

# Design of Physically Grounded Communication System

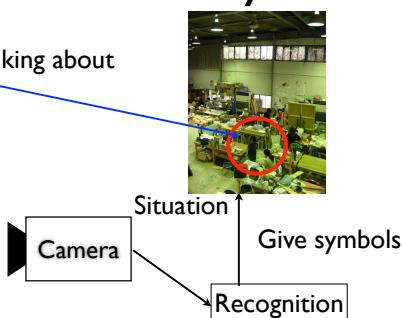
Michita Imai

## Situation Theory

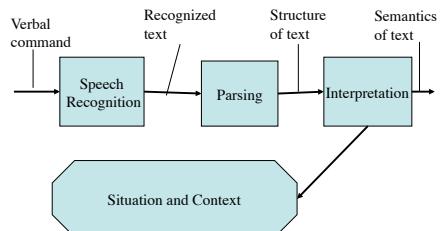
- We interpret communication contents based on a situation.

## Situation Theory

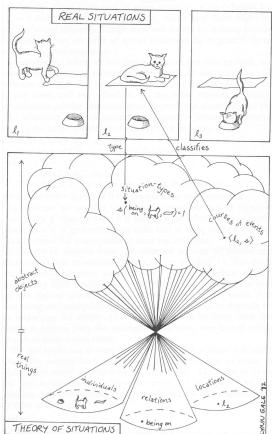
- They are talking about something.



## Situated Semantic Expression

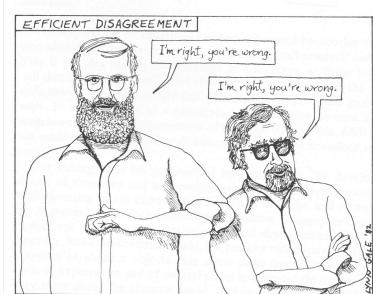


## Situation Theory



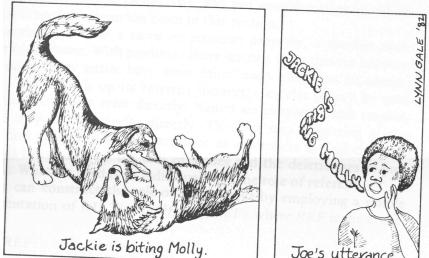
## Situation and Language

I'm right, you are wrong.



## Situation and Language

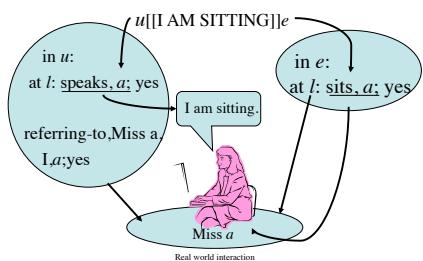
Jackie is biting Molly.



## Situated Semantic Expression

- $u[[I\ AM\ SITTING]]e$   
in  $u$ : at  $l$ : speaks,  $a$ ; yes  
in  $e$ : at  $l$ : sits,  $a$ ; yes  
•  $u$  denotes a discourse situation[談話状況];  
who is speaking, when and where, what words are being uttered, and to whom.
- $e$  denotes a recognized/described situation[記述状況];  
what events occur and where.

## Situated Semantic Expression



## Situated Semantic Expression

- The aim: Extract Semantic Structure from Natural Language
- Semantic Structure to deal with information given by a human in NL
- NL has a situated expression

## Semantic Expression

- A honest person tell the truth.
- 正直な人は真実を言う.
  - Expression
  - Tell, Honest-Person, Truth
  - Tell(Honest-Person, Truth)

## Semantic Expression

- Semantics in classical logic:
  - Gives True or False.
  - Tell(Honest-Person, Truth)  $\leftarrow$  True or False?

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## Semantic Expression

- Semantics in classical logic:
- Gives True or False.
- Tell(Honest-Person, Truth)  $\leftarrow$  True or False?
- Is-a(Glass, Fragile)  $\leftarrow$  True or False?  
    ↑  
• Semantics from God's ideal viewpoint.

## Semantic Expression

- Semantics from God's ideal viewpoint.
- There is frequently no ideal viewpoint.
- like(Girls, EXILE)

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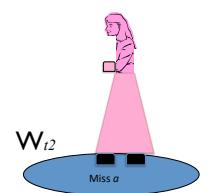


## Semantic Expression

- Modal Logic 様相論理
- Multi-World Model 多重世界論
  - Individual view gives the truth.
  - $W_i |= \text{like}(\text{Girls}, \text{EXILE})$
- $W_{imai} |= \text{like}(\text{Girls}, \text{EXILE}) \leftarrow \text{False}$
- $W_{anzai} |= \text{like}(\text{Girls}, \text{EXILE}) \leftarrow \text{True}$

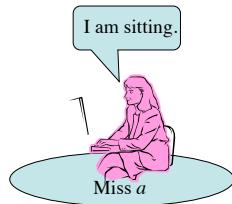
## Semantic Expression

- $W_{t1} |= \text{Sit}(\text{Miss}-a) \leftarrow \text{True}$
- $W_{t2} |= \text{Sit}(\text{Miss}-a) \leftarrow \text{False}$



## Semantic Expression

- Binding function:  $f(\text{word}) = \text{Real-Object}$
- $f(I) = \text{Miss-a}$
- $W_{i,f(I)=\text{Miss-a}} | = \text{Sit}(I) \leftarrow \text{True}$



## Semantic Expression

- $W_{i,f(I)=\text{Miss-a}} | = \text{Sit}(I) \leftarrow \text{True}$
- Do we want to tell someone the truth in a conversation?
- Does the system want to know the truth?
- No!!!



