A Diagnostic Study of Visual Question Answering with Analogical Reasoning

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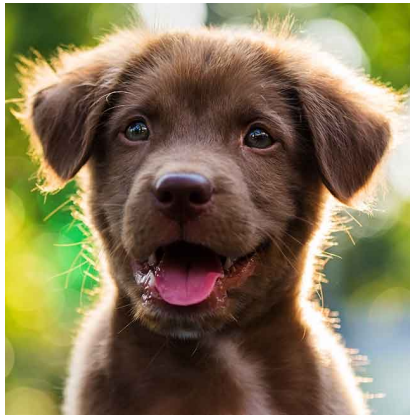
[1]Nanyang Technological University [2]I2R, A*STAR [3]IHPC, A*STAR

Analogical Reasoning

King is to *Queen* as *Emperor* is to *Empress*

Analogical Reasoning



brown dog

is to

white dog

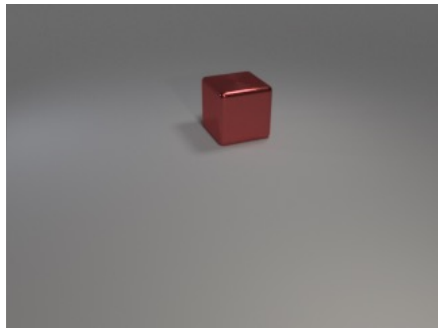
as

brown cat

is to

white cat

Analogical Reasoning



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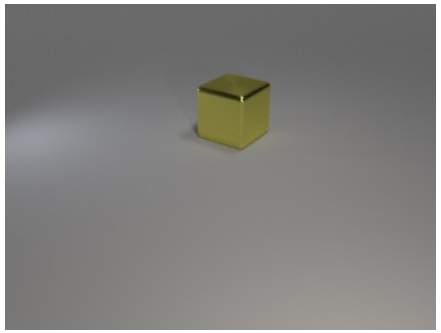

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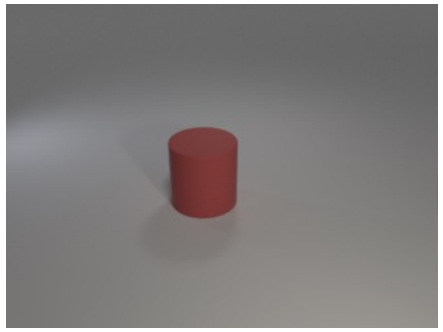

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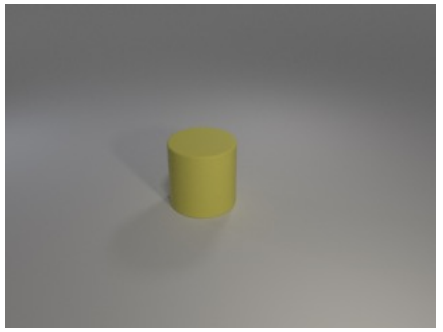
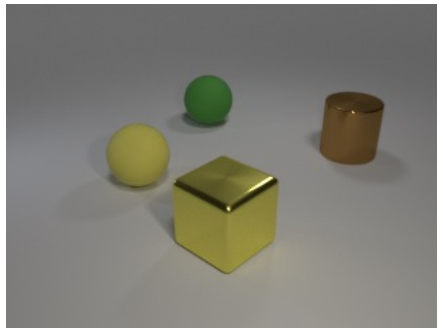


Analogical Reasoning



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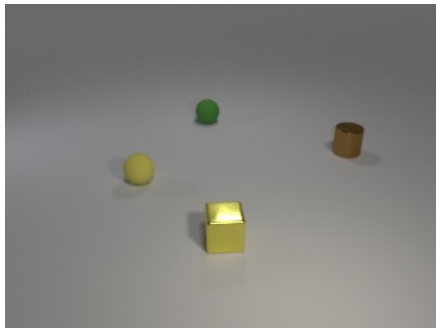

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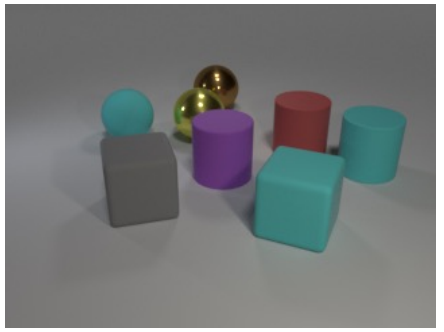

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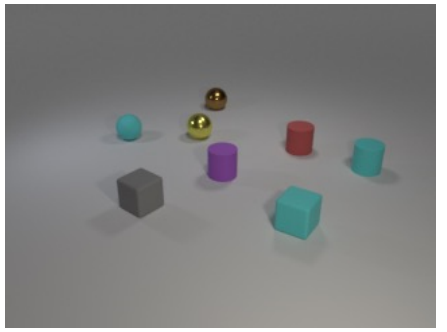

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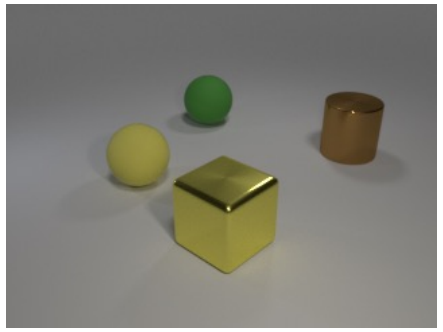

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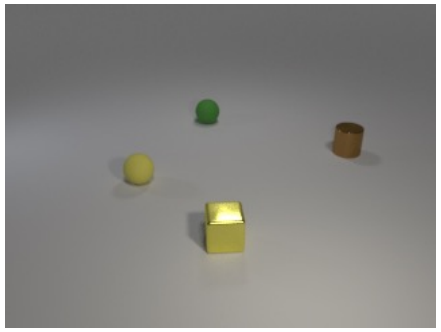

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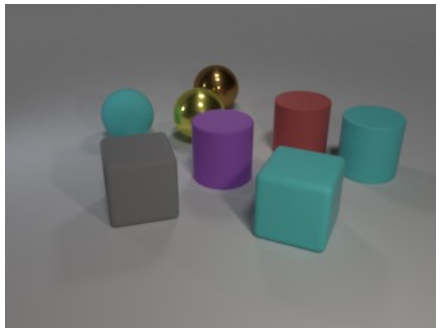
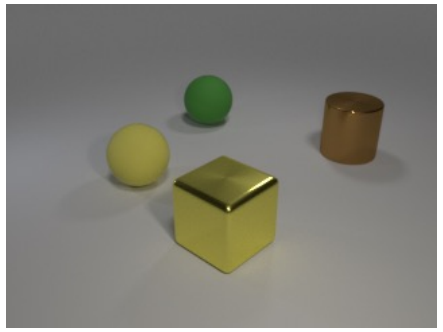


is to

ask questions on the original content

Analogical Reasoning



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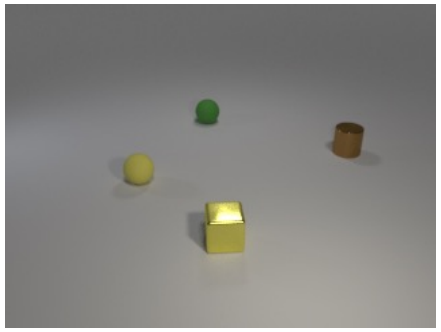

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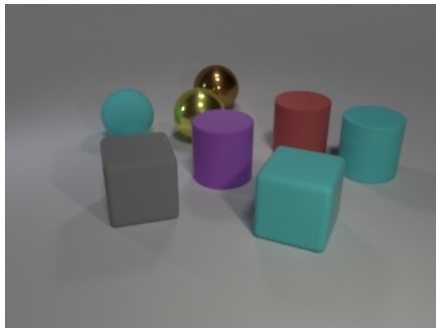

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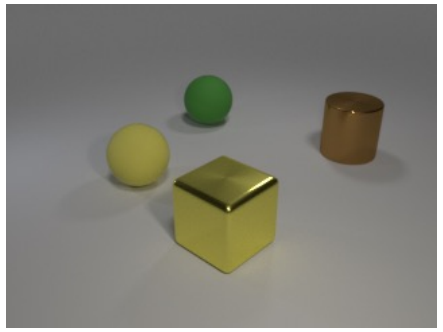
Visual Question Answering (VQA)

Analogical Reasoning



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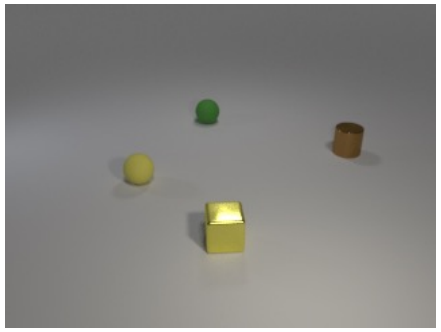

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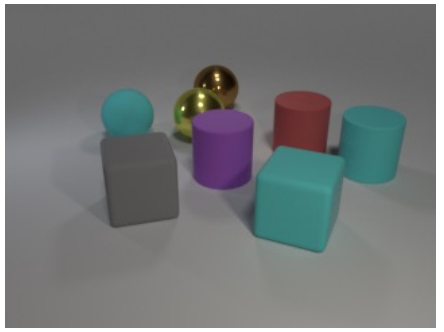

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Visual Question Answering (VQA)

