



One-shot Learning for Question-Answering in Gaokao History Challenge

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Introduction

Gaokao challenge

- Teach machines to pass university admission exams (Gaokao in Chinese)
- This task is to solve comprehensive questions and has to be based on knowledge representation and semantic computation rather than word form matching in the previous work.
- This paper presents a neural model with NTM for a challenging deep question answering task from history examinations. We also release a Chinese comprehensive deep question answering dataset and have launched a new research line for the Gaokao challenge.

Q: “农民可能充当一种极端保守的角色，也可能充当一种具有高度革命性的角色。”试结合有关史实评析这一观点。
“Peasants may act as an extremely conservative role, or may be highly revolutionary.” Try to analyze this view in the light of the relevant historical facts.
A: 农民阶级的经济地位和所处的时代条件决定了它可能充当一种具有高度革命性的角色。以太平天国运动为例，在斗争过程中颁布的《天朝田亩制度》就突出反映了农民阶级要求废除封建土地所有制的强烈愿望，表现出了高度的革命性。农民阶级存在的这种两面性是由其经济地位即受地主阶级压迫和小生产者的地位所决定的。
The economic and social conditions of peasants determine that they may act as a highly revolutionary role. Taking the Taiping Heavenly Kingdom movement as an example, the promulgated regulation “heavenly land system” reflected the peasant class’s demands and strong desire of abolishing the system of feudal land ownership, which shows a strong degree of revolution. The dual nature of the peasant class is also the result of its economic status, that is, under the oppression of the landlord class and the status of the small producers.
Q: 有人说“文艺复兴”是一场复古运动，你如何看待？如何评价其意义？
Some people think the Renaissance is a retro campaign. What’s your opinion and how to evaluate its historic significance?
A: 文艺复兴运动从表面的含义来看，是一种复兴古希腊罗马时期的哲学、文学和艺术的活动，是一种复古运动，但从其深层的含义看，它却是一场思想解放运动，是一次思想领域里的变革。
The Renaissance is seemingly regarded as a retro movement of philosophy, literature and art of ancient Greece and Rome. However, it is actually an ideological liberation movement and a revolution of thoughts from a deeper inspection.

- Comprehensive question examples from Gaokao history

Corpus

	Train	Test
# QA pairs	964	965
Avg # words in questions	18	25
Avg # words in answers	46	48
Max # words in questions	478	482
Max # words in answers	4,652	4,387
# Candidate answer set	1,929	
# Vocabulary	10,806	

