Textual Inference and Question Answering

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Textual inference

- 我很开心!
- 我好伤心!
- 我好不开心!
- 我怎么会不开心呢!

语法层面

可以直接从文本中获取语义，学习分类，主要从语法层面上进行区分。

一种生长在非洲的反刍偶蹄动物，是世界上现存最高的陆生动物？
a. 狮子 b.马 c.猫头鹰 d.长颈鹿

领域知识：训练数据 or 知识工程

百度百科:长颈鹿是陆地上最高的动物。

直接从文本的语义中无法直接获取答案，但是训练数据足够多，也是可以学习到特定的推理规则。

问题：测试集上没有出现过的动物？

- 知识
- 规则

Who is wearing glasses?

man

woman

Where is the child sitting?

fridge

arms

Is the umbrella upside down?

yes

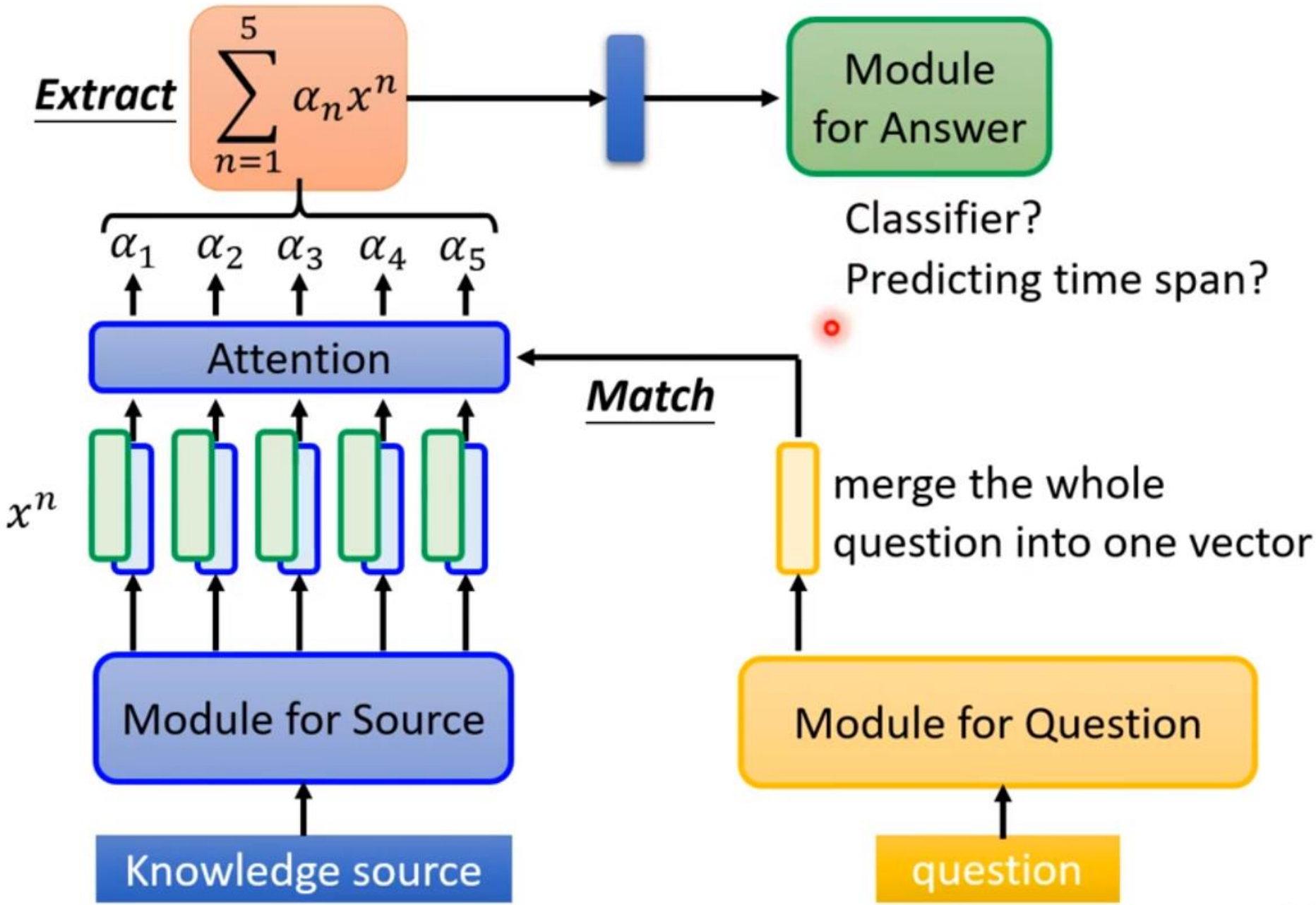
no

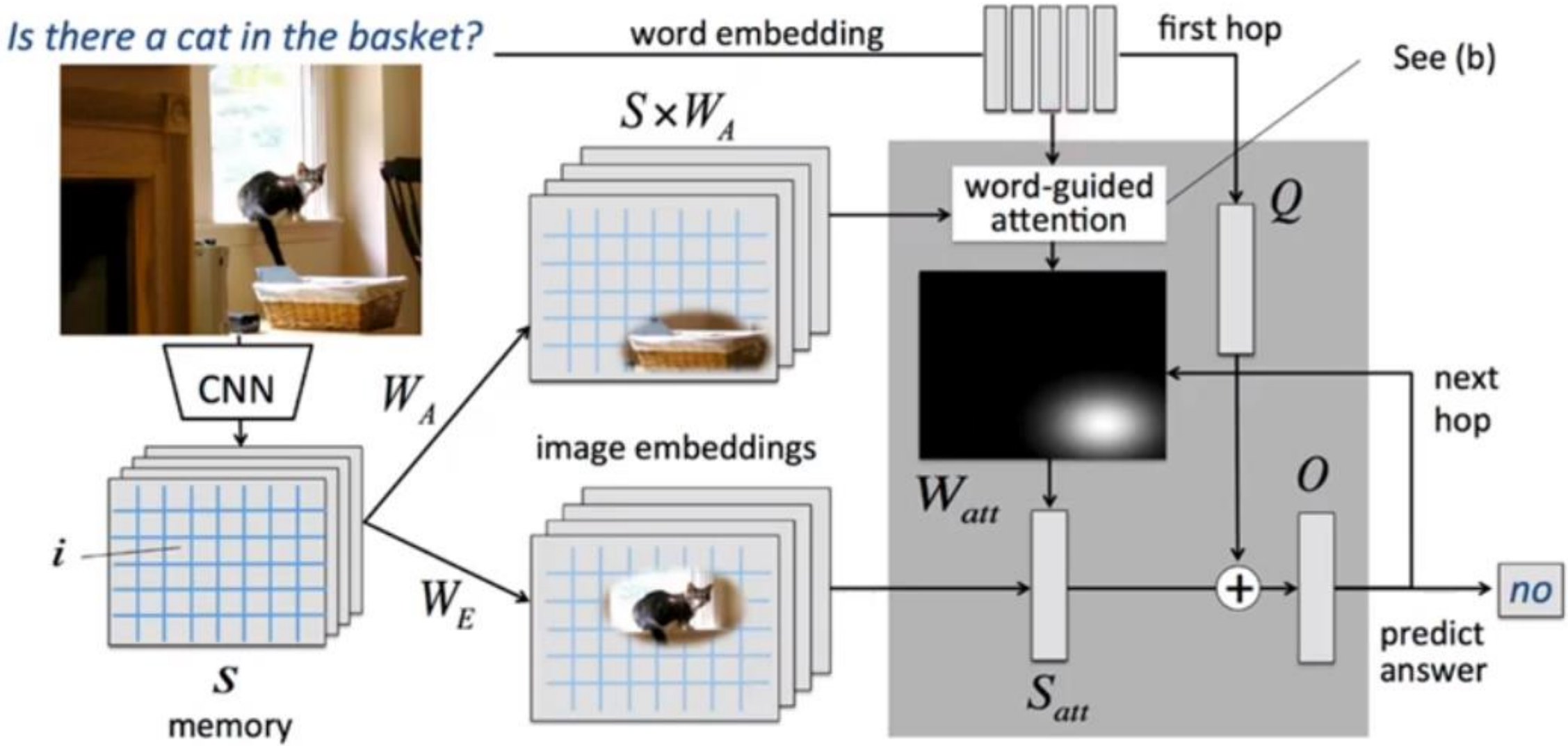
How many children are in the bed?

2

1

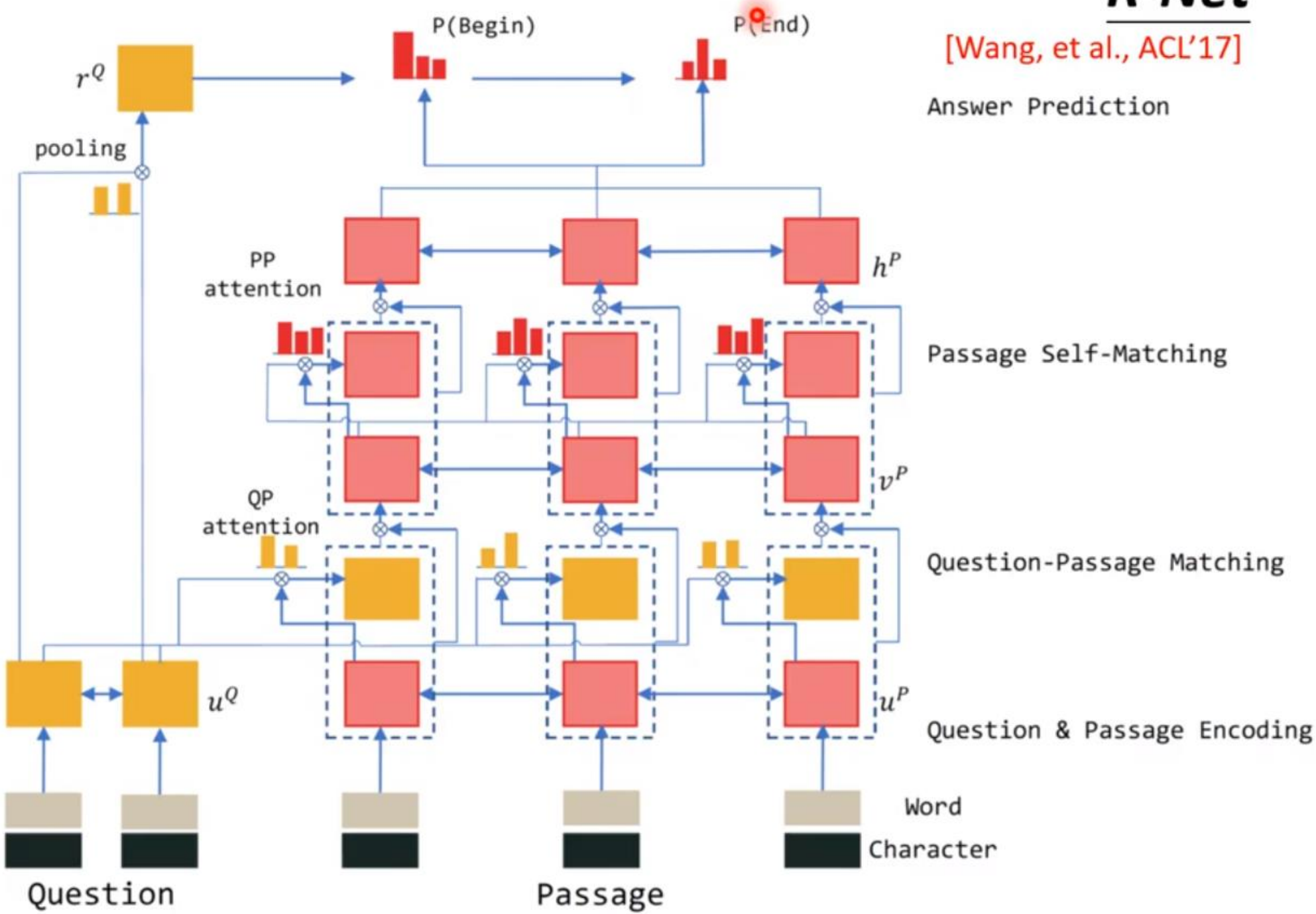
Query-to-context Attention



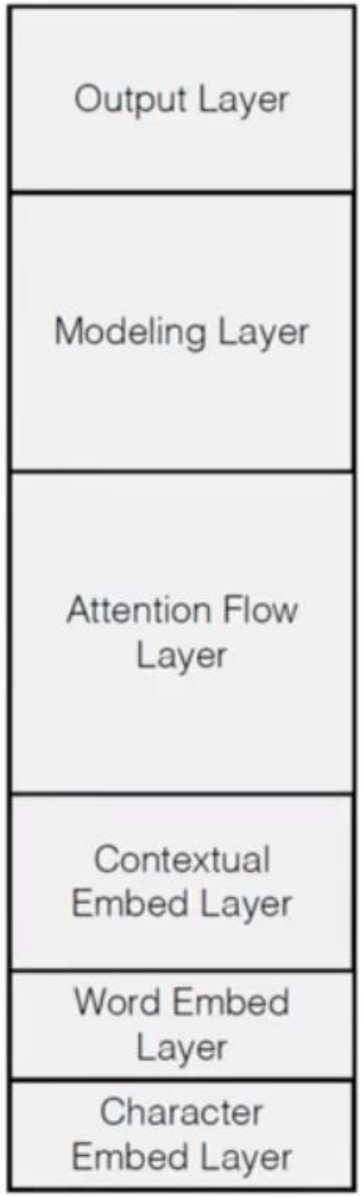

Is there a cat in the basket?
word embedding
first hop
See (b)
$S \times W_A$
word-guided attention
Q
CNN
W_A
next hop
image embeddings
W_{att}
O
i
W_E
no
predict answer
s
memory
S_{att}

