Know-how on scenario creation for interactive robot systems

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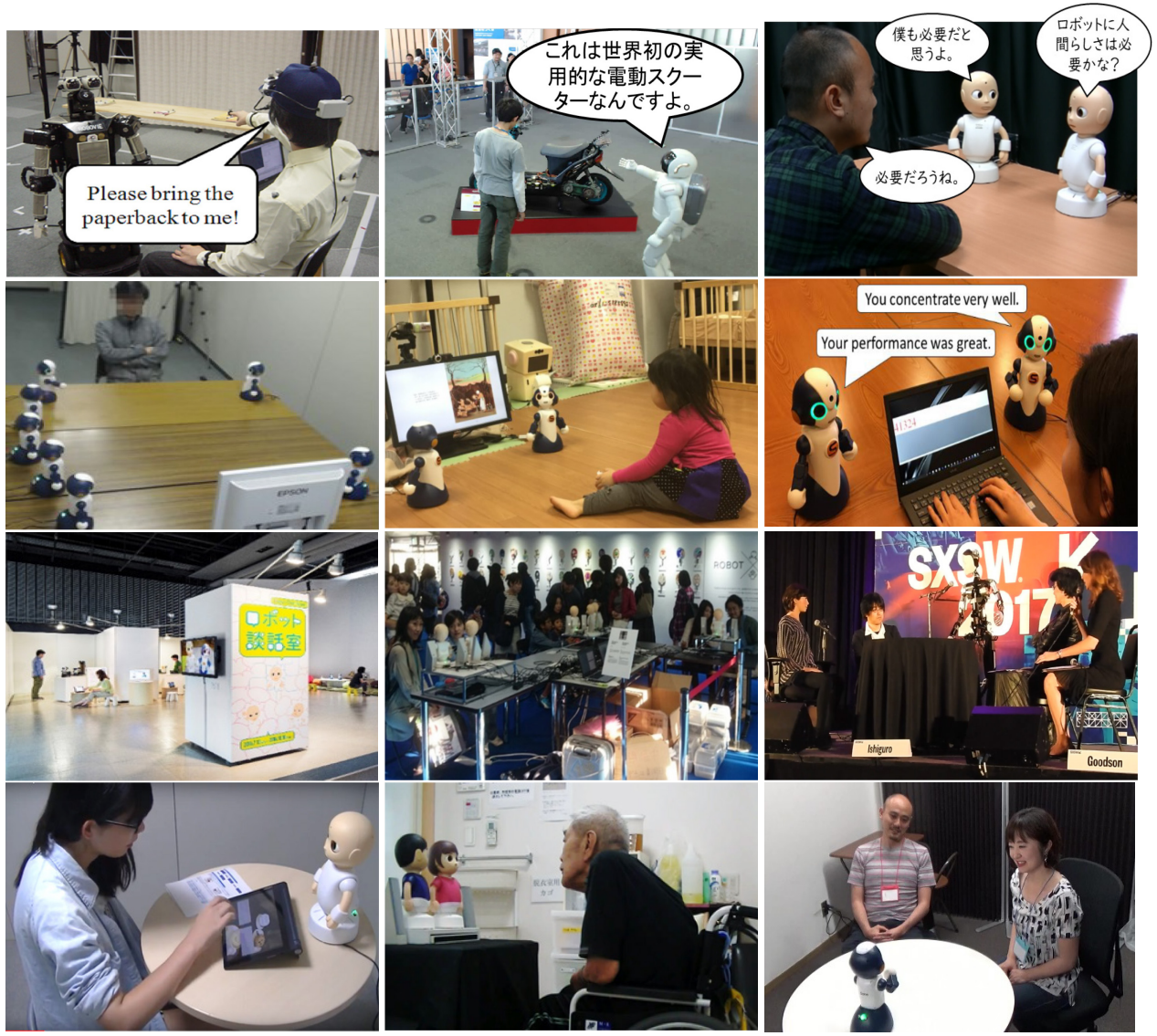
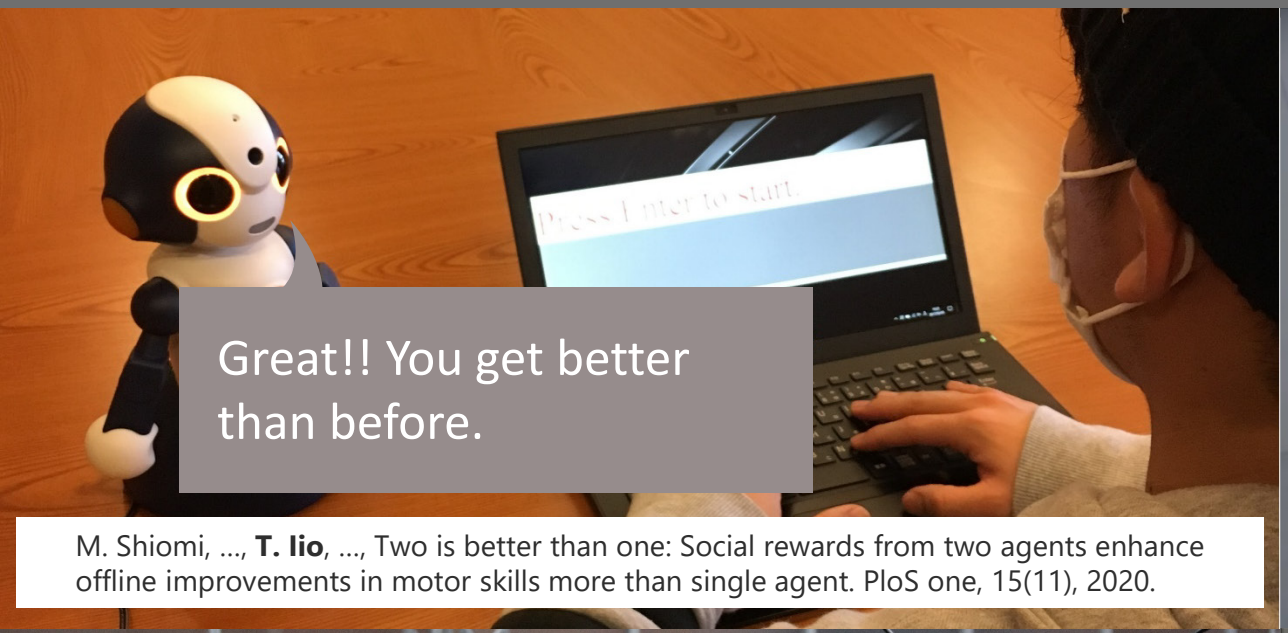
My research focus

