# Lab 7

# AR Markers

This lecture is part of the RACECAR-MN introductory robotics course.
You can visit the course webpage at mitll-racecar-mn.readthedocs.io.

# Objectives

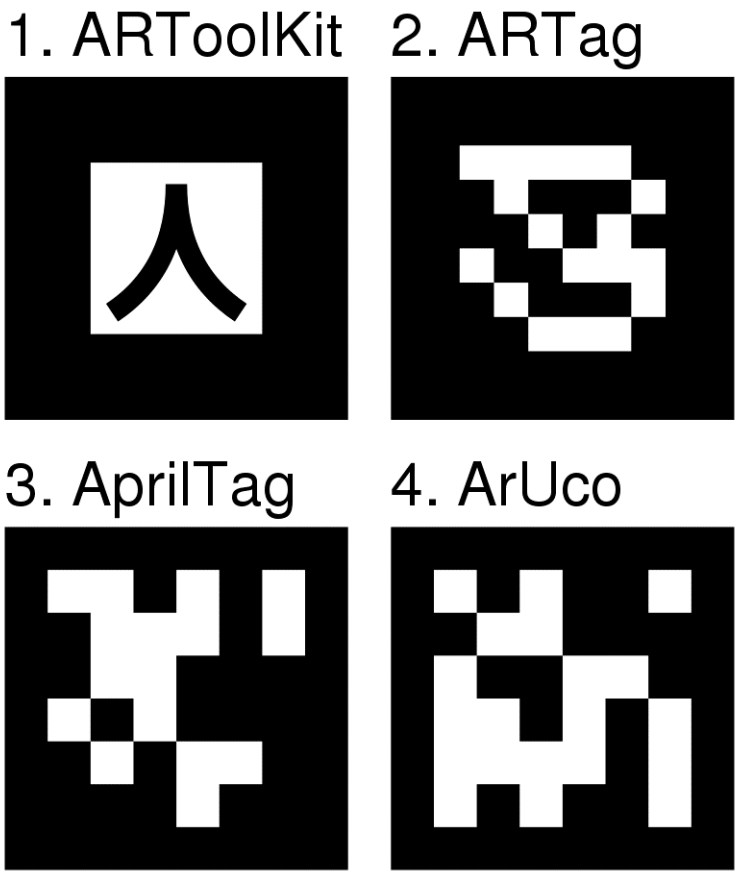
**Main Objective**: Combine your previous lab solutions to complete the time trial racecourse

## Learning Objectives

- Identify the location, orientation, and id of AR markers in a color image
- Make decisions based on information provided by AR markers

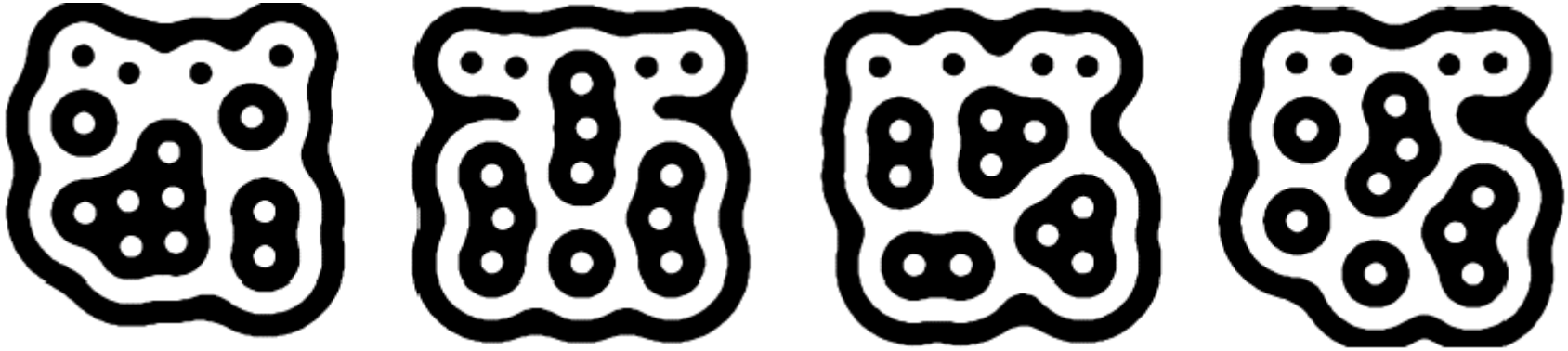
# AR Markers

- **Fiducial markers** used for augmented reality
- Common characteristics:
  - **high contrast**
  - **bi-tonal**
  - **square**
  - **bordered**



