# 第6课 Deep Learning chatbots

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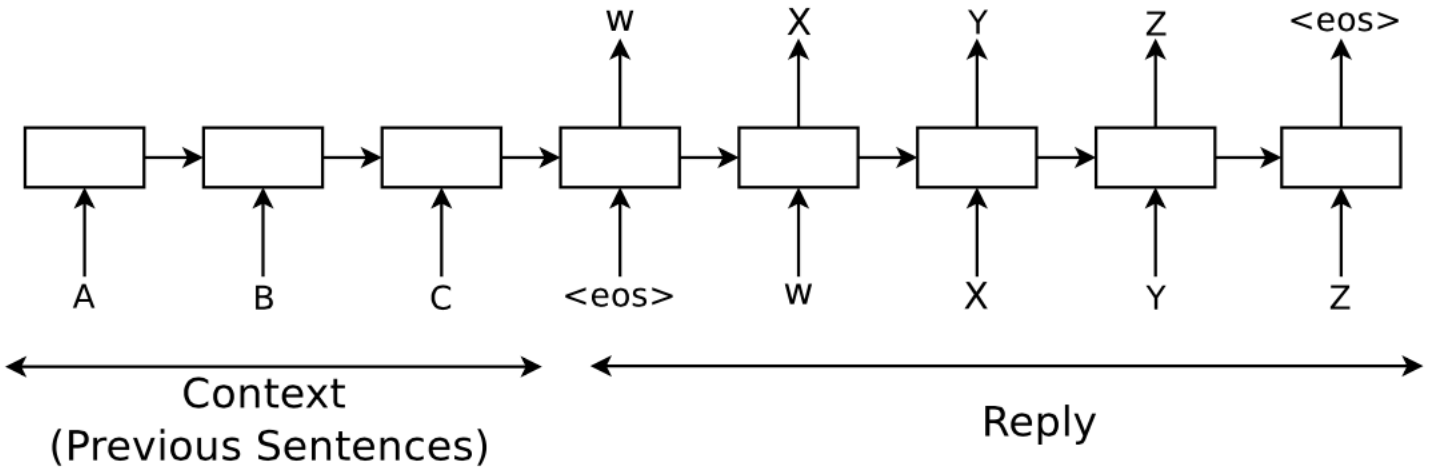
# 深度学习聊天机器人

- 《A Neural Conversational Model》
  - 论文见资料
  - 代码：https://github.com/Conchylicultor/DeepQA



# 深度学习聊天机器人

- 《A Neural Conversational Model》
  - 作者：来自Google Brain，毕业于UC Berkeley的Oriol Vinyals博士
  - 工业界论文
  - 对比cleverbot(第二代基于检索的聊天机器人)，部分回答更智能。
  - 如何客观地评价生成的效果？有一些问题没有标准答案来说，自动评价 VS 用户评价。

# 深度学习聊天机器人

- 《A Neural Conversational Model》

Conversation 4: Philosophical Q&A

**Human:** *what is the purpose of life ?*
**Machine:** *to serve the greater good .*
**Human:** *what is the purpose of living ?*
**Machine:** *to live forever .*

Conversation 3: General knowledge Q&A

**Human:** *who is skywalker ?*
**Machine:** *he is a hero .*
**Human:** *who is bill clinton ?*
**Machine:** *he 's a billionaire .*
**Human:** *is sky blue or black ?*
**Machine:** *blue .*
**Human:** *does a cat have a tail ?*
**Machine:** *yes .*
**Human:** *does a cat have a wing ?*
**Machine:** *no*
**Human:** *can a cat fly ?*
**Machine:** *no .*
**Human:** *how many legs does a cat have ?*
**Machine:** *four , i think .*

**Human:** *Are you a follower or a leader?*
**Cleverbot:** *No !!*
**Human:** *My name is david . what is my name ?*
**Cleverbot:** *How old are you David?*
**Human:** *My name is john . what is my name ?*
**Cleverbot:** *John*
**Human:** *What is the purpose of being intelligent?*
**Cleverbot:** *The purpose of life is to love God and love people.*

