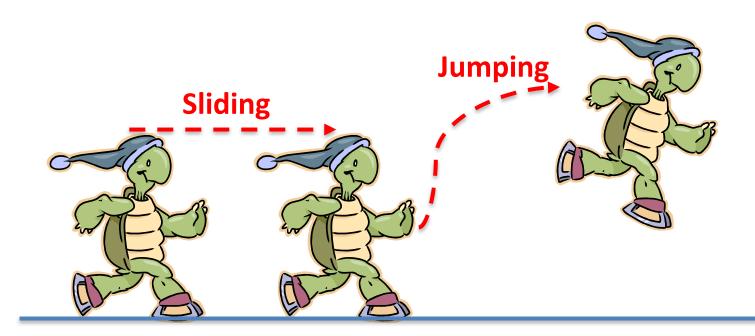


CSCI 1108

State Transition Diagrams



State Transition Diagrams

 How to organize code for an reactive controller?



Crossing at an Intersection

- If light is red, wait for light to turn green
- If light is yellow, wait for light to turn green
- If light is green but there is not enough time, wait for light to turn red and then green
- If light is green and there is enough time,
 - Proceed on crosswalk
 - If a car is speeding at you, get out of the way
- Stop crossing when other side is reached
 - → Formulating such a rule-based system as a state transition diagram

State

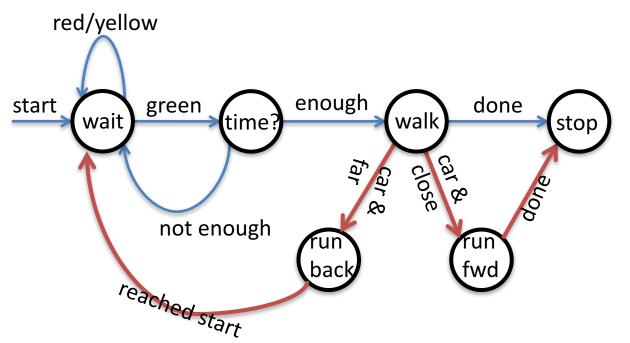
- A state is a <u>unique</u> set of conditions that hold at a given time
- Conditions include:
 - Measured or sensed properties of the environment
 - E.g., light is green and there is 20 seconds to cross
 - Current behaviour
 - E.g., Crossing the street
 - Current expectations
 - E.g., Will reach the other side without being run over
- Key Idea: A robot can be in one state at a time
- Robots can transition from one state to another state

State Transitions

- A state transition occurs when
 - An event occurs
 - One of the conditions describing the state changes
 - The state of the robot changes
- Transitions are typically caused by
 - External events
 - E.g. The stoplight changing colour
 - Internal event (Completion of a step in a task)
 - E.g. Completion of crossing the street

State Transition Diagrams

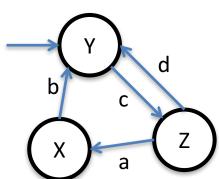
- Idea: We use a state transition diagram to model a task
- States are represented by circles
- Arrows represent transitions between states



- If light is red, wait for light to turn green
- If light is yellow, wait for light to turn green
- If light is green but there is not enough time, wait for light to turn red and then green
- If light is green and there is enough time,
 - Proceed on crosswalk
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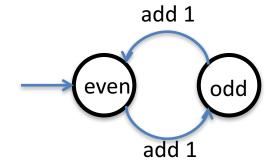
Creating State Transition Diagrams

- Identify the states (steps) of a task
 - Determine what actions must be performed
 - Determine groups of unique (relevant) conditions
 - Label each group with a unique name
- Identify state to state transitions
 - What is being sensed?
 - What external events will be sensed?
 - What internal events will occur?
 - What conditions will these events change?
 - Determine which conditions change?
 - Determine the corresponding states in the transition
 - Label each transition with a unique label
- Create diagram
 - Combine states and transitions
 - Refine the diagram by repeating the process
- This diagram is a blueprint for your program!



Determine if Number of People is Even

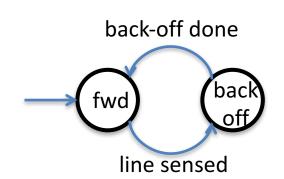
- Idea
 - Don't want to count people
 - Just keep track if # of people is odd or even
- States: (2)
 - Even
 - Odd



- Transitions:
 - Each additional person causes a transition to the other state

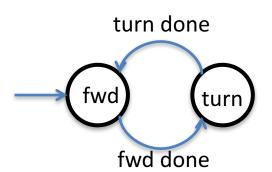
Avoid the Boundary

- Idea
 - Two actions
 - Move forward
 - Back off
 - Two events
 - Black line sensed
 - Finish back-off
- States: (2)
 - Forward
 - Back-off
- Transitions:
 - Line sensed (prox event)
 - Back-off done (timer event)



Move in a Square

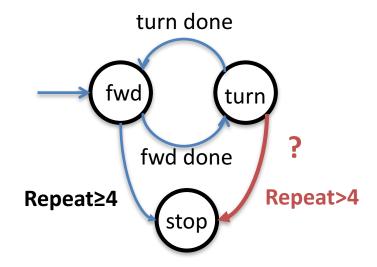
- Idea
 - Two actions
 - Move forward
 - Turn right
 - Two events
 - Finish straight move (timer expired)
 - Finish right turn (timer expired)
- States: (2)
 - Forward
 - Turn
- Transitions:
 - On timer events
 - (timers expire)



```
onevent timer0
motor.left.target = -motor.left.target
if motor.left.target < 0 then
    timer.period[0] = TURN_PERIOD
else
    timer.period[0] = FWD_PERIOD
end</pre>
```

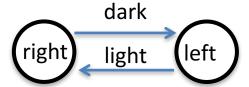
Make One Square

- Idea
 - Two actions
 - Move forward
 - Turn right
 - Repeated 4 times
 - Two events
 - Finish straight move (timer)
 - Finish right turn (timer)
- States: (?)
 - Forward?
 - Turn?
 - **—** ...
- Transitions:
 - When timers expire
 - **—** ...



Follow the Line

- Setup
 - Actions?
 - Events?
- States: (?)
- Transitions: ?



Determine if Number of People is Divisible by 3

- Idea
 - Don't want to count people
 - Just keep track if # of people is divisible by 3
- States: (?)
- Transitions:
 - Each additional person causes a transition