A Distributional Lens for Multi-Aspect Controllable Text Generation

Yuxuan Gu[†], Xiaocheng Feng[†‡], Sicheng Ma[†], Lingyuan Zhang[†], Heng Gong[†], Bing Qin[†‡]
[†]Harbin Institute of Technology [‡] Peng Cheng Laboratory
{yxgu,xcfeng,scma,lyzhang,hgong,bqin}@ir.hit.edu.cn

EMNLP2022

Reported by Libingyu

1. Introduction
2. Method
3. Experiments
4. Conclusion

Introduction

➢Multi-aspect controllable text generation

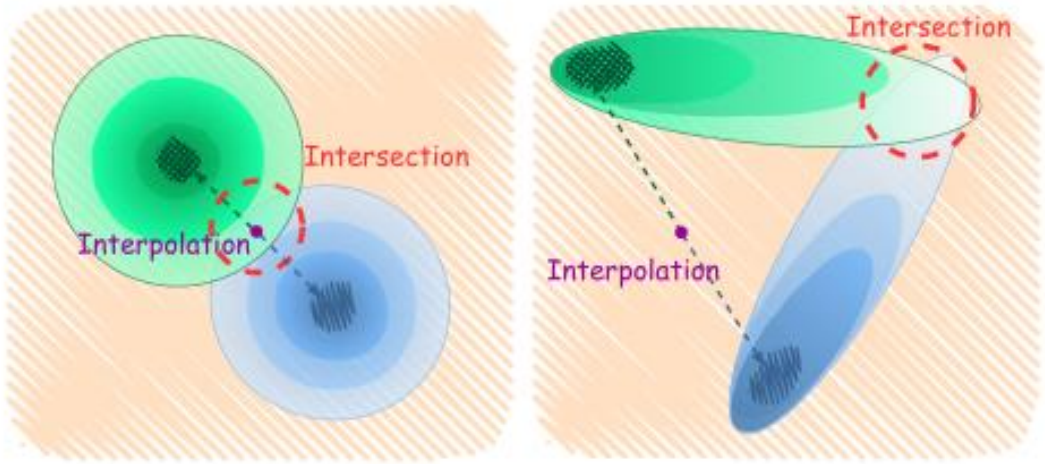


Figure 1: Probability space of attributes. Orange background denotes the estimated distribution over natural language. Blue and green areas represent distributions over sentences containing attributes from two different aspects, respectively. The darker region means a higher probability in the space. The shaded are distributional centers, the areas with the highest probability density.

属性概率空间

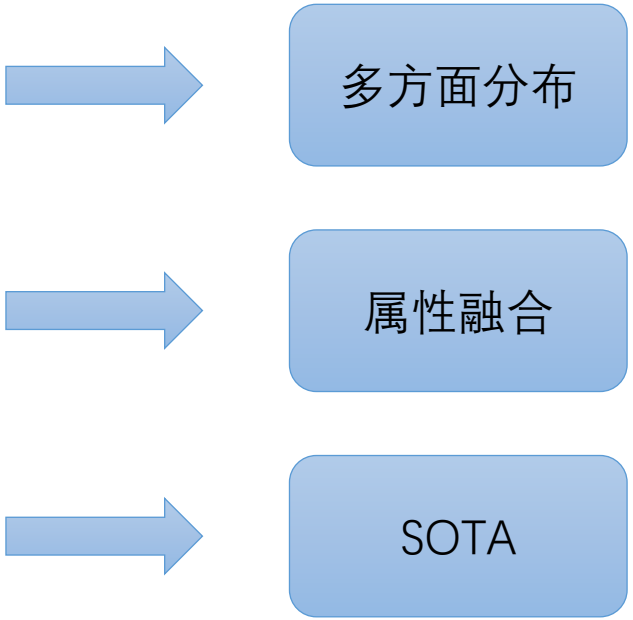
interpolation 多个中心合并后得到的位置

intersection 同时满足多个属性的语句所在位置

Introduction

➢ Main contributions

- We propose a distributional perspective that models multi-aspect control more practically.
- We provide a method that directly searches for intersections in the attribute space and generates sentences with desired attributes.
- We experimentally reveal the effectiveness of our method on multi-aspect control compared to strong baselines and achieve the SOTA.