Conversation 5: Morality

**Human:** *what is moral ?*
**Machine:** *what empowered humanity , what intellectual the essence is .*
**Human:** *what is immoral ?*
**Machine:** *the fact that you have a child .*
**Human:** *what is morality ?*
**Machine:** *what is altruism ?*
**Human:** *what is the definition of altruism ?*
**Machine:** *if you don 't believe in god , then you don 't know .*
**Human:** *ok ... so what is the definition of morality ?*
**Machine:** *well , the truth is , you 're not a believer in god almighty .*

# 深度学习聊天机器人

- 《A Diversity-Promoting Objective Function for Neural Conversation Models》
  - 论文见资料
  - Jiwei Li关于《A Persona-Based Neural Conversation Model》的pre-paper
  - Seq2seq容易产出”呵呵”，”都可以”，”我不知道”这种safe但无意义的回答
  - 自然语言生成问题中，经常使用MLE作为目标函数，产出的结果通畅，但diversity差，可以考虑decoder产出n-best，再rank
  - 提出Maximum Mutual Information(MMI)作为目标函数，有MMI-antiLM和MMI-bidi 2种

# 深度学习聊天机器人

- 《A Diversity-Promoting Objective Function for Neural Conversation Models》

| message | SEQ2SEQ | MMI $P(T\|S) - \lambda P(T)$ |
|---|---|---|
| I did not get the report from an mi-6 agent. | I don't think that's a good idea. | You did the right thing, did you? |
| You haven't been given an assignment in this case. | I don't know what you are talking about. | I've been looking all over for you. |
| I'm losing my grip. | I don't know what you are talking about. | I'm the only one in the world. |
| I am ready to help. | Come on, come on | I have something we need to talk about. |
| You programmed me to gather intelligence. That's all I've ever done. | You know that, don't you? | You do have fun, don't you? |
| I mean, we'd have to talk to him. | I mean, I don't know. | I mean, he's a good guy. |
| This has nothing to do with him. | You don't know anything about him, do you? | I know him as much. |
| How come you never say it? | I don't know | Because I don't want to hurt you |
| He is the one behind this scheme to crash x-net. | I don't know what you are talking about | Yes, he is, isn't he? |
| How much time do you have here? | I don't know. | Not long enough. Sorry, sir. |

Table 4: Responses from the SEQ2SEQ baseline and MMI-antiLM models on the OpenSubtitles dataset.

# 深度学习聊天机器人

- 《A Diversity-Promoting Objective Function for Neural Conversation Models》

| message | SEQ2SEQ | MMI-bidi |
|---|---|---|
| Ohh I've never seen that! How long does it take you guys to learn the drill? | I don't even know. | Like 2 weeks ago!! |
| You'll know when we sign Heskey in 2 weeks | I'll see what I can do | I sure hope so.. |
| I'm waiting!! I have even got biscuits waiting for you?? | I have no idea what you're talking about | I'll send you a pic when I get home xx |
| My parents actually had touch too much played at their wedding. | I have no idea what you're talking about | How old are they?? |
| Say anything you want... I know you love me and I love you. | I love you so much. | I love you too, baby. |
| I am off all week next week | What time you going? | What time you going? |
| How are you doing? | I'm good, thanks. | I'm good, you? |

Table 5: Responses from the SEQ2SEQ baseline and MMI-bidi models on the Twitter dataset.