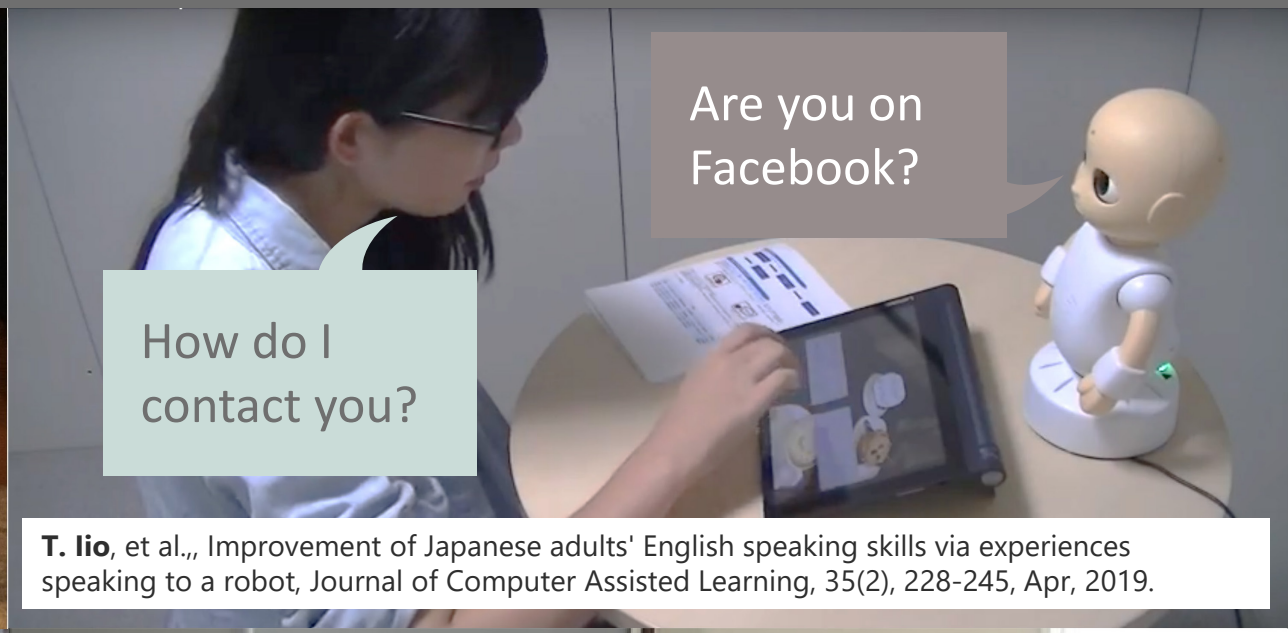
- To understand the impact of social robots on human cognition, behavior, and society.
- To realize robotic systems that enrich people's lives.



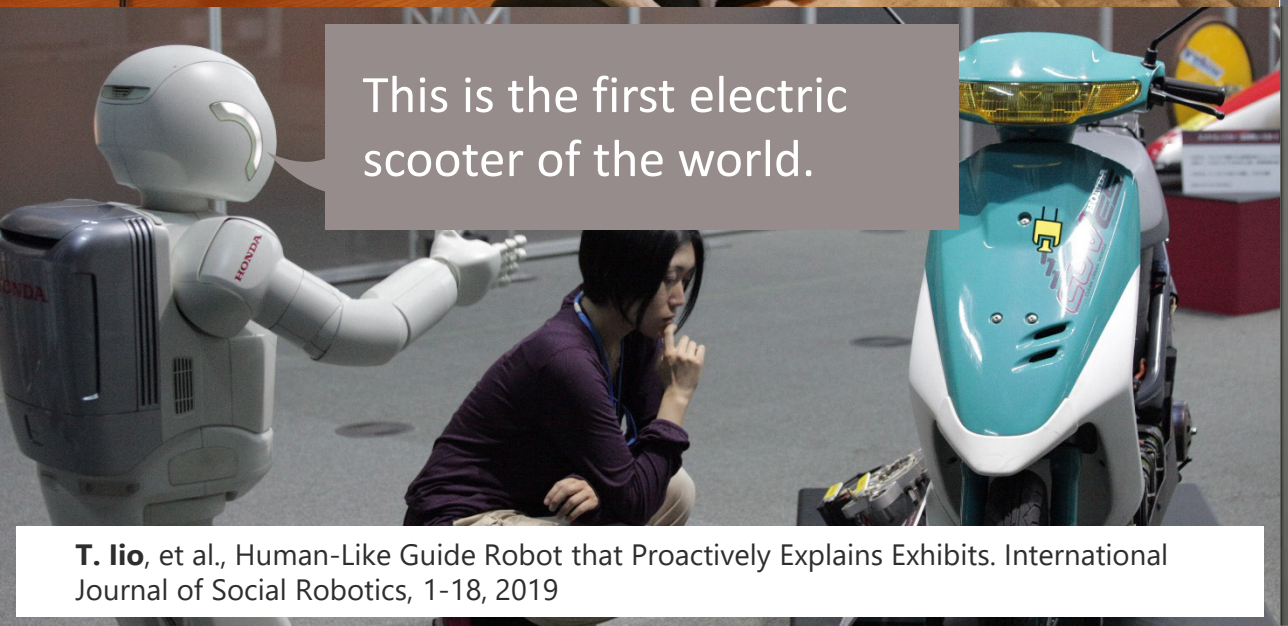
Examples of dialogue with robots



M. Shiomi, ..., **T. Iio**, ..., Two is better than one: Social rewards from two agents enhance offline improvements in motor skills more than single agent. PloS one, 15(11), 2020.



T. Iio, et al.,, Improvement of Japanese adults' English speaking skills via experiences speaking to a robot, Journal of Computer Assisted Learning, 35(2), 228-245, Apr, 2019.



T. Iio, et al., Human-Like Guide Robot that Proactively Explains Exhibits. International Journal of Social Robotics, 1-18, 2019

T. Iio, et al., Twin-Robot Dialogue System with Robustness against Speech Recognition Failure in Human-Robot Dialogue with Elderly People, Appl. Sci. 2020, 10(4), 1522;

