COMP1531



🎨 Design - Conceptual Modelling

Lecture 7.2

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In This Lecture

- Why? 🤔
 - A critical element of software design is to be able to translate complex system ideas into something high level and understandable
- What?
 - Conceptual Model
 - State Diagrams









Figure 1: Mathematical Model
$$\frac{dC}{dt} = \frac{s_c C}{1 + (R_b + N_b + T_b + L_b)/b_{c\infty}} + \frac{k_{cp}}{v_m} (P - C) - (k_{crc} + k_{cnc} + k_{ctc} + k_{clc})C - \mu_c C$$

$$\frac{dP}{dt} = \frac{k_{cp}}{v_b} (C - P) - \mu_p P$$

$$\frac{dR_c}{dt} = \frac{s_{rc}R_c}{1 + R_b/b_{r\infty}} + k_{crc}C - k_{rcm}R_c - \mu_{rc}R_c \qquad \frac{dR_m}{dt} = k_{rcm}R_c - \frac{k_{rmb}}{v_m} R_m - \mu_{rm}R_m$$

$$\frac{dN_c}{dt} = \frac{s_{nc}N_c}{1 + N_b/b_{n\infty}} + k_{cnc}C - k_{ncm}N_c - \mu_{nc}N_c \qquad \frac{dN_m}{dt} = k_{ncm}R_c - \frac{k_{nmb}}{v_m} N_m - \mu_{nm}N_m$$

$$\frac{dT_c}{dt} = \frac{s_{tc}T_c}{1 + T_b/b_{t\infty}} + k_{ctc}C - k_{tcm}T_c - \mu_{tc}T_c \qquad \frac{dT_c}{dt} = k_{tcm}T_c - \frac{k_{tmb}}{v_m} T_c - \mu_{tc}T_c$$

$$\frac{dL_c}{dt} = \frac{s_{tc}L_c}{1 + L_b/b_{t\infty}} + k_{ctc}C - k_{tcm}L_c - \mu_{tc}L_c \qquad \frac{dL_c}{dt} = k_{tcm}L_c - \frac{k_{tmb}}{v_m} L_c - \mu_{tc}L_c$$

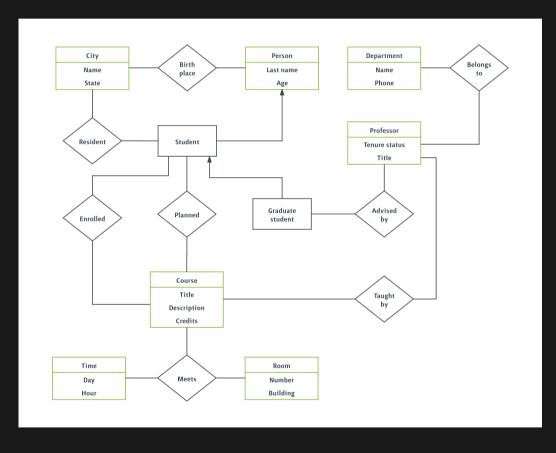
$$\frac{dR_b}{dt} = \frac{k_{rmb}}{v_m} R_m - \mu_{rb}R_b \qquad \frac{dT_b}{dt} = \frac{k_{tmb}}{v_m} T_m - \mu_{tb}T_b$$

$$\frac{dN_b}{dt} = \frac{k_{nmb}}{v_m} N_m - \mu_{nb}N_b \qquad \frac{dL_b}{dt} = \frac{k_{tmb}}{v_m} L_m - \mu_{tb}L_b$$