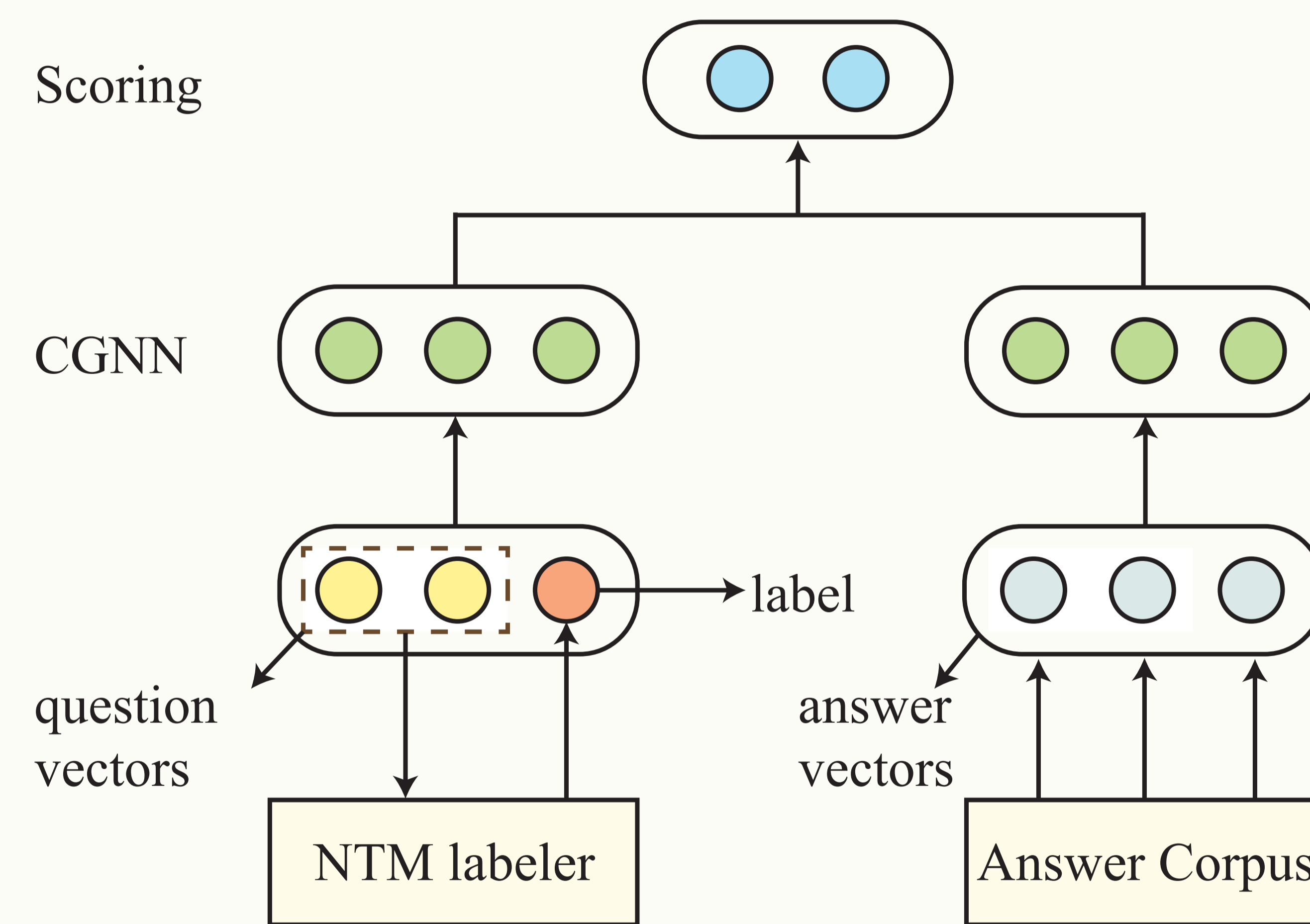
- Data statistics of the comprehensive question-answering corpus.
- 1,929 must-to-be-mastered history facts from the standard history textbook.
- To specify a key perspective on historical questions, five classes are annotated.
- One-shot learning is supposed to effectively represent the questions in the feature space with a small set of training data.

Class Labels	Answers
背景 Background	运用我们从古代诗文、戏曲、民间传说中已经学到的知识，举例说明中国古代自给自足的自然经济的状况。 Using the knowledge learned from ancient poetic proses, operas, and folklores, exemplify the situation of self-sufficiency of natural economy in ancient China.
原因 Cause	春秋战国时期是社会剧烈动荡的历史阶段，为什么在这样的时期会出现思想文化活跃的局面。 The Spring-autumn and Warring States Period was the historical stage of the violent social unrest. Why would there be an active ideological and cultural phenomenon in such a period?
主张 Claim	在启蒙运动中，众多的启蒙思想家的共性思想主张是什么？他们之间有何继承和发展。 During the Enlightenment, what is the common thought of those enlightening thinkers? What is the inheritance and development between them?
事实 Fact	“农民可能充当一种极端保守的角色，也可能充当一种具有高度革命性的角色。”试结合有关史实评析这一观点。 “Farmers may act as an extremely conservative role, or may be highly revolutionary.” Try to analyze this view in the light of the relevant historical facts.
意义 Influence	用历史唯物主义和辩证唯物主义的观点来分析古代雅典民主政治和罗马法发展的历程，了解它们对后世的作用和影响。 From the perspective of historical and dialectical materialism, analyze the history of Athens’s democratic politics and the development of Rome law in ancient times, and understand their roles and influences on later generations.

