SLAM: worked example
Autonomous Mobile Robots

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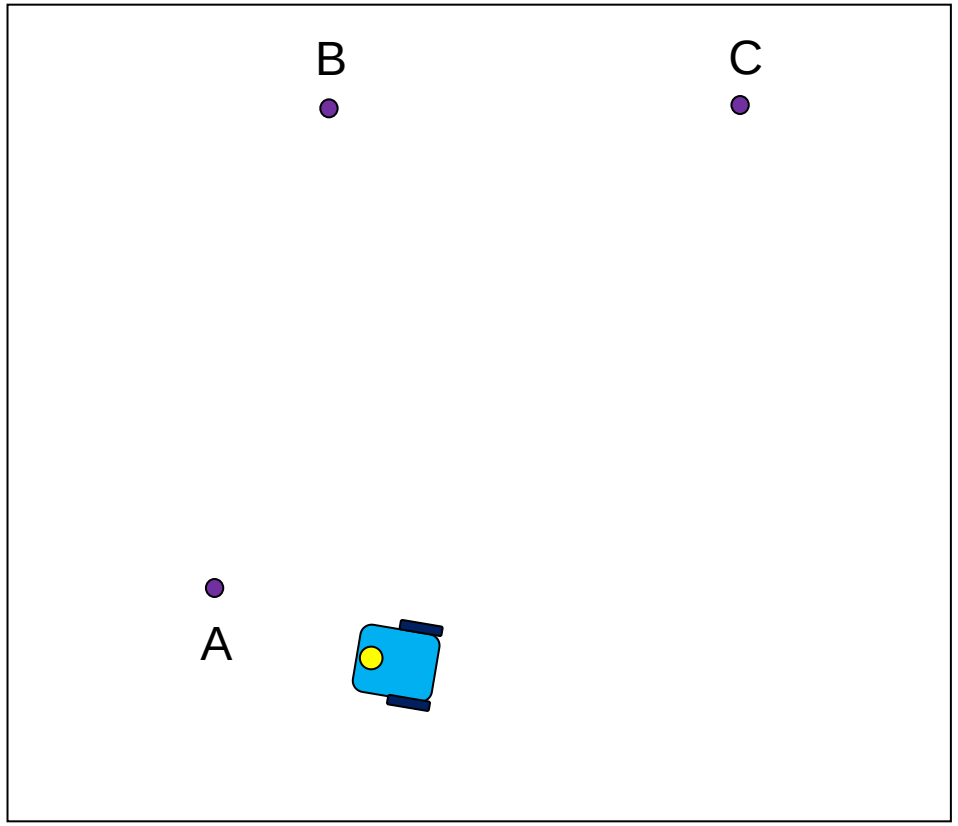
SLAM | how to do SLAM

- Use internal representations for
  - the positions of landmarks (: map)
  - the camera parameters

- Assumption:
  Robot's uncertainty at starting position is zero



Start: robot has zero uncertainty

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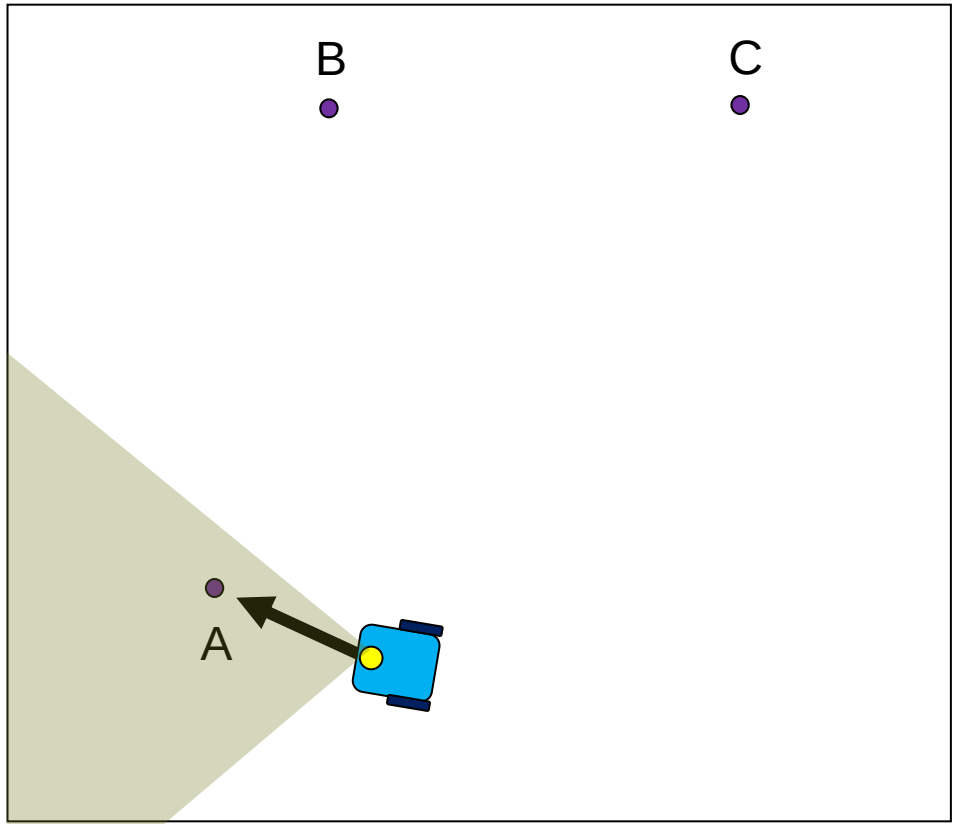
On every frame:

