

# Shaping Dialogues with a Humanoid Robot Based on an E-Learning System

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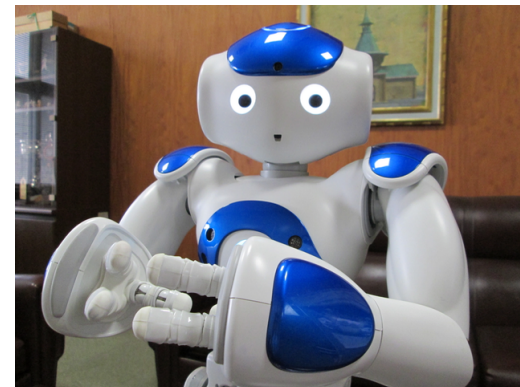
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## Purpose

We use a humanoid robot to participate in dialogues based on a learning system.

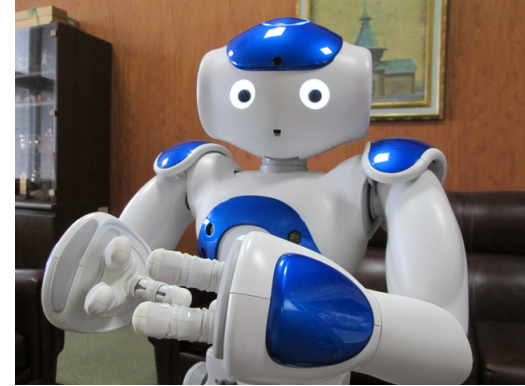
- We discuss a means of rendering instructor-robot dialogues effective for impressing students in the classroom.
- We consider a common form of dialogue seen in comedy routines, movie scenarios and a science education TV program.
- We discuss the use of Topic Maps technology in the web learning system from the viewpoint of transferring topics and associations for the robot's speech.

Aldebaran NAO

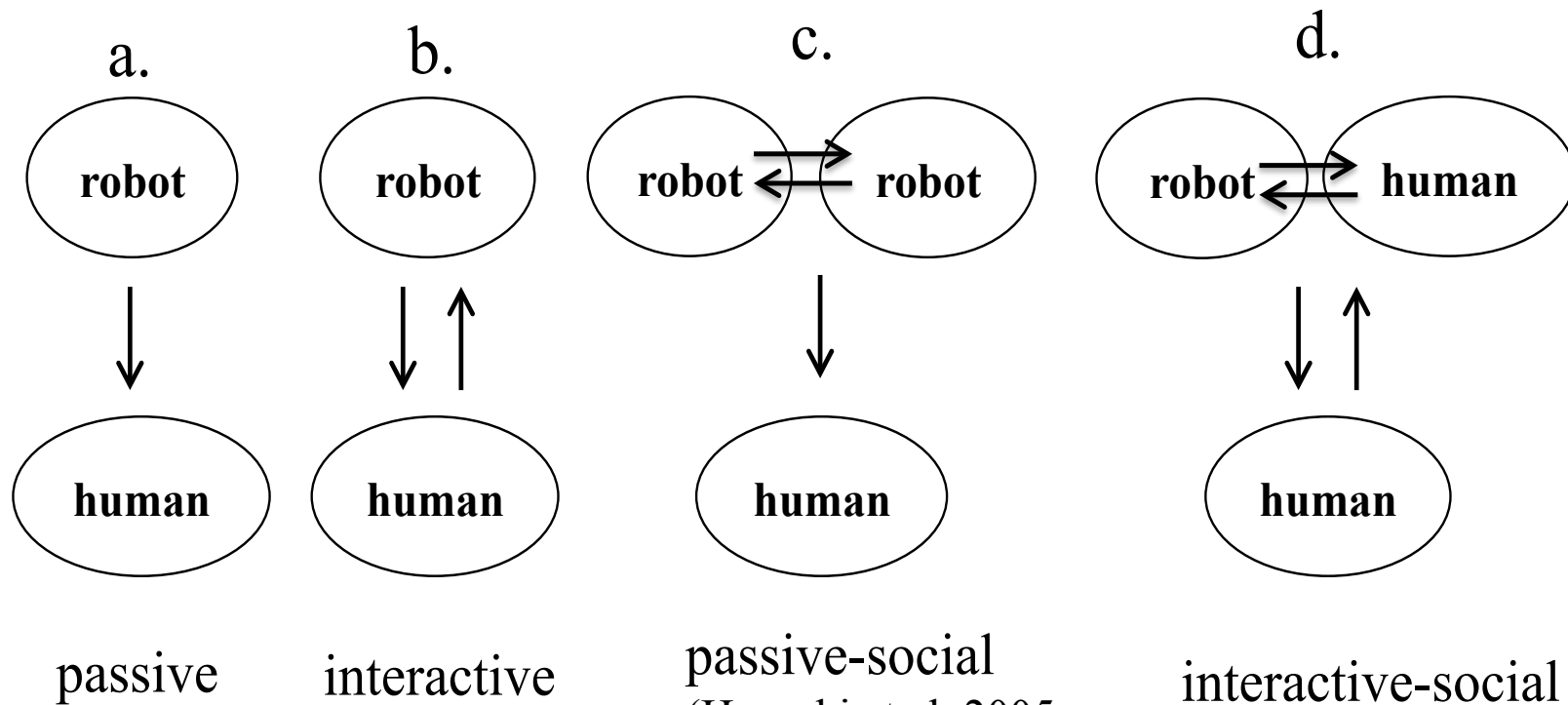


## Method: Humanoid Robot

- We introduce a humanoid robot NAO (Aldebaran Robotics) for conducting dialogue with an instructor in the classroom.
- NAO has multi-lingual speech recognition.
- The voice for Japanese speech is based on that of a popular voice actress to ensure that the speech sounds realistic.
- Speech recognition can be successful when the words to be recognized are listed in advance of recognition.
- NAO can transmit URL requests and use APIs through Wi-Fi.