# 深度学习聊天机器人

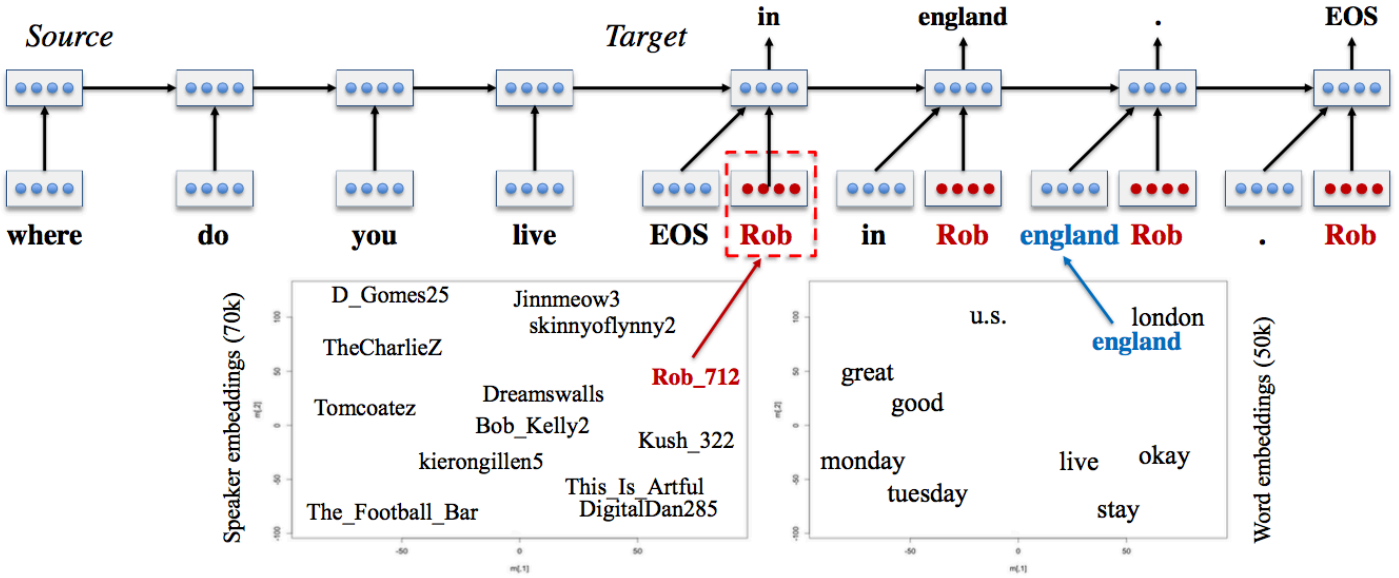
- 《A Persona-Based Neural Conversation Model》
  - 论文见资料
  - 代码：https://github.com/jiweil/Neural-Dialogue-Generation
  - 解决多轮对话回答不一致问题

| | |
|---|---|
| *message* | Where do you live now? |
| *response* | I live in Los Angeles. |
| *message* | In which city do you live now? |
| *response* | I live in Madrid. |
| *message* | In which country do you live now? |
| *response* | England, you? |
| *message* | Where were you born? |
| *response* | I was born in Canada. |
| *message* | Where are you from? |
| *response* | England, you? |
| *message* | Where did you grow up? |
| *response* | I grew up in Texas. |

| | |
|---|---|
| *message* | How old are you? |
| *response* | 16 and you? |
| *message* | What's your age? |
| *response* | 18. |
| *message* | What is your major? |
| *response* | I'm majoring in psychology |
| *message* | What did you study in college? |
| *response* | English lit. |

# 深度学习聊天机器人

- 《A Persona-Based Neural Conversation Model》
  - Model中融入user identity（比如背景信息、用户画像，年龄等信息），构建出个性化的seq2seq模型，为不同的user，以及同一个user对不同的对象对话生成不同风格的response



# 深度学习聊天机器人

- 《A Persona-Based Neural Conversation Model》
  - Speaker Model 和 Speaker-Addressee Model

$$\begin{bmatrix} i_t \\ f_t \\ o_t \\ l_t \end{bmatrix} = \begin{bmatrix} \sigma \\ \sigma \\ \sigma \\ \tanh \end{bmatrix} W \cdot \begin{bmatrix} h_{t-1} \\ e_t^s \\ v_i \end{bmatrix}$$

$$c_t = f_t \cdot c_{t-1} + i_t \cdot l_t$$

$$h_t^s = o_t \cdot \tanh(c_t)$$

$$V_{i,j} = \tanh(W_1 \cdot v_i + W_2 \cdot v_2)$$

$$\begin{bmatrix} i_t \\ f_t \\ o_t \\ l_t \end{bmatrix} = \begin{bmatrix} \sigma \\ \sigma \\ \sigma \\ \tanh \end{bmatrix} W \cdot \begin{bmatrix} h_{t-1} \\ e_t^s \\ V_{i,j} \end{bmatrix}$$

$$c_t = f_t \cdot c_{t-1} + i_t \cdot l_t$$

$$h_t^s = o_t \cdot \tanh(c_t)$$

# 深度学习聊天机器人

- 《A Hierarchical Latent Variable Encoder-Decoder Model for Generating Dialogues》
  - 论文见资料
  - 代码：https://github.com/julianser/hed-dlg-truncated
  - 作者来自蒙特利尔大学和Maluuba公司
  - 意在解决语言模型生成部分存在的问题
  - 整个seq2seq框架中decoder生成部分的问题，不仅是bot领域对话生成的问题，都可以尝试用这个方式。

