Poetry Generation
Introduction to Computational Creativity

Jukka Toivanen
Poetry

- Essentially a very sophisticated way to convey thoughts and feelings with tight interaction between content and form
- Usually short (compared to stories, novels)
- More freedom regarding grammar
- But also more requirements for the form (and content)
- Many different criteria for the aesthetic value
- One of the most studied forms of creative NLG
Research Goals?

- Test bed for NLP, data mining and machine learning methods
- Ultimate AI challenge
- Artistic results on their own
- Some day also better understanding of creativity and human thought processes (cognitive modeling)
Different Ways to Handle Syntax

- Fixed templates
- Generative grammars
- Statistical language modeling from existing texts
- Assembly from text fragments
- ...

09/13/15
Different Ways to Handle Semantics

- None (just statistical language modeling)
- Association-based analysis and lexical selection
- Assembly from fragments with known semantics
- Formal logical semantics
Existing Systems

Several systems have been developed:

- ASPERA (Gervás 2001): Case-based reasoning approach
- The work of Manurung et al. (2000): Rich linguistic knowledge based on strong formalisms for syntax, semantics, and phonetics
- Full-FACE poetry generation by Colton et al. (2012)
- Many others
Evolutionary Poetry

- Evolutionary algorithms in poetry generation
- McGonagall system by Manurung et al.
  - Grammaticality
  - Meaningfulness
  - Poeticness
- Poetry generation as a state space search problem
- Genetic algorithms to solve this problem
Example

the cat is the cat which is dead;

the bread which is gone is the bread; the cat which consumed

the bread is the cat

which gobbled the bread which is gone
Our Research on Poetry Generation

- Especially, what kind of automatic and maximally unsupervised methods could be used to generate poetry
  - Statistics of word co-occurrences
  - Morphological analysis and synthesis
  - Constraint satisfaction methods
  - Document-specific content
Document-Specific Poetry

- Generating poetry that reflects loosely a specific news story or other document
- Evoking fresh mental images and viewpoints that are related to the document but not exactly contained in it
  - Using document-specific words in poetry generation
  - Extension of the basic word substitution based poetry generation method by Toivanen et al. (2012)
Our Aims in Poetry Generation

- Maximally unsupervised
  - Minimum amount of hand-crafted linguistic, world, and poetry domain knowledge
    - No explicit grammars
    - No manually generated templates
    - No knowledge bases
  - Use of statistical corpus-based methods
- Fresh mental images evoked by novel associations
Benefits and Restrictions of this Approach

- **Pros:**
  - Flexibility
  - Language independence
  - Direct learning from corpora, minimal amount of hand-crafted rules

- **Cons:**
  - The quality of the results varies
  - There are still many aspects in the generation procedures that are difficult to control
Word Association Analysis

- Finding content words for replacement poetry
- General association calculation method proposed by Gross et al. (2012)
- Recent extension to document specific associations (Gross, Doucet, and Toivonen 2014)
  - Which word pairs are novel in a specific document?
  - A background corpus as a reference of novelty
  - Contrasting a specific document (called foreground) to a set of documents in the background corpus
  - log-likelihood ratio (LLR) used to measure document-specific word associations
Justin Bieber on Miami drink-drive charge after 'road racing'

Pop star Justin Bieber has appeared before a Miami court accused of driving under the influence of alcohol, marijuana and prescription drugs. Police said the Canadian was arrested early on Thursday after racing his sports car on a Miami Beach street. They said he did not co-operate when pulled over and also charged him with resisting arrest without violence and having an expired driving licence. (…)

BBC News, 23 January 2014
Document-Specific Word Associations

• Descriptive associations could be:
  • “bieber” and ”alcohol”
  • ”bieber” and ”prescription”
  • ”justin” and ”alcohol”
  • …

• Not so descriptive associations include:
  • “justin” and “bieber”
  • “sports” and “car”
  • “driving” and “licence”
How to Find Document-Specific Word Associations

Counts in the News Story

<table>
<thead>
<tr>
<th></th>
<th>Bieber</th>
<th>¬ Bieber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>¬ Alcohol</td>
<td>4</td>
<td>22</td>
</tr>
</tbody>
</table>

Counts in the Background Corpus

<table>
<thead>
<tr>
<th></th>
<th>Bieber</th>
<th>¬ Bieber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>0.</td>
<td>19419.</td>
</tr>
<tr>
<td>¬ Alcohol</td>
<td>244.</td>
<td>33967685.</td>
</tr>
</tbody>
</table>
How to Find Document-Specific Word Associations

### Counts in the News Story

<table>
<thead>
<tr>
<th></th>
<th>Justin</th>
<th>¬ Justin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bieber</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>¬ Bieber</td>
<td>0</td>
<td>22</td>
</tr>
</tbody>
</table>

