Robert Joseph Flaherty, (February 16, 1884 July 23, 1951) was an American film-maker. Flaherty was married to Frances H. Flaherty until his death in 1951.
### The Data to Text Generation Task

#### Input Set of Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth name</td>
<td>Robert Joseph Flaherty</td>
</tr>
<tr>
<td>Birth date</td>
<td>February 16, 1884</td>
</tr>
<tr>
<td>Birth place</td>
<td>Iron Mountain, Michigan, U.S.</td>
</tr>
<tr>
<td>Death date</td>
<td>July 23, 1951 (aged 67)</td>
</tr>
<tr>
<td>Death place</td>
<td>Dummerston, Vermont, U.S.</td>
</tr>
<tr>
<td>Cause of death</td>
<td>Cerebral thrombosis</td>
</tr>
<tr>
<td>Occupation</td>
<td>Filmmaker</td>
</tr>
<tr>
<td>Spouse(s)</td>
<td>Frances Johnson Hubbard</td>
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#### Output Verbalisation

Robert Joseph Flaherty, (February 16, 1884 July 23, 1951) was an American film-maker. Flaherty was married to Frances H. Flaherty until his death in 1951.

**Application?** Automatic generation of descriptions for Amazon
Robert Joseph Flaherty, (February 16, 1884 July 23, 1951) was an American film-maker. Flaherty was married to Frances H. Flaherty until his death in 1951.

Application? Automatic generation of descriptions for Amazon
Approach? Neural Generator trained on Loosely Related Texts
Joseph Flaherty, (February 16, 1884 – July 23, 1951) was an American film-maker who directed and produced the first commercially successful feature-length documentary film, Nanook of the North (1922). Flaherty was married to writer Frances H. Flaherty from 1914 until his death in 1951. Frances worked on several of her husband’s films, and received an Academy Award nomination for Best Original Story for Louisiana Story (1948).

[Lebret et al., 2016, Wiseman et al., 2017]
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Distribute attention weights & Memorised high frequency sub-sequences!

[Ghader and Monz, 2017]
Our Approach, Pre-Train a Content Alignment Model

**Birth name** Robert Flaherty

**Birth date** February 16 1884

**Birth place** Iron Mountain

**Dead date** July 23 1951

**Spouse(s)** Frances J. Flaherty
Our Approach, Use the Content Alignment Information for Training
Content Alignment Intuition

- Multi-Instance Learning to discover Property-Word Alignments
- Loosely related (Property Set, Text) pairs provide high level supervision

Property Set Bag

<table>
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Bag Labels

Flaherty was married to writer Frances H. Flaherty from 1914 until his death in 1951.

[Keeler and Rumelhart, 1992, Karpathy and Fei-Fei, 2015]
Content Alignment Intuition

- **Multi-Instance Learning** to discover Property-Word Alignments
- Loosely related (Property Set, Text) pairs provide high level supervision

**Property Set Bag**

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**Bag Labels**

Flaherty was married to writer Frances H. Flaherty from 1914 until his death in 1951.

[Keeler and Rumelhart, 1992, Karpathy and Fei-Fei, 2015]
Content Alignment Model

\[ S_{Ps} = \sum_{t=1}^{|s|} \max_{i \in \{1, \ldots, |\mathcal{P}|\}} p_i \cdot w_t \]

\[ \mathcal{L}_{CA} = \max(0, S_{Ps} - S_{Ps'} + 1) + \max(0, S_{Ps} - S_{P's} + 1) \]

- \( \mathcal{P} \) is a property set and \( s \) a sentence from the text
- each property vector \( p_i \) is learned by an LSTM encoder
- word vectors \( w_t \) are hidden states of an LSTM sentence encoder

[Keeler and Rumelhart, 1992, Karpathy and Fei-Fei, 2015]
Multi-Task Learning

Content Alignment Model

Property Encoder

Attention

Alignment Labels

\[
\begin{align*}
\hat{y}_1 & \quad a_1 \\
\hat{y}_2 & \quad a_2 \\
\hat{y}_3 & \quad a_3 \\
\hat{y}_4 & \quad a_4
\end{align*}
\]

\[
\begin{align*}
<y> & \quad y_1 \\
y_1 & \quad y_2 \\
y_2 & \quad y_3 \\
y_3 & \quad y_4
\end{align*}
\]
Predicting Alignment Labels

- Words from the original text are associated with **Alignment Labels** \( a \) indicating whether the word aligns to some property in the input
- **Simultaneously predict** words and alignments, **EDMTL model**

\[
\mathcal{L}_{MTL} = \lambda \mathcal{L}_{wNLL} + (1 - \lambda) \mathcal{L}_{aln}
\]

\[
\mathcal{L}_{wNLL} = - \sum_{t=1}^{\mid Y \mid} \log P(y_t|y_{1:t-1}, X)
\]

\[
\mathcal{L}_{aln} = - \sum_{t=1}^{\mid Y \mid} \log P(a_t|y_{1:t-1}, X)
\]

[Caruana, 1993]
Training to Optimise Content

- **Target Content** is set of words from the original text with positive alignments
- Trained to maximise a Content Precision Reward, EDRL model

\[ r(\hat{Y}) = \gamma^{pr} \cdot r^{pr}(\hat{Y}) \]

