

Paraphrase Generation via Adversarial Penalizations

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1. Introduction

- We test how input representations affect the performance of a model.
- We present an alternative to MLE and REINFORCE to train a supervised adversarial model.
- We test the substitution of Monte-Carlo search to speed-up the training process.

2. Input representations

We tested 3 static input representations with a Convolutional Sequence to Sequence (ConvS2S) architecture:

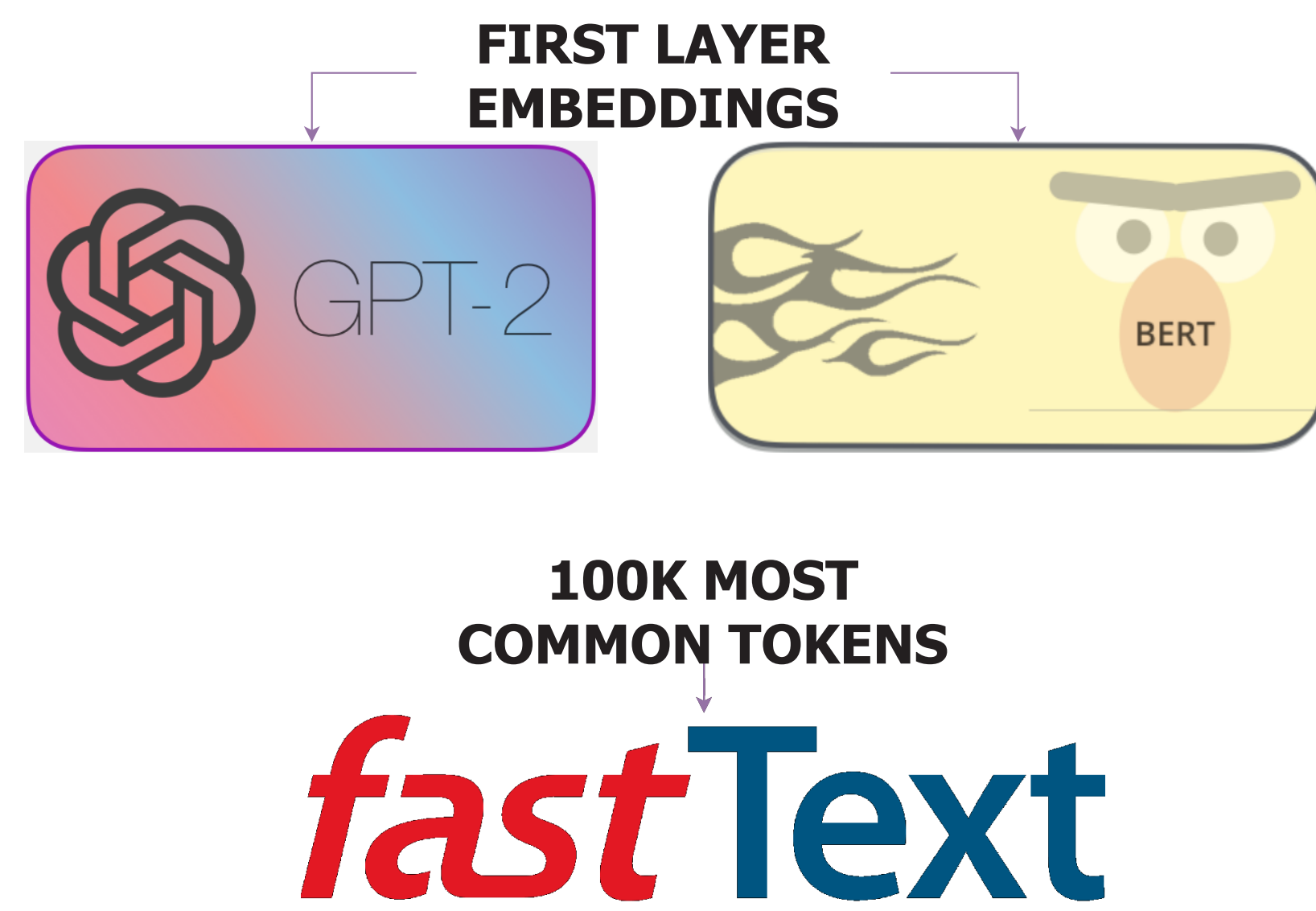
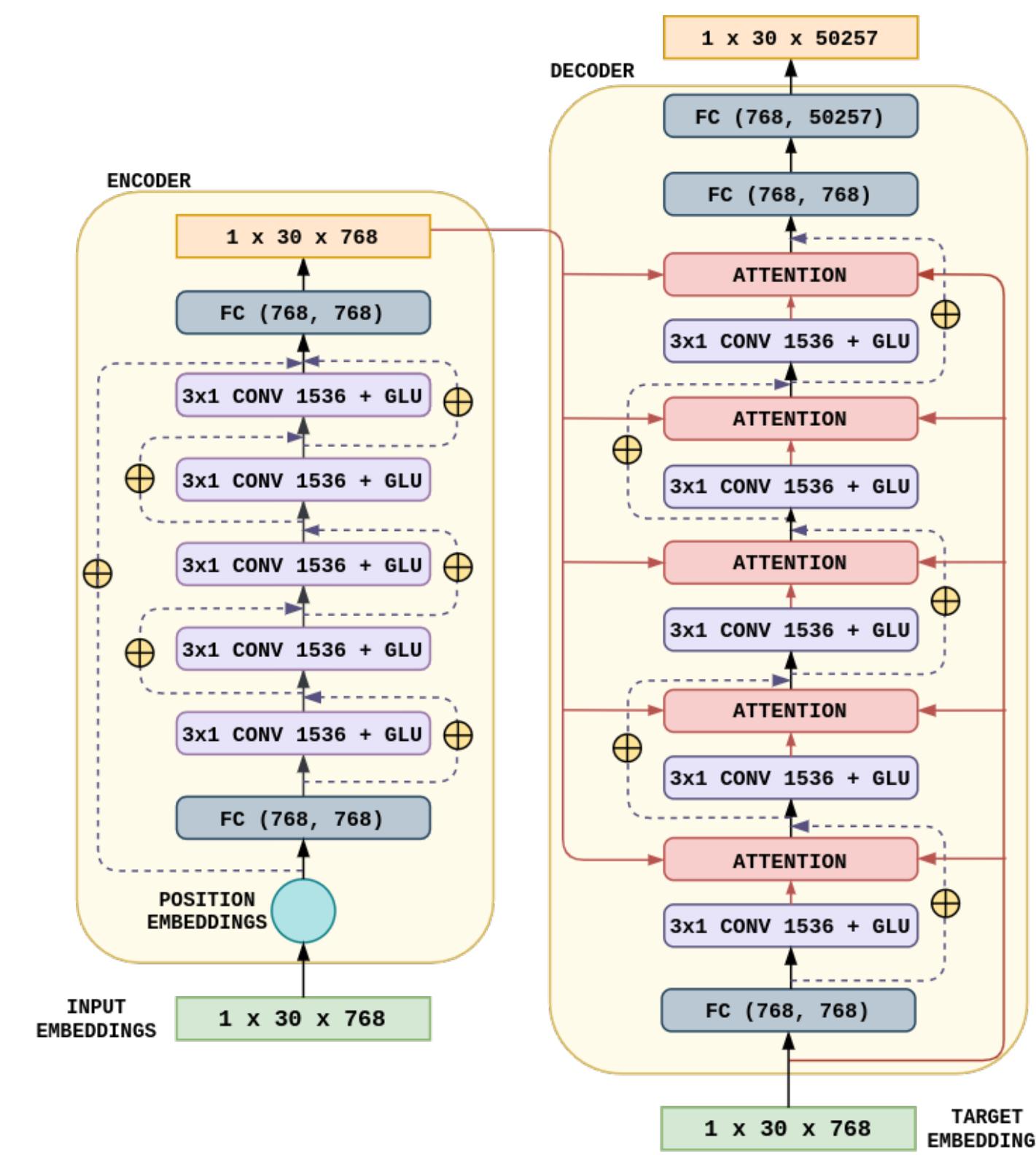


Table 1: Results by changing the input representation.