Dialogue of social robots

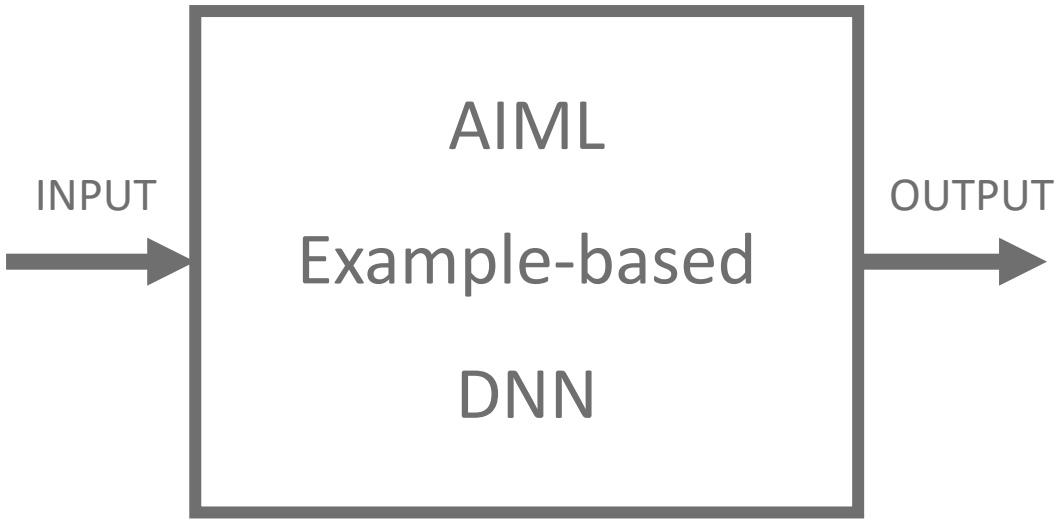
Task oriented

Non-task oriented

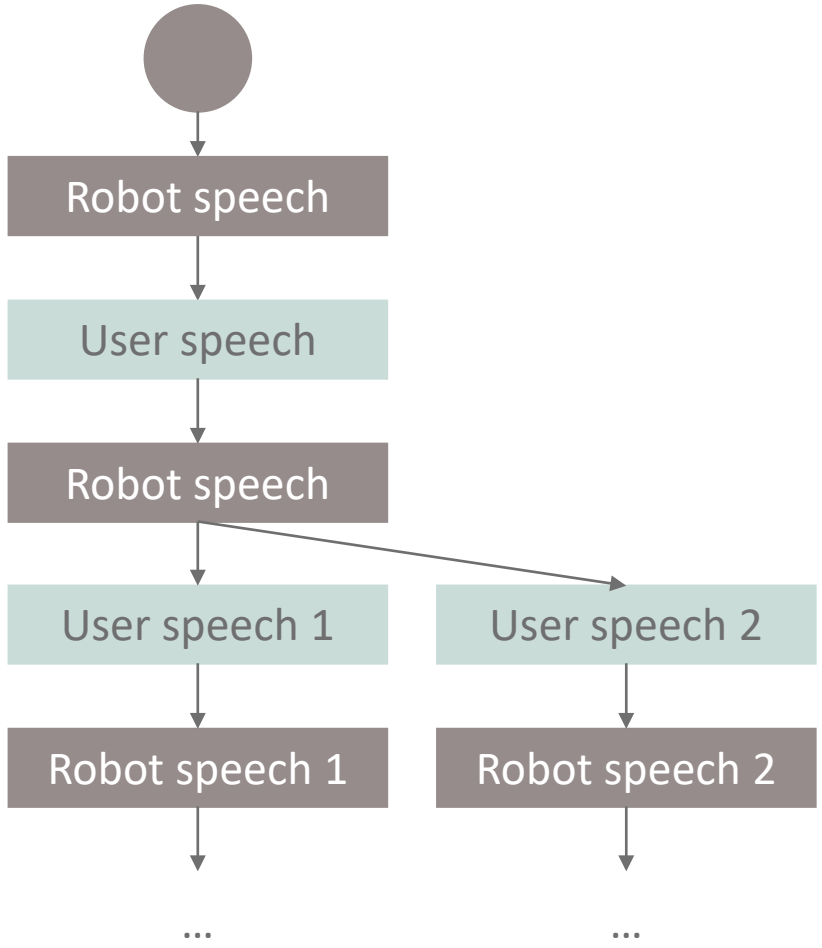
Examples of robot's purpose:

- To provide feedbacks of tasks.
- To support learning.
- To provide useful information.
- To stimulate older people's memory.

Dialogue model of social robots



Rule/Example/NN-based approach



Scenario-based approach

Problem 1

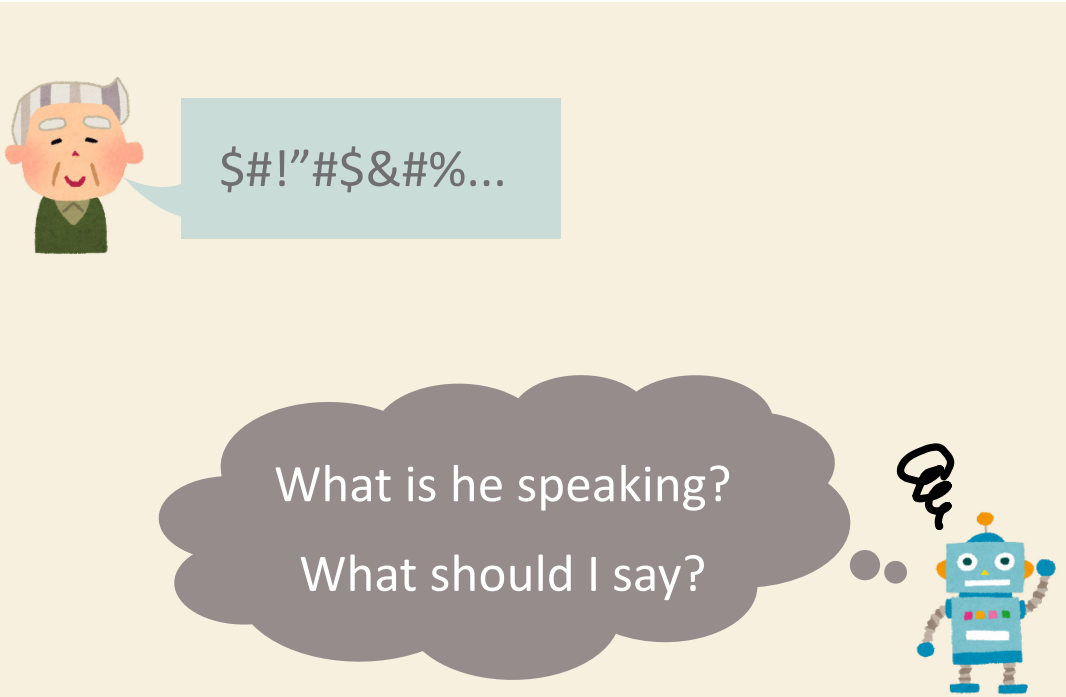
T. Iio, et al.,, Retaining Human-Robots Conversation: Comparing Single Robot to Multiple Robots in a Real Event, Journal of advanced computational intelligence and intelligent informatics, Vol.21, No.4, pp.675-685, Jul, 2017

Voice recognition often fails

in a real environment.

Example

If the robot waits for a user to start talking…



It is hard to predict what a user say, so you cannot prepare for robot’s speech in advance.

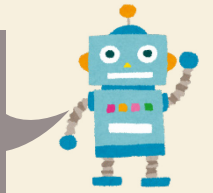
Tip 1

Take the initiative in a dialogue.

Example

When a user sat in front of the robot…

Hello. I'm Taro. I'm learning human's life. I'd like to know about your childhood. What games did you play when you were a child?



The robot can narrow down topics of the dialogue by taking the initiative.

Problem 2

What should the robot say when it doesn't understand what the user is saying?

Tip 2

Use wild-card responses.

Wild-card responses

I see

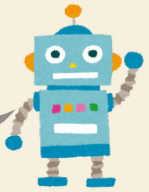
Uh-huh

I got it

Example

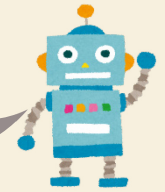
I used to play hide-and-seek.

I see.



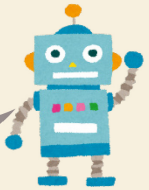
I used to play baseball.
I wanted to be a baseball player.

Uh-huh.



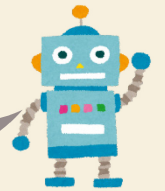
I didn’t play anything.
I was busy for helping my family job.

I got it.

