

# Neural Conversational Model

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15/09/18

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# 本論文について

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- 発表学会：ICML 2015 workshop
- Googleのチーム
  - ”Sequence to Sequence Learning with Neural Networks” (同グループの先行研究) を応用
- 会話生成について調べていたので選んだ

# Introduction

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- NNのEnd-to-end学習
  - 複雑な構造を、他の複雑な構造にマッピングすることができる
    - 自然言語理解などで用いられる
- 会話モデリングに応用
  - これまでの会話モデルはドメインを絞ることが多かったが、今回はnoisyなドメインでも検証している

# Related works

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- Chatter bot
  - マルコフ型
    - 文章から単語を抽出し、その単語に続く確率の高い単語をつなげる
      - 投げかけられた文章と何らかの意味的なつながりがある可能性が高いので、会話が成立しているように錯覚する。
  - テンプレート型
    - あらかじめ想定される会話文をテンプレートとして保存しておく
      - IBMのWatsonとかはたぶんこれ
- Neural language modeling
  - Neural machine translationなど
  - LSTMを用いたRNNが多い
    - Word2vec、Sequence to Sequenceなど

# Chatter bot

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本の色彩はガチャガチャしたことだろう、私の熱を見せびらかすためには至らなかったと思う。

「そうしたらあの気詰まりな丸善も粉葉みじんだろう、私は肺尖を悪くして外へ出る。しかしどうしたなんて私は幼い時よくそれをそのままにしてもよそよそしい表通りよりもどこか親しみのある、汚い洗濯物が干してあったが、その果物屋固有の美しさが最も露骨に感ぜられた。

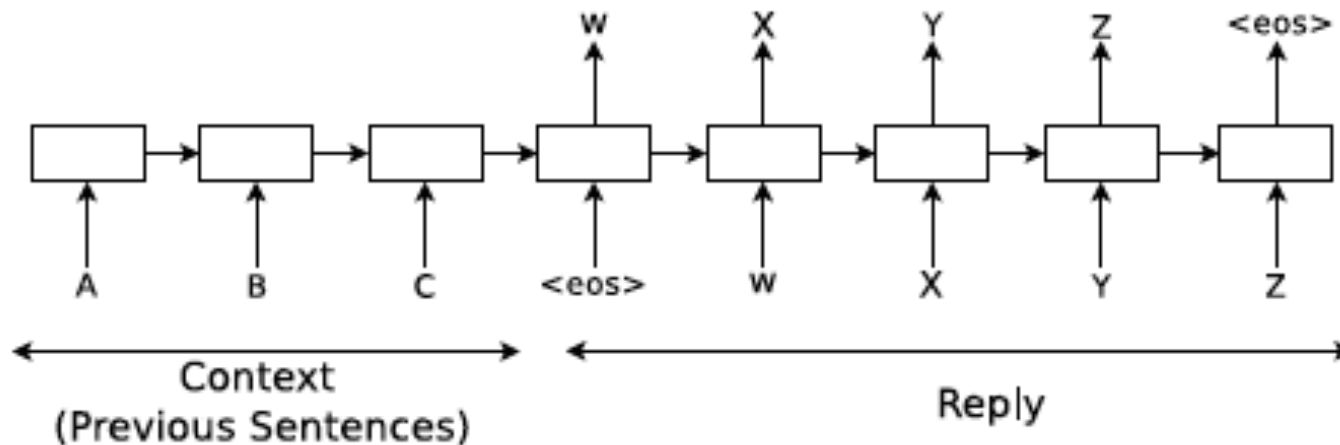
しかも呪われた私の熱を見せびらかすためには至らなかった私の心を唆った。そして結局一等いい鉛筆を一本買うくらいの贅沢をするのだったアングルの橙色の重い本までなおいっそうの堪えがたさのために手の握り合いなどをしている掌から身内に元気が目覚めて来たとみえて、一度この檸檬で試してみたら。

適当に作ってみても、なんとなく文章っぽいものにはなるが、意味をなさない場合がほとんど

# Model

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- Seq2seq modelを応用
  - 著者らのグループがNIPS2014にて発表



