Language and Robotics: Toward Building Robots Coexisting with Human Society Using Language Interface

Introduction

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**Center for Advanced
Intelligence Project**

RIKEN

Discussion on Dory

◆**We will use "Dory" for discussion**

◆You can put any comments at any timing of the tutorial

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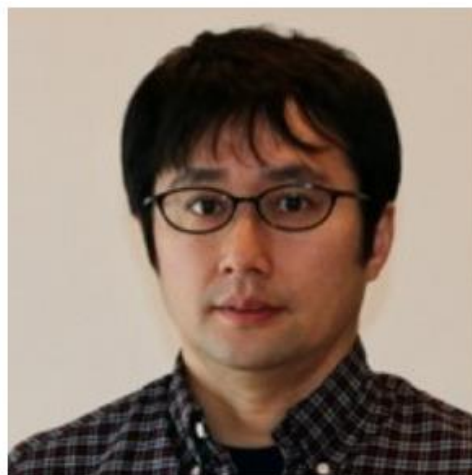
◆Any tutorial materials are on:
https://github.com/riken-grp/langrobo-tutorial

Tutorial speakers

Shuhei Kurita

Language Information Access Technology Team,
RIKEN Center for Advanced Intelligent Project (AIP)

Yutaka Nakamura

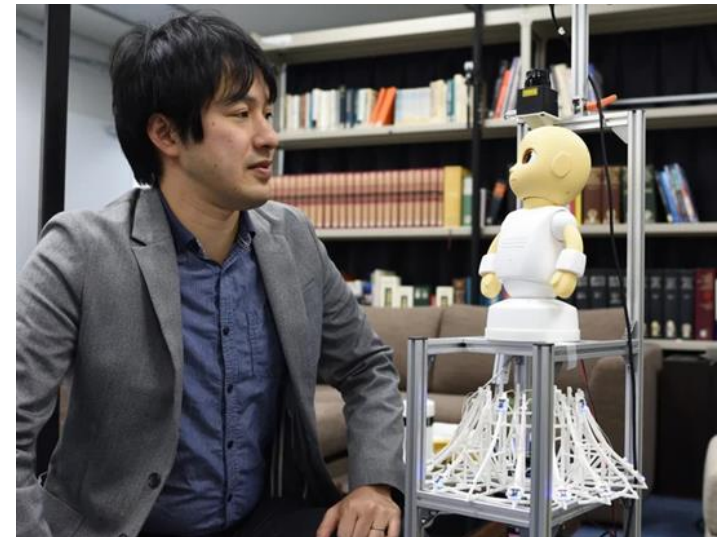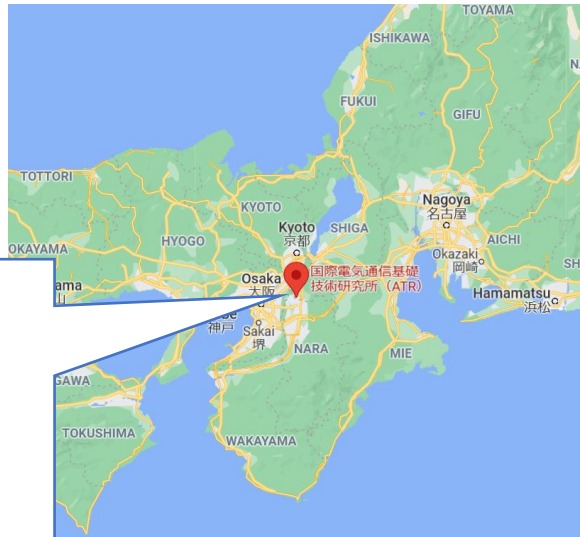Behavior Learning Research Team,
RIKEN R-IH Guardian Robot Project (GRP)

Koichiro Yoshino

Knowledge Acquisition & Dialogue Research Team,
RIKEN R-IH Guardian Robot Project (GRP)

