

# 4533 : Unsupervised Controllable Text Formalization

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# Unsupervised Text Formalization

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## Task: Natural Language Transformation

## Overview

- Framework for controllable natural language transformation.

- Features:
  - personalized transformation scheme, handles inflections to generate data for each "input, output, control" triplet
  - representation of language semantics
  - use Off-the-shelf NLP models for the verification and scoring
  - control the degree of the intended attribute defined at the output.
  - learning to incorporate multiple control inputs (which can be dependent)

## System Description

### Training scheme

- 1. Pretraining** as an autoencoder for better information representation
- 2. Exploration**
  - synthesize instances of input text, output text and control
  - sample  $c$  outputs which maximizes the cumulative score
- 3. Exploitation**
  - Train control predictor based on sampled  $\langle X, Y, c \rangle$  instances
  - Train Enc-Dec using sampled  $\langle X, Y, c \rangle$  and control predictor

### 1. Pretraining

$$(X, Y, c)$$

### 2. Exploration

$$(X, Y, c)$$

### 3. Exploitation

$$(X, Y, c)$$

☒ Under Training ☐ No Training ☐ Evaluated

## Sampling and Score calculation

## Dataset and Results

### Sampling

- Sample 1 sentences which maximizes the cumulative score:
 
$$Y_c = \underset{Y}{\operatorname{argmax}}_Y [G(X, Y) + V_{\text{Sample}}(Y_c)]$$

### Cumulative score calculation:

- Cumulative score for the sampled sentence is generated as,

$$G(X, Y) = F_{\text{Enc}}(X, Y) + F_{\text{Dec}}(Y, Y_c) + F_{\text{Enc}}(Y_c, Y_c)$$

$F_{\text{Enc}}(X, Y)$  is document similarity  
 $F_{\text{Dec}}(Y, Y_c)$  for fluency  
 $F_{\text{Enc}}(Y_c, Y_c)$  is French - Kincaid readability

### Control Determination:

- Control value of  $c$  for the newly sampled example is determined as,

$$c = \begin{cases} 1, & \text{if } c_1 < p_1 \\ 2, & \text{if } p_1 < c_1 < p_2 \\ 3, & \text{if } c_2 < p_2 \end{cases} \quad c' = r^{c/(c_1/c_2)}$$

## Example input and transformed sentences

Model	Ctrl	Input	Output
W2Vec-High	High	If you did not attend the child in a hospital room per policy	The first nurse on the opposing will be a primary nurse per policy
W2Vec-Mid	Mid	If you did not attend the child in a primary nurse per policy	The first nurse on the opposing will be a primary nurse per policy
W2Vec-Low	Low	If you did not attend the child in a primary nurse per policy	The first nurse on the opposing will be a primary nurse per policy
Naïve-Mid	Mid	If you did not attend the child in a primary nurse per policy	The first nurse on the opposing will be a primary nurse per policy
Naïve-Low	Low	If you did not attend the child in a primary nurse per policy	The first nurse on the opposing will be a primary nurse per policy
Decoder-High	High	If you did not attend the child in a primary nurse per policy	The first nurse on the opposing will be a primary nurse per policy
Decoder-Mid	Mid	If you did not attend the child in a primary nurse per policy	The first nurse on the opposing will be a primary nurse per policy
Decoder-Low	Low	If you did not attend the child in a primary nurse per policy	The first nurse on the opposing will be a primary nurse per policy

## Curated Dataset

14432 sentences which are simple and informal in nature

## Comparison with Existing Supervised Method

Model	CTRL		CTRL		CTRL		Number of test sets
	W2Vec-High	W2Vec-Mid	W2Vec-High	W2Vec-Mid	W2Vec-High	W2Vec-Mid	
Formalness Score	Mid	High	Mid	High	Mid	High	None
Readability	0.568	0.538	0.538	0.538	0.534	0.534	0.03
Relativeness	0.72	0.74	0.77	0.77	0.78	0.78	0.05
IM Score	0.84	0.84	0.82	0.82	0.80	0.80	0.05
Average test score (normalized between [0 - 1])							
Average readability gain (on the 0.54)							