### Counts in the Background Corpus

<table>
<thead>
<tr>
<th></th>
<th>Justin</th>
<th>¬ Justin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bieber</td>
<td>5.</td>
<td>239.</td>
</tr>
<tr>
<td>¬ Bieber</td>
<td>3747.</td>
<td>33983357.</td>
</tr>
</tbody>
</table>
How to Find Document-Specific Word Associations

<table>
<thead>
<tr>
<th>Foreground Counts</th>
<th>Background Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>( w_1 )</td>
<td>( w_1 )</td>
</tr>
<tr>
<td>( \neg w_1 )</td>
<td>( \neg w_1 )</td>
</tr>
<tr>
<td>( w_2 )</td>
<td>( k'_{11} )</td>
</tr>
<tr>
<td>( k_{11} )</td>
<td>( k_{12} )</td>
</tr>
<tr>
<td>( k_{11} )</td>
<td>( k_{12} )</td>
</tr>
<tr>
<td>( \neg w_2 )</td>
<td>( k'_{21} )</td>
</tr>
<tr>
<td>( k_{21} )</td>
<td>( k_{22} )</td>
</tr>
<tr>
<td>( k'_{21} )</td>
<td>( k'_{22} )</td>
</tr>
</tbody>
</table>

\[
D_{LLR} = 2 \sum_{i=1}^{2} \sum_{j=1}^{2} k_{ij} \left( \log(p_{ij}) - \log(q_{ij}) \right).
\]
Document-Specific Word Associations

- Find word pairs whose co-occurrence distribution in the document deviates most from the background corpus
- These words are descriptive for the novel content of the document in question
- Use these words as replacements in the poetry generation phase
### Example Associations

<table>
<thead>
<tr>
<th>Most novel pairs</th>
<th>Least novel pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>say, bieber</td>
<td>los, angeles</td>
</tr>
<tr>
<td>say, police</td>
<td>later, jail</td>
</tr>
<tr>
<td>miami, bieber</td>
<td>sport, car</td>
</tr>
<tr>
<td>miami, say</td>
<td>car, early</td>
</tr>
<tr>
<td>bieber, police</td>
<td>thursday, early</td>
</tr>
<tr>
<td>beach, bieber</td>
<td>marijuana, alcohol</td>
</tr>
<tr>
<td>beach, police</td>
<td>prescription, alcohol</td>
</tr>
<tr>
<td>car, say</td>
<td>sport, thursday</td>
</tr>
<tr>
<td>bieber, alcohol</td>
<td>car, street</td>
</tr>
<tr>
<td>bieber, los</td>
<td>prescription, marijuana</td>
</tr>
</tbody>
</table>
Overview of the Generation

- Word substitution method as described by Toivanen et al. (2012)
  - A piece of text from a corpus (e.g. poetry)
  - Replacing most of the words with words relevant to a specific news story
  - Morphological analysis and synthesis
    - Stanford POS-tagger (Toutanova et al., 2003)
    - morpha & morphg tools (Minnen, Carroll, and Pearce, 2001)
    - For other languages (Finnish, German, French) other tools needed
Overview of the Generation Process

Is it the dirt, the squalor, the wear of human bodies, and the dead faces of our neighbours? These are but symbols.

*Project Gutenberg, Imagist Poetry*

Is it the *entourage*, the *sport*, the *singer* of *later lamborghini*, and the *early thursdays* of our *singers*? These are but *justins*.

*P.O. Eticus-Apparatus*
The corpus from which templates were taken contained mostly Imagist poetry from the Project Gutenberg

Background corpus was the English Wikipedia

Several different news stories, e.g.
  - Justin Bieber drinking and driving
  - Huawei profits surging
  - Ukrainian prime minister resigning
  - US states reconsidering execution methods

The following poems were selected randomly and presented as they are
Huawei Profits Surge...

Oaks

and impact technologies,

rise buying with transfer, rise:

their comfortable technology.
Ukrainian Prime Minister Resigning...

And always concrete! Oh, if I could ride

With my week resigned concrete against the repeal

Do you resign I’d have a parliament like you at my television

With your azarov and your week that you resign me? O ukrainian week,

How I resign you for your parliamentary legislation!
US States Reconsidering Execution Methods

I die;

perhaps I have begun; this is a doubt;

this is a prisoner;

and there is state....
Some Examples of Societal Impact
Book with Heikki Paakkanen

家でやろう
[tee se kotona. kiitos]
Brain Poetry at the Frankfurt Book Fair
Closer Look at the Intentionality

- What to express in a poem?
  - Converting logical formulas into poetry
  - Converting knowledge base information into poetry
  - Conveying semantic relationships in different ways
- Does poetry always aim to express specific information?
  - Which one is more important, content or form?
  - Different literary theories have different views of this (e.g. Russian Formalism vs. Structuralism)
References


