Language Technology

Introduction

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Overview

Speech and Language Technology

- “Language” half of “Taal- en Spraaktechnologie” (Language and Speech Technology").
- Focus on APPLICATIONS of computational linguistics
  - practical and commercial applications, where one attempts to do something practically useful
  - but also scientific applications, where one applies technology in order to satisfy scientific curiosity
  - ... and naturally, points of overlap!

Computational Linguistics

aka "Natural Language Processing"– study of language from a computational perspective

- recognizing language vs. non-language, which language
- indexing, organizing and storing language data
- analyzing language with respect to structure
  - *left* is past tense of *leave*
  - *The Eindhoven CEO* is subject of the sentence *The Eindhoven CEO refused comment on the rumor that SONY had contacted him.*
  - *The old men and women* might be analyzed as AMBIGUOUS, i.e. potentially having two different structures
- classifying texts wrt subject matter, authorship, ...
- generating appropriate language given information
- summarizing texts
- translating Dutch texts into English

...

Focus on Application

- CL beyond the “talking dog” stage, i.e. beyond the stage where “it’s neat that you can get computers to do that”
- Little focus on the underlying technology, e.g. how does a part-of-speech tagger work
- More focus on what to you ask when you apply CL
  - EVALUATION, ASSESSMENT, VALIDATION
- Sketch of variety of areas
- Attention to application of practical and of scientific interest.

Requirements

- Six 2-hr. lectures, Mon. 13:15-15
- Website http://www.let.rug.nl/nerbonne/teach/ling-tech/ & Nestor (under course name)
  - Weekly readings, some exam questions
- One 2-hr. examination preparation session, Thurs. Oct. 8
- One 3-hr. exam, Mon., Oct. 26, 9:00 am, Examenhal
- One 3-hr. resit exam, Thurs. Jan. 14, Examenhal

Possible NL Applications

Mode: speech, print, handwriting

Task: recognize, generate, understand, converse, translate, index, correct, search (retrieve), language learning

Medium/Locale: (mobile) telephone, PC, automobile, toys, factory floor, PDA

Application $\in$ **Mode** $\times$ **Task** $\times$ **Medium**

Falling price of hardware, growing demand (Information Highway),...

Natural Language Interfaces in 1980's

- Natural Language Interfaces (NLIs) to DBs favorite 1980's application target
- Little or no commercial, practical use

Why were NLIs popular?

- Excellent research vehicle
- PC interfaces still clunky, mostly command-line based
  - GUIs hadn't become established

Turing Test

"Turing Test"

- test intelligence via NL fluency
- disputed value as intelligence test
  - evidence (Moore, 1987)? OR
  - sufficient proof (Turing, 1950)?
  - insufficient?—Searle (1984) and others
  - too hard—French (1990), Shieber (1993/4)

What does the Turing test test?

CORE (for NLI)

- linguistic knowledge
- immediate discourse context
- domain knowledge

others

- intentional models or task models
- common sense models
- user modeling
- flexibility (learning, robustness)
- knowledge of likely errors

All plusses for research vehicle!

Loebner Prize Competition

A “Turing Competition”

- Computer Museum, Boston
- Naive judges distinguish programs, people
- No professional entries
- **Some judges fooled!**
- ELIZA tactics most successful

Probably no value

—Shieber, *Comm. of ACM*, 1993/94

NLI's: From Lab to Market

NLI as Product Prototype, Motivation

- expressive
- concise
- no training in programming
- no familiarity needed with particular data structures and program organization

1970's development—Intellect, Ladder, etc.

Intelligence is marketable!

Later NLI's

Motivation for NLIs

- expressive
  Problem: linguistic knowledge
- concise
  Problem: contextual resolution
- no training in programming
  Problem: incompleteness
  Androutsopoulos: "most frequent complaint"
- no familiarity needed with particular data structures and program organization
  Problem: no automation, standardization of domain mapping

Moral: good research vehicles may be poor products

Graphical User Interfaces

NLIs were overtaken by GUIs

- less expressive
- equally concise
- “habitable” (Schneiderman)
- automated domain mapping (without information hiding, reformulation)

NLI/GUI—Perrault & Grosz, 1988

"NLIs superior to GUIs in some applications", where

- nonintuitive encoding
- complex information
- complex problem-solving

But:

- nonintuitive encodings need translations for any interface
- complexity raises the stakes—in postponed comparison

A few commercially successful NLIs (late '80's

- very expensive
- limited deployment
  personnel, sales dbs
- ATIS (US) / OVIS (NL)

Cost/benefit vis-à-vis GUIs very unfavorable

Large problem: eroding motivation given success of GUI's

NLI's: What went wrong?

- Too little attention to EVALUATION
  - How well does software accomplish the task it was designed for (technology specific)?
    - How many words are known/unknown to the system? How many word senses?
    - How many sentences are parsed correctly? (needs further refinement)
  - Note that these questions can be answered per module irregardless of application
- Too little attention to ASSESSMENT
  - How well is software suited to solving a particular problem (application specific)?
    - How many users obtain the information they seek?
    - If a user does not obtain the information sought, has he otherwise benefited from using the system?

Later developments

Seeking ecological niches away from GUIs

- with speech in tasks w. hands/eyes busy
  - address book in auto navigation system
- remote from graphics terminals
  telephony
- handicapped support

Access to textual information

- See KLM's question-answering system (developed by Q-Go)

Newer NLP applications

- Lots of NLP in Google, other IR
- MT: Systran, Google Translate
  - Software localization
- Grammar checkers, spell-checkers (now context sensitive)
- Controlled English (Boeing et al.) monitoring comprehensibility of technical documentation
- Text-to-Speech for dyslectics *inter alia* Fluency, Kurzweil, Nuance, ...
- Text clipping services
- CALL
- OCR correction (Xerox)

Applying NLP—Summarizing

- Even if the technology is good, applying it is tricky
- Evaluation, assessment essential
- Lots of current attempts

Applications in Pure Science?

Non-CL examples

- Astronomy relied on optics (the telescope) from the Renaissance on, biology later (on the microscope)
- Archaeology, paleontology rely on carbon dating
- Linguistics relies on audio recording, signal processing (electrical engineering)
- Anthropology uses techniques from population genetics to model diffusion of culture

CL Applications in other Sciences

- Psycholinguistics wants estimates of frequency, not just for words, but also for constructions. This requires automatic processing.
- Psychology and psycholinguistics builds models of processing and learning of such complexity that computational simulation plays a role in checking plausibility, consistency.
- Given how complex language is, computational processing sensible in order to allow more general probes and measures
  - pronunciation differences in dialects, foreign accents
  - syntactic differences in languages, varieties
  - probing languages and varieties for indication of historical relatedness
  - examples in course!

Measuring scientific success

- VALIDATING a proposed measure involves showing that it indeed measures what it purports to
  - showing that a measure of syntactic complexity indeed predicts processing difficulties