Analogical VQA

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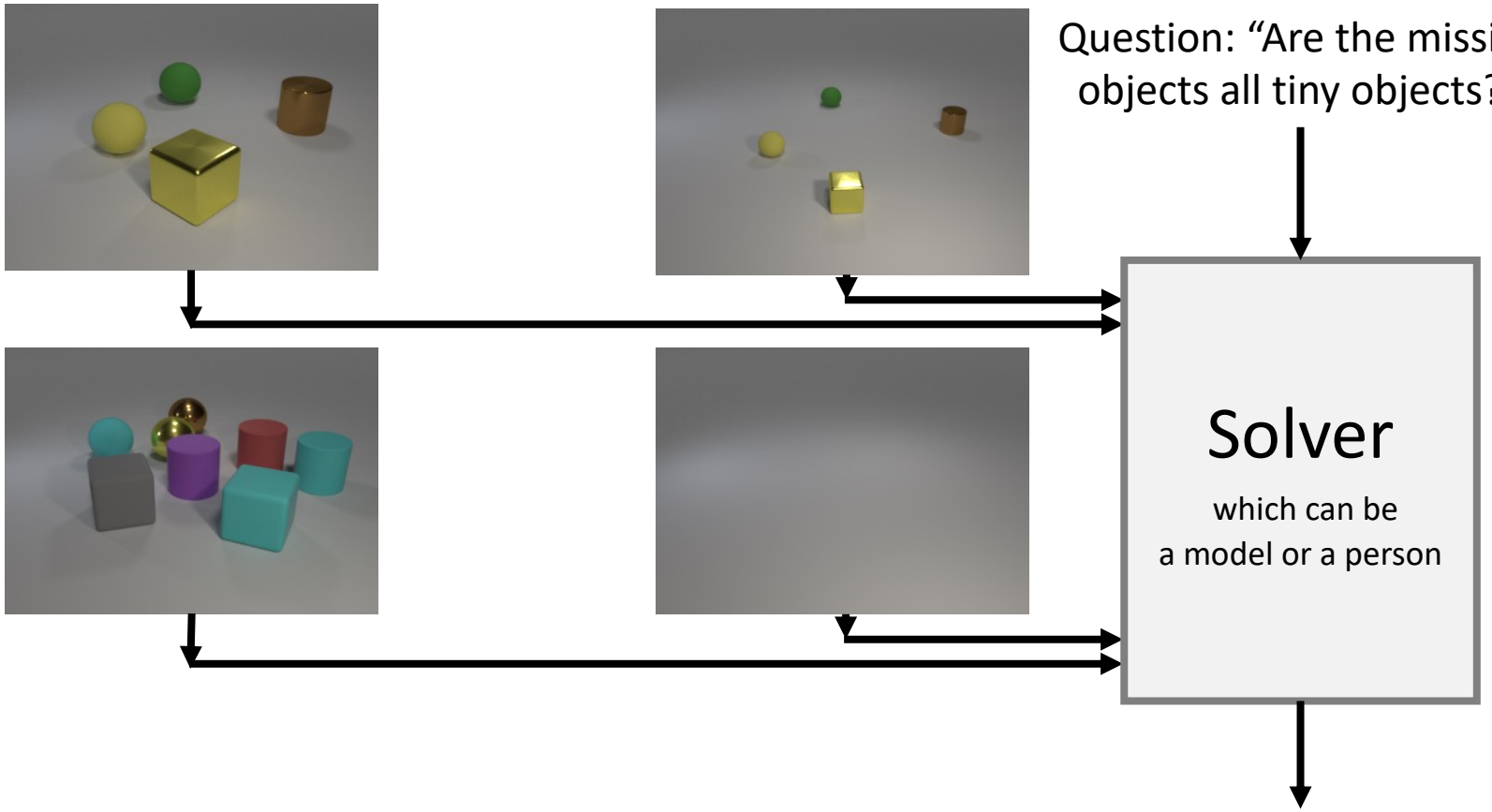

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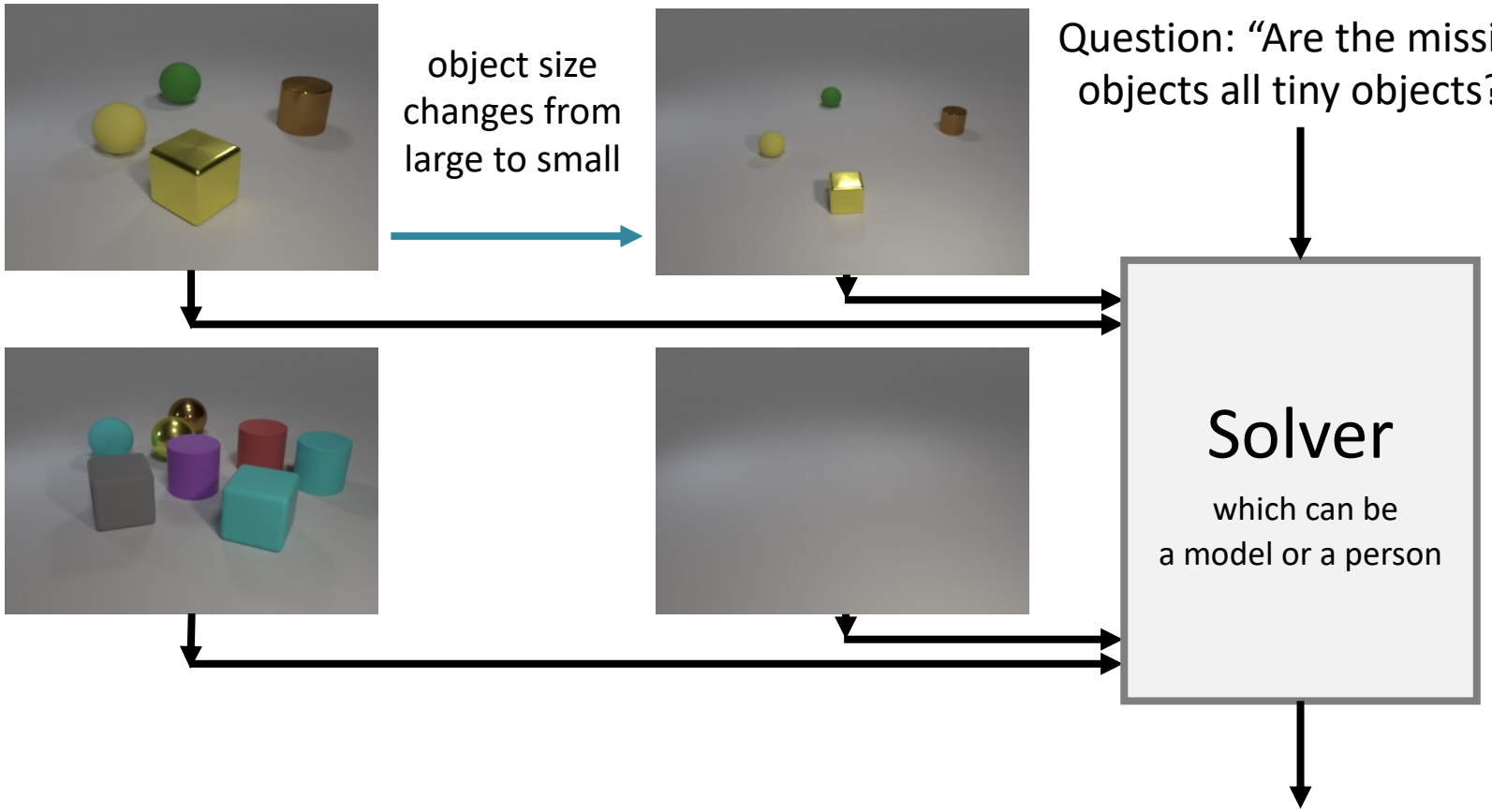

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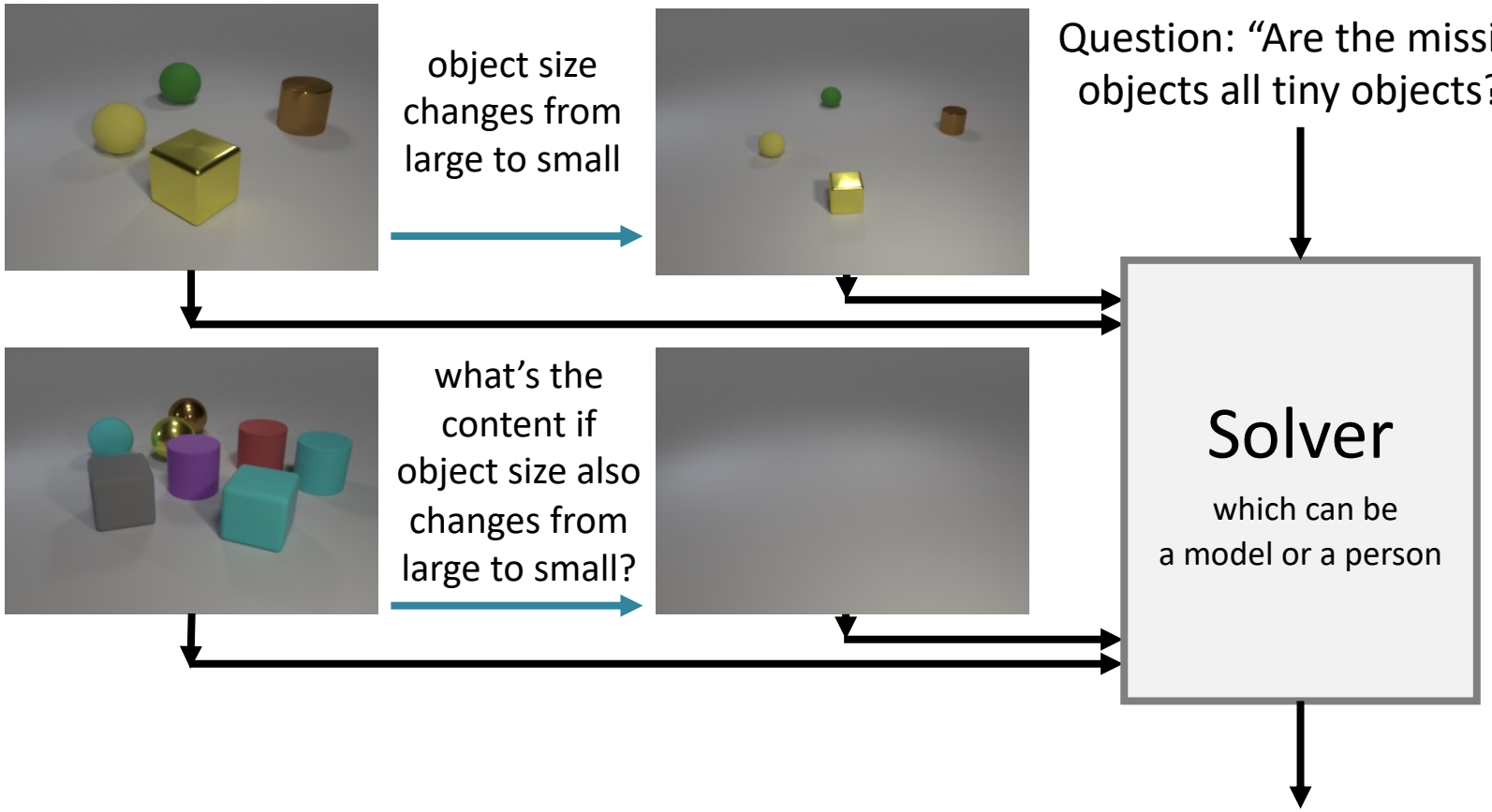

