Generating Intermediate Steps for NLI with Commonsense Knowledge Retrieval and Next-Step Prediction

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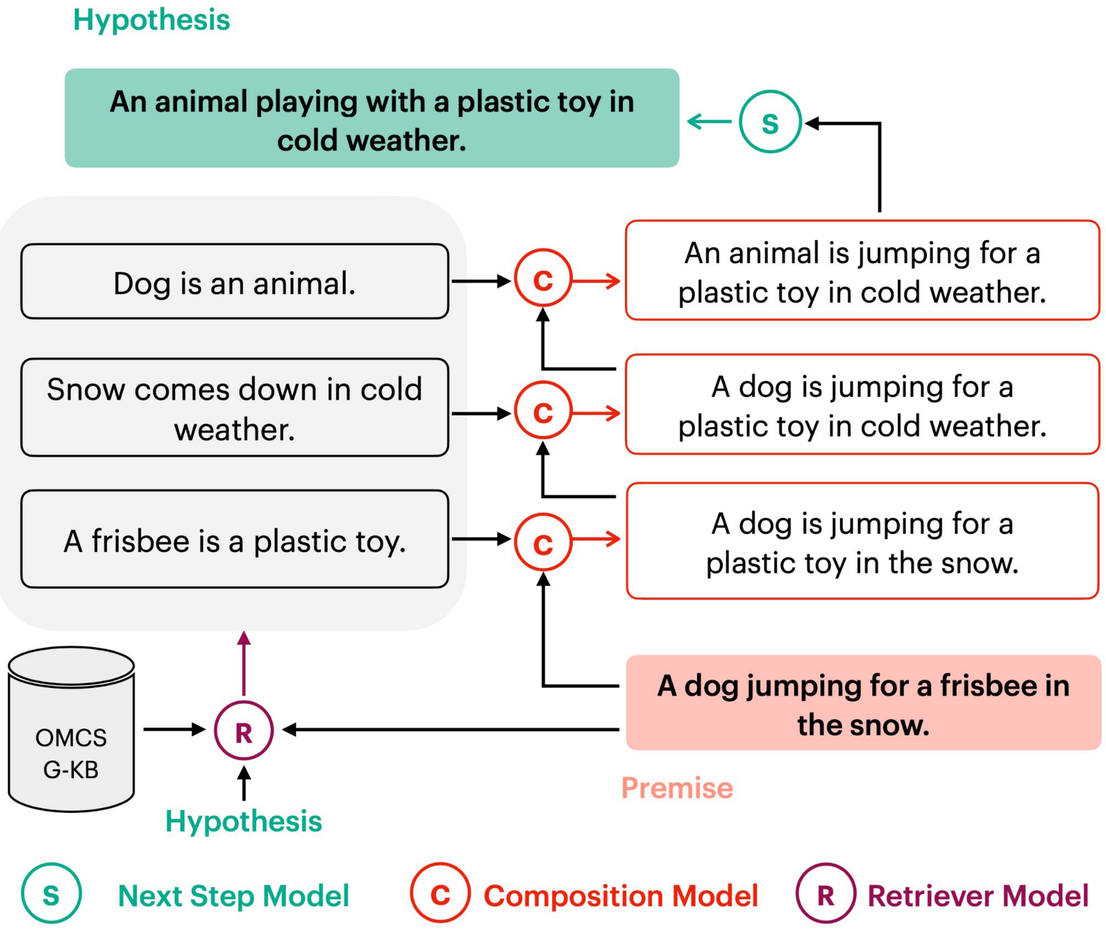
Overview



Models

- Fine-tuned T5 Large model on SNLI, MED datasets for next step (entailed, monotonic sentence) generation.
- Commonsense fact retrieval from the Open Mind Common Sense and Generics-KB corpus using the all-mpnet-base-v2 sentence embedding model.
- Fine-tuned T5 Large model on Entailment Bank, RuleTaker datasets for composed sentence generation.

Methodology

Unconstrained Proof Search (UPS)

- Recursively use the step generator model to generate the intermediate steps.

