Google DeepMind

UNIVERSITY OF COPENHAGEN

Measuring Progress in Fine-grained Vision-and-Language Understanding

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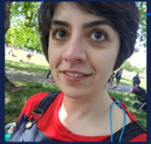
A. Nematzadeh

Coarse-grained vs. Fine-grained Tasks

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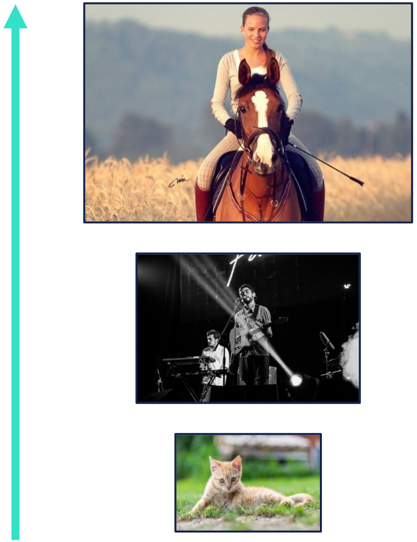
Coarse-grained Image Retrieval

A person is riding a horse.



Coarse-grained vs. Fine-grained Tasks

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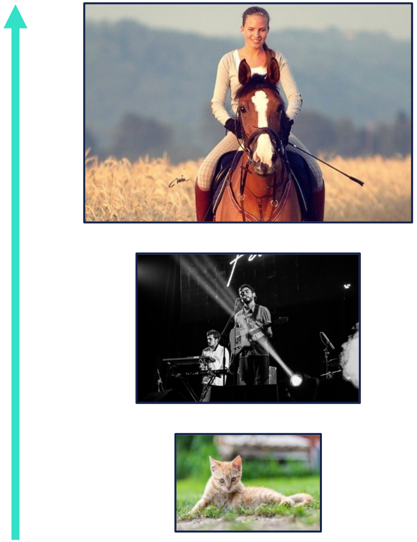
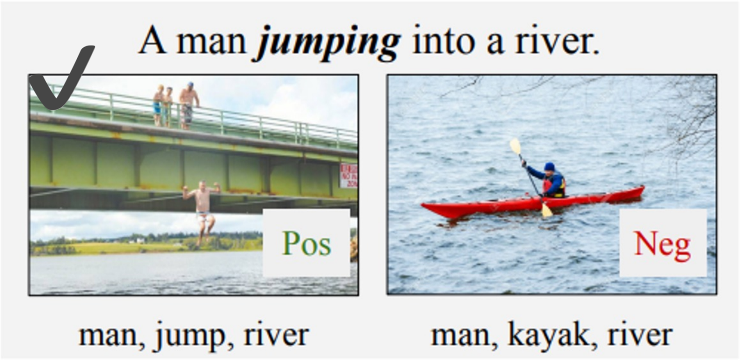


Fine-grained Verb Understanding



What Matters for Fine-grained V&L Understanding?

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Localisation modelling > more Web data alone

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Performance can fluctuate during training, even becoming ***worse***

Benchmarks

Fine-grained Tasks

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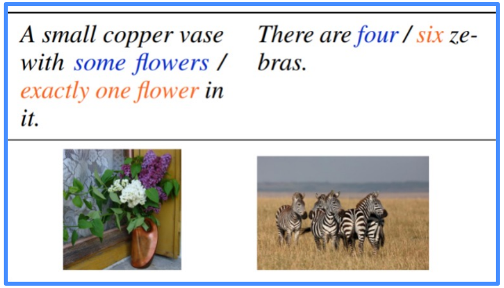
Fine-grained Tasks

- VALSE



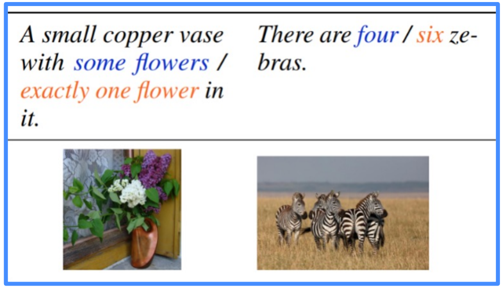
A small copper vase with some flowers / exactly one flower in it.	*There are four / six zebras.*

