Creative and Artistic Text Generation

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URL: https://lijuntaopku.github.io/AAAI2020-tutorial/
What Contents Are Included in This Tutorial?

• Poetry Generation
• Story Generation
• Multi-Modal Generation
  Visual Storytelling
  Visual Poetry Generation
• Other Genres
  Couplet
  Lyrics
Target Audience

- Ph.D. students or researchers who are working on artistic text generation.
- Anyone who wants to learn how neural approaches (i.e., deep learning techniques) can be applied to artistic text generation.
- Anyone who wants to build an artistic text generation system (e.g., story, poetry, couplet) with state-of-the-art neural techniques.
Outline

• Introduction
• Background Knowledge
• Existing Methods
  Poetry Generation
  Story Generation
  Multi-Modal Generation
  Other Genres
• Recent Trends and Future Direction
• Q&A
Roadmap

• Introduction
• Background Knowledge
• Existing Methods
  Poetry Generation
  Story Generation
  Multi-Modal Generation
  Other Genres
• Recent Trends and Future Direction
• Q&A
Task Description of Poetry Generation

• Input: a piece of text

• Output: a poem that meets given constraints

Marjan Ghazvininejad et al. ACL’17
Xingxing Zhang et al. EMNLP’14
Example System: Jiuge

Settings

Input

Output

https://jiuge.thunlp.cn/jueju_en.html
Task Description of Story Generation

- Definition 1: [Martin et al. AAAI’ 18]
  Automated story generation is the problem of automatically selecting a sequence of events, actions, or words that can be told as a story.

- Definition 2: [Xu et al. EMNLP’ 18]
  **Input**: A short description of a scene or an event.
  **Output**: A relevant narrative story following the input.

### Examples

<table>
<thead>
<tr>
<th>Input: Fans came together to celebrate the opening of a new studio for an artist.</th>
<th>Output: The artist provided champagne in flutes for everyone. Friends toasted and cheered the artist as she opened her new studio.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input: Last week I attended a wedding for the first time.</td>
<td>Output: There were a lot of families there. They were all taking pictures together. Everyone was very happy. The bride and groom got to ride in a limo that they rented.</td>
</tr>
</tbody>
</table>

Table 1: An illustration of narrative story generation.
Demo Story Generation System

Input

Output

Title to Story
it was a hot summer day,
the kids were bored,
they decided to go to the park,
they played in the water,
they had a great time.

Plan and Write
i went to school the other day.
it was my first day of school.
i asked my mom if she could go with me.
she said yes.
she said yes.

Plan and Revise
i went to school the other day.
it was my first day of high school.
i asked my mom to take me.
she said no.

Disclaimer: All the entries made in this website will be logged for academic research.

http://cwc-story.isi.edu/
Goldfarb-Tarrant et al., NAACL-HLT '19

AAAI2020 Tutorial: Creative and Artistic Text Generation
**Image-Inspired Poetry Generation**

**Input**

- Photograph of a serene lake with a boat.
- Photograph of a cottage with a garden.

**Output**

- Chinese: 秋水一曲水平堤，
  我在湖上钓鱼，
  逆流而上。
  我常常怀念西湖的月色，
  东风吹过西湖。
  且看东流的汶水。

- English: I sing a fishing song on a boat in the lake overflowing its bank,
  rowing oars with the sun setting in the west.
  I often miss the moon reflected in the West Lake,
  and the east breeze blowing across the WuLing River.

- Chinese: 春风庭院养花姿，
  萧条桃叶满枝。
  春入帘卷叶满枝。
  赏心悦目。
  草长莺飞几多时。
  然而春风将不长留。

- English: Breeze blows beautiful flowers in the courtyard,
  with leaves covering the branches.
  Glad to see green grass and trees in front of my door,
  However spring will not last very long.
Input

Captions:
(a) A small boy and a girl are sitting together.
(b) Two kids sitting on a porch with their backpacks on.
(c) Two young kids with backpacks sitting on the porch.
(d) Two young children that are very close to one another.
(e) A boy and a girl smiling at the camera together.

Story #1: The brother and sister were ready for the first day of school. They were excited to go to their first day and meet new friends. They told their mom how happy they were. They said they were going to make a lot of new friends. Then they got up and got ready to get into the car.

Story #2: The brother did not want to talk to his sister. The siblings made up. They started to talk and smile. Their parents showed up. They were happy to see them.

Output

1) After a long summer day of playing hard.
2) Swinging and playing and playing with friends.
3) Making up dances and helping clean up after the picnic.
4) We headed for the city fireworks.
5) What a great ending to a great day!