- **Predict** how the robot has moved
- **Measure**
- **Update** the internal representations



First measurement of feature A

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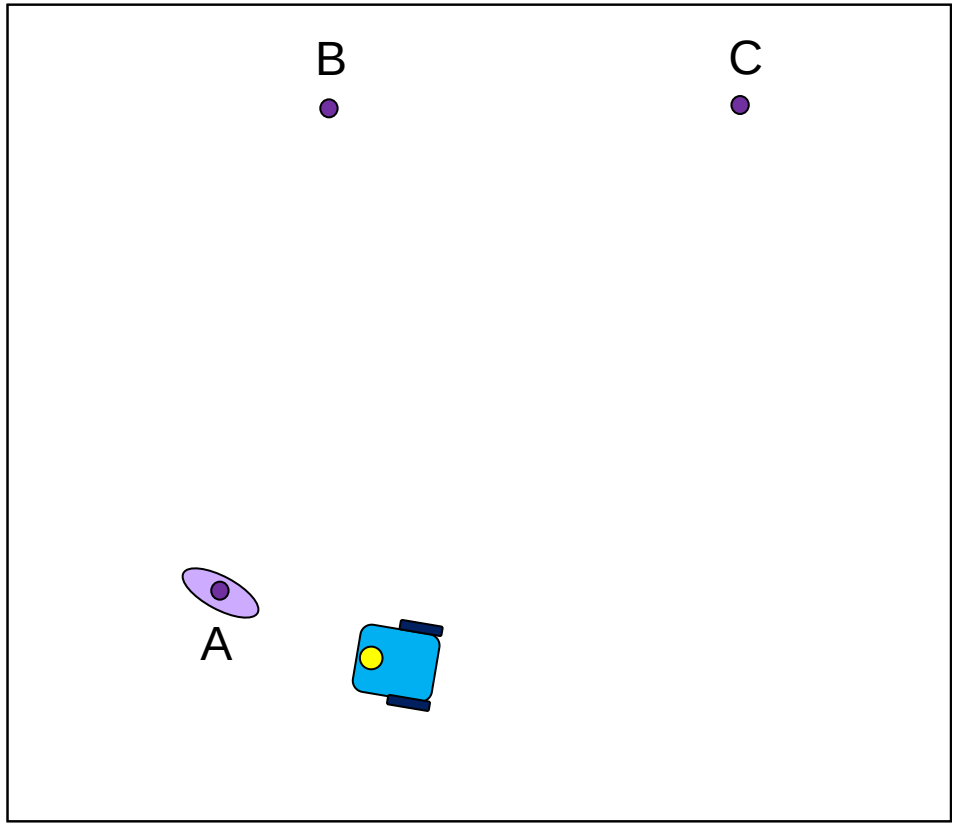
- The robot observes a feature which is mapped with an uncertainty related to the **measurement model**

On every frame:

- **Predict** how the robot has moved
- **Measure**
- **Update** the internal representations