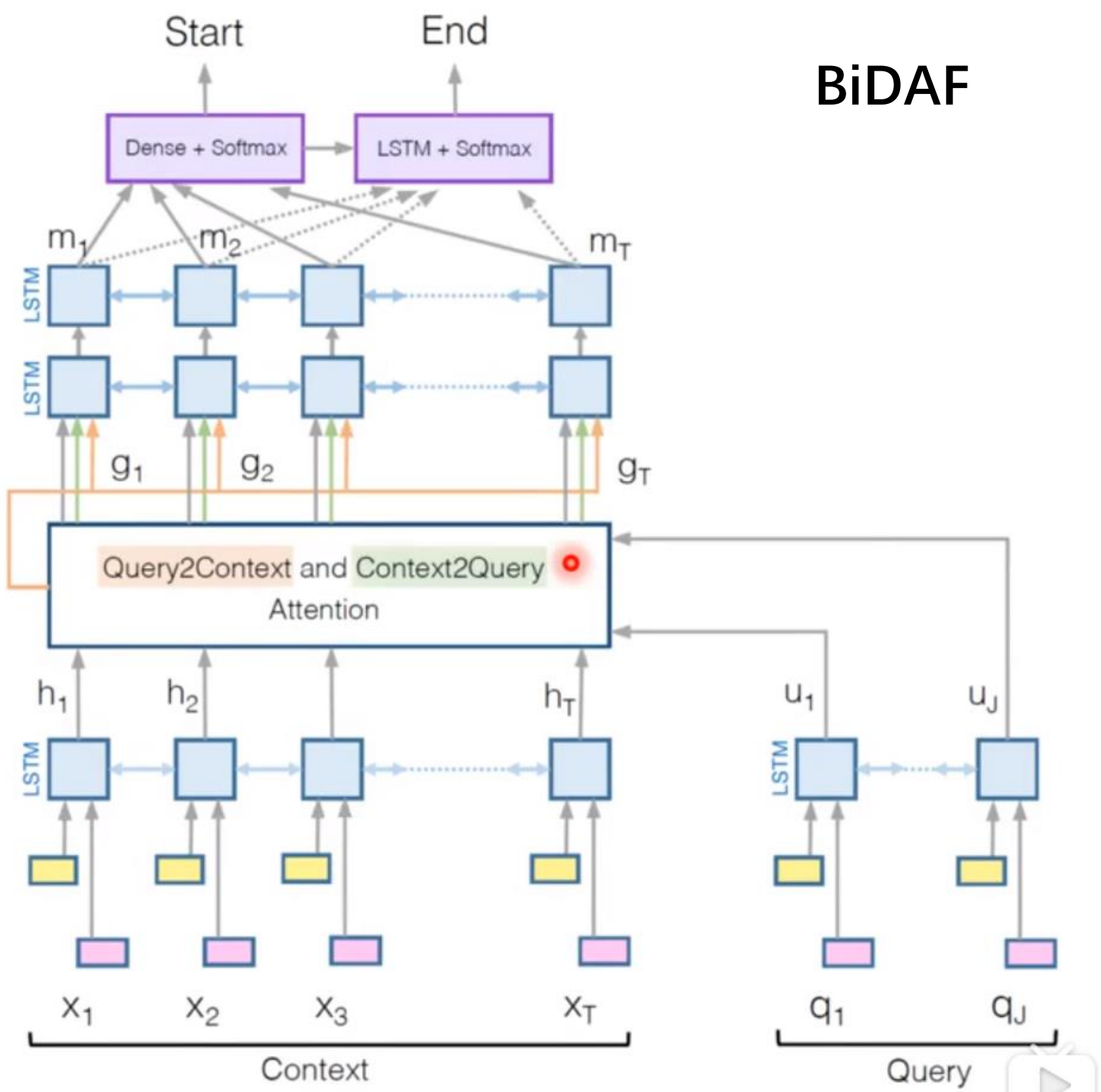
R-Net

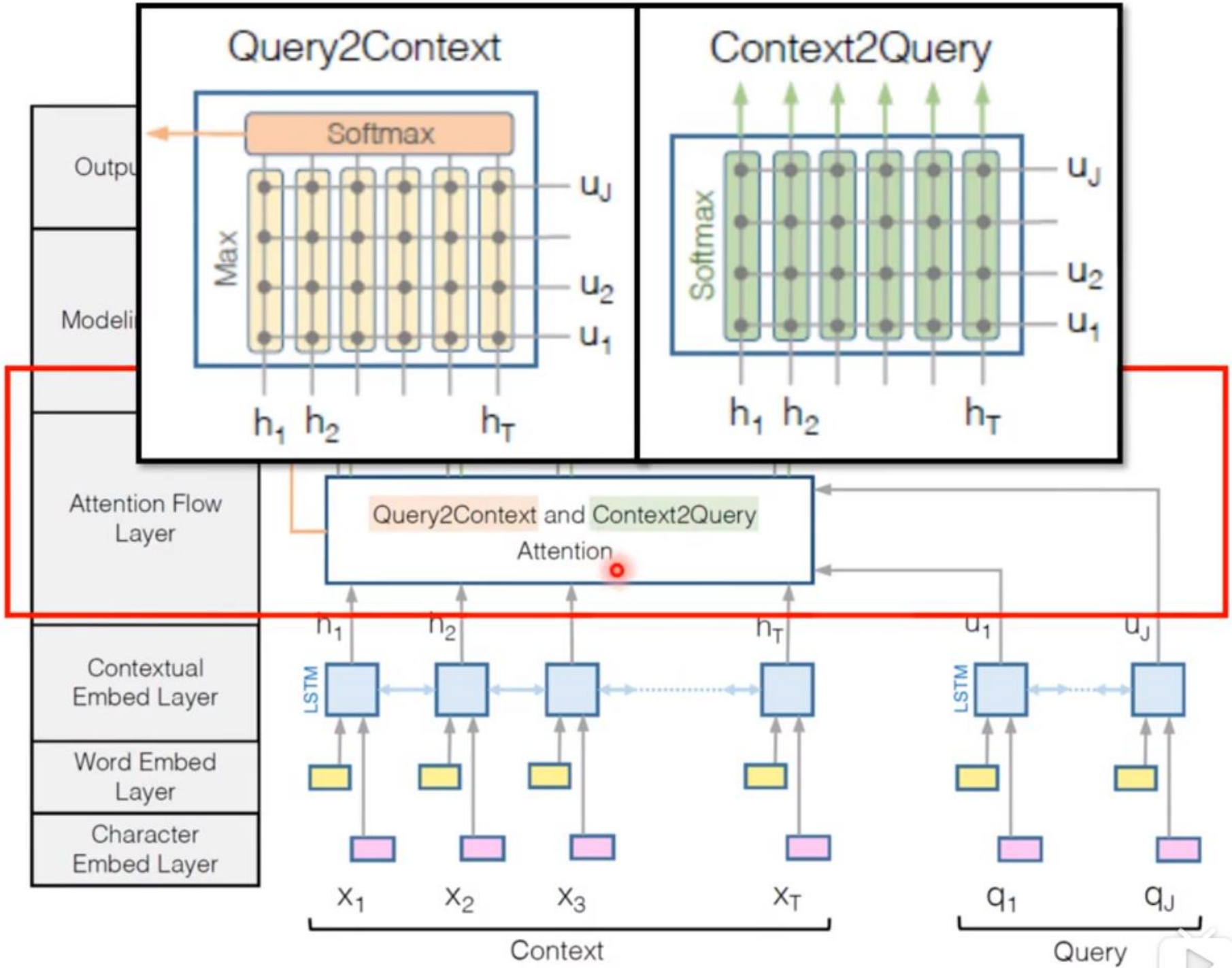
[Wang, et al., ACL'17]



BiDAF


Output Layer
Modeling Layer
Attention Flow Layer
Contextual Embed Layer
Word Embed Layer
Character Embed Layer

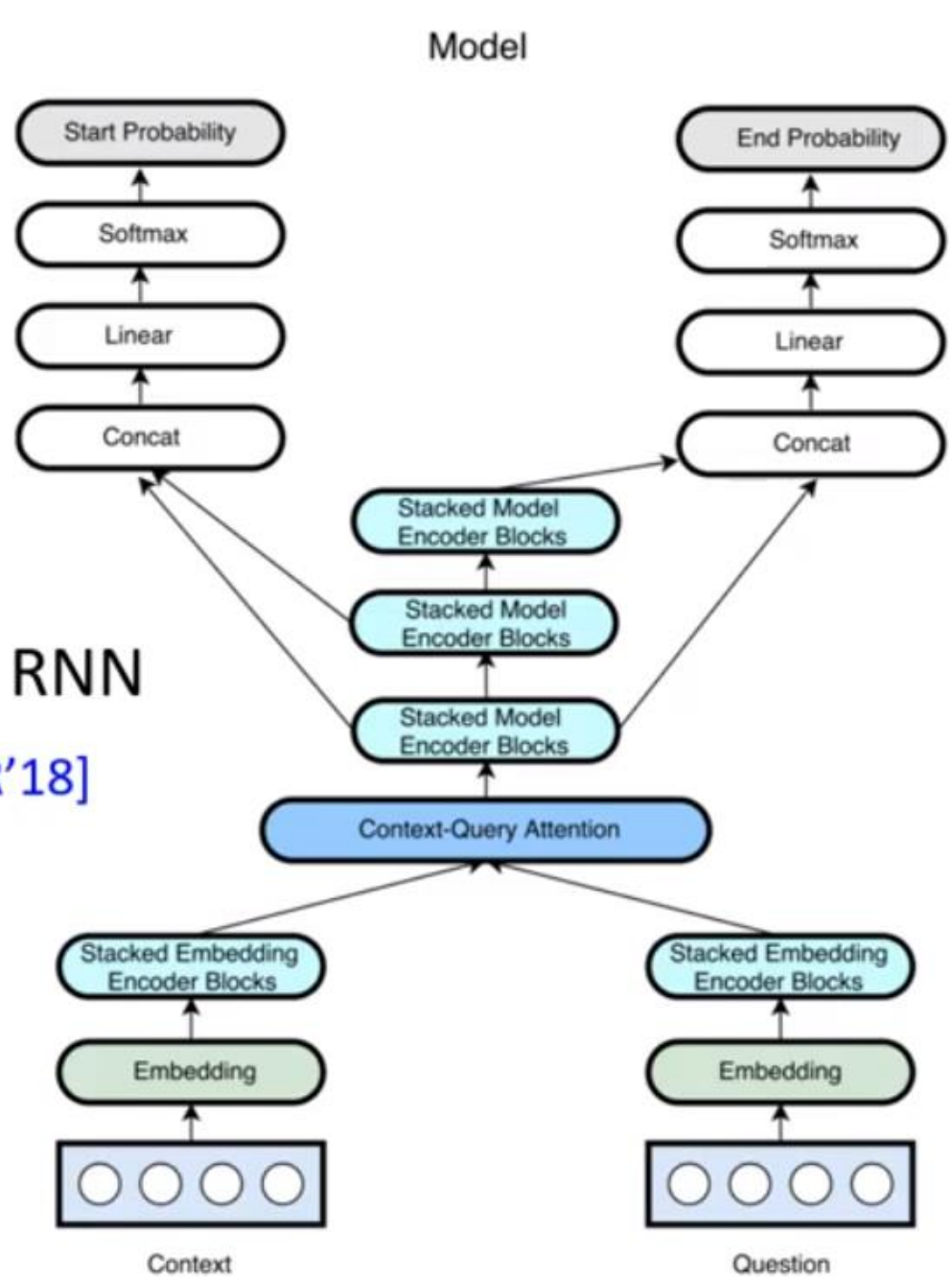

Start
End
Dense + Softmax
LSTM + Softmax
m_1
m_2
m_T
LSTM
LSTM
g_1
g_2
g_T
Query2Context and Context2Query Attention
h_1
h_2
h_T
u_1
u_J
LSTM
LSTM
x_1
x_2
x_3
x_T
q_1
q_J
Context
Query

