Lecture - 1

# Networked and Multi-agent Control Systems (ELL805)

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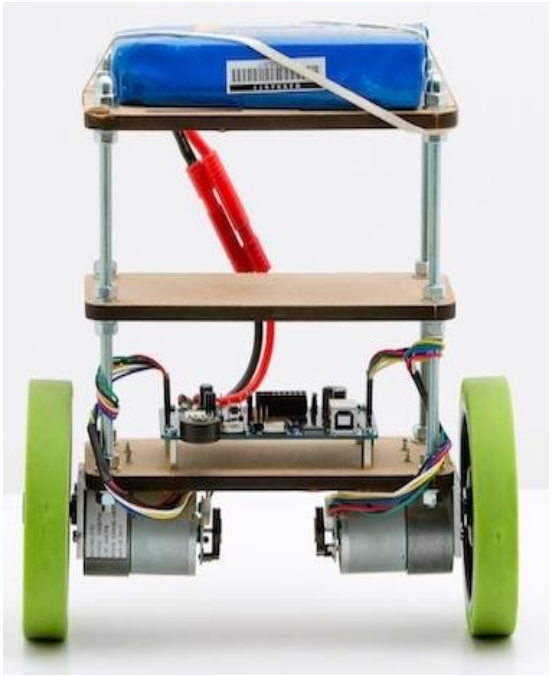
# A mobile robot…

- ***How to Control?***

***(Control objective: To keep it vertically upright and move in a specified path)***

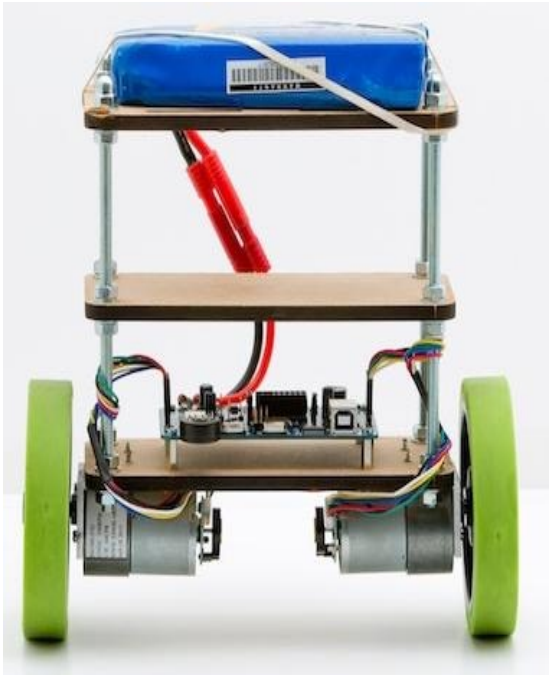


Balanduino

[Image taken from: https://balanduino.tkjelectronics.dk/]

# A mobile robot…

- ***Obtain Mathematical model***, (in the form of state space or transfer function)…
- ***Do system analysis*** (Time response, Stability, Controllability, Observability)….
- ***Design feedback control***



Balanduino

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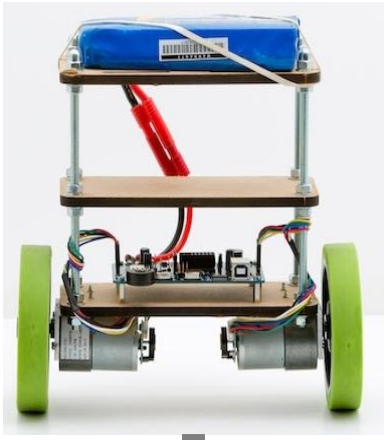
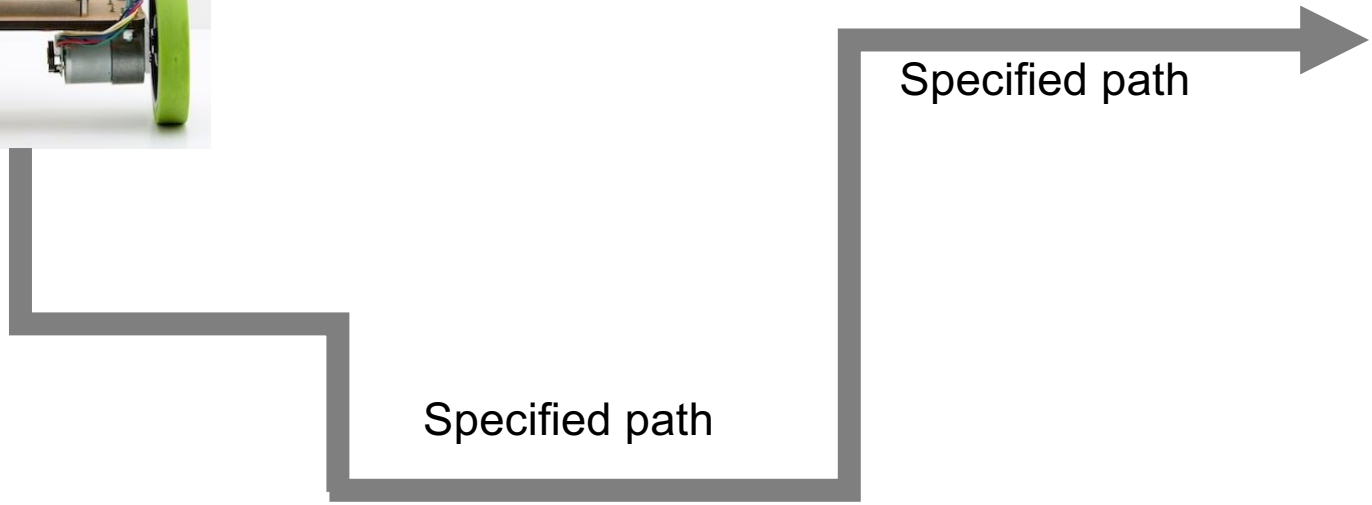
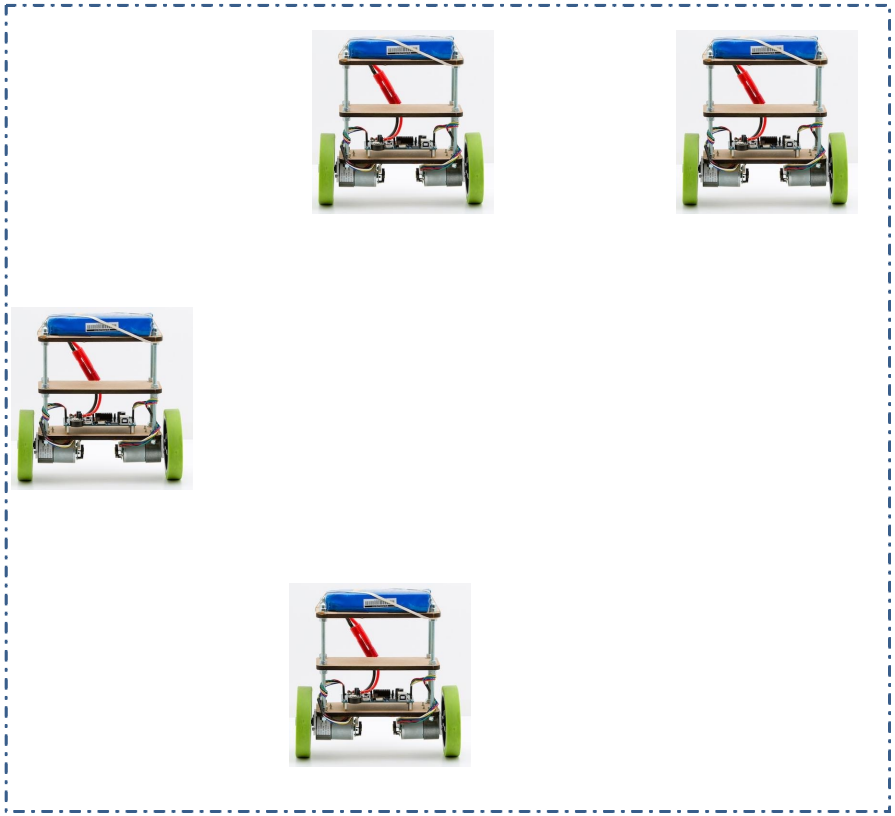
# Path Following Robot…





