Watch this lesson on YouTube

https://youtu.be/5l2gmXRORL0

Robotics: Mobility

Area 2 – **Technologies**

Lesson 7 – **Robotics**

Sequence ID – **23b**

CSIC

SPARKLE

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DISCLAIMER

A2.L7.T1b Robotics: Mobility

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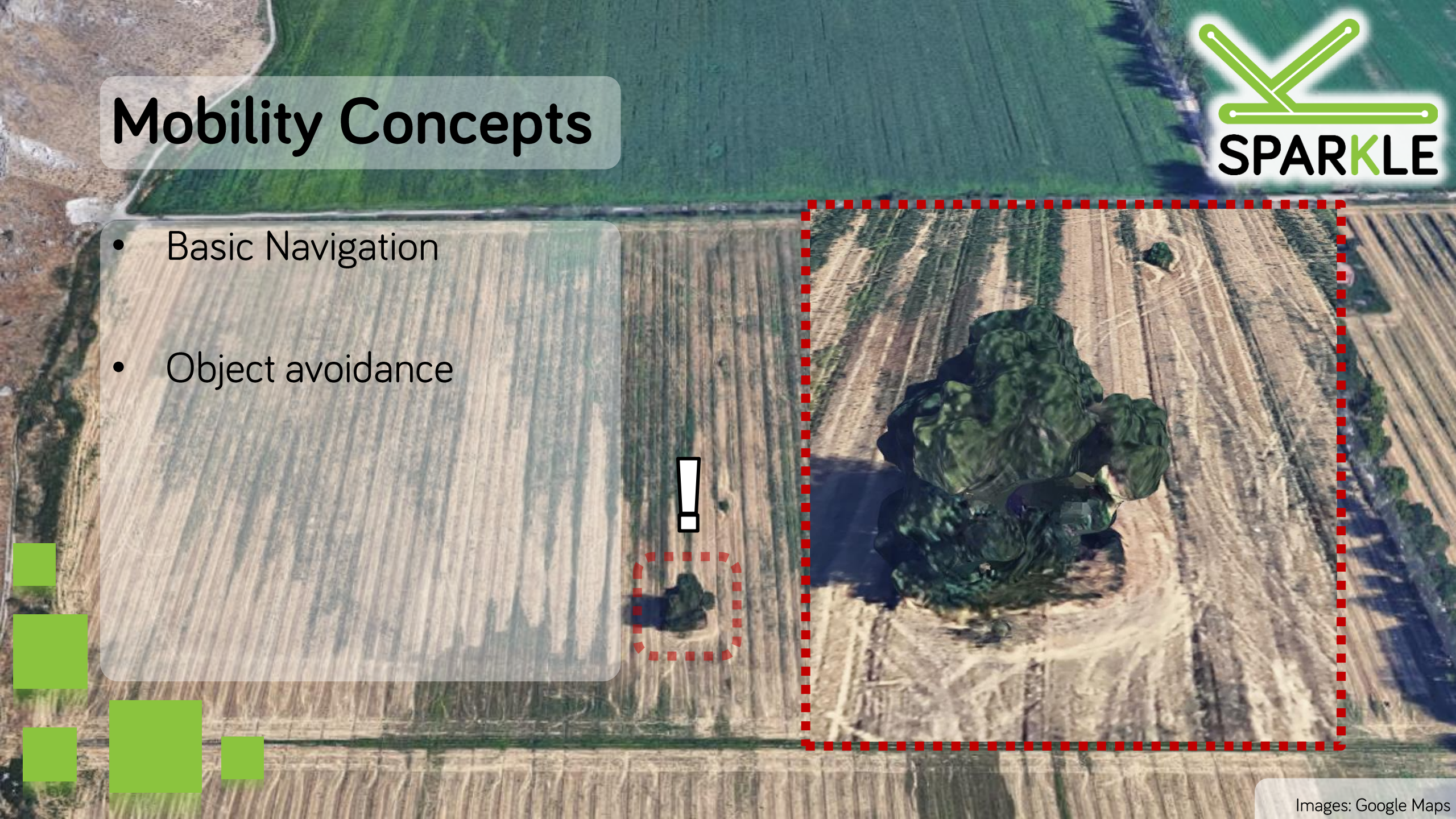
Mobility Concepts

- Basic Navigation

Images: Google Maps

Mobility Concepts

- Basic Navigation
- Object avoidance



Images: Google Maps

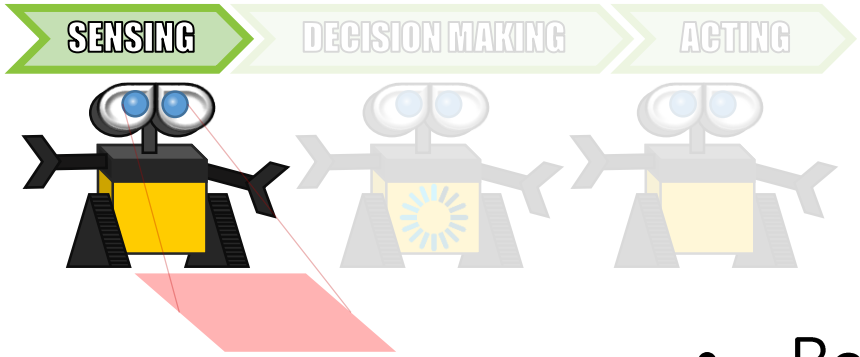
Mobility Concepts

- Basic Navigation
- Object avoidance
- Path planning

- Refuelling
- Charging
- Restocking
- Offloading
- Turning Radius
- Number of Vehicles
- Order of the fields