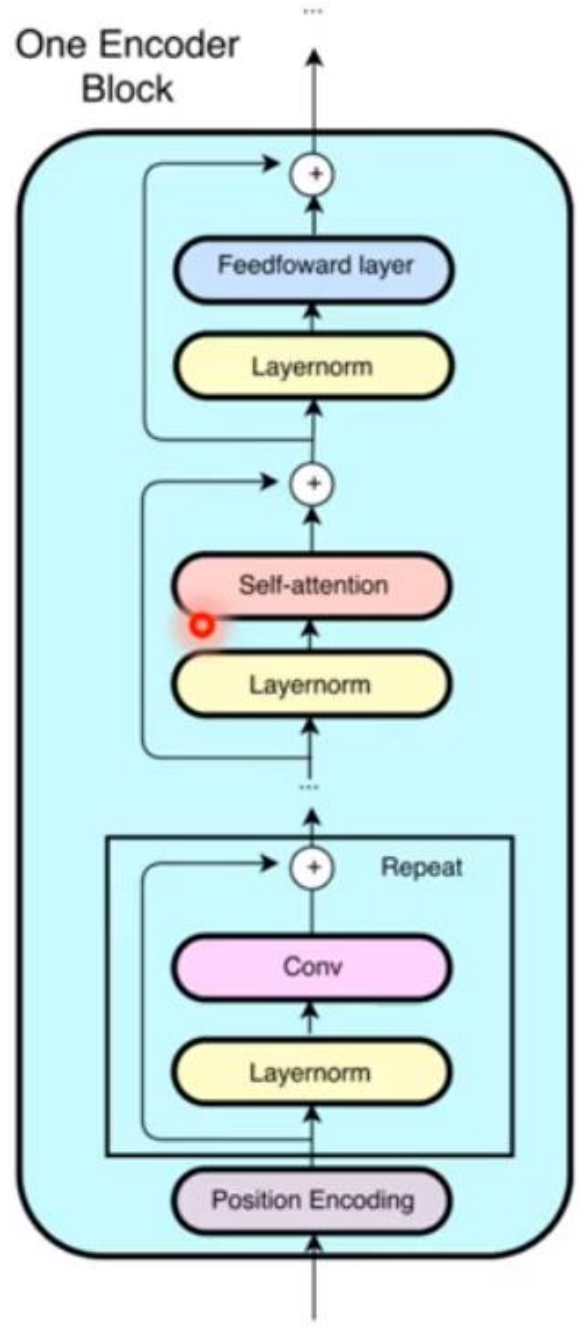

Query2Context
Softmax
Max
u_J
u_2
u_1
h_1 h_2 h_T
Context2Query
Softmax
u_J
u_2
u_1
h_1 h_2 h_T
Outpu
Modeli
Attention Flow Layer
Query2Context and Context2Query Attention
Contextual Embed Layer
Word Embed Layer
Character Embed Layer
LSTM
LSTM
h_1 h_2 h_T
u_1 u_J
x_1 x_2 x_3 x_T
q_1 q_J
Context
Query

QANet

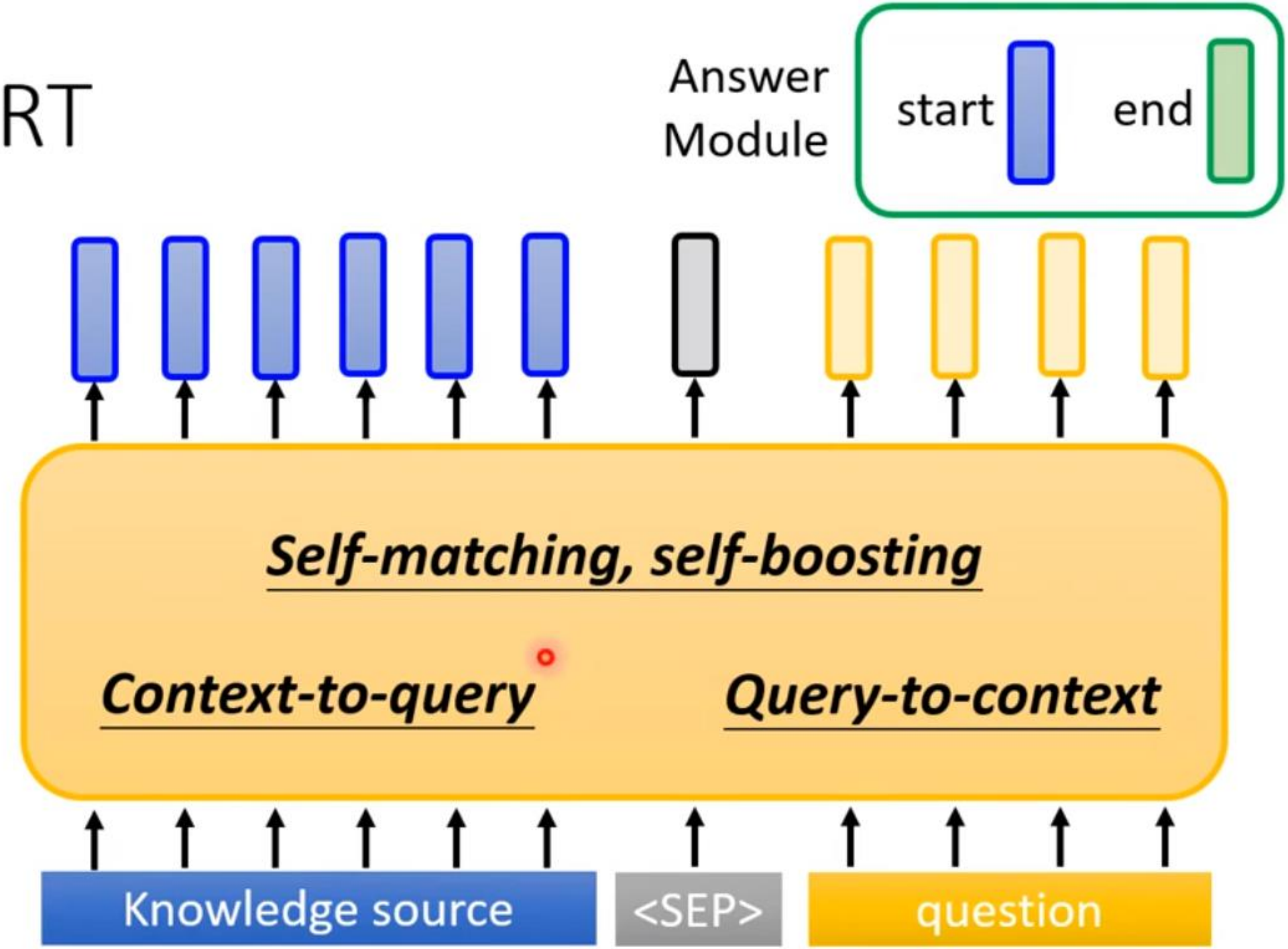
Do not use RNN

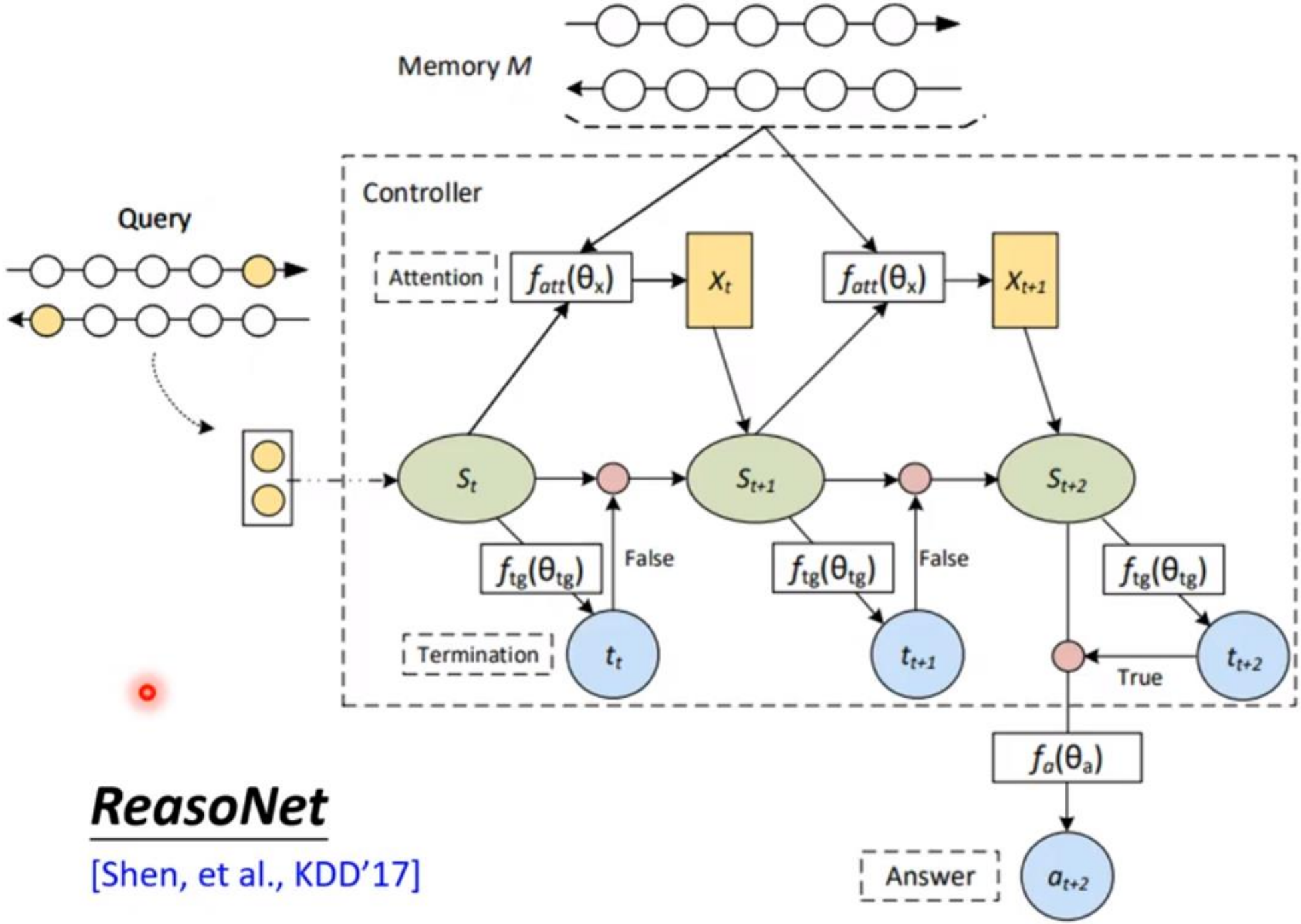
[Yu, et al., ICLR'18]





BERT

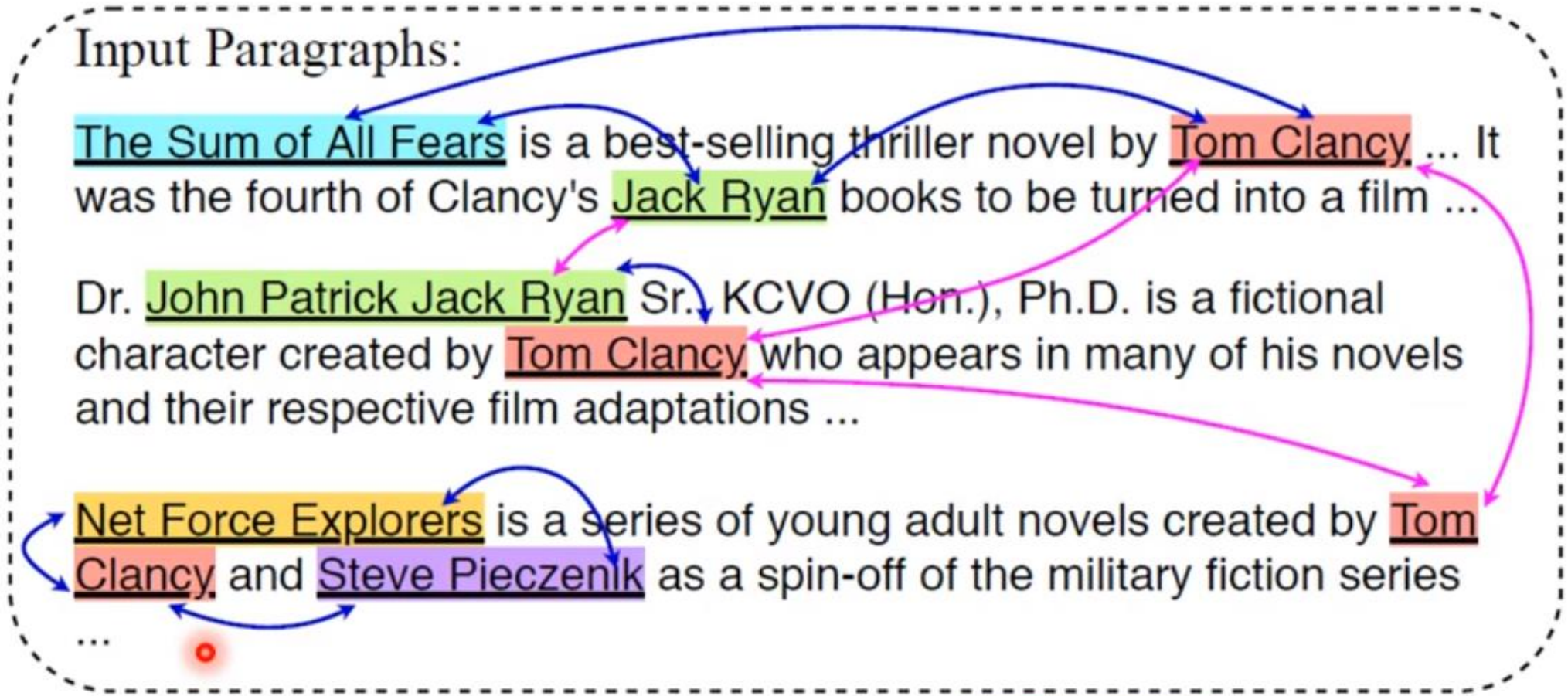

Answer Module
start
end
Self-matching, self-boosting
Context-to-query
Query-to-context
Knowledge source
<SEP>
question