# A Group of Mobile Robots…



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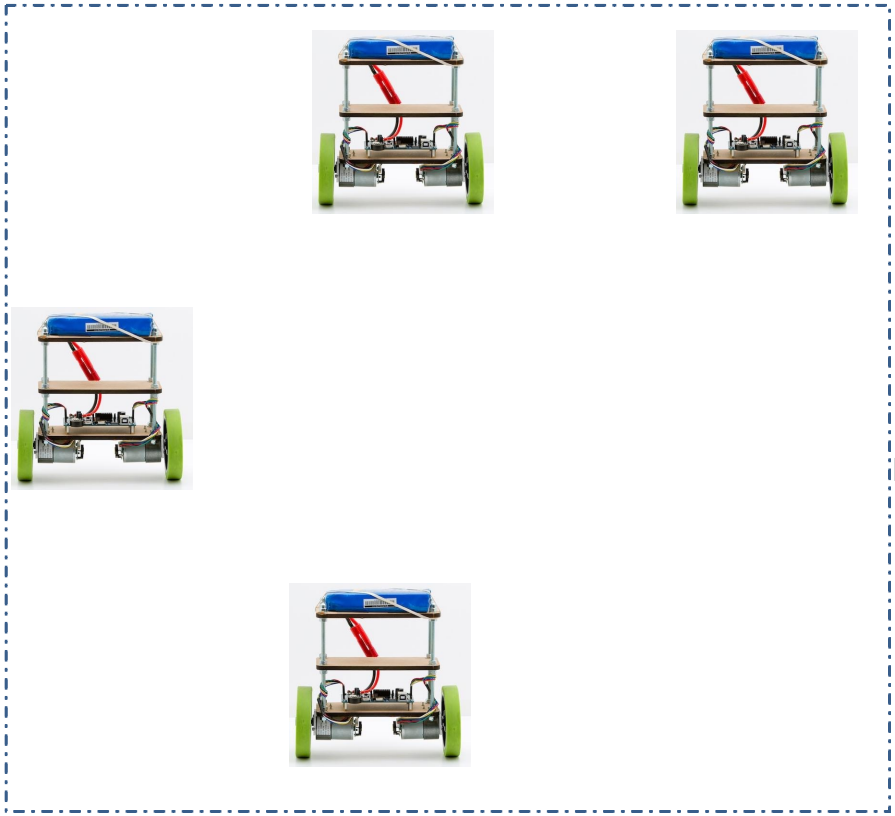
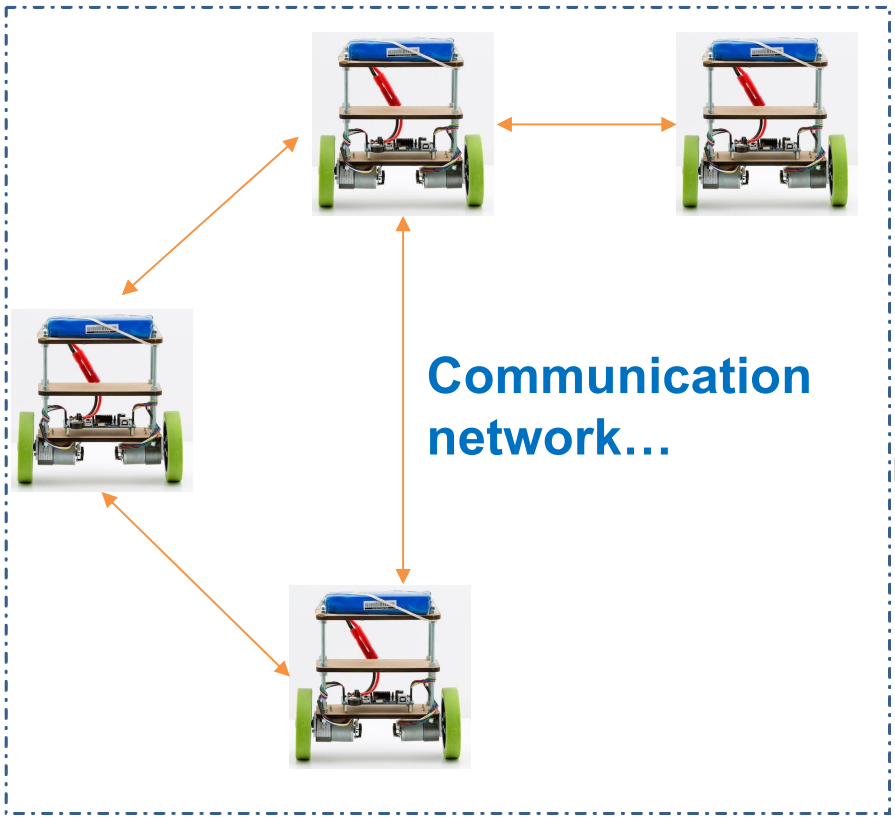