Method

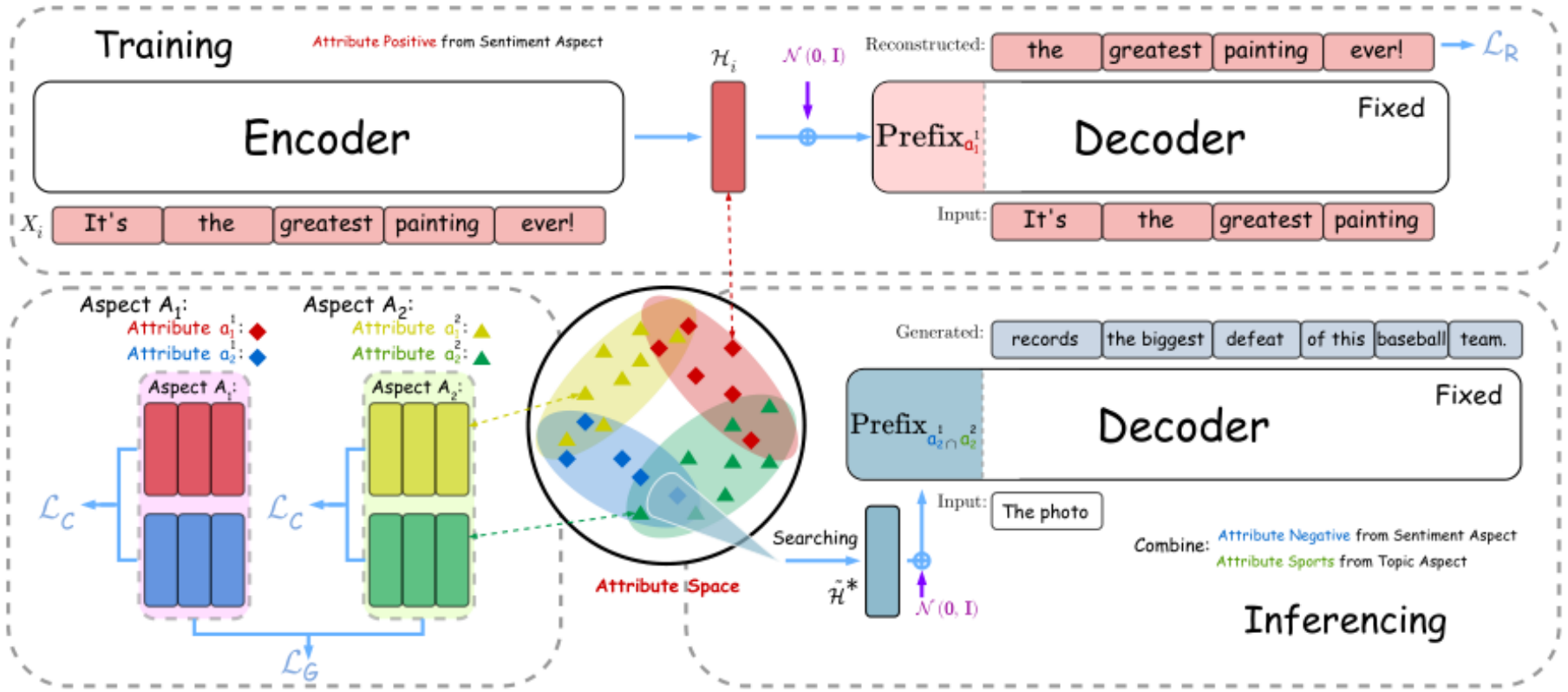
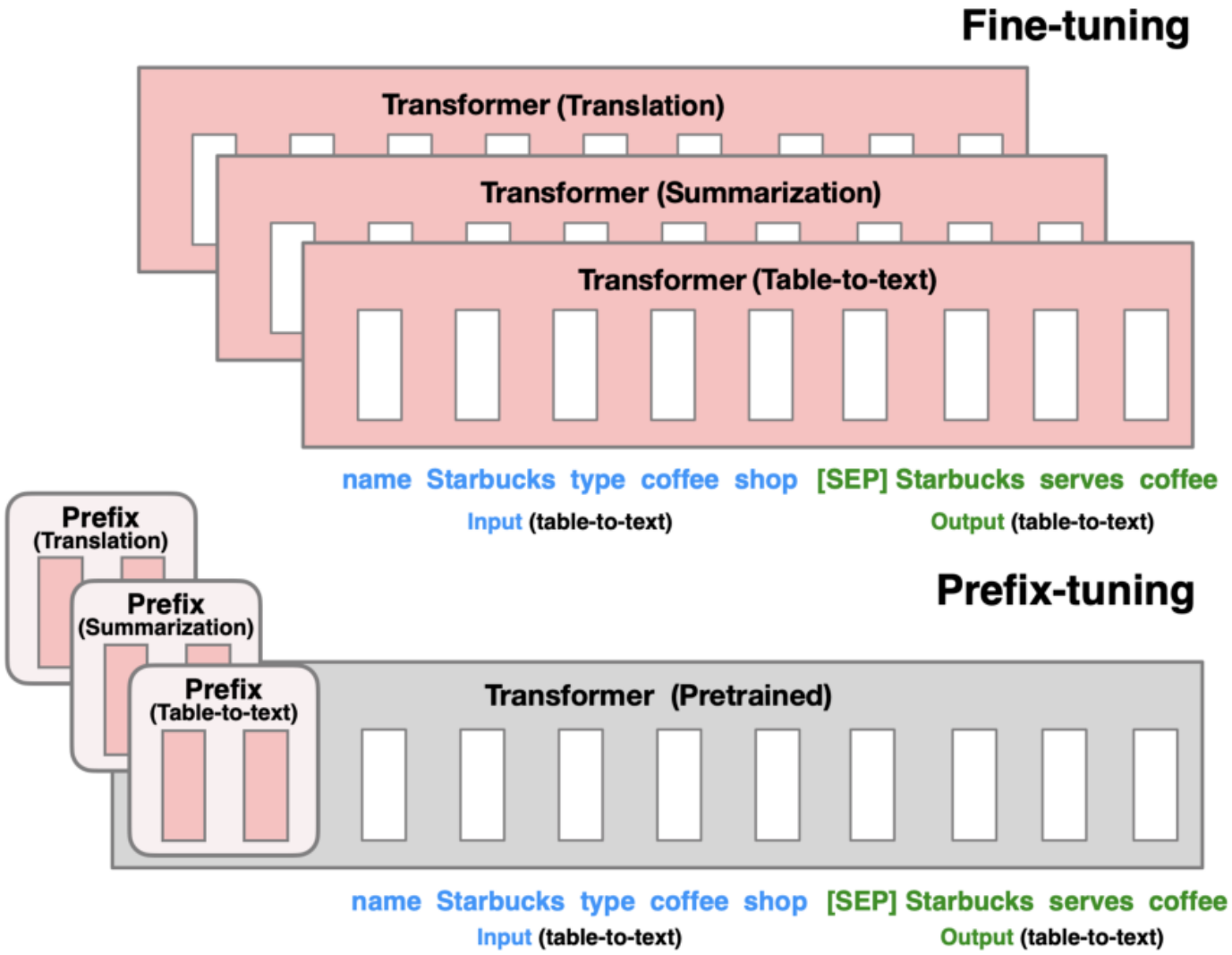


