LAB 6. Finite State Machines

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Agenda

1. FMS models
   - old-style rotary telephone model
   - cruise control system model
     - in-class exercise

Finite State Machines

Telephone model using FSM

- plain, old-style phone
  - possible states
    - busy, ringing, connected, dialing, on hook, off hook
  - user actions
    - change the phone state
      - » picking up the phone, dialing number, etc.

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Telephone model using FSM

- transition function

	handset replaced	handset lifted	number dialed	Called party answers	Called party hangs up	line in use	phone rings
On hook, idle							
Off hook, idle							
Dialing, off hook							
Busy, off hook							
Connected, off hook							
Ringing, on hook							

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Telephone model using FSM

- transition function

	handset replaced	handset lifted	number dialed	Called party answers	Called party hangs up	line in use	phone rings
On hook, idle		Off hook					Ringing
Off hook, idle	On hook		Dialing				
Dialing, off hook	On hook			Connected		Busy	
Busy, off hook	On hook						
Connected, off hook	On hook				Busy		
Ringing, on hook		Connected					

	handset replaced	handset lifted	number dialed	Called party answers	Called party hangs up	line in use	phone rings
On hook, idle		Off hook					Ringing
Off hook, idle	On hook		Dialing				
Dialing, off hook	On hook			Connected		Busy	
Busy, off hook	On hook						
Connected, off hook	On hook				Busy		
Ringing, on hook		Connected					

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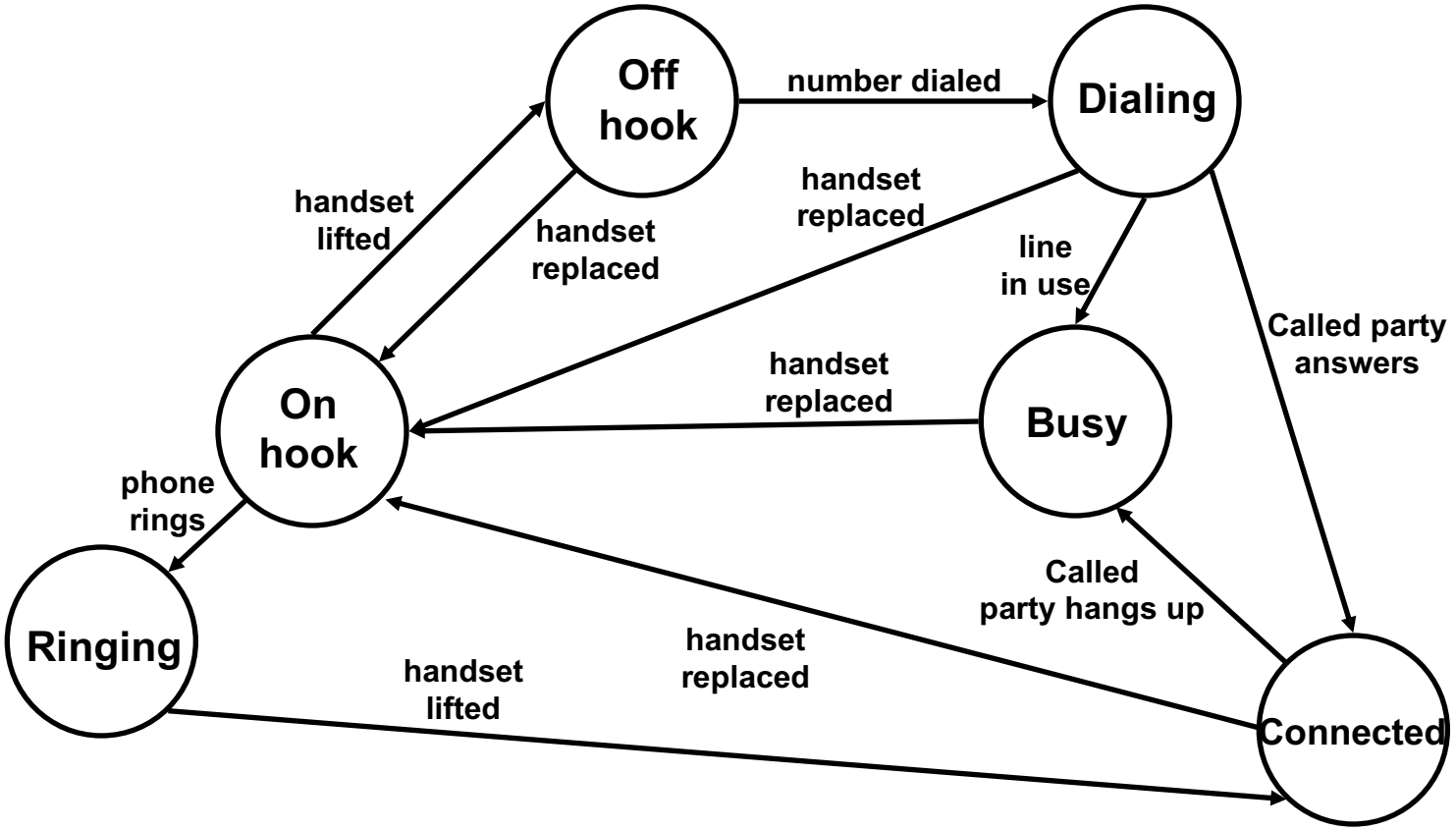
Telephone model using FSM



Finite State Machines

Cruise-control system (CCS) model using FSM

- CCS used to automatically maintain speed of a car
- Pressing brake causes that the system to temporarily revert to manual control until resume is pressed
- CCS can be directed to increase or decrease speed to reach a new maintenance speed
- System Inputs:
  - CCS ON/OFF
  - Engine ON/OFF (CCS only active if the engine is ON)
  - Pulses (generated every revolution of the wheel)
  - Accelerator (accelerator has been pressed)
  - Brake (brake has been pressed)
  - Increase/Decrease maintained speed (only if CCS is ON)
  - Resume (resume the last maintained speed; only if CCS is ON)
- System Output:
  - Throttle (setting for engine throttle)

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CCS model using FSM

- Definition of the system states:
  - Current engine status: ON/OFF
  - Current CCS status: ON/OFF
  - Current status of the throttle
    - same (throttle does not change, CCS is ON)
    - increase (throttle opens , CCS is ON)
    - decrease (throttle closes , CCS is ON)
    - manual (CCS is OFF, driver has control over the car)
      - » outside of the model scope
  - The CCS maintains the speed: YES/NO
    - if driver presses brake then NO
    - CCS system must be on

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CCS model using FSM

- Definition of the system states:
  - the situation when CCS is ON, brake was pressed (CCS does not maintain the speed), and the throttle is in same position is not considered
    - the driver would need to keep pressing acceleration with power that does not change the throttle
  - there is no oscillations due to the control mechanism of the CCS
    - e.g. driving uphill CCS system would increase throttle, but would not go over the desired speed

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CCS model using FSM

- Definition of the system states:

State	Engine	CCS	Throttle	CCS maintains speed
S1	off	off	same	no
S2	on	off	manual	no
S3	on	on	same	yes
S4	on	on	increase	yes
S5	on	on	decrease	yes
S6	on	on	increase	no
S7	on	on	decrease	no

Finite State Machines

Fill out the LAB report

- **group work**
- **turn it back to the instructor when finished**
- **grade will be individual (equal for every team member)**

Homework and Next Time

prepare yourself for the next LAB

- **review the Petri Nets theory**
  - **next time you will learn a software tool for drawing and simulating Petri Nets**