

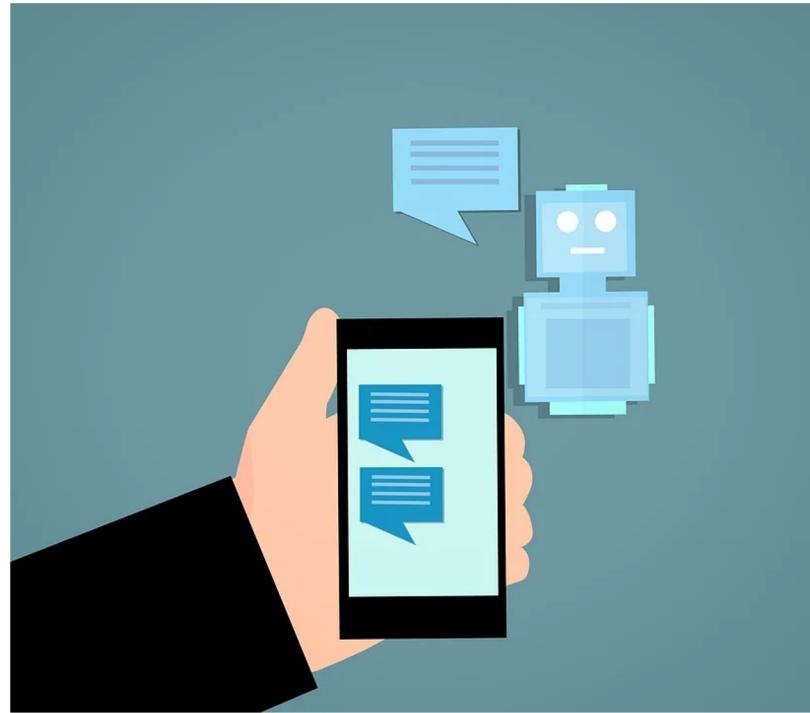
# **KAIST-Samsung DS AI Expert**

## **대화 시스템 (Dialogue System)**

TA 이정관, 서석인 (2020. 08. 13)

TA 함동훈, 황형주 (2020. 08. 20)