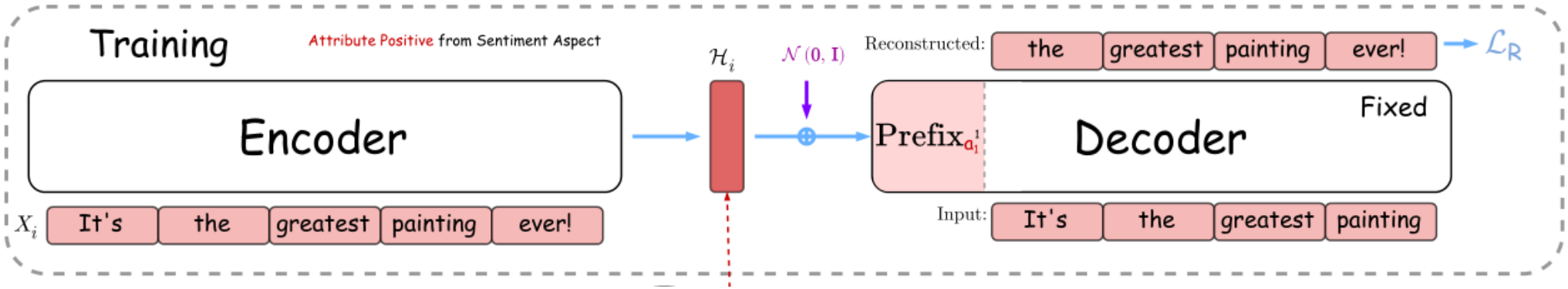
Figure 2: An overview of our method. **Top**: Illustration of our autoencoder structure with prefix-tuning deployed on the fixed decoder, where latent representations $\mathcal{H}_i$ constitute an estimated attribute space. **Bottom Left**: Illustration of attribute classification loss $\mathcal{L}_C$ and aspect gap loss $\mathcal{L}_G$ attached to the attribute space. **Bottom Right**: Inferencing stage with prefix mapped from the intersection of attributes.