### Human Evaluation

### Output control agreement accuracy

- Rank readability of different control outputs
- 80-2% agreement between human rated rank labels and ranking based on output control value

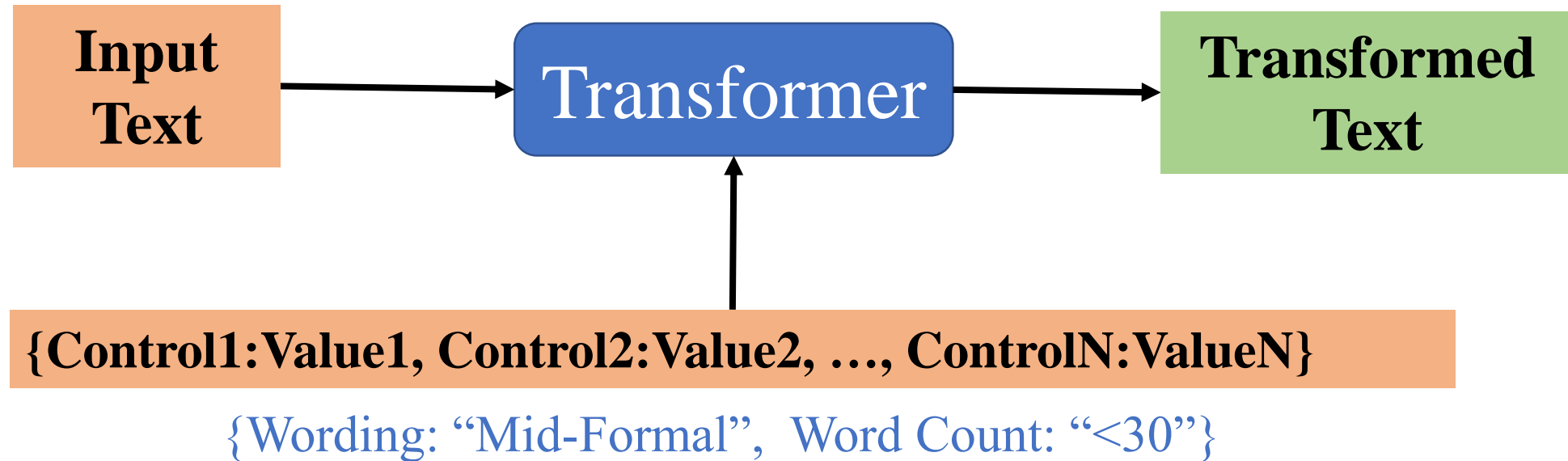
## Indirect Comparison with Supervised Systems

- Reversed-simplification Task

System	BLEU-1	BLEU-2	BLEU-3	BLEU-4
Mueller et al.	3.00	4.84		



# Task: Natural Language Transformation



- We experiment on transforming a given text to a more formal style

# Overview


- Framework for **controllable natural language transformation**
  - **unsupervised** training scheme
  - learning to incorporate **multiple control inputs**
  - way to **preserve language semantics**
  - **control the degree** of the intended attribute desired at the output
  - use **off-the-shelf NLP modules**

See you at the poster

# 4533: Unsupervised Controllable Text Formalization

### Unsupervised Controllable Text Formalization

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#### Task: Natural Language Transformation

Input Text → Transform → Transformed Text

[Control1:Value1, Control2:Value2, ..., ControlN:ValueN]

Generating "Mild formal", "Hard Casual", etc.

