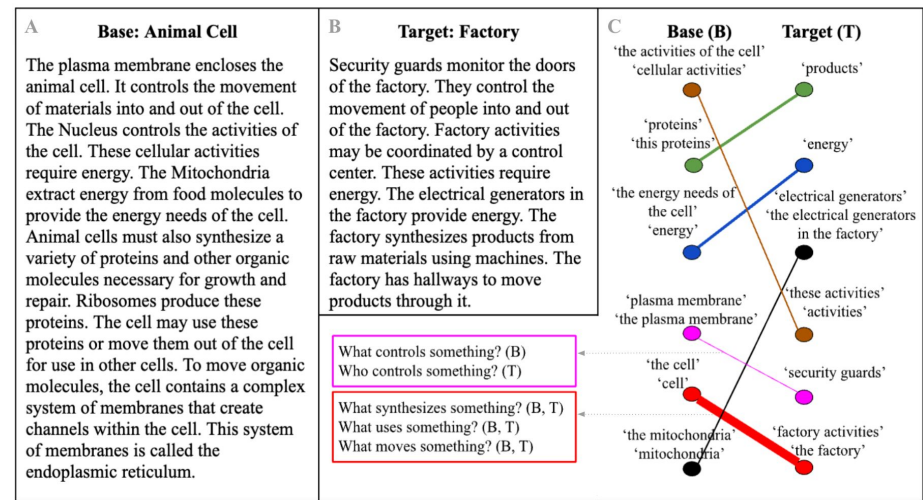


1) Analogical Reasoning over Natural Language Paragraphs (2022-2023)



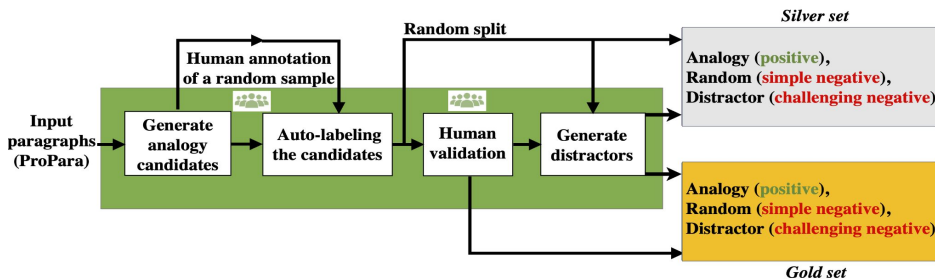
Life is a Circus and We are the Clowns: Automatically Finding Analogies between Situations and Processes

Oren Sultan, Dafna Shahaf



ParallelPARC: A Scalable Pipeline for Generating Natural-Language Analogies

Oren Sultan, Yonatan Bitton, Ron Yosef, Dafna Shahaf



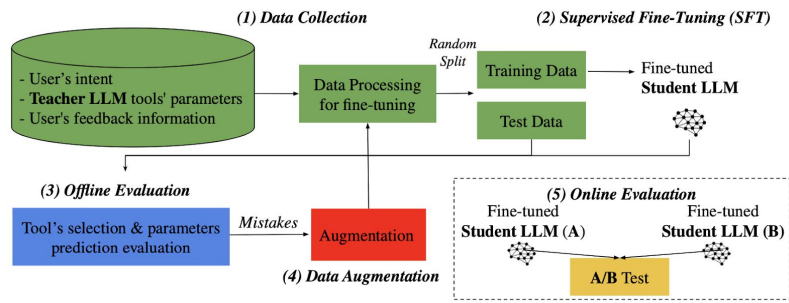
Base	Target	Similar Relations
Title: How does a solar panel work? Domain: Engineering Paragraph: solar energy <i>powers</i> an electric current within a solar panel. The photovoltaic cells within the panel <i>convert</i> the energy from the sun into electricity. The electrical wires then <i>spread</i> this power throughout the panel. The electric current is then used to <i>power</i> whatever the panel is connected to.	Title: How does photosynthesis occur? Domain: Natural Science Paragraph: Photosynthesis occurs when sunlight <i>powers</i> chemical reactions within the chloroplasts of a plant. The chloroplasts are able to <i>transform</i> the energy from the sunlight into usable energy for the plant . This energy is then used to produce nutrients for the plant, which are then <i>distributed</i> throughout the plant .	(solar energy, <i>powers</i> , electric current) (sunlight, <i>powers</i> , chemical reactions) (photovoltaic cells, <i>convert</i> , energy) (chloroplasts, <i>transform</i> , energy) (electrical wires, <i>spread</i> , power) (plants, <i>distribute</i> , nutrients)

2) Combining LLMs with tools – A neuro-symbolic approach (2024-2025)



Visual Editing with LLM-based Tool Chaining: An Efficient Distillation Approach for Real-Time Applications