A group of mobile robots *collectively* need to travel in a specified path…

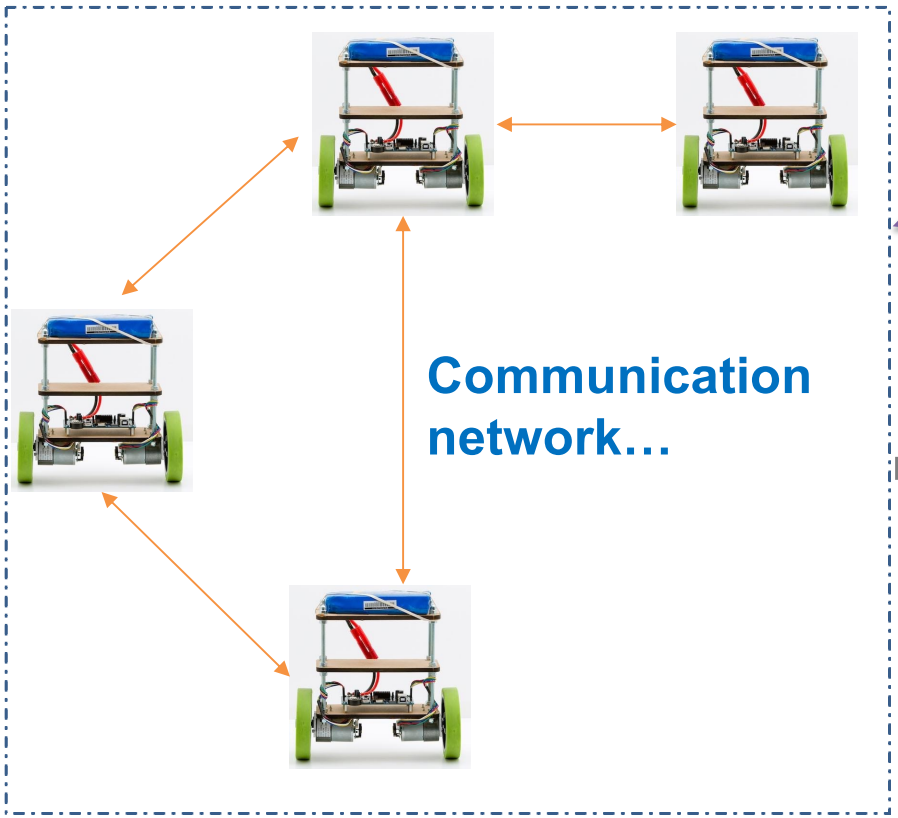
Specified path

# A Group of Mobile Robots…




A group of mobile robots *collectively* need to travel in a specified path…

# A Group of Mobile Robots…

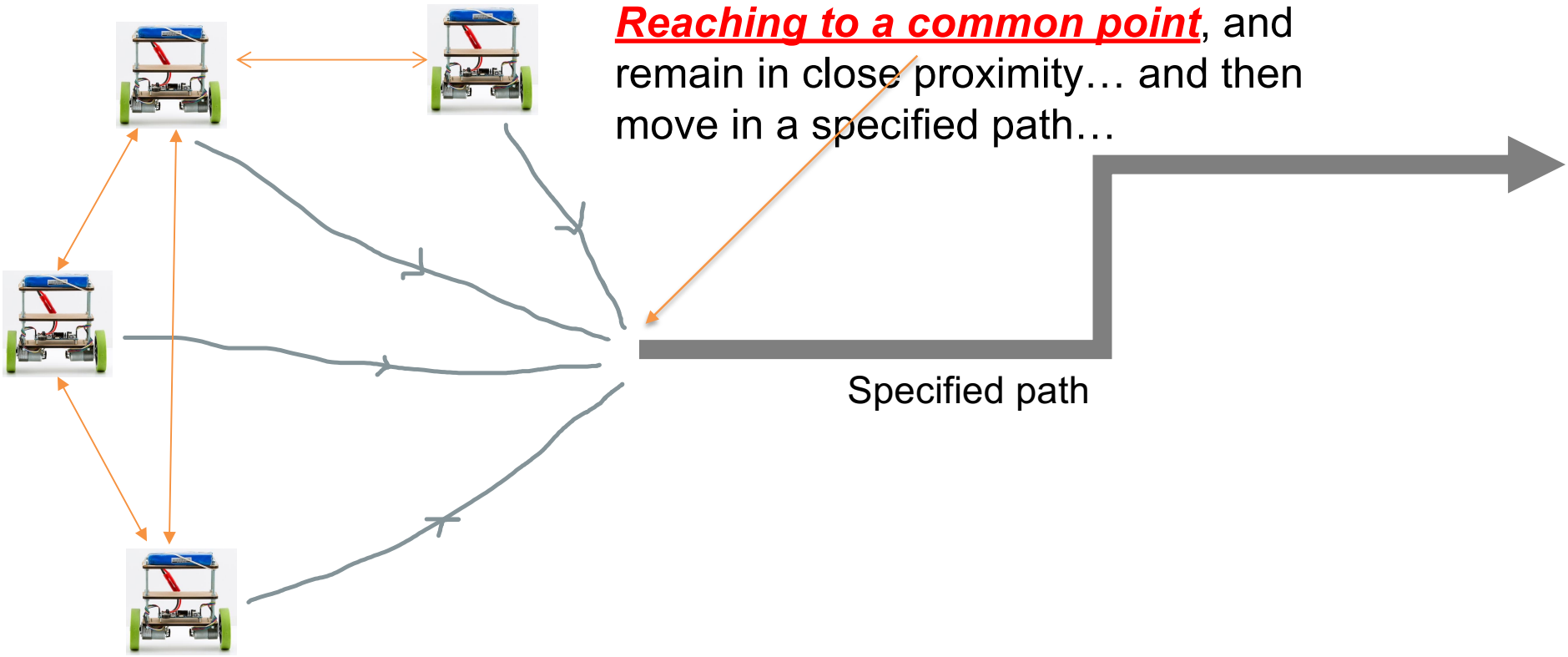