# Types of dialogue between human and humanoid robot

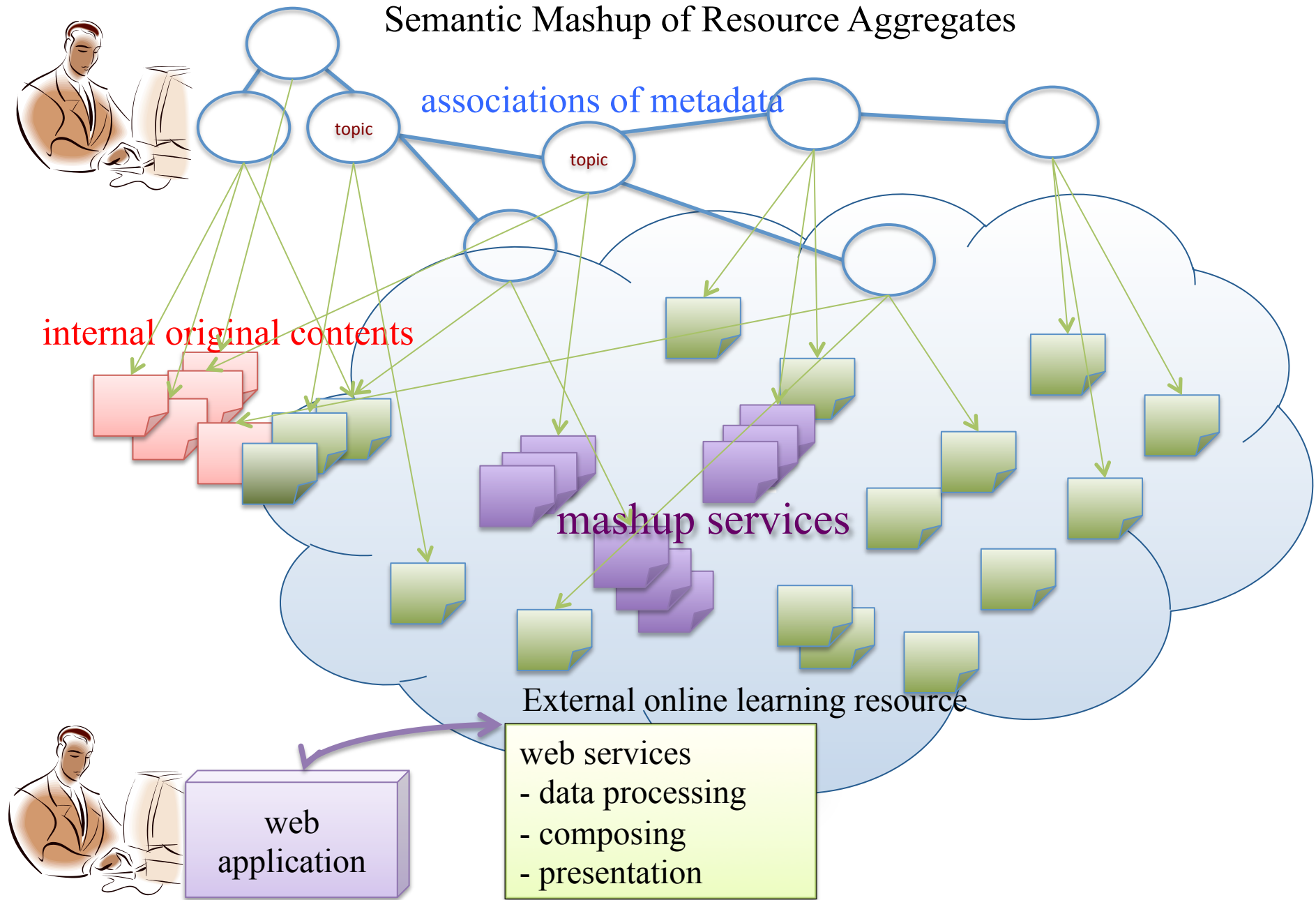


Kanda et al.(2002) found that seeing conversation between robots can activate human-robot communication.