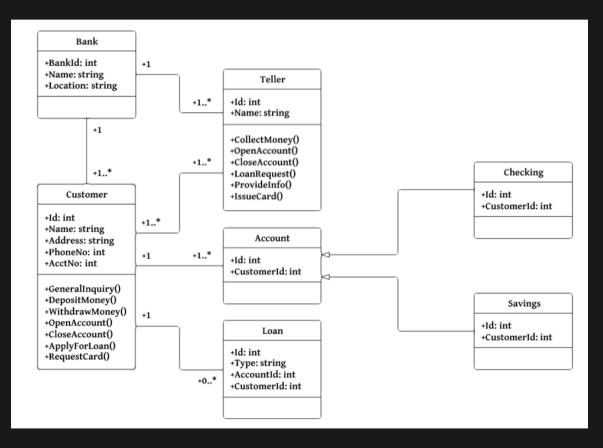




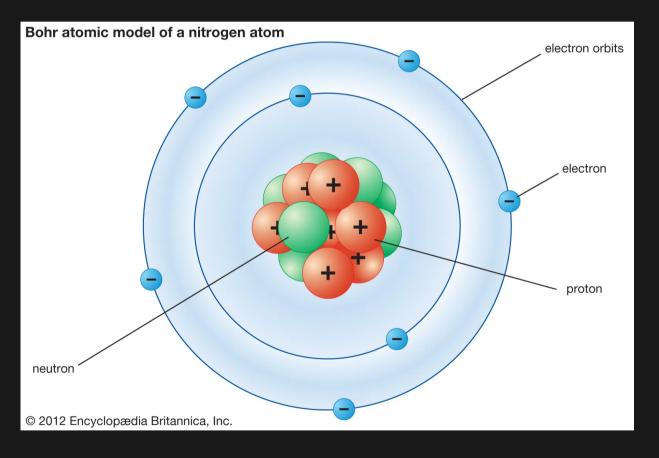






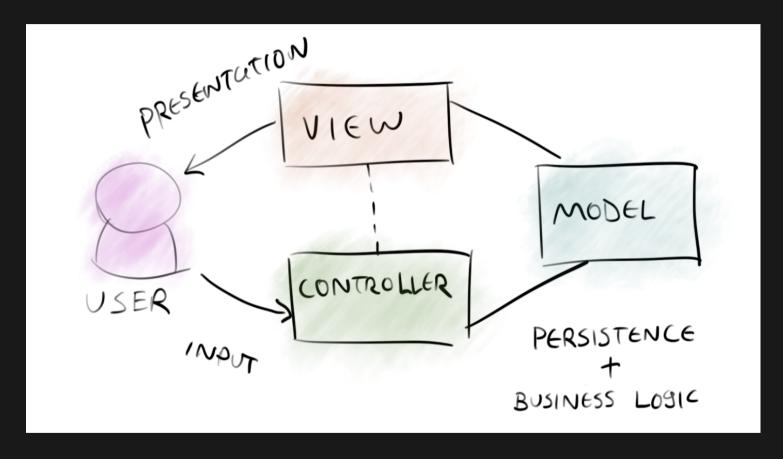












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A **model** is a simplified representation to assist in understanding something more complex.

This covers everything from mathematics through to model aeroplanes.

Conceptual Modelling

A **conceptual model** is a type of model that captures a system in a conceptual way rather than a physical way.

They tend to be diagramatic or visual.

Conceptual Modelling

Examples include:

- Mathematical models
- **Data models**: To model databases
- **Domain models**: To model components of a software system
- State transition models: To model how a program operates at different stages

Conceptual Modelling

Generally conceptual models in software will be one of two types:

- Structural Emphasise the static structure of the system. Examples include:
 - UML class diagrams (object oriented programming)
 - ER diagrams (database design)
- Behavioural Emphasise the dynamic behaviour. Examples include:
 - State diagrams (state machines)
 - Use case diagram (user flows)

We will discuss some of these, and explore state diagrams in detail.

What Are Models Used For?

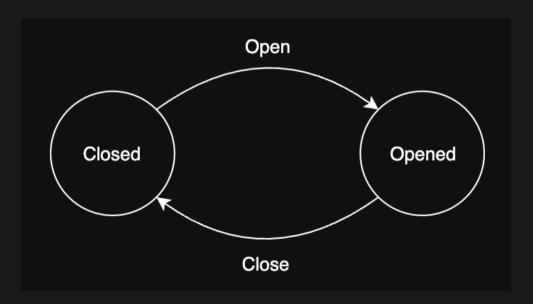
- To predict future states of affairs.
- Understand the current state of affairs.
- Determine the past state of affairs.
- To convey the fundamental principles and basic functionality of systems i.e. help communicate



- Four fundamental objectives of communicating with a conceptual model:
 - Enhance an individual's understanding of the representative system
 - Facilitate efficient conveyance of system details between stakeholders
 - Provide a point of reference for system designers to extract system specifications
 - Document the system for future reference and provide a means for collaboration
 Kung and Solvberg (1986)