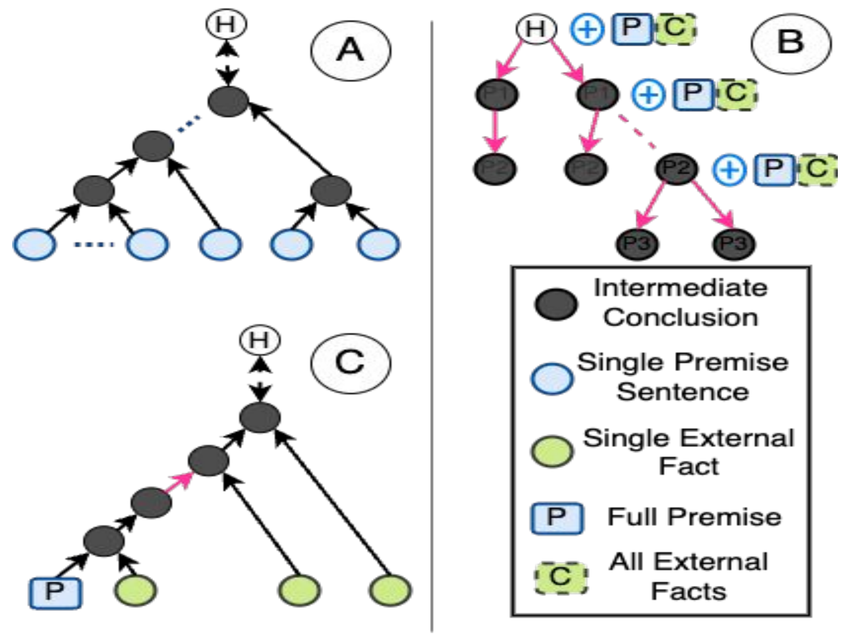
Proof Search with Facts (PSF)

- Retrieve relevant facts from commonsense knowledge base.
- Use the next step generator model or the composition model with the retrieved facts to generate the intermediate steps.

Generated Proofs:

Premise (P) & Hypothesis (H)	Proof	Remarks
P: A female guitarist is playing on stage. **H:** A woman is playing her instrument.	**F1:** A guitar is an instrument. **F1** & **P** → **Monotone** → **I1** A woman is playing an instrument. **I1** → **H**	Correct proof with fact composition.
P: Bicyclist ride the course near the ocean as the day comes to an end. **H:** The cyclist was riding near the ocean at sunset.	**F1:** Sunsets can happen at the end of the day. **F1** & **P** → **I1:** A cyclist ride the course near the ocean during the sunset. **I1** → **H**	Correct proof with fact composition.
P: An old woman in a white hat and purple and blue clothes is sitting down by a wooden building. **H:** There is a building.	**P** → **I1:** A woman is sitting by a wooden building. **I1** → **I2:** The building is made out of wood. **I2** → **H**	Unconstrained proof without fact composition.

Class of Algorithms



- **A** Uses a select-compose-iterate strategy and do not use open- ended set of facts.
- **B** Uses backward-chaining, while taking the entire premise and (optional) external facts into context in each step.
- **C** (Ours) Use forward chaining, and add single retrieved fact in each step (or uses monotonic entailment generator to generate entailments)

Results

Human Verification Results

Method	Correct	Minimal	Useful	Follows
Prover UPS	69.45	75.32	-	-
Prover PSF	**84.66**	74.66	**45.18**	**82.54**
Entailer	74.23	72.66	31.81	77.27

NLI Results

Method	MNLI and Proofs %	MNLI	MED	LoNLI
Prover	1	**85.22**	**42.89**	**64.97**
Entailer		84.73	39.10	66.99
Prover	5	**87.58**	**42.91**	**69.92**
Entailer		86.93	39.72	68.55
Prover	10	**88.48**	**44.30**	**74.87**
Entailer		88.02	40.95	64.58

Code and Data

https://github.com/deepanwayx/prover