NLP Tasks

Hung-yi Lee
Usually people call them “NLP” tasks.
Category

Model

Model

w_1 \quad w_2 \quad w_3 \quad w_4 \quad w_5

c_1 \quad c_2 \quad c_3 \quad c_4 \quad c_5

class

Model

w_1 \quad w_2 \quad w_3 \quad w_4 \quad w_5

class
Category

Encoder

- $w_1$
- $w_2$
- $w_3$
- $w_4$
- $w_5$

Decoder

+ copy mechanism?

attention

Model

seq2seq

$w_6$
$w_7$
$w_8$
$w_9$
Category

What happy if there are more than two input sequences?

Simply concatenate ...

Integrate Attention between sequence
<table>
<thead>
<tr>
<th></th>
<th>One Sequence</th>
<th>Multiple Sequences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One Class</strong></td>
<td>Sentiment Classification</td>
<td>NLI</td>
</tr>
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<td>Stance Detection</td>
<td>Search Engine</td>
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<td>Extractive QA</td>
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<td><strong>General Sequence</strong></td>
<td>Abstractive Summarization</td>
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<td></td>
<td>NLG</td>
<td></td>
</tr>
<tr>
<td><strong>Other?</strong></td>
<td></td>
<td>Parsing, Coreference Resolution</td>
</tr>
</tbody>
</table>

Legend:
- **One Sequence** tasks typically involve processing text as a single sequence.
- **Multiple Sequences** tasks involve processing multiple sequences or tokens.
- **Copy from Input** tasks involve copying text from an input source.
- **General Sequence** tasks are applicable to various types of sequences.
- **Other?** tasks include tasks not specifically listed in the table.
Part-of-Speech (POS) Tagging

• Annotate each word in a sentence with a part-of-speech (e.g. Verb, Adjective, Noun)

Input: sequence
Output: class for each token
Word Segmentation

- for Chinese

Input: sequence
Output: class for each token

Model

台湾大学 简称 台大

Down-stream Task

台湾大学 简称 台大
『楊公再興之神』

（出自《笑傲江湖》）
The results of parsing can be used in the downstream tasks.
Coreference Resolution
(指代消解)

Paul Allen was born on January 21, 1953. He attended Lakeside School, where he befriended Bill Gates. Paul and Bill used a teletype terminal at their high school, Lakeside, to develop their programming skills on several time-sharing computer systems.

Source of example:
https://demo.allennlp.org/coreference-resolution/
Summarization

- **Extractive** summarization

Input: sequence
Output: class for each token

(Here a token is a sentence)
Summarization

- **Abstractive** summarization

Input: sequence  
Output: sequence  
(copy is encouraged)

Model

Pointer network:  
encouraging direct copy from input
Unsupervised machine translation is a critical research direction.
### Grammar Error Correction

**Input:** sequence  
**Output:** sequence

(copy is encouraged)

---

#### Example 1

<table>
<thead>
<tr>
<th>$x$</th>
<th>[ Bolt can have run race ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>[ Bolt could have run the race ]</td>
</tr>
<tr>
<td>$\text{diff}$</td>
<td>(C,[]) (C,Bolt) (D,can) (I,can,could) (C,have) (C,run) (I,run,he) (C,race) (C,[])</td>
</tr>
<tr>
<td>$e$</td>
<td>C C R(could) C A(the) C C</td>
</tr>
<tr>
<td></td>
<td>↑ ↑ ↑ ↑ ↑ ↑ ↑</td>
</tr>
<tr>
<td></td>
<td>[ Bolt can have run race ]</td>
</tr>
</tbody>
</table>

#### Example 2

<table>
<thead>
<tr>
<th>$x$</th>
<th>[ He still won race ! ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>[ However, he still won ! ]</td>
</tr>
<tr>
<td>$\text{diff}$</td>
<td>(C,[]) (I,[,However,]) (D,He) (I,He,he) (C,still) (C,run) (D,-race) (C,!) (C,[])</td>
</tr>
<tr>
<td>$e$</td>
<td>A(However,) T_case C C D C C</td>
</tr>
<tr>
<td></td>
<td>↑ ↑ ↑ ↑ ↑ ↑ ↑</td>
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<tr>
<td></td>
<td>[ He still won race ! ]</td>
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柯南劇場版《紺青之拳》還蠻有趣的