- A diagrammatic representation of a state.
- Simple example: a door
- Some variation in notation, though typically: states are circles, transitions are labelled arrows connecting them





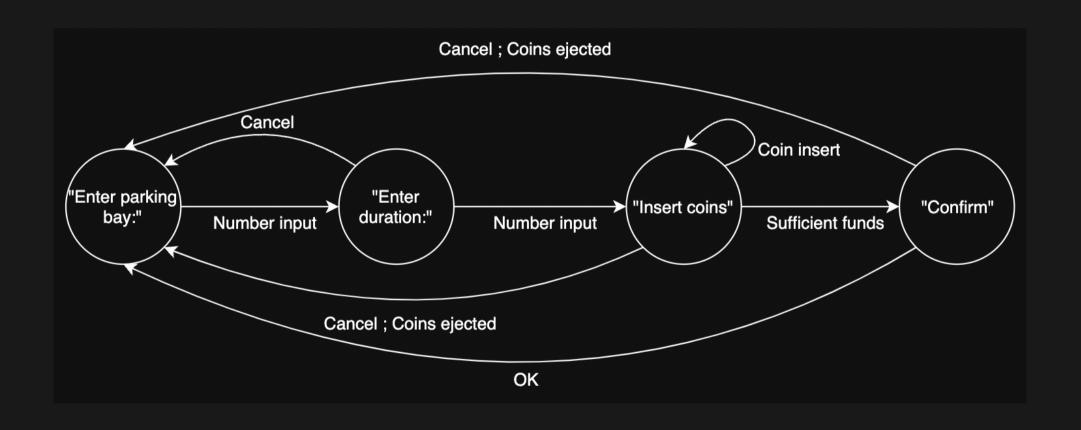
State diagrams are used to describe state machines.

State machines (i.e. software) are made up of a finite number of states.

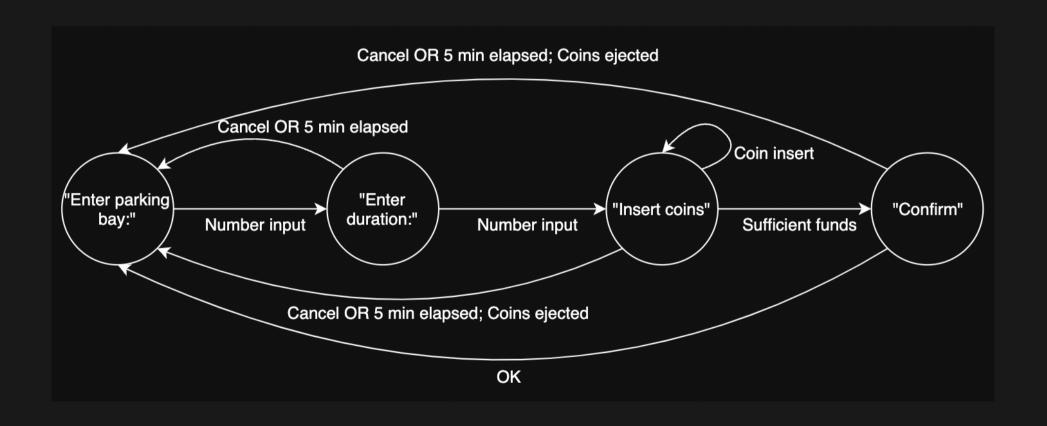
The machine (i.e. software) can be transitioned from one state to another through an action

- For example:
 - UIs with different screens
 - Network protocols
 - Conversational interfaces

Parking Meter Example



Parking Meter Example



Quick Activity

Can we model the opal card system as a state machine?



For Fun: A Complex Conceptual Model

- In 2015 a UNSW student wrote a conceptual model "Gallium" based off of previous research to represent the energy usage of a solar car as it drove from Darwin to Adelaide
- The model was written in python and modeled the physical system of the vehicle and it's energy consumption over a fixed distance in response to a dynamic environmental and physical characteristics

The model calculated the energy usage across a number of fixed-distance intervals (e.g. a 200 metre stretch of road) over a 3000km journey across Australia.

Feedback



Or go to the form here.