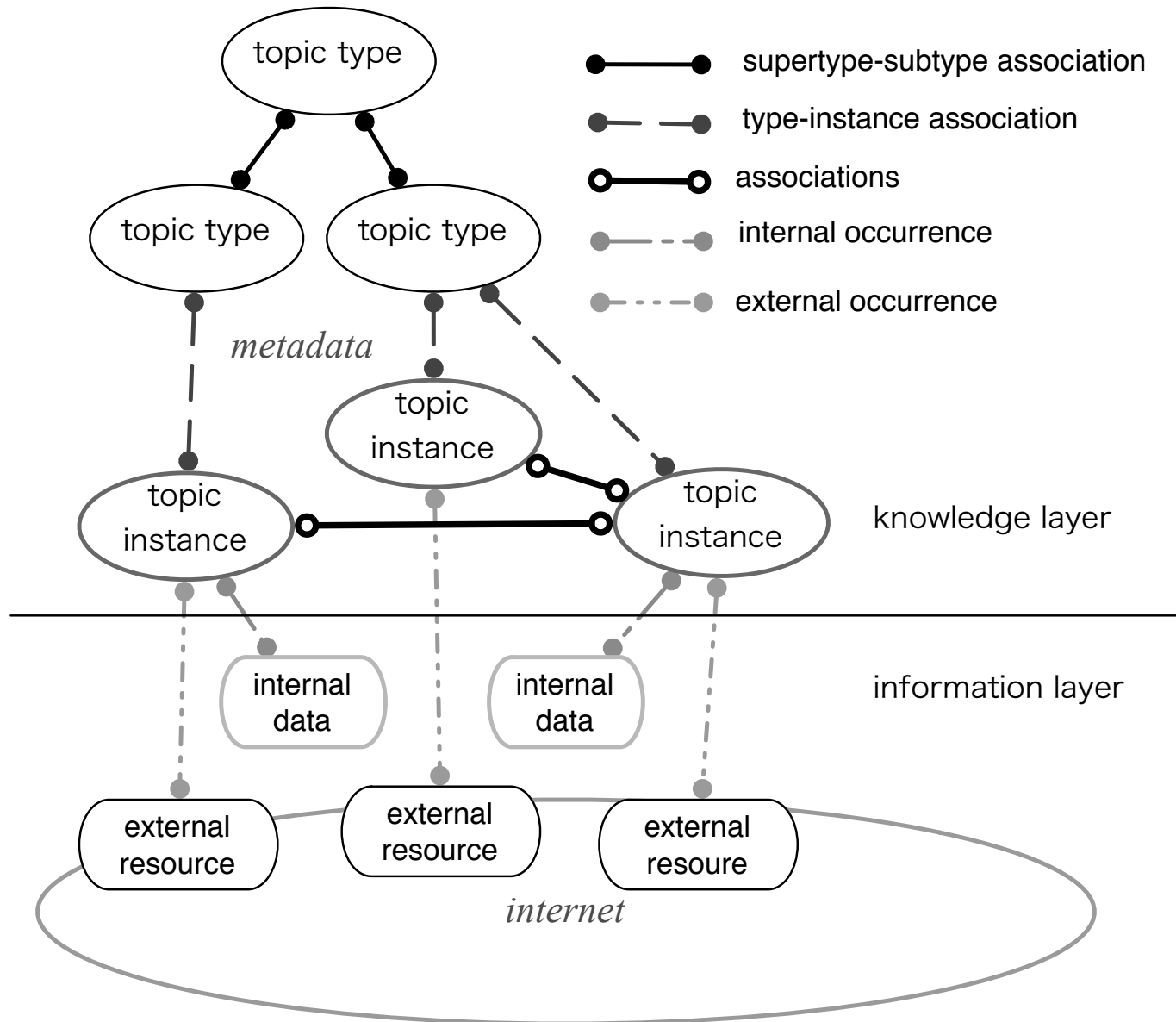
We may extend the notion of interactive-social to the demonstration of experiments in front of learners, posing hypothesis, operating the apparatus, and observing and discussing phenomena.



# "Cloud" of learning resource



# Topic Maps Online Learning System: Topic Maps Constructs



Topic Maps is a semantic indexing technology for improving findability of web resources.

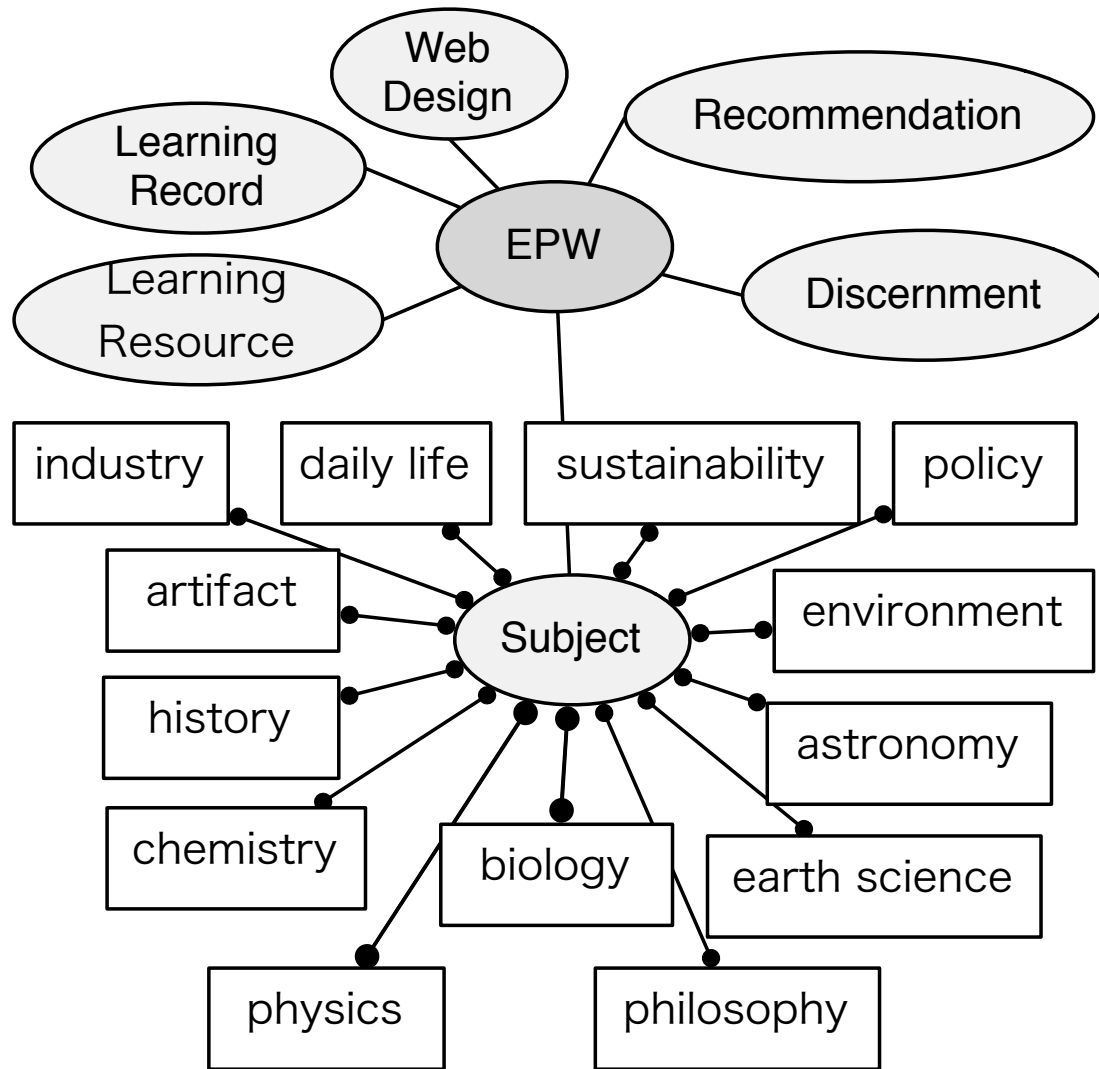
A topic represents an entity, an object, or a notion. Usually, one or more topic instances are defined for a topic type.