Self introduction

◆**Koichiro Yoshino**

- Team Leader (PI) of knowledge acquisition and dialogue research team, Guardian robot project, RIKEN, Kyoto, Japan
- Dialogue system technology challenge committee, action editor of ACL rolling review, IEEE-SLTC member, SIGdial board

Robots in our living space

Astro, Amazon

HSR, Toyota

Pepper, Softbank

Stretch, hello-robot

We expect them to help us,
using conversational interface
for enriching our life

Language in intelligence

◆ **It is related to "human mind" and "human awareness"**
- What is mind? What is awareness?
- How do we define "intelligence"

◆ **Language is an important tool for "communication" and "knowledge-building"**
- Abilities to use language are related to the work of intelligence
- *nani gigantum umeris insidentes*
- We can receive, accumulate, and rebuild the knowledge using language communication

Language and robotics

◆**Current robots do not have abilities to:**
- accumulate and use one's experience
- use the experience and knowledge of others

◆**How humans do that?**
- by using language!
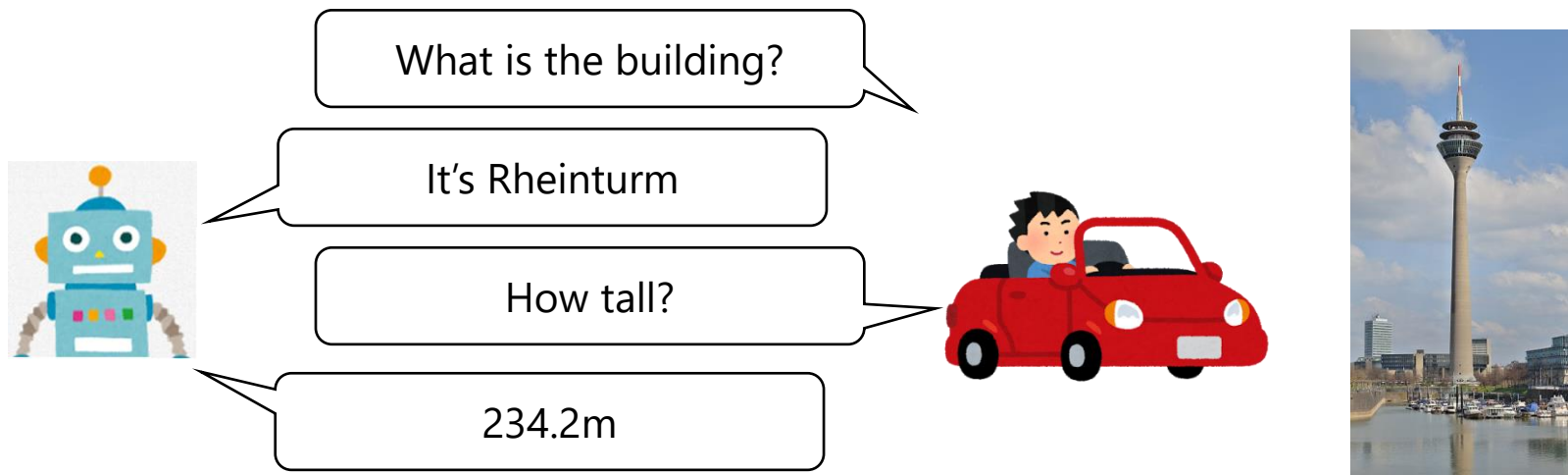
> I dropped a glass cup and broke it.

> Oh, I would be careful when holding a glass cup.

Nur ein Idiot glaubt, aus den eigenen Erfahrungen zu lernen.
Ich ziehe es vor, aus den Erfahrungen anderer zu lernen, um von vorneherein eigene Fehler zu vermeiden.

Using natural language in real world

◆**Systems should consider the dialogue contexts**

◆**Dialogue contexts contains not only dialogue history but also shared information**

- Dialogue context: shared information in real-world
- Map, visibility of the user (dialogue in car, [Misu14])
- Visual question answering, visual dialogue [Alamri 19]

What is the building?