# 대화 시스템 (Dialogue System)



# 대화 시스템 (Dialogue System)

## Chit-Chat

: 자연스러운 대화에 초점

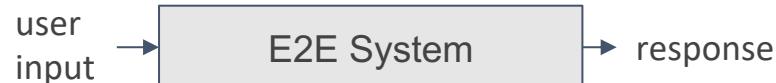
## Task-Oriented

: 태스크 완료에 초점

## Pipelined

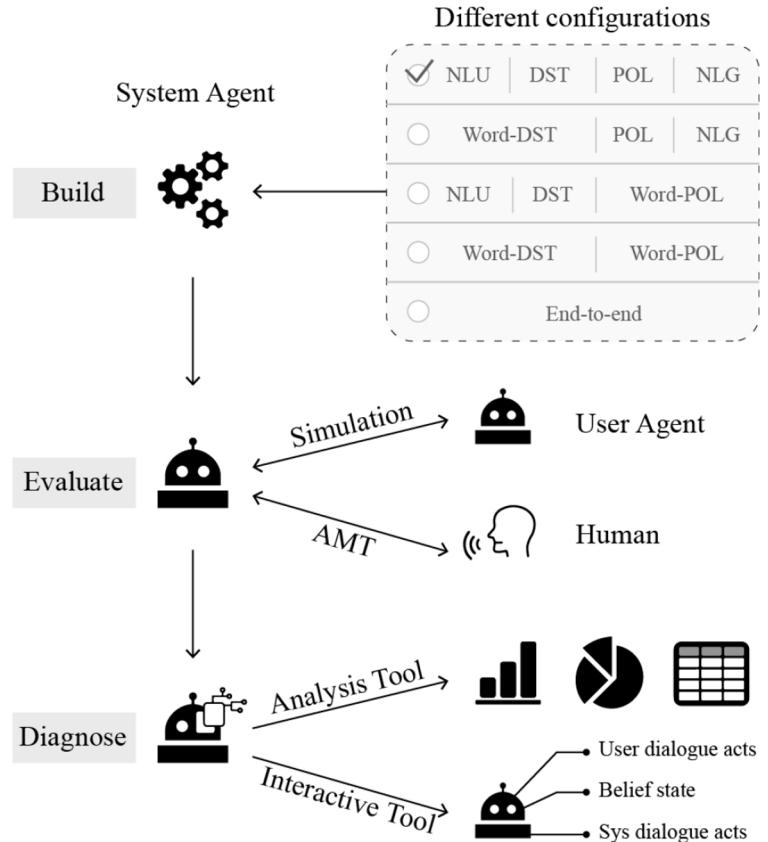


## End-to-End



# ConvLab 소개

- Task-Oriented Dialogue System을 여러 모듈로 구축하고, End-to-End 평가 및 대화시스템을 진단 할 수 있는 오픈 소스 툴킷
- ConvLab-2\*에서는 여러 대화 모듈들을 통합하고 더 많은 데이터셋 지원
- <https://github.com/thu-coai/ConvLab-2>

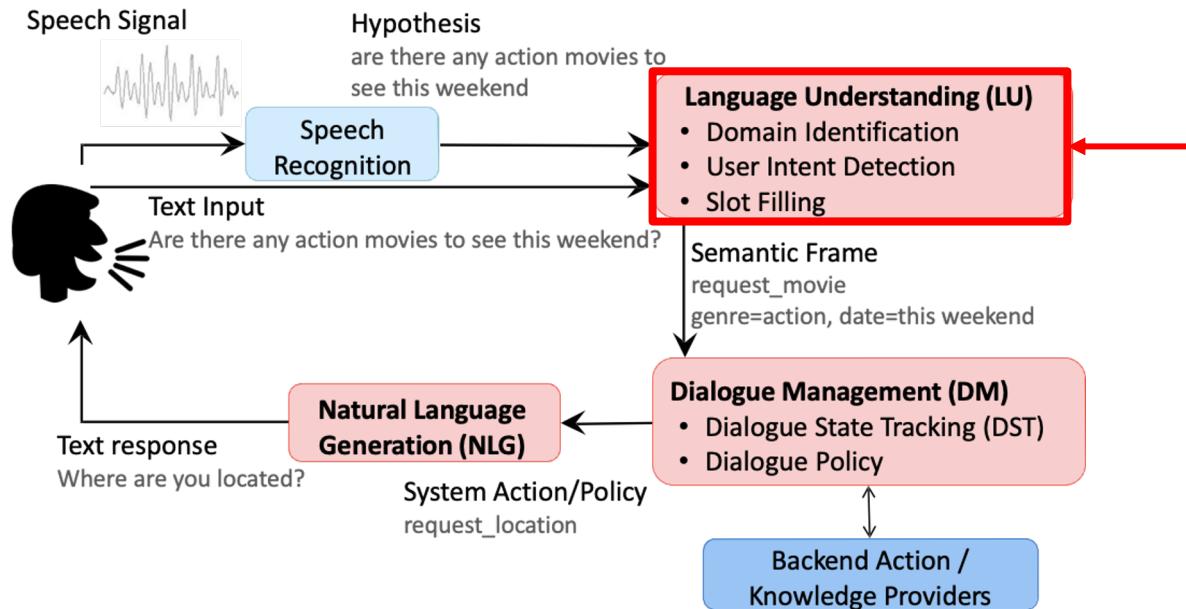


# 오늘 실습 내용!

- ConvLab을 이용한 대화 시스템 모듈 실습
  - BERT-NLU 구현
  - Pipelined Dialogue System 실습
  - End-to-End Dialogue System 실습