***Networked Multi-agent system***

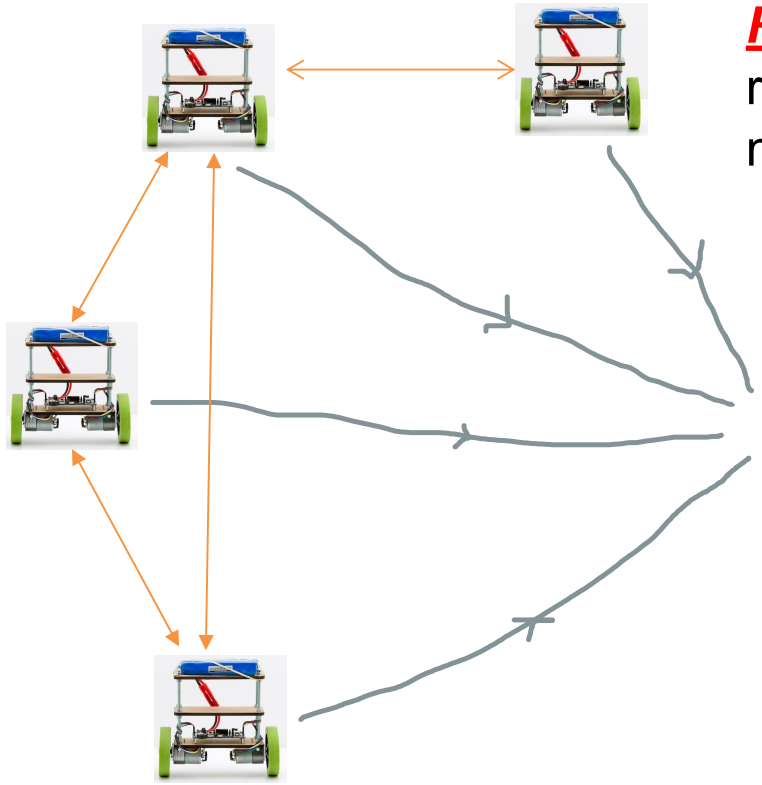
A group of mobile robots *collectively* need to *travel* *in a specified path*…

Specified path

# Different scenarios…



# Different scenarios….



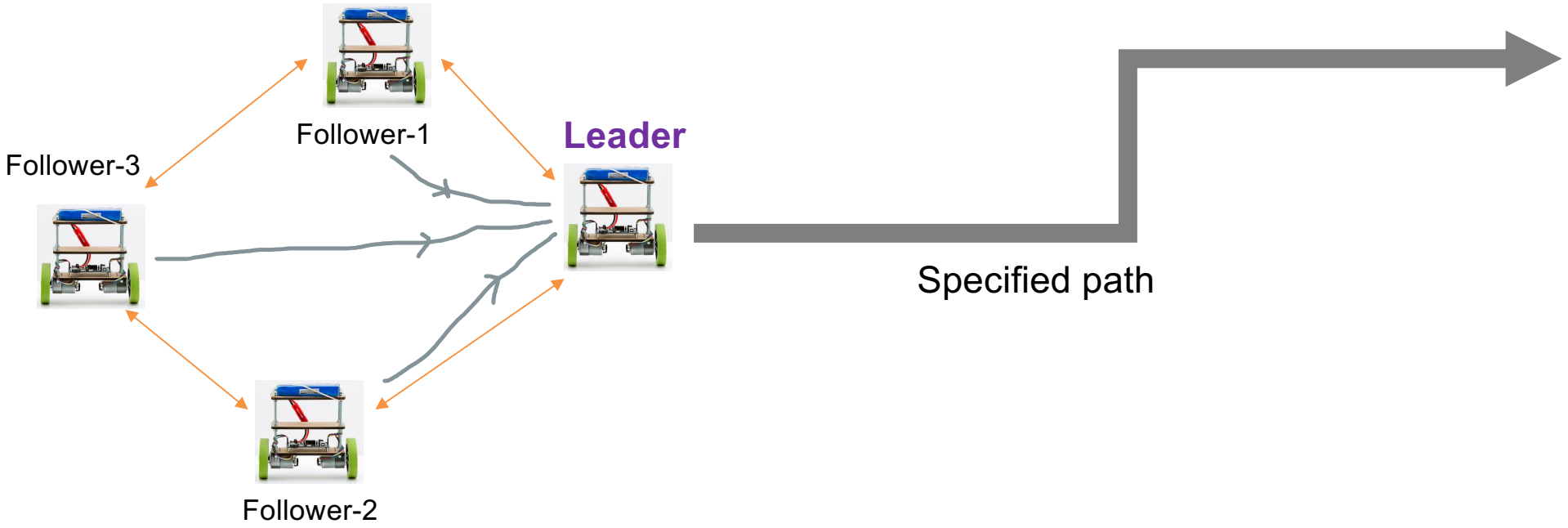
***Reaching to a common point***, and remain in close proximity… and then move in a specified path…