Images: Google Maps

Basic Navigation



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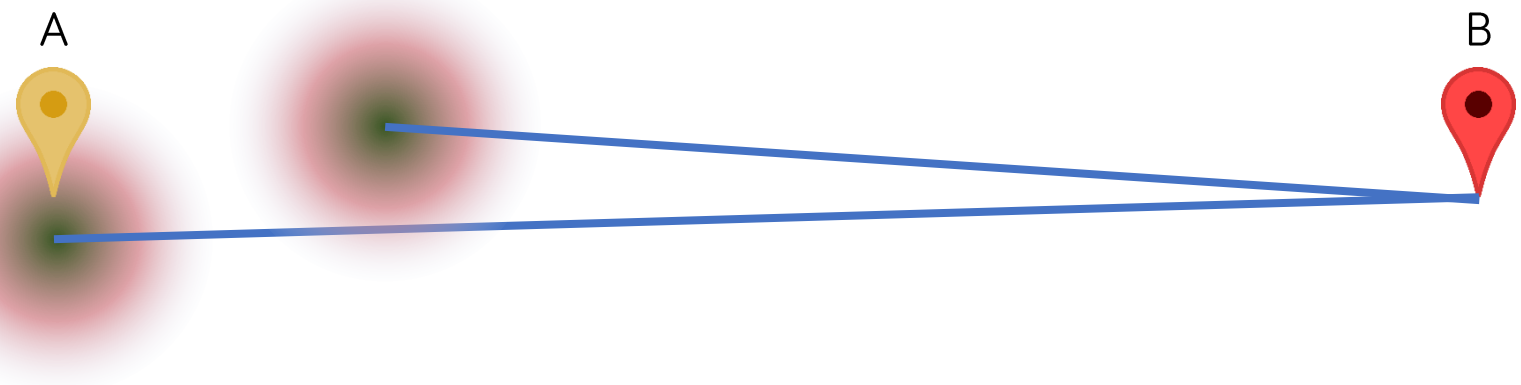
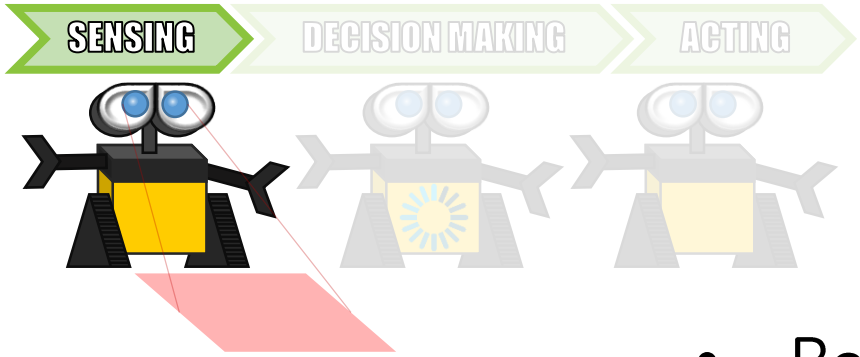
- Basic sensing
  - Location (GPS)