ReasoNet

[Shen, et al., KDD'17]

Graph Neural Network

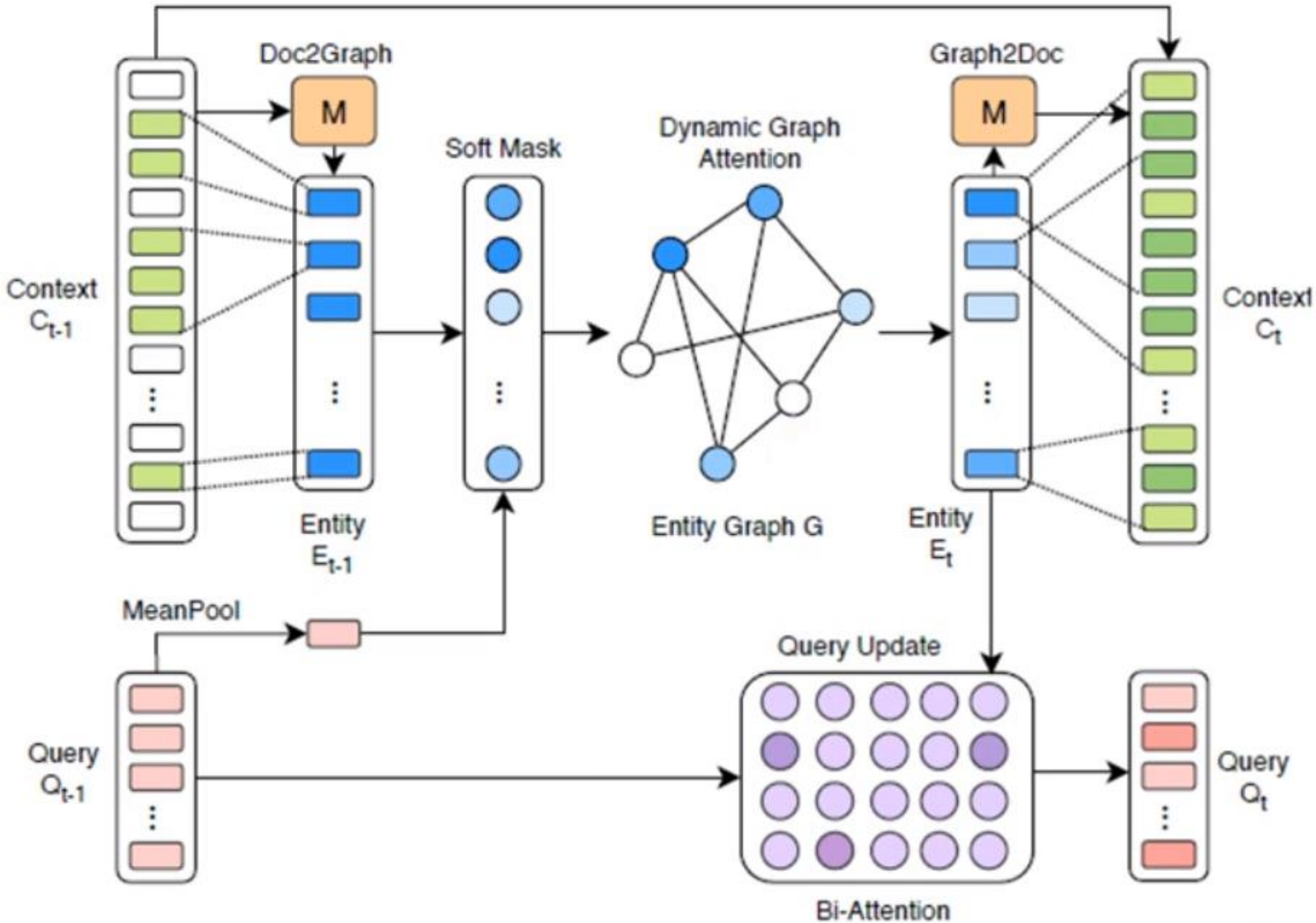


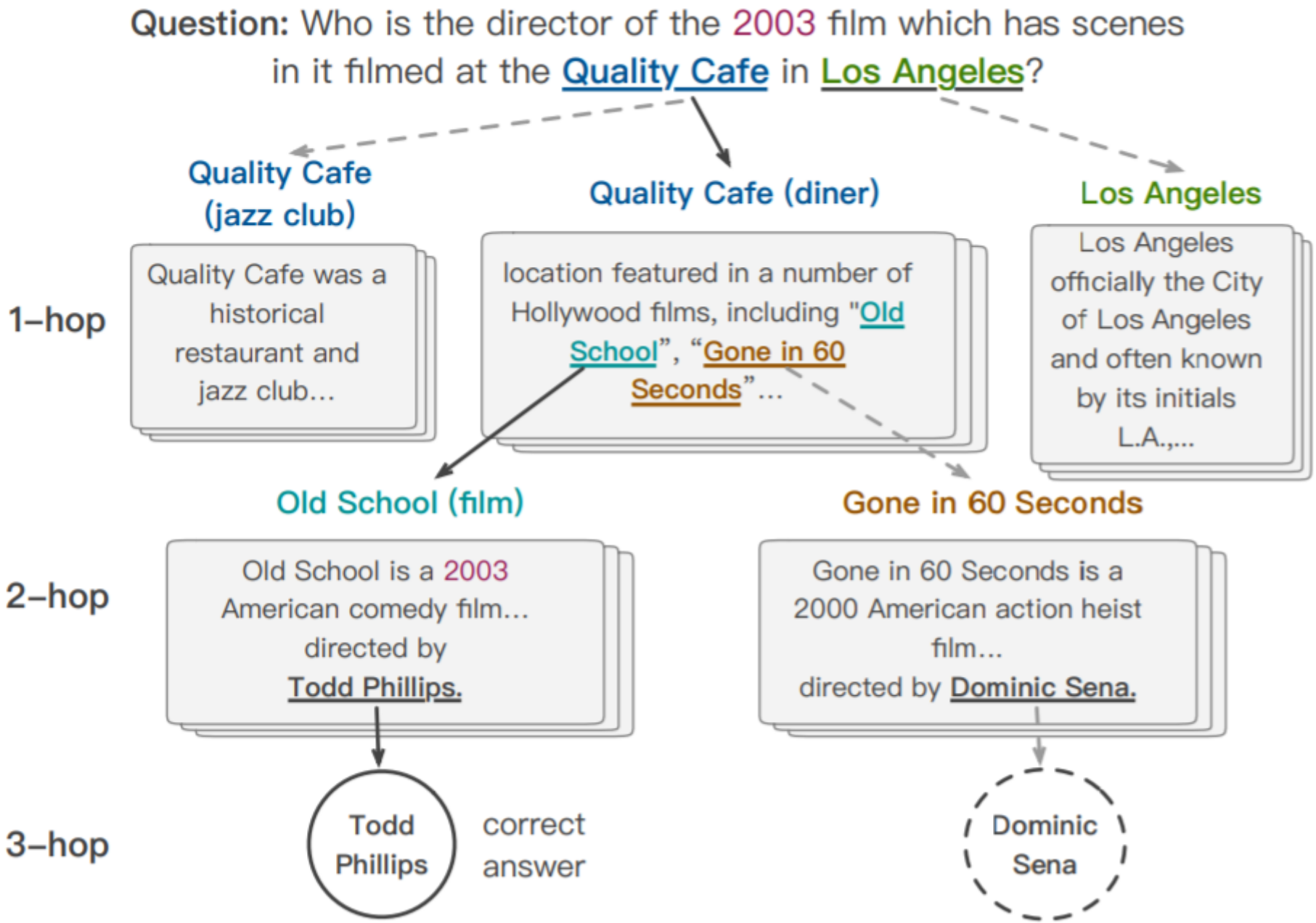
Question: What fiction character created by Tom Clancy was turned into a film in 2002?

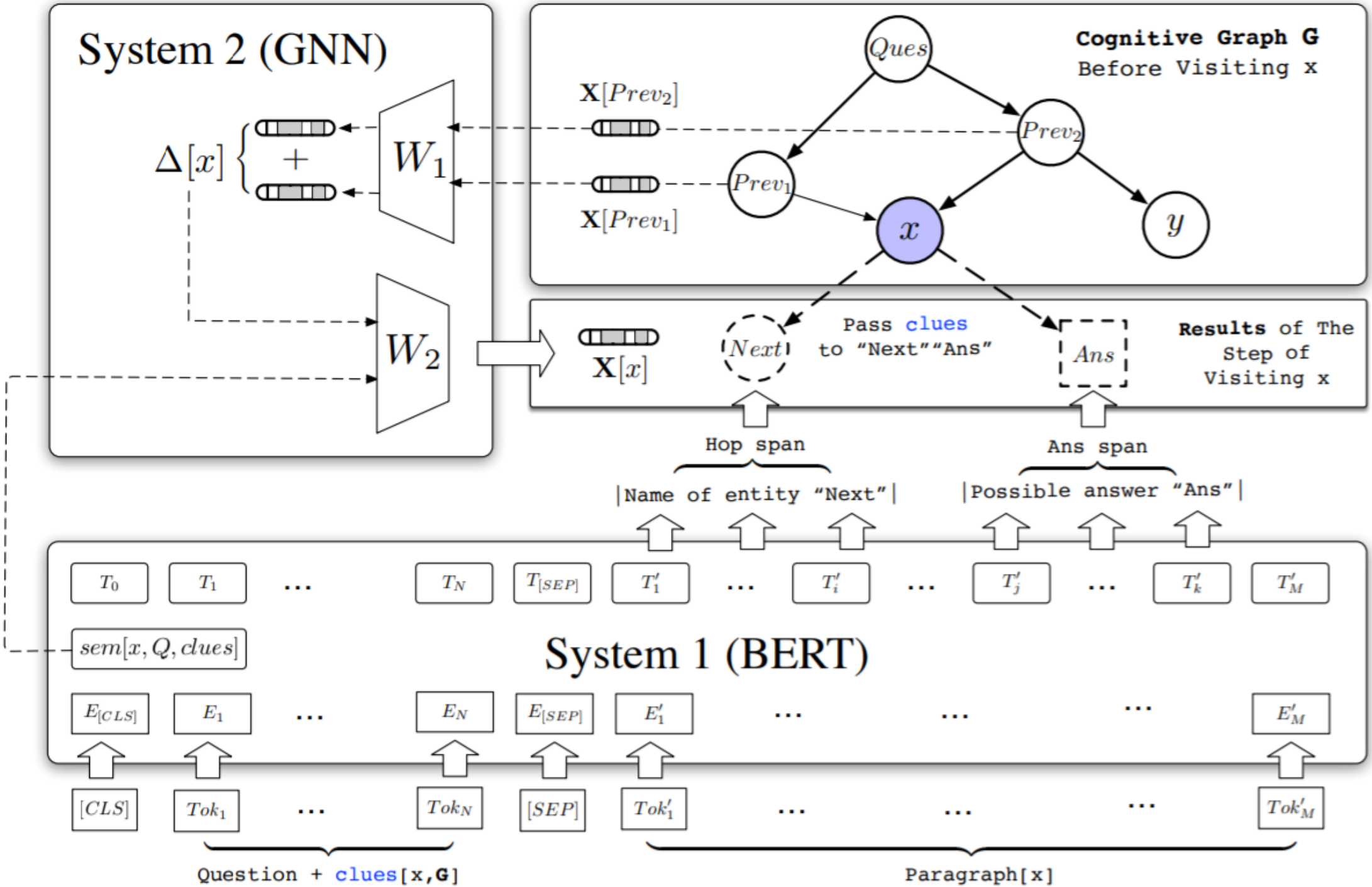
Answer: Jack Ryan

[Qiu, et al., ACL'19]

