Distributed Algorithm for Swarm Robots in Graph

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Outline

Gathering Asynchronous and Oblivious Robots on Basic Graph Topologies Under the Look-Compute-Move Model

By

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Model of Swarm Robots

- multiple sensing agent
- no wired or wireless communication
- identical in appearances (eg. point)
- minimal computational power and storage
- placed at nodes of a given unebeled graph
- execue look-compute-move cycle
- asychronous
- oblivious
- no agreement in direction and orientation

Model of graph

- Anonymous
- no agreement in direction and orientation
- Undirected

Problems

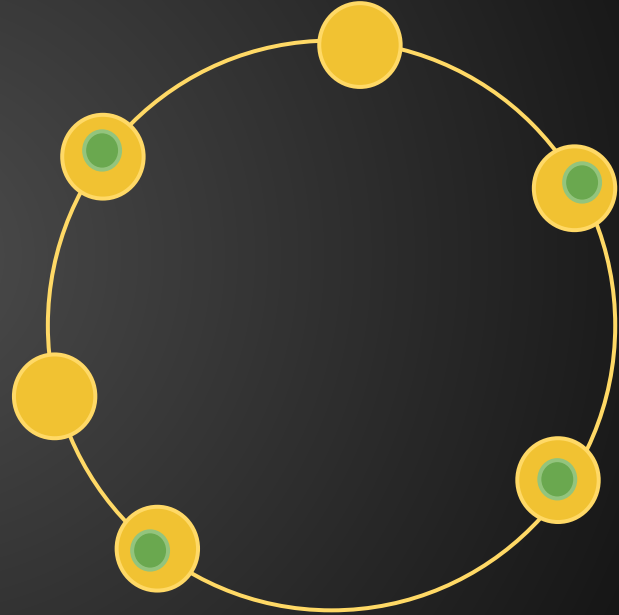Traversing the graph to achieve several goals:
- exploring the graph
- *gathering at a particular node*

Where is the problem?
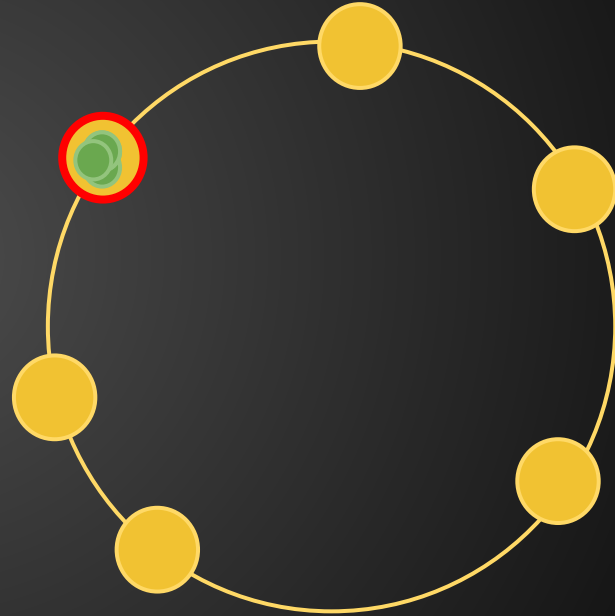
Gathering in a ring

Definition of the problem:

- **k** robots placed over the **n** nodes of a ring
- initially nodes are occupied by at most one robot
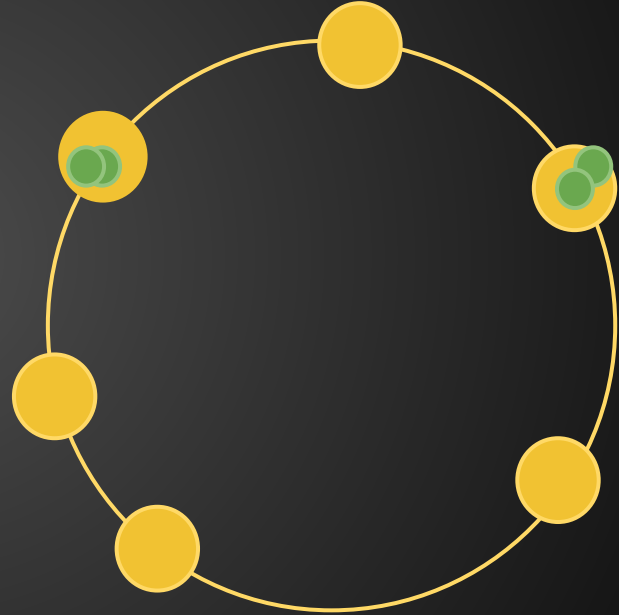
Gathering in a ring

Definition of the problem:

- **k** robots placed over the **n** nodes of a ring
- initially nodes are occupied by at most one robot
- the robots have to gather at a single node of the graph

Gathering in a ring

- Multiplicity may occur during the execution of the algorithm

Gathering in a ring

Multiplicity Detection	Can detect if a node have more than one robot	Can detect the exact number of the robot in a node having multiplicity
Global Weak	For the other nodes	
Global Strong		For the other nodes
Local Weak	For the node it resides in	
Local Strong		For the node it resides in