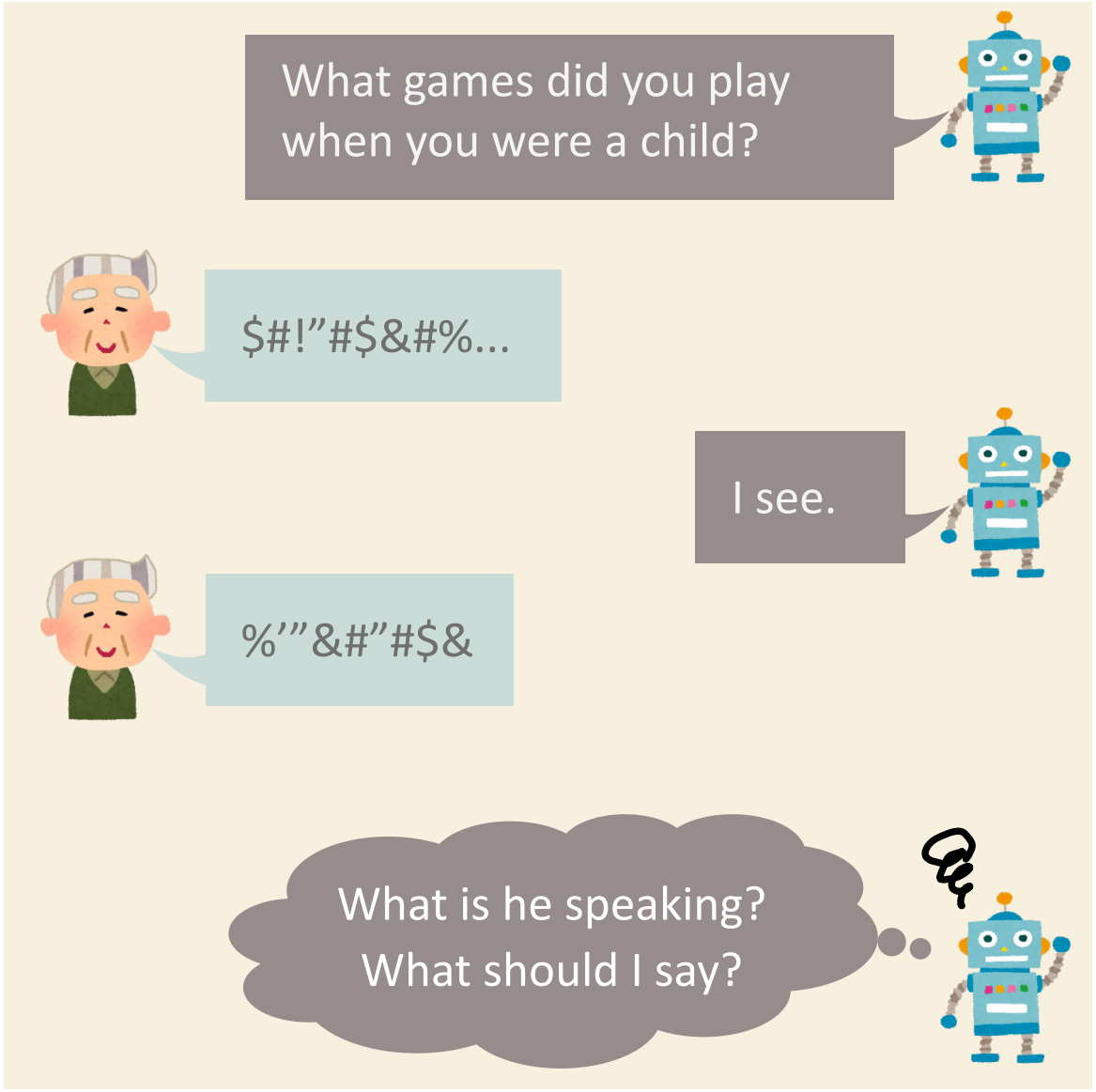


I cannot remember that.

I see.



Problem 3

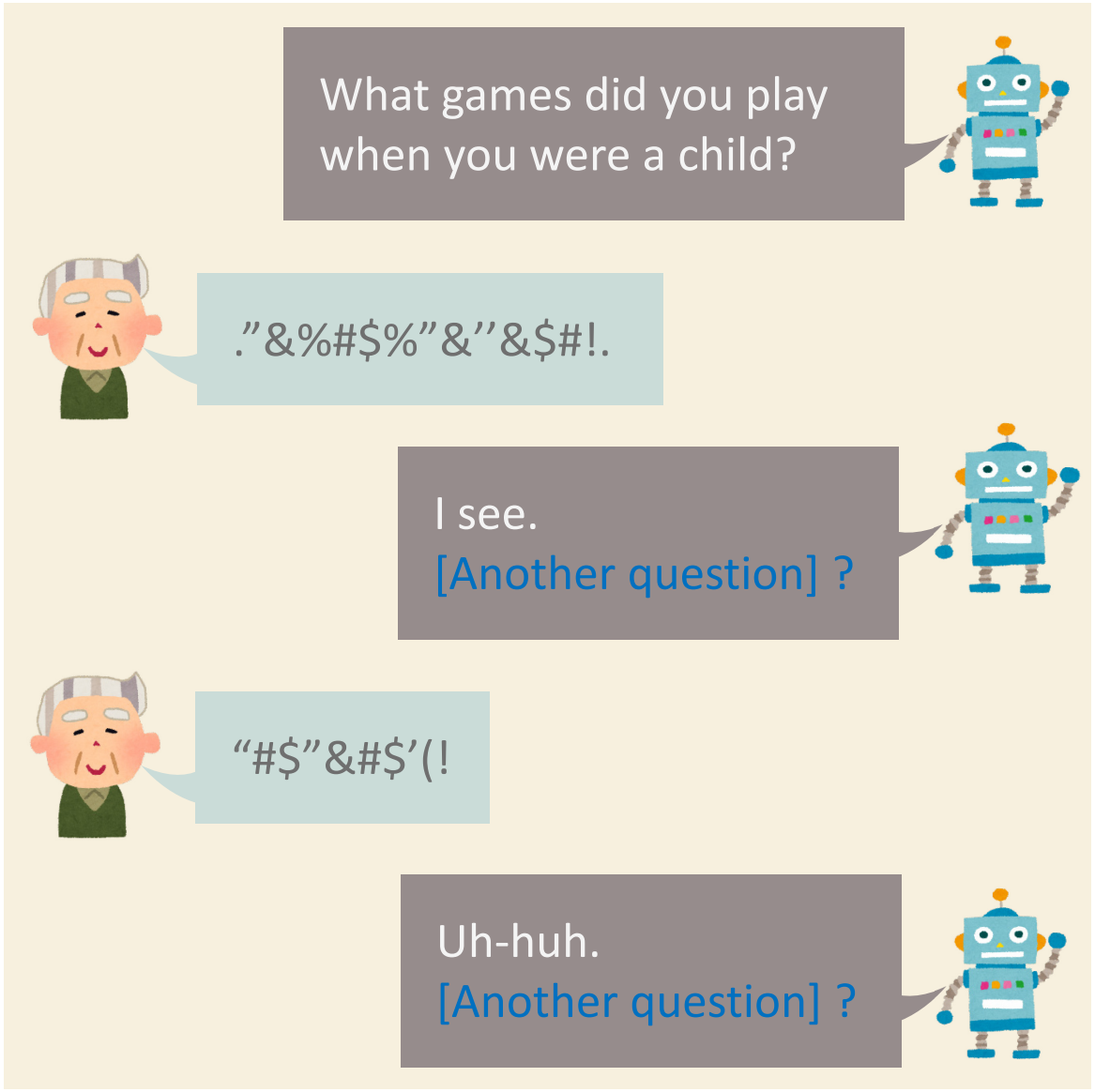


What should the robot say at the third and later turn?