Graph Neural Network

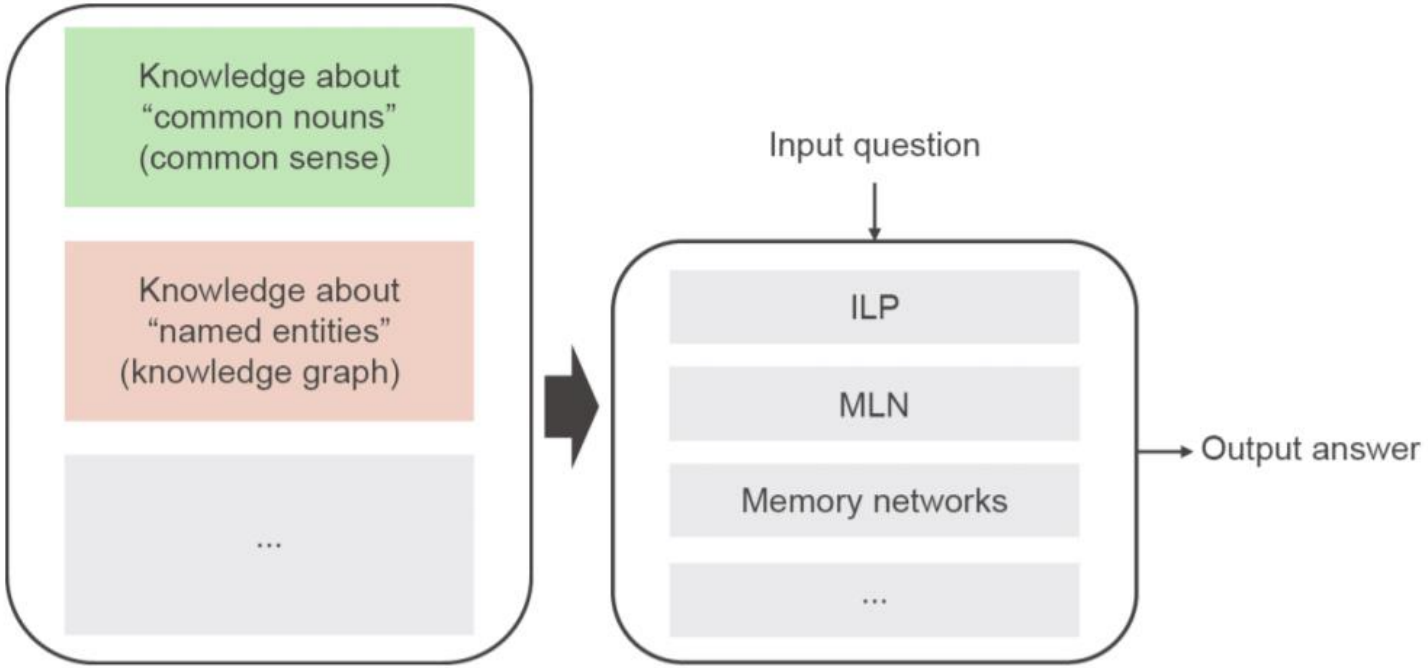



Question: Who is the director of the 2003 film which has scenes in it filmed at the Quality Cafe in Los Angeles?
Quality Cafe (jazz club)
Quality Cafe (diner)
Los Angeles
1–hop
Quality Cafe was a historical restaurant and jazz club...
location featured in a number of Hollywood films, including "Old School", "Gone in 60 Seconds"...
Los Angeles officially the City of Los Angeles and often known by its initials L.A.,...
Old School (film)
Gone in 60 Seconds
2–hop
Old School is a 2003 American comedy film... directed by Todd Phillips.
Gone in 60 Seconds is a 2000 American action heist film... directed by Dominic Sena.
3–hop
Todd Phillips
correct answer
Dominic Sena


System 2 (GNN)
$\Delta[x]$
+
W_1
W_2
$\mathbf{X}[Prev_2]$
$\mathbf{X}[Prev_1]$
$\mathbf{X}[x]$
Ques
$Prev_2$
$Prev_1$
x
y
Cognitive Graph G
Before Visiting x
Next
Pass clues
to "Next""Ans"
Ans
Results of The
Step of
Visiting x
Hop span
Ans span
|Name of entity "Next"|
|Possible answer "Ans"|
T_0 T_1 ... T_N $T_{[SEP]}$ T'_1 ... T'_i ... T'_j ... T'_k T'_M
$sem[x, Q, clues]$
System 1 (BERT)
$E_{[CLS]}$ E_1 ... E_N $E_{[SEP]}$ E'_1 ... ... E'_M
[CLS] Tok_1 ... Tok_N [SEP] Tok'_1 ... ... Tok'_M
Question + clues[x,G]
Paragraph[x]

reasoning system should have two components:

- Knowledge, such as a knowledge graph, common sense, rules, assertions extracted from raw texts, etc.;
- An inference engine, to generate answers to questions by manipulating existing knowledge.



https://www.sciencedirect.com/science/article/pii/S2095809919304928

https://www.msra.cn/zh-cn/people/ming-zhou

AliCoCo: Alibaba E-commerce Cognitive Concept Net

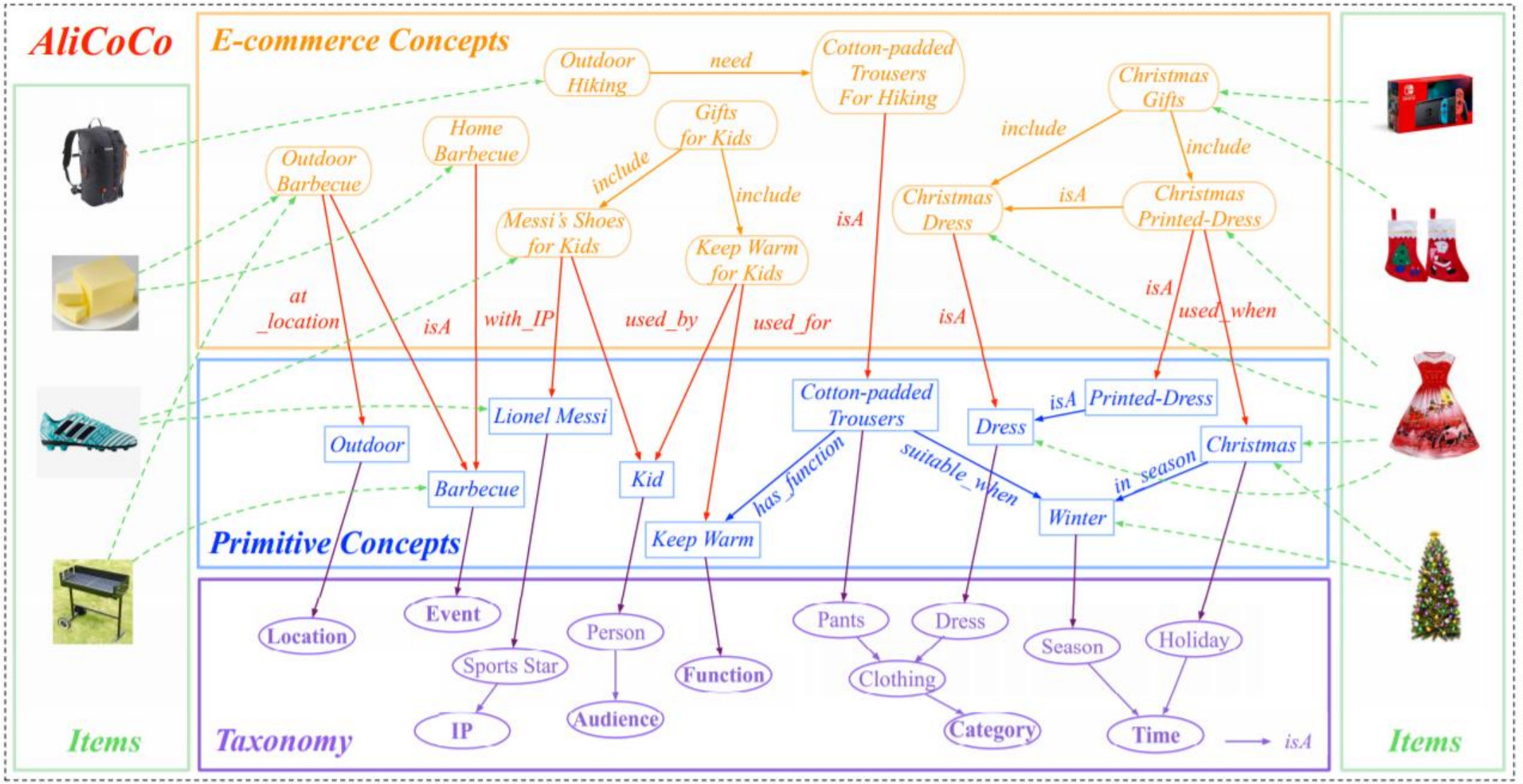


Figure 1: Overview of "AliCoCo", which consists of four layers: e-commerce concepts, primitive concepts, taxonomy and items.

AliCoCo: Alibaba E-commerce Cognitive Concept Net

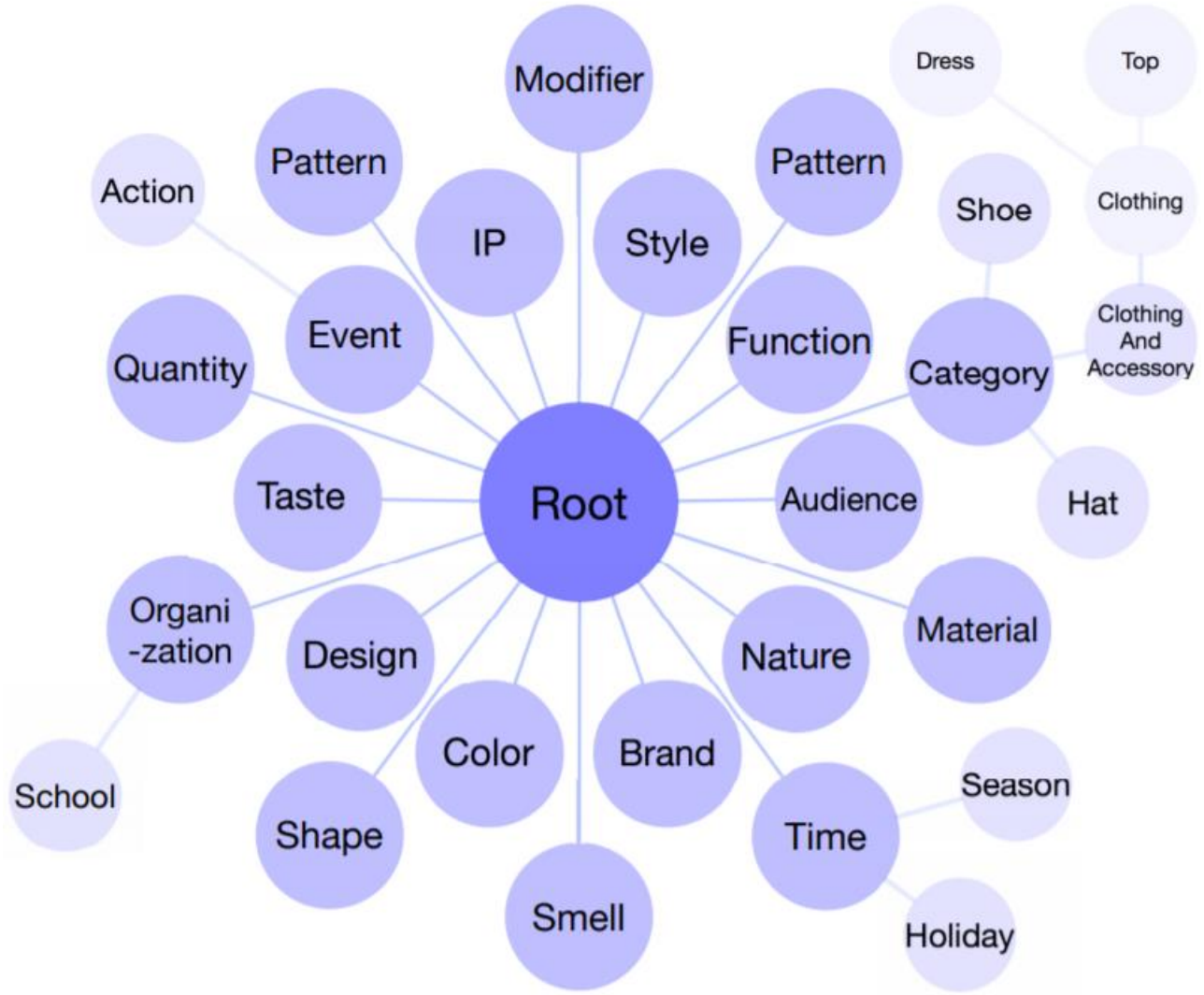


Figure 3: Overview of the taxonomy in AliCoCo.