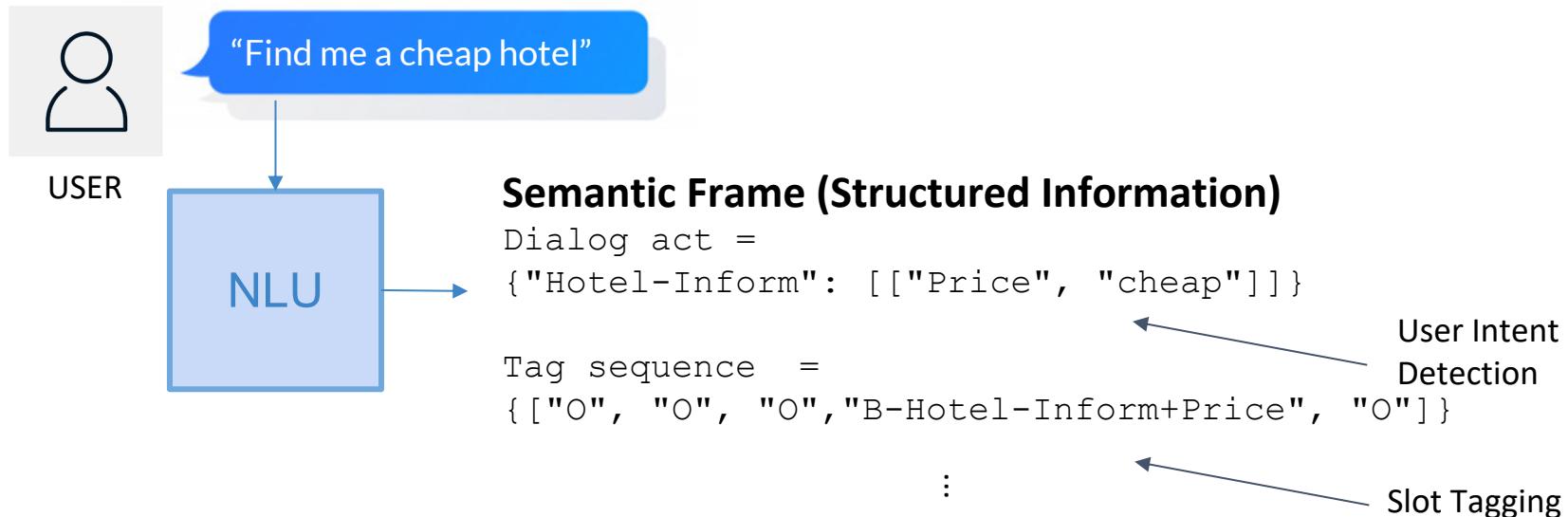
실습 주제 1:  
**BERT-NLU 구현**

# Recab : LU Module?



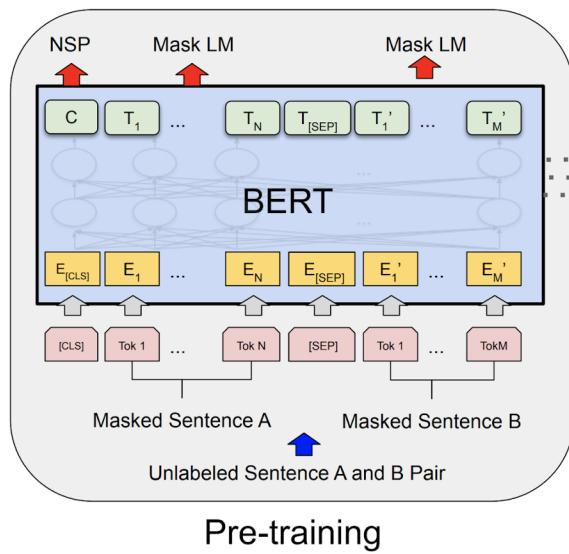
- **NLU : Natural Language Understanding (자연어 이해)**

# Recap : NLU Module?

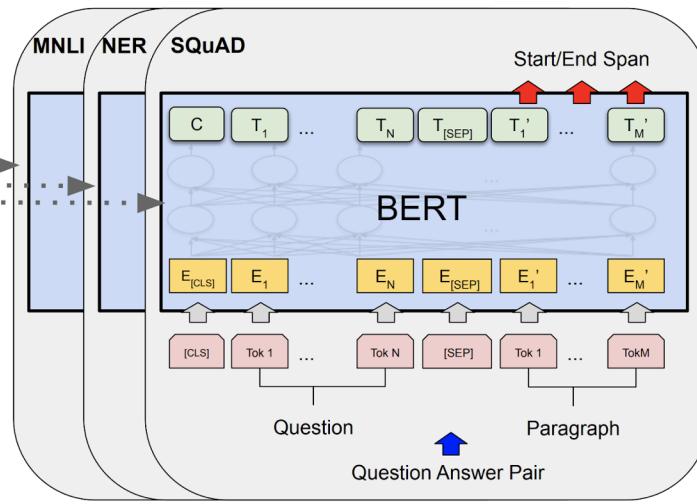


- 자연어를 입력받아 상대적으로 챗봇이 처리하기 쉬운 구조화된 정보를 출력

# Recab : BERT\* (Bidirectional Encoder Representations from Transformers)



Pre-training



Fine-Tuning



- **대규모 사전학습 자연어 모델** (Large-scale Pre-trained Language Model)의 일종으로, 높은 자연어 처리 성능으로 최근 NLP 커뮤니티의 주목을 받고 있음