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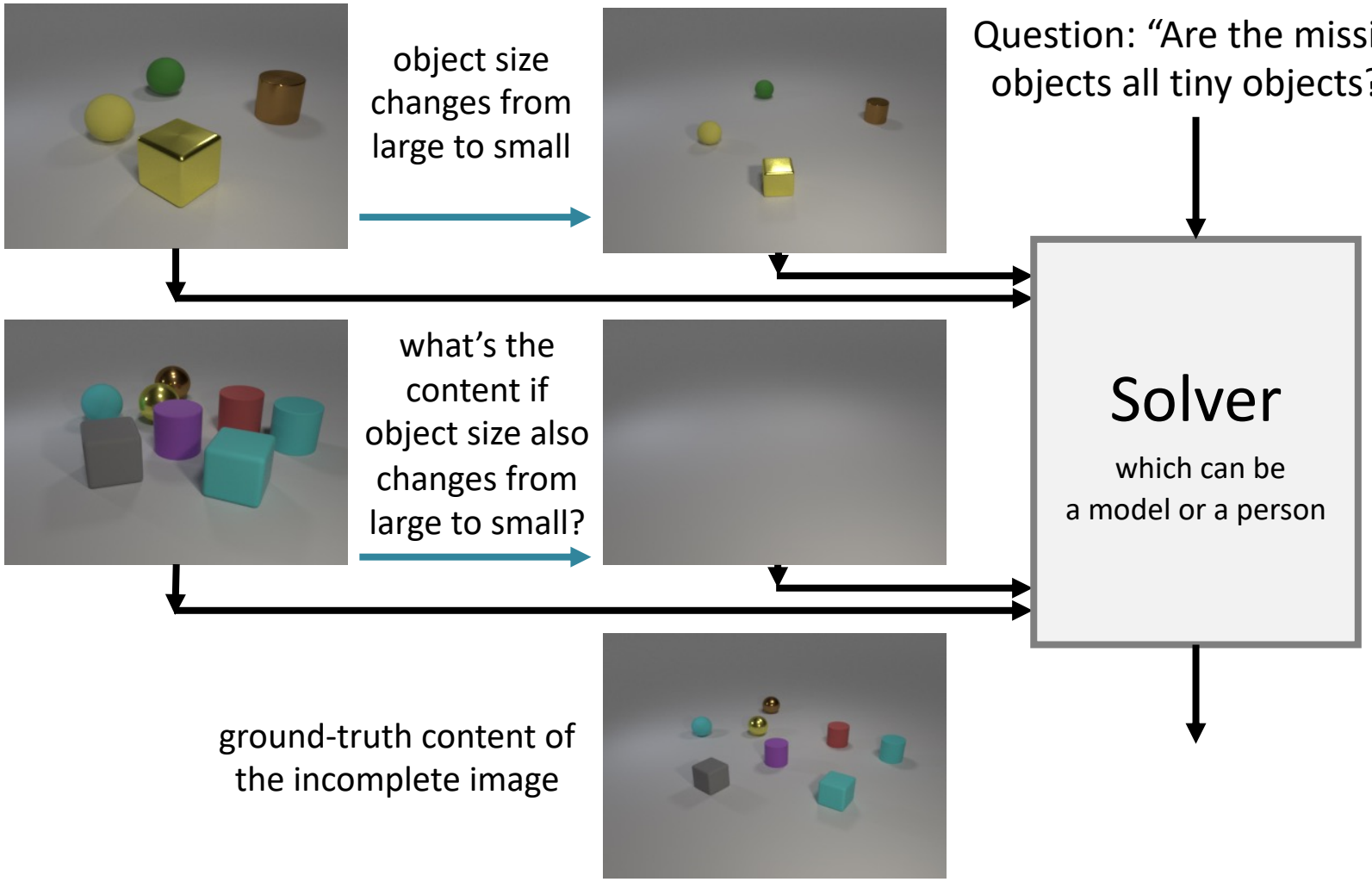

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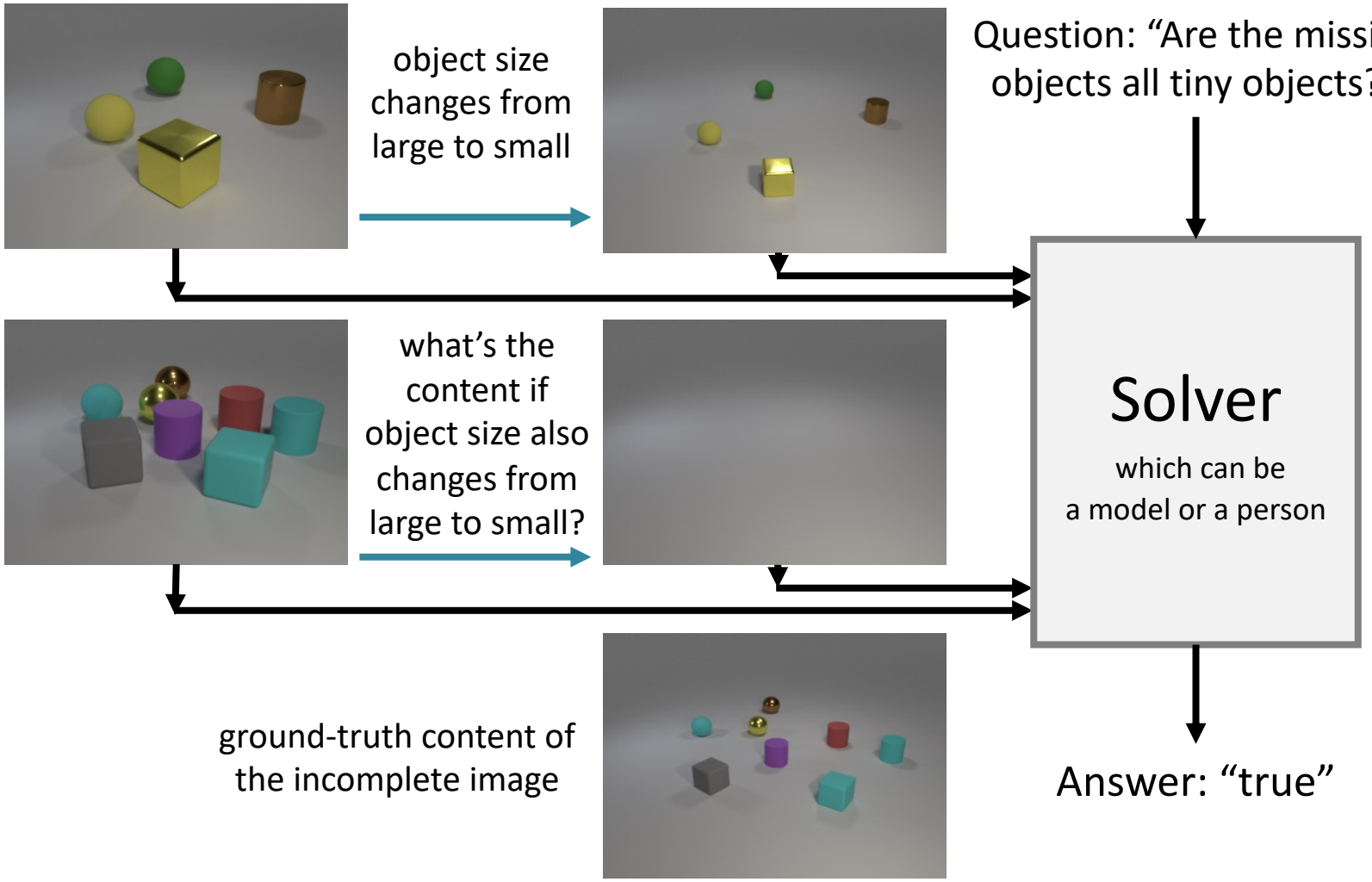
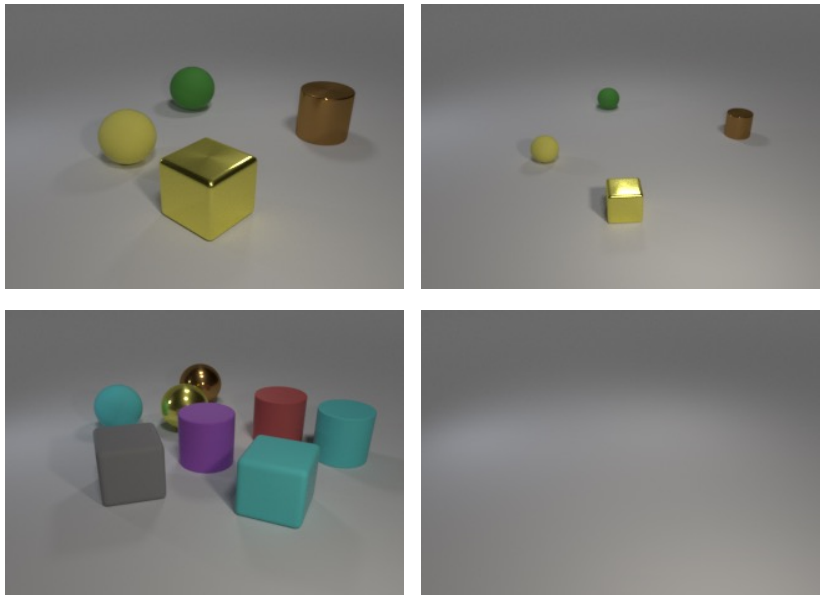


CLEVR-Analogy Dataset

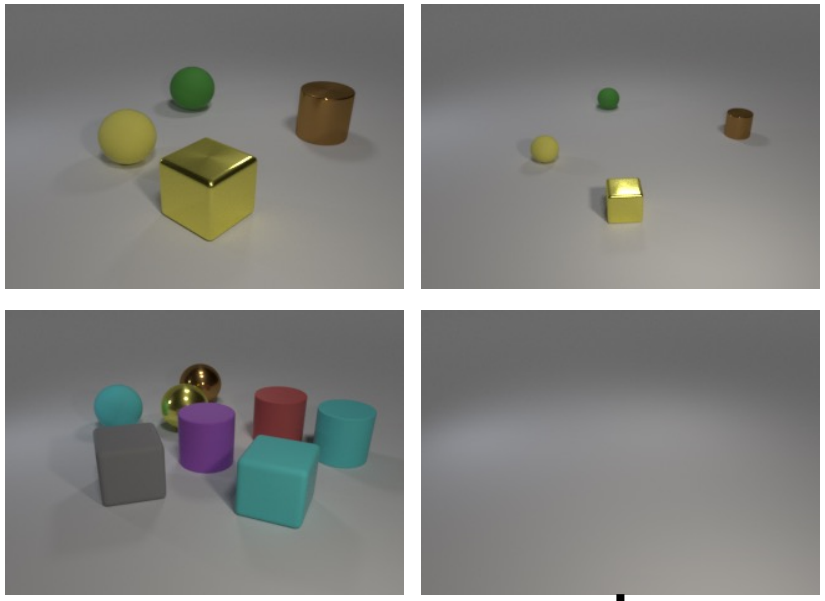


Images

Question: “Are the missing objects all tiny objects?”