Basic Navigation



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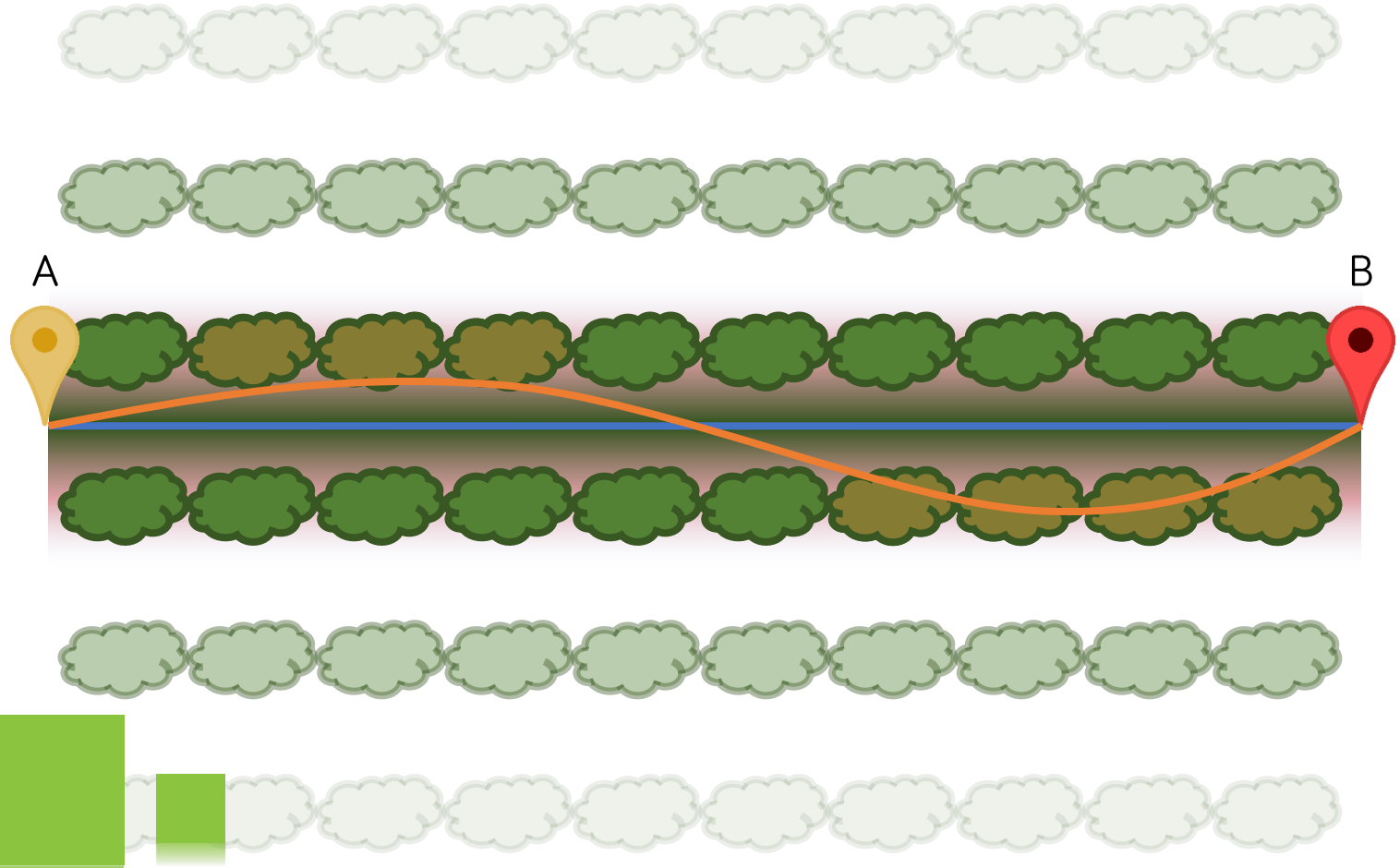
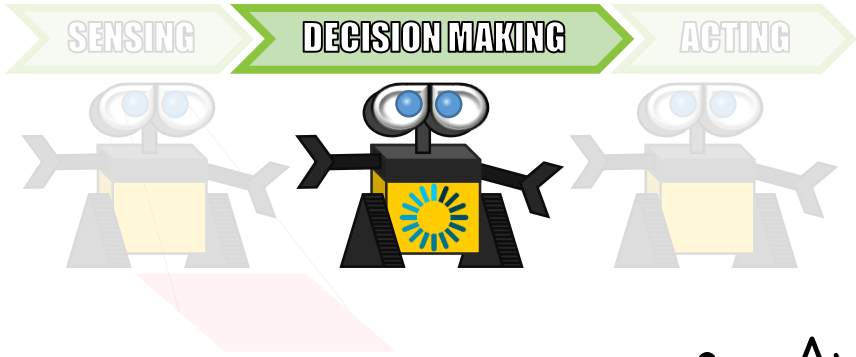


- Basic sensing
  - Location (GPS)
- Improving accuracy
  - High Accuracy positioning (RTK)
  - Odometry
  - Row/Crop Identification