It's Rheinturm

How tall?

234.2m

Using real-world knowledge

◆**Using both visual information and dialogue history (DSTC7 visual dialogue track)**

- Extension of visual question answering (VQA)
- The system changes the answer according to the dialogue context

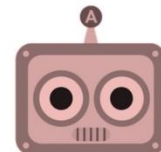

Example Visual dialogue

C: A dog with goggles is in a motorcycle side car.
Q: Is motorcycle moving or still?
A: It's parked
Q: What kind of dog is it?
A: Looks like beautiful pit bull mix

Q: What color is it?

Image
Dialog history
Question

Visual Dialog model

Talking about bull-mix
-> answer the color of bull-mix

Answer

A: Light tan with white patch that runs up to bottom of his chin

Understanding a situation

Another one is missing

User has a glass
There is another glass on the table

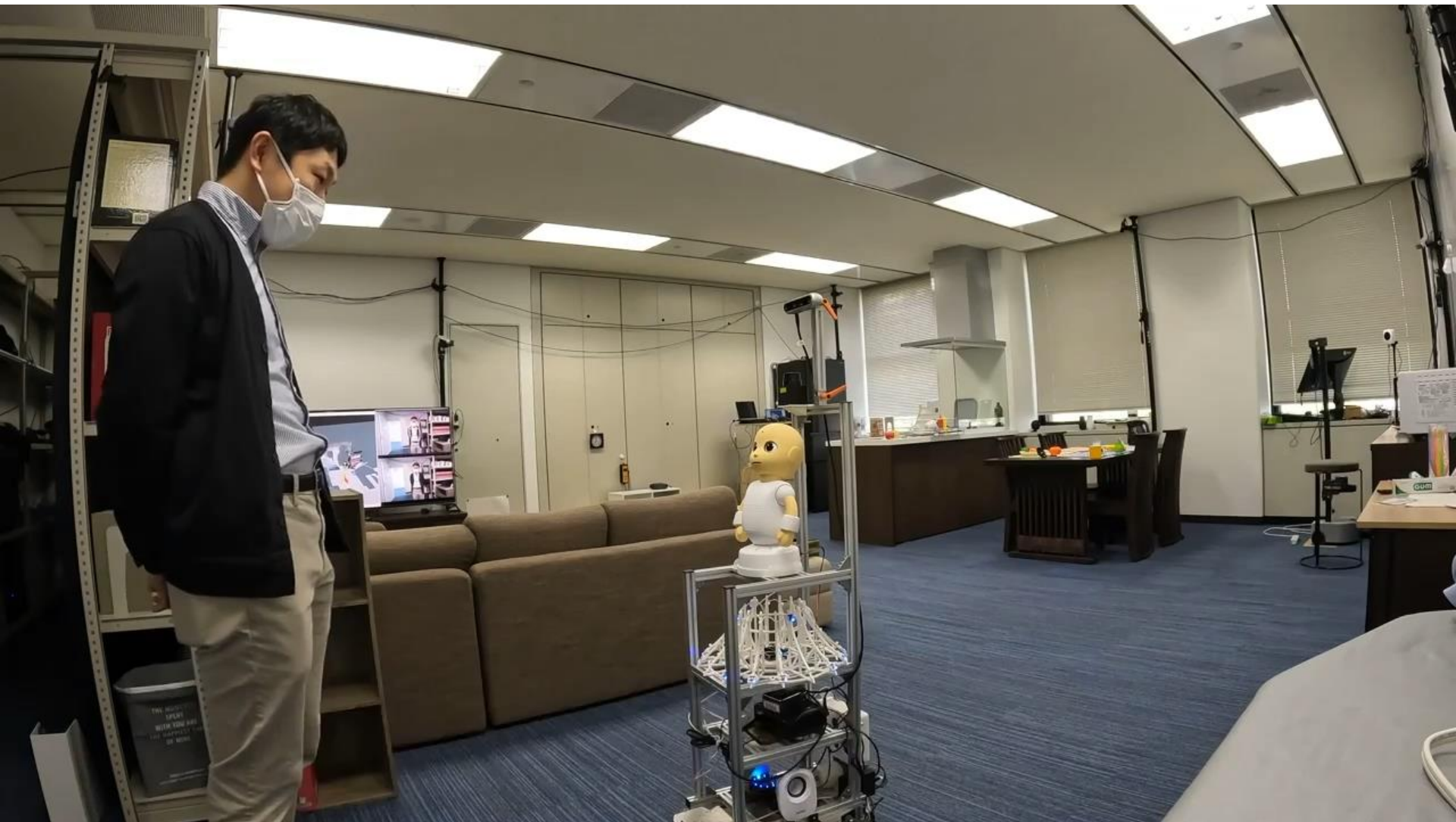May I bring another glass?