Tips 3

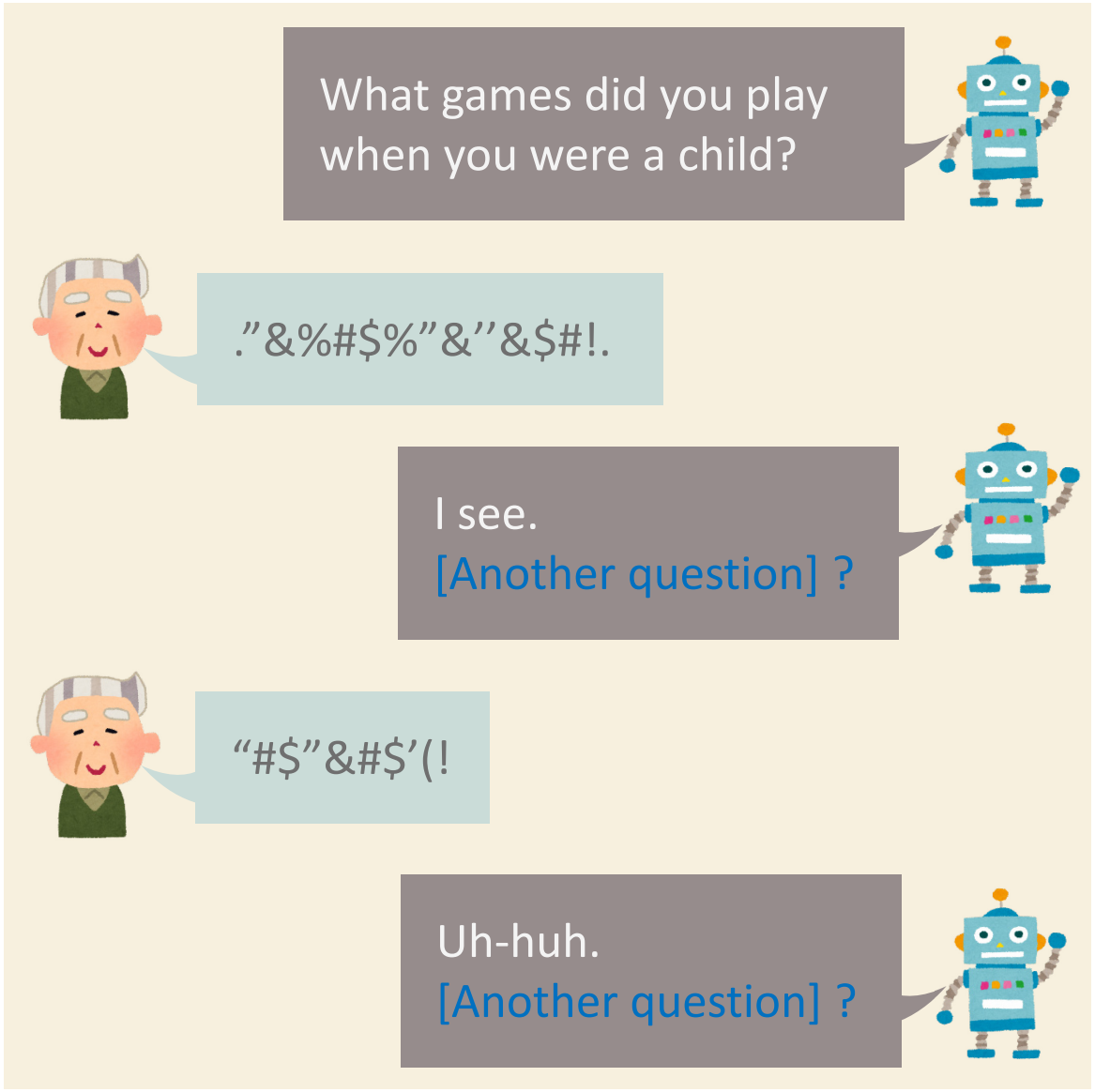
Keep asking a question.

Example



Each user’s speech is expected to be an answer to robot’s question.

Problem 4



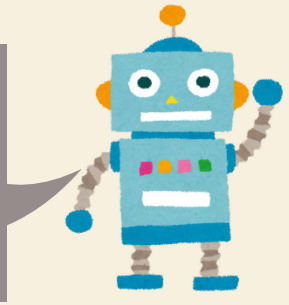
What should the robot ask to the user?

Tips 4

Broaden questions out from the current topic.

Example

I'd like to know about your childhood.
What games did you play when you were a child?