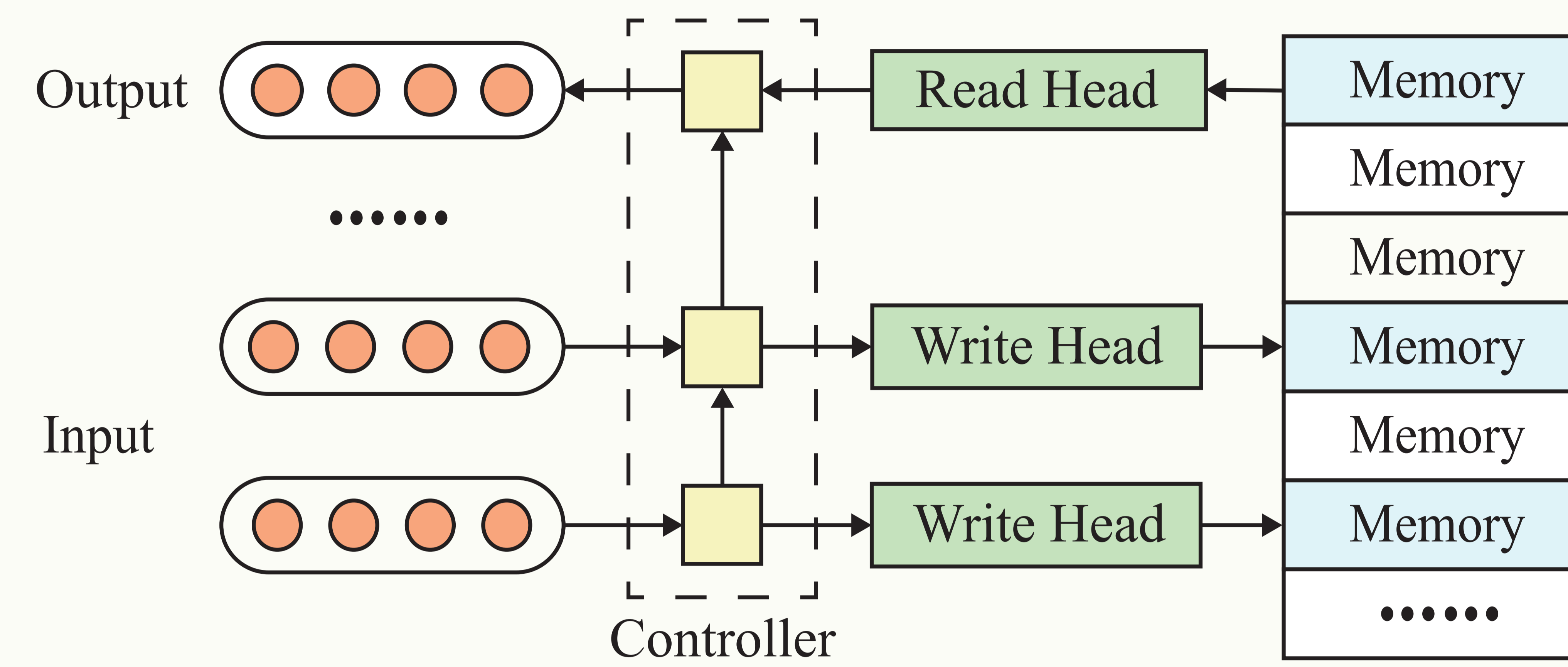
- Examples of Text Fragments of 5 classes

