

Reinforcement Memory Networks

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Example 1

- Fact
 - Mary went to the bathroom.
 - John moved to the hallway.
 - Mary travelled to the office.
- Question
 - Where is Mary?

Example 1

- Fact
 - Mary went to the bathroom.
 - John moved to the hallway.
 - Mary travelled to the office.
- Question
 - Where is Mary?
- Answer
 - office

Example 2

- Fact
 - John picked up the apple.
 - John went to the office.
 - John went to the kitchen.
 - John dropped the apple.
 - Mary travelled to the office.
- Question
 - Where was the apple before the kitchen?

Example 2

- Fact

- | |
|-----------------------------|
| • John picked up the apple. |
| • John went to the office. |
| • John went to the kitchen. |
- John dropped the apple.
 - Mary travelled to the office.



- Question

- Where was the apple before the kitchen?

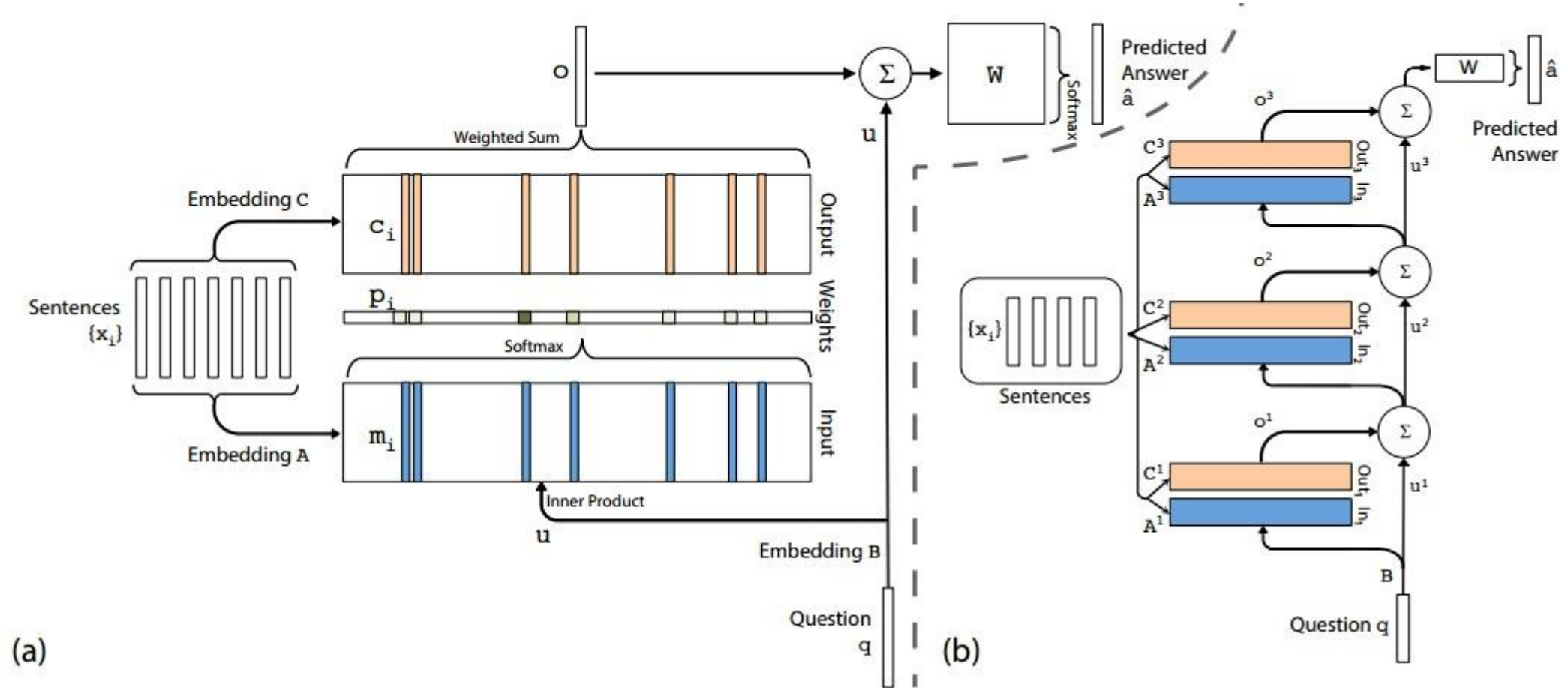
- Answer

- office

Memory Network

- 1. Have a question! → Memory only with a question
- 2. Read facts. → Find information
- 3. Have new knowledge. → Write into Memory
- 4. Back to (2) or Answer the question

End-To-End Memory Networks(MemN2N)



Question 1

- 1. Have a question! → Memory only with a question
- 2. Read facts. → Find information
- 3. Have new knowledge. → Write into Memory
- **4. Back to (2) or Answer the question**

