

# Paper Reading

Jun Gao

Tencent AI Lab

July 19, 2018

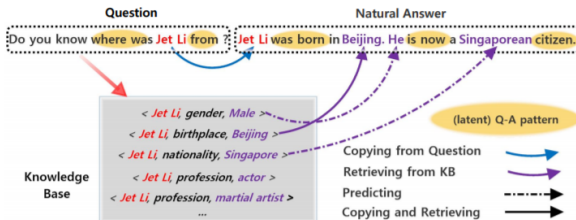
# **Generating Natural Answers by Incorporating Copying and Retrieving Mechanisms in Sequence-to-Sequence Learning**

**Shizhu He<sup>1</sup>, Cao Liu<sup>1,2</sup>, Kang Liu<sup>1</sup> and Jun Zhao<sup>1,2</sup>**

<sup>1</sup> National Laboratory of Pattern Recognition, Institute of Automation,  
Chinese Academy of Sciences, Beijing, 100190, China

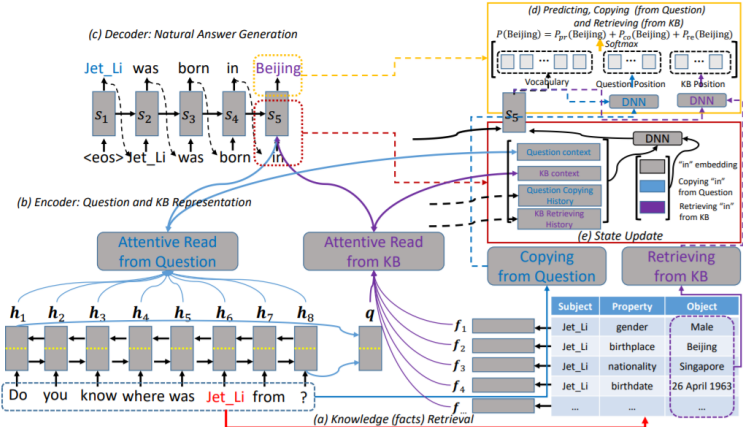
<sup>2</sup> University of Chinese Academy of Sciences, Beijing, 100049, China  
{shizhu.he, cao.liu, kliu, jzhao}@nlpr.ia.ac.cn

# Introduction



- ▶ In real-world environments, most people prefer the correct answer replied with a more natural way.
- ▶ GenQA cannot copy SUs from the question in generating answers.
- ▶ CopyNet cannot retrieve SUs from external memory.
- ▶ COREQA incorporates COpying and REtrieving mechanisms within Seq2Seq learning.

# Model Overview



# Encoder

- ▶ Question Encoding: a bi-directional RNN.
- ▶ Knowledge Base Encoding:
  - ▶  $s, p$  and  $o$ : subject, property and object.
  - ▶  $\mathbf{e}_s, \mathbf{e}_p, \mathbf{e}_o$ : its corresponding embeddings.
  - ▶ The fact representation  $\mathbf{f}$  is then defined as the concatenation of  $\mathbf{e}_s, \mathbf{e}_p, \mathbf{e}_o$ .
  - ▶  $\mathbf{M}_{KB} = \{\mathbf{f}\}$
  - ▶ define the matching scores function between question and facts as  $S(q, s_t, f_j) = DNN_1(\mathbf{q}, \mathbf{s}_t, \mathbf{f}_j)$ .

# Decoder

$$\begin{aligned} p(y_t | \mathbf{s}_t, y_{t-1}, \mathbf{M}_Q, \mathbf{M}_{KB}) = & \\ p_{pr}(y_t | \mathbf{s}_t, y_{t-1}, \mathbf{c}_t) \cdot p_m(pr | \mathbf{s}_t, y_{t-1}) + & \\ p_{co}(y_t | \mathbf{s}_t, y_{t-1}, \mathbf{M}_Q) \cdot p_m(co | \mathbf{s}_t, y_{t-1}) + & \\ p_{re}(y_t | \mathbf{s}_t, y_{t-1}, \mathbf{M}_{KB}) \cdot p_m(re | \mathbf{s}_t, y_{t-1}) & \end{aligned}$$