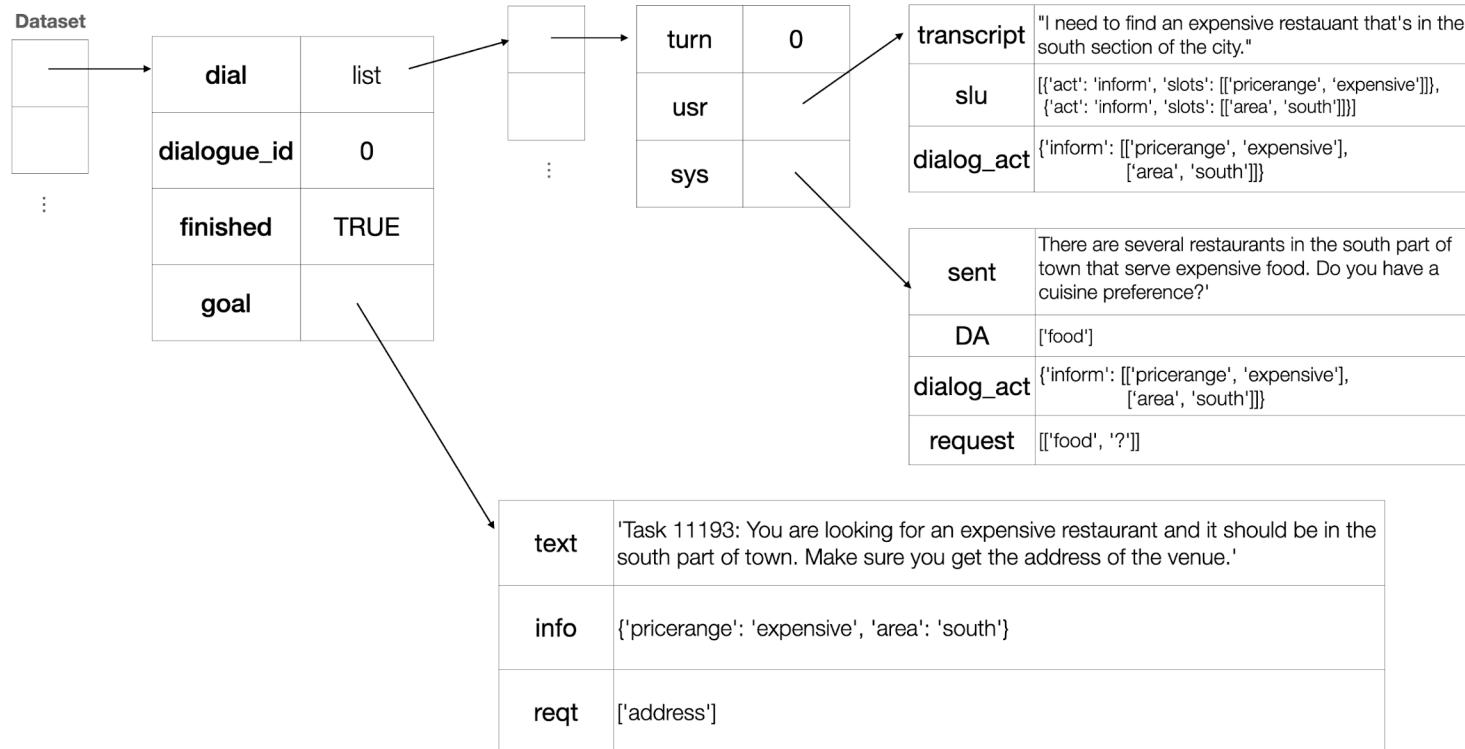
\* Devlin, Jacob, et al. "Bert: Pre-training of deep bidirectional transformers for language understanding." NAACL 2019

# BERT-NLU

- 사전 학습된 BERT를 대화 시스템 데이터셋에서 **Fine-tuning**  
e.g. MultiWOZ, Camrest, ...  
  
→ 오늘 BERT-NLU 실습에 사용될 데이터셋
- 구조화된 데이터를 다루기 위해 **특수 토큰(special token)**들을 이용  
e.g. '[CLS]', '[SEP]', ...

