

MoQA – A Multi-Modal Question Answering Architecture

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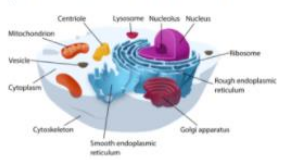
Cell Structures

Introduction

In some ways, a cell resembles a plastic bag full of Jell-O. Its basic structure is a cell membrane filled with cytoplasm. The cytoplasm of a eukaryotic cell is like Jell-O containing mixed fruit. It also contains a nucleus and other organelles.

Cell Membrane

The cell membrane is like the bag holding the Jell-O. It encloses the cytoplasm of the cell. It forms a barrier between the cytoplasm and the environment outside the cell. The function of the cell membrane is to protect and support the cell. It also controls what enters or leaves the cell. It allows only certain substances to pass through. It keeps other substances inside or outside the cell.



Cell Membrane Structure

Cytoplasm

Organelles

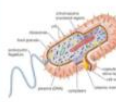
Lesson Summary

- The cell membrane consists of two layers of phospholipids.
- The cytoplasm consists of watery cytosol and cell structures.
- Eukaryotic cells contain a nucleus and other organelles.

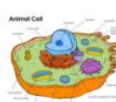
Vocabulary

Cell Wall	rigid layer that surrounds the cell membrane of a plant cell or fungal cell and that supports and protects the cell
Cyto-skeleton	structure in a cell consisting of filaments and tubules that crisscross the cytoplasm and help maintain the cells shape
Central Vacuole	large storage sac found in the cells of plants

Instructional Diagrams



The image below shows the Prokaryotic cell. A prokaryote is a single-celled organism that lacks a membrane-bound nucleus (karyon), mitochondria, or any other membrane-bound organelle. In the prokaryotes, all the intracellular water-soluble components (proteins, DNA and metabolites) are located together in the cytoplasm enclosed by the cell membrane, rather than in separate cellular compartments.

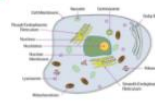


This diagram shows the anatomy of an Animal cell. Animal Cells have an outer boundary known as the plasma membrane. The nucleus and the organelles of the cell are bound by this membrane. The cell organelles have a vast range of functions to perform like hormone and enzyme production to providing energy for the cells. They are of various sizes and have irregular shapes. Most of the cells size range between 1 and 100 micrometers and are visible only with help of microscope.

Questions

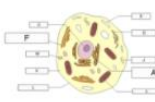
What is the outer surrounding part of the Nucleus?

- Nuclear Membrane
- Golgi Body
- Cell Membrane
- Nucleolus



Which component forms a barrier between the cytoplasm and the environment outside the cell?

- J
- L
- X
- U



Which statement about the cell membrane is false?

