

Human Language Technology & Linguistics

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차 례

- ❖ Human Language Technology (HLT)
- ❖ Two Interesting Examples
 - Case Study 1: Question Answering System
 - Case Study 2: Spoken Dialogue System
- ❖ HLT Applications

Goals of the HLT

Goals

Computers would be a lot more useful if they could handle our email, do our library research, talk to us...

But they are fazed by **natural human language**.

How can we make computers have abilities to handle human language? (Or help them learn it as kids do?)

Human Language Technology

Levels of Languages

- **Phonetics/phonology/morphology** – what words (or subwords) are we dealing with?
- **Syntax** – what phrases are we dealing with? Which words modify one another?
- **Semantics** – what's the literal meaning?
- **Pragmatics** – what should you conclude from the fact that I said something? How should you react?

What's hard – all different levels of ambiguities

Ambiguities

John stopped at the **donut store** on his way home from work. He thought a coffee was good **every few hours**. But **It** turned out to be **too expensive** there.

- **Donut**: To get a donut (donut; spare tire) for his car?
- **Donut store**: store where sells donuts? or is run by donuts? or looks like a big donut? or made of donut?
- **Every few hours**: That's how often he thought it? Or that's for coffee?
- **It**: the particular coffee that was good every few hours? the donut store? the situation
- **Too expensive**: too expensive for what?

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Human Language Technology (HLT)

Two Interesting Examples

- Case Study 1: Question Answering System
- Case Study 2: Spoken Dialogue System

HLT Applications

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Case 1: Question Answering

Mary went **shopping** for a new coat. She **found** a red one she really liked. When she **got it home**, she discovered that it **went perfectly with** her favorite dress.

- Questions:
 - Q1: What did Mary go shopping for?
 - Q2: What did Mary find that she liked?
 - Q3: Did Mary buy anything?

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Case 1: Question Answering

Mary went **shopping** for a new coat. She **found** a red one she really liked. When she **got it home**, she discovered that it **went perfectly with** her favorite dress.

1. Using **Templates** and **Patterns**

- “Mary went shopping for a new coat.”
- **Q1**: Can be answered – “a new coat”
- **Q2**: Unless the template set is very large, this question is not answerable .
- **Q3**: No answer will be found.
- **Comments**:
 - The ability to answer the most direct questions is dependent on the exact form.

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Case 1: Question Answering

2. Using **Linguistic Knowledge**

“She found a red one she really liked.”

- Convert the input text into a structured form representing the meaning of sentences.
- Convert Questions into that form, and find answers by matching structured forms.
- Q1: Can be answered – “a new coat.”
- Q2: Can be answered – “a red coat.”
- Q3: Can not be answered.

Comments:

- Less brittle than the first program with respect to exact forms.
- Some additional information is necessary to find an answer to question 3.

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Case 1: Question Answering

3. Using **Linguistic Knowledge** and **World Knowledge**

- Convert input text into a **structured form representing the meaning of sentences**, and combine that form with other structured forms describing prior **world knowledge** about the objects and situations.

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Case 1: Question Answering

Shopping Script:
 roles:C(customer),
 S(salesperson)
 props:M(merchandise),
 D(dollars)
 location:L(a store)

```

    graph TD
      1[C enters L] --> 2[C begins looking around]
      2 --> 3[C looks for a specific M]
      2 --> 4[C looks for any interesting M]
      3 --> 5[C asks S for help]
      4 --> 5
      5 --> 6[ ]
      6 --> 7[C finds M']
      6 --> 8[C fails to find M]
      7 --> 9[C leaves L]
      7 --> 10[C buys M']
      8 --> 11[C leaves L]
      8 --> 12[goto step 2]
      10 --> 13[C leaves L]
      13 --> 14[C gets M']
    
```

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Case 1: Question Answering

Mary went **shopping** for a new coat. She **found** a red one she really liked. When she **got it home**, she discovered that it **went perfectly with** her favorite dress.

- “When she got it home , she discovered that it went perfectly with her favorite dress.”
- Q1: Can be answered – “a new coat.”
- Q2: Can be answered – “a red coat.”
- Q3: “Yes, She bought a red coat.”

Comments:

- more powerful than the first two programs because it exploits more knowledge .
- it is exploiting AI techniques.
- a general reasoning mechanism is missing from this program.

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Case 2: Spoken Dialogue System

Overview

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Case 2: Spoken Dialogue System

Dialogue

- **대화란?**
 - ✓ 하나 이상의 행위자가 서로의 정보 및 의도를 언어로써 전달하는 행위
- **대화처리**
 - ✓ **대화이해**: 상대방의 발화로부터 그 의도(intention)을 파악하는 과정
 - ✓ **대화생성**: 상대방에게 전달하고 싶은 의미 및 의도를 언어로 생성하는 과정

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Case 2: Spoken Dialogue System

고려 사항

- 언어는 해당 언어권의 특정한 규칙과 관습에 의해 이루어지는 행위
- 언어는 세상의 지식을 가정하고 벌어지는 행위
- **Collaborative Dialogue**
 - ✓ 대화는 상대방이 화자의 의도를 알아 낼 수 있도록 언어를 사용하여 발화하는 행위이다.
 - ✓ 대화의 순서, 내용 등에 내포되어 있는 규칙이 존재

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Case 2: Spoken Dialogue System

Anaphora Resolution

- Anaphora (대 용어)
 - Pronouns or Definite nouns
- Centers
 - Forward-looking center(Cf)
 - 잠재적으로 다음에 센터가 될 수 있는 것들
 - Topic word > 주어 > 직접목적어 > 간접목적어 > 기타
 - Preferred center(Cp)
 - Cf 중에서 가장 우선 순위가 높은 센터. 가장 선호하는 센터
 - Backward-looking center(Cb)
 - 현재 문장의 Cf중에 하나. 이전 문장의 Cf에 의해서 결정됨
 - Cp(U_{i-1})이 Cb(U_i)가 될 가장 높은 확률을 가짐.