An association links two topics, defining the role types of topics.

Occurrences are a specific type of association that connects a topic with resources.

The networked construction of topics is called topic map ontology.

# Topic Maps Online Learning System: back bones of the online learning system, “Everyday Physics on Web” <http://tm.u-gakugei.ac.jp/epw/>



Learning Resource topic represents types of online materials.

Web Design topic defines the layouts of the web pages.

Discernment topic structures an avatar and conversation system.

Subject topics represent subjects of knowledge. Subjects consists of 13 domains.

# Topic Maps Online Learning System: Web Page

**Everyday Physics on Web Topic Map**  
Topic Maps, a bridge between Information and Knowledge.

Navigation: Top | アバター選択 | マイルーム | News | 講座 | ドリル | リソース | サポート | About

ようこそshumさん ここは理科の学習サイトです。アバタールームへどうぞ。

shumさんのアバタールーム (講座未登録の人は、自動的に「物理学」)

Avatar dialogue:  
ふ〜ん、おもしろそう。  
実験資料には、おもしろ実験ビデオなどがあるよ！やってみてもいいかも！

Personal learning history (Recent Posts):

Post Title	Date
shumさんがこれまで見てきたコンテンツ(1284回)と送信	02/28
21世紀後半の理科教育	02/27
中世の帝国1	02/26
21世紀後半の理科教育	02/25
21世紀後半の理科教育	02/24
市民の科学リテラシー	02/23
市民の科学リテラシー	02/22
市民の科学リテラシー	02/21
市民の科学リテラシー	02/20
市民の科学リテラシー	02/19
市民の科学リテラシー	02/18
市民の科学リテラシー	02/17
市民の科学リテラシー	02/16
なぜ科学リテラシーを学ばねばならないのか	02/15
なぜ科学リテラシーを学ばねばならないのか	02/14
なぜ科学リテラシーを学ばねばならないのか	02/13
なぜ科学リテラシーを学ばねばならないのか	02/12
なぜ科学リテラシーを学ばねばならないのか	02/11
なぜ科学リテラシーを学ばねばならないのか	02/10
なぜ科学リテラシーを学ばねばならないのか	02/09
なぜ科学リテラシーを学ばねばならないのか	02/08
なぜ科学リテラシーを学ばねばならないのか	02/07
なぜ科学リテラシーを学ばねばならないのか	02/06
なぜ科学リテラシーを学ばねばならないのか	02/05
なぜ科学リテラシーを学ばねばならないのか	02/04
なぜ科学リテラシーを学ばねばならないのか	02/03
なぜ科学リテラシーを学ばねばならないのか	02/02
熱力学の法則 基礎問題1	02/01
感想: test	01/31
感想: test	01/30
感想: test	01/29
感想: test	01/28
中世の帝国1	01/27
中世の帝国1	01/26



# Use of Topic Maps Remote Access Protocol (TMRAP) API

We used the Ontopia development and runtime environment, which is equipped with a topic map query language and the tolog tag library for Java Server Pages (JSP).

To request topic map query from the robot, the Ontopia Topic Maps Remote Access Protocol (TMRAP) API was used as shown below.

```
import requests
url = "http://tm.u-gakugei.ac.jp/epw/tmrap/get-tolog?
topicmap=postgresql-85601&tolog=using+psi1+for+i%22http%3A%2F
%2Ftopicmaps.u-gakugei.ac.jp%2Fpsi%2F%22+using+psi2+for+i%22http%3A%2F
%2Fpsi.topicmaps.org%2Fiso13250%2Fmodel%2F%22+select+%24tnv%2C+
%24tjnv+from+instance-of%28%24t%2C+psi1%3A" + subjectname + "%29%2C
+topic-name%28%24t%2C+%24tn%29%2C+type%28%24tn%2C+psi2%3Atopic-
name%29%2C+value%28%24tn%2C+%24tnv%29%2C+topic-name%28%24t%2C+
%24tjn%29%2C+type%28%24tjn%2C+psi1%3AName_Ja%29%2C+value
%28%24tjn%2C+%24tjnv%29%3F"
req = requests.get(url)
tree = et.ElementTree(req.content)
xml = tree.getroot()
```

# Comedy Routine

	century	Name of art	Roles of players		
England, USA	19th	Double act, or comedy duo	Straight man	Funny man	Spoken from two contrasting viewpoints, the humor effectively takes its shape.
Japan	20th	( <i>Shabekuri</i> ) <i>manzai</i>	<i>Tsukkomi</i>	<i>Boke</i>	The <i>boke</i> player creates and absurd interpretation of reality, and the <i>tsukkomi</i> player corrects the <i>boke</i> player's failures. Dialogues between these <i>boke</i> and <i>tsukkomi</i> players shape the humor.