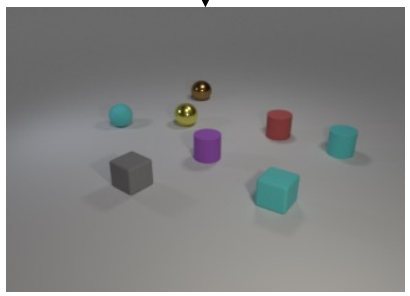
Answer: “true”

CLEVR-Analogy Dataset



Images

ground-truth content of the incomplete image



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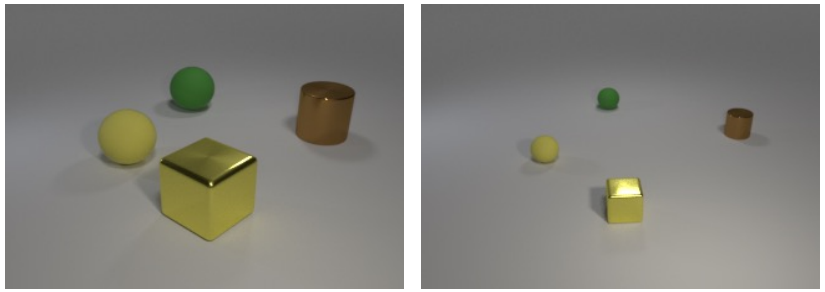

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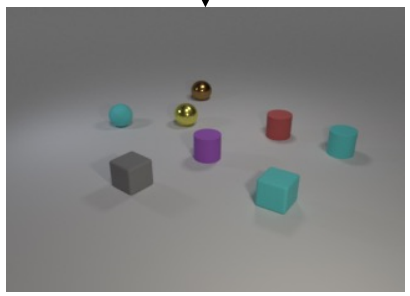

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Scene-graph-like **object annotation**

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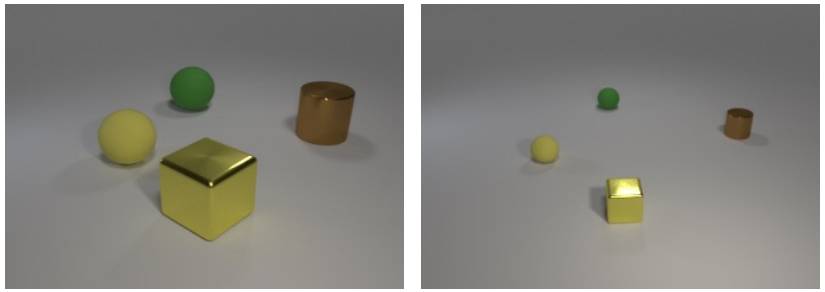

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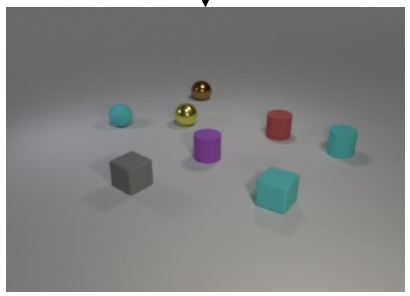

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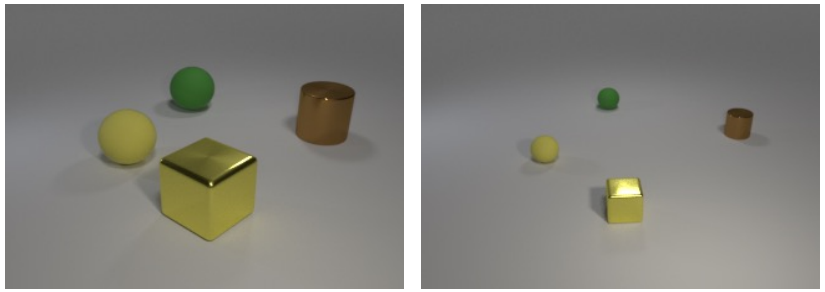
Functional programs that comprises the question

Scene-graph-like **object annotation**

CLEVR-Analogy Dataset



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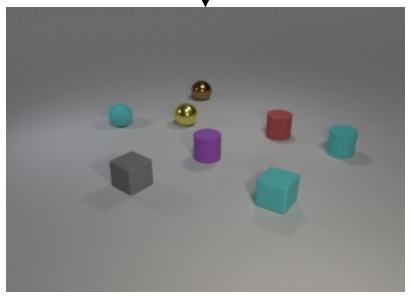

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Functional programs that comprises the question

Scene-graph-like **object annotation**

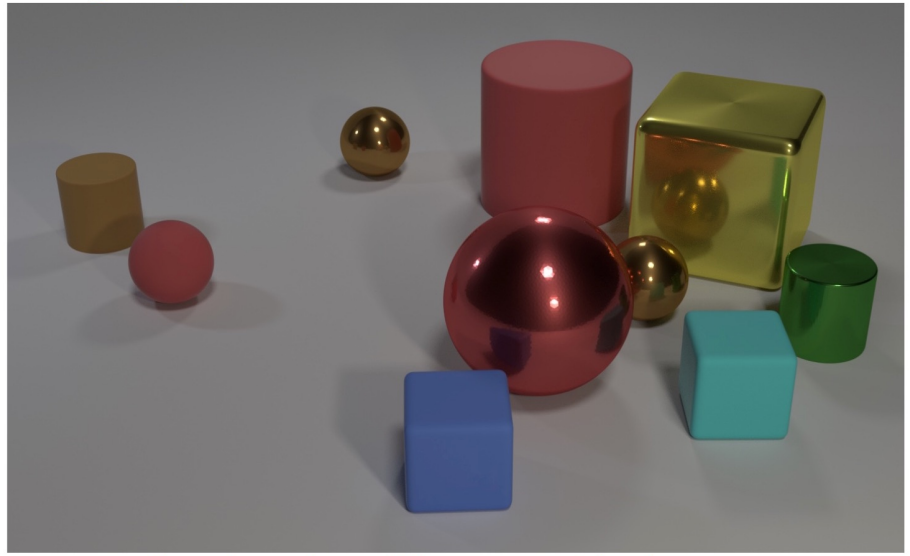
479,900 Analogical VQA problems

CLEVR-Analogy Dataset

Built upon CLEVR

Taken from CLEVR's project page: https://cs.stanford.edu/people/jcjohns/clevr/

Questions in CLEVR test various aspects of visual reasoning including **attribute identification**, **counting**, **comparison**, **spatial relationships**, and **logical operations**.



Q: Are there an **equal number** of **large things** and **metal spheres**?

Q: **What size** is the **cylinder** **that is left of** the **brown metal** thing **that is left of** the **big sphere**?

Q: There is a **sphere** with the **same size as** the **metal cube**; is it **made of the same material as** the **small red sphere**?

Q: **How many** objects are **either** **small cylinders** or **red** things?

J. Johnson, B. Hariharan, L. van der Maaten, L. Fei- Fei, C. L. Zitnick, and R. Girshick, "Clevr: A diagnostic dataset for compositional language and elementary visual reasoning," in *2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2017, pp. 1988–1997.

CLEVR-Analogy Dataset

Built upon CLEVR

+

Analogy Rules

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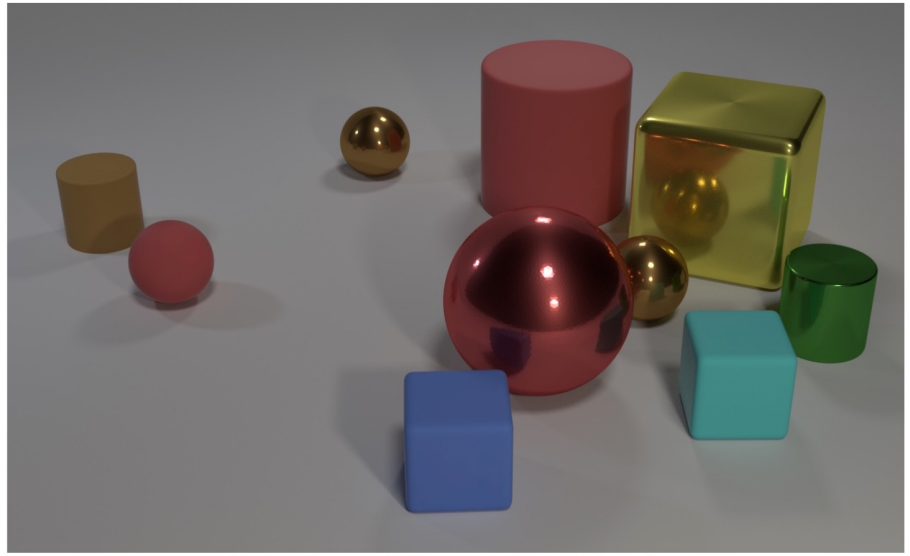