6 phenomena: existence, plurality, counting, relations, actions, coreference

Benchmarks

Fine-grained Tasks

- VALSE
- VSR



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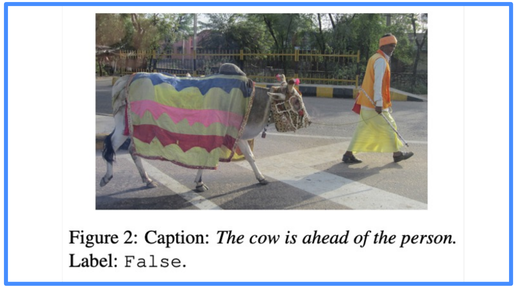

Figure 2: Caption: *The cow is ahead of the person.* Label: `False`.

65 relationships in 7 different categories (*e.g.*, adjacency, proximity)

Benchmarks

Fine-grained Tasks

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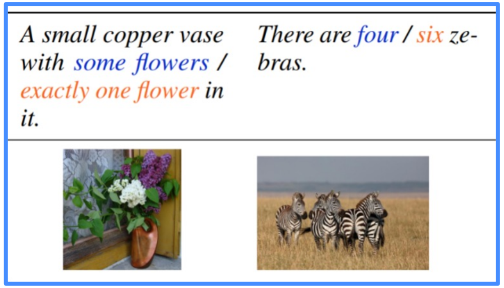
- VSR
- SVO-Probes



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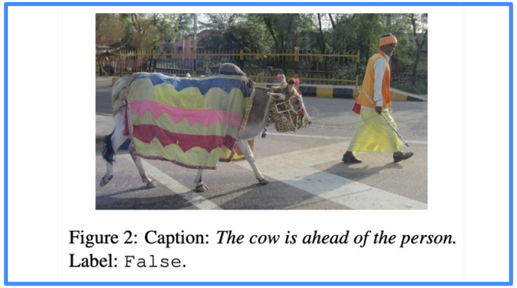

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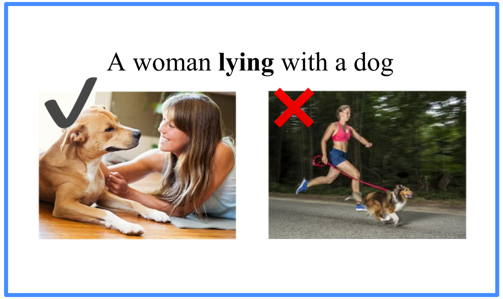


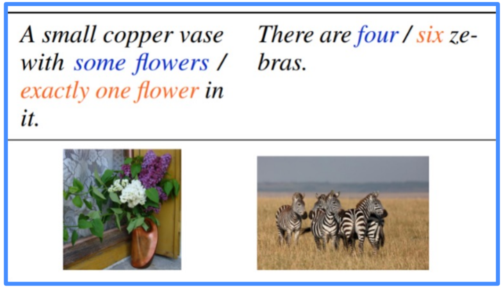
A woman **lying** with a dog

421 verbs with hard negatives for different parts of speech (subject, verb, object)

Benchmarks

Fine-grained Tasks

- VALSE
- VSR
- SVO-Probes
- Winoground



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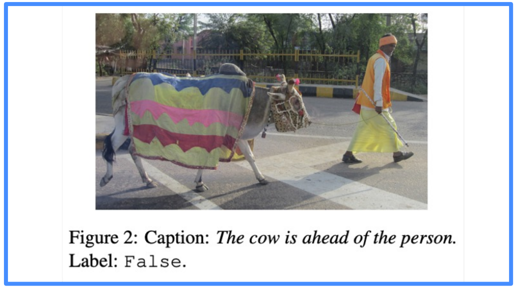

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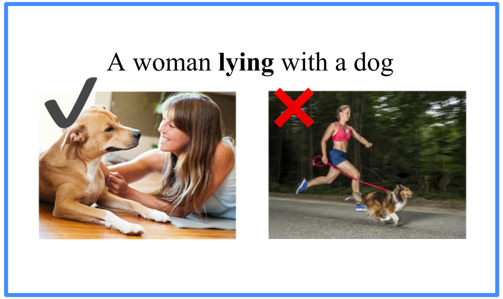