AliCoCo: Alibaba E-commerce Cognitive Concept Net

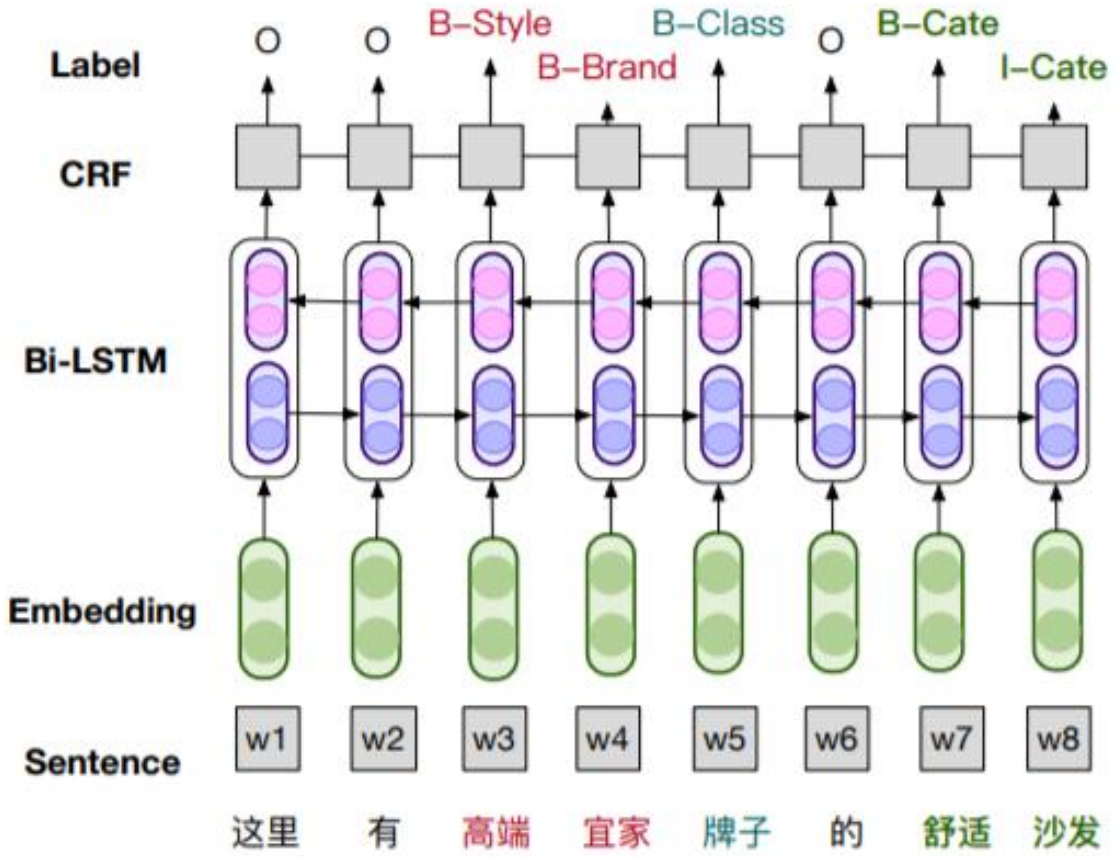


Figure 4: Principle architecture of a BiLSTM-CRF model

AliCoCo: Alibaba E-commerce Cognitive Concept Net

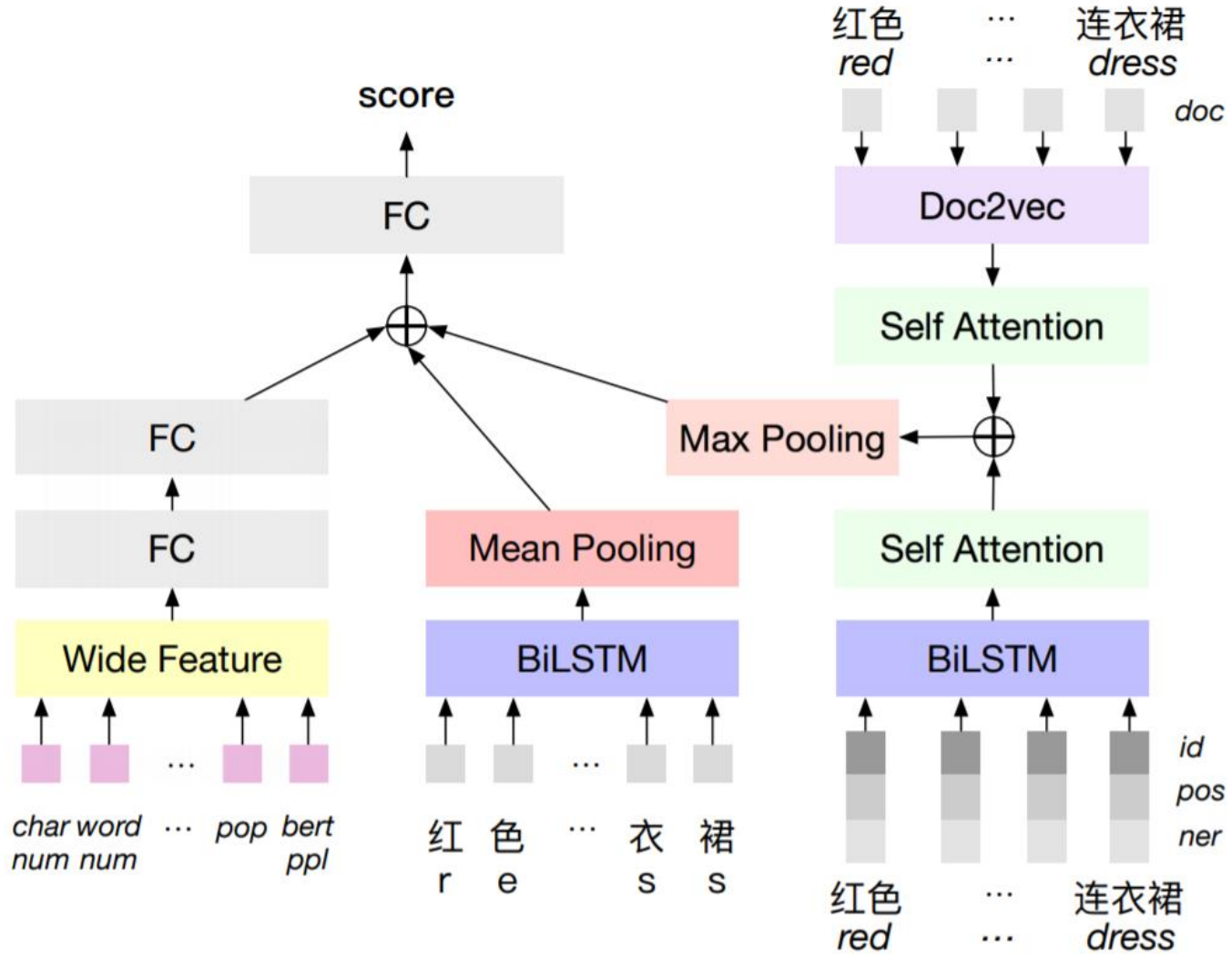


Figure 5: Overview of knowledge-enhanced deep model for e-commerce concept classification.

AliCoCo: Alibaba E-commerce Cognitive Concept Net

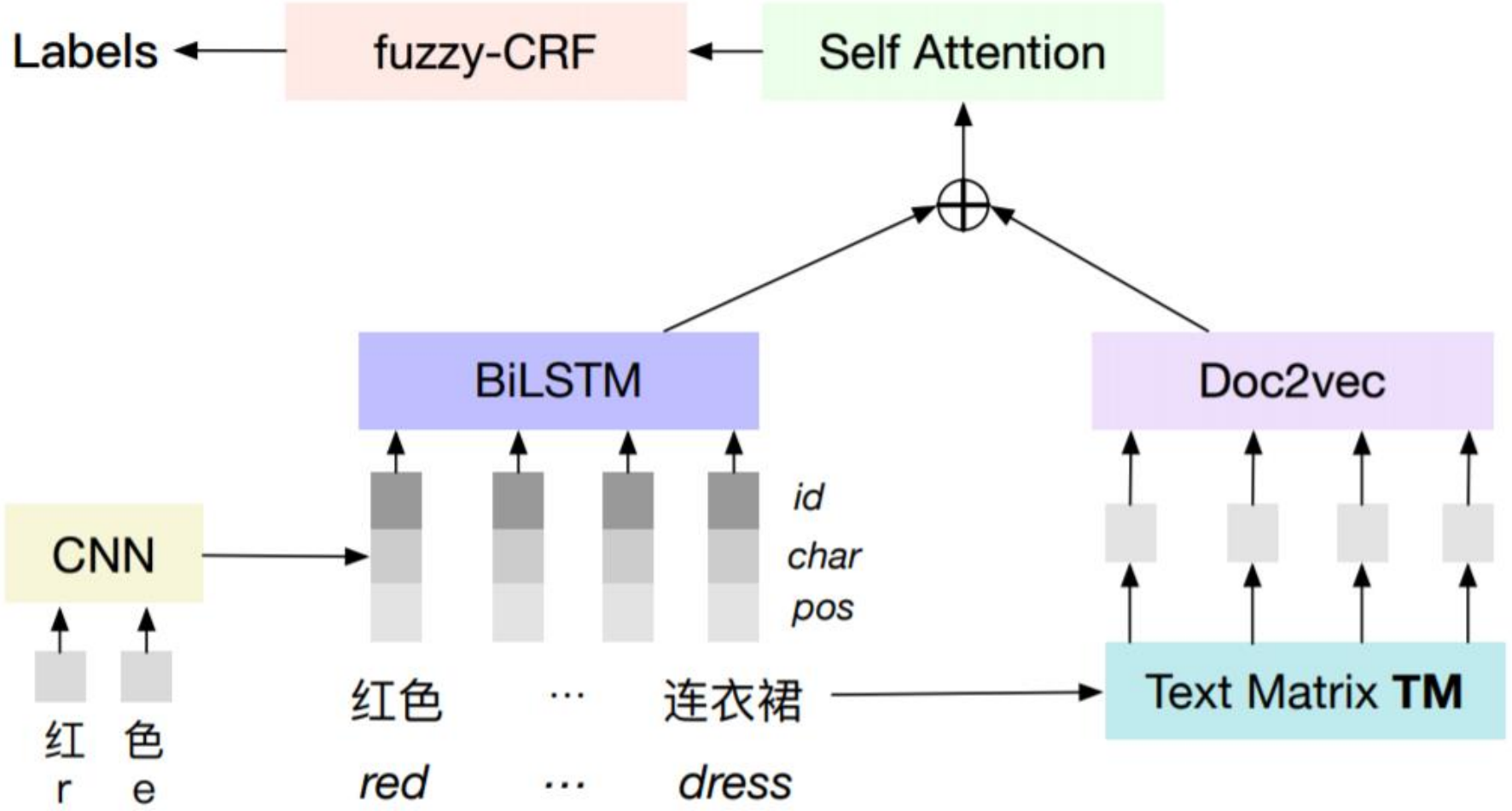


Figure 6: Overview of text-augmented deep NER model for e-commerce concept tagging.

AliCoCo: Alibaba E-commerce Cognitive Concept Net

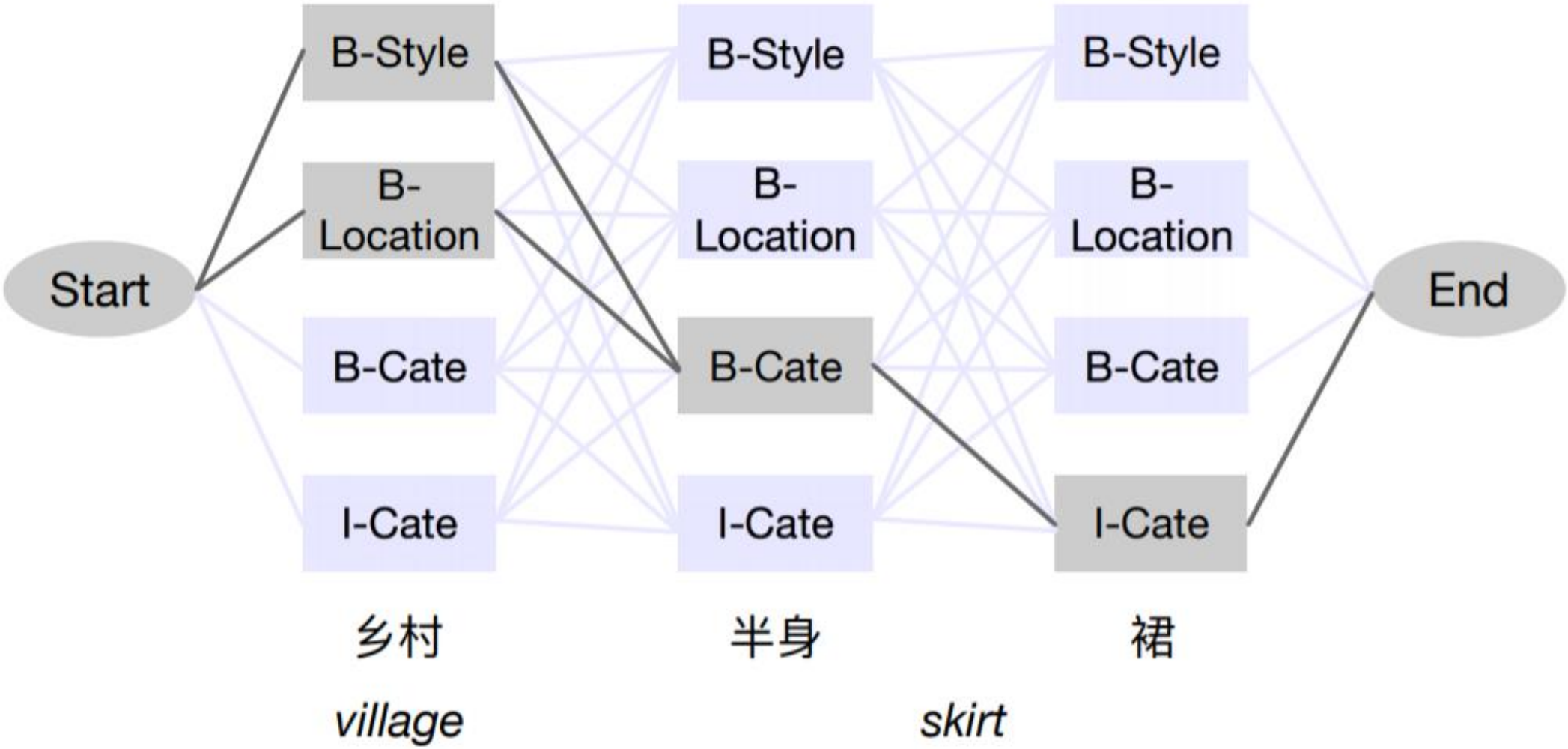


Figure 7: A real example in fuzzy CRF layer.

