## UML Essentials Dynamic Modeling

Excerpts from: Object Oriented Software Engineering by Lethbridge/Laganière and Applying UML and Patterns by Larman, C.

#### Dynamic model (diagram) elements (model run-time)

- Instances of classes
  - Shown as boxes with the class and object identifier underlined
- Actors
  - Use the stick-person symbol as in use case diagrams
- Messages
  - Shown as arrows from actor to object, or from object to object

Two types of dynamic diagram is the **Sequence diagram** and the **State Transition diagram** 

# Sequence Diagrams – Modeling Interaction

1. Student selects Register for Courses option

2. System retrieves a list of the available courses

3. Student specifies the desired course

4. System shows a list of the available sections

5. Student selects the course section

6. System verifies if the student has passed prerequisites

7. System add course section to student's Schedule

8. System displays modified student's Schedule

9. Steps 3-8 repeated until student finished



# Sequence diagrams

•A sequence diagram shows the sequence of messages exchanged by the set of objects performing a certain task

- The objects are arranged horizontally across the diagram.
- An actor that initiates the interaction is often shown on the left.
- The vertical dimension represents time.
- A vertical line, called a *lifeline*, is attached to each object or actor.
- The lifeline becomes a broad box, called an *activation box* during the *live activation* period.
- A message is represented as an arrow between activation boxes of the sender and receiver.
  - A message is labelled and can have an argument list and a return value.

# Sequence Diagrams – Elements



### Sequence diagrams – an example



# Sequence diagrams – same example, more details



### Sequence diagrams – an example with object deletion

 If an object's life ends, this is shown with an X at the end of the lifeline



# State Transition Diagrams

•A state diagram describes the behaviour of a system, some part of a system, or an *individual object*.

- At any given point in time, the system or object is in a certain state.
  - Being in a state means that it will behave in a *specific* way in response to any events that occur.
- Some events will cause the system to change state.
  - In the new state, the system will behave in a different way to events.
- A state diagram is a directed graph where the nodes are states and the arcs are transitions.

# State diagrams – an example

• tic-tac-toe game



#### States

- At any given point in time, the system is in one state.
- It will remain in this state until an event occurs that causes it to change state.
- A state is represented by a rounded rectangle containing the name of the state.
- Special states:
  - A black circle represents the start state
  - A circle with a ring around it represents an *end state*

# Transitions

- A transition represents a change of state in response to an event.
  - It is considered to occur instantaneously.
- The label on each transition is the event that causes the change of state.

# Activities and Actions

- An *activity* takes place while the system is *in* a state.
  - Takes a period of time
  - System may transition out of a state when activity is completed.
- An action takes place effectively instantaneously.
  - Upon entry or exit into/from a particular state

# State diagrams – an example with conditional transitions