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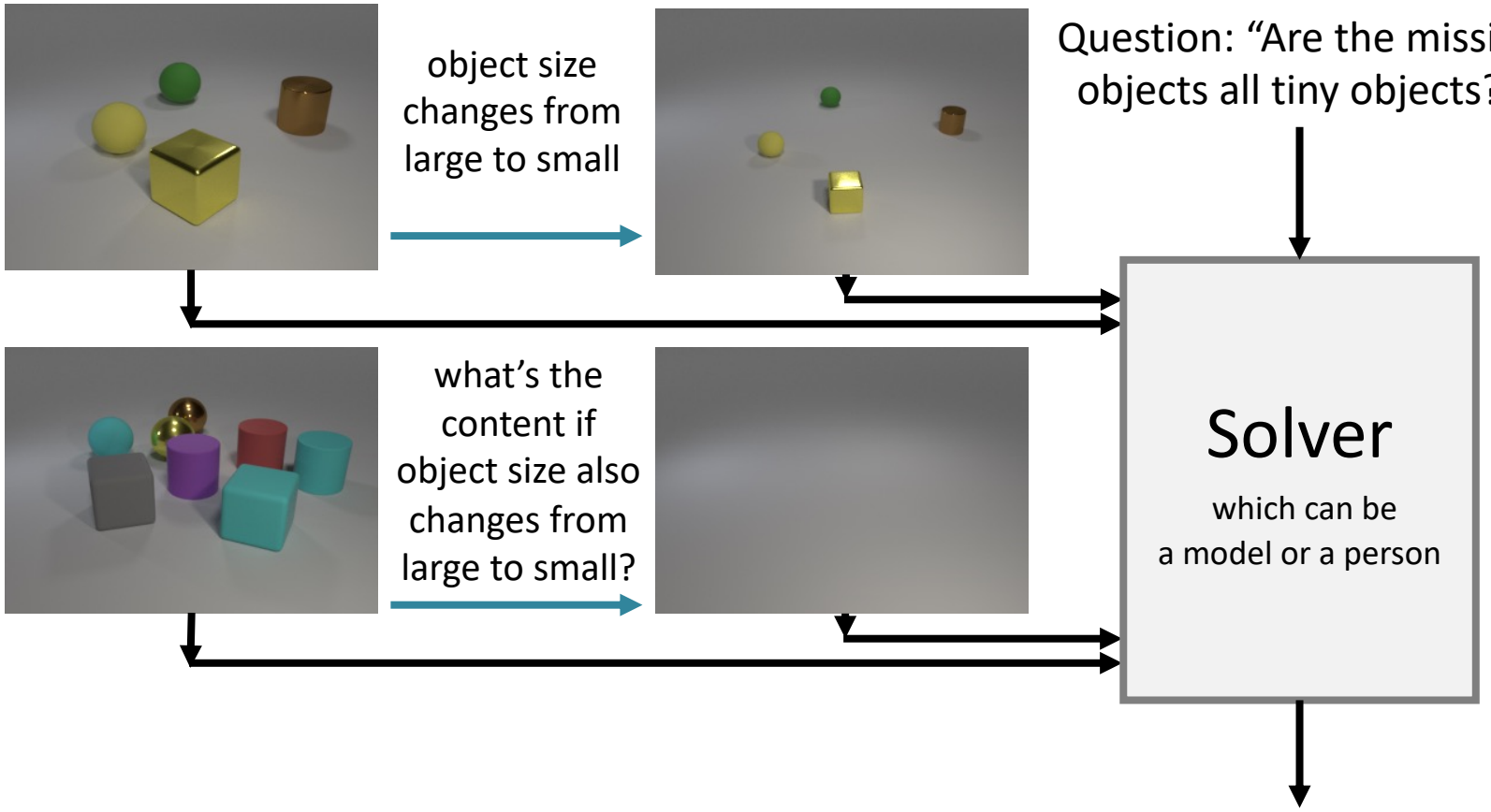
Analogical VQA



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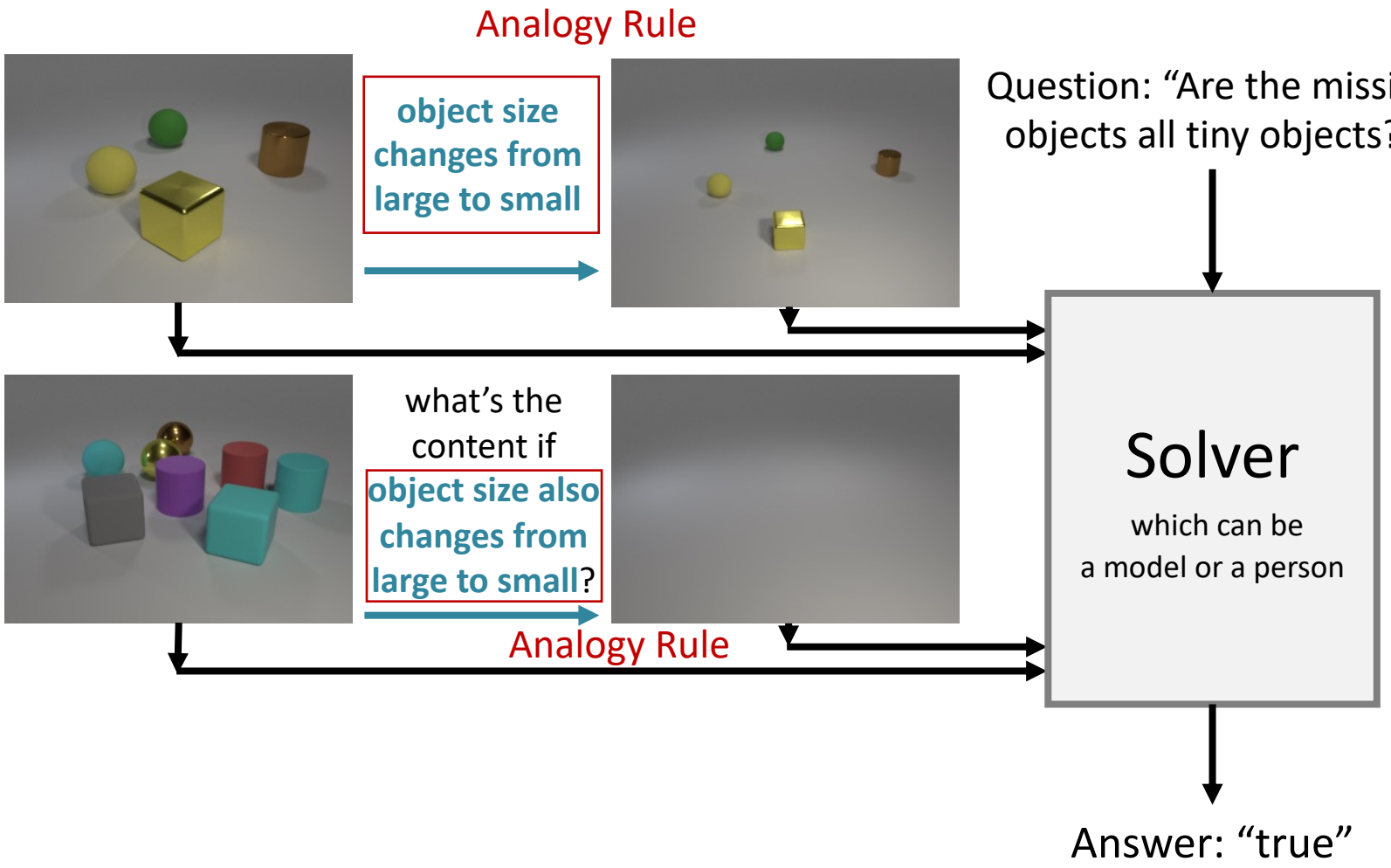
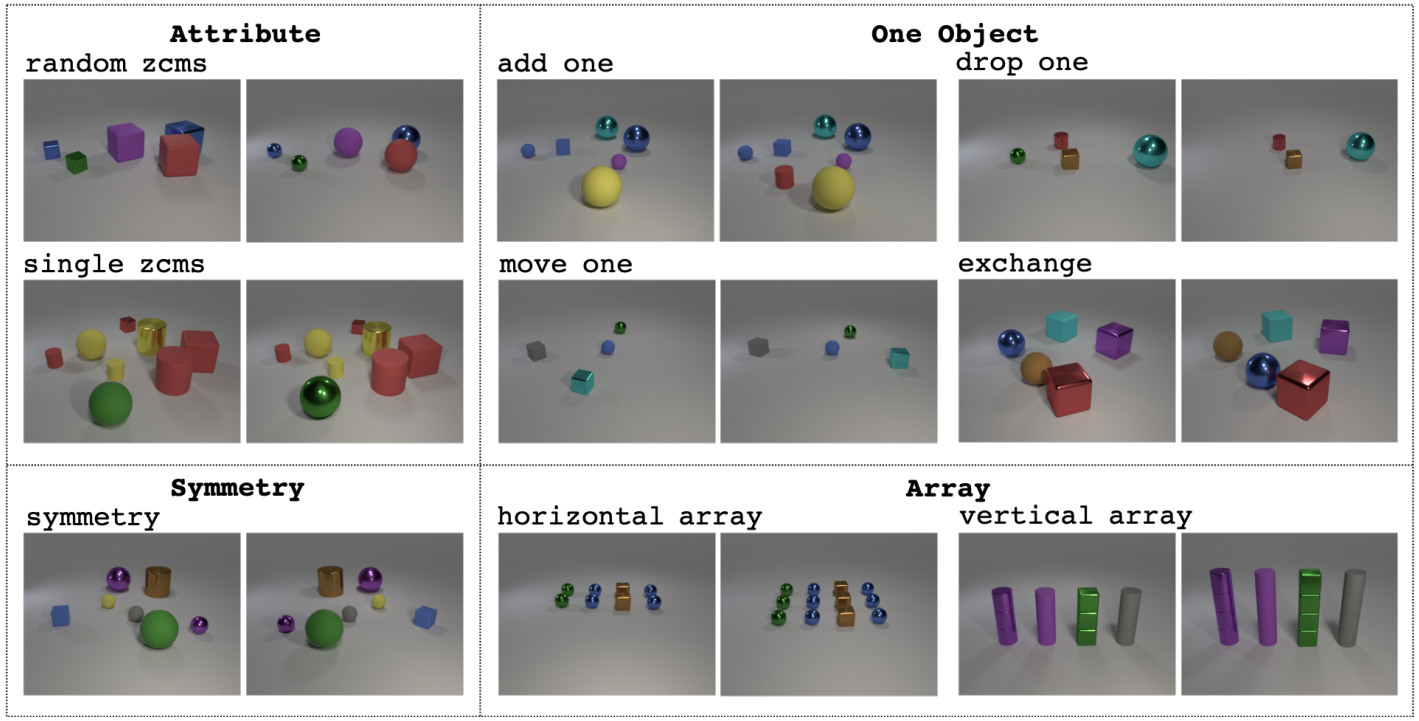