Basic Navigation



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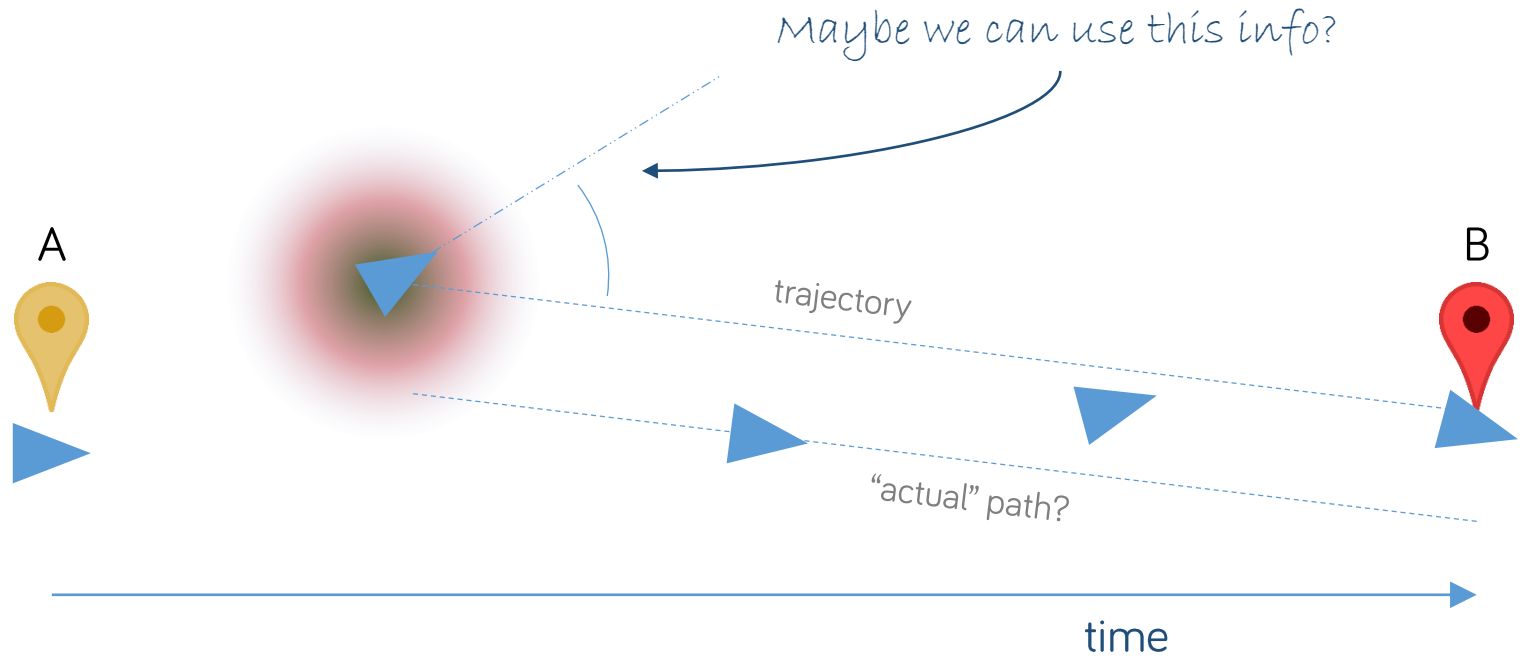
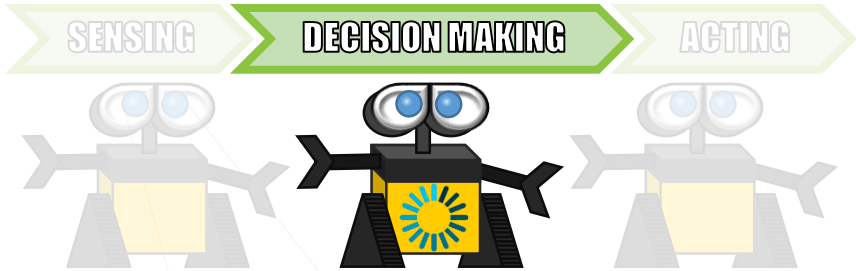
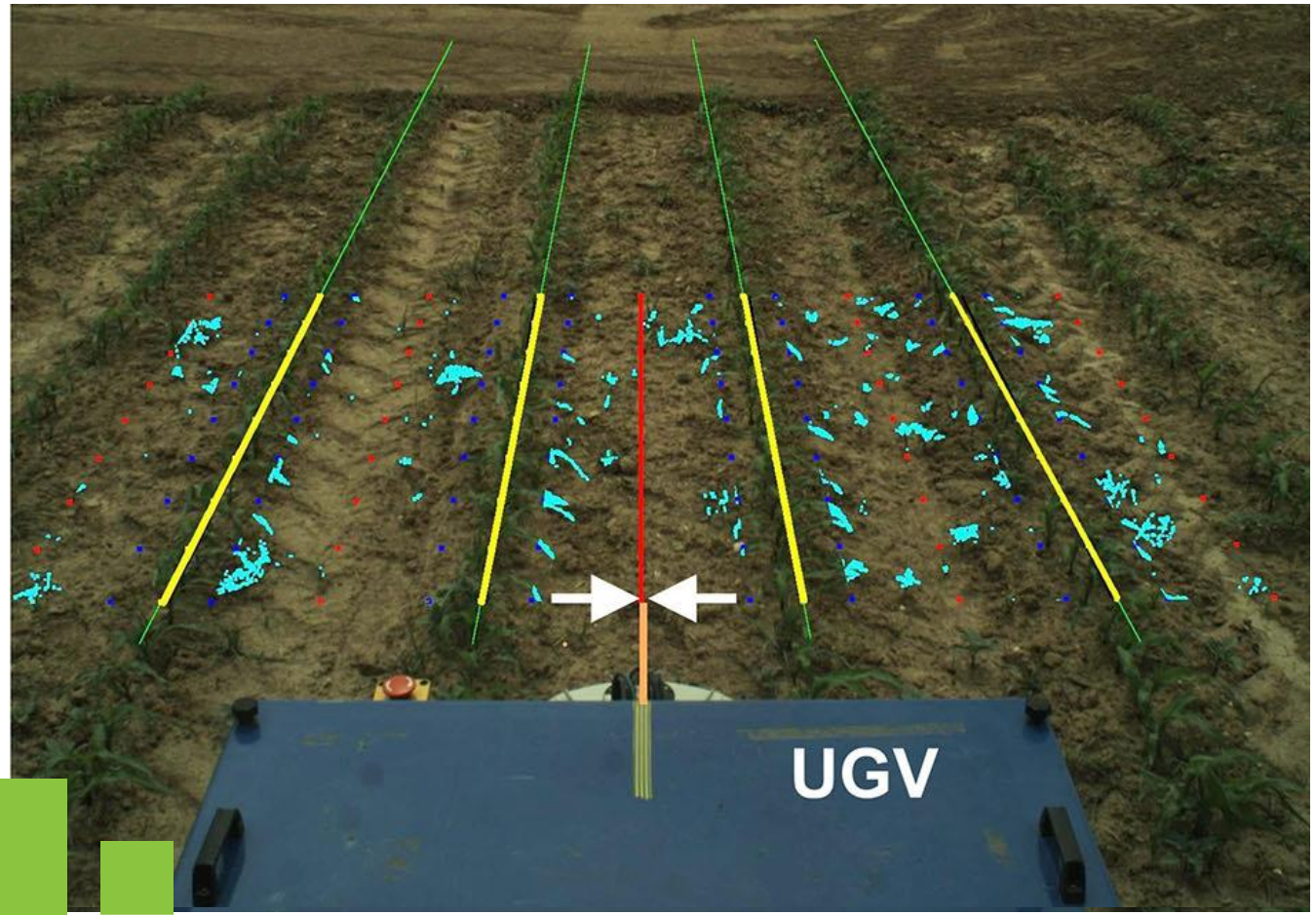
- Averaging
- Odometry