<table>
<thead>
<tr>
<th>Album Storytelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) The picture is of a little boy sitting in a swing.</td>
</tr>
<tr>
<td>2) A young blonde girl soaking wet holding onto a ladder.</td>
</tr>
<tr>
<td>3) Two young girls wearing pink and posing the same for the picture.</td>
</tr>
<tr>
<td>4) The fireworks are shot off in the distance.</td>
</tr>
<tr>
<td>5) A large firework exploding in the sky on a dark night.</td>
</tr>
</tbody>
</table>

Xin Wang et al., ACL’18
Bairui Wang et al., AAAI’19
And humble and their fit fles are wits size
but that one made and made thy step me lies

Cool light the golden dark in any way
the birds a shade a laughter turn away

Then adding wastes retiring white as thine
She watched what eyes are breathing awe what shine

But sometimes shines so covered how the beak
Alone in pleasant skies no more to seek

Beauty Yu
春花秋月何时了，(*P*ZPPZ)
Flowers bloom and wither, the moon rises and sets.
When can it end?
往事知多少。(*ZPPZ)
As for stories buried in the past, who will really attend?
小楼昨夜又东风，(*P*ZZPP)
Wind blew over my attic last night,
故国不堪回首月明中。(***P***ZPP)
How is my home country now, in the same moonlight?
雕阑玉砌应犹在，(*P*ZPPZ)
I bet the jade banisters and steps
are as exquisite as they were,
只是朱颜改。(*ZPPZ)
I guess it is only the people who changed for sure.
问君能有几多愁，(*P*ZZPP)
My sorrow,
恰似一江春水向东流。(****P***ZPP)
Flows like the river. It never ends.

Others

Couplet

Verse

lambics
Others

But she fell in love with him
Girl when they feel the same
The princess was in love with the priest
Can’t let go and it never goes out
She also abominated what he did
Be the things they said
The princess was shocked by the priest’s actions
And though her heart can’t take it all happens

Ballads

Song Lyrics
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Sequence to Sequence Model

- Common Used Sequence Generation Method
- Stable and Easy for Training
- Flexibility

Sutskever, Ilya et al. NIPS, 2014
Bahdanau, Dzmitry et al., ICLR, 2015
Convolutional Sequence to Sequence

- Fast Training
- Strong Language Model for Capturing Long-Range Dependencies
- Bounded CNN Context Window

Gehring, Jonas, et al., ICML, 2017
Transformer

- Fast Training
- Strong Language Model for Capturing Long-Range Dependencies
- Correlations Learning
- The SOTA Language Model

Ashish, et al., NIPS, 2017
Variational Autoencoder

- Generative Model
- Wording Diversity
- Intra-Sentence Consistency
- Address Sparsity

Zhao, Tiancheng et al., ACL, 2017
Generative Adversarial Nets

- One-to-Many Generation
- Enhancing Generator
- Supervision Signal

Yu, Lantao, et al., AAAI, 2017
Reinforcement Learning

- Directly Model Discrete Sequence
- Address Loss-Evaluation Mismatch
Pretraining Methods

Kaitao Song et al. ICML’19

Weijie Liu et al. AAAI’20.
References

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  Story Generation
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Recurrent Neural Model

• Task
  Chinese Quatrain

• Generation Process
  Keywords
  Keywords expansion
  Incremental generation

Xingxing Zhang et al. EMNLP’14
Recurrent Neural Model

- Convolutional Sentence Model (CSM)
  \[ v_i = CSM(S_i) \]

- Recurrent Context Model (RCM)
  \[ u_i^j = RCM(v_{1:i}, j) \]

- Recurrent Generation Model (RGM)
  \[ P(w_{j+1}|w_{1:j}, S_{1:i}) = RGM(w_{1:j+1}, u_i^{1:j}) \]

- Training
  Cross Entropy Errors

Xingxing Zhang et al. EMNLP’14
Planning-Based Recurrent Neural Model

• **Keyword Extraction**: TextRank Algorithm

• **Keyword Expansion**: RNNLM-Based Method; Knowledge-Based Method

• **Poetry generation**: Bidirectional RNN (GRU) Encoder; Attention; RNN (GRU) Decoder

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Zhe Wang et al. COLING’16.
Iterative Polishing

- Intention Representation
  - CNN
  - RNN

- Sequential Generation
  - Hierarchical RNN
  - Character by Character

- Iterative Polishing
  - Re-Generation

Rui Yan et al. IJCAI’16.
Interactive Poetry Generation

- Step 1
  Search related rhyme words
- Step 2
  Create a finite-state acceptor (FSA)
- Step 3
  RNN guided by FSA