柯南劇場版《紺青之拳》槽點很多

柯南劇場版《紺青之拳》雖然槽點很多，但還蠻有趣的

柯南劇場版《紺青之拳》雖然還蠻有趣的，但槽點很多
Stance Detection

Input: two sequences
Output: a class

Source: 李宏毅是個型男 (post on twitter or FB)

Reply: 他只是個死臭酸宅

Many systems use the Support, Denying, Querying, and Commenting (SDQC) labels for classifying replies.

Used in Veracity Prediction
Veracity Prediction

Veracity prediction examples:

u1: Hostage-taker in supermarket siege killed, reports say. #ParisAttacks –LINK– [true]

u1: OMG. #Prince rumoured to be performing in Toronto today. Exciting! [false]


Input: several sequences
Output: class
**Natural Language Inference (NLI)**

Input: two sequences
Output: a class

contradiction
t entailment
neutral

Model

premise: A person on a horse jumps over a broken down airplane

hypothesis: A person is at a diner. contradiction

hypothesis: A person is outdoors, on a horse. entailment

hypothesis: person is training his horse for a competition. neutral
Input: two sequences
Output: a class

Model

Search Engine

Source of image: https://www.blog.google/products/search/search-language-understanding-bert/
Question Answering (QA)
Question Answering

Input: several sequences
Output: sequence

Knowledge source

unstructured documents

question

Filter out irrelevant documents

search engine

QA

answer

Reading comprehension
Question Answering

- Extractive QA: Answer in the document

Input: several sequences
Output: sequence (copy from input)

In meteorology, precipitation is any product of the condensation of atmospheric water vapor that falls under gravity. The main forms of precipitation include drizzle, rain, sleet, snow, graupel and hail... Precipitation forms as smaller droplets coalesce via collision with other rain drops or ice crystals within a cloud. Short, intense periods of rainfall at certain locations are called “showers”.

What causes precipitation to fall?
- gravity
  - $s = 17, e = 17$

What is another main form of precipitation besides drizzle, rain, snow, sleet and hail?
- graupel
  - $s = 77, e = 79$

Where do water droplets collide with ice crystals to form precipitation?
- within a cloud
  - $s = 77, e = 79$
Dialogue

Chatting

Task-oriented
Chatting

User: What is your name?
Cleverbot: Weil ich dich nicht kennw.
User: What is your name?
Cleverbot: Li.
User: Are you Li?
Cleverbot: No i'm Mara.
User: Are you Mara?
Cleverbot: No.
User: Who you are?
Cleverbot: I just said your name you don't need to know my name.
User: Do you know my name?
Cleverbot: No that is why I am asking you.
User: Can you tell me your name?
Cleverbot: I already told you.
User: You are Mara?
Cleverbot: I'm sorry.
User: Sorry for what?
Cleverbot: For not remembering your name.
User: Do you remember your name?
Cleverbot: Yes I do...
User: What is your name?
Cleverbot: Once again, I can't tell you.
User: You have told me that you are Mara.
Cleverbot: I am a boy.
User: Are you a boy?
Cleverbot: Yes.
User: Are you a girl?
Cleverbot: No, are you?
User: No. How old are you?
Cleverbot: 2000 years old.
User: You are so old!
Cleverbot: No i'm quite young.
User: How old are you?
Cleverbot: Why do you keep asking me that?
User: Because I want to know your age.
Cleverbot: What if I do not want to tell you.
User: Then don't tell me your age.
Cleverbot: My name is Blue Monday.
Chatting

Human

Model

Machine

Hello 😊

Hi 😊

Hello 😊

Hi 😊
Chatting

Human: How's your day?