# Classification of Essential Expressions of *Manzai*

Based on T. Abe (2006)

Category of expression	Subcategory	Function
<i>furi</i> (Introduces a topic for humor)	<i>suji furi</i> (furi of a topic)	Introduces a topic.
	<i>mae furi</i> (furi of a condition)	Deepens the topic.
<i>boke</i> (Provides the main body of humor)	<i>boke</i> based on an expectation	Creates humor on an expectation
	<i>boke</i> unexpected	Creates unexpected humor under the construction of a furi.
<i>tsukkomi</i> (Completes the funniness of the dialogue)	<i>tsukkomi</i> to call attention	Repeats or clarifies the humor.
	<i>tsukkomi</i> to add information	Corrects errors, clarifies or figures the meaning, or criticizes.

# Cinema Plot

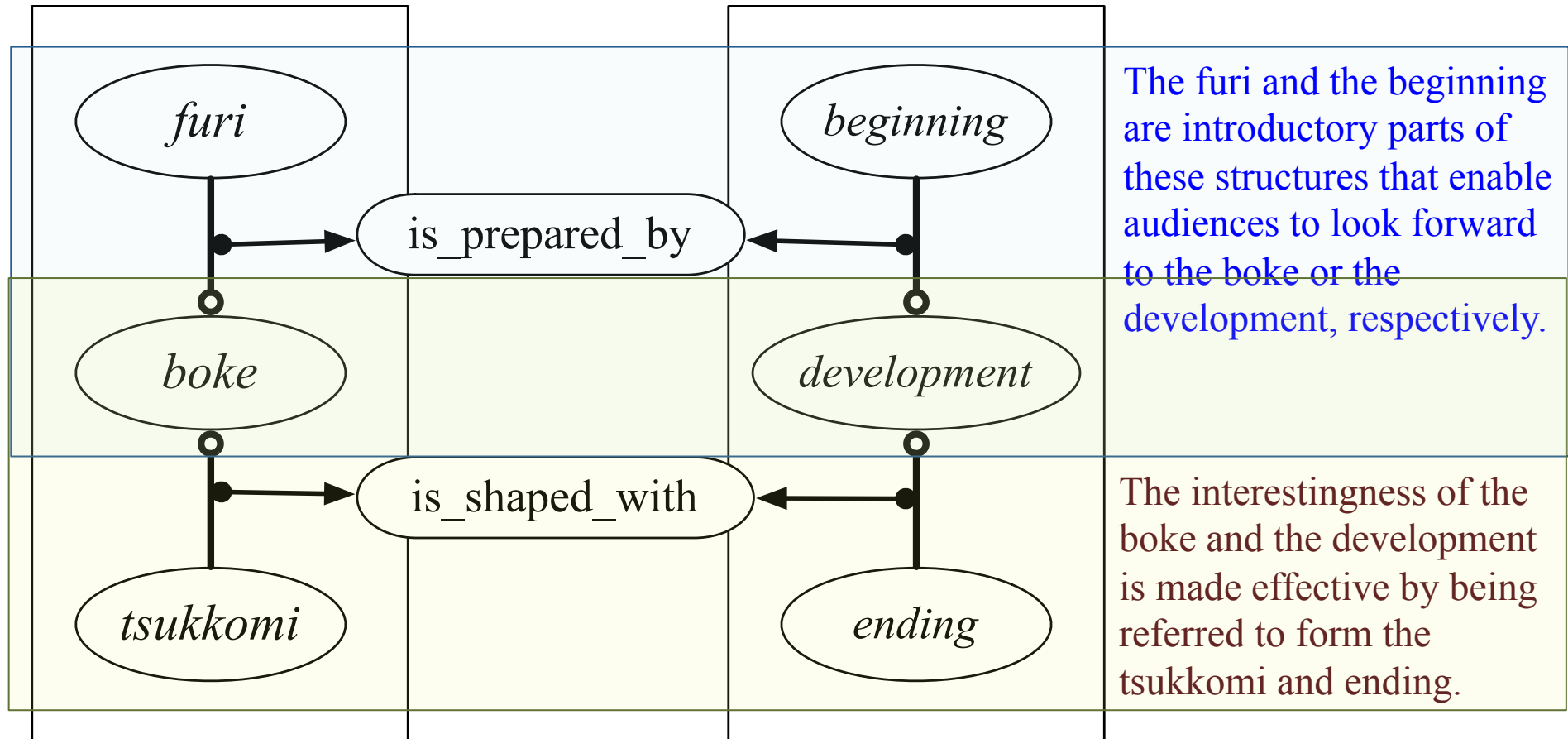
Through analyses of numerous movie scenarios that achieved commercial success, Kaneko (2008) found that there existed a common pattern of scenarios.