Model

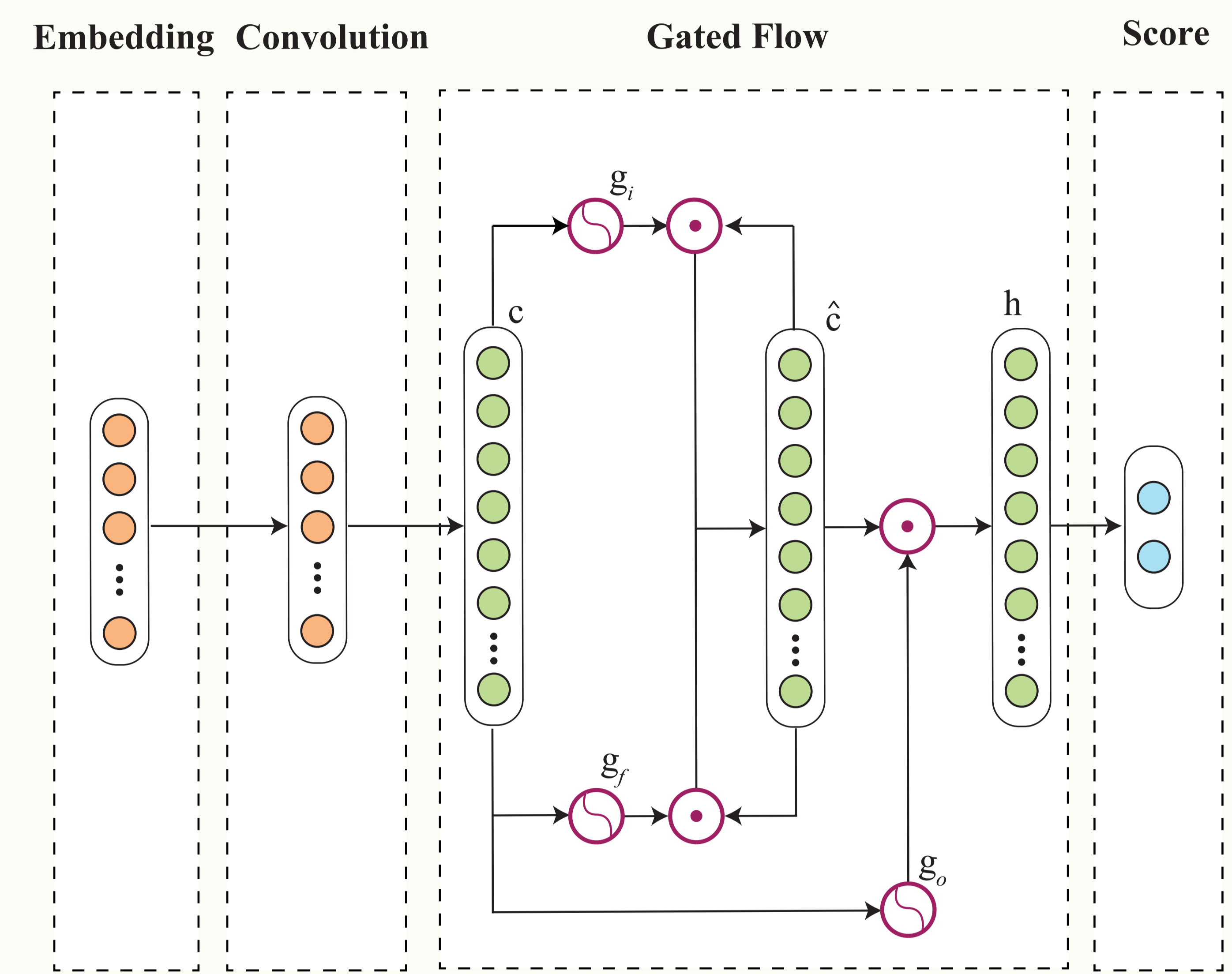
- A hybrid neural model for deep questionanswering task from history examinations
- Cooperative gated neural network (CGNN) for feature representation and answer retrieval
- NTM as one-shot learning module to classify the question type and annotate the corresponding label
- The concatenated label vectors and question representation are fed to CGNN for jointly scoring candidate answers.