AliCoCo: Alibaba E-commerce Cognitive Concept Net

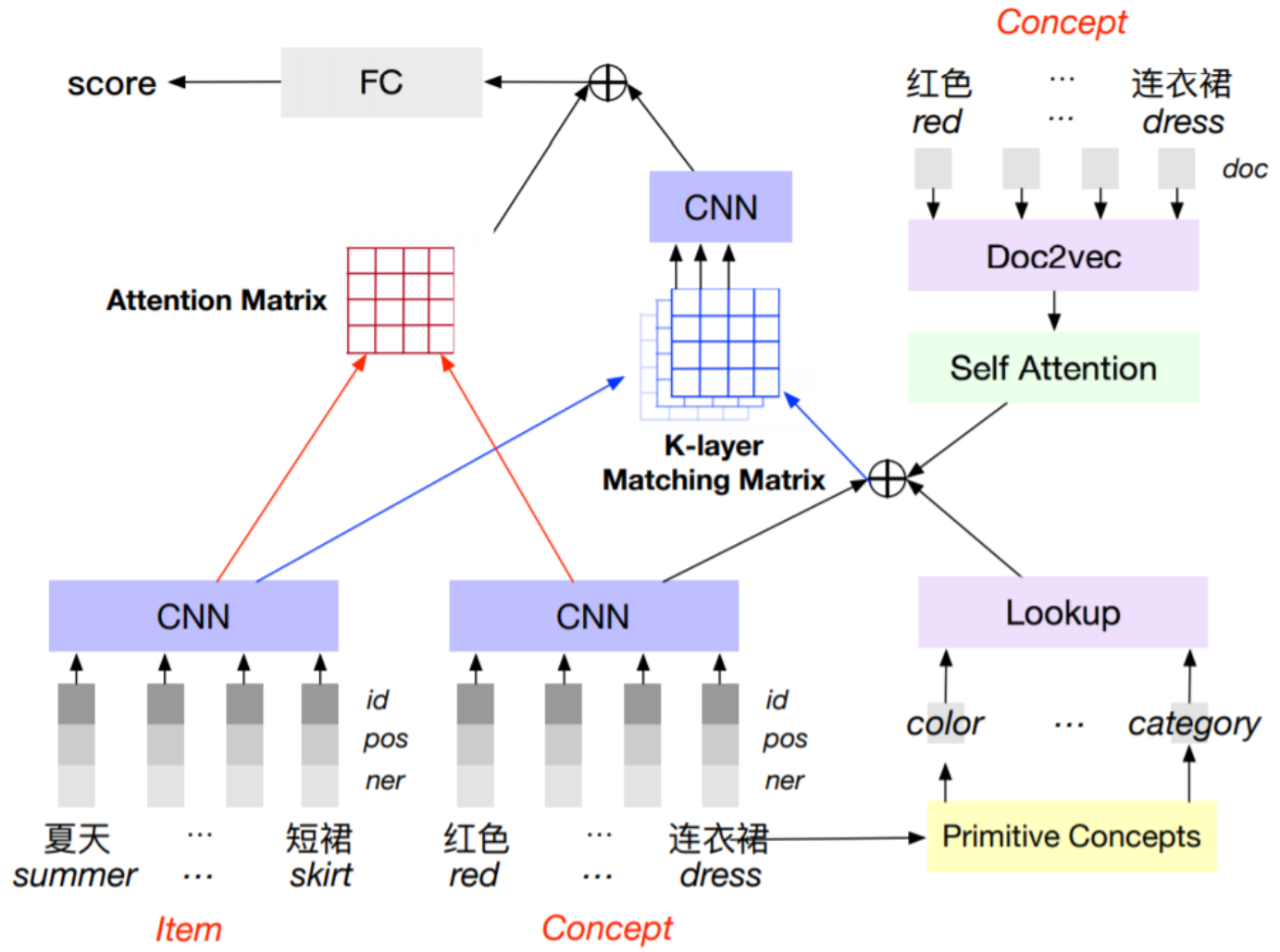
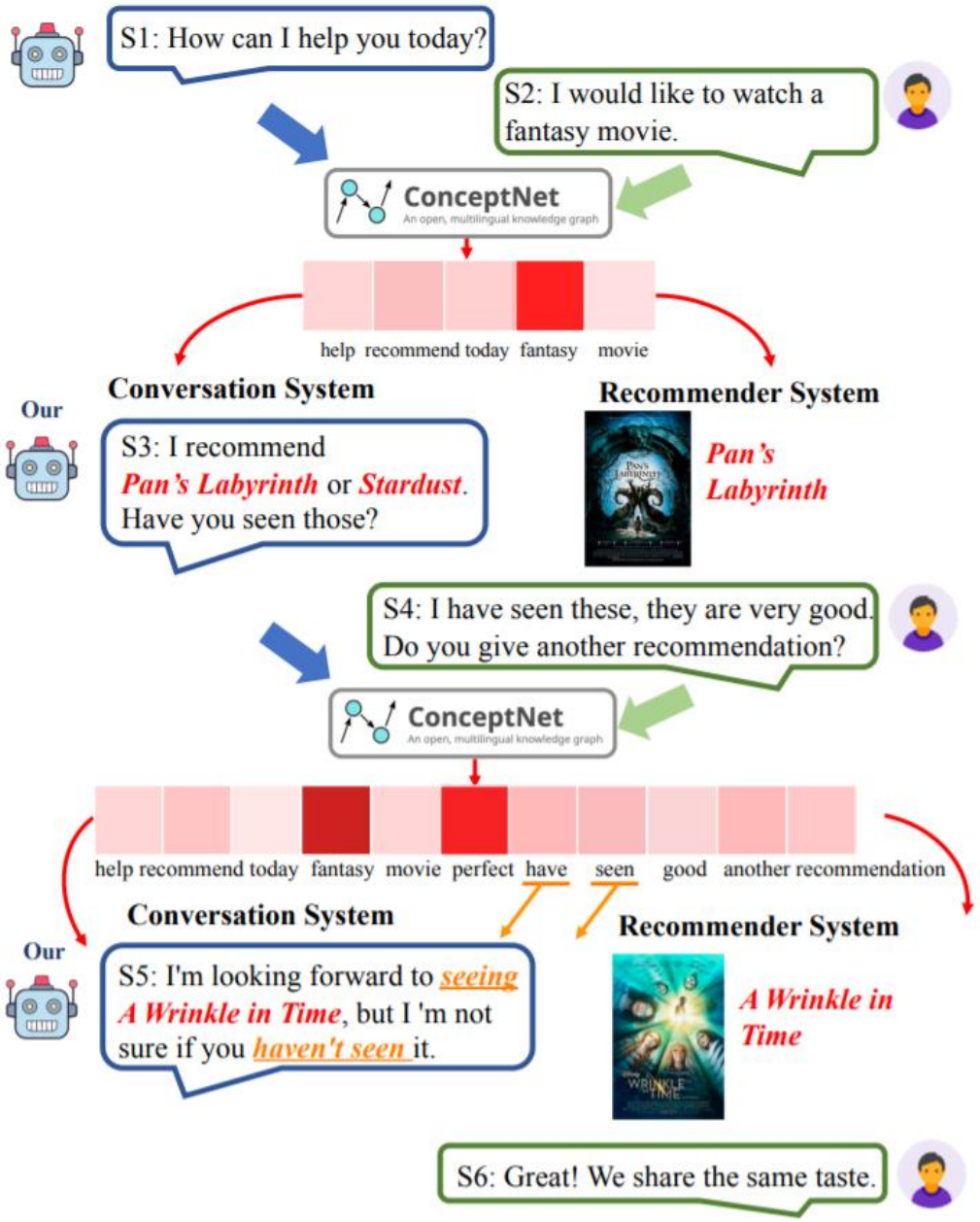


Figure 8: Overview of knowledge-aware deep semantic matching model for association between e-commerce concepts and items.

Improving Conversational Recommender Systems via Knowledge Graph based Semantic Fusion



Improving Conversational Recommender Systems via Knowledge Graph based Semantic Fusion

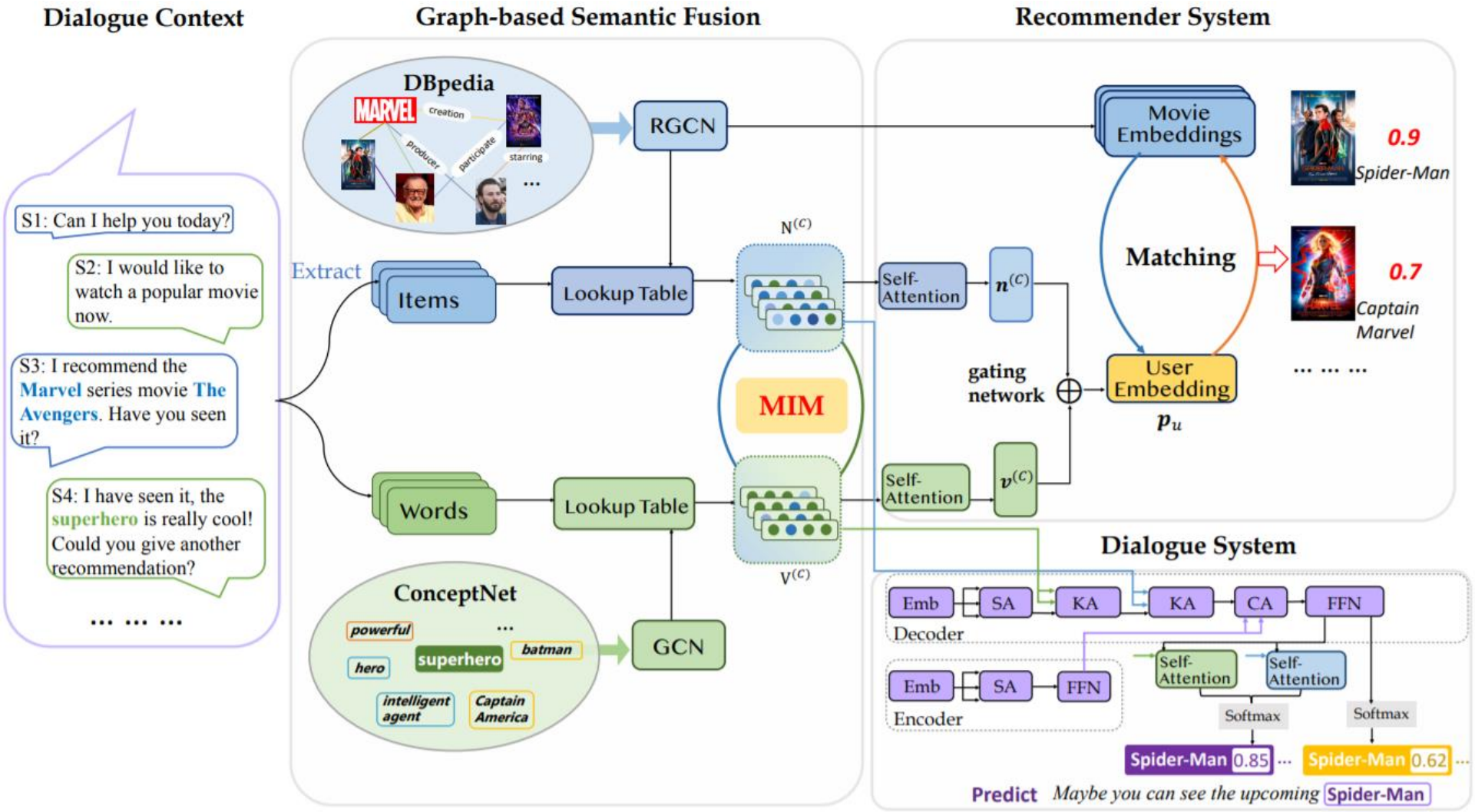


Figure 1: The overview of our model with a movie recommendation scenario. Here,"SA", "KA", and "CA" denotes *self-attention*, *KG-based attention* and *context-based attention*, respectively.

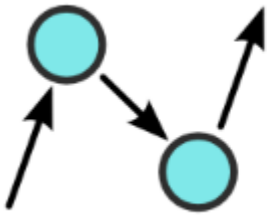
Commonsense Reasoning

判断哪些是雷人台词?

- 八百里一枪命中!
- 我爷爷五岁时候被鬼子杀害了!

- 直接从文本中无法获取答案，需要常识。
- 常识一般都过于复杂，难以归纳和表示。

一个模型能够掌握常识，说明这个模型已经具备很强的学习能力，能够轻松应对通用知识和领域知识。



ConceptNet

An open, multilingual knowledge graph

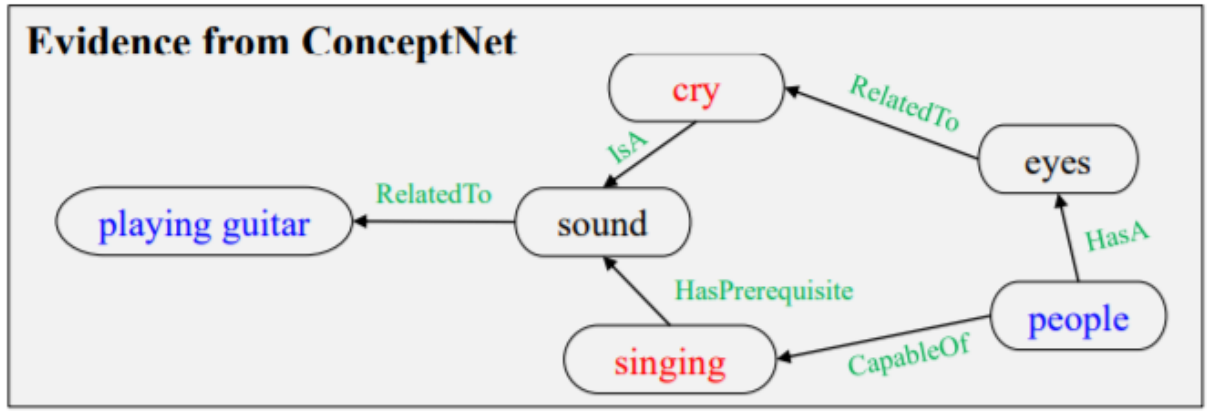
What is ConceptNet?