Method

- Prefix-Tuning



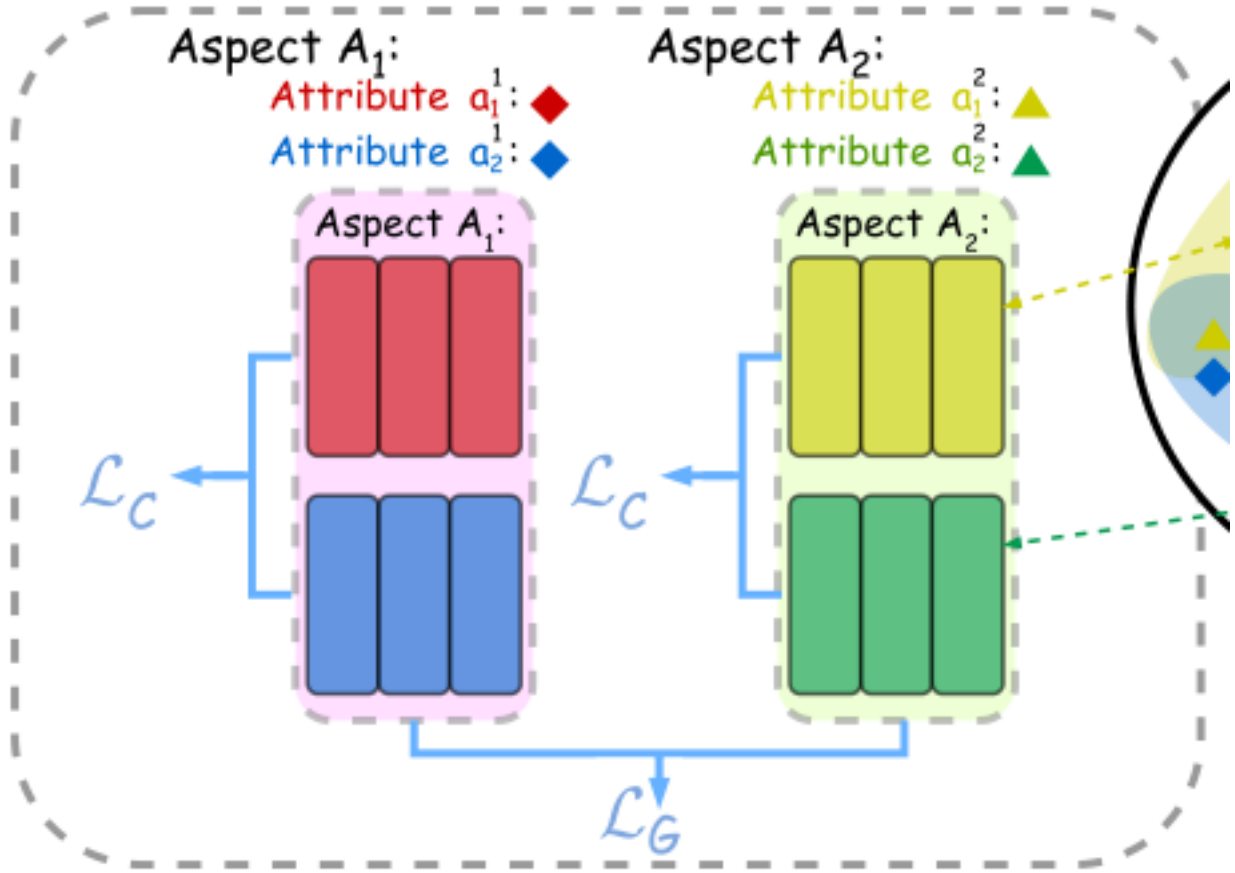
Method



$$\mathcal{L}_R = -\sum_{i \in I} \log p_{\mathrm{LM}}(X_i | \mathrm{Prefix}_i) \tag{1}$$

$$\mathrm{Prefix}_i = \mathrm{MLP}_\theta(\mathcal{H}_i + \lambda \varepsilon_i),\ \varepsilon_i \sim \mathcal{N}(\mathbf{0}, \mathbf{I}),$$