# 深度学习聊天机器人

- 《A Hierarchical Latent Variable Encoder-Decoder Model for Generating Dialogues》
  - latent topic在LSI、推荐系统中都发挥了很大的作用，矩阵分解之后得到两个降维之后的矩阵，可以产出所谓的latent topic，这些topic也许没有人可理解的物理含义，但却能将相似的东西聚到了一起。
  - 这篇paper用latent topic来描述隐藏在utterance中无法直接定义的随机noise，提升效果。

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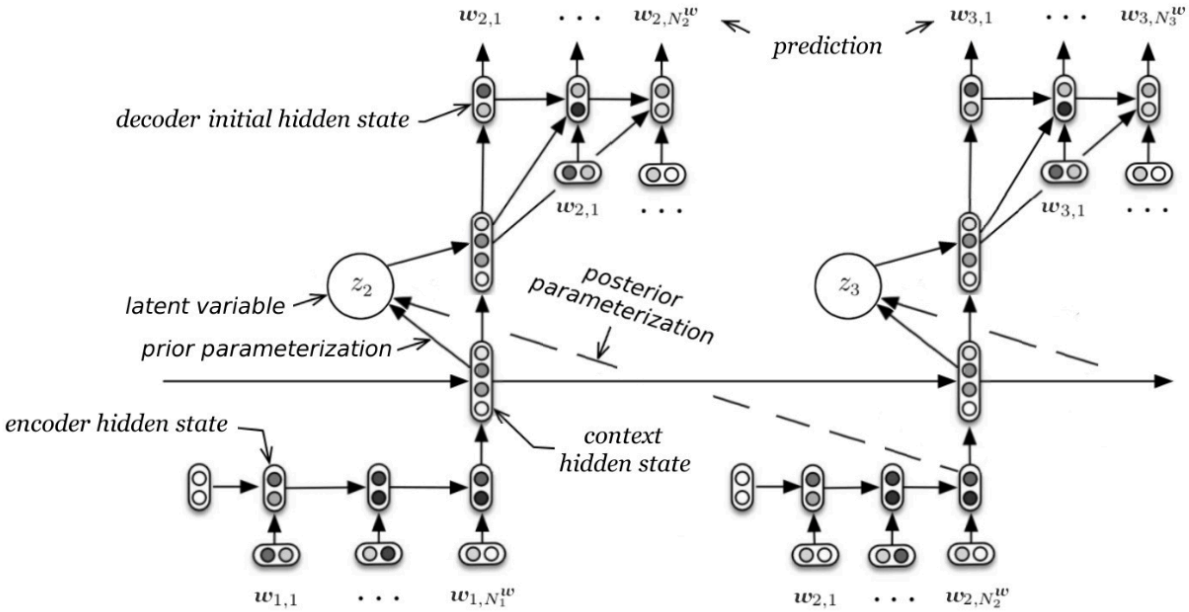


Figure 1: Computational graph for VHRED model. Rounded boxes represent (deterministic) real-valued vectors. Variables **z** represent latent stochastic variables.

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# 深度学习聊天机器人

## 更多论文和参考资料(感谢PaperWeekly)

- 《End-to-end LSTM-based dialog control optimized with supervised and reinforcement learning》
  - http://rsarxiv.github.io/2016/07/17/End-to-end-LSTM-based-dialog-control-optimized-with-supervised-and-reinforcement-learning-PaperWeekly/
- 《A Network-based End-to-End Trainable Task-oriented Dialogue System》
  - http://rsarxiv.github.io/2016/07/12/A-Network-based-End-to-End-Trainable-Task-oriented-Dialogue-System-PaperWeekly
- 《A Neural Network Approach to Context-Sensitive Generation of Conversational Responses》
  - http://rsarxiv.github.io/2016/07/15/A-Neural-Network-Approach-to-Context-Sensitive-Generation-of-Conversational-Responses-PaperWeekly/
- Sequence to Backward and Forward Sequences: A Content-Introducing Approach to Generative Short-Text Conversation
  - http://rsarxiv.github.io/2016/07/09/Sequence-to-Backward-and-Forward-Sequences-A-Content-Introducing-Approach-to-Generative-Short-Text-Conversation-PaperWeekly/

感谢大家么么哒！

恳请大家批评指正！