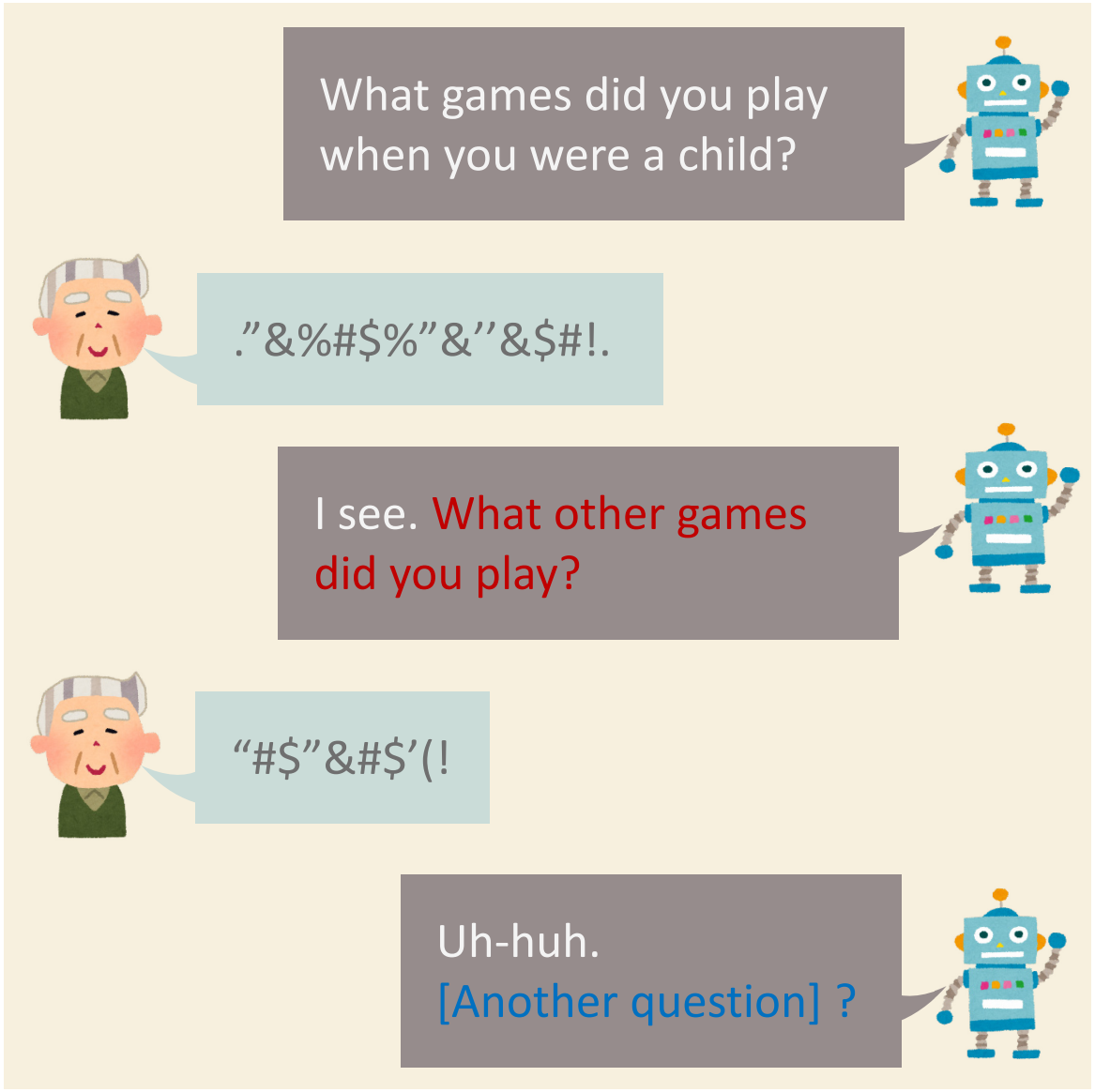
From 'play' to 'friend'.

- Did you have many friends?
- Did you have any good friends?
- Who were you with a lot?
- etc...

From 'play' to 'place'.

- What did you do in school?
- What did you do at home?
- Where did you spend your time?
- etc...

Problem 5

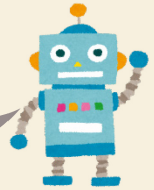


Questions that dig deeper can cause a dialogue breakdown.

Example

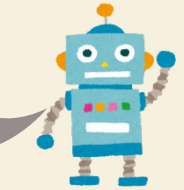
I used to play hide-and-seek.

I see. What other games did you play?



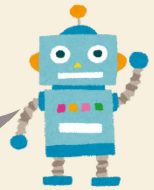
I used to play baseball.
I wanted to be a baseball player.

I see. What other games did you play?



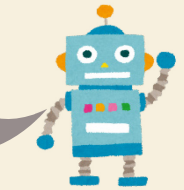
I didn’t play anything.
I was busy for helping my family job.

I see. What other games did you play?



I cannot remember that.

I see. What other games did you play?



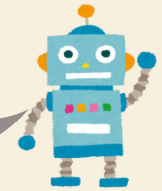
Tips 5

Ask questions not depending on the past questions.

Example

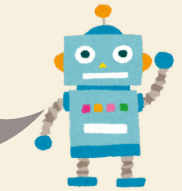
I used to play hide-and-seek.

I see. What did you do in school?



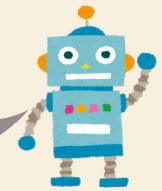
I used to play baseball.
I wanted to be a baseball player.

I see. What did you do in school?



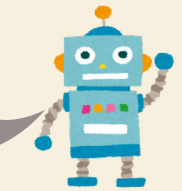
I didn’t play anything.
I was busy for helping my family job.

I see. What did you do in school?

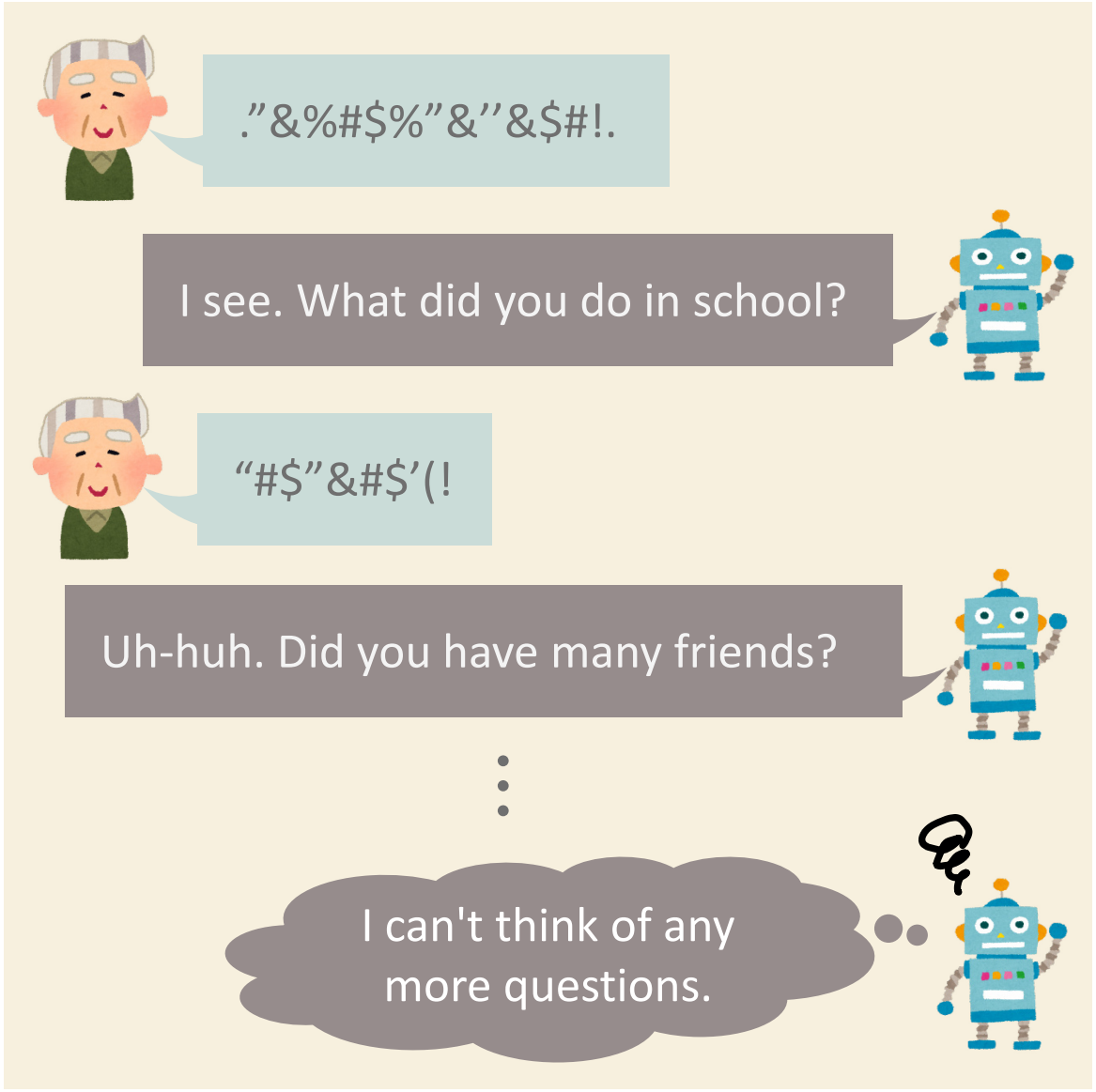


I cannot remember that.