Specified path

***Consensus or Rendezvous or Synchronization…***

# Different scenarios….

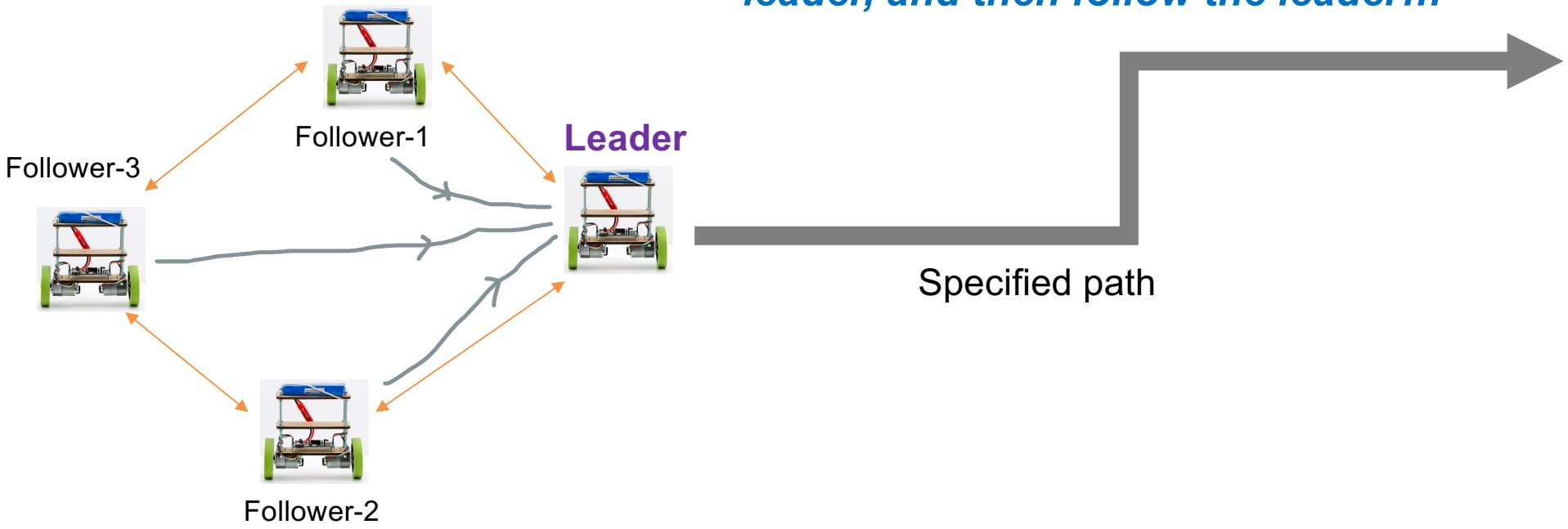
## Leader-Follower Architecture



# Different scenarios….

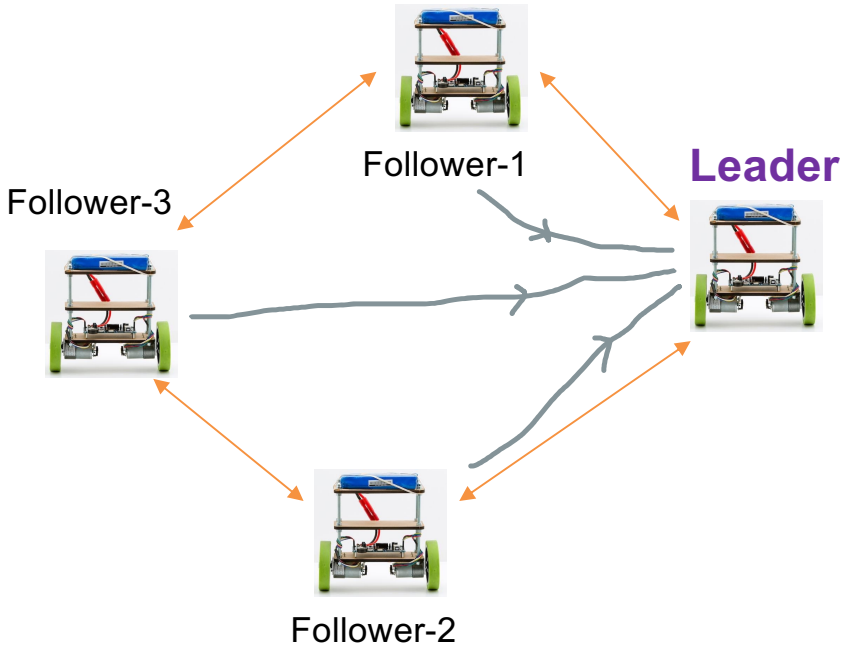
## Leader-Follower Architecture

***First, the