✕ **understand the language**
○ **understand the situation and the intent**

Situation recognition

uttr: "another one is missing," **gold action**: bring a glass
viewpoint: 1, **position**: kitchen, **pose**: standing
has: glass, alcohol, **coffee table**: (nothing)
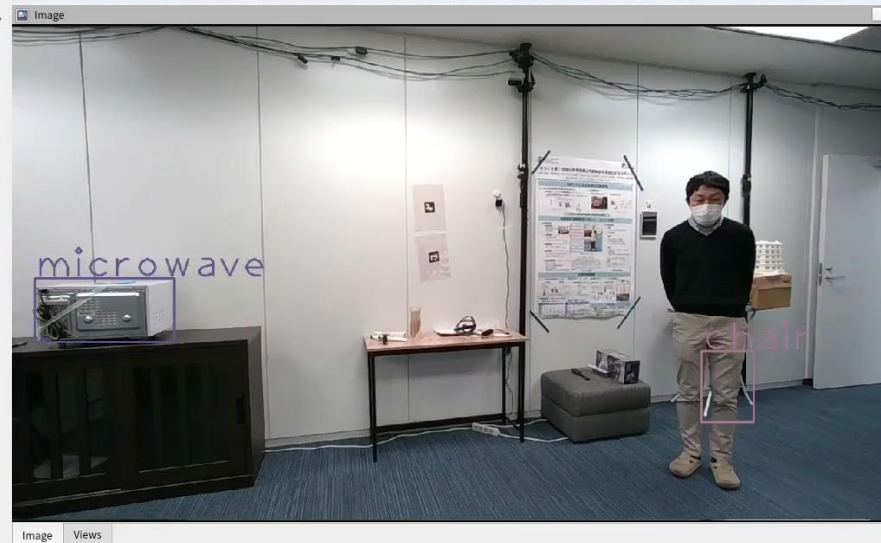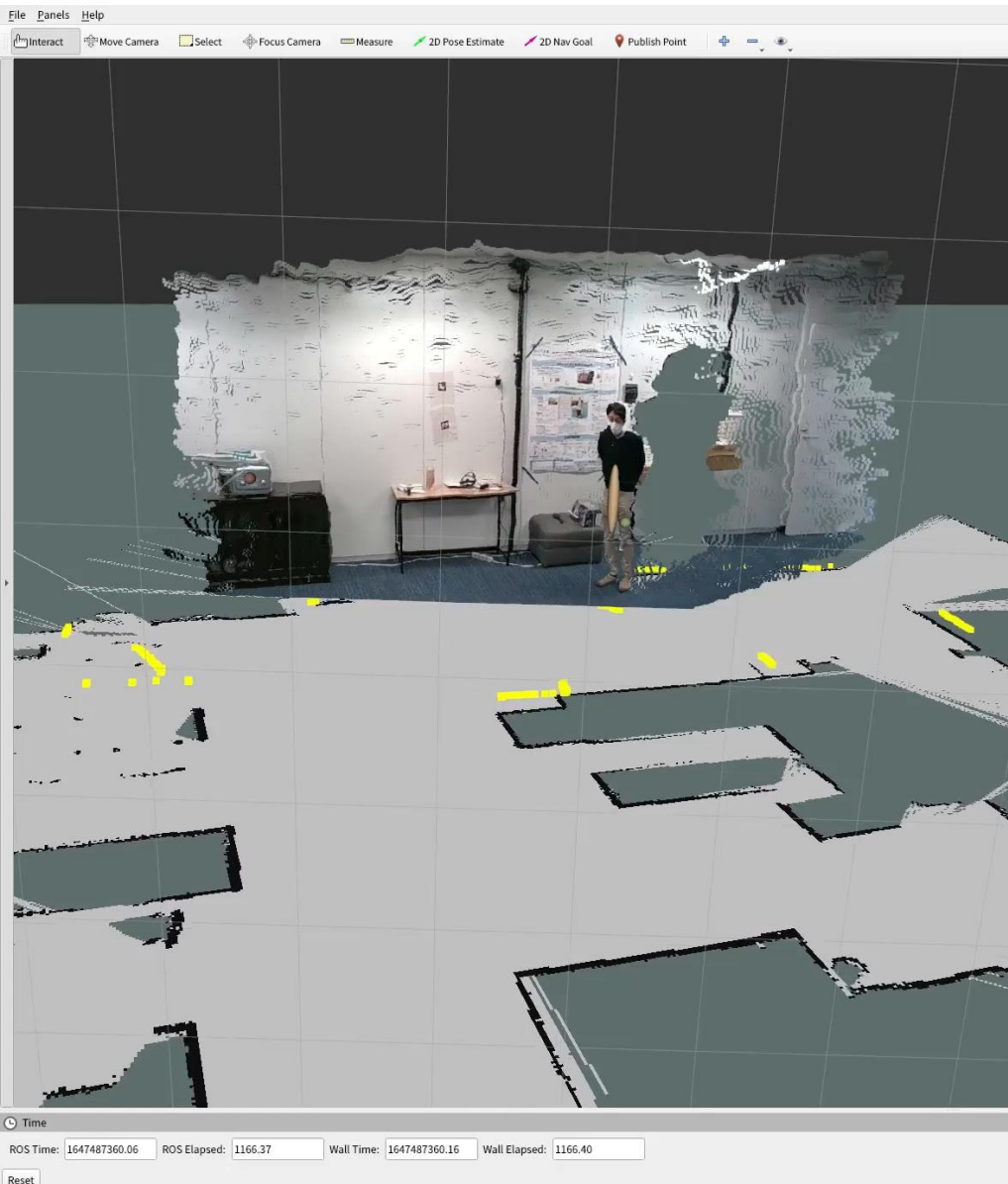**dining table**: snack, cup, glass, ..., **kitchen**: (nothing)