Basic Navigation



SPARKLE

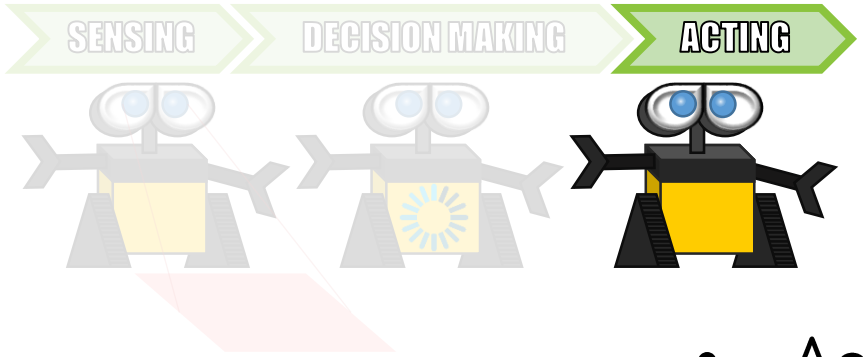


- Averaging
- Odometry
- Row/Crop Identification

- Decision =
  - Trajectory
  - Error correction

Image source: Gonzalez-de-Santos, P. et al. 2017

Basic Navigation



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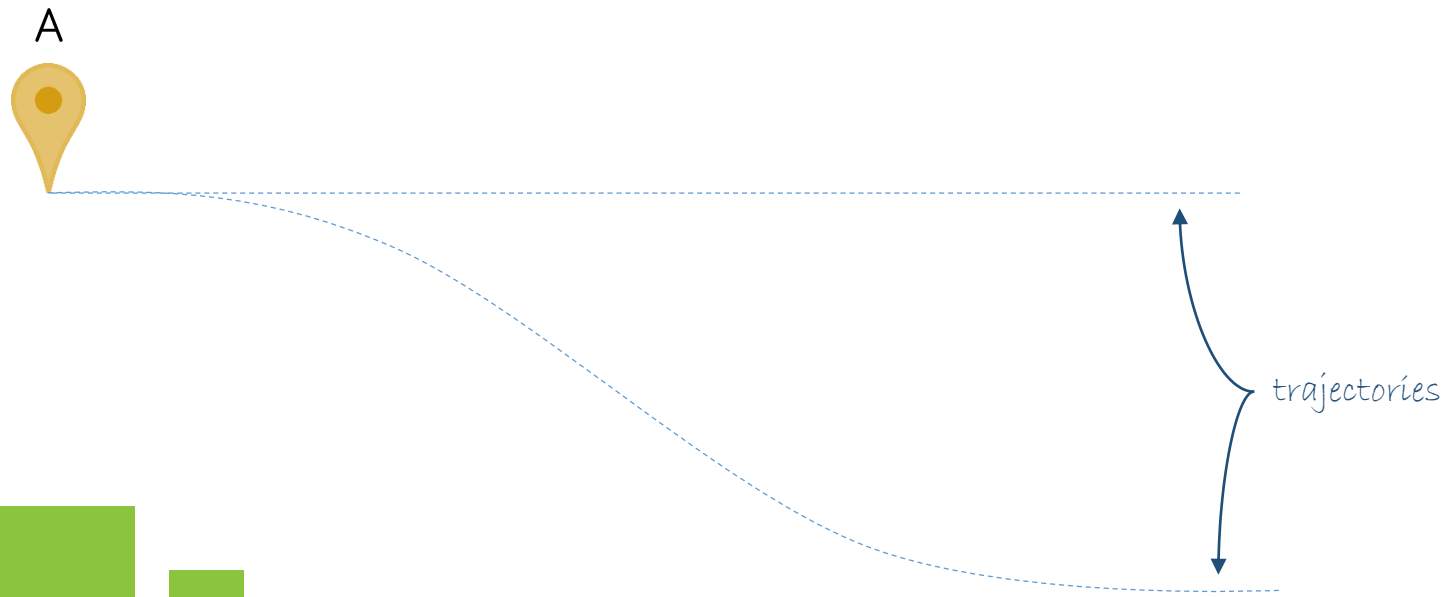
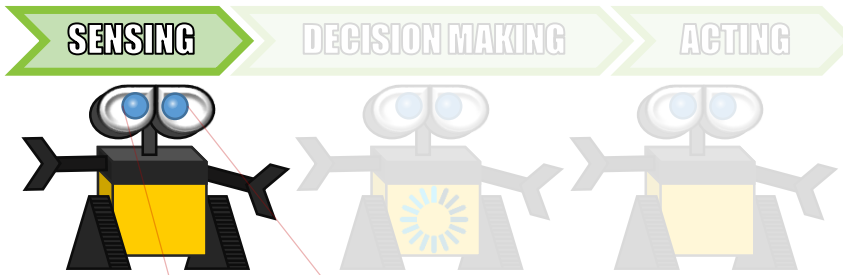
- Accelerate
- Decelerate