ConceptNet is a freely-available semantic network, designed to help computers understand the meanings of words that people use.

ConceptNet originated from the crowdsourcing project Open Mind Common Sense, which was launched in 1999 at the MIT Media Lab. It has since grown to include knowledge from other crowdsourced resources, expert-created resources, and games with a purpose.

Graph-Based Reasoning over Heterogeneous External Knowledge for Commonsense Question Answering

Question: What do people typically do while playing guitar?
A. cry **B**. hear sounds **C**. singing (✓) **D**. anthritis **E**. making music



Evidence from Wikipedia

A. cry
- What can yearn, cry without tears?
- What is to cry and to weep?

C. singing
- She also performed them, playing guitar and singing.
- Jakszyk led the band, playing guitar and singing.

E. making music
- Making music and playing guitar are his hobbies.
- He began making music when he started guitar lessons.

Figure 1: An example from the CommonsenseQA dataset which requires multiple external knowledge to make the correct prediction. ConceptNet evidence helps pick up choices (A, C) and Wikipedia evidence helps pick up choices (C, E). Combining both evidence will derive the right answer C. Words in blue are the concepts in the question. Words in green are the relations from ConceptNet. Words in red are the choices picked up by evidence.

Graph-Based Reasoning over Heterogeneous External Knowledge for Commonsense Question Answering

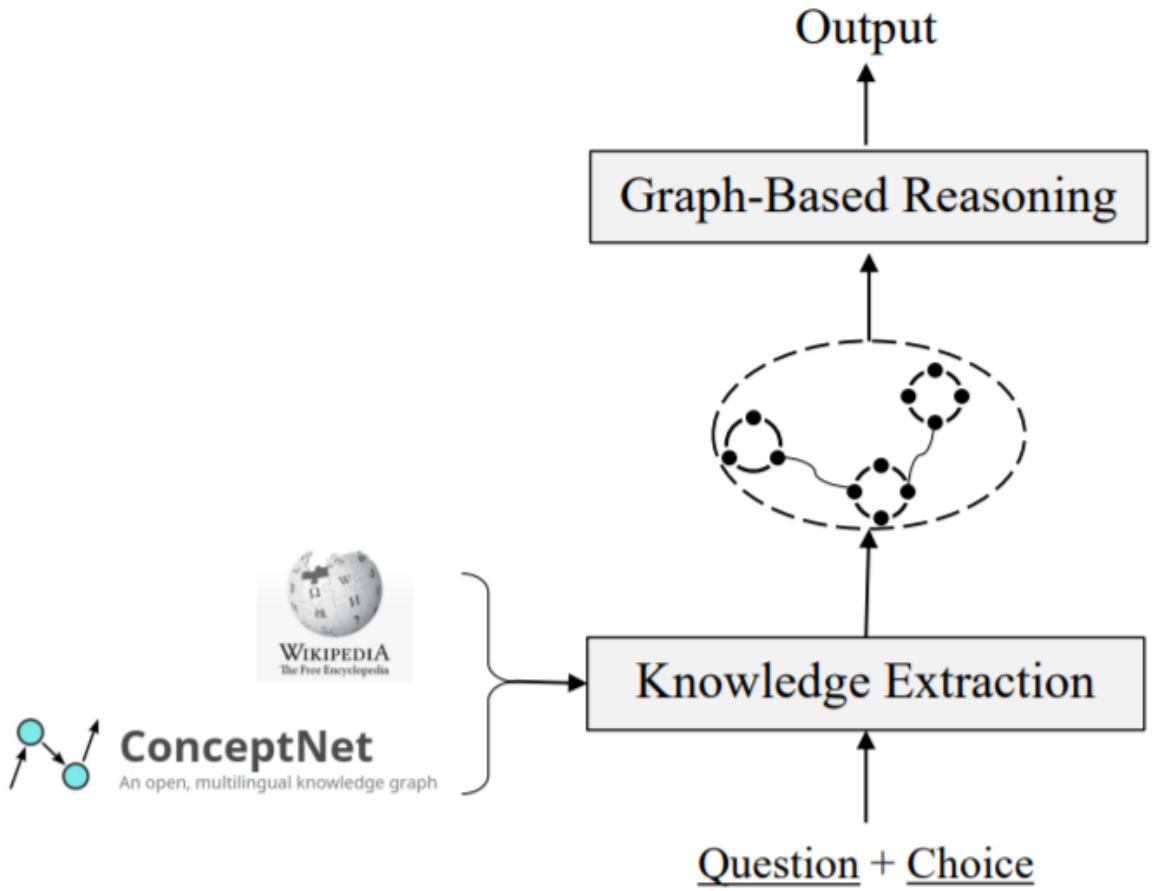


Figure 2: An overview of our approach.

Graph-Based Reasoning over Heterogeneous External Knowledge for Commonsense Question Answering

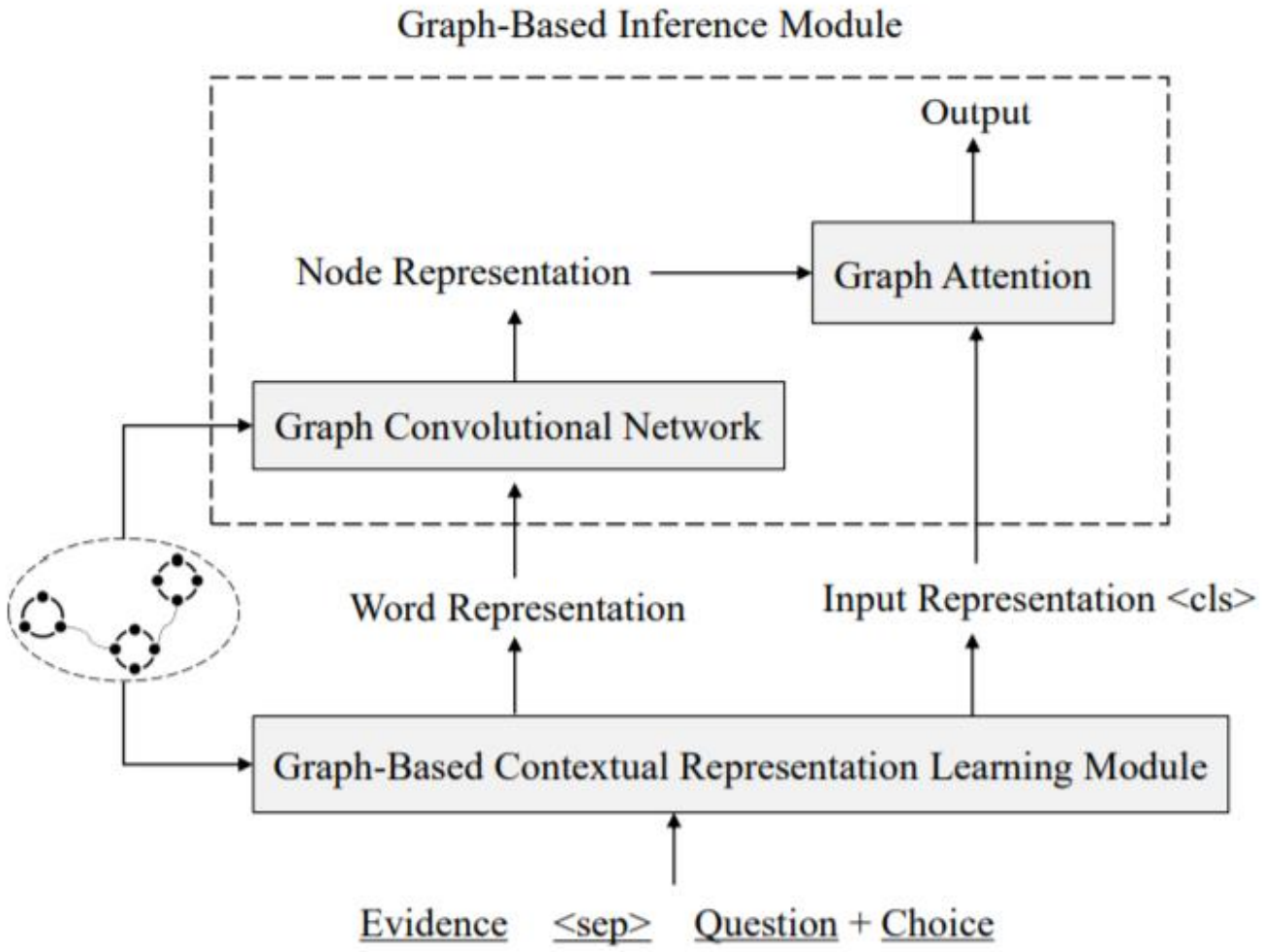


Figure 5: An overview of our proposed graph-based reasoning model.

Graph-Based Reasoning over Heterogeneous External Knowledge for Commonsense Question Answering

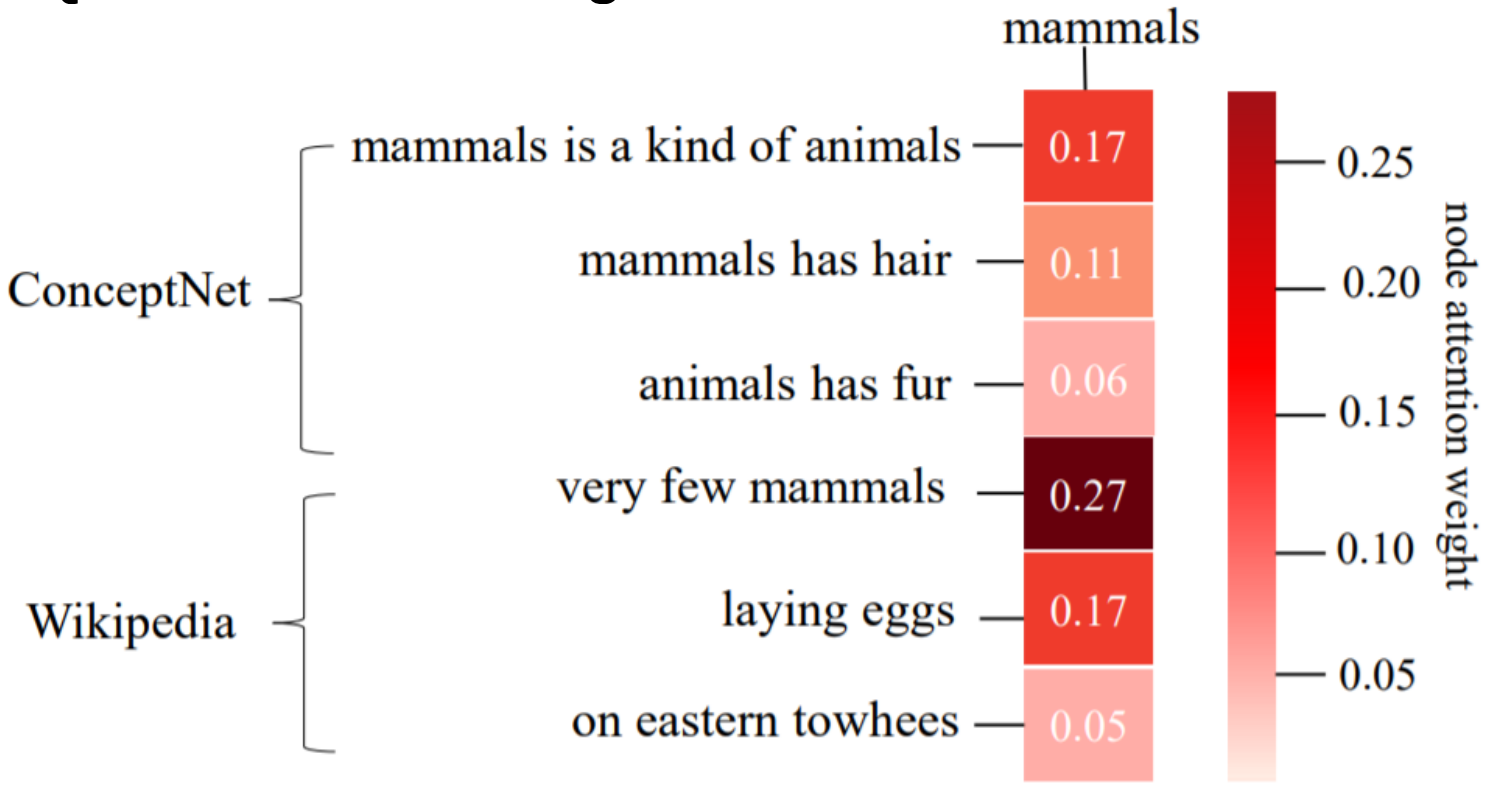


Figure 6: An attention heat-map for the question "Animals who have hair and don't lay eggs are what?" and the answer "mammals". The nodes in ConpcetNet are in natural language format and the template is: IsA (is a kind of), HasA (has).