# Camrest 데이터셋

- Cambridge Restaurant Dialogue 데이터셋: 식당예약 대화 데이터



# BERT-NLU 학습과정

- **Step 0.** (준비물) 사전학습된 BERT weight 파일
- **Step 1.** 데이터셋 Pre-processing  
(structured data → text with special token)
- **Step 2.** BERT Fine-tuning
- **Step 3.** 생성된 결과를 구조화된 데이터로 Post-processing  
(text with special token → structured data)

# BERT-NLU 평가

NLU 모델 평가결과

	Precision	Recall	F1
BERTNLU	82.48	85.59	84.01
MILU	80.29	83.63	81.92
SVMNLU	74.96	50.74	60.52

End-to-End 평가결과

NLU	DST	Policy	NLG	Complete rate	Success rate	Book rate
BERTNLU	RuleDST	RulePolicy	TemplateNLG	92.1	85.5	91.5
MILU	RuleDST	RulePolicy	TemplateNLG	89.9	83.1	90.9
SVMNLU	RuleDST	RulePolicy	TemplateNLG	84.2	70.4	76.1

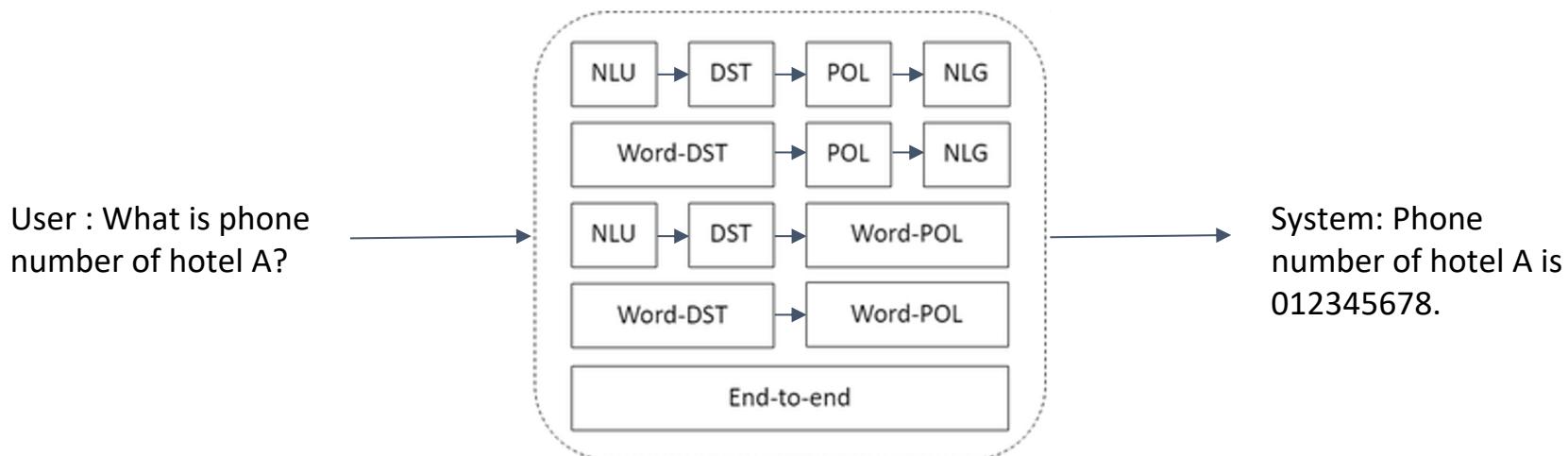
# BERT-NLU 실습

- **실습 1-1** : BERT Pre-processing 과정 이해하기
- **실습 1-2** : BERT Fine-tuning 구현 및 학습
- **실습 1-3** : BERT Post-processing 구현 및 결과 평가하기