- Steering

- Breaking



Object Avoidance



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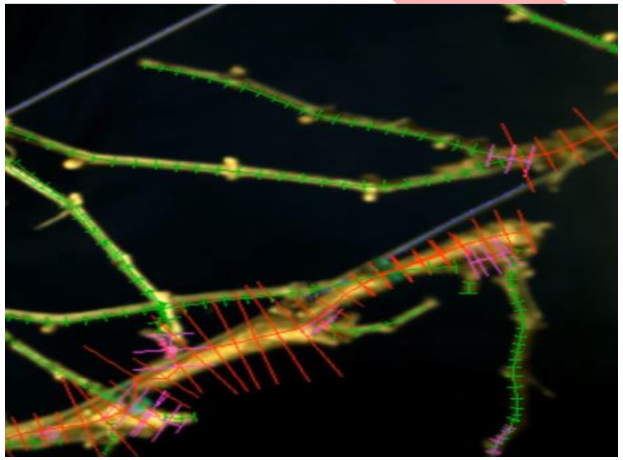
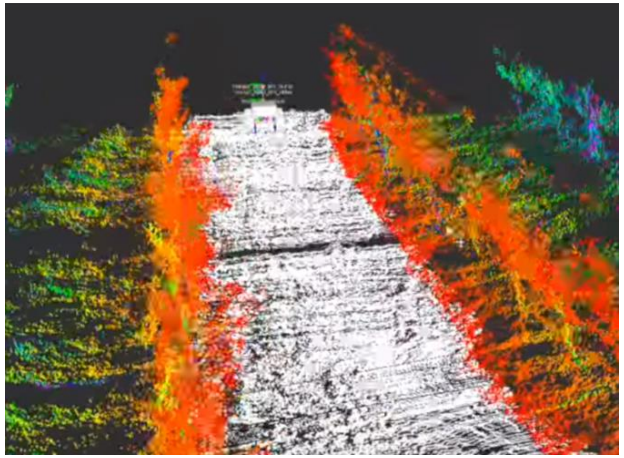
- Cameras
- 3D Imaging
- Hyperspectral

Non-invasive sensing

- Physical





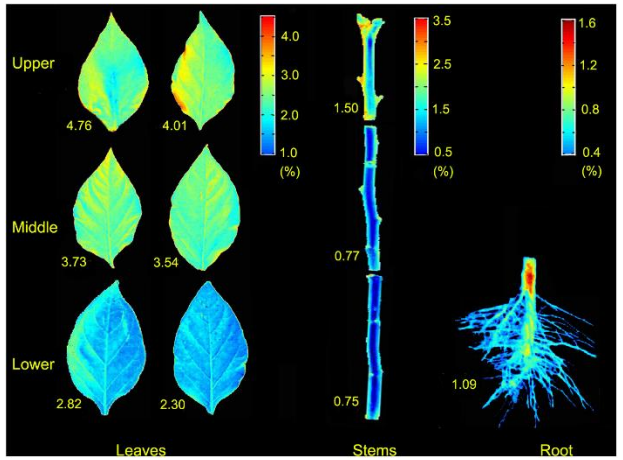
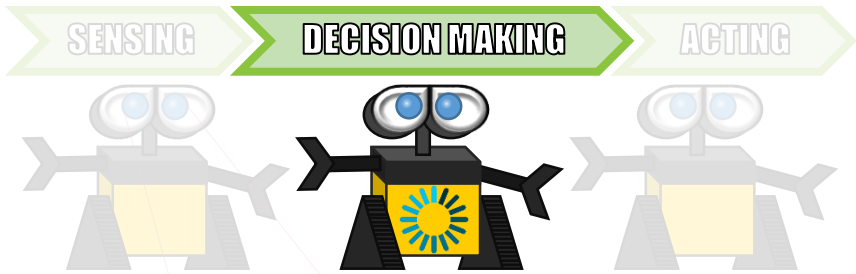


Image sources: Vision Robotics; VINBOT; Yu, K.-Q. et al. (2014); Guss

Object Avoidance



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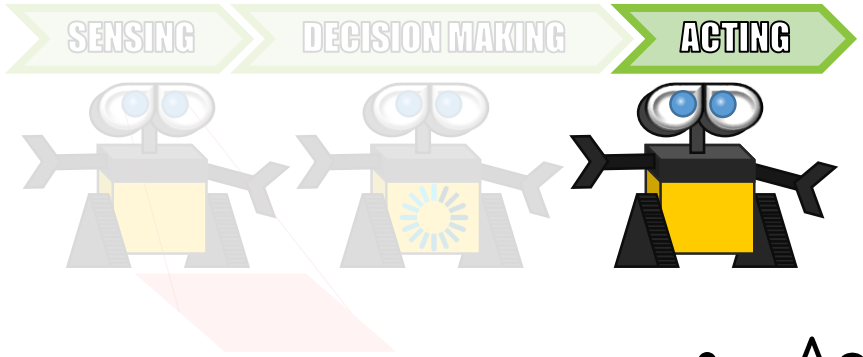
- Data Modification
- Feature Extraction
- Danger Assessment
- Trajectory Update