Method

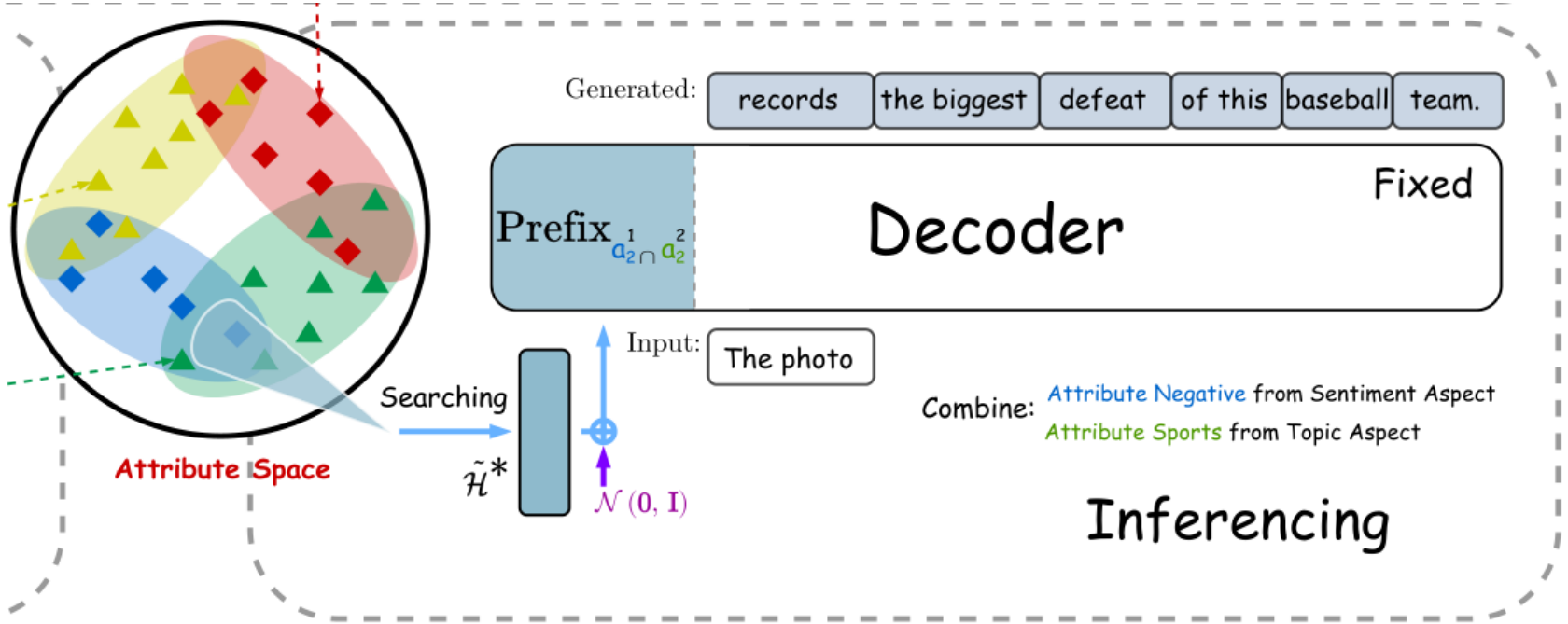


属性分类丢失LC和方面间隙丢失LG说明：

$$\mathcal{L}_C = -\sum_{t=1}^{|\mathbf{A}|}\sum_{\tau=1}^{|A_t|}\sum_{i\in I_\tau^t}\log p_{\pi_t}(a_\tau^t|\mathcal{H}_i). \quad (2)$$

$$\mathcal{L}_G = \sum_{1\le t_1<t_2\le|\mathbf{A}|}\left\|\sum_{i\in I^{t_1}}\frac{\mathcal{H}_i}{|I^{t_1}|}-\sum_{j\in I^{t_2}}\frac{\mathcal{H}_j}{|I^{t_2}|}\right\|_2, \quad (3)$$

Method



$$Y = \arg\max_{y} \; p_{\mathrm{LM}}(y|\mathrm{Prefix}^*; \mathcal{X})$$

$$\mathrm{Prefix}^* = \mathrm{MLP}_\theta(\tilde{\mathcal{H}}^* + \lambda\varepsilon_i), \; \varepsilon_i \sim \mathcal{N}(\mathbf{0}, \mathbf{I}). \tag{5}$$

Algorithm 1 Intersection Searching

Input: $\mathcal{H}_i, i \in \bigcup_{t=1}^{N} I_{\alpha_t}^t$ from N attributes
ω_{α_t} weight of each attribute
Output: Intersection of N attributes: $\tilde{\mathcal{H}}^*$