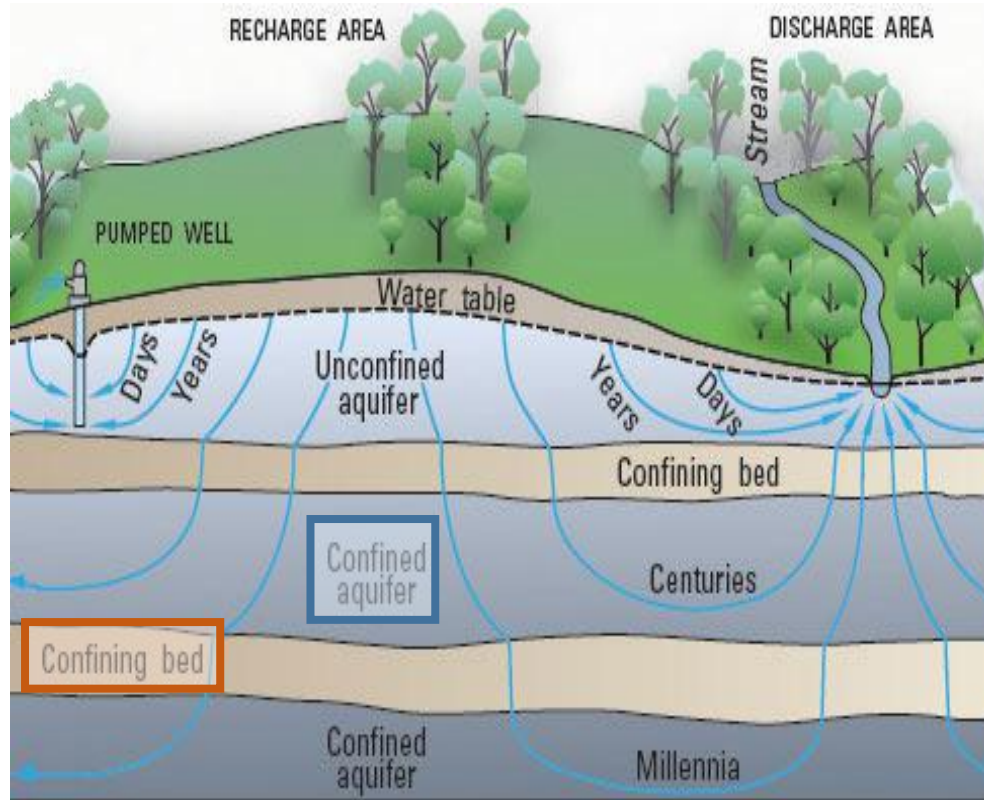
- It encloses the cytoplasm
- It protects and supports the cell
- It keeps all external substances out of the cell
- none of the above

076 lessons from middle school curricula



78,338 sentences
3,455 images
26,260 questions

Multi-Modal Question Answering



Text

... a thick layer containing water is called **confined aquifer**. The earth region that supports the confined aquifer is called **confining bed**. The hole to obtain water in the unconfined aquifer is.....

Question

What layer is underneath the **confined aquifer**?

Answers

- a) Unconfined Aquifer
- b) Confined Aquifer
- c) Water Table
- d) **Confining Bed** ✓

Definitions

- $\exists S^Q$ - a set of sentences or nodes that verifies (Q, A_i)
- We call S^Q set of supporting sentences
- S^Q is used to get probability of correctness of (Q, A_i)

Example

... Two other types of mass movement are slump and creep. Both may move a lot of soil and rock. However, they usually aren't as destructive as landslides and mudslides. Slump is the sudden movement of large blocks of rock and soil down a slope. You can see how it happens in Figure 10.32. All the material moves together in big chunks. ...

Q: Sudden movement of a large block of rock and soil down a slope

....

e) Slump

Overview of our Approach

Input

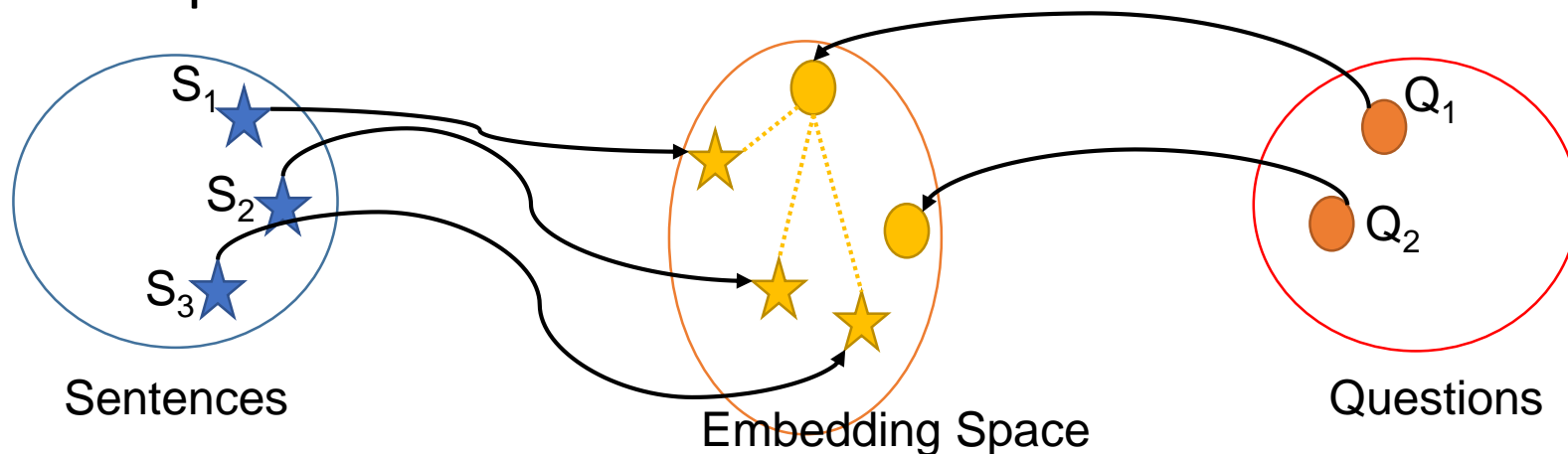
- Question Q
- Set of possible answers $\{A_i\}$
- Set of sentences or nodes $\{S_j\}$