Analogy Rules

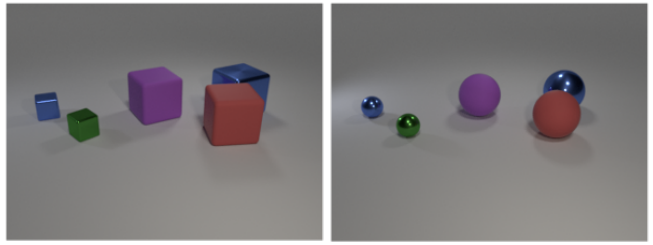


- 4 broad categories
- 9 analogy rules

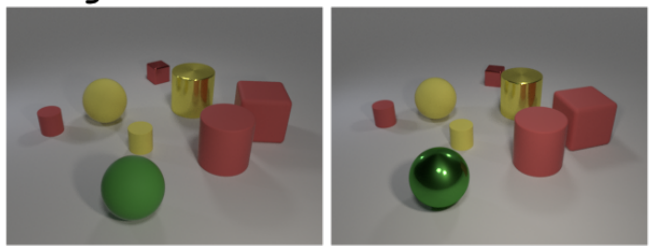
Analogy Rules

Attribute

random zcms

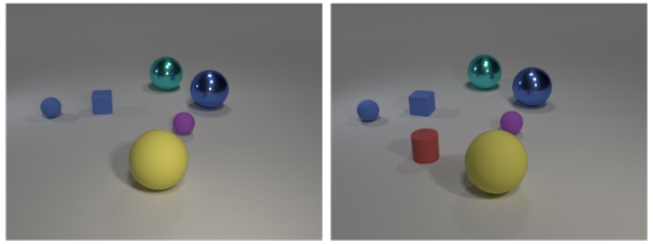


single zcms

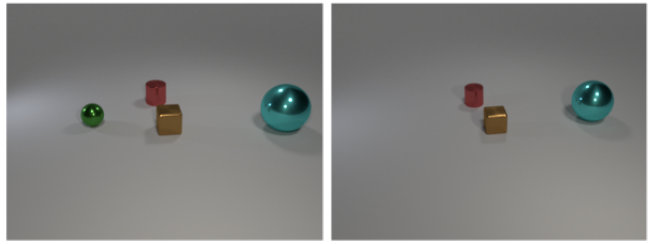


One Object

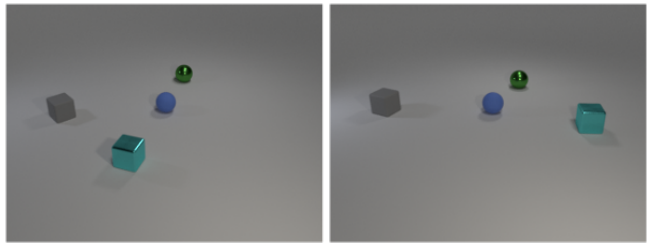
add one



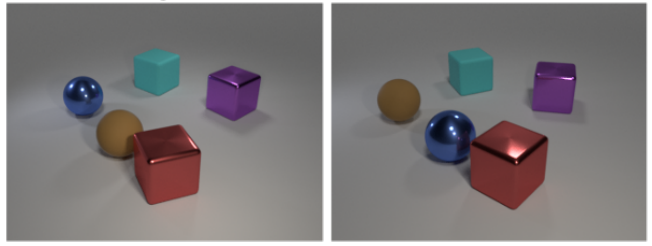
drop one



move one

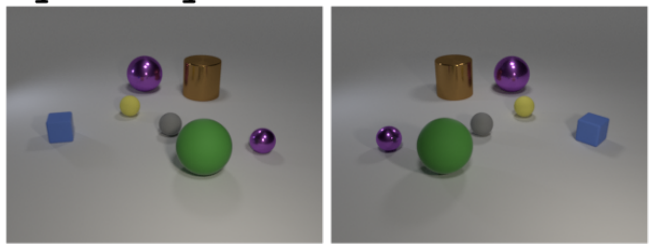


exchange



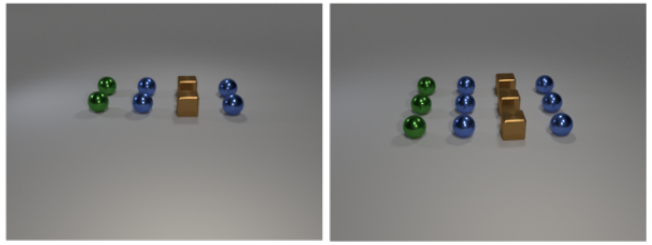
Symmetry

symmetry

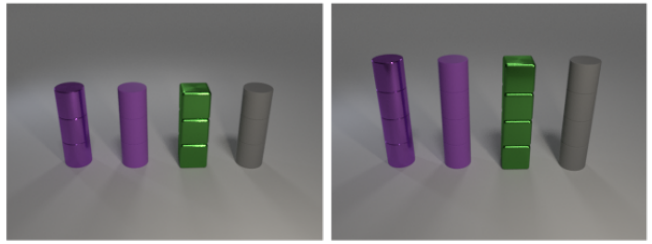


Array

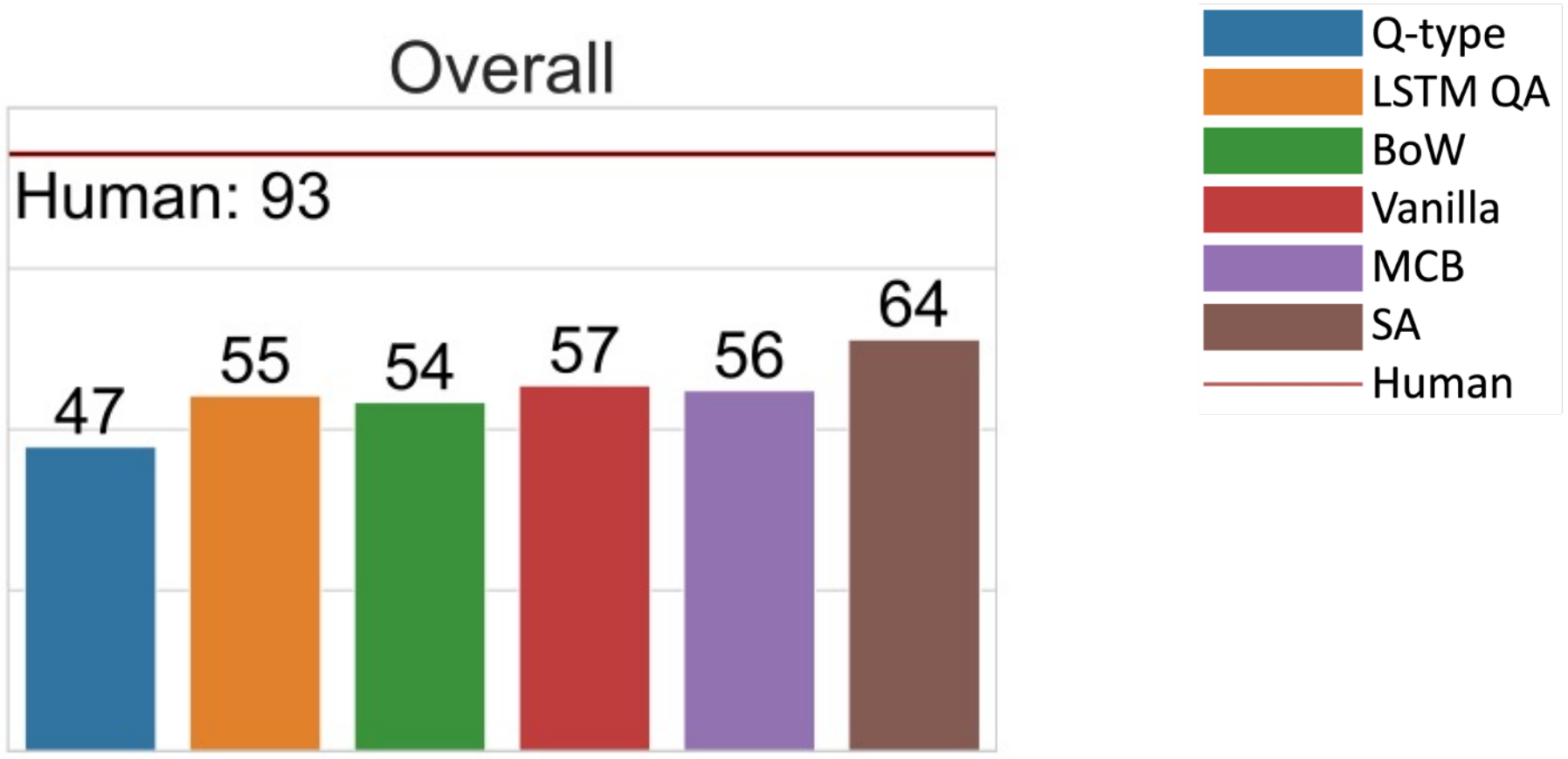
horizontal array



vertical array



Analogical VQA Accuracy



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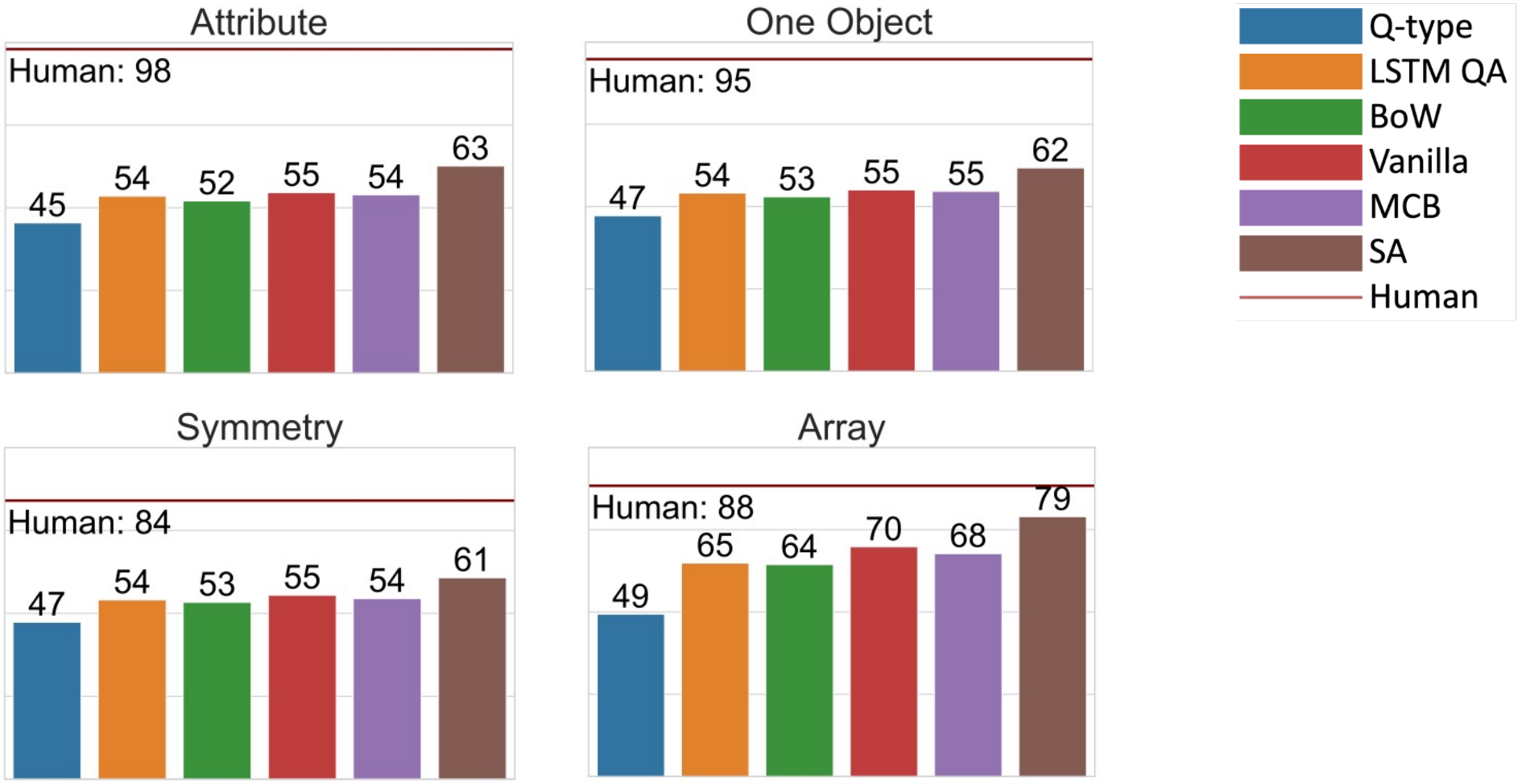
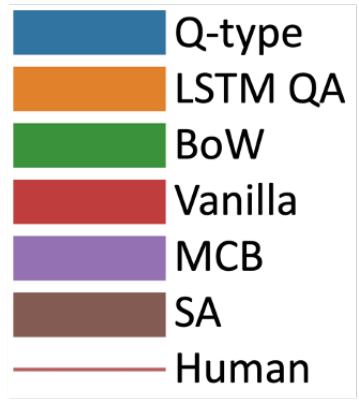
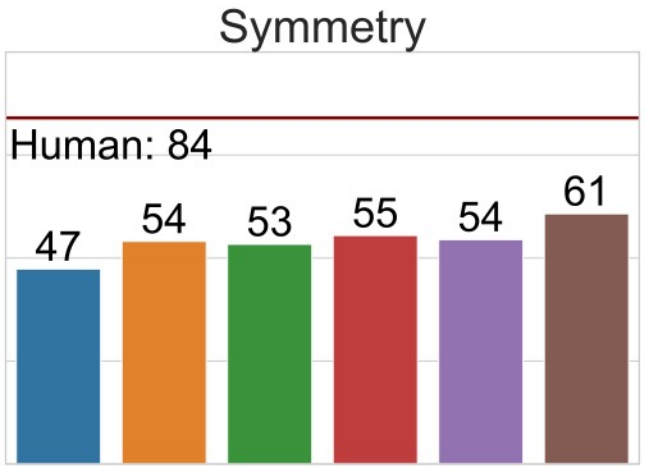


