1 Overview

- taxanomy
- MR path planning
  - Discrete
  - continous
- Concurrent assignment and path planning

2 Taxanomy

- Domain : continous and Discrete
  - continous planning time parameterised trajecteroies
  - planning on graphs or grids
- Goal assignment
  - **Labeled** each robot has pre determined goal
  - **Inlabeled** no pre determined path but goal must be reached
- problem representation
  - **coupled** joint state of all robots in the system
  - **Decoupled** each robot is represented individually
- planning
  - **Reactive** dynamic obstacle avoidance
  - **Deliberative** optimilaty
- Computation
  - **Centralised**
  - **Decentralised**

3 Multi agent path planning

- Multi agent path planning is also called as multi agent path planning
- discretized robot
- point robots - holonomic and no motion constrains

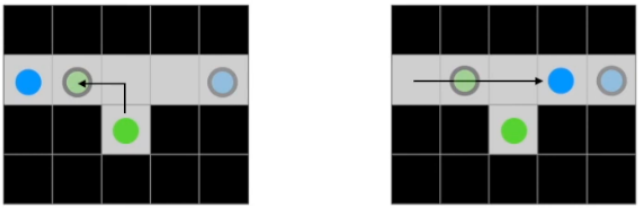
3.1 The problem

- no of agents at start location with predefined goal in known environment
- **Task** find a collsion free path
  - generally this is an Labeled problem
  - **application** logistics,automated warehouse
- **allowed motion** - north,south,east,west

3.1.1 Performance metrics

- **Makespan** - time of last robots arrival
- **Flowtime** - sum of arrival time, over all robots

4 Coupled vs decoupled



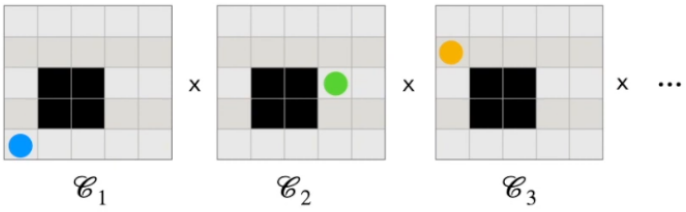
Figuur 1:

- coupled planning gives completeness
- Decoupled path planning is not complete in general(prone to Deadlock)

5 Coupled path planning

- Complexity over decoupled
- but more power solution
- coupled formulation:
  - Robot i has configuration space [1] of C_i
  - Then joint state is given by product:
    $X = C_1 * C_2 * C_3 * C_4 \ldots\ldots$
  - dimensionality grows linearly
  - A* requires time that is exponential to space
- for N robots in M cells in grid world

[1] a complete specification of the position of every point in the system



Figuur 2:

- we have M^N states to consider
- Facts
  - NP hard [2] to solve optimally for make span and flow time minimisation
  - impossible to minimize both objective

[2] Non polynomial computational time cane be reduced