Gathering in a ring

- Symmetric Configuration
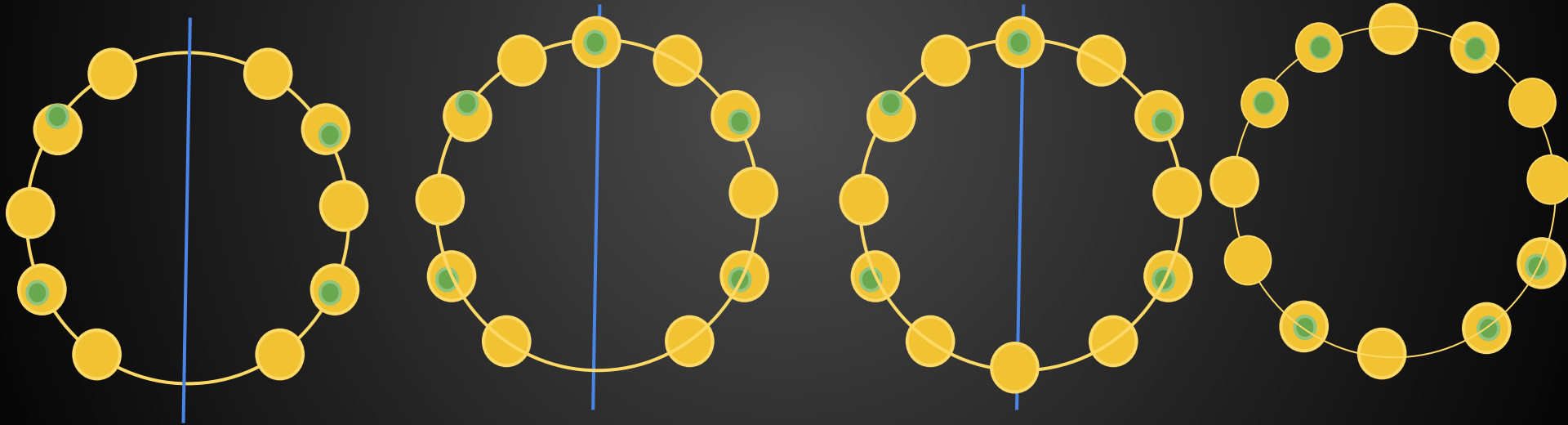
Gathering in a ring: With global weak multiplicity detection

1. select a unique node to gather.
2. move the robots to that node maintaining the.
3. Continue till a node with multiplicity is created.
4. Move the remaining robots to the node with multiplicity, maintaining the asymmetry.

Assumption:
- **initially asymmetric or line of symmetry = 1**
- **Initially no multiplicity node**
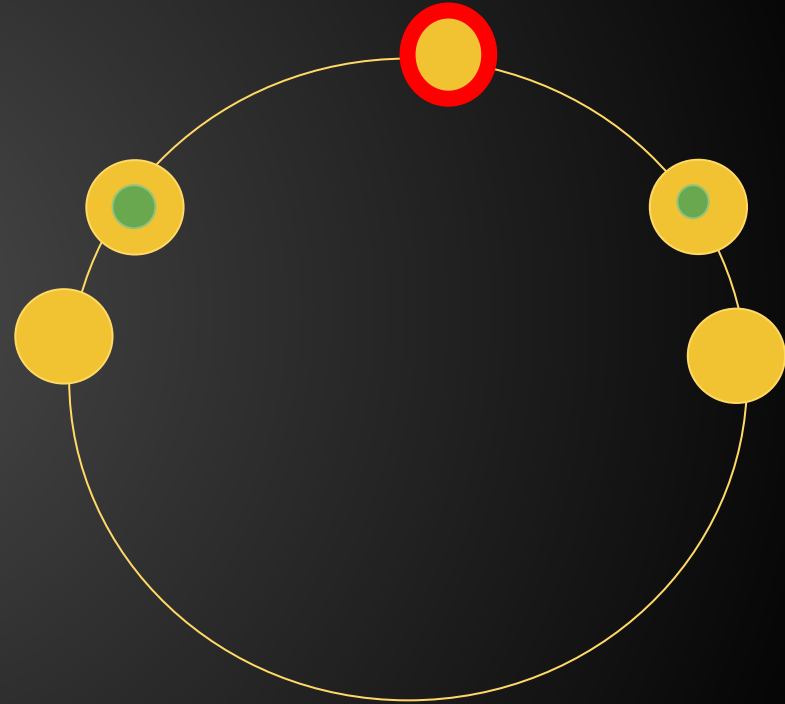
Gathering in a ring: Four robots in five nodes

No soution till now

Gathering in a ring: two robots

No soution till now

Assumption: *initially no multiplicity*

Gathering in a ring: Even number of robots

1. Solution for all symmetric cases for more than 18 robots and a node lie on the line of symmetry.
2. If the robots lie in line of symmetry one of the robots may be selected to break symmetry.
3. If no robot lies on the line of symmetry two robots can be selected to move to create multiplicity nodes

Assumption: *initially no multiplicity*

Gathering in a ring: Even number (between 4 to 18) of robots and a node lie on the line of symmetry

No soution till now

Assumption: *initially no multiplicity*

Gathering in a ring: Local Weak Multiplicity

- **Initially asymmetric/aperiodic configuration and k < n/2**
- **k is odd and <n-3**
- **n is odd, k is even and 10 <= k <= n-5**

Gathering in grid

- **Odd x Odd**
- **Odd x Even**
- **Even x Even**

Robots have no line of symmetry

Gathering in tree

- **In general no solution.**

What are the minimum requirements ?