# AR Markers - Outliers

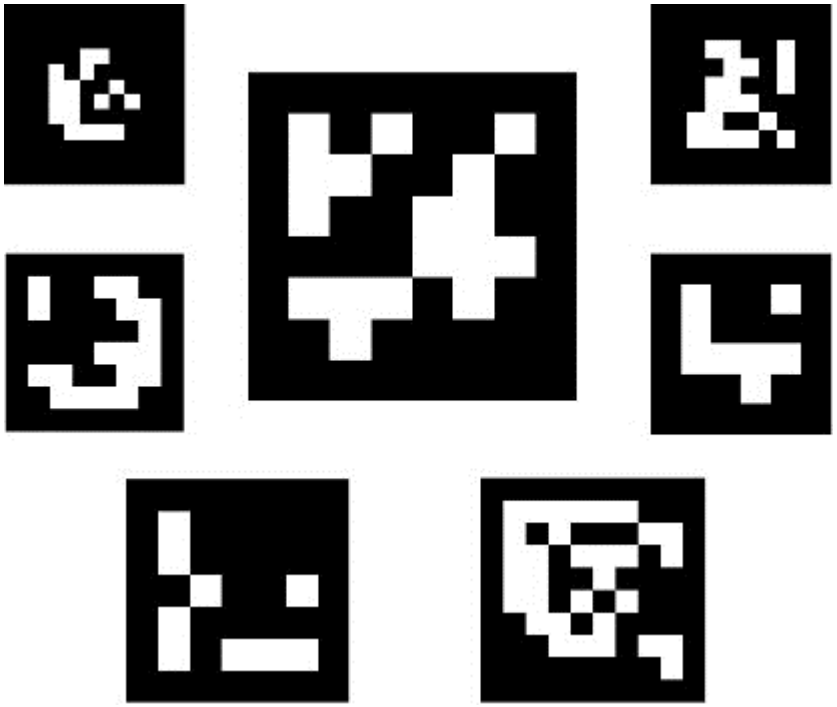
- ReacTIVision



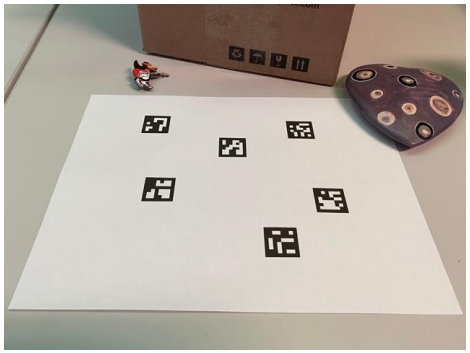
- ARToolKit

# ArUco OpenCV

- Border of black with a binary encoding in the center
- Checks orientation
- Marker id is not determined by binary coding in the marker but the index in a defined dictionary



# ArUco OpenCV



Original image

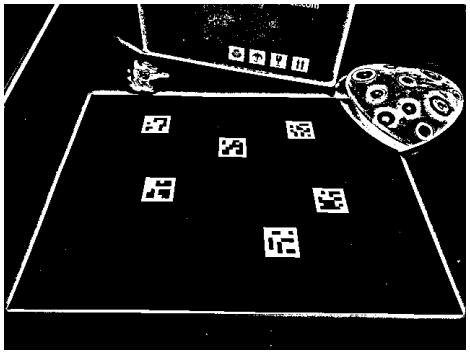
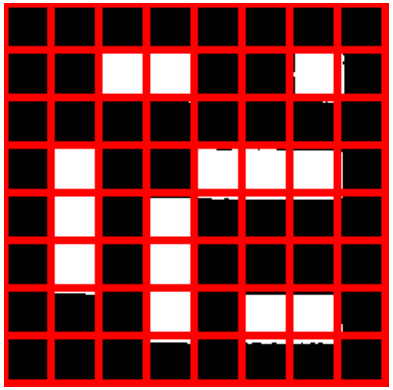


