Tailored Sequence to Sequence Models to Different Conversation Scenarios

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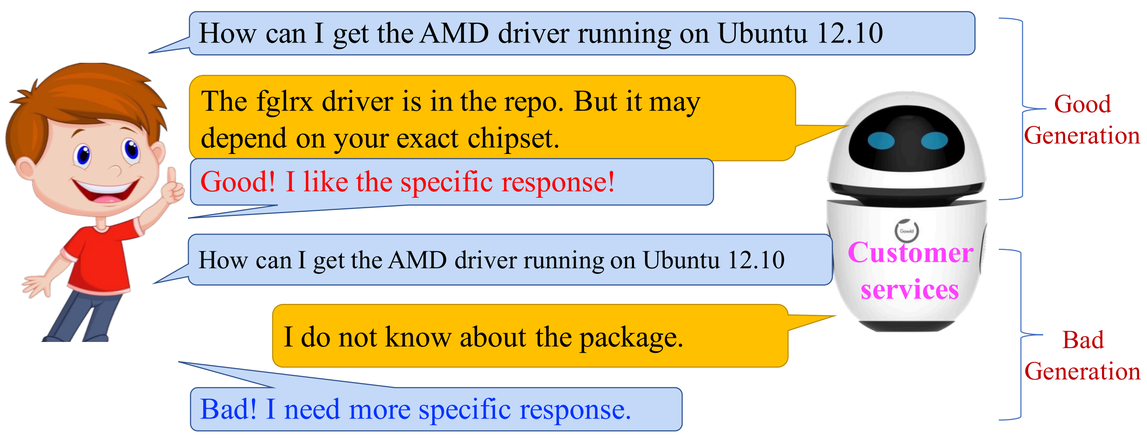
Background:

Open-domain Conversation Generation （Chatbot） is an artificial intelligence which conducts a conversation via auditory or textual methods, designing to convincingly simulate how a human would behave as a conversational partner, thereby passing the Turning test. ——wiki

Different Conversation Scenarios need different conversation strategy. The specific-requirement scenario, like **customer services**, need the **specific and accurate response**. While the diverse-requirement scenario, like **chatbot**, need the **diverse and interesting response**. We defined the Post as $X=\{x_1,\ldots,x_M\}$, $x_i \in V$ and Response as $Y=\{y_1,\ldots,y_N\}$, $y_i \in V$.

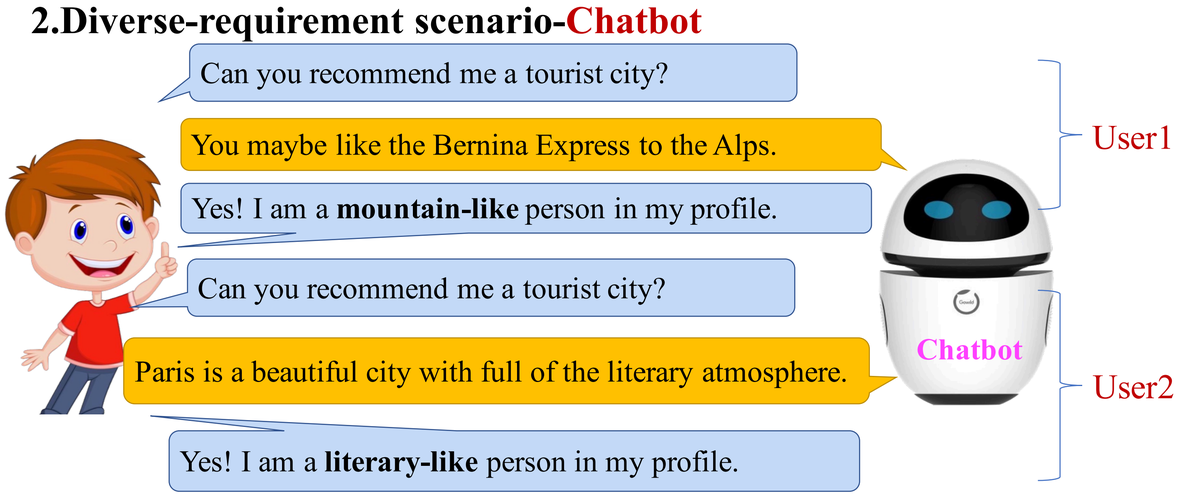
Motivation: The requirements for different conversation scenarios are distinct.

1.Specific-requirement scenario-Customer Services



The model should have the ability to reply specific and accurate responses.

2.Diverse-requirement scenario-Chatbot



The model should have the ability to reply different responses.

Model

1. Maximum Generated Likelihood Criteria(MGL) for specific-requirement

The **most significant post-response matching pattern** is good enough for optimization!

Idea: Capture the specific matching pattern between post and response, rather than the average of multiple ground-truth responses.

Solution: Given the post X and its ground-truth responses $\{Y_X^{(1)}, Y_X^{(2)}, \ldots, Y_X^{(m_X)}\}$, the objective function is:

$$\mathcal{L} = \sum_{X} \sum_{k=1}^{m_X} \max \log P(Y_X^{(k)}|X)$$

where m_X is the number of ground-truth responses for post X.

Tips: You can take any pick-strategy which is suitable for your task.

2. CVaR Criteria for diverse-requirement

Pay **more attention to the worst-cases** after pre-trained and make the **generation probability average for every** ground-truth responses.

Idea: The model should capture the various matching patterns between post and its ground-truth.

Solution: Optimize the conditional value-at-risk (CVaR), **a prominent risk measure used extensively in finance**.