## Situation Semantic

- We want to give the other a piece of information.

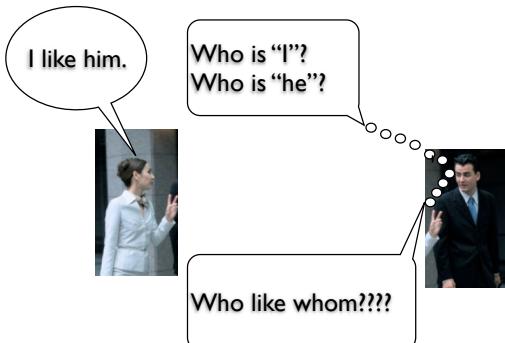


## Situation Semantic

- We want to give the other information.



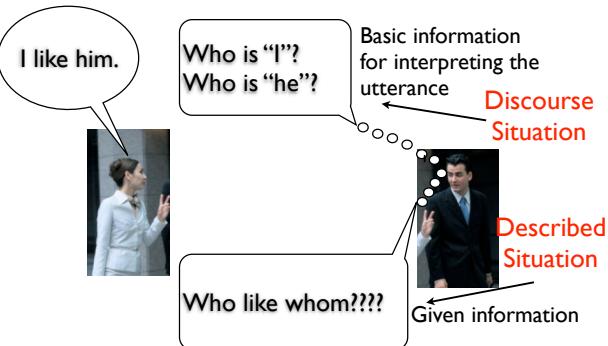
## Situation Semantic



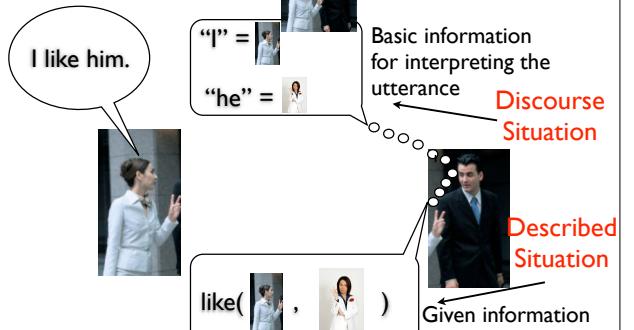
## Situation Semantic

- Discourse Situation
- Described Situation

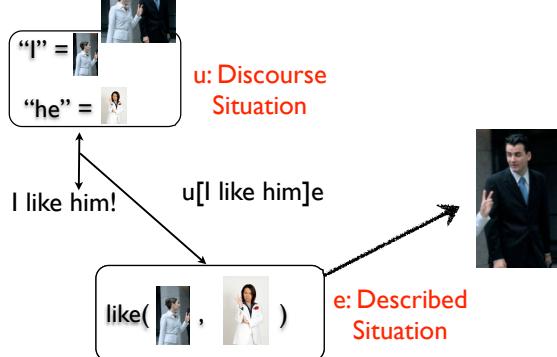
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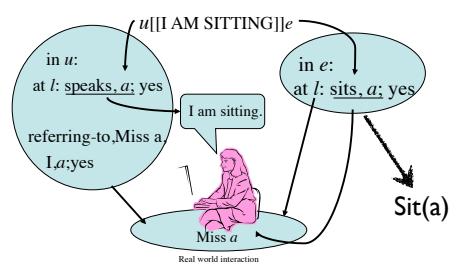
## Situation Semantic

- Information flow
  - like( , )
- Not determine the truth
  - Difference from Modal-logic
  - $W_{if(I)=Miss-a} |= Sit(I) \leftarrow True$

## Situation Semantic

- Determine the referent (指示対象) based on Discourse Situation

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## Situation Semantic

- Change the meaning depends on the difference of Discourse Situation

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Right(A) and Wrong (B)

at l1:  
speaking, A; yes  
addressing, A, B; yes  
referring-to, A, I, A;yes  
referring-to, A, YOU, B;yes

at l1:  
right,A;yes  
wrong,B;yes

u[[I am right. You are wrong.]]e

Change the meaning depends on the difference of Discourse Situation



Right(B) and Wrong (A)

at l1:  
speaking, B; yes  
addressing, B, A; yes  
referring-to, B, I, B;yes  
referring-to, B, YOU, A;yes