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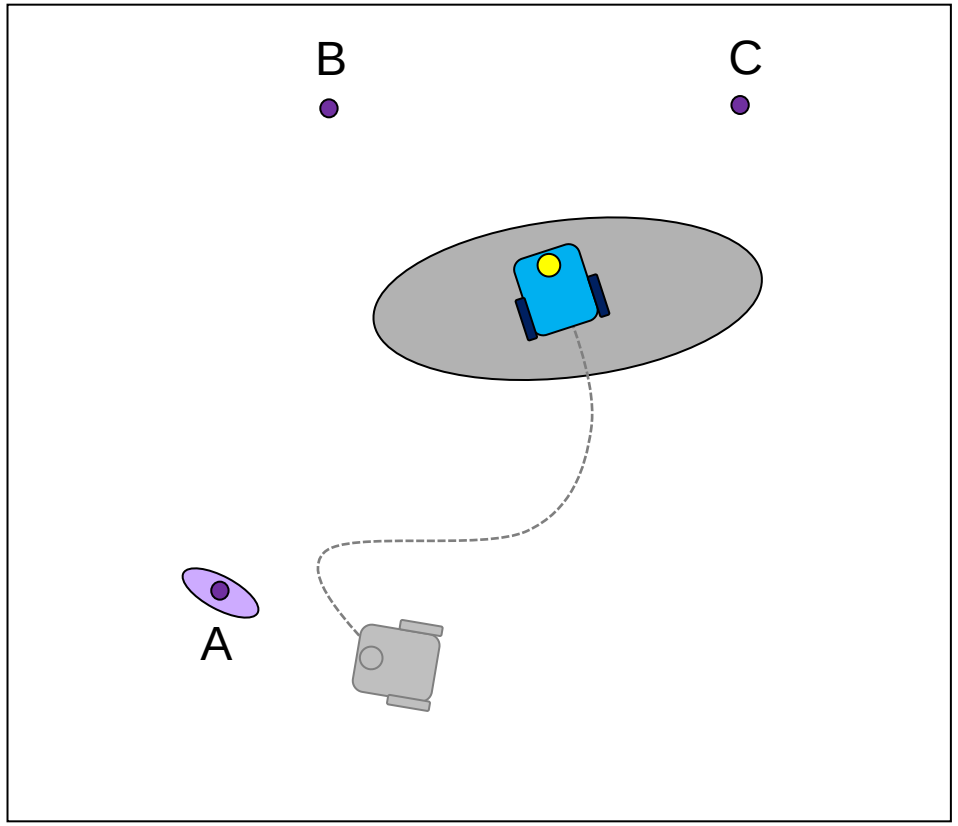
- As the robot moves, its pose uncertainty increases, obeying the robot's **motion model**.

On every frame:

- **Predict** how the robot has moved
- **Measure**
- **Update** the internal representations



Robot moves forwards: uncertainty grows

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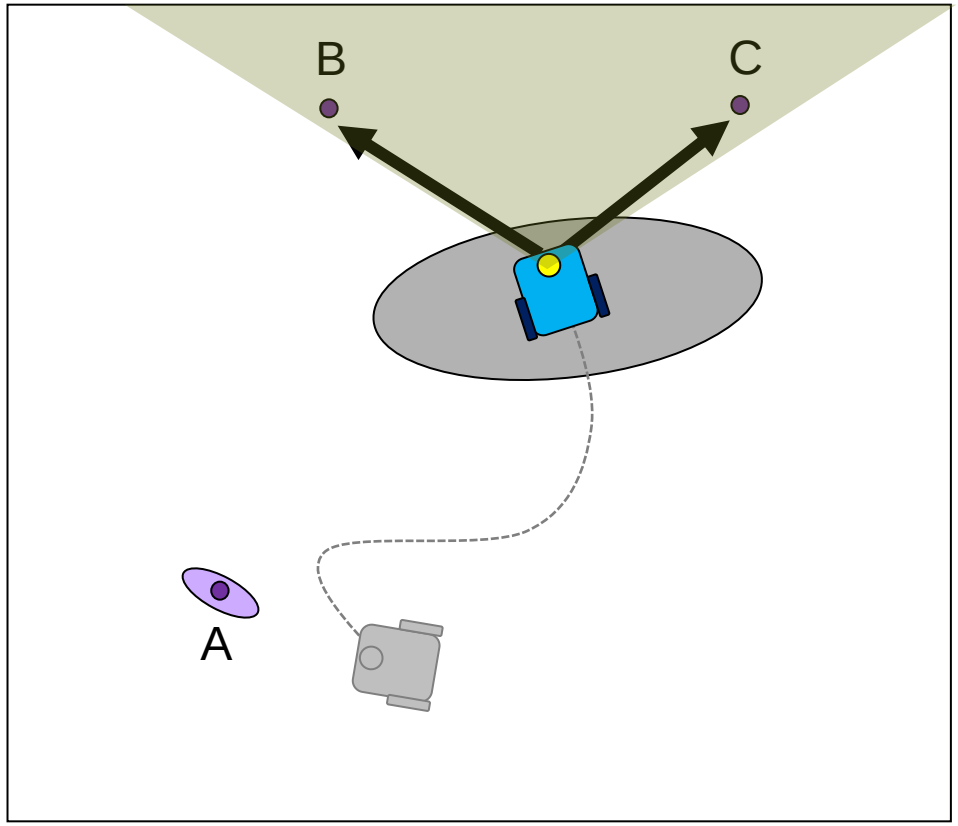
- Robot observes two new features.