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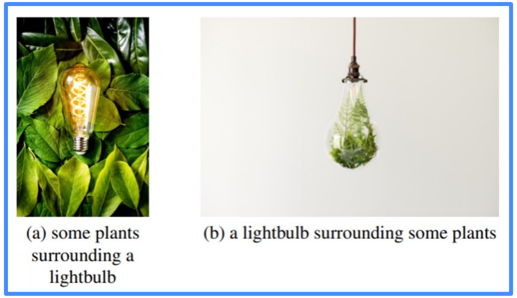

(a) some plants surrounding a lightbulb

(b) a lightbulb surrounding some plants

Tests a compositionality across 6 linguistic and visual phenomena

Benchmarks

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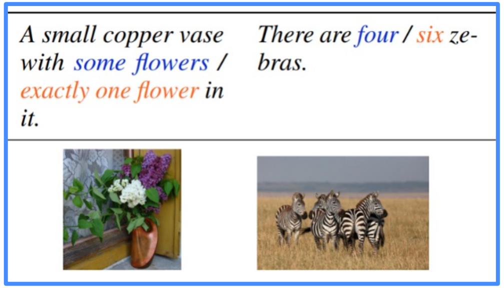

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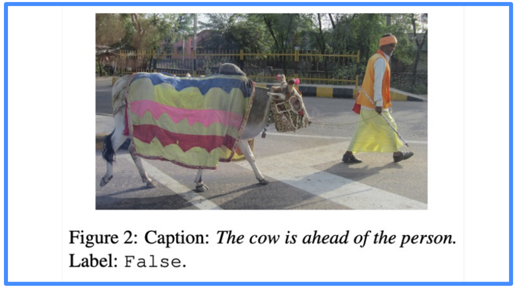

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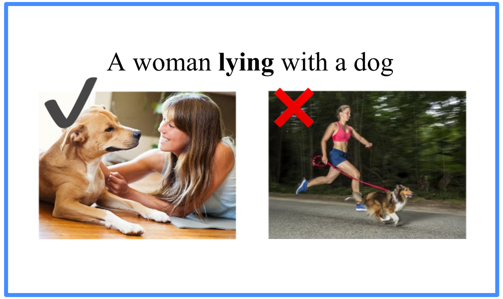

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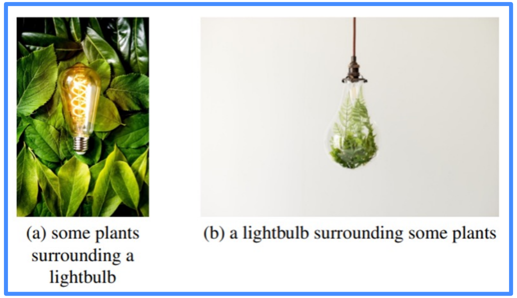

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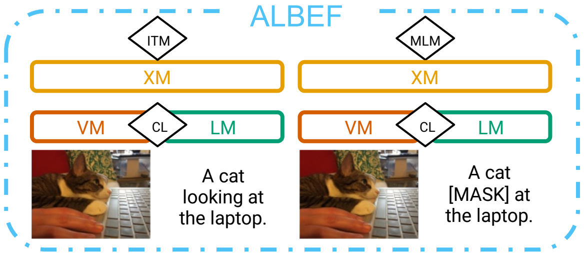
Coarse-grained Retrieval Tasks (Flickr30K, COCO)

Baselines

Baselines

Coarse-grained Models

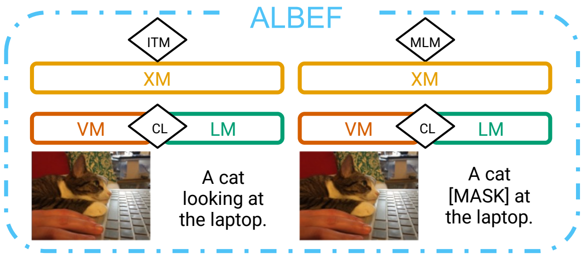
- ALBEF (baseline)



Baselines

Coarse-grained Models

- ALBEF (baseline)
- BLIP (~ALBEF but w/ autoregressive LM)



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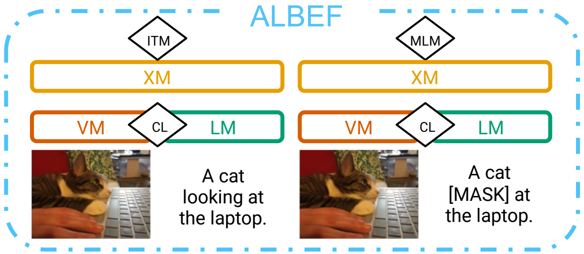

Fine-grained Models

Newly proposed fine-grained models do not test on fine-grained tasks!