# 실습 주제 2: Pipelined Dialogue System

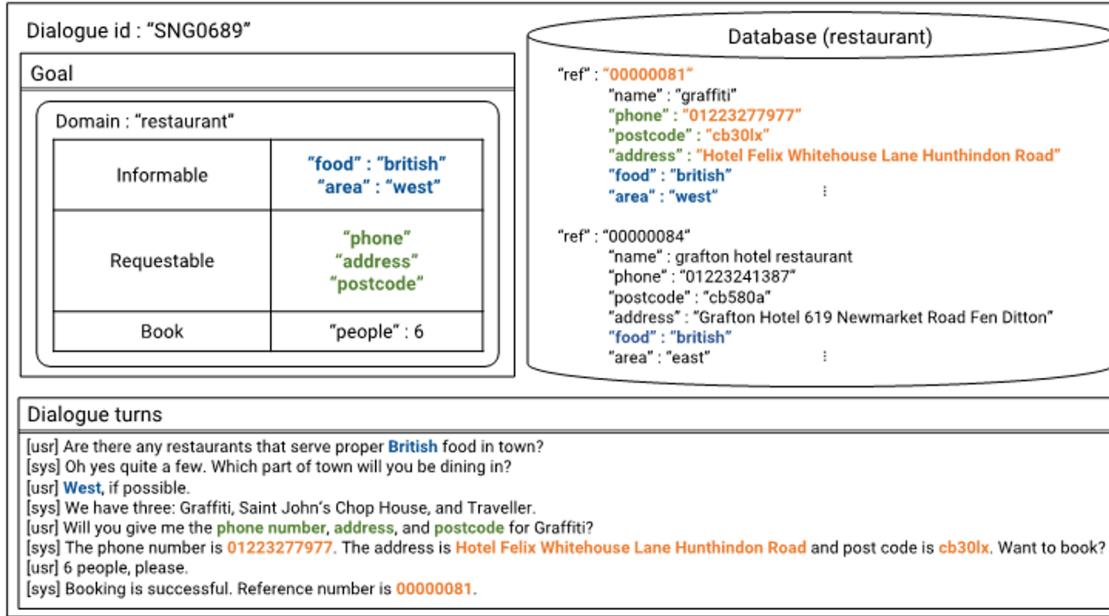
# 실습 목표 : ConvLab을 이용한 Pipelined 대화 시스템 구축

- Open-Domain Dialogue System 과는 다르게, Goal-Oriented Dialogue System의 경우 pipelined architecture로 디자인 되는 경우가 많음 (DB, API call.. )
- ConvLab은 Multi-Domain Dialogue System을 구축하기 위한 Framework로, 각 모듈 및 evaluator를 포함한다.



# MultiWOZ\* 데이터셋

- 7 개의 도메인(호텔, 기차, 식당, ..)에 걸친 대화 약 만개를 갖는 대규모 멀티 턴 대화 데이터셋



Blue : Informable slot

Yellow-Green : Requestable slot name

Orange : Requestable slot value

\* Budzianowski, Paweł, et al. "MultiWOZ-A Large-Scale Multi-Domain Wizard-of-Oz Dataset for Task-Oriented Dialogue Modelling." *Proceedings of the 2018 Conference on Empirical Methods in Natural Language Processing*. 2018.

# MultiWOZ\* 데이터셋

- 각 대화에는 일련의 대화 상태와 해당 시스템 대화 동작이 표시됨

```
<usr> I am looking for a place to stay that has cheap price range it should be in a type of hotel
```

```
<sys> Okay , do you have a specific area you want to stay in ?
```

```
    "metadata": {"hotel": { "semi": { "name": "not mentioned",
                                         "area": "not mentioned",
                                         "parking": "not mentioned",
                                         "pricerange": "cheap",
                                         "stars": "not mentioned",
                                         "internet": "not mentioned",
                                         "type": "hotel"}}

    "dialog_act": {"Hotel-Request": [["Area", "?"]]}}


```

```
<usr> No, I just need to make sure it 's cheap, oh, and I need parking
```

\* Budzianowski, Paweł, et al. "MultiWOZ-A Large-Scale Multi-Domain Wizard-of-Oz Dataset for Task-Oriented Dialogue Modelling." *Proceedings of the 2018 Conference on Empirical Methods in Natural Language Processing*. 2018.

# ConvLab을 통한 대화시스템 구축 및 평가

- Step 0. 현재 ConvLab 내부의 모듈 (NLU, DST, Policy, NLG)를 조합해서 다양한 대화 시스템 agent를 만든다.
- Step 1. ConvLab 내부의 evaluator를 사용해 각 agent의 성능을 평가해본다.

\* Lee, Sungjin, Qi Zhu, Ryuichi Takanobu, Xiang Li, Yaoqin Zhang, Zheng Zhang, Jinchao Li et al. "Convlab: Multi-domain end-to-end dialog system platform." *arXiv preprint arXiv:1904.08637* (2019).