On every frame:

- **Predict** how the robot has moved
- **Measure**
- **Update** the internal representations



Robot makes first measurements of B & C

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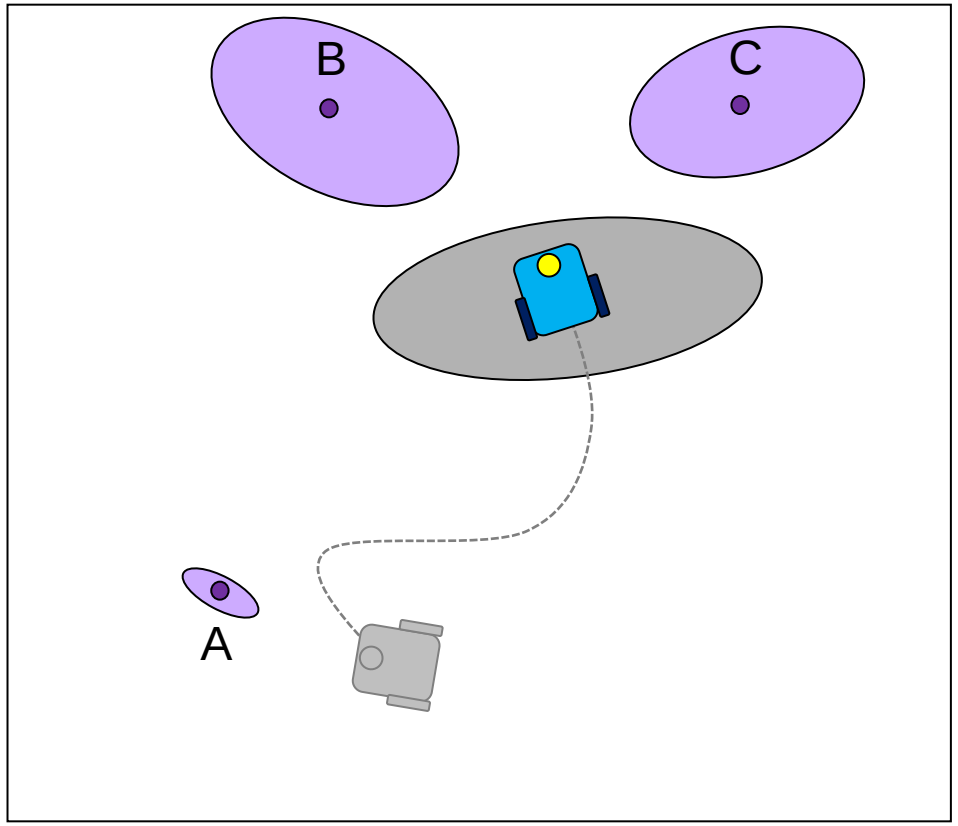
- Their position uncertainty results from the **combination** of the measurement error with the robot pose uncertainty.

⇨ map becomes **correlated** with the robot pose estimate.