Plot phase	Content
beginning	Something occurs in ordinary life, and the main character decides to confront it.
development	The character enters into a difficult situation, makes some progress with the help of others, and changes viewpoints.
ending	There is a showdown, elimination, and satisfaction, and the character

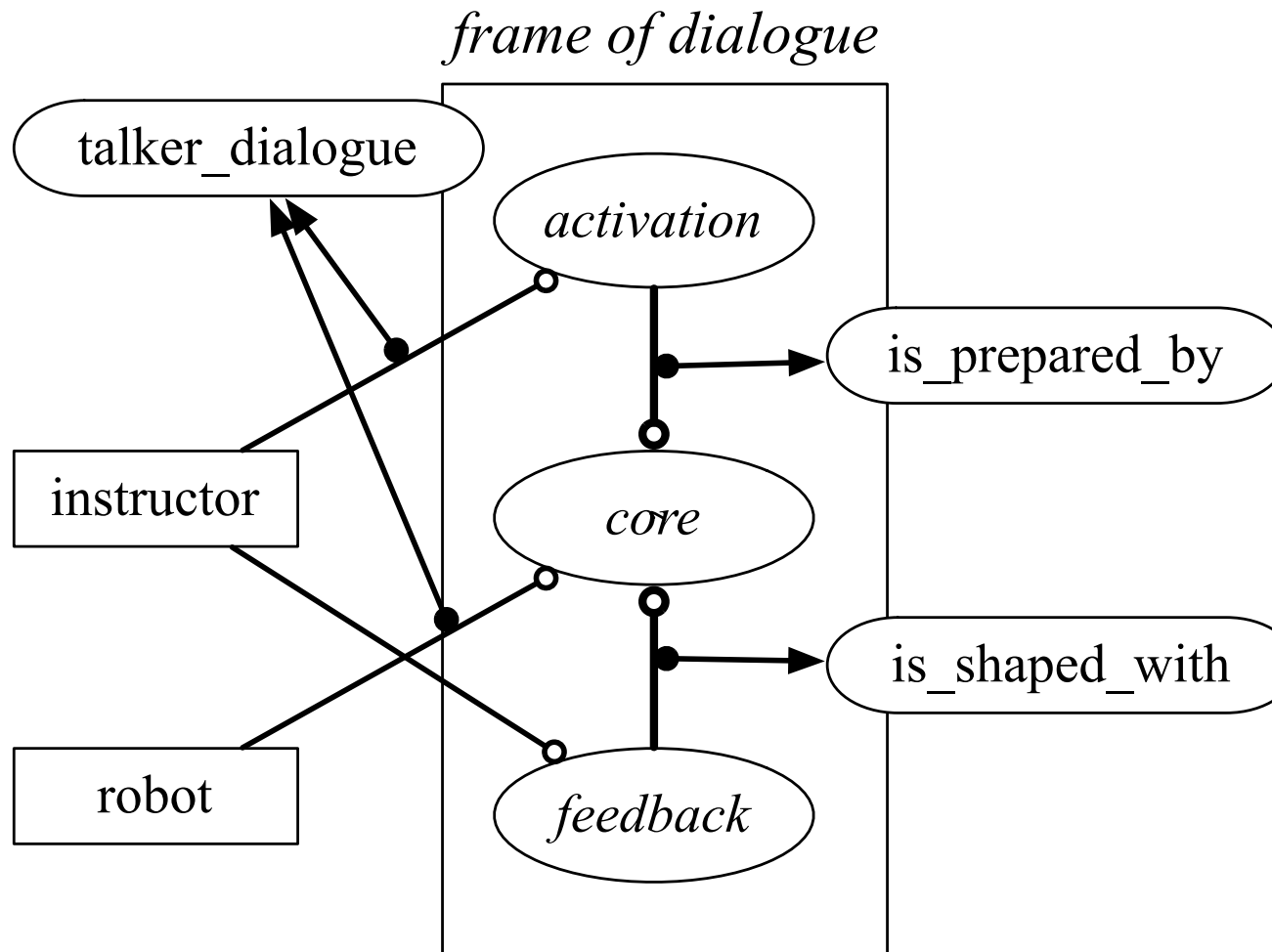
# Common features in the structures of *manzai* expression and movie plot

*Manzai* expressions

Movie plots



# Frame of three phases dialogue between an instructor and a humanoid robot



Based on the common nature found in *manzai* expressions and movie plots, we propose a frame of dialogue between the human instructor and the humanoid robot.

The roles of the instructor are to draw the learners' attention to the robot's speech at the beginning and to make the meaning or interestingness of the robot's speech clear at the end.

## Application of the frame of dialogue to a science experiment program, NHK “A crow thinks”

A corner of the program, “Practice of thinking”, provides an introduction to the experiment and a quiz on what happens, and demonstrates a real experiment with a replay to focus on the essential phenomena.

This short corner stimulates the viewer’s interest.