\( r^{pr} \) is the unigram precision of \( \hat{Y} \) and **Target Content**

\[ \mathcal{L}_{RL} = -\mathbb{E}(\hat{y}_1, \ldots, \hat{y}_{|Y|}) \sim P_{\pi}(\cdot|X)[r(\hat{y}_1, \ldots, \hat{y}_{|Y|})] \]

[Williams, 1992, Ranzato et al., 2016, Zhang and Lapata, 2017]
Experimental Setup

- properties and abstracts about people (WikiBio [Lebret et al., 2016])
- Encoder-Decoder baseline, ED model
- Hand-crafted templates for 50 most frequent relations, Templ
Experimental Setup

- Encoder-Decoder baseline, **ED model**
- Hand-crafted templates for 50 most frequent relations, **Templ**
- **Automatic BLEU-4** on gold texts
- **Human ranking** of 4 models and gold texts; AMT judges

**Ranking criteria:**
1. Is the text faithful to the set of properties?
2. Is the text comprehensible and fluent?
Automatic Evaluation Results

BLEU-4

Gold Texts

Templ
ED
EDMTL
EDRL

40
30
20
15
10
5
Gold Texts

14 / 20
Human Evaluation Results

significance at $p < 0.05$
Dorsey Burnette (December 28, 1932 – August 19, 1979) was an American early rockabilly singer. He was a member of the Rock and Roll Trio.
Dorsey Burnette (December 28, 1932 – August 19, 1979) was an American early rockabilly singer. He was a member of the Rock and Roll Trio.

ED:
Dorsey Burnette (December 28, 1932 – August 19, 1979) was an American singer and songwriter. He was a member of the Rock band the band from YEAR to YEAR.
Example Output

Property Set:

name= dorsey burnette, date= may 2012, bot= blevintron bot, background= solo singer, birth= december 28 , 1932, birth place= memphis, tennessee, death place= {los angeles; canoga park, california}, death= august 19 , 1979, associated acts= the rock and roll trio, hometown= memphis, tennessee, genre= {rock and roll; rockabilly; country music}, occupation= {composer; singer}, instruments= {rockabilly bass; vocals; acoustic guitar}, record labels= {era records; coral records; smash records; imperial records; capitol records; dot records; reprise records}

Gold Text:
Dorsey Burnette (December 28 , 1932 – August 19 , 1979) was an american early rockabilly singer. He was a member of the Rock and Roll Trio.

EDMTL:

Dorothy Burnette (December 28 , 1932 – August 19 , 1979) was an american country music singer and songwriter. He was a member of the Rock band Roll.
Example Output

Property Set:

```
name = dorsey burnette, date = may 2012, bot = blevintron bot, background = solo singer, birth = december 28, 1932, birth place = memphis, tennessee, death place = {los angeles; canoga park, california}, death = august 19, 1979, associated acts = the rock and roll trio, hometown = memphis, tennessee, genre = {rock and roll; rockabilly; country music}, occupation = {composer; singer}, instruments = {rockabilly bass; vocals; acoustic guitar}, record labels = {era records; coral records; smash records; imperial records; capitol records; dot records; reprise records}
```

Gold Text:
Dorsey Burnette (December 28, 1932 – August 19, 1979) was an american early rockabilly singer. He was a member of the Rock and Roll Trio.

EDRL:
Burnette Burnette (December 28, 1932 – August 19, 1979) was an american singer and songwriter. He was born in memphis, Tennessee.
Conclusions

- Explicit content modelling benefits generation from loosely related Data-Text pairs
- Novel Content Selection Mechanism based on Multi-Instance Learning
- Two frameworks, MTL and RL, to instill content requirements in the training process

Future work

- Modelling target document structure (e.g. phrases or sentences)
Thank you!
Questions?
Multitask learning: A knowledge-based source of inductive bias.

What does attention in neural machine translation pay attention to?

Deep visual-semantic alignments for generating image descriptions.

A self-organizing integrated segmentation and recognition neural net.

Neural text generation from structured data with application to the biography domain.

Sequence level training with recurrent neural networks.


Experimental Setup

Based on WikiBio dataset, properties and abstracts ([Lebret et al., 2016])

train/devel/test: 165,324 / 25,399 / 23,162

- Content Aligner optimised on development set
  ▶ 2 annotators manually aligned 132 (Data, Sentence) pairs
  ▶ select model with best word alignment f-score .36
  ▶ inter-annotator agreement f-score .72

- Encoder-Decoder baseline, ED model

- Hand-crafted templates for 50 most freq. relations, Templ
Evaluation

- **Gold text collection**, Revised Abstracts (RevAbs)
  AMT annotators, 200 test examples, 3 revisions

- **Automatic BLEU-4** on original and revised abstracts

- **Human ranking** of 4 models and RevAbs; AMT judges, 200 revised examples, 3 judgments

- **Ranking criteria**: (1) Is the text faithful to the set of properties?
  (2) Is the text comprehensible and fluent?
Gold text collection
Automatic Evaluation Results

![Bar chart showing BLEU-4 scores for Abstracts and RevAbs.

- **Abstracts**: 
  - Templ: 5
  - ED: 10
  - EDMTL: 15
  - EDRL: 20

- **RevAbs**: 
  - Templ: 30
  - ED: 35
  - EDMTL: 40
  - EDRL: 40

Legend: 
- Templ
- ED
- EDMTL
- EDRL