- Model architecture



- Question Type Labeling

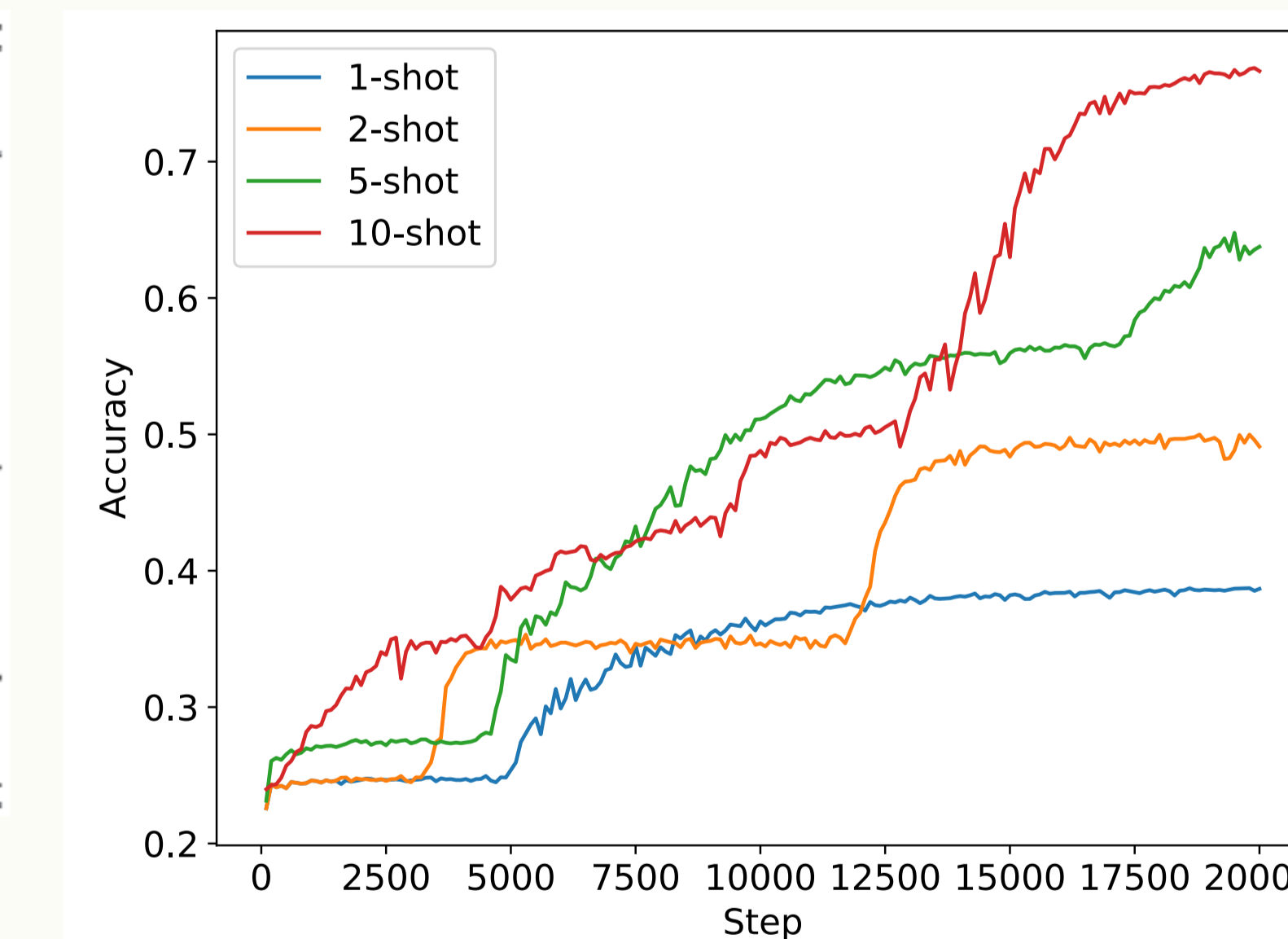


- CGNN architecture

Experiments

- Our experimental results show that the adopted CGNN together with other neural models works much better than BM25. With an NTM labeler, all the deep neural models are further enhanced.