Oren Sultan, Alex Khasin, Guy Shiran, Asnat Greenstein-Messica, Dafna Shahaf



Adjust

```
{
  "exposure": 0,
  "contrast": 10,
  "brightness": 10,
  "highlights": 20,
  "shadows": -10,
  "saturation": 15,
  "vibrance": 15,
  "temperature": 30,
  "tint": 10,
  "hue": 0,
  "bloom": 0,
  "sharpen": 0,
  "structure": 0,
  "linearOffset": 0
}
```

Selective adjust

```
{
  "red": {"saturation": 20, "luminance": 10},
  "orange": {"saturation": 30, "luminance": 20},
  "yellow": {"saturation": 40, "luminance": 30},
  "green": {"saturation": -20, "luminance": 0},
  "cyan": {"saturation": -20, "luminance": 0},
  "blue": {"saturation": 0, "luminance": 0}
}
```

Filter

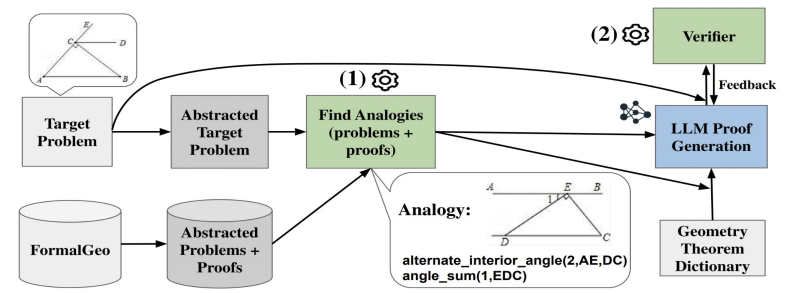
```
{
  "name": "faded_HighNoon",
  "intensity": 40
}
```

“Golden hour”



Towards Reliable Proof Generation with LLMs: A Neuro-Symbolic Approach

Oren Sultan, Eitan Stern, Dafna Shahaf



Problem:

Description: " $\angle ABC = 40^\circ$, $CD \parallel AB$, BC is perpendicular to AC . Find the measure of $\angle ECD$ "

Construction: $Shape(CA, AB, BC), Shape(EC, CD) \dots$

Construction (extended): $Shape(AB, BC, CA), Shape(BC, CA, AB) \dots$

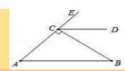
Conditions: $Equal(MeasureOfAngle(ABC), 40), ParallelBetweenLine(CD, AB) \dots$

Goal: $Value(MeasureOfAngle(ECD))$

Answer: 50

Proof:

- 1) $parallel_property_alternate_interior_angle(1, CD, AB)$
- 2) $angle_addition(1, ECD, DCB)$
- 3) $adjacent_complementary_angle(1, ECB, BCA)$



Theorem Dictionary (GDL):

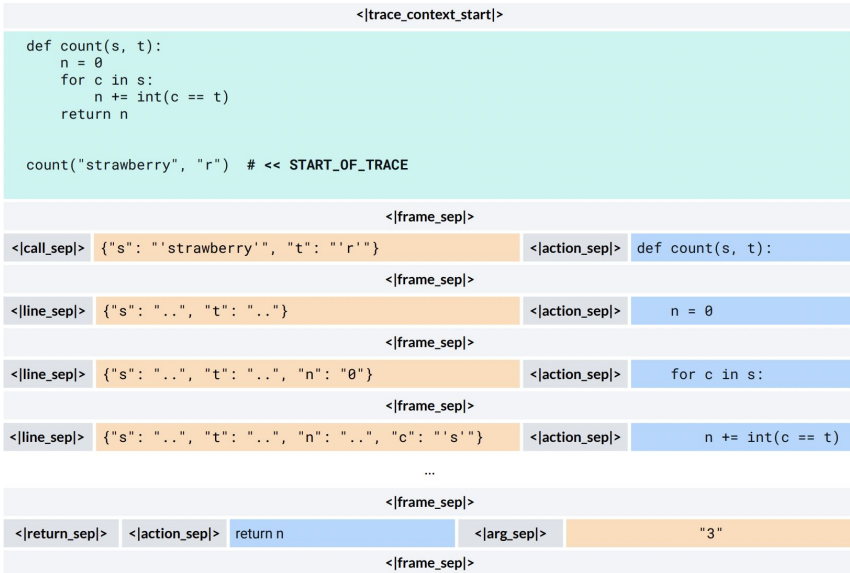
```
parallel_property_alternate_interior_angle(AB, CD):
{
  1: {
    premises:
      ParallelBetweenLine(AB, CD) & Line(AD),
    conclusions: Equal(MeasureOfAngle(BAD), ...)
  },
  2: { ... },
  ...
}
angle_addition(ABC, CBD): {
  1: { ... },
  ...
}
```

3) Code World Models (CWM) and the Halting Problem (2025)



CWM: An Open-Weights LLM for Research on Code Generation with World Models

Meta FAIR CodeGen Team, **Oren Sultan**



LLMs versus the Halting Problem: Revisiting Program Termination Prediction

Oren Sultan, Jordi Armengol-Estapé, Pascal Kesseli, Julien Vanegue, Dafna Shahaf, Peter O'Hearn, Yossi Adi