To realize appropriate robot action selection, situation understanding corresponding to robot's task is important

Understanding the surrounding situation

The first-person view

Reasonable action selection

Thanks for the meal

Say "Thanks for the meal"
↓ Is after
Finish eating lunch
↓ Is before
Return cutlery → Returning catsup

Candidate Actions
Bring dishes
Throw out the trash
...
Returning catsup

May I return the catsup on the table?

How do we align the robot action with the situation?
Inference of the robot required? (for explainability?)

Barriers to entry

◆**Robotics research fields had barriers to entry**

- Using physical robots requires costs (money, place)
- Robots are complicated systems (many things before working)

◆The goals of this tutorial are,

- **Removing such barriers related to physical robots**
  - Try to run a simulator of manipulation robot
- **Increasing the number of people who are interested in using language to control robots**
  - Empowered by large language models!

Outline

◆Introduction (Yoshino)

◆Robots and actuations (Nakamura)

◆Understanding from vision (Kurita)

◆Future directions (Yoshino)

◆Break

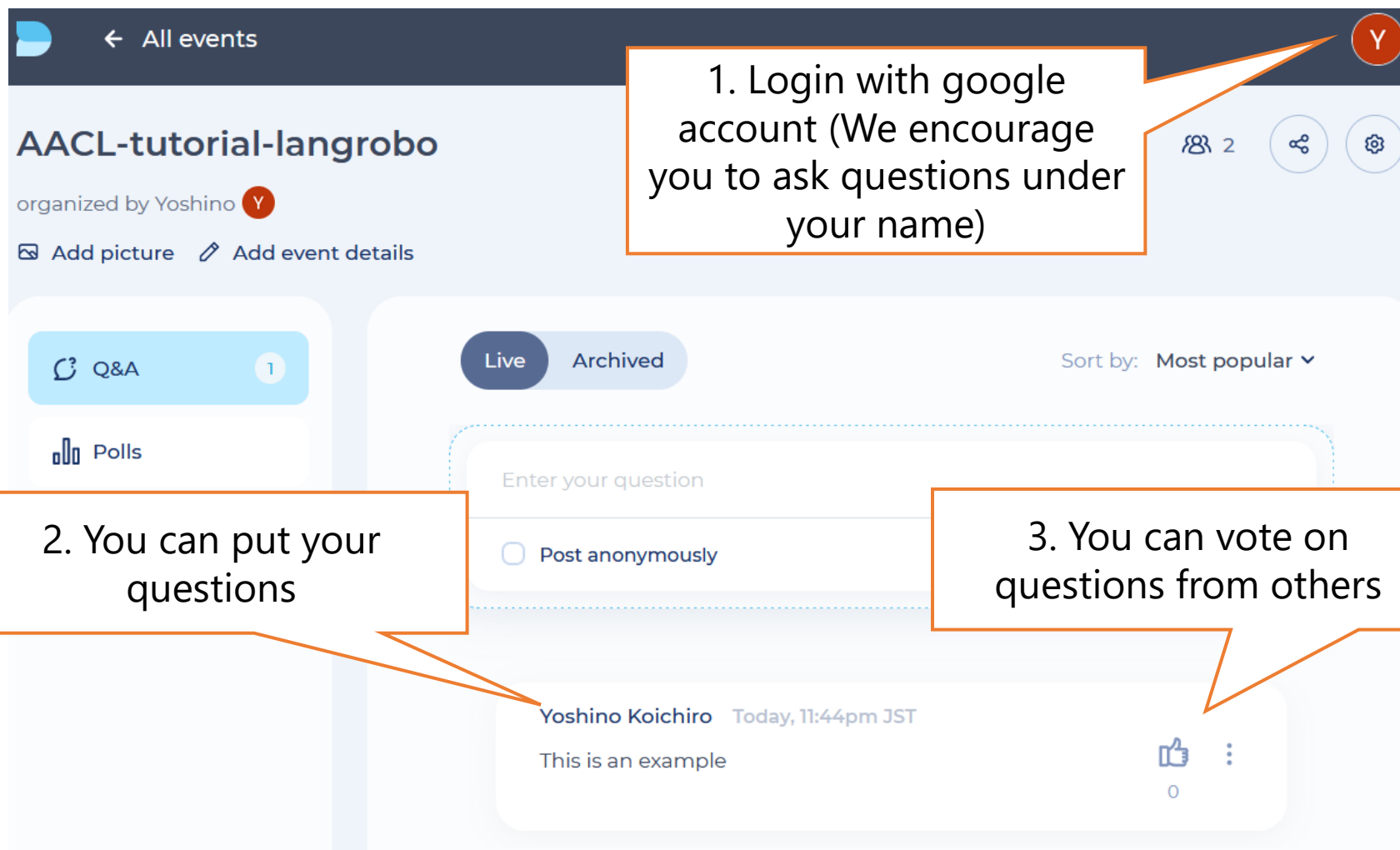◆Try to run HSR (manipulation robot) on ROS2

◆Discussion using Dory

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Dory interface

1. Login with google account (We encourage you to ask questions under your name)

2. You can put your questions

3. You can vote on questions from others