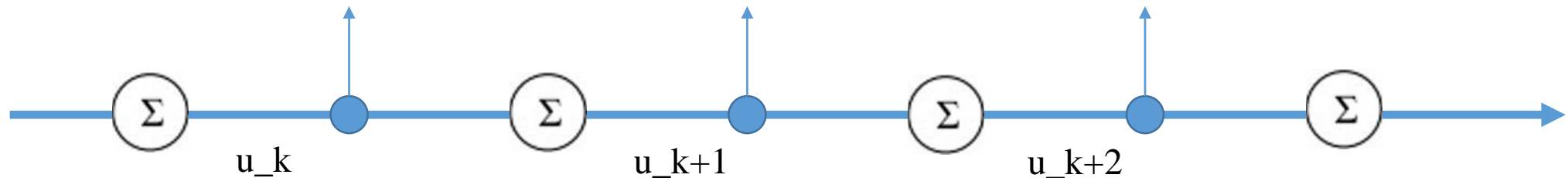


One hop

- Need performing a variable number of hops
 - Predict a special class “STOP”
 - Reinforcement Learning

QMemN2N

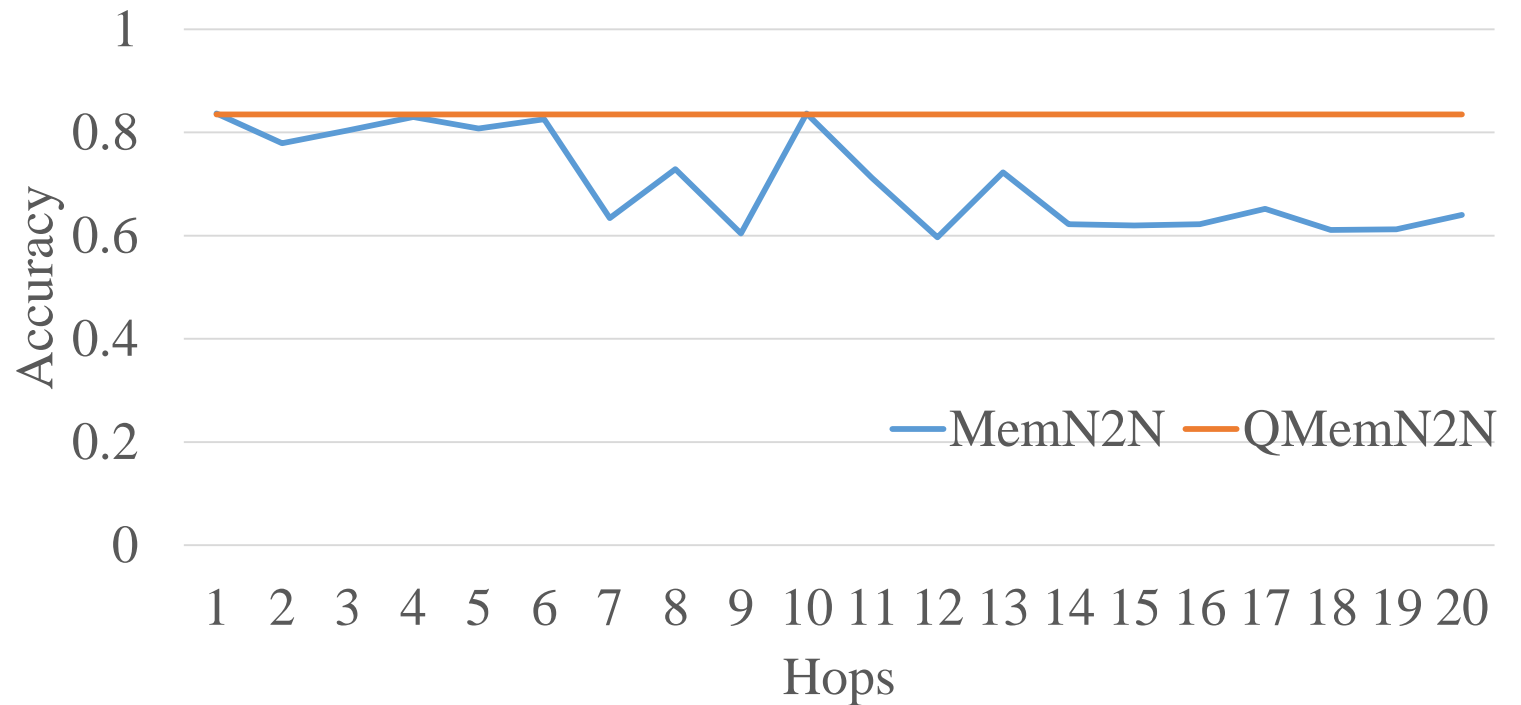
- States: $u_1 \dots u_k$
- Actions: 0/1
- Reward: correct answer 1.0, wrong answer -1.0, otherwise 0
- Steps
 - Train MemN2N
 - Train DQN(Deep Q Learning), 20 hops maximum