Image: Google Maps

Object Avoidance



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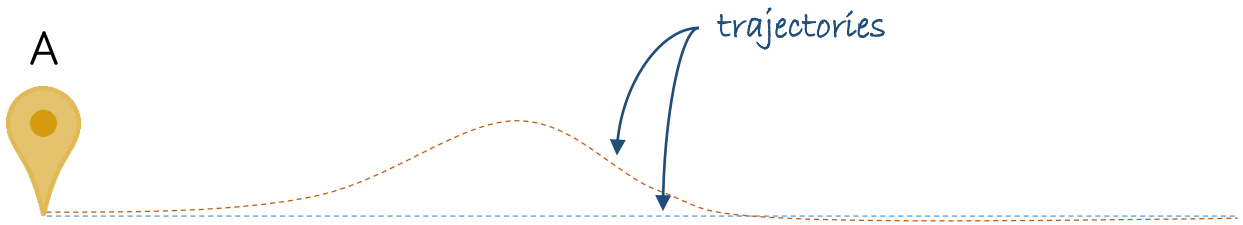
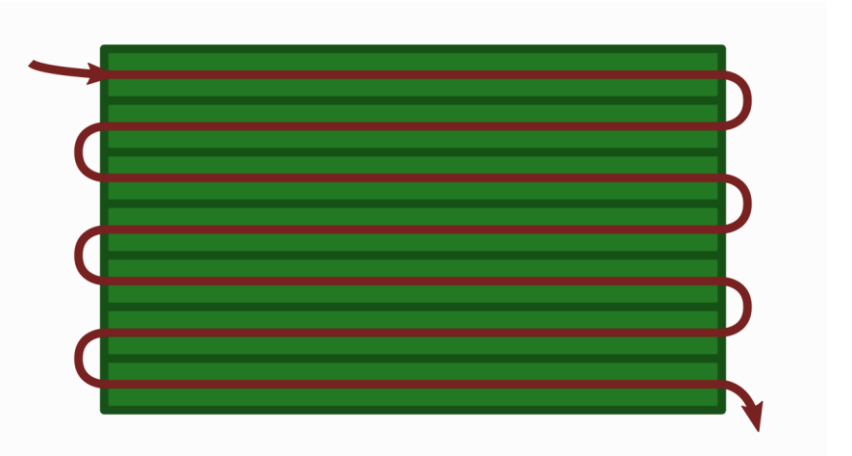


- Accelerate
- Decelerate
- Steering
- Breaking

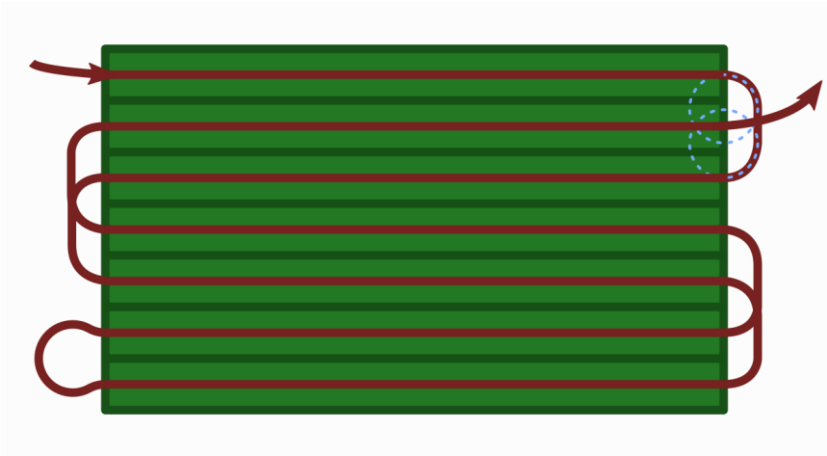
Path Planning

SPARKLE



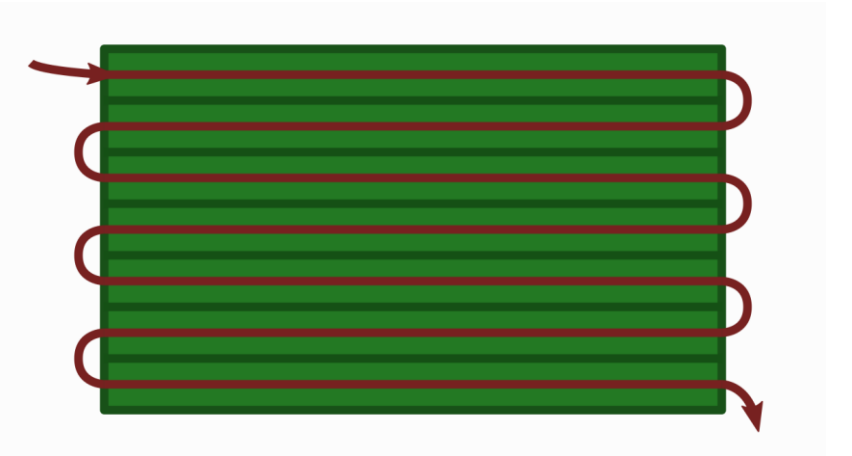
- “Simple”