- We experiment on transforming a given text to a more formal style

#### Overview

- Framework for controllable natural language transformation.
- Features:
  - unsupervised training scheme, handles infeasibility to annotate data for each <input, output, control> triples
  - preservation of language semantics
  - use Off-the-shelf NLP modules for verification and scoring
  - control the degree of the intended attribute desired at the output.
  - learning to incorporate multiple control inputs (which can be dependent)

#### System Description

**1. Pretraining**  $(X, c_d)$

$X \rightarrow$  Encoder  $\rightarrow$  Decoder  $\rightarrow c_d$

$c_d$  is default control

**2. Exploration**  $(X, c_d)$

$X \rightarrow$  Encoder  $\rightarrow$  Decoder  $\rightarrow c_d$

Scorer (Readability, Fluency, Formality) → Sampler →  $(X, Y_p)$

**3. Exploitation**  $(X, Y_p, c)$

Learning Control Predictor:  $X \rightarrow$  Encoder  $\rightarrow$  Predictor  $\rightarrow c$

Learning encoder decoder:  $X \rightarrow$  Encoder  $\rightarrow$  Decoder  $\rightarrow c$

Scorer (Readability, Fluency, Formality) → Sampler →  $(X, Y_p)$

Final output:  $(1 - \lambda) * c_d + \lambda * c$

Legend: Under Training (Green), No Training (Red), External (Blue)

#### Sampling and Score calculation

**Sampling**

- Sample k sentences which maximizes the cumulative score
- $Y_p = \text{argmax}_Y \{ G(X, Y) \mid Y \in \{ Y_p, \text{Sample}_k(Y_p) \} \}$

**Cumulative score calculation:**

- Cumulative score for the sampled sentence is generated as,
- $G(X, Y) = \beta_r r_f(X, Y) + \beta_f r_f(X, Y) + \beta_d r_d(X, Y)$
- $r_f(X, Y)$  is document similarity
- $r_f(Y)$  is fluency
- $r_d(Y)$  is Flesch – Kincaid readability

**Control Determination:**

- Control value (c) for the newly sampled example is determined as,
- $c = \begin{cases} 1, & \text{if } c_r < p_1 \\ 2, & \text{if } p_1 < c_r < p_2 \\ 3, & \text{if } c_r > p_2 \end{cases}$   $c_r = r_d(Y_p) / r_d(X)$

#### Dataset and Results

**Curated Dataset** [Code & data: <https://github.com/parajain/uctf>]

- 14432 sentences which are simple and informal in nature

**Comparison with Existing Unsupervised Method**

Mode	CTRL WITH PREDICTOR		CTRL NO PREDICTOR		CTRL ONESHOT		Moshir et al., 2017
	Mid	High	Mid	High	Mid	High	
Formality Control							
Readability	0.568	0.583	0.538	0.538	0.554	0.554	0.33
Fluency	0.72	0.74	0.72	0.72	0.78	0.78	0.65
IM Score	0.34	0.34	0.32	0.32	0.30	0.30	0.16


Average test-set scores (normalized between [0 - 1])

• Average readability grade of the input (0.54)

**Human Evaluation**

- Rank readability of different control outputs
- 80.2% agreement between human rated rank labels and ranking based on output control value

**Output control agreement accuracy**



#### Example input and transformed sentences

Mode - Ctrl	Input sentence	Input sentence
WwPwPd - Mid	18 year old who abandoned her child in a hospital later got custody	the first sync after upgrading will be slow
WwPwPd - Mid	18 year old who suspended her kid in a infirmary resultant got custody	the first synchronous afterward upgrading will be slow
WwPwPd - High	18 year old who deserted her rike in a infirmary resultant got detention	the first synchronous afterward upgrading will be suggest
WwPwPd - Mid	18 class old who deserted her child in a infirmary accompanying get detention	the introductory synchronous afterward upgrading will be guess
WwPwPd - High	18 class old who deserted her child in a infirmary accompanying get detention	the introductory synchronous afterward upgrading will be guess
Oneshot - Mid	18 yr old who abandoned her rike in a hospital subsequently get detention	the eighthly sync later upgrading hequally be tedious
Oneshot - High	18 class old who deserted her rike in a hospital subsequently get detention	the eighthly sync later upgrading hequally be tedious

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Thank you