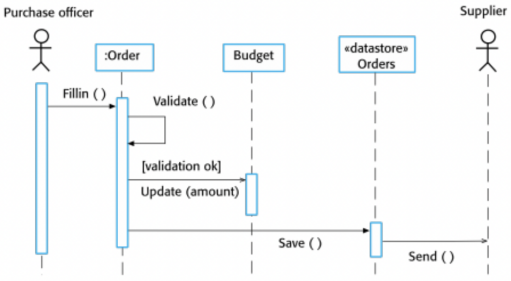
a. 

26. Composite (has-a) Class

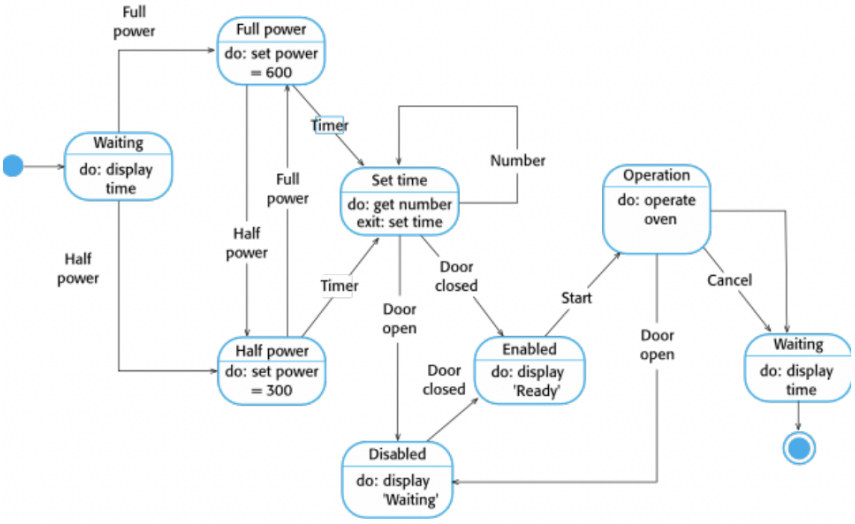
a. 

27. Dependencies / associations
    a. 

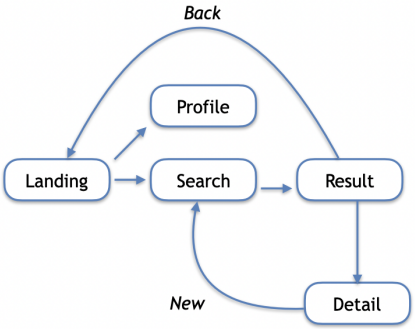
28. Behavioral models
    a. Behavioral models are models of the dynamic behavior of a system as it is executing. They show what happens or what is supposed to happen when a system responds to a stimulus from its environment.
    b. You can think of these stimuli as being of two types:
        i. Data Some data arrives that has to be processed by the system.
        ii. Events Some event happens that triggers system processing. Events may have associated data, although this is not always the case.
29. Data-driven modeling
    a. Many business systems are data-processing systems that are primarily driven by data. They are controlled by the data input to the system, with relatively little external event processing.
    b. Data-driven models show the sequence of actions involved in processing input data and generating an associated output.
    c. They are particularly useful during the analysis of requirements as they can be used to show end-to-end processing in a system.
30. An activity model of an insulin pump's operation
    a. 

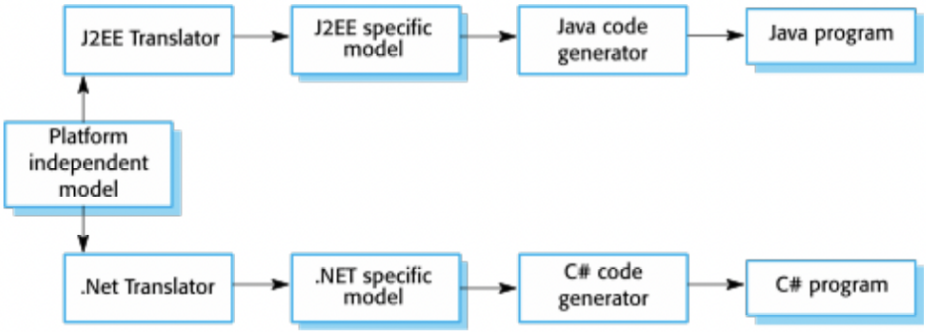
31. Order processing
    a. 

32. Event-driven modeling
    a. Real-time systems are often event-driven, with minimal data processing. For example, a landline phone switching system responds to events such as ‘receiver off hook’ by generating a dial tone.
    b. Event-driven modeling shows how a system responds to external and internal events.
    c. It is based on the assumption that a system has a finite number of states and that events (stimuli) may cause a transition from one state to another.
33. State machine models
    a. These model the behavior of the system in response to external and internal events.
    b. They show the system’s responses to stimuli so are often used for modeling real-time systems.
    c. State machine models show system states as nodes and events as arcs between these nodes. When an event occurs, the system moves from one state to another.
    d. Statecharts are an integral part of the UML and are used to represent state machine models.
34. State diagram of a microwave oven
    a.



35. State / flow diagram for a web app
    a.



36. Why me model …decoupling
    a. 

37. Bottom line
    a. We use diagrams to express intent
    b. Which one you use is decided by what you are trying to convey
    c. Almost always a diagram is better than a bunch of text at explaining something
    d. UML is the system of choice for most projects
    e. We'll also use ERDs, network diagrams, swimlanes, and other tools that we haven't seen yet