On every frame:

- **Predict** how the robot has moved
- **Measure**
- **Update** the internal representations



Robot makes first measurements of B & C

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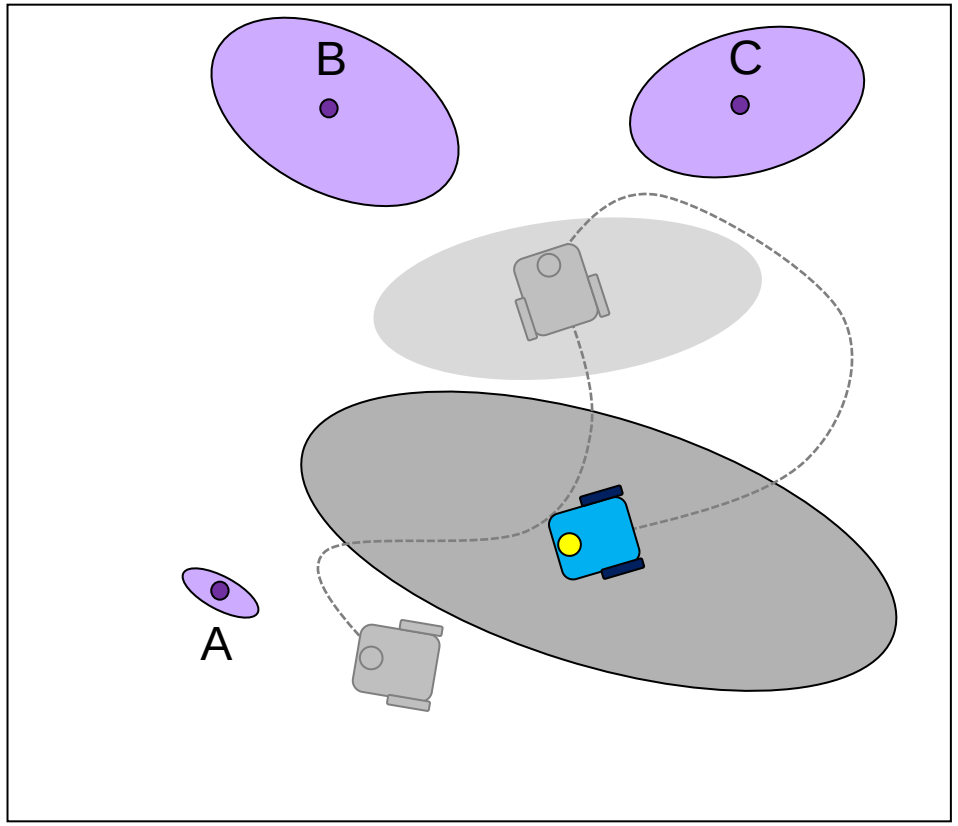
- Robot moves again and its uncertainty increases (motion model)

On every frame:

- **Predict** how the robot has moved
- **Measure**
- **Update** the internal representations



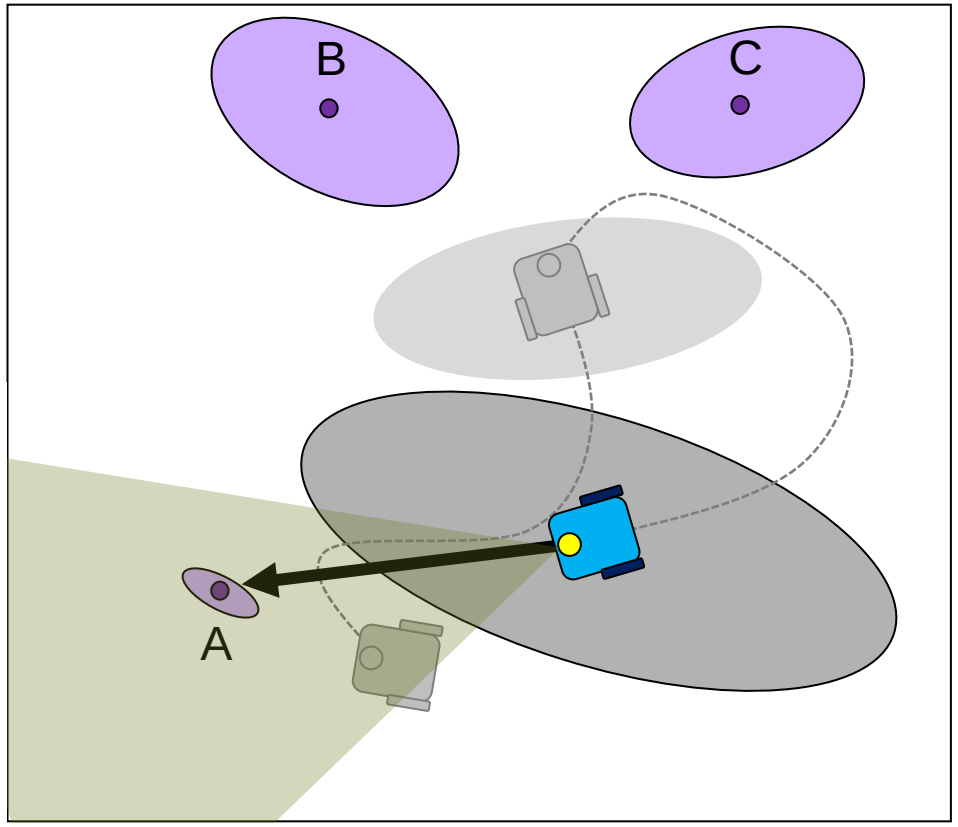
Robot moves again: uncertainty grows more