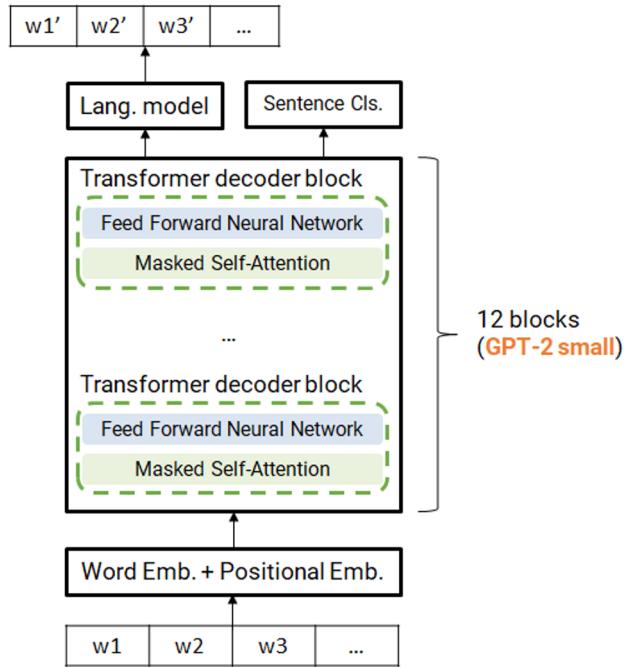
# ConvLab에서 사용가능한 모듈들

- NLU : BERT NLU, MILU NLU, SVM NLU
- DST : Rule-DST
- NLU + DST : SUMBT, TRADE, MDBT
- Policy : MLE Policy, DQN Policy, PPO Policy, GDPL Policy
- NLG : SC-LSTM, Template NLG

# 실습 주제 3: Neural Pipeline (End-to-End 대화시스템)

# What is GPT\*?

GPT(Generative PreTraining model)\* : Transformer Layer 기반 언어 생성 모델



Parameters	Layers	$d_{model}$
117M	12	768
345M	24	1024
762M	36	1280
1542M	48	1600

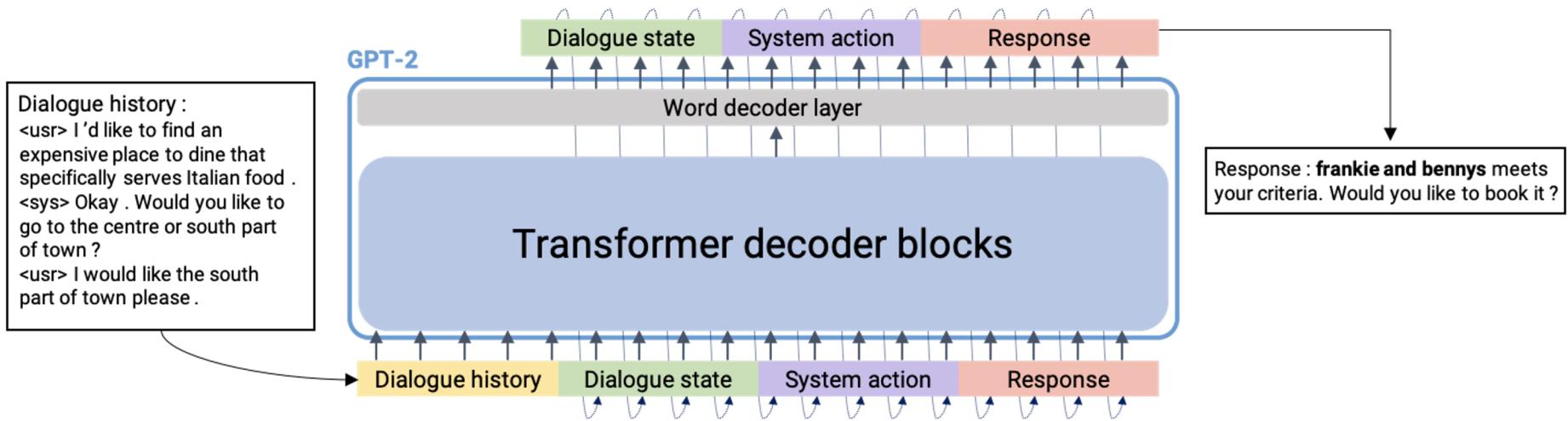
Architecture hyperparameters of GPT-2<sup>[2]</sup>

