Natural Language Generation

A survey

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September 24, 2010

Outline

Traditional Natural Language Generation systems

- Natural Language Generation (NLG) involves automatically producing human (natural) language from a computational representation of information.
- Information can be linguistic, knowledge about the world, knowledge about the speaker/audience, ...
- Traditionally, NLG systems were concerned with:
  - *What should I say?*
  - *How should I say it?*
- Many interrelated planning processes:
  - Decide on information to be said.
  - Construct discourse plan.
  - "Chunk" information into units of discourse.
  - Select appropriate phrases and words.
  - Produce grammatically correct output.

Present-day systems

- Macroplanning (what to say).
- Microplanning (how to say it).
- A third stage: Realization (Reiter 1994).

Macroplanning (what to say)

- Macroplanning involves content choice and organization.
- Input is one or more communicative goals:
  - *Explain* some state;
  - *Describe* some object;
  - *Relate* some events; and so on.
- States, objects, events, etc. are defined in the NLG system's knowledge base.
- Output is a (tree) structure:
  - Leaves are sentence-sized groupings of representation items.
  - Internal nodes are inter-sentence relations (e.g., *Cause*, *Sequence*, *Elaboration*, ...
  - This tree represents the discourse structure of the text.

Macroplanners (how they work)

- To construct the discourse structure, a macroplanner requires a set of *templates* to organize the knowledge representation items.
  - Schemas. Topic structure of stereotypical paragraphs.
  - Relations/plans. More flexible relations among discourse units.
- Macroplanning has used various theories of text linguistics (e.g., Rhetorical Structure Theory).
- Also various AI planning methods for constructing the discourse tree.

Microplanning (how to say it)

- Microplanning (*sentence planning*) involves sentence-sized groupings of info in leaves of the discourse tree.
- Various issues:
  - *Sentence scoping*: Whether and how to combine two leaves.
    I was hungry today. I went to Burger King.
    I was hungry today so I went to Burger King.
  - *Pronominalization.*
  - *Aggregating*: Removing repetitions.
    Smoking is bad for you. Smoking shortens your life. Smoking makes you smell bad.
    Smoking is bad for you, shortens your life, and makes you smell bad.
  - *Thematization.*
  - *Topic ordering.*
- Special-purpose microplanners exist, but so far no general-purpose microplanner.

Realization (how to say it)

- Realization involves generation of surface level of text.
- Input is underlying deep-syntactic representation.
- Realizer needs lexicons, grammars, lexical ontologies.
- Output is grammatical, fluent (?) sentence.

Types of realizers

- Canned text.
- Template-filling.
- Linguistics-based.
- Statistics-based.

Linguistic generators

- FUF/SURGE (Elhadad, 1992):
  - Input, lexicon, grammar in same notation.
  - Uses unification to merge all relevant info, produce sentence specification.
- Penman/KPML (ISI/USC, late 1980s, Matthiessen and Bateman, 1991):
  - Large interrlated grammar blends lexis, syntax, semantics.
  - Uses explicit linguistic theory: Systemic Functional Linguistics.
  - Involves pragmatic functions of language: speaker attitude, relationship to intended audience.

Statistical generator

- Nitrogen (Langkilde and Knight, 1998):
  - Statistically-based generation.
  - Uses "overgenerate-and-prune" strategy.
  - Weak phrase structure grammar generates literally millions of possible sentences corresponding to input specification.
  - Statistical ranker chooses most fluent sequence at each choice point. Uses three-word window.
  - Determines fluency by consulting table of hundreds of millions of trigrams from Wall Street Journal.

The Virtual Human Project

- http://www.youtube.com/uscict

What is missing?

- Fluent expressive text.
- Affect (emotion).
- Subtleties and nuances of language and gesture.
- Personalization.