followers synchronize with leader, and then follow the leader…***



# Different scenarios….

## Leader-Follower Architecture

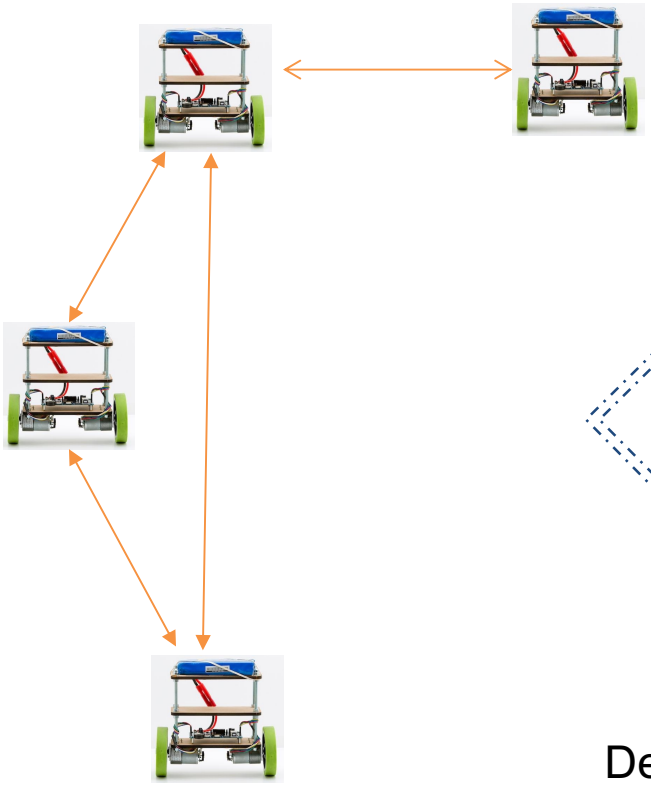



***First, the followers synchronize with leader, and then follow the leader…***

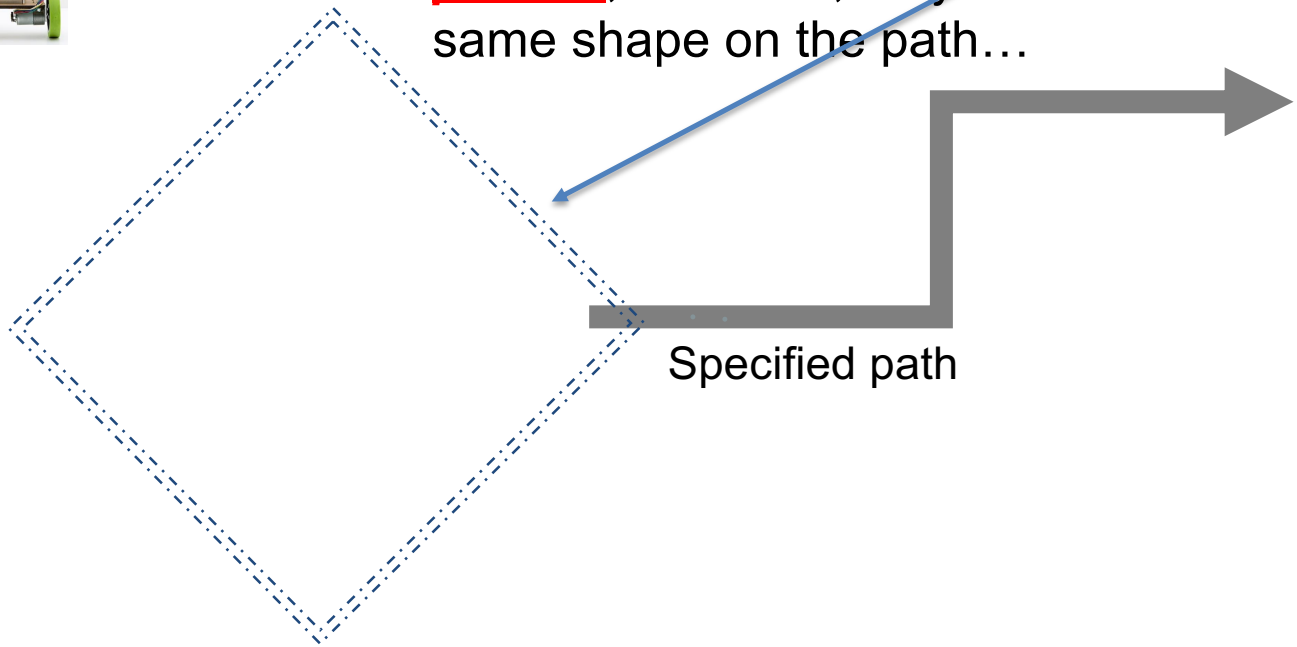