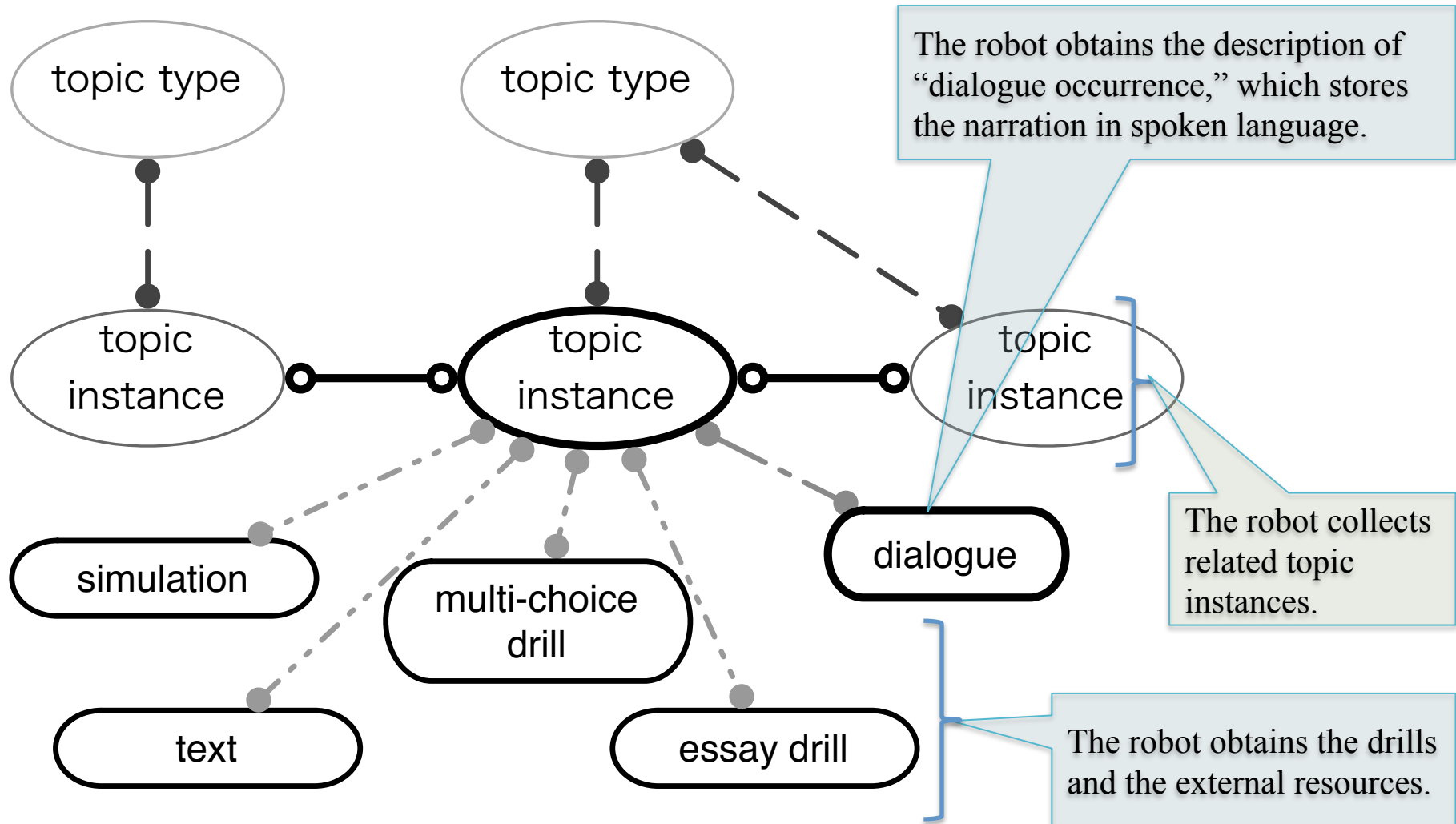
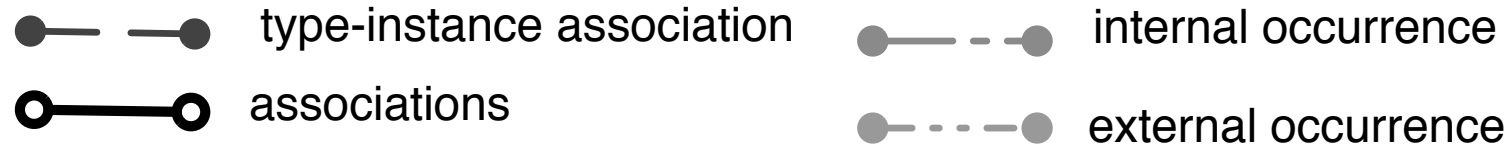
phase	content
Activation	A woman personality provides a pre-experiment or pre-observation to compare with the main experiment, and introduces the main experiment. The personality asks what will happen, giving three possible choices of the experimental result.
Core	The personality demonstrates the main experiment.
Feedback	A slow replay is shown to verify the result. Following the phrase, “But, why does this happen? The secret of this is...,” the personality begins to provide a brief explanation of the physical mechanisms. Soon the explanation is interrupted, and the program is closed with the phrase, “From here, it’s you who are a thinking crow.”

## Examples of “Practice of Thinking.”

Theme	phase	content
Two balloons interconnected by a pipe.	<i>Activation</i>	A pipe with a valve connects two identical balloons inflated to different sizes. A flow of air is inferred to occur upon opening the valve as a result of the balloons’ elasticity. A quiz on which direction the air flows in the pipe is presented.
	<i>Core</i>	The large balloon grows larger, while the small one becomes smaller.
	<i>Feedback</i>	The result is shown again with a closer look. A hint is partially spoken casting a glance on the larger balloon.
Helium balloon falling	<i>Activation</i>	An air balloon placed on a tray is shown to fall with the tray when they are released. A helium balloon is shown to rise in the air. The question is asked, what if the helium balloon held on the tray is released with the tray.
	<i>Core</i>	Helium balloon falls with the tray until the tray reaches the floor.
	<i>Feedback</i>	A slow motion replay is shown. A partial hint is given on the collision of air molecules with the balloon.
Two candles burning	<i>Activation</i>	One burning candle inside a glass covered with a lid is shown extinguishing. Long and short candles are burnt and put inside the glass. A quiz is asked which one is extinguished earlier.
	<i>Core</i>	The longer candle burns out first.
	<i>Feedback</i>	Attention is paid to CO <sub>2</sub> gas and temperature.