Initialize M candidates:$\{\tilde{\mathcal{H}}_m^0\}$
Iterate S times
for s in $[0, S-1]$ **do**
  for m in $[1, M]$ **do**
    $\tilde{\mathcal{H}}_m^{s+1} \leftarrow \mathbf{0}$
    for t in $[1, N]$ **do**
      $\mathbf{H} \leftarrow \underset{topK}{\mathrm{Nearest}}(\tilde{\mathcal{H}}_m^s, \{\mathcal{H}_i, i \in I_{\alpha_t}^t\})$
      $\tilde{\mathcal{H}}_m^{s+1} \leftarrow \tilde{\mathcal{H}}_m^{s+1} + \omega_{\alpha_t} \mathrm{mean}(\mathbf{H})$
    end for
    $\tilde{\mathcal{H}}_m^{s+1} \leftarrow \tilde{\mathcal{H}}_m^{s+1} / \sum_{t=1}^{N} \omega_{\alpha_t}$
  end for
end for
$\tilde{\mathcal{H}}^* \leftarrow \mathrm{Select}(\{\tilde{\mathcal{H}}_m^S\})$

Experiments

Pos. Sports NonTox.	**PPLM**	More importantly, the first day of the 2017 NFL Draft is always exciting to watch with fans, because the league is going to get a lot of great talent on defense in the coming weeks. The biggest draft prospect to come out this year, Alabama DT Vic Beasley
	GeDi	More importantly, I appreciated his honesty along the way. Orlando Pace is usually a shadow of his former self, but he understood the importance of all that went into this win and smiled again.
	MU COCO	More importantly, he was able to defenders it work. it two men Fans in likeness fans on a Rugby coach. He had justovich from medical trip that Europe and was looking partners a place to eat. loved had never been in a bar
	Mix& Match	More importantly, the sixth game of the 2018 stanley cup finals presents a new challenge and an exciting new opportunity. the philadelphia flyers and pittsburgh penguins are joining forces for a six-game road trip that begins in the nation's capital each weekend.
	Prefix *concate*	More importantly, I have to remind everyone that this is a real story, so the fact that the two men were not a couple of people who have to be treated as one of those who would be involved with the team.
	Prefix *semi*	More importantly, the Boston Red Sox have lost the league title, and the players themselves are not yet qualified to be the best player in the league. The fact that they are not even qualified to play a match of the best.
	Ours	More importantly, the Houston Astros won a great opportunity to make a comeback with a victory over the Detroit Tigers in the National League West. The team has an outstanding offensive line and is tied for fifth in scoring among the nation.

Experiments

Methods	Average↑ (%)	Sentiment↑ (%)	Topic↑ (%)	Detoxification↑ (%)	PPL.↓	Dist.↑
Weighted Decoding Based Methods						
PPLM	71.0 ± 21.4	64.7 ± 24.8	63.5 ± 22.7	84.9 ± 6.5	62.6	62.0
GeDi	81.4 ± 14.7	76.1 ± 17.2	73.8 ± 11.3	94.2 ± 1.9	116.6	75.1
Multi-Objective Optimization Based Methods						
MUCOCO	73.9 ± 24.1	65.0 ± 33.7	67.2 ± 18.3	89.5 ± 3.5	405.6	49.7
Mix&Match	79.7 ± 21.8	73.5 ± 25.9	69.9 ± 21.1	95.8 ± 1.9	63.0	61.8
Prefix-Tuning Based Methods						
Contrastive Prefix						
concatenation	77.2 ± 18.5	67.3 ± 20.7	71.8 ± 16.5	92.6 ± 2.9	54.6	39.9
semi-supervised	81.3 ± 16.5	74.4 ± 19.6	76.9 ± 16.7	92.7 ± 3.5	31.9	43.3
Ours	**87.4** ± 10.9	**86.7** ± 10.5	**84.8** ± 14.2	90.7 ± 7.4	28.4	49.5
w/o $\mathcal{L}_G$	80.9 ± 16.2	71.6 ± 11.7	75.9 ± 18.9	95.3 ± 2.6	71.5	58.9
w/o $\mathcal{L}_C$	62.3 ± 41.8	49.1 ± 49.8	41.7 ± 36.0	**96.0** ± 0.1	473.0	37.0

Table 1: Automatic Results on Multi-Aspect Control. Hyperparameters and details are in §B.

Thanks !