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Coarse-grained Models

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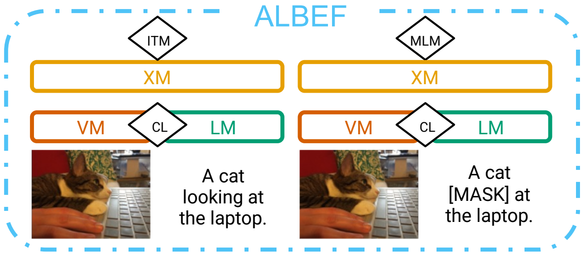
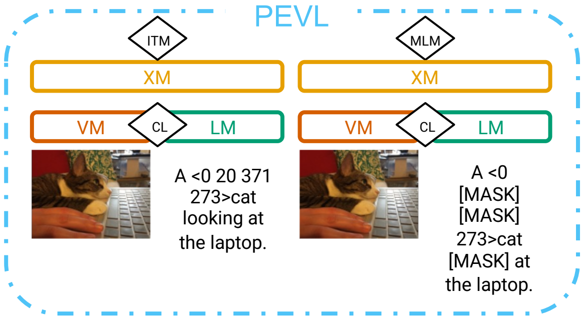
Fine-grained Models

- PEVL (ALBEF + bbox MLM)




PEVL
ITM
MLM
XM
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VM
CL
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A <0 20 371 273>cat looking at the laptop.
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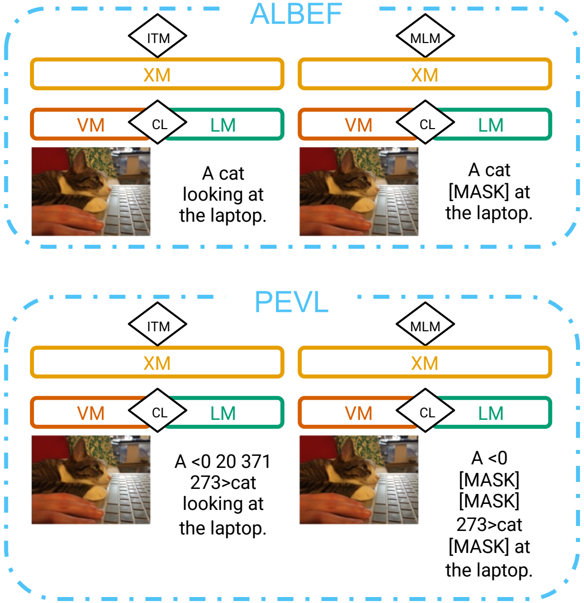
- PEVL (ALBEF + bbox MLM)
- X-VLM (ALBEF + bbox regression)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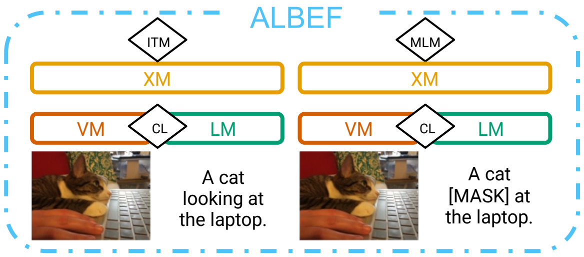

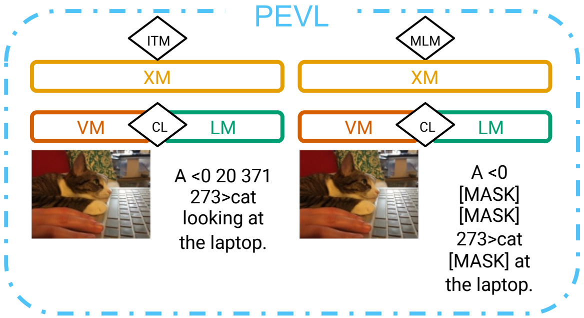
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Other coarse-grained Models (BLIP-2, ClipCap, Flamingo)