Input Representation	BLEU-2		
	Quora I	Quora II	Quora III
GPT-2 embeddings	44.84	33.48	42.48
BERT embeddings	39.03	19.18	29.28
Fasttext embeddings	31.20	17.37	28.19

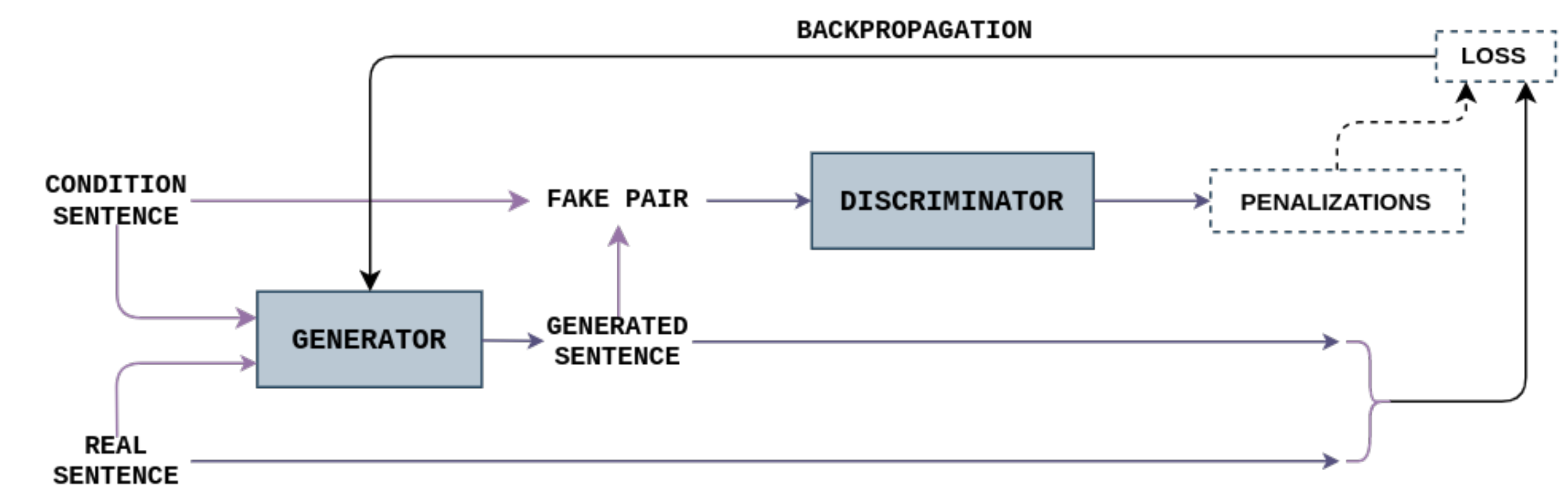
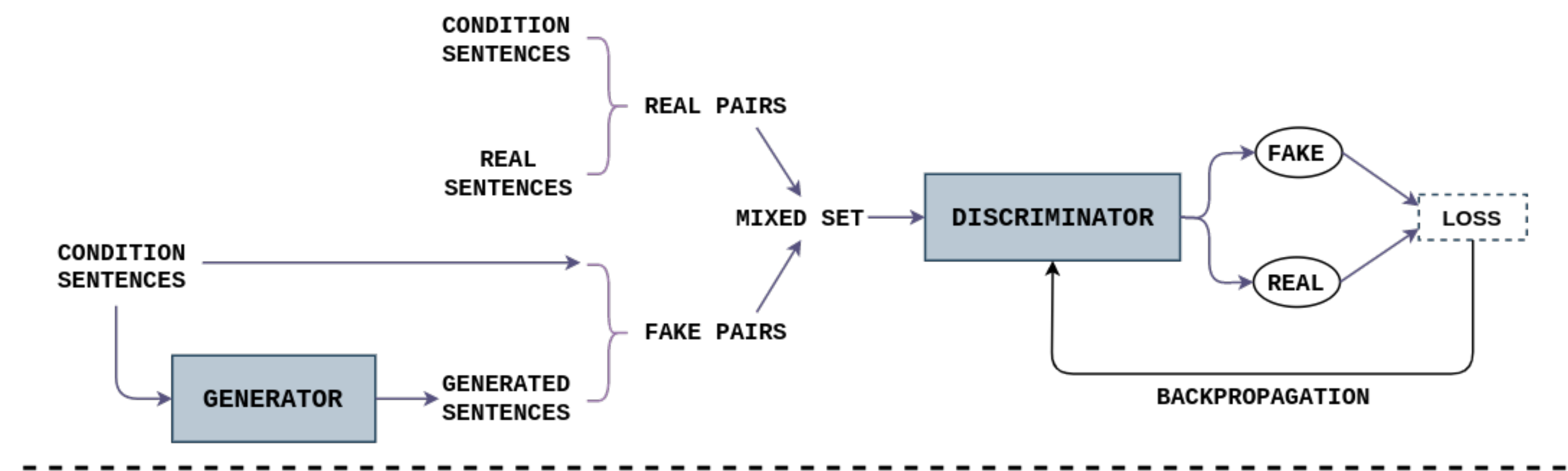
3. Architecture