# Robot's access to the topic map

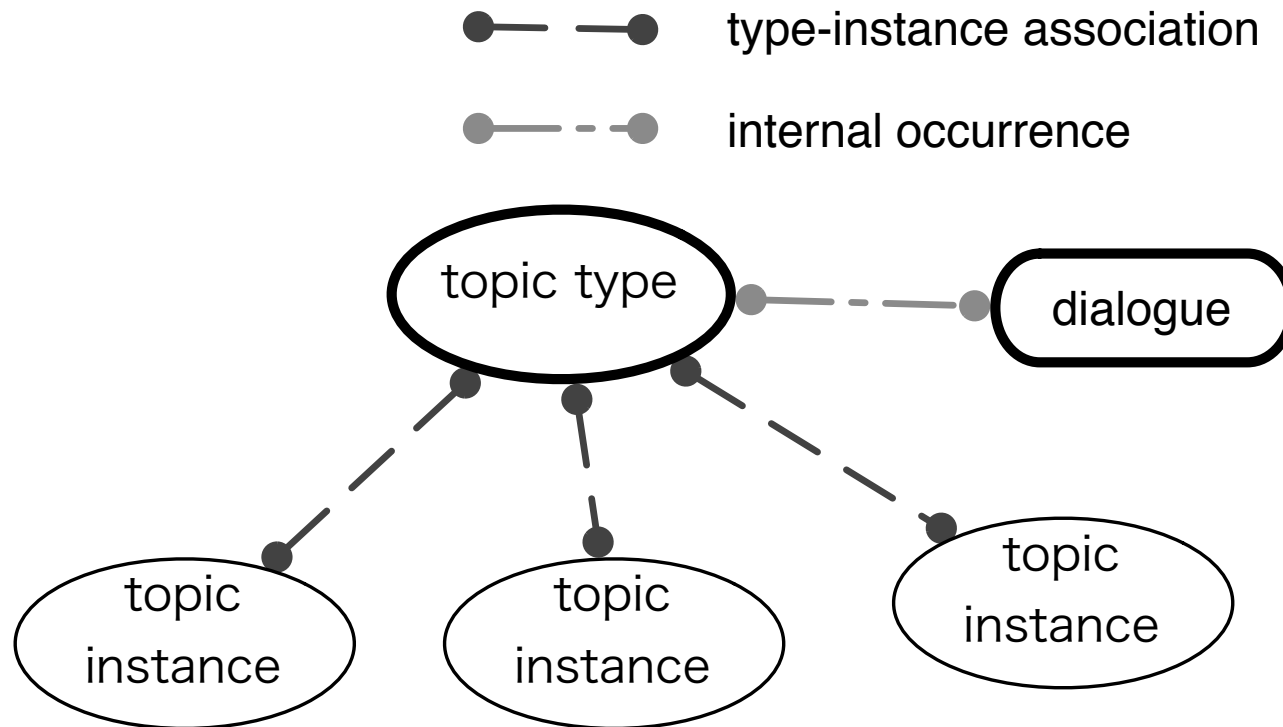


# Default setting of robot's dialogue

1	<p>First, the robot obtains all the subject topics and stores their topic names. The topic names are added to the list for speech recognition.</p>
2	<p>When the robot recognizes one of the topic names in the instructor's speech, it retrieves the dialogue occurrence of the topic type. The robot narrates the dialogue occurrence.</p> <ul style="list-style-type: none"><li>&gt; Some catholic philosopher recited the view of modern science as a pioneer. A typical person is Roger Bacon.</li><li>&gt;&gt; Roger Bacon is an English philosopher and Franciscan friar in the 13th century. He had lectures at Oxford University. Bacon proposed that theologians should focus primary on the Bible itself, learning the languages of its original sources. At the same time, he conducted experiments and observation in his lectures.</li><li>&gt; Researches on Bible and physics may look conflicting. However, he might be interested always in the object itself, rather than the miner distinctions in the debate on them.</li></ul>
3	<p>The robot asks the instructor if it should present the drill or the external resources.</p> <ul style="list-style-type: none"><li>&gt;&gt; Do you try a quiz of Roger Bacon?</li></ul>
4	<p>The robot asks the instructor if it should present one of the topic instances associated with the original content.</p> <ul style="list-style-type: none"><li>&gt;&gt; Roger Bacon is associated with Thomas Aquinas, Francis Bacon.</li></ul>
5	<p>If the robot recognizes one of the topic names listed in the default subject topic list it obtains occurrences and associated topics and narrates the dialogue</p>

# Robot's access in the case of a call of a topic type

When the robot recognizes the name of a topic type, it obtains the dialogue occurrence to narrate. Then, the robot obtains the topic instances associated with the original topic type for the candidates of the next step of the dialogue.



## Concluding Remarks

- We constructed a dialogue application of the humanoid robot NAO as an interface of an online learning system.
- We considered the shape of the dialogue between the instructor and the robot to stimulate learners' interest and to receive learners' request at any time.
- We found a common structure among *manzai* dialogues, movie plots, and a TV program of science experiments. They have three phases, activation, core, and feedback, of which the first and third phases are effectively used to raise curiosity regarding the content of the core phase.
- On the basis of this consideration, we proposed a three-phase dialogue frame for a conversation-like instructor–robot demonstration.