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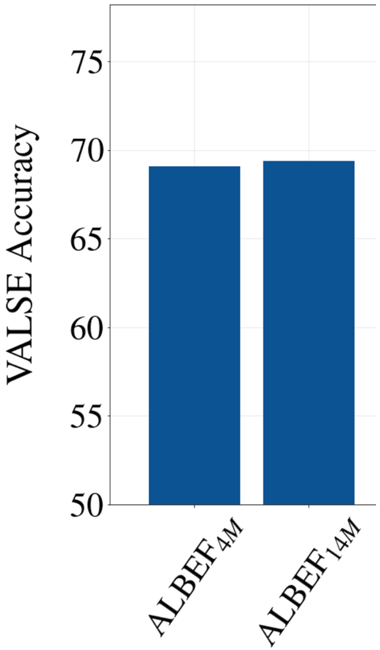

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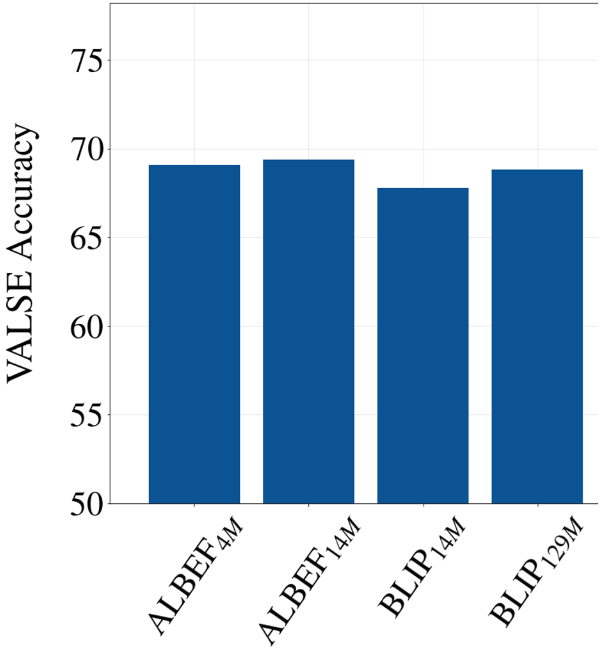

~ALBEF w/ autoregressive LM

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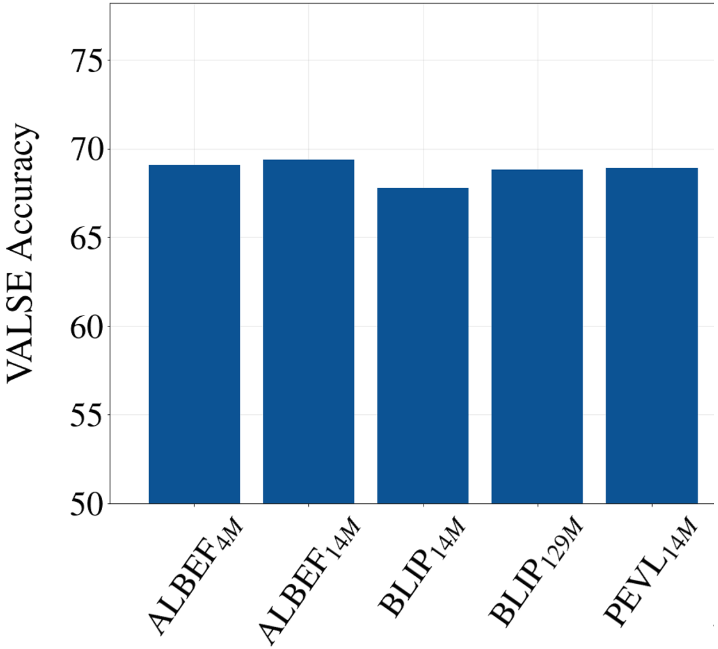