Specified path

***Leader-Follower Synchronization…***

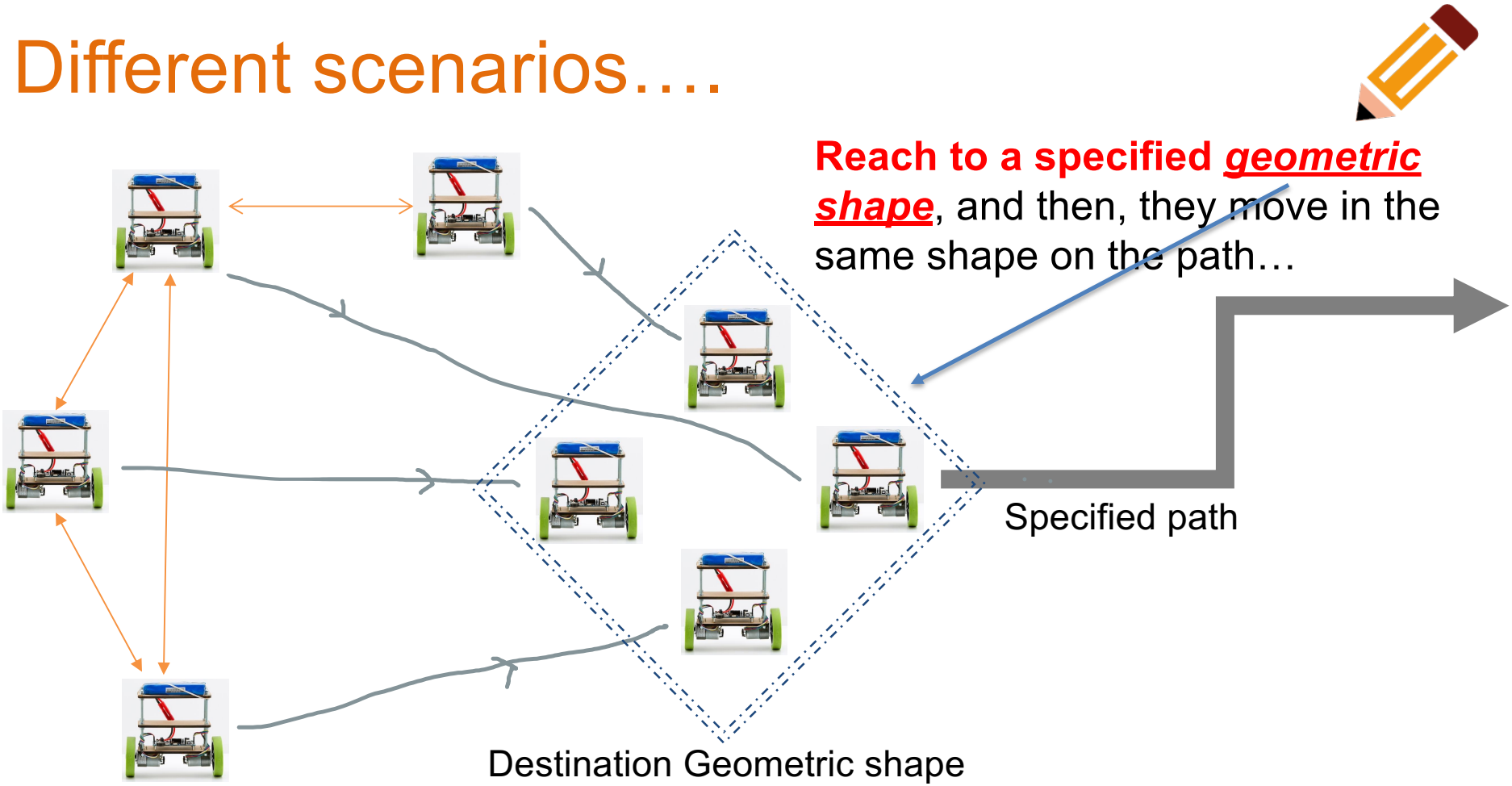
# Different scenarios….



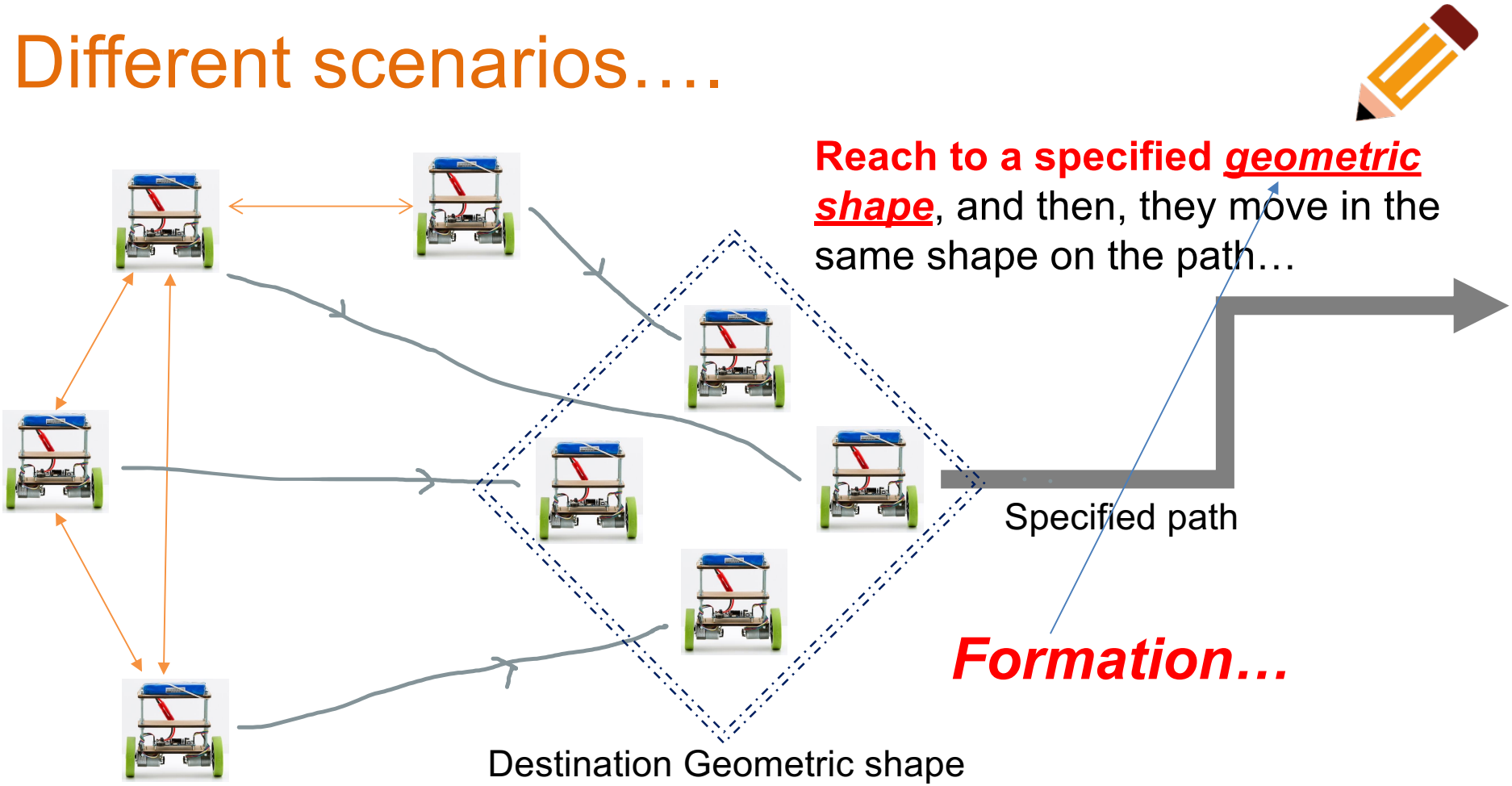
**Reach to a specified *geometric pattern***, and then, they move in the same shape on the path…