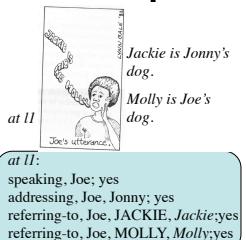
at l1:  
right,B;yes  
wrong,A;yes

u[[I am right. You are wrong.]]e

## Situation Semantic

- Distinguish real entities from the names of objects
- Word: Jackie
- Real dog: JACKIE

## Situated Semantic Expression



at l2

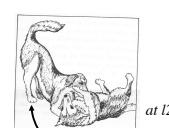
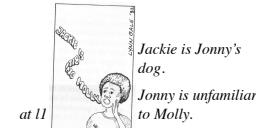
at l2:  
biting, JACKIE  
MOLLY , yes

u[[Jackie is biting Molly]]e

Real world interaction

biting(JACKIE, MOLLY)

## Situated Semantic Expression



at l2

at l2:  
speaking, Joe; yes  
addressing, Joe, Jonny; yes  
referring-to, Joe, JACKIE, Jackie;yes  
referring-to, Joe, MOLLY, b;yes

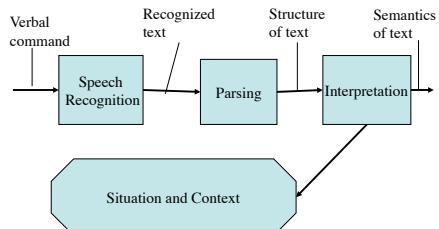
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Real world interaction

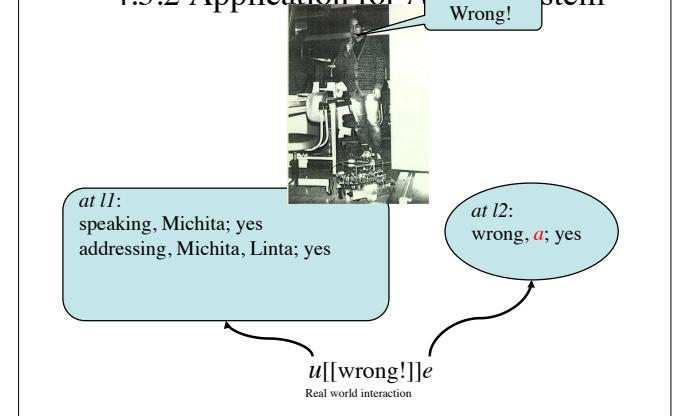
at l2:  
biting, JACKIE  
b , yes

biting(JACKIE, b)

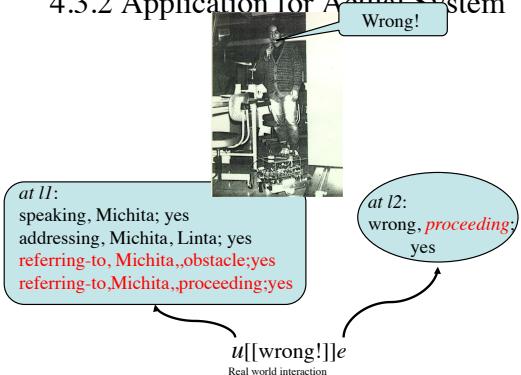
# Situated Semantic Expression



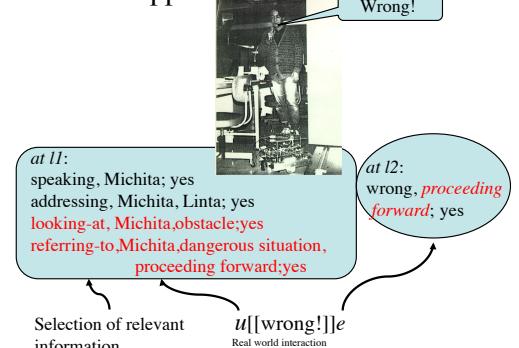
## 4.3.2 Application for Actual System



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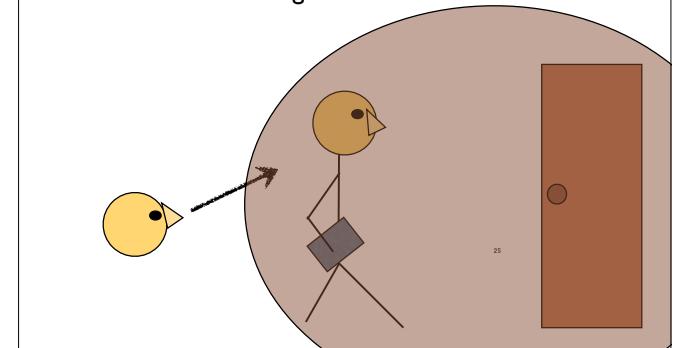
# Situation Theory

- Let's write semantic expression
  - "I saw him bring his book to his room."
  - Draw two figures to show two situations.
  - Write two semantic expression related to each situations.

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# Situation Theory

- "I saw him bring his book to his room."



## Situation Theory

- Notice that there are two or more discourse situation in a real conversation.
- Speaker's discourse situation and hearer's discourse situation
- There is a subtle difference in the interpretation (described situation) between a speaker and a hearer.

## Focus of Attention

- They are talking about what she is reading.



Discourse Situation

Described Situation