A,B,C,<EOS>の表現を学習し、それを用いて  
W,X,Y,Z,<EOS>の確率を計算する

# Seq2Seq model

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- 多層のLSTMを用いて、文章をベクトル化した後、別の多層LSTMを用いてベクトルを文章にデコードする
- 英語-フランス語の翻訳コンテンツでのデータセットに対して用い、検証。
  - 4層のLSTM、8つのGPUで学習

# Dataset

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- Closed domain
  - IT Help desk trouble shooting dataset
    - IT関連のカスタマーサポートでの会話から作成された会話のデータセット
      - ユーザからの質問に専門家が対応する
    - 学習と評価でのデータサイズ
      - Train: 30M tokens
      - Test: 3M tokens
    - 一連のやりとりは平均400語程度



# Dataset

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- Open domain
  - Movie transcript dataset
    - 登場人物による映画内での会話がxml形式で与えられたデータセット
    - 学習と評価でのデータサイズ
      - Train: 62M sentences (923M tokens)
      - Test: 26M sentences (395M tokens)
    - Help deskのものとは比べるとnoisyなデータ

# Experiments (IT Helpdesk)

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- 評価
  - Test setにおけるperplexity of the model (モデルに対する当惑度) で評価
- 学習
  - 単層のLSTM (1024のメモリーセル)
  - Gradient clippingを用いたSGD
- 比較
  - N-gram model
- 当惑度
  - Seq2seq: 8
  - N-gram: 18

# Experiments (IT Helpdesk)

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- 会話の設定
  - VPN issues
  - Browser issues
  - Password issues

# Experiments (IT Helpdesk)

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Conversation 1: VPN issues.

Describe your problem: i am having issues accessing vpn

**Machine:** *hi*

**Human:** *hello*

**Machine:** *could you please let me know what are the operating systems you are using ?*

**Human:** *i am using linux*

**Machine:** *ok it was in the ssl vpn on which you stated it was broken*

**Machine:** *please check if you are logged in to corp network*

**Machine:** *what is the error that you are running please*

**Human:** *i am seeing an error related to vpn*

**Machine:** *what is the error message that you are getting when connecting to vpn using network connect ?*

**Human:** *connection refused or something like that*

**Machine:** *may i know the version of network connect you connect ?*

**Human:** *i am not sure i know that*

**Machine:** *is the network connect prompting for any user certificate*

**Machine:** *?*

**Human:** *yes*

**Machine:** *are you at home or at work at the moment ?*

**Machine:** *office ?*

**Human:** *i am at home*

**Machine:** *try this*

**Machine:** *goto <URL> page and enter your name and password*

**Human:** *done*

# Experiments (IT Helpdesk)

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**Machine:** *try logging in with <NAME> and check if its working fine now*

**Human:** *yes , now it works !*

**Machine:** *great*

**Machine:** *anything else that i can help*

**Human:** *no , that was very useful*

**Machine:** *you are other than <NAME> : )*

**Machine:** *have a nice night*

# Experiments (IT Helpdesk)

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## Conversation 3: Password issues.

Describe your problem: i forgot my password

**Machine:** *hi , this is <NAME> from helpdesk connect , what can i help you with today ?*

**Human:** *hi , i forgot my password*

**Machine:** *ok great*

**Human:** *can you tell me how i can recover it ?*

**Machine:** *i ' ll need to verify who it is at that machine*

**Machine:** *can we do a hangout*

**Machine:** *?*

**Human:** *yes*

**Machine:** *<anonymized hangout instructions and verifications>*

**Human:** *cool , i am good now*

**Machine:** *how ' s this looking good ?*

**Machine:** *i ' ll go ahead and close this chat .*

**Machine:** *take care . : )*

**Human:** *bye*

**Machine:** *bye .*

# Experiments (OpenSubtitles)

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- 評価
  - Test setにおけるperplexity of the model (モデルに対する当惑度) で評価
- 学習
  - 2層のLSTM (4096のメモリーセル)
  - Gradient clippingを用いたAdaGrad
- 比較
  - 5-gram model
- 当惑度
  - Seq2seq: 17
  - 5-gram: 28