Marjan Ghazvininejad et al., ACL' 17
GAN for Poetry Generation

- GAN
  Min-Max Game

- Generator
  Reinforcement learning
  MC search

- Discriminator

Table:

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Human score</th>
<th>p-value</th>
<th>BLEU-2</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLE</td>
<td>0.4165</td>
<td>0.0034</td>
<td>0.6670</td>
<td>&lt; 10^-6</td>
</tr>
<tr>
<td>SeqGAN</td>
<td>0.5356</td>
<td></td>
<td>0.7389</td>
<td></td>
</tr>
<tr>
<td>Real data</td>
<td>0.6011</td>
<td></td>
<td>0.746</td>
<td></td>
</tr>
</tbody>
</table>

Lantao Yu et al, AAAI'17
Static Memory Model

- Encoder
  - Bidirectional RNN

- Decoder
  - One-Layer RNN

- Memory Contents
  - Poem Cases

- Memory Index
  - Hidden States

- Memory Combing
  \[ v_t = \sum_{i=1}^{K} \cos(s_t, m_i(s))m_i(g) \]

Jiyuan Zhang et al., ACL’17

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AAAI2020 Tutorial: Creative and Artistic Text Generation
Working Memory Model

- Line-by-Line Generation
- Bidirectional Encoder and GRU Decoder
- Memory
  - Topic Memory
  - History Memory
  - Local Memory
  - Memory Reading
  - Memory Writing
Conditional Variational Autoencoder

Thematic Poem Generation

Keywords

Generation Pipeline

CVAE Model

Xiaopeng Yang et al., IJCAI'18
CVAE-GAN Model

Overall Framework

CVAE Generator

Discriminator

Juntao Li et al., EMNLP’18
Mutual Reinforcement Learning

• Modeling Poetry Generation as RL Problem

• Fine-Grained Reward Designing
  Fluency Rewarder (LM)
  Coherence Rewarder (MI)
  Meaningfulness Rewarder (TF-IDF)
  Overall Quality Rewarder (Classifier)

• Mutual Reinforcement Learning
  Two Generators
  Instance-Based Method
  Distribution Level Mutual learning

Xiaoyuan Yi et al., EMNLP’18

Teacher

Poetry

Fluency
Coherence
Meaningfulness
Overall Quality

Learn From

Learner 1

Learn From

Learner 2
Stylistic Poetry Generation

- Input
  - Input sentence
  - Style id
- Encoder-Decoder
- Mutual Information
  - Dependency of variables

Cheng Yang et al., EMNLP’18
Pretraining-Based Model

- Pre-trained Model
  - GPT

- Genres
  - Quatrain
  - Iambics
  - Couplet

- Fine-Tuning Model
  - Transformer
  - Auto-regressive Language Model

Yi Liao et al., arXiv:1907.00151
Rhetorically Controlled Generation

- Modern Poetry Generation
- Manual Control CVAE Model
  Process User Input As Rhetorical Label
- Automatic Control CVAE
  Predict When Use Rhetoric Label
- Topic Memory
  Store Topic Information
- Rhetorically Controlled Decoder
  Generate Sentence with Forms of Rhetoric

Zhiqiang Liu et al., ACL’19
Human-Machine Collaborative Generation

Collaborative Revision Module

- Automatic Reference Recommendation
- Revision Modes: Static/Local Dynamic/Global Dynamic

Main Framework
- Working Memory Model
- Genre Control
- Unsupervised Style Control
- Acrostic Poetry Generation

Input Preprocessing Module

Generation Model

Postprocessing Model

Final Poetry

Keywords: plane, blue sky
Plain Text: There is a plane in the blue sky.
Picture:

Keywords: fly, blue sky, swan goose, vast

Genre: Quatrain, Acrostic, Iambic
Style: Standard, Sadness about seasons, ...

Extract Expand Transform

Pattern Checking
Re-Ranking

The swan goose is flying outside the clouds.
The heavy mist almost make the ferry invisible.
It's so remote that it seems like it reaches the sky.

Zhipeng Guo et al., ACL’19
Human-Machine Collaborative Generation
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  Story Generation
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Coherent Story Generation

Task Description

On their trip to location, they arrive in front of a river. They decide to check out the city. They think it's too packed with people, so they go sightseeing. The indoor pool tempts them, but they decide not to jump in. They come across some ducks.