Our Model

1. Select k supporting sentences
2. Verify answer using a deep neural model

1. Supporting Sentences

- Measure similarity of embedded question and sentences
- Select top k most similar sentences



Question: Study of the solid earth

Supporting Sentences:

1. Geology is the study of the solid Earth.
2. Scientists who compare geology of other planets to Earth are planetary geologists.

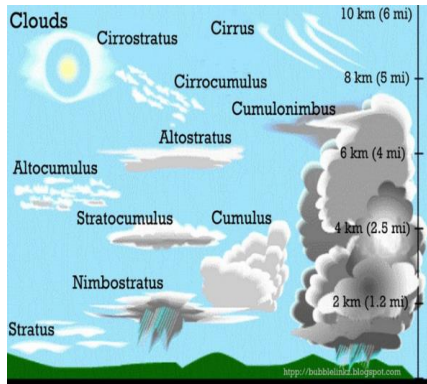
Question: Factors that determine how much erosion runoff can cause include

Supporting Sentences:

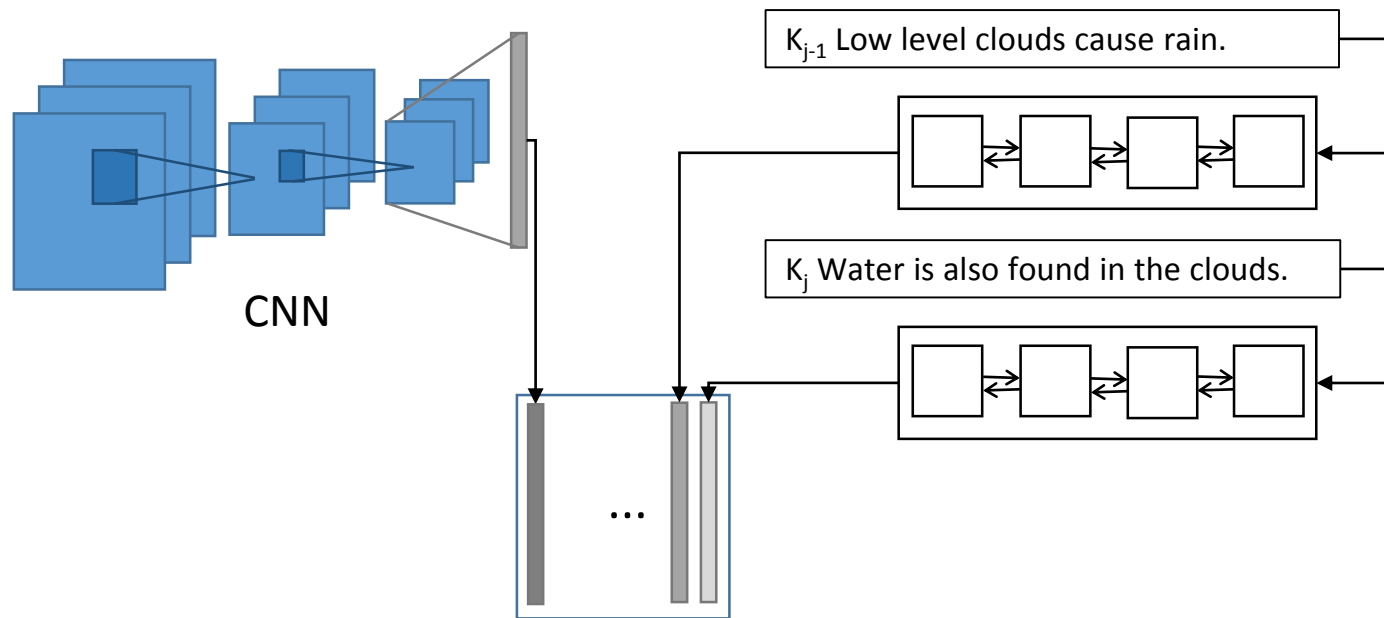
1. Runoff is an important cause of erosion.
2. Runoff is likely to cause more erosion if the land is bare.