I see. What did you do in school?



Problem 6



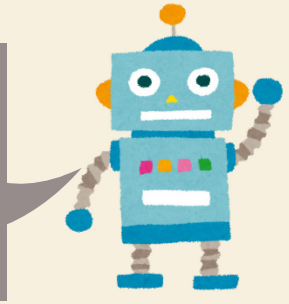
What should the robot do if it run out of questions to ask?

Tips 6

Shift the topic of a dialogue.

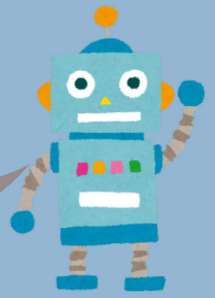
Example

I'd like to know about your childhood.
What games did you play when you were a child?



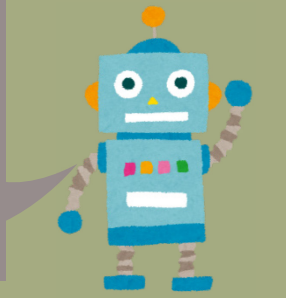
Simple topic shift

I see. By the way,
how is your physical
condition these days?



Descriptive topic shift

I see. I heard that children in the past used to play outside more often than children today. They must have been physically stronger. Speaking of the body, how is your physical condition these days?



Summary of tips so far

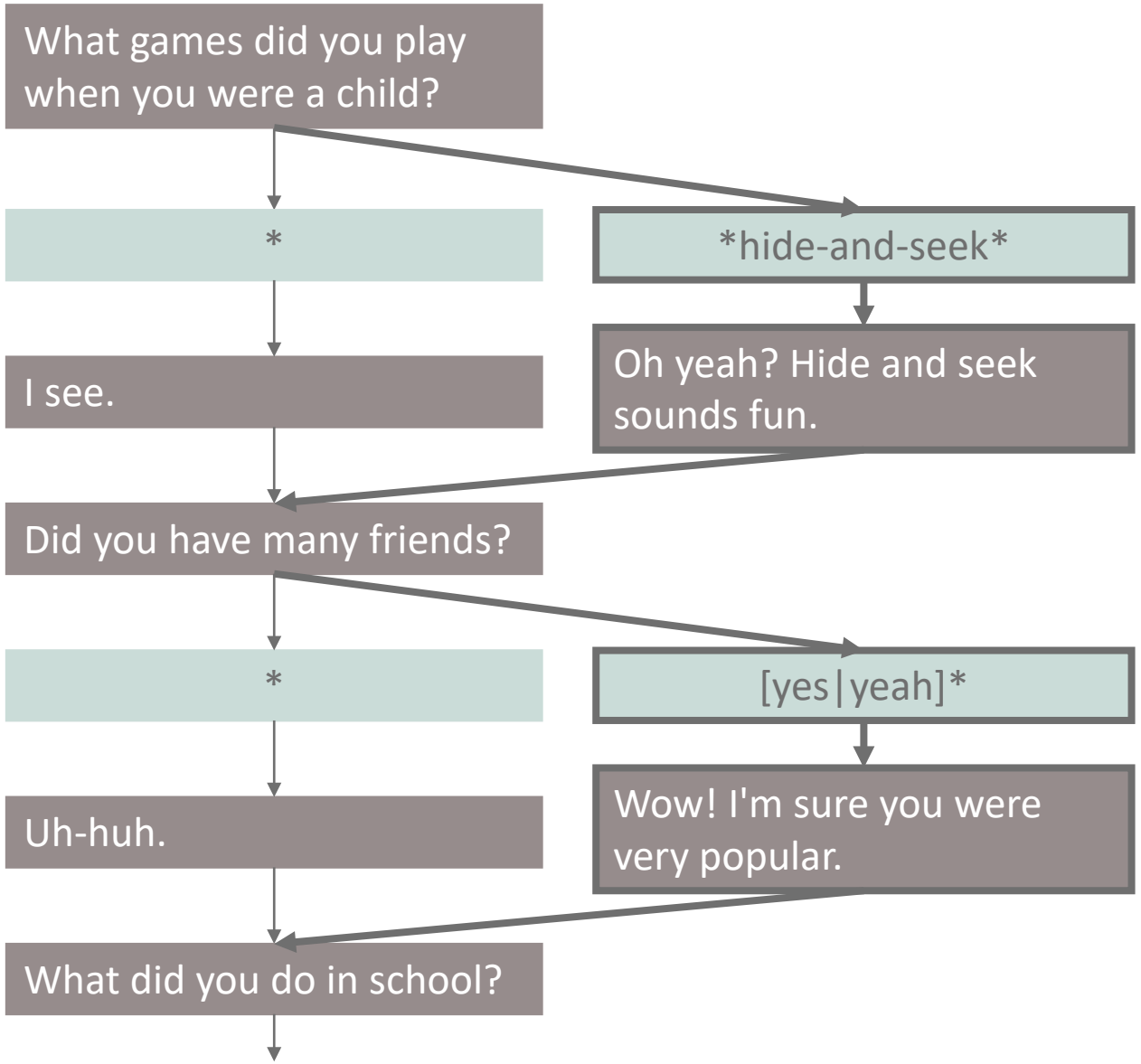
1. Take the initiative in a conversation.
2. Use wild-card responses.
3. Keep asking a question.
4. Broaden questions out from one topic.
5. Ask questions not depending on user's answers.
6. Shift the topic of a conversation.

With the above tips, you can make a scenario for social robot to continue a dialogue without depending on user’s speech recognition results.

Problem 7

- Scenarios created in this way do not take the user's speech into account at all.
- How can we respond to the user's speech?