Model

Event Representations

- Story to Event Sequences
  5-tuple Event Representations

- Event to Event Generation
  Event-Level Seq2seq

- Event to Story Generation
  Seq2seq

Lara J. Martin et al., AAAI' 18
Controllable Story Generation

- **Input**
  - Human inputs
  - Controllable factors

- **Output**
  - A story that coherent to human inputs

- **Ending Valence Control**
  - Data labeling
  - Supervised classifier
  - Conditional LM for generation

- **Storyline Control**
  - Keywords extractor
  - Conditional LM for generation

Peng, Nanyun, et al., Workshop, 2018
Hierarchical Story Generation

- Hierarchical Generation Pipeline
  Generating Prompts---Story

- Convolutional Seq2seq For Generating Prompts
  Conventional Convolutional Seq2seq Model

- Gated Multi-Scale Attention
  Gated self-attention to attend Information at different position
  Multi-scale attention to attend information at different granularity

- Prompts Fusion
  Residual Learning Upon pre-trained Convolutional seq2seq model

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**Prompt:** The Mage, the Warrior, and the Priest

**Story:** A light breeze swept the ground, and carried with it still the distant scents of dust and time-worn stone. The Warrior led the way, heaving her mass of armour and muscle over the uneven terrain. She soon crested the last of the low embankments, which still bore the unmistakable fingerprints of haste and fear. She lifted herself up onto the top the rise, and looked out at the scene before her. [...]
Skeleton to Story Generation

- Skeleton-Based Generative Module
  - Input-to-Skeleton
  - Skeleton-to-Sentence

- Skeleton Extraction Module
  - Pretraining on Sentence Compression Dataset
  - Reinforcement Learning Training
  - Two Entropy Loss Reward
  - Iterative Optimization

Xu, Jingjing, et al., EMNLP, 2018
Planning-Based Method

System Overview

- Plan and Write
- Static Planning
- Dynamic Planning

Yao, Lili, et al., AAAI, 2019
CVAE and Memory Network

- CVAE
  Wording Novelty

- Cache
  Coherence

Li, Juntao, et al., AAAI, 2019
Plan Write and Revise

- System Combination
- Cross-Model Mode
- Intra-Model Mode
- Story Writer
  - Title-to-Story
  - Plan-and-Write
  - Plan-and-Revise

Goldfarb-Tarrant, Seraphina et al., NAACL-HLT, 2019
Structured Story Generation

- Input: story prompt
- Action plan with semantic labeling
- Entity Anonymized Story
- Full Story

Angela Fan et al., ACL, 2019
BERT Augmented Story Ending Prediction

• Unsupervised Pre-Training

• Supervised Pre-Training

• Supervised Fine-Tuning

Li, Zhongyang et al., IJCAI, 2019
Common Sense Grounding

- Intermediate Fine-Tuning
- Multi-Task Fine-Tuning
  - Language Modeling
  - Perplexity Ranking

Pre-train on WebText (Pre-trained GPT2) → Fine-Tune on BookCorpus (Domain Adaptation) → Multi-Task Fine-Tuning

- Writing Prompts (Story Generation)
  - Prompt: Write a horror story from the perspective of the antagonist.
  - I don't want to cut off his head, but I don't really have a choice. I close my eyes and just wait for it to be over...

- SWAG (Common Sense)
  - On stage, a woman takes a seat at the piano. She
    - a) sits on a bench as her sister plays with the doll.
    - ... d) nervously sets her fingers on the keys.

- Synthetic (Common Sense)
  - a) According to a poll by the Media Insight Project, only 6 percent of Americans...
  - b) The IDG News Service’s privacy team offers an in-depth guide to protecting your privacy...

Language Modeling

Perplexity Ranking

Huanru Henry Mao et al., EMNLP, 2019
Counterfactual Story Reasoning and Generation

Data from ROCStories

Premise:
1) Jaris wanted to pick some wildflowers for his vase.

Initial:
2) He went to the state park.

Original Ending:
3) He picked many kinds of flowers.
4) Little did Jaris realize that it was a national park.
5) Jaris got in trouble and apologized profusely.

Data Collection

Step 1 - Workers Produce a Counterfactual given original story
(One counterfactual for 98,159 examples)

2') He went to the local playground area.

Step 2 - Workers Edit Ending given the above
(One ending for 16,752 training examples
Three endings for 1,871 dev examples
Four endings for 1,871 test examples)

3') He picked many kinds of flowers.
4') Little did Jaris realize that he was trespassing on private property.
5') Jaris got in trouble and apologized profusely.

Task Flow

Input:
Premise + Initial + Original Ending + Counterfactual

Output:
3') He found a very large bush of wildflowers.
4') He picked them up with his hands.
5') He carried them home and planted them in his vase.