Analogical VQA Accuracy





Analogy Rules

Attribute

random zcms

single zcms

One Object

add one

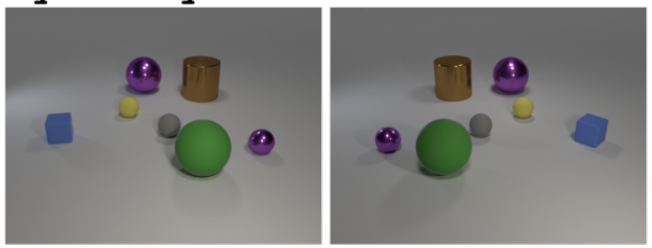
drop one

move one

exchange

Symmetry

symmetry

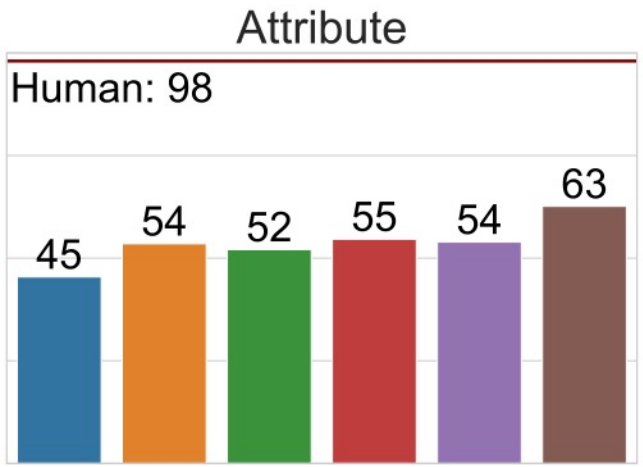


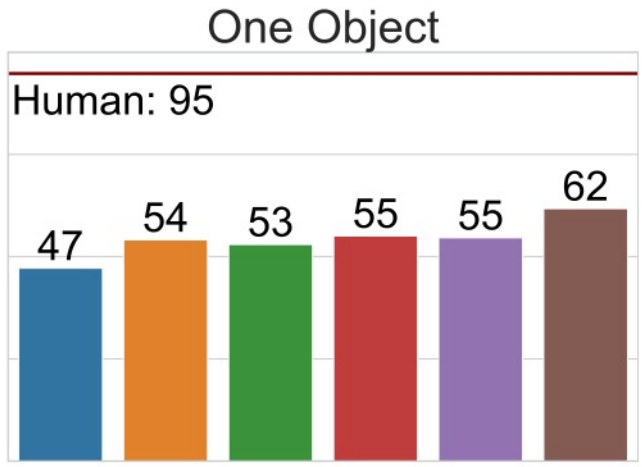
Array

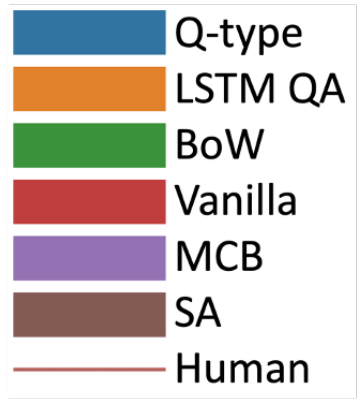
horizontal array

vertical array

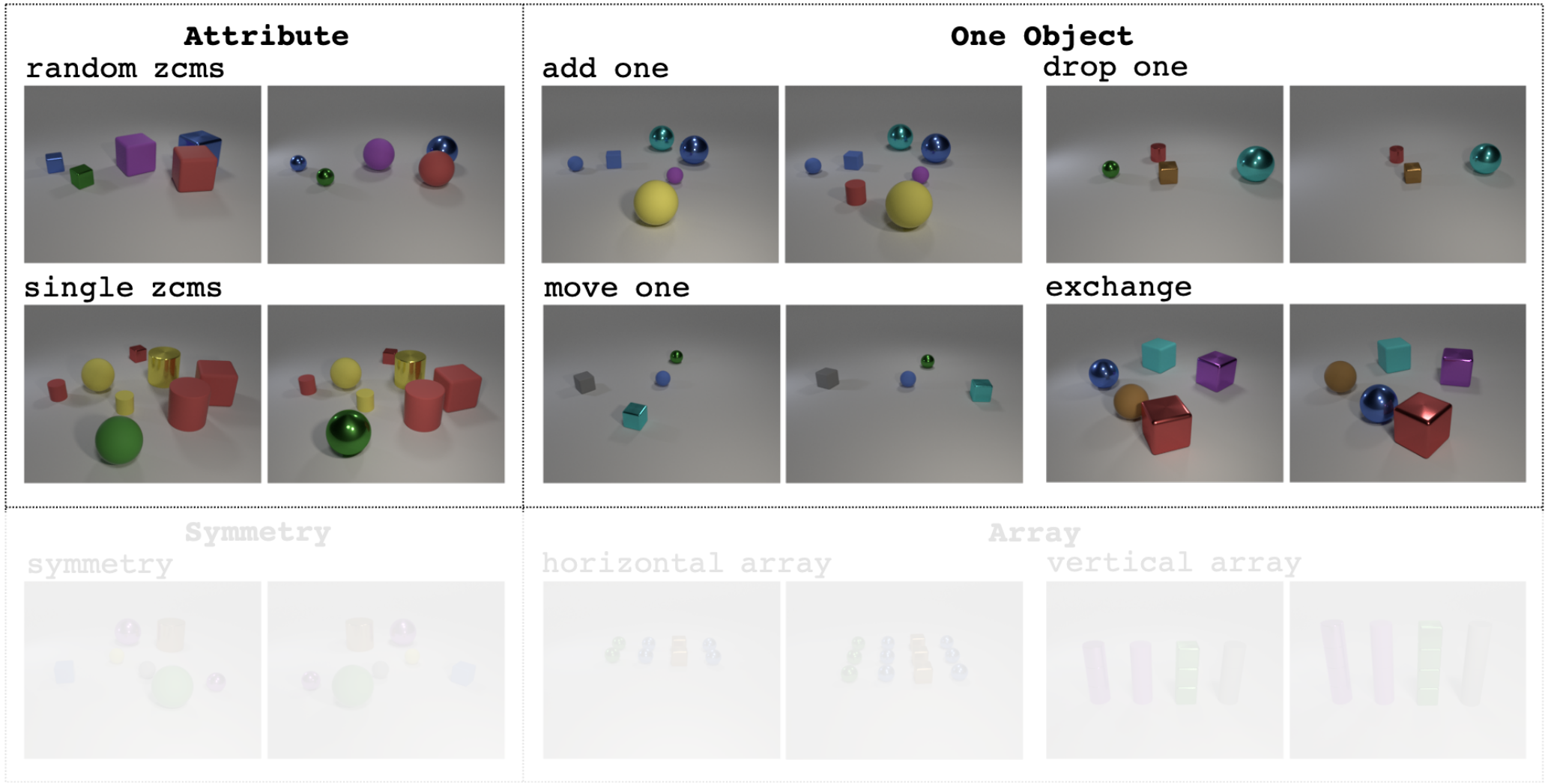
Analogical VQA Accuracy



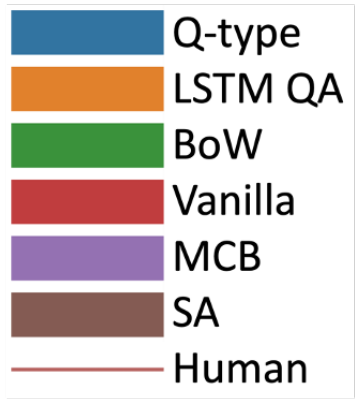


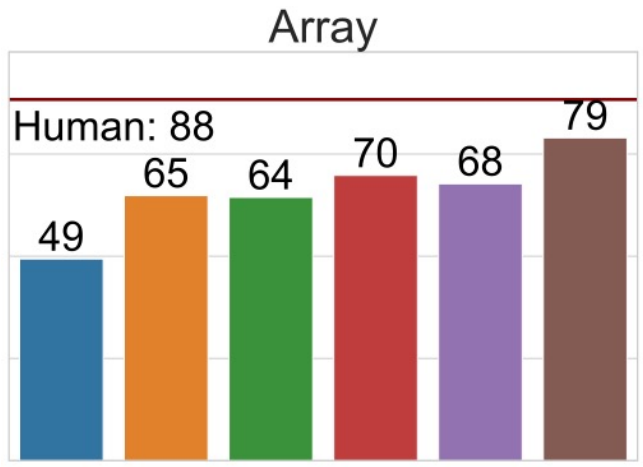


Analogy Rules



Analogical VQA Accuracy





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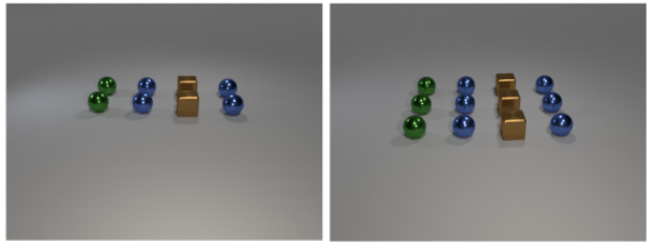
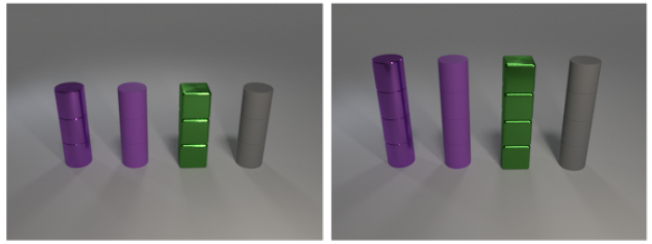
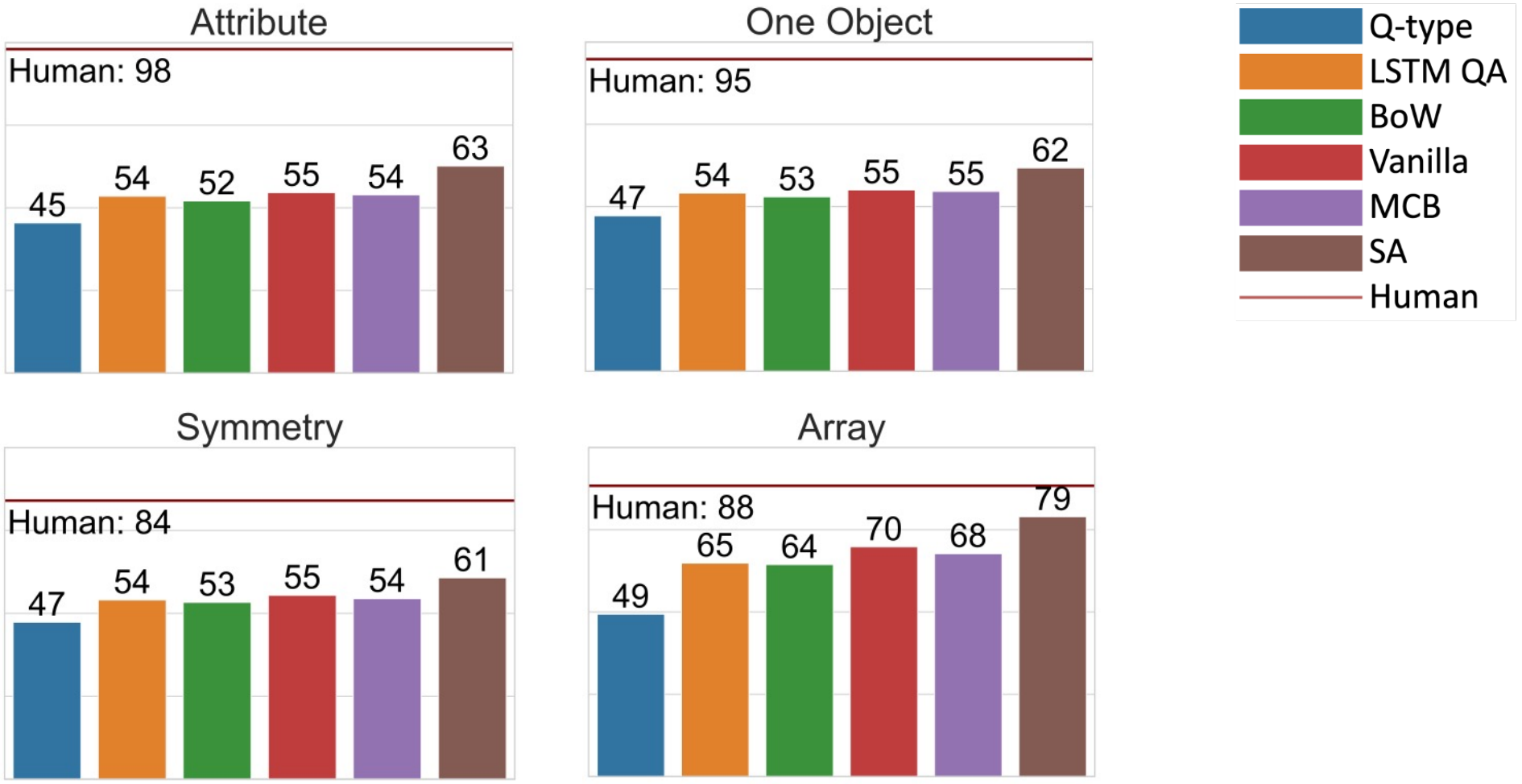


vertical array



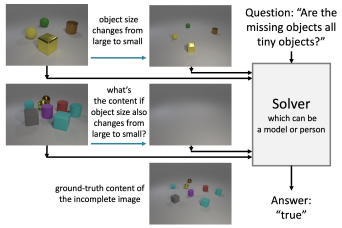