Results

Task 9: Simple Negation

Sandra travelled to the office.
Fred is no longer in the office.
Is Fred in the office? A:no
Is Sandra in the office? A:yes



Task 9: Simple Negation

Results

Task 15: Basic Deduction

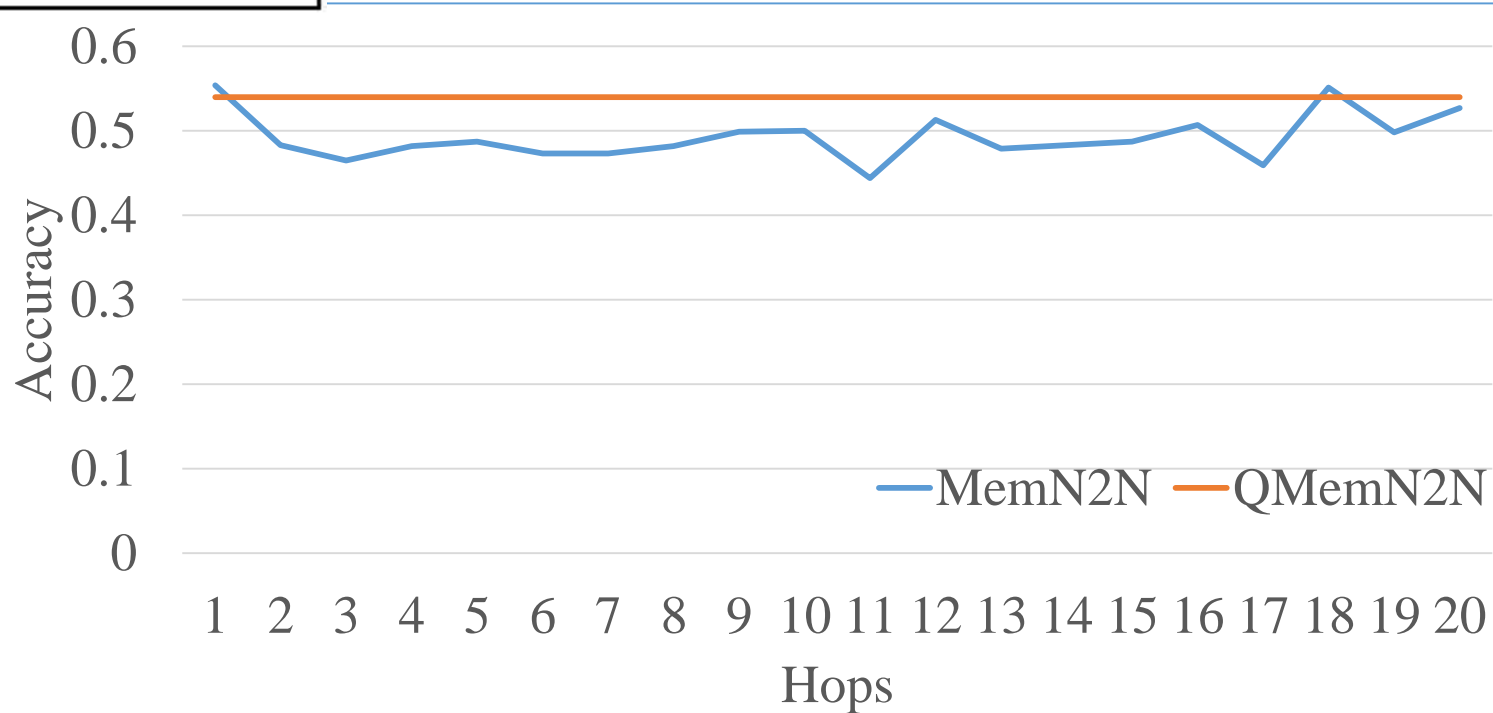
Sheep are afraid of wolves.

Cats are afraid of dogs.

Mice are afraid of cats.

Gertrude is a sheep.

What is Gertrude afraid of? **A:wolves**



Task 15: Basic Deduction

Results

Task	MemN2N	QMemN2N
1	99.60%	99.40%
2	74.50%	34.50%
3	51.70%	24.80%
4	85.10%	85.70%
5	84.90%	87.10%
6	91.60%	92.30%
7	76.00%	76.60%
8	85.70%	84.80%
9	77.90%	83.50%
10	69.30%	72.30%
11	85.80%	85.40%
12	99.70%	99.90%
13	90.60%	90.40%
14	81.60%	84.80%
15	48.30%	54.00%
16	44.50%	47.60%
17	51.70%	49.60%
18	89.60%	89.90%
19	11.80%	11.20%
20	100.00%	99.90%

Question 2

- 1. Have a question! → Memory only with a question
- 2. **Read facts. → Find information**
- 3. Have new knowledge. → Write into Memory
- 4. Back to (2) or Answer the question



One hop

- Need balancing exploitation and exploration

Thanks