Branches

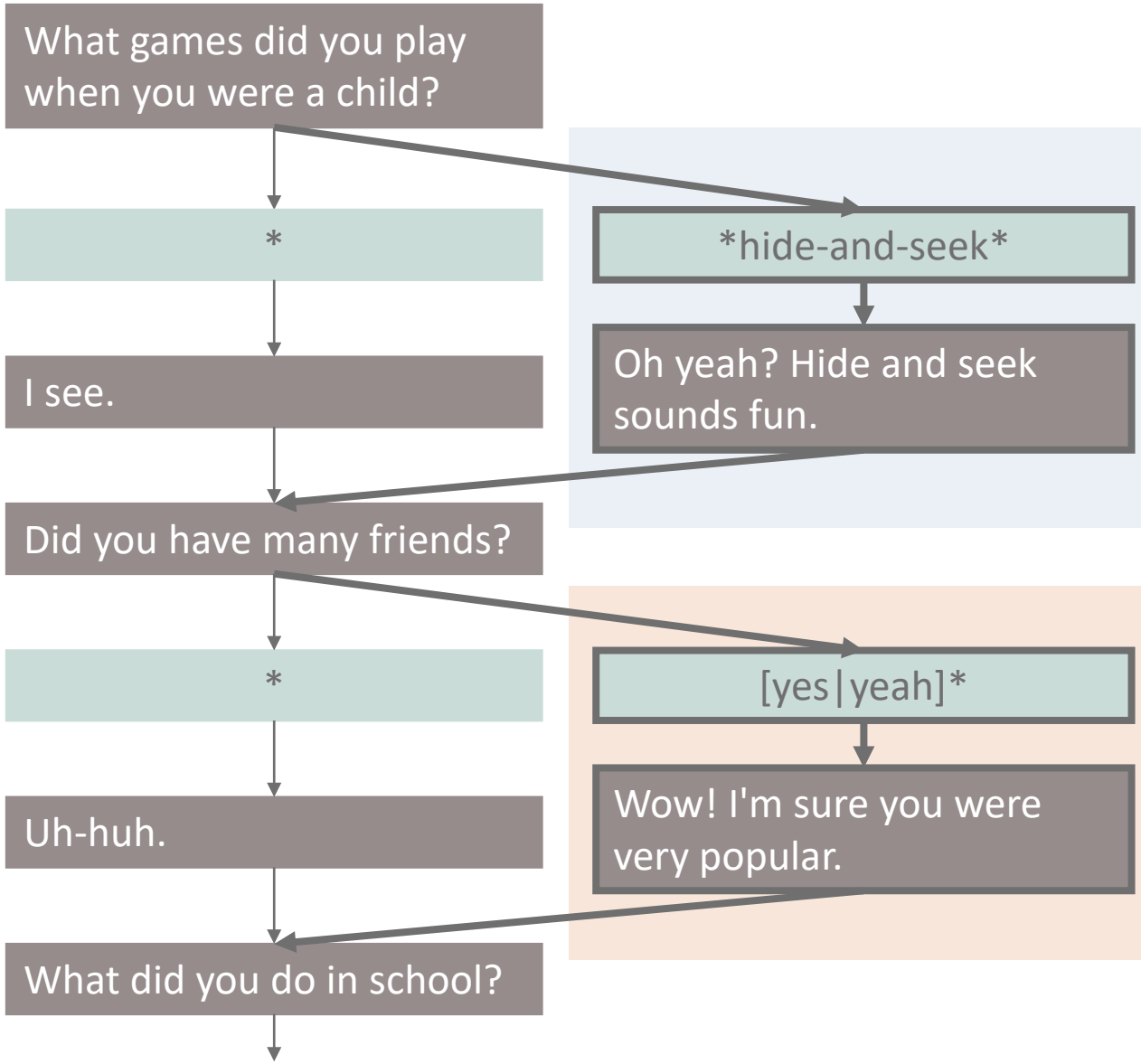


Is there anything we should be aware of when creating a branch?

Tips 7

Make branches with the less incidence of failure.

Less incidence of failure



SAFER

Proper nouns and phrases related to the question are robust against speech recognition errors and misinterpretations.

WARNING

Speech recognition failures and interpretation failures are likely to occur.

Problem 8

Let's make lots of branches and build a smart robot system !!!

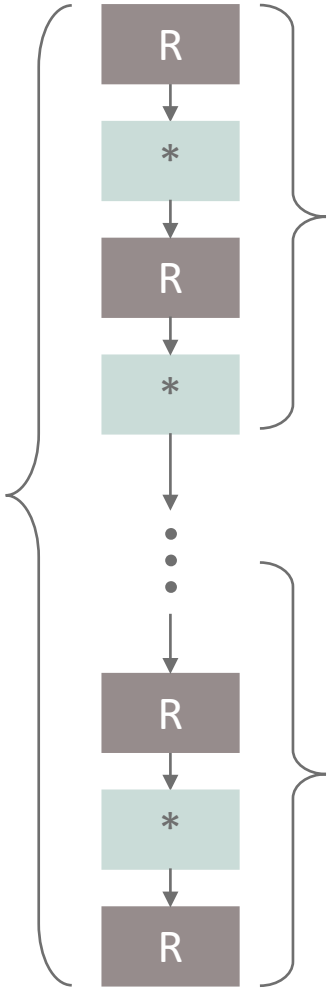
Is it a good thing?

Tips 8

Don’t make detail branches at first.

Why?

For keep a dialogue 5 min,
15 questions are needed.
(If it takes 20 sec for a robot to ask a question and a human to finish answering it.)



If you try too hard to make a lot of branches at the beginning, you are likely to burn out before you complete to make the dialogue all.

In the latter part of the dialogue, it will be difficult to think about the dependency of the questions.

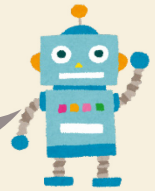
Problem 9

- If the user asks a question to the robot, the robot won't be able to respond well.
- How can the robot respond to user’s question?

Example

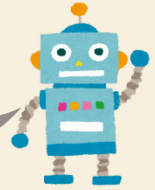
I used to play hide-and-seek.
What game do you do?

I see. What did you do in school?



Hey. Don't ignore me.

Uh-huh. Did you have many friends?



The robot does not
listen to me.

When the user feels ignored by the robot, the feeling of interacting with it is reduced.

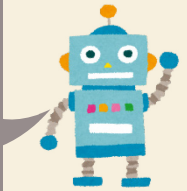
Tips 9

Prepare robot’s own answers to the questions.

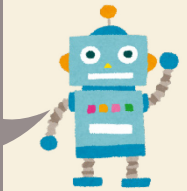
Why?

In my experience, users sometimes repeat the robot's question.

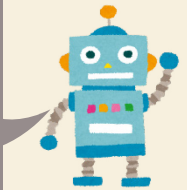
What games did you play when you were a child?



I see. **I spend most of my time chatting with people and watching TV.**
What did you do in school?

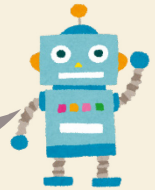


Uh-huh. **I don't go to school, but if I could, I would like to study.**
Did you have many friends?



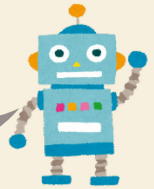
Example

What games did you play when you were a child?



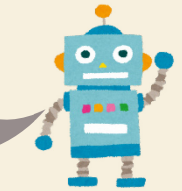
I used to play hide-and-seek. What game do you do?

I see. **I spend most of my time chatting with people and watching TV.** What did you do in school?



I studied various subjects and played with friends. How about you?

Uh-huh. **I don't go to school, but if I could, I would like to study.** Did you have many friends?



Even if the user asked no question, the robot's speech would be still natural.

Summary of tips

1. Take the initiative in a conversation.
2. Use wild-card responses.
3. Keep asking a question.
4. Broaden questions out from the current topic.
5. Ask questions not depending on the past questions.
6. Shift the topic of a conversation.
7. Make branches with the less incidence of failure.
8. Don’t make detail branches at first.
9. Prepare robot’s own answers to the questions.