Training of GPT-2 consists of two steps

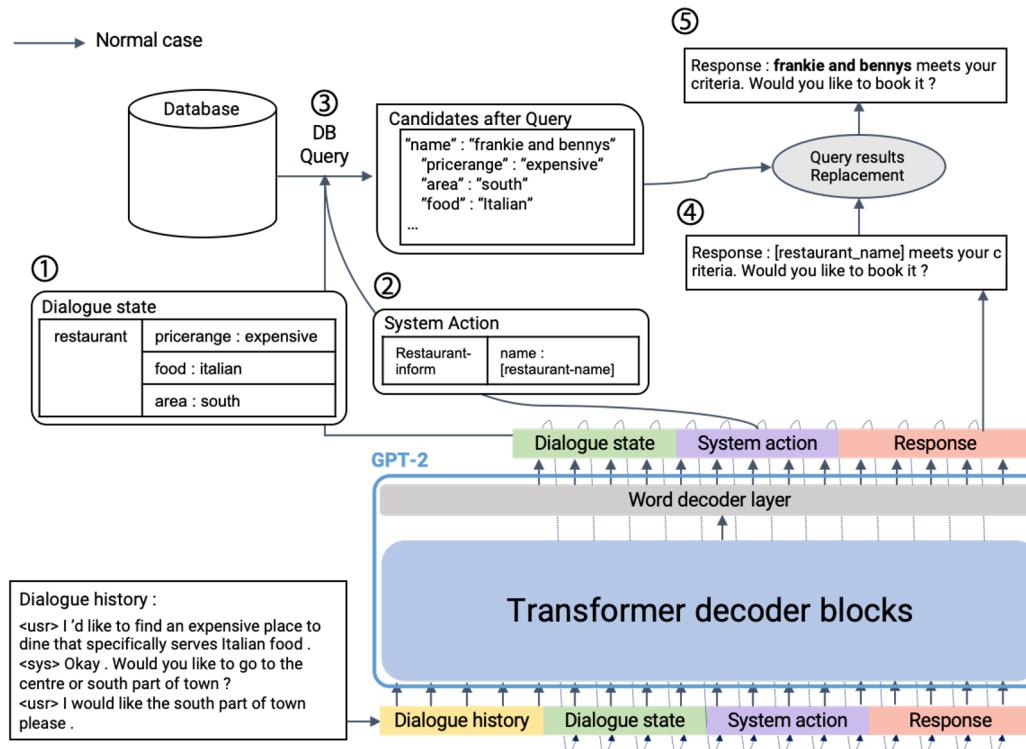
1. Unsupervised **pre-training**  
**(left-to-right language model)**
2. Supervised training on a specific language domain with auxiliary task  
(sentence

\* Radford, Alec, et al. "Improving Language Understanding by Generative Pre-Training."  
-1--1-:fication)

# End-to-End Neural Pipeline for Goal-oriented Dialogue System using GPT-2\*



# End-to-End Neural Pipeline for Goal-oriented Dialogue System using GPT-2\*



# End-to-End Neural Pipeline을 활용한 예제

[usr] Hello I want to eat expensive european food in south of city .

Dialogue State : <restaurant> <food> european <pricerange> expensive <area> south  
DB Search : None

System Action : <restaurant-nooffer> <food> european <pricerange> expensive <area> south  
[sys] I'm sorry, but there are no expensive European restaurants in the south.

[usr] How about mexican food ?

Dialogue State : <restaurant> <food> mexican <pricerange> expensive <area> south  
DB search : {name : 'chiquito restaurant bar', area : 'south', pricerange : 'expensive', ...}  
System Action : <restaurant-recommend> <name> [restaurant-name] <booking-inform> <none> <none>  
[sys] Chiquito Restaurant Bar is a good choice. Would you like me to book you a table?

[usr] Yes please, and give me their address .

Dialogue State : <restaurant> <food> mexican <pricerange> expensive <area> south  
DB search : {name : 'chiquito restaurant bar', area : 'south', pricerange : 'expensive', ...}  
System Action : <restaurant-inform> <addr> [restaurant\_addr]  
[sys] Their address is 2G Cambridge Leisure Park Cherry Hinton Road Cherry Hinton.

[usr] Could you recommend a museum in south?

Dialogue State : <attraction> <type> museum <area> south  
DB search : {name : 'byard art', type : 'museum', area : 'south', entrance fee : 'free'}  
System Action : <attraction-recommend> <name> [attraction\_name]  
[sys] byard art is a great place.