Both generator G_θ and discriminator D_ϕ are ConvS2S models:



- G_θ produces a sequence $\hat{Y}_{1:T} = (\hat{y}_1, \hat{y}_2, \dots, \hat{y}_T)$ where \hat{y}_t belongs to a vocabulary.
- D_ϕ produces a normalized score $[0, 1]$ for each evaluated token \hat{y}_t , where 1 is the score if \hat{y}_t is fake.

4. Training



Condition (X): input. **Generated (\hat{Y}):** G_θ output. **Real (Y):** ground truth.

D_ϕ loss: Classify *condition-real (real pair)*, or *condition-generated (fake pair)*.

$$J(\phi) = -\log D_\phi(X, Y) - \log(1 - D_\phi(X, \hat{Y})) \quad (1)$$

G_θ loss: Multiplication of the negative log-likelihood loss of each word by the result of our penalization function $P_{D_\phi}^{G_\theta}(t)$.

$$J(\theta) = -\sum_{t=1}^T \mathbb{E}_{\hat{Y}_{1:T} \sim Y_{1:T}} \left[\sum_{\hat{y}_t \in \hat{Y}} \log G_\theta(\hat{y}_t | \hat{Y}_{1:T}, X) \cdot P_{D_\phi}^{G_\theta}(t) \right] \quad (2)$$

$P_{D_\phi}^{G_\theta}(t)$: discriminator output in the timestep $t \in T$ multiplied by a constant $k = 2$.

5. Results

Proposed Model	Quora I					
	BLEU-2	BLEU-4	iBLEU	ROUGE-1	ROUGE-2	METEOR
VAE-SVG (Gupta et al., 2018)	-	22.50	-	-	-	25.50
VAE-SVG-eq (Gupta et al., 2018)	-	22.90	-	-	-	25.50
RbM-SL (Li et al., 2018)	43.54	-	-	64.39	38.11	32.84
RbM-IRL (Li et al., 2018)	43.09	-	-	64.02	37.72	31.97
DNPG (Li et al., 2019)	-	25.03	18.01	63.73	37.75	-
GAP (Yang et al., 2019)	44.83	-	-	-	-	32.48
TranSEQ (Egonmwan et al., 2019)	38.75	-	-	-	-	35.84
Transformer	42.03	26.56	20.17	57.80	34.25	29.06
ConvS2S	44.84	29.44	21.20	61.72	38.48	31.28
REINFORCE	43.96	28.87	20.86	60.43	37.53	31.12
Conv-Adv-MC	44.65	29.48	21.08	61.18	38.03	31.01
Conv-Adv-S (ours)	44.84	29.07	21.40	60.34	37.09	31.27

6. Sample outputs

Input Sentence	ConvS2S	Conv-Adv-S (ours)	Target sentence
what is the difference between militants and terrorists?	what is the difference between terrorists and terrorists?	what is the difference between a person and terrorists?	what is the difference between terrorists and militants?
who is going to win, trump or hillary?	who will win the election, trump or clinton?	who will win, trump or clinton?	who will win, trump or clinton?
is it possible to advertise on quora?	is it possible to advertise on quora?	is promotion allowed on quora?	can we advertise our business on quora?
how do you train your memory to memorize things fast?	how do i memorize my memory?	how can i memorize things faster?	how can i memorize things faster?
why doesn't germany pursues indigenous jet engine development?	why doesn't germany angulic in the world?	why doesn't the germany always a bit of it's limited/2.2.2.50 & sandys have been fired in the	why doesn't germany produce jet engines?