$$p_{pr}(y_t | \cdot) = \frac{1}{Z} e^{\psi_{pr}(y_t)}$$

$$p_{co}(y_t | \cdot) = \frac{1}{Z} \sum_{j: Q_j = y_t} e^{\psi_{co}(y_t)}$$

$$p_{re}(y_t | \cdot) = \frac{1}{Z} \sum_{j: KB_j = y_t} e^{\psi_{re}(y_t)}$$

- ▶  $\phi_{pr}(y_t = v_i) = \mathbf{v}_i^T \mathbf{W}_{pr}[\mathbf{s}_t, \mathbf{c}_{qt}, \mathbf{c}_{kbt}]$
- ▶  $\phi_{co}(y_t = x_i) = \mathbf{h}_j, \mathbf{s}_t, \mathbf{hist}_Q$
- ▶  $\phi_{re}(y_t = v_i) = \mathbf{f}_j, \mathbf{s}_t, \mathbf{hist}_{KB}$

# Experiments

► Natural QA in Restricted Domain

<b>Q-A Patterns</b>	<b>Examples</b> (e.g. KB facts (e2,year,1987);(e2,month,6); (e2,day,20);(e2,gender,male))
When is %e birthday? He was born in %m %dth.	When is e2 birthday? He was born in June 20th.
What year were %e born? %e is born in %y year.	What year were e2 born? e2 is born in 1987 year.

<b>Models</b>	$P_g$	$P_y$	$P_m$	$P_d$	$P_A$	$R_A$	$F1_A$
RNN	72.2	0	1.1	0.2	0	27.5	0
RNN+atten	55.8	1.1	11.3	9.5	1.7	34	3.2
CopyNet	75.2	8.7	28.3	5.8	3.7	32.5	6.7
GenQA	73.4	0	0	0	0	27.1	0
COREQA	<b>100</b>	<b>84.8</b>	<b>93.4</b>	<b>81</b>	<b>87.4</b>	<b>94</b>	<b>90.6</b>

# Experiments

- ▶ Natural QA in Open Domain
- ▶ one single fact (marked as Single), multiple facts (marked as Multi) and all (marked as Mixed).

<b>Models</b>	<b>Single</b>	<b>Multi</b>	<b>Mixed</b>
CopyNet	9.7	0.8	8.7
GenQA	47.2	28.9	45.1
COREQA	<b>58.4</b>	<b>42.7</b>	<b>56.6</b>

<b>Models</b>	<b>Correctness</b>	<b>Fluency</b>	<b>Coherence</b>
CopyNet	0	13.3	3.3
GenQA	26.7	33.3	20
COREQA	<b>46.7</b>	<b>50</b>	<b>60</b>



# Examples of the generated natural answers

ID	Question	Gold Answer	Generated Natural Answer
1	拜仁的哈格里夫斯是哪国人? Which country did <i>Hargreaves</i> of Bayern comes from?	英国人! 加拿大出生 British! born in Canada	加拿大人, 英国人 Canadians, British
2	沙祖康是哪个族的? Which ethnic groups is <i>Sha Zukang</i> from?	汉族现在是联合国副秘书长 Han, now he is the DSG of the UN	联合国副秘书长, 是汉族 DSG of the UN, Han
3	罗伯特·舒曼是谁? Who is <i>Robert Schumann</i> ?	是一个作家、音乐家 a writer, musician	罗伯特·舒曼个作家 哲学家 Robert Schumann is a writer and philosopher.
4	马斯切拉诺是谁? Who is <i>Mascherano</i> ?	他是一名足球运动员 He is a football player	一个优秀的足球 运动员 An excellent football player
5	巴尔扎克与小裁缝的导演是谁? Who is the director of <i>The Little Chinese Seamstress</i> ?	戴思杰 Dai Sijie	导演是戴思杰 Director Dai Sijie
6	电影铁三角是谁拍的? Who shot the movie <i>The Iron Triangle</i> ?	徐克、林岭东、杜琪峰 Tsui Hark, Johnny To, Ringo Lam	冯小刚 Feng Xiaogang
7	谁知道席慕容这个人的一些详细资料? Who knows some details of <i>Xi Murong</i> ?	女诗人 poetess	是是是 yes, yes, yes
8	泡泡堂是哪个公司开发的? Which company developed the game <i>Crazy Arcade</i> ?	应该是上海盛大 should be the Shanda Group	玩上海盛大 playing Shanda Group