Analogical VQA Accuracy



Analogical Reasoning

Task

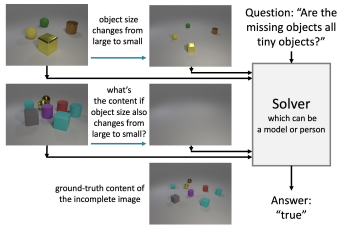
Analogical VQA



Analogical Reasoning

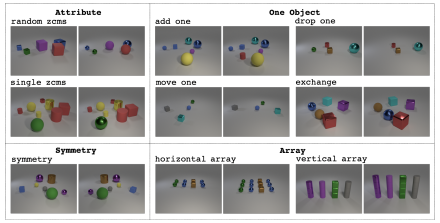
Task

Analogical VQA



Dataset

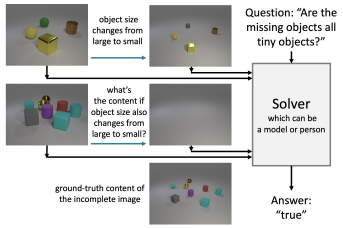
CLEVR-Analogy



Analogical Reasoning

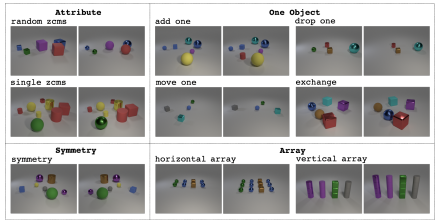
Task

Analogical VQA

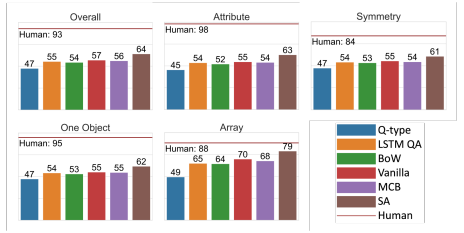


Dataset

CLEVR-Analogy



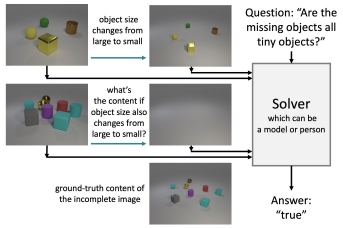
Experiments & Analysis



Analogical Reasoning

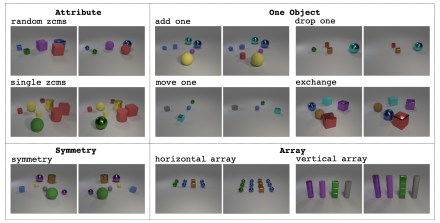
Task

Analogical VQA

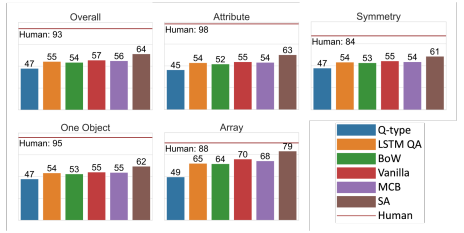


Dataset

CLEVR-Analogy



Experiments & Analysis



- Broader analogical reasoning tasks
- Need stronger models in terms of analogical reasoning
- ……

Thank you for your attention