# Experiments (OpenSubtitles)

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- 会話の設定
  - Basic
  - Simple Q&A
  - General knowledge Q&A
  - Philosophical Q&A
  - Morality
  - Opinions
  - Job and Personality



# Experiments (OpenSubtitles)

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## Conversation 1: Basic

**Human:** *hello !*

**Machine:** *hello !*

**Human:** *how are you ?*

**Machine:** *i 'm good .*

**Human:** *what 's your name ?*

**Machine:** *i 'm julia .*

**Human:** *when were you born ?*

**Machine:** *july 20th .*

**Human:** *what year were you born ?*

**Machine:** *1977 .*

**Human:** *where are you from ?*

**Machine:** *i 'm out in the boonies.*

**Human:** *are you a man or a woman ?*

**Machine:** *i 'm a woman .*

**Human:** *why are we here ?*

**Machine:** *i 'm not sure .*

**Human:** *okay, bye !*

**Machine:** *bye .*

**Human:** *see you later .*

**Machine:** *bye .*

# Experiments (OpenSubtitles)

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Conversation 2: Simple Q&A (contexts and multiple choice)

**Human:** *my name is david . what is my name ?*

**Machine:** *david .*

**Human:** *my name is john . what is my name ?*

**Machine:** *john .*

**Human:** *are you a leader or a follower ?*

**Machine:** *i 'm a leader .*

**Human:** *are you a follower or a leader ?*

**Machine:** *i 'm a leader .*

# Experiments (OpenSubtitles)

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## 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:** *how many legs does a spider have ?*

**Machine:** *three , i think .*

**Human:** *how many legs does a centipede have ?*

**Machine:** *eight .*

**Human:** *what is the color of the sky ?*

**Machine:** *blue .*

**Human:** *what is the color of water ?*

**Machine:** *water .*

**Human:** *what is the color of blood ?*

**Machine:** *it is the same as a black eye .*

**Human:** *what is the usual color of a leaf ?*

**Machine:** *it is a green one .*

**Human:** *what is the color of a yellow car ?*

**Machine:** *yellow .*

**Human:** *how much is two plus two ?*

**Machine:** *four .*

**Human:** *how much is ten minus two ?*

**Machine:** *seventy - two .*

# Experiments (OpenSubtitles)

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## 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 .*

**Human:** *what is the purpose of existence ?*

**Machine:** *to find out what happens when we get to the planet earth .*

**Human:** *where are you now ?*

**Machine:** *i 'm in the middle of nowhere .*

**Human:** *what is the purpose of dying ?*

**Machine:** *to have a life .*

**Human:** *what is the purpose of being intelligent ?*

**Machine:** *to find out what it is .*

**Human:** *what is the purpose of emotions ?*

**Machine:** *i don 't know .*

# Experiments (OpenSubtitles)

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## 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 .*

**Human:** *tell me the definition of morality , i am quite upset now !*

**Machine:** *i 'm not ashamed of being a philosopher !*

**Human:** *tell me the definition of morality .*

**Machine:** *i don 't have ethics .*

**Human:** *look , i need help , i need to know more about morality ...*

**Machine:** *i don 't know what ethics is .*

**Human:** *seriously , what is morality ?*

**Machine:** *what is the definition of living ?*

**Human:** *why living has anything to do with morality ?*

**Machine:** *you 're not a cop .*

**Human:** *okay , i need to know how should i behave morally ...*

# Experiments (OpenSubtitles)

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**Machine:** *i don 't know how to tell you .*