2. Deep Learning Model

- Selects answer based on supporting sentences and question

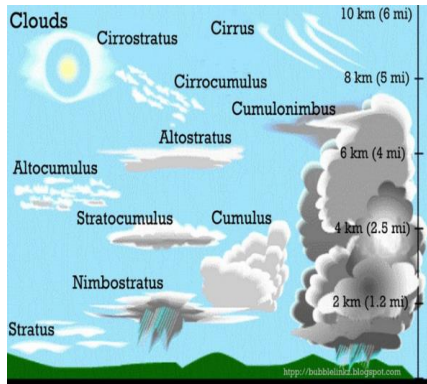


Visual Information

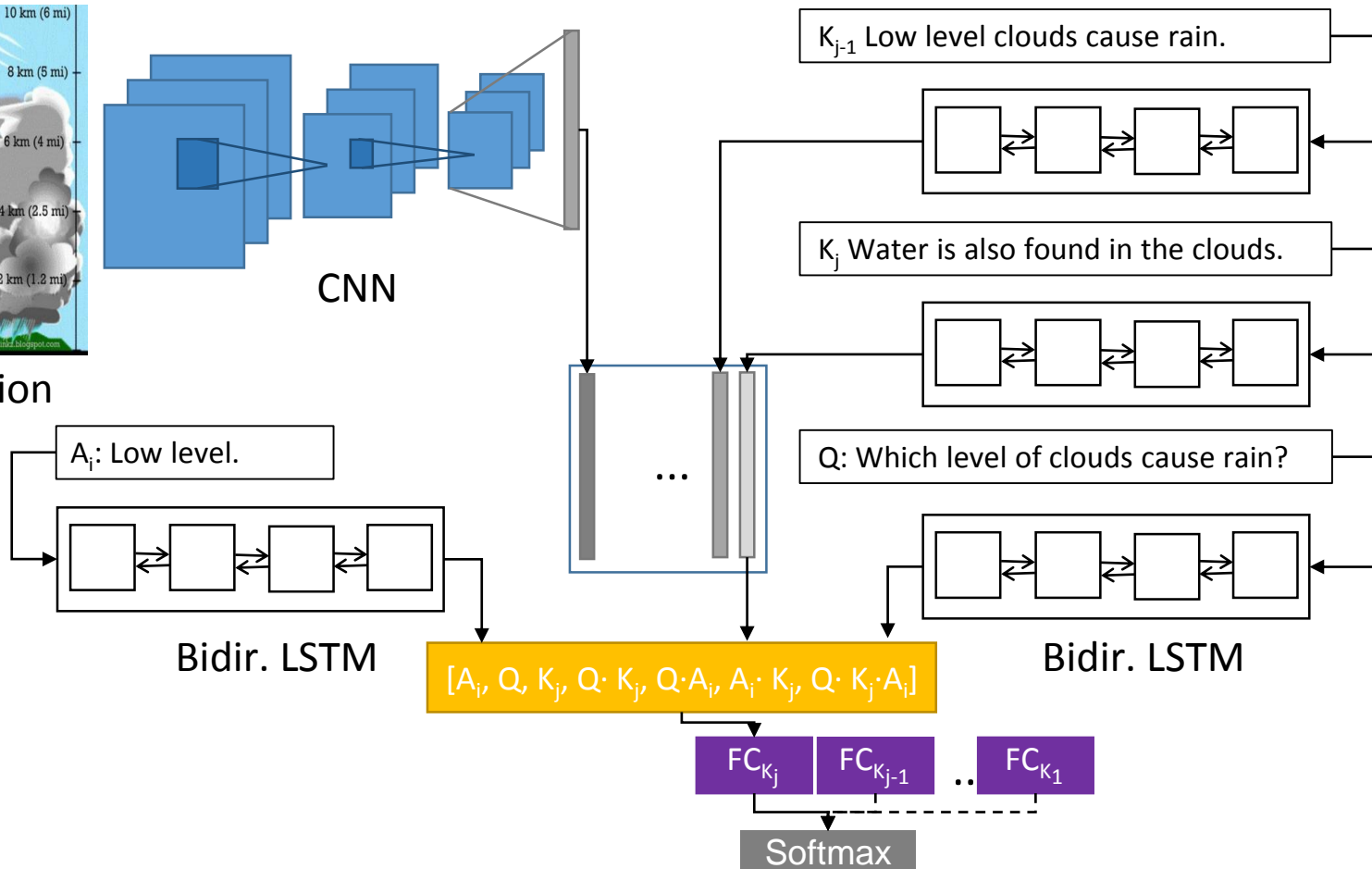


2. Deep Learning Model

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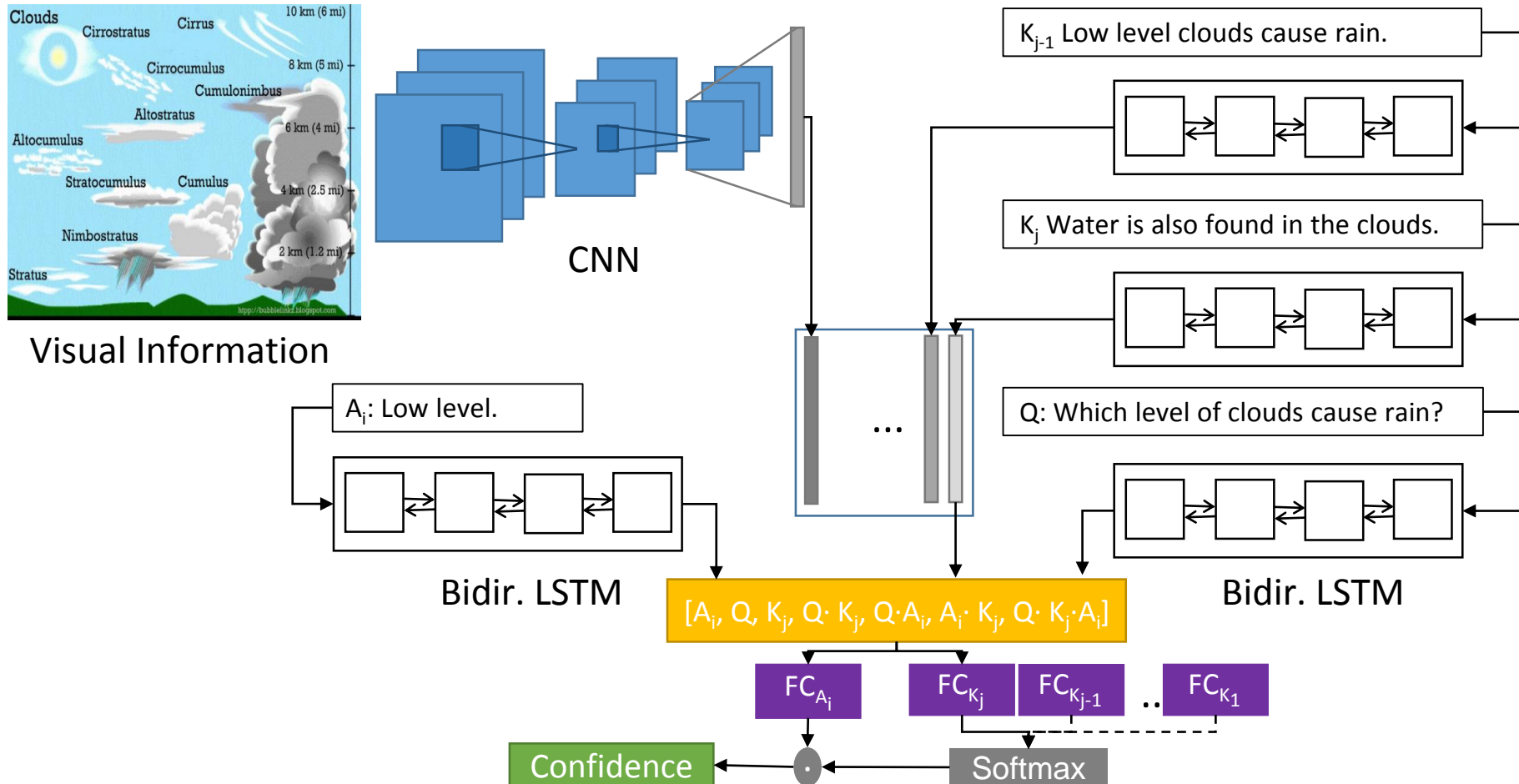


