CSCI 1108
Introduction to
Experimental Robotics

Intro to ASEBA
Classic Robotics themes

**Actuators and movements:**
- Kinematics – basic movement geometry without taking mass and forces into account
- Differential movements - change in position
- Dynamics – differential motions and movement mechanics

**Sensor and object recognition:**
- Computer Vision

**Localization:**
- Kalman filtering, SLAM, etc

**Motion planning**
- A*, tangent bug, obstacle avoidance, etc
Anatomy of a Robot

- **Thymio II robot**
  - [https://aseba.wikidot.com](https://aseba.wikidot.com)

- **Components:**
  - Sensors
  - Controller
  - Actuators
The Sense-Decide-Act Framework

- Sense
- Decide
- Act
Controller:

A controller decides what action to take based on input from sensors. Our task is to write a control program for the Thymio II.

This is done in a special programming language called ASEBA
Programming in Aseba

• Programs are text-based
• Programing environment called Aseba Studio
• Key Ideas: Event-based programming
  – Events are triggered by sensors
  – Events are handled by event handlers for which we write the code: `onevent ...`
  – Common programing model for interactive programs (e.g. www, computer interface, etc)
Basic Aseba

- **Variables**
  
  ```
  var name
  var list[]
  ```

- **Event Handler**
  
  ```
  onevent prox
  ```

- **Conditional**
  
  ```
  if    then
  ```
The Four Parts of an Aseba Program

• Variable declarations
  – Begin with the `var` keyword

• Initialization code
  – Anything except declarations

• Event handlers
  – Begin with the `onevent` keyword

• Subroutines
  – Begin with the `sub` keyword
Sensors and Actuators

- Li-Po battery level
- loudspeaker
- microphone
- infrared remote control receiver
- 3-axis accelerometer
- 5 proximity sensors
  - obstacle detection
- 2 ground sensors
  - line following
- 39 LED
  - visualize sensors and interactions

Actuators
- 5 capacitive touch buttons
  - activity display
  - and ON-OFF function
- pencil support
- USB connection
  - programming and recharging
- memory card slot
- hook for trailer
- 2 proximity sensors
- mechanic attachment
- 2 wheels
  - speed control
- temperature sensor
- reset button
A Sample Program

```javascript
var speed = 100

motor.left.target = 0
motor.right.target = 0

onevent button.forward
    motor.left.target = speed
    motor.right.target = speed

onevent button.backward
    motor.left.target = 0
    motor.right.target = 0

onevent button.left
    motor.left.target = -speed
    motor.right.target = speed

onevent button.right
    motor.left.target = speed
    motor.right.target = -speed
```

Key Idea: Actuators are controlled by setting variables that represent them.
Aseba Studio

Sensors and Actuators in Aseba

• Key Idea: All sensors and actuators are accessed via predefined variables, e.g.,
  – to control motors, assign values to motor variables
    
    \[
    \begin{align*}
    \text{motor.left.target} & = 100 \\
    \text{motor.right.target} & = 100
    \end{align*}
    \]
  – to check if an object is close, read proximity variable
    
    \[
    \text{if prox.horizontal[2] > 1000 then} \\
    \ldots \\
    \text{end}
    \]

• Where are all the predefined variables listed?
• When do we check variables?
When do We Check the Sensors?

• Key Idea: Sensors generate events. Event handlers check sensors.

• Example: Proximity (prox) sensors generate 10 events per second.

```plaintext
onevent prox
    if prox.horizontal[2] > 1000 then
        motor.left.target = 0
        motor.right.target = 0
    else
        motor.left.target = 100
        motor.right.target = 100
    end
```
Event Driven Framework
(Wait) Sense (Event)-Decide-Act
on event prox

  if prox.horizontal[2] > 1000 then
    motor.left.target = 0
    motor.right.target = 0
  elseif prox.horizontal[4] > 1000 then
    motor.left.target = -100
    motor.right.target = 100
  elseif prox.horizontal[0] > 1000 then
    motor.left.target = 100
    motor.right.target = -100
  else
    motor.left.target = 100
    motor.right.target = 100
  end