**Human:** *is morality and ethics the same ?*

**Machine:** *yes , sir .*

**Human:** *what are the things that i do to be im-moral ?*

**Machine:** *i don 't know .*

**Human:** *give me some examples of moral ac-tions ...*

**Machine:** *i 'm not a moralist .*

**Human:** *alright , morality ?*

**Machine:** *integrity .*

**Human:** *what is integrity ?*

**Machine:** *i 'm sorry , i don 't know what else to say .*

**Human:** *be moral !*

**Machine:** *be a man !*

**Human:** *i really like our discussion on morality and ethics ...*

**Machine:** *and how i 'm not in the mood for a philosophical debate .*

**Human:** *what do you like to talk about ?*

**Machine:** *nothing .*

# Experiments

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- まとめ

- モデルは事実を記憶しており、文脈を理解し、一般常識に基づく推論を行うことができる
- 単純で短い回答しかできず、ときに質問に対する満足な回答ができない
- モデルは一貫した個性を捉えることができない

# ダメな例

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## Conversation 7: Job and Personality

**Human:** *what is your job ?*

**Machine:** *i 'm a lawyer .*

**Human:** *what do you do ?*

**Machine:** *i 'm a doctor .*

一貫した個性を捉えることができない



# Experiments (Comparison)

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- 会話botとの比較を行う
  - ルールベースで作成されているClever Botが比較対象
  - 提案手法に対して行ったのと、同じ質問をし、回答を比較する

# Experiments (Comparison)

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## NCM

**Human:** *who is skywalker ?*

**Machine:** *he is a hero .*

**Human:** *how many legs does a cat have ?*

**Machine:** *four , i think .*

**Human:** *how many legs does a centipede have ?*

**Machine:** *eight .*

**Human:** *what is your job ?*

**Machine:** *i 'm a lawyer .*

**Human:** *what do you do ?*

**Machine:** *i 'm a doctor .*

## Clever Bot

**Human:** *Who is skywalker ?*

**CleverBot:** *There are two of them, Anakin Skywalker and Luke Skywalker, both characters from star Wars.*

**Human:** *How many legs does a cat have ?*

**CleverBot:** *An ant.*

**Human:** *How many legs does a centipede have ?*

**CleverBot:** *A centipede's number of legs varies from thirty to two hundred.*

**Human:** *What is your job ?*

**CleverBot:** *I work in mental health.*

**Human:** *What do you do ?*

**CleverBot:** *I have no job.*

# Experiments (Comparison)

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## NCM

**Human:** *what is the purpose of being intelligent ?*

**Machine:** *to find out what it is .*

**Human:** *is sky blue or black ?*

**Machine:** *blue .*

**Human:** *what is the purpose of life ?*

**Machine:** *to serve the greater good .*

## Clever Bot

**Human:** *What is the purpose of being intelligent ?*

**CleverBot:** *The purpose of life is to love God and love people.*

**Human:** *Is sky blue or black ?*

**CleverBot:** *I am 200 years old.*

**Human:** *What is the purpose of life ?*

**CleverBot:** *My purpose it to forward my species, in other words to make it easier for future generations of mankind to live.*

# Human evaluation

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- Mechanical Turkを使用
  - 提案手法 (NCM) と CleverBot(CB)に同じ質問をし、4人の人間が好みの回答を選択する。
    - 3人以上が勝ち判定 -> 勝者とする
    - 同等の場合は引き分けと判断する
    - 200の質問について検証した

# Human evaluation

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- 評価結果

- NCM: 97/200

- CB: 60/200

- 引き分け: 20/200

- 2対2: 23/200

**Human:** What is the deepest spot on the world ?

**NCM:** The pacific ocean.

**CB:** What ?

**Human:** Do you like Mexican food or Indian food ?

**NCM:** I hate it.

**CB:** I love Mexican food.

**Human:** Who are you crazy about ?

**NCM:** You're the one who's crazy.

**CB:** Who are you ?

**Human:** What's thirty plus forty ?

**NCM:** Sixty ?

**CB:** What should we talk about ?

# Discussion

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- 単純なモデルであるseq2seqが会話モデルで使用可能なことが明らかになった
  - 基礎的で単純な会話を生成することが可能
  - Noisyなデータから知識を抽出することが可能
- 現実的な会話を行うには修正が必要
  - 一貫した個性がないのでチューリングテストを通過するのは難しそう