SLAM | how to do SLAM

- Robot re-observes an old feature
  ⇨ **Loop closure** detection

On every frame:

- **Predict** how the robot has moved
- **Measure**
- **Update** the internal representations

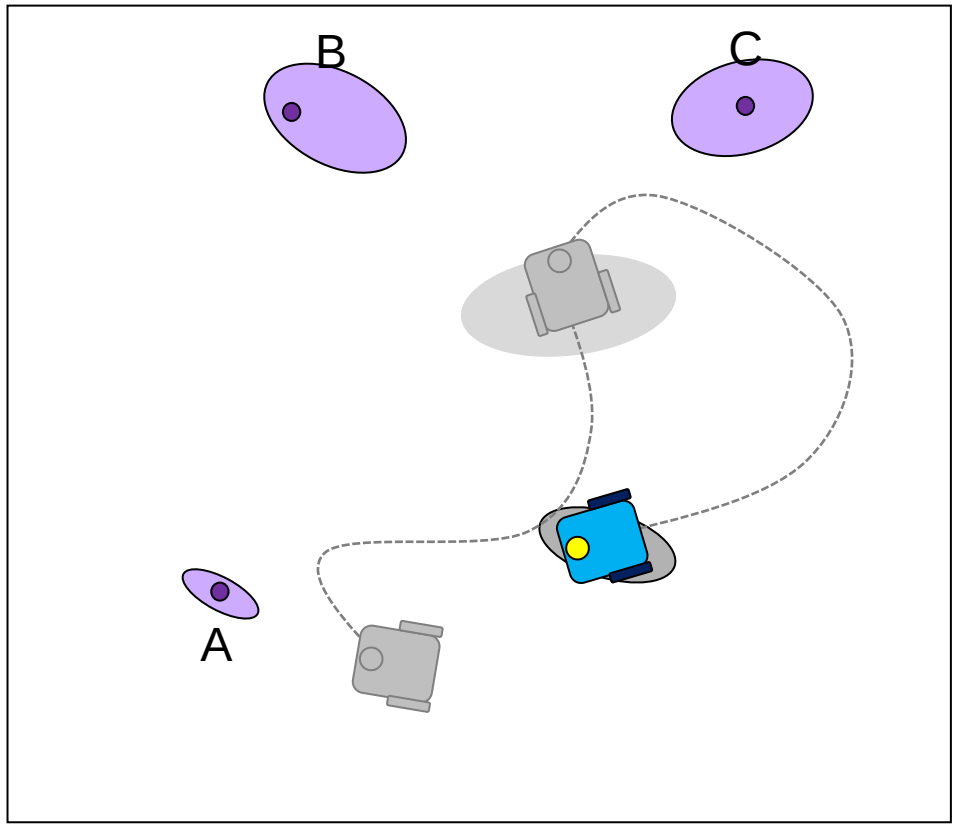


SLAM | how to do SLAM

- Robot updates its position: the resulting **pose** estimate becomes **correlated** with the feature **location estimates**.
- Robot's uncertainty **shrinks** and so does the uncertainty in the rest of the map

On every frame:

- **Predict** how the robot has moved
- **Measure**
- **Update** the internal representations



Robot re-measures A: "loop closure" uncertainty shrinks