Machine: Hi 😊

Human: Hello 😊

Machine: Hi 😊

Human: How's your day?
Chatting

Personality

Empathy

Knowledge

M: Hi 😊

H: Hello 😊

Model

how's your day?
Task-oriented

<table>
<thead>
<tr>
<th></th>
<th>Agent</th>
<th>你好，這裡是夏季商務旅館，請問有什麼能為您服務的嗎？</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>User</td>
<td>我要訂房</td>
</tr>
<tr>
<td>3</td>
<td>Agent</td>
<td>沒問題，請問怎麼稱呼您？</td>
</tr>
<tr>
<td>4</td>
<td>User</td>
<td>我姓林</td>
</tr>
<tr>
<td>5</td>
<td>Agent</td>
<td>林小姐您好，請問您預計何時入住？</td>
</tr>
<tr>
<td>6</td>
<td>User</td>
<td>9月9日晚上入住</td>
</tr>
<tr>
<td>7</td>
<td>Agent</td>
<td>請問要住幾個晚上呢？</td>
</tr>
<tr>
<td>8</td>
<td>User</td>
<td>2晚</td>
</tr>
<tr>
<td>9</td>
<td>Agent</td>
<td>請問訂房人數總共是幾位呢？</td>
</tr>
<tr>
<td>10</td>
<td>User</td>
<td>5位</td>
</tr>
<tr>
<td>11</td>
<td>Agent</td>
<td>請問您要預定的房型？</td>
</tr>
<tr>
<td>12</td>
<td>User</td>
<td>一間豪華套房，一間豪華客房</td>
</tr>
<tr>
<td>13</td>
<td>Agent</td>
<td>好的，您入住的日期是9月9日星期一，退房時間為9月11日星期三。請問確認訂房嗎？</td>
</tr>
<tr>
<td>14</td>
<td>User</td>
<td>ok</td>
</tr>
</tbody>
</table>

(source of image: 科技大擂台 2020 簡章範例)
**Natural Language Generation (NLG)**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 1 | Greeting | Ask (入住日)  
|   |   | Ask (退房日)  
|   |   | ……  

<p>| | | |</p>
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<td>ok</td>
</tr>
</tbody>
</table>
State: What has happened in this dialogue

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agent: 您好，這裡是夏季商務旅館，請問有什麼能為您服務的呢？</td>
<td></td>
</tr>
<tr>
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<td>User: 我要訂房</td>
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<td>User: ok</td>
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Natural Language Understanding (NLU)

• Intent Classification

• Slot Filling

Provide Information

我打算9月9日入住，9月11日退房

Slot:

我打算9月9日入住，9月11日退房

......
Task-oriented

**ASR**

**User Input**

**State Tracker**

**End-to-end**

**Policy**

**TTS**

**System Output**

**Dialogue History**

Input: several sequences, Output: a sequence
Knowledge Extraction
Knowledge

Step 1: Extract Entity
Ron Weasley

Step 2: Extract Relation
Is a student of
Hogwarts

Is husband of
Hermione Granger

(warning: The following description oversimplifies the task)
Name Entity Recognition (NER)

Harry Potter is a student of Hogwarts and lived on Privet Drive.

Name entity recognition
people, organizations, places are usually name entity

Harry Potter is a student of Hogwarts and lived on Privet Drive.

Input: sequence
Output: class for each token (just like POS tagging, slot filling)
Relation Extraction

Harry Potter is a student of Hogwarts and lived on Privet Drive.

Harry Potter
Hogwarts

Relation Extraction

“is a student of”

Harry Potter is a student of Hogwarts and lived on Privet Drive.

Hogwarts
Privet Drive

Relation Extraction

“none”
GLUE

General Language Understanding Evaluation (GLUE)

https://gluebenchmark.com/

- Corpus of Linguistic Acceptability (CoLA)
- Stanford Sentiment Treebank (SST-2)
- Microsoft Research Paraphrase Corpus (MRPC)
- Quora Question Pairs (QQP)
- Semantic Textual Similarity Benchmark (STS-B)
- Multi-Genre Natural Language Inference (MNLI)
- Question-answering NLI (QNLI)
- Recognizing Textual Entailment (RTE)
- Winograd NLI (WNLI)

GLUE also has Chinese version (https://www.cluebenchmarks.com/)
Super GLUE

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**BoolQ**

**Passage:** Barq’s – Barq’s is an American soft drink. Its brand of root beer is notable for having caffeine. Barq’s, created by Edward Barq and bottled since the turn of the 20th century, is owned by the Barq family but bottled by the Coca-Cola Company. It was known as Barq’s Famous Olde Tyme Root Beer until 2012.