Given the post X and its ground-truth responses $\{Y_X^{(1)}, Y_X^{(2)}, \ldots, Y_X^{(m_X)}\}$, the objective function is:

$$\mathcal{L} = \sum_{X} \frac{1}{1-\alpha} \sum_{Y_X^{(k)} \epsilon y_{1-\alpha}} P(Y_X^{(k)}|X)$$

$$\mathrm{Sup}\{P\left(Y_X^{(i)}\middle|X\right) : Y_X^{(i)} \epsilon y_{1-\alpha}\} \leq \alpha$$

where m_X is the number of ground-truth responses for post X.

Straightforward: Pay more attention to the post-responses pairs who are not generated well enough.

Conclusion: Not only improve the **generation quality**, but also improve the ability of generating **diverse responses for beam-search**.

2.1 Why CVaR can generate diverse response?

Example: Given the post X and the three number of ground-truth responses {R1,R2,R3},the conditional probability of the pre-trained model is in Time=1. Setting α=1/3, in each time step, we select two responses for deep optimization(the green color).

	Time 1	Time 2	Time N
X	Waiting for Wade in the final games.	Waiting for Wade in the final games.	Waiting for Wade in the final games.
R1	Everyone has his favorite stars.	Everyone has his favorite stars.	Everyone has his favorite stars.
	P(R1|X)=0.5	P(R1|X)=0.3 ⬇	P(R1|X)=0.34
R2	Analysis is much better than Sina.	Analysis is much better than Sina.	Analysis is much better than Sina.
	P(R2|X)=0.2	P(R2|X)=0.3 ⬆	P(R2|X)=0.33
R3	Waiting for the explosion of Mr.Flash.	Waiting for the explosion of Mr.Flash.	Waiting for the explosion of Mr.Flash.
	P(R3|X)=0.3	P(R3|X)=0.4 ⬆	P(R3|X)=0.33

… → average

Experiments

Experiment setting

- **Dataset**: Ubuntu corpus for specific-requirement
  Chinese Weibo Dataset for diverse-requirement
- **Human evaluation**: 3 students evaluate 300 post-generation pairs for each model.
- **Human criteria**:+3(strong-related) +2(common) +1(unrelated or nonfluent)
- **Group-overlap *overlap*** and **Group-diversity *divrs*** indicate the overlap and cosine similarity of every two generation for each post. The smaller, the better.

Human evaluation

Model	Human score distribution(%) 1	2	3	Ave.	Kappa
Seq2Seq-att	46.5	38.6	14.9	1.684	0.387
MMI	42	38	20	1.78	0.395
Adver-REGS	42	26	32	1.9	0.379
Single	49	14	37	1.88	0.383
MGL	33	16	51 ⬆	2.18 ⬆	0.372
CVaR	40	12	48	2.08	0.381

MGL model produces more fluent and specific results and obtains higher human evaluation score than other models.

1.Specific-requirement Scenario

Metric-based evaluation

model	distinct-1	distinct-2	BLEU	PPL
Seq2Seq-att	0.351	4.36	1.294	47.84
MMI	0.283	4.84	1.297	42.52
Adver-REGS	0.268	5.07	1.279	37.71
Single	0.324	5.27	1.342	30.36
MGL	0.358 ⬆	6.3 ⬆	1.354 ⬆	26.34 ⬇
CVaR	0.294	5.52	1.29	30.03

MGL obtains the highest distinct score, indicating that our model can generate more specific responses.

Case study

post	Install grub to the hdd where the bios is set to boot.
response	So I would not just install it to /boot?
Seq2Seq-att	A log file a bug with the install cd.
MMI	What do you mean?
Adver-REGS	How do I install grub?
Single	Do you delete grub?
MGL	I have boot with the window from the grub and it go from the boot menu.
CVaR	If you have grub on the same pc, it is 0 0 boot partition.

MGL model can generate more specific response than other average methods.

2.Diverse-requirement Scenario

Metric-based evaluation

model	BLEU	PPL	overlap	divrs
Seq2Seq	1.616	132.93	67.26	87.83
Seq2Seq-att	1.62	76.95	63.38	85.32
Adver-REGS	1.635	84.77	57.96	84.94
Mechanism	1.642	90.48	57.67	84.64
MGL	1.703	36.25	66.92	86.22
CVaR	1.652	70.94	38.96 ⬇	71.38 ⬇

CVaR model obtains the lower overlap and divrs than baselines.

Case study

post	总决赛继续等待韦德(Waiting for Wade in the final games.)
response	每个人都有每个人的喜爱(Everyone has his favorite stars.)
response	比新浪分析的好多了(Analysis is much better than Sina)
Mechanism	韦德真伟大啊!支持!(Wade is really great! Support him!)
Mechanism	韦德越来越好。(Wade will be better)
Mechanism	韦德威武!(Wade is mighty)
CVaR	决赛一定要去看看的!(I must go and see the final games)
CVaR	詹皇怎么还能这么快啊(How can James be so fast)
CVaR	决赛是一种对对手的打击,热火加油(The final games is a blow for the opposite. Heat come on)

CVaR model produces both fluent and diverse results.(about game, friend and team)

Conclusions

Maximum Generation Likelihood Model can **adapt to the specific-requirement scenario**, and it can be used in many other specific-requirement task.

CVaR Model is a **robust distribution** method from finance domain, which can improve the generation **quality for the difficult example**. And it can also improve **the diversity** of generation for the beam search.

CVaR Model can also used in **many other tasks**, in order to **improve the generation robust**. Sometimes, improve the diversity of the task.