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Case 2: Spoken Dialogue System

Centering Formalism

	$Cb(U_i) = Cb(U_{i-1})$	$Cb(U_i) \neq Cb(U_{i-1})$
$Cb(U_i) = Cp(U_i)$	CONTINUE	SMOOTH SHIFT
$Cb(U_i) \neq Cp(U_i)$	RETAIN	ROUGH SHIFT

- Example
 - Jack saw Sam at the party. (Jack, [Jack, Sam, Party])
 - He clearly had drunk too much.
 - (Jack, [He: Jack]) (1) continue
 - (Sam, [He: Sam]) (3) S-shift

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Case 2: Spoken Dialogue System

Speech Acts/ Dialogue Acts

- Speech Act Theory by John Austin (영국언어학자, 1960년대)
 - “언어란 무엇인가?” -> “언어는 무엇을 하는가?”
 - Locutionary act: 문장을 말하는 행위
 - Illocutionary act: 문장을 말하는 과정에서 수행하는 행동
 - Ask, Request, Inform, Deny, Confirm, Promise etc.
 - Perlocutionary act: 말한 문장이 수행한 행동에서 오는 효과
- Example
 - “펜 좀 빌릴 수 있을까요?”
 - L: 펜을 빌릴 수 있는 가능성을 묻는 질문을 하는 행동
 - I: 펜을 빌려달라는 요청을 하는 질문
 - P: 듣는 사람이 질문자에게 펜을 빌려주는 효과

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Case 2: Spoken Dialogue System

Recognition of Speech acts

- Utterance Understanding
 - 어떻게 하면 화자가 의도한 illocutionary act를 문장으로 찾을 수 있을가를 해결해야 함
 - 예) Open the window. Vs. Can you open the window
- 필요정보
 - 문장의 surface linguistic features: 문형, cue phrase, 동사의 종류, 시제, 화자 정보...
 - 이전 문장의 speech act: Discourse structure를 반영한 hierarchically recent utterance의 파악이 중요함
 - 영역계획, duration, pause 등

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Human Language Technology (HLT)

Two Interesting Examples

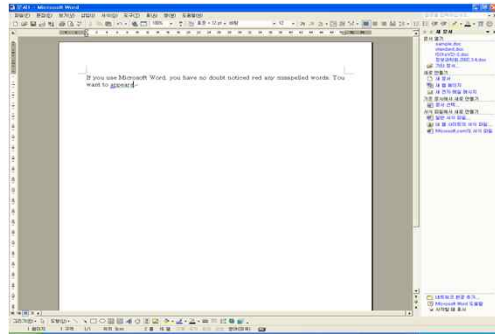
- Case Study 1: Question Answering System
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HLT Applications

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HLT Applications (1)

Spelling/Grammar Checking



HLT Applications (2)

News Categorization



HLT Applications (3)

Information Extraction



HLT Applications (4)

Question Answering



HLT Applications (5)

Ubiquitous Computing

Embodied Virtuality (ubiquitous computing)

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HLT Applications (6)

Smart Home

- ❑ 아준미: 요즘 이영애 나오는 인기있는 드라마가 뭐지?
- ❑ DTV: MBC 에서 방영중인 대장금입니다.
- ❑ 아준미: 대장군 재방송 어디서 해?
- ❑ DTV: 지금은 방송중이 아니고, 채널 36 에서 오후 2 시에 방영예정입니다.
- ❑ 아준미: 그럼, 그거 녹화해 줘.
- ❑ DTV: 네, 알겠습니다.

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HLT Applications (7)

Intelligent Robot

반향음, 원거리 음성명령, 로봇잡음, 주변잡음

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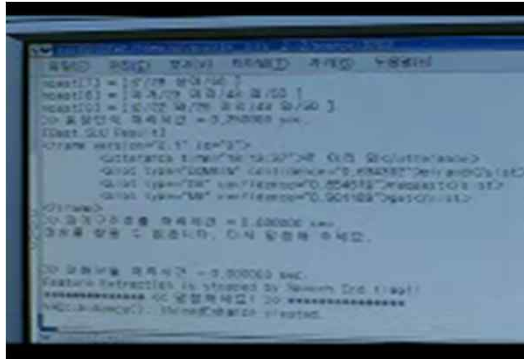
HLT Applications (8)

Telematics

차량단말기 내장 음성 인식 / 합성 / 인증 및 음성 미들웨어, 텔레매틱스 단말기, PDA 차량 Controller, GPS, 자동차 적용 음성 전처리, 무선 통신망, 음성 HMI 기반 텔레매틱스 단말기, 대화체 음성인식, 음성 HMI 기반 LBS 응용, Voice Portal for Email, VAD and Internet Contents, 음성 미들웨어, 차량정보센터, 이동정보검색, 음성정보서비스 구조 및 응용 시나리오

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Demo of Dialogues System (1)



Demo of Dialogues System (2)