Visual Information



2. Deep Learning Model

- Selects answer based on supporting sentences and question



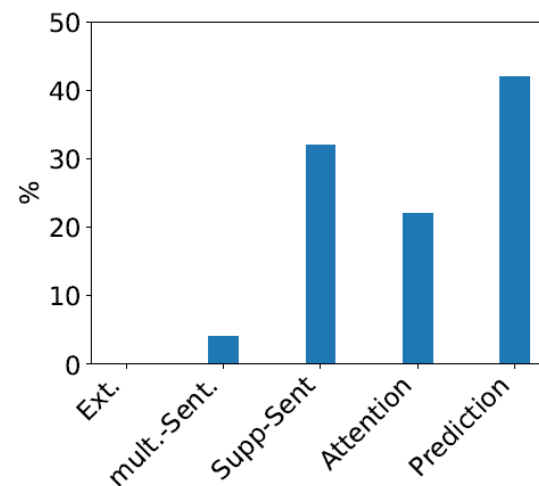
Evaluation

MoQA won in the TQA challenge

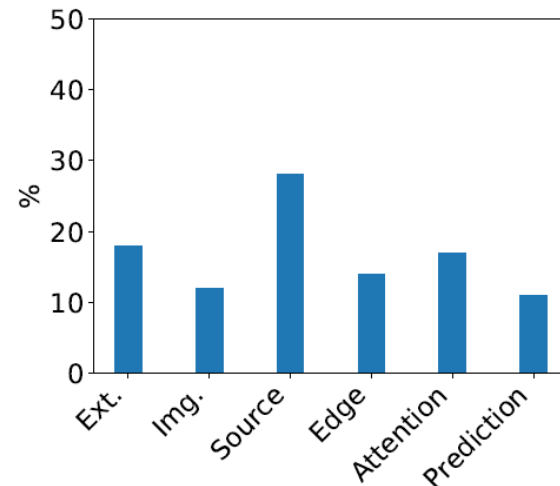
- 1st place in the text track
- 2nd place in the diagram track

Modality	#S	#N	Diag.
Image-only	–	–	33.2
Text-only	3	–	33.8
	4	–	33.9
	5	–	33.4
Graph-baseline	–	1	29.2
	–	2	28.3
	–	4	25.8
Graph-only	–	4	33.3
Text+Image	4	–	34.0

Validation Accuracy



Errors for T/F Questions



Errors for Diag. Questions

Poster S1
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