Method	1-shot	2-shot	5-shot	10-shot
Naive Bayes	22.1	25.7	30.1	34.1
K-Means	12.5	15.7	15.8	16.1
SVM	19.1	21.8	30.2	45.2
Feedforward	20.1	22.7	21.3	21.6
LSTM	23.8	28.5	32.5	38.2
NTMs	38.7	49.1	63.9	76.6



- Accuracy for labeling task.
- Labeling accuracy curve.

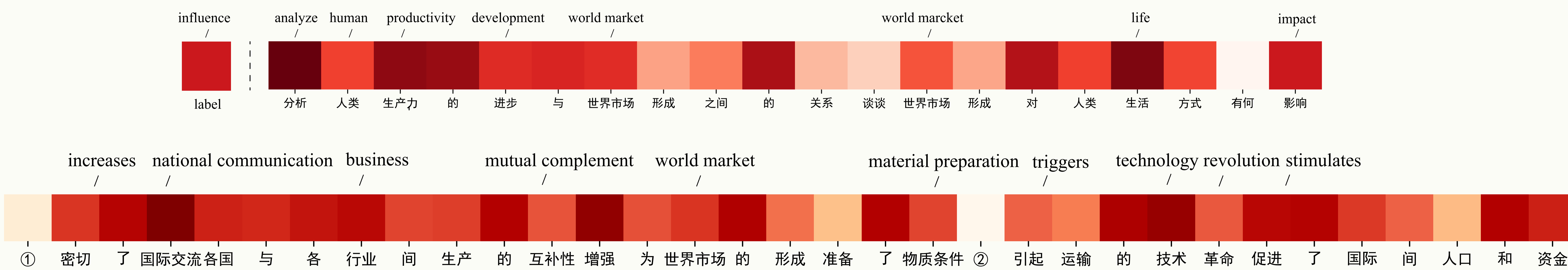
Method	Precision	Recall	F1-score
BM25	8.6 (8.7)	23.2 (23.7)	12.5 (12.7)
CNN	9.8 (27.0)	21.1 (45.0)	13.4 (33.8)
GRU	11.4 (32.9)	24.1 (50.4)	15.5 (39.8)
LSTM	8.4 (30.6)	21.2 (48.0)	12.0 (37.4)
+	22.2	26.8	25.4
CNN+Highway	15.8 (33.2)	30.5 (50.6)	20.8 (40.1)
CNN+GRU	17.4 (32.4)	31.1 (50.8)	22.3 (39.6)
CNN+LSTM	12.7 (27.5)	21.4 (47.0)	16.0 (34.7)
CGNN	18.2 (33.7)	31.6 (51.6)	23.1 (40.8)
+	15.5	20.0	17.7

- Answer retrieval performance without and with NTM labels (in brackets). “+” means the performance gains with the help of NTM labels.

Type	Proportion	Precision	Recall	F1-score
Background	16.0	38.0	56.3	45.4
Cause	8.4	48.6	67.5	56.5
Claim	4.7	47.8	65.1	55.1
Fact	51.0	23.0	42.0	29.7
Influence	19.9	39.0	54.5	45.5

- Question type distribution and model performance of CGNN.

- Question: please analyze the relationship between human productivity development and world market formation, and evaluate the impact of the formation of global market on human lifestyles.
- Answer (extract): the development of human productivity increases the frequency of national communication, strengthens the mutual complement among nations and business, provides sufficient material preparation for global market formation, triggers the technology revolution of transportation and stimulates both migration and liquidity among nations.



- Visualization for question and answer representation weights after gated flow.