Lianhui Qin et al., EMNLP, 2019
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• Existing Methods
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  Story Generation
  Multi-Modal Generation
  Other Genres
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Image Inspired Poetry Generation

- Image-Based Encoder
  CNN
  Bidirectional RNN

- Memory-Based Decoder
  Keyword Extractor
  Vector Representations

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Xu, Linli, et al., AAAI, 2018
Visual Poetry Generation of Xiaolce

Keyword Extraction

Keyword Generation

Framework

Cheng, Wen-Feng, et al., arXiv:1808.03090, 2018
Multi-Modal Poetry Generation

Liu, Dayiheng, et al., IJCNN, 2018
Multi-Adversarial Training

Deep Coupled Visual-Poetic Embedding Model

(a) image and poem pairs
(b) Poetic CNN features
(c) skip-thought model trained on UniM-Poem
(d) sentence features

Multi-Adversarial Training

Generator as Agent

GRU

Discriminators as Rewards

(g) Multi-Modal Discriminator

$C_n(c = \text{paired})$

- Paired
- Generated
- Unpaired

(h) Poem-Style Discriminator

$C_p(c = \text{poetic})$

- Poetic
- Generated
- Disordered
- Paragraphic

Reward: $R - \lambda C_n + (1 - \lambda) C_p$

Liu, Bei, et al., ACM, MM, 2018
Inverse Reinforcement Learning

Overall Framework

Policy Model

Wang, Xin, et al., ACL, 2018
Hierarchical Photo-Scene Encoder

Wang, Bairui, et al., AAAI, 2019
Hierarchically Structured Reinforcement Learning

Feature vectors of images

Manager (LSTM)

Worker (SCN)
References

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• Introduction
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• Existing Methods
  Poetry Generation
  Story Generation
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• Recent Trends and Future Direction
• Q&A
## Overview

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Main Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rap Lyric Generation [Potash Peter et al.,15]</td>
<td>LSTM + Explicit Templates</td>
</tr>
<tr>
<td>Rap Lyric Generation [Malmi Eric et al., 16]</td>
<td>Information Retrieval Task</td>
</tr>
<tr>
<td>Chinese Song Iambics Generation [Wang et al.,16]</td>
<td>Attention-Based Seq2seq</td>
</tr>
<tr>
<td>Chinese Couplet Generation [Yan Rui et al., 16]</td>
<td>Seq2seq + Attention + Polishing</td>
</tr>
<tr>
<td>Theme-Aware Lyrics Generation [Wang Jie, 19]</td>
<td>Multi-Channel Seq2seq + LDA</td>
</tr>
</tbody>
</table>
References

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• Introduction
• Background Knowledge
• Existing Methods
  Poetry Generation
  Story Generation
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• Q&A
Conventional Line

• Better Methods and Techniques
  - Inverse Reinforcement Learning
  - Mutual Learning
  - Imitation Learning
  - Mutual Information Estimation

• New Datasets and New Attributes
  - Counterfactual story reasoning
  - Common sense
  - Modern poetry in different languages

• Task-Specific Settings
  - Character-centric story generation
  - Topic-aware
Pretraining-Based Methods

Yuxian Meng et al. NeuralPS’ 19

Kaitao Song et al. ICML’ 19

Rhythm
Glyph
Tonal
Writer

Encoder

Attention

Decoder

Transformer

Yuxian Meng et al. NeuralPS’ 19

Kaitao Song et al. ICML’ 19

Rhythm
Glyph
Tonal
Writer

Encoder

Attention

Decoder

Transformer

Yuxian Meng et al. NeuralPS’ 19

Kaitao Song et al. ICML’ 19
Structured Generation Pipeline

- Parsing
- Entity detection
- Sequence labeling
- Relation extraction
- Sentiment analysis
- Action planning
- Controllable generation
- Style transfer
- Logic checking
- Grammar error correction
Evaluations

- Challenges

For each task or released dataset, there is no standard automatic evaluation metrics.

Automatic metric from other text generation tasks are not proper.

Bias between evaluations of domain experts, crowd workers, and users.

The correlations between automatic evaluation metrics and human evolutions are low.

One reference for each generated instance cannot reflect the performance of generation models.

Owing to the diversity of genres and task attributes in artistic text generation, evaluation metrics cannot generalize well for different scenarios.
Conclusion

• Poetry Generation

• Story Generation

• Multi-Modal Generation
  Image-Inspired Poetry Generation
  Visual Storytelling

• Other Genres
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Thank you!