**Question:** is barq’s root beer a pepsi product  
**Answer:** No

---

**CB**

**Text:** B: And yet, uh, I we-, I hope to see employer based, you know, helping out. You know, child, uh, care centers at the place of employment and things like that, that will help out. A: Uh-huh. B: What do you think, do you think we are, setting a trend?

**Hypothesis:** they are setting a trend  
**Entailment:** Unknown

---

**COPA**

**Premise:** My body cast a shadow over the grass.

**Question:** What’s the CAUSE for this?

**Alternative 1:** The sun was rising.  
**Alternative 2:** The grass was cut.

**Correct Alternative:** 1

---

**MultiRC**

**Paragraph:** Susan wanted to have a birthday party. She called all of her friends. She has five friends. Her mom said that Susan can invite them all to the party. Her first friend could not go to the party because she was sick. Her second friend was going out of town. Her third friend was not so sure if her parents would let her. The fourth friend said maybe. The fifth friend could go to the party for sure. Susan was a little sad. On the day of the party, all five friends showed up. Each friend had a present for Susan. Susan was happy and sent each friend a thank you card the next week.

**Question:** Did Susan’s sick friend recover?  
**Candidate answers:** Yes, she recovered (T), No (F), Yes (T), No, she didn’t recover (F), Yes, she was at Susan’s party (T)
Super GLUE

**Paragraph:** *(CNN)* Puerto Rico on Sunday overwhelmingly voted for statehood. But Congress, the only body that can approve new states, will ultimately decide whether the status of the US commonwealth changes. Ninety-seven percent of the votes in the nonbinding referendum favored statehood, an increase over the results of a 2012 referendum, official results from the State Electoral Commission show. It was the fifth such vote on statehood. "Today, we the people of Puerto Rico are sending a strong and clear message to the US Congress ... and to the world ... claiming our equal rights as American citizens, Puerto Rico Gov. Ricardo Rossello said in a news release. @highlight Puerto Rico voted Sunday in favor of US statehood

**Query** For one, they can truthfully say, “Don’t blame me, I didn’t vote for them,” when discussing the <placeholder> presidency  

**Correct Entities:** US

**Text:** Dana Reeve, the widow of the actor Christopher Reeve, has died of lung cancer at age 44, according to the Christopher Reeve Foundation.

**Hypothesis:** Christopher Reeve had an accident.  

**Entailment:** False

**Context 1:** Room and board.  

**Context 2:** He nailed boards across the windows.

**Sense match:** False

**Text:** Mark told Pete many lies about himself, which Pete included in his book. He should have been more truthful.  

**Coreference:** False
DecaNLP

https://decanlp.com/

• 10 NLP tasks
• Solving by the same model

<table>
<thead>
<tr>
<th>Question</th>
<th>Context</th>
<th>Answer</th>
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<tbody>
<tr>
<td>What is a major importance of Southern California in relation to California and the US?</td>
<td>...Southern California is a major economic center for the state of California and the US....</td>
<td>major economic center</td>
</tr>
<tr>
<td>What is the translation from English to German?</td>
<td>Most of the planet is ocean water.</td>
<td>Der Großteil der Erde ist Meerwasser</td>
</tr>
<tr>
<td>What is the summary?</td>
<td>Harry Potter star Daniel Radcliffe gains access to a reported £320 million fortune...</td>
<td>Harry Potter star Daniel Radcliffe gets £320M fortune...</td>
</tr>
<tr>
<td>Hypothesis: Product and geography are what make cream skimming work. Entailment, neutral, or contradiction?</td>
<td>Premise: Conceptually cream skimming has two basic dimensions – product and geography.</td>
<td>Entailment</td>
</tr>
<tr>
<td>Is this sentence positive or negative?</td>
<td>A stirring, funny and finally transporting re-imagining of Beauty and the Beast and 1930s horror film.</td>
<td>positive</td>
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<td></td>
<td>Parsing, Coreference Resolution</td>
</tr>
</tbody>
</table>