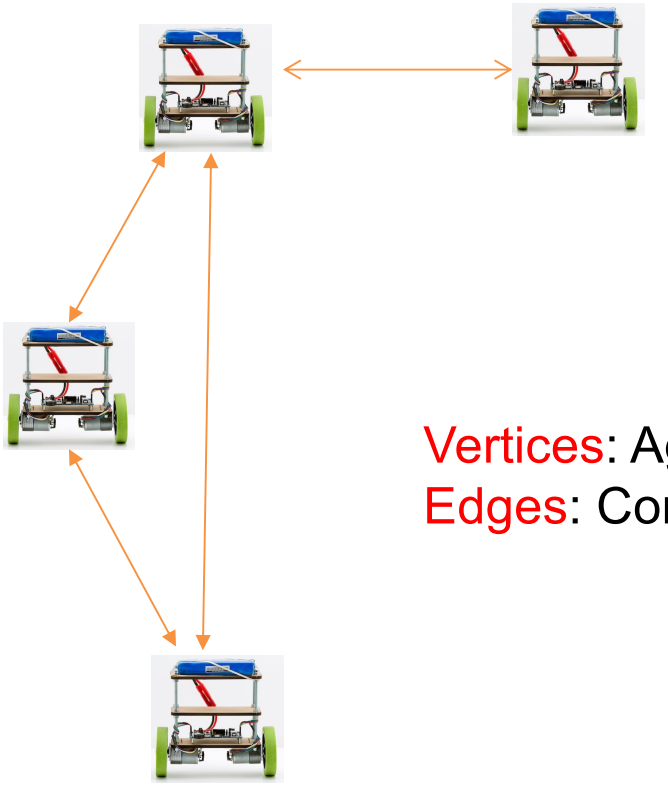
# Different scenarios….



# Different scenarios….

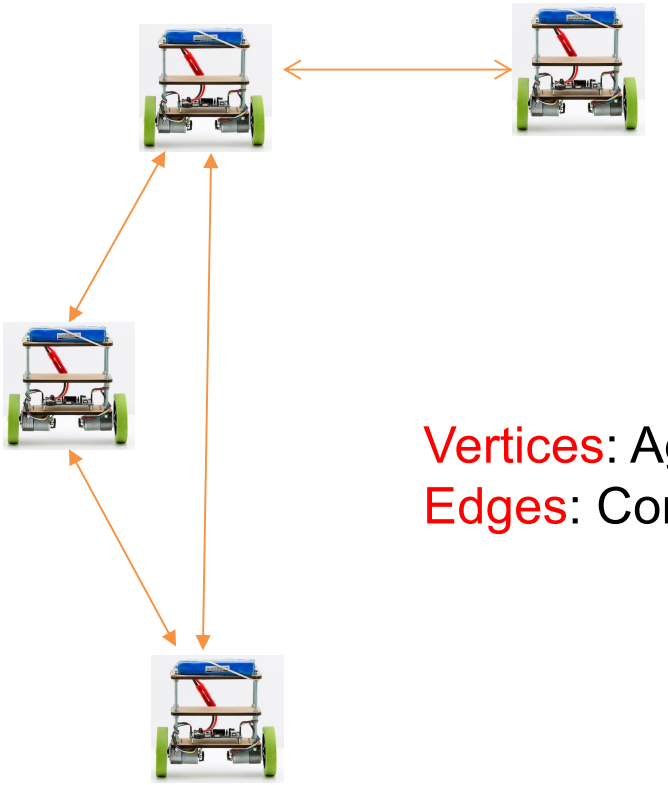


# Graph Representation…



Vertices: Agents
Edges: Communication topology

# Graph Representation…



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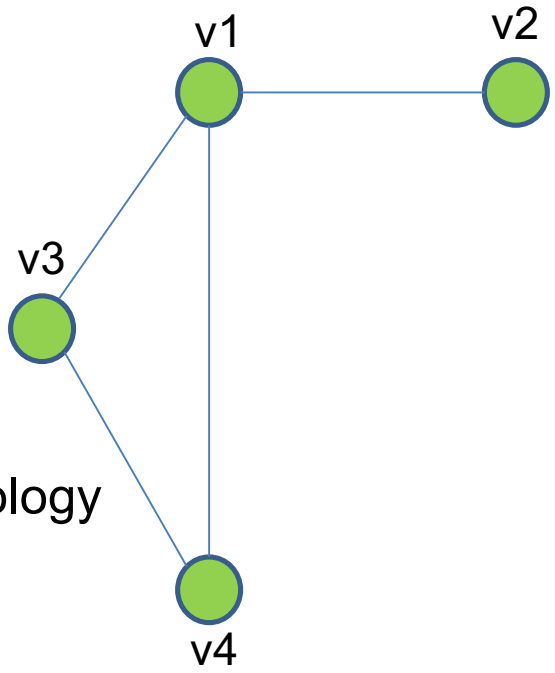


Graph with vertices and edges

# Organization of the Course…

- **Graph Theory** (Algebraic graph theory)
- **Agreement/Consensus protocol** **(Single integrator type dynamics)**
- **Formation Control**
- **Consensus and Leader-Follower Synchronization Control** **(General LTI dynamics)**

# Evaluation…

- **Minor Exam: 35%**
- **Major Exam: 45%**
- **Course Project: 20%**

- **If you are Auditing, then you need to score at least “C” grade to get Audit pass (NP).**

# Lecture Timing and Venue

- Venue: LH527
- Time: Tuesday, Wednesday and Friday (10 AM-11 AM)

*Thank You…*