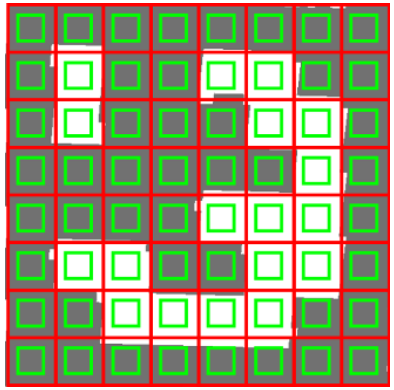
Image with threshold

Marker candidate

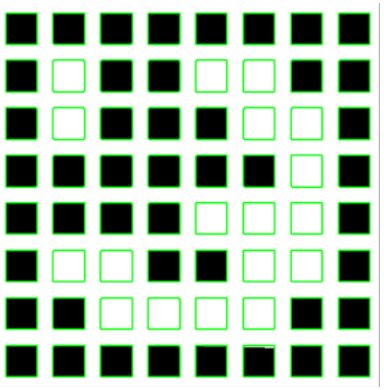
Removed perspective



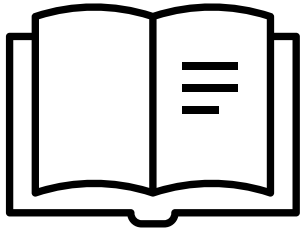
Applied grid



Cell margin

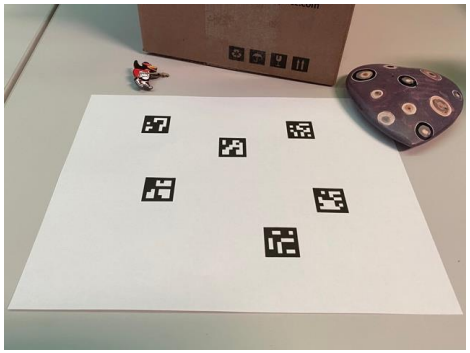


Final sampling margin



Dictionary lookup

# ArUco OpenCV



Original image

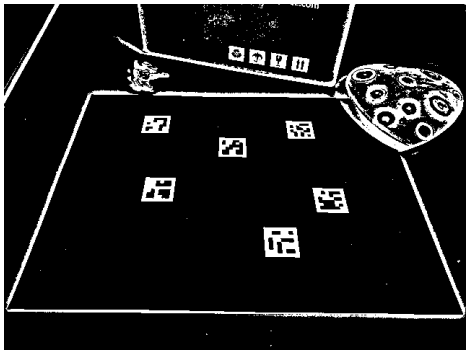


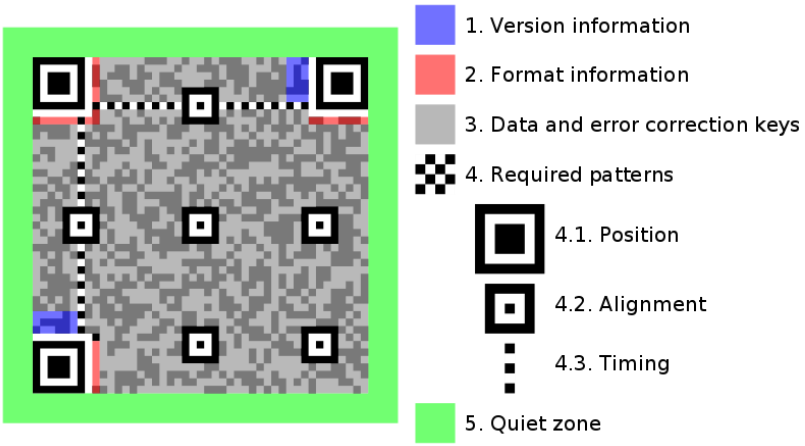
Image with threshold

Marker candidate

Removed perspective

# Information Gained

- **ArUco Markers** encode
  - Corner location
  - Marker id (dictionary index)
- **QR Codes** encode
  - Binary data



# QR vs AR

Group activity

- QR codes have all the common characteristics of AR markers but are commonly used to direct to a URL
- What major differences are there between QR codes and AR markers like ArUco markers?
- Why would a QR code be a bad AR marker?