- Larger vehicles

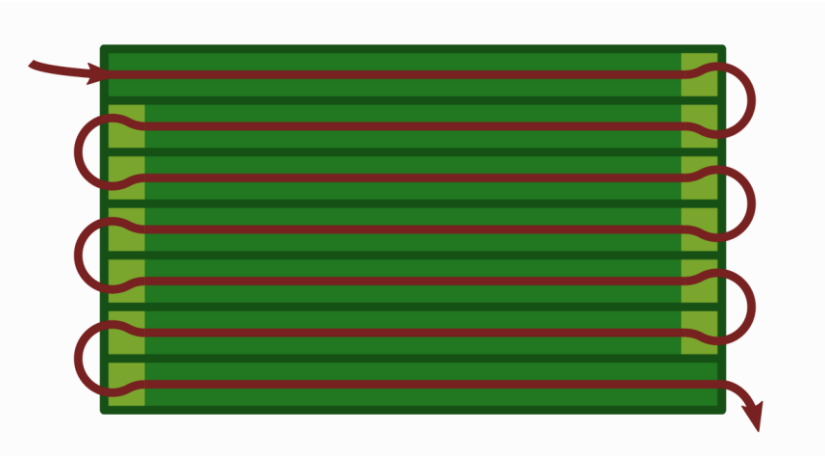


- Better path?

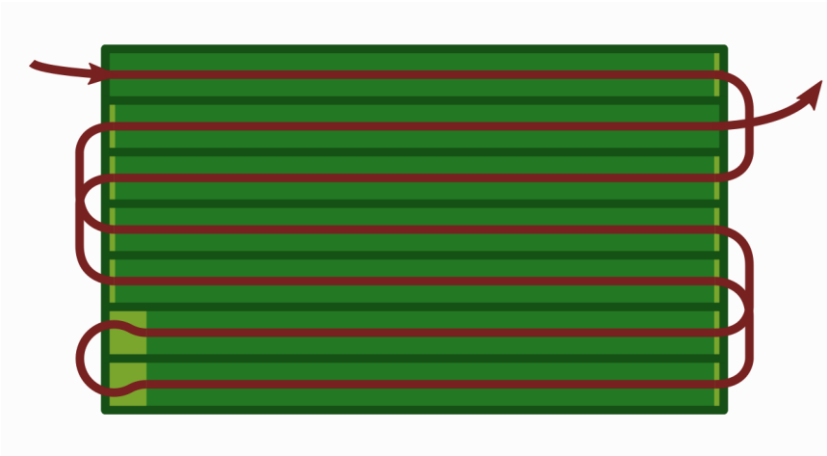
Path Planning



- “Simple”



- Larger vehicles



- Better path!
  - Headway-wise…

Path Planning

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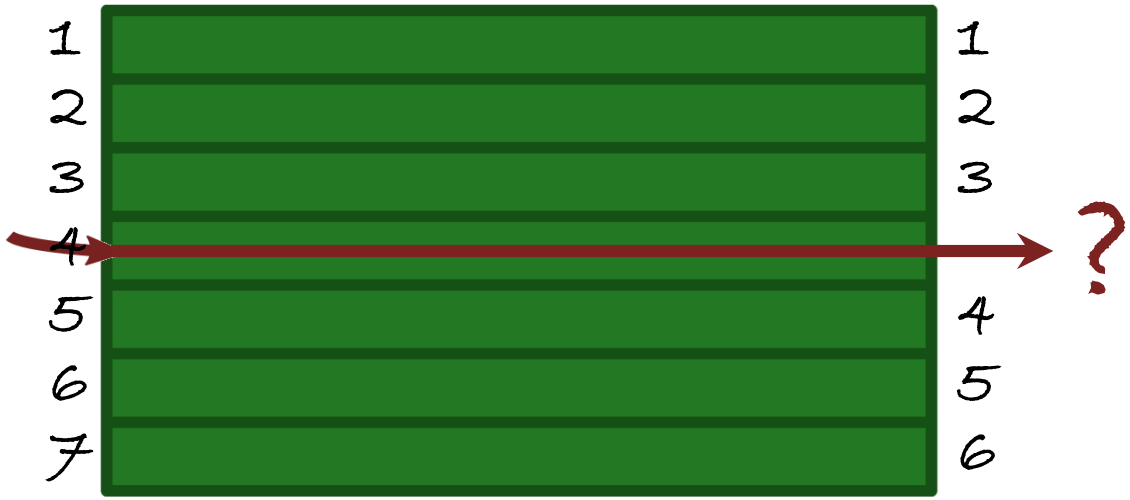
- Physical Constraints
  - Vehicle size
  - Fields
    - Shape
    - Size
    - Location
  - Number of Vehicles
- Optimisation Constraints
  - Depot
    - Refuelling/Recharging
    - Restocking/Offloading
  - Energy Consumption
  - Speed
  - Preventive Maintenances

...and more...

Path Planning



$$N_{options} = 7 \times 6 \times 5 \times \cdots \times 1$$

$$N_{options} = 5040$$

Extra Options:

- 1 more crop line?
  $\times 8$
- Other side entry?
  $\times 2$
- n Other Vehicles?
  $\times n$

$N_{options} = 161{,}280$