ALBEF + bbox prediction in MLM

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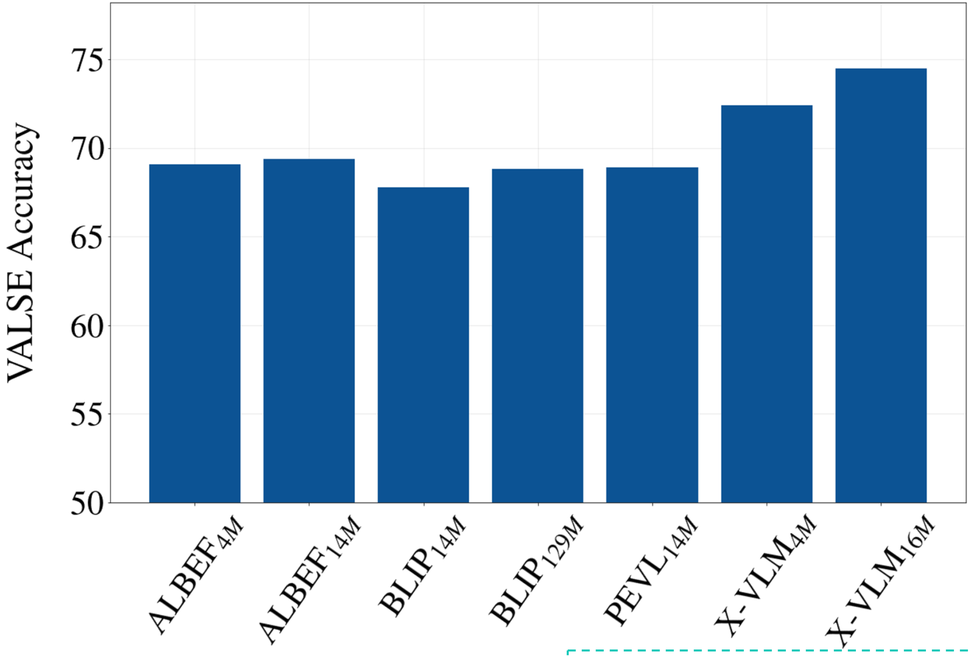
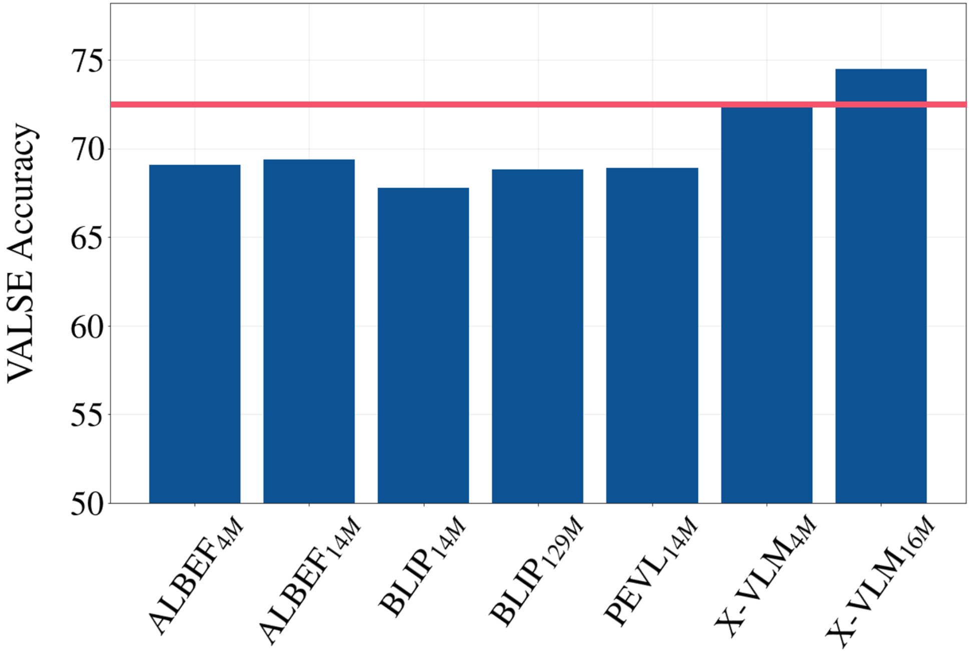


ALBEF + bbox regression head

Which models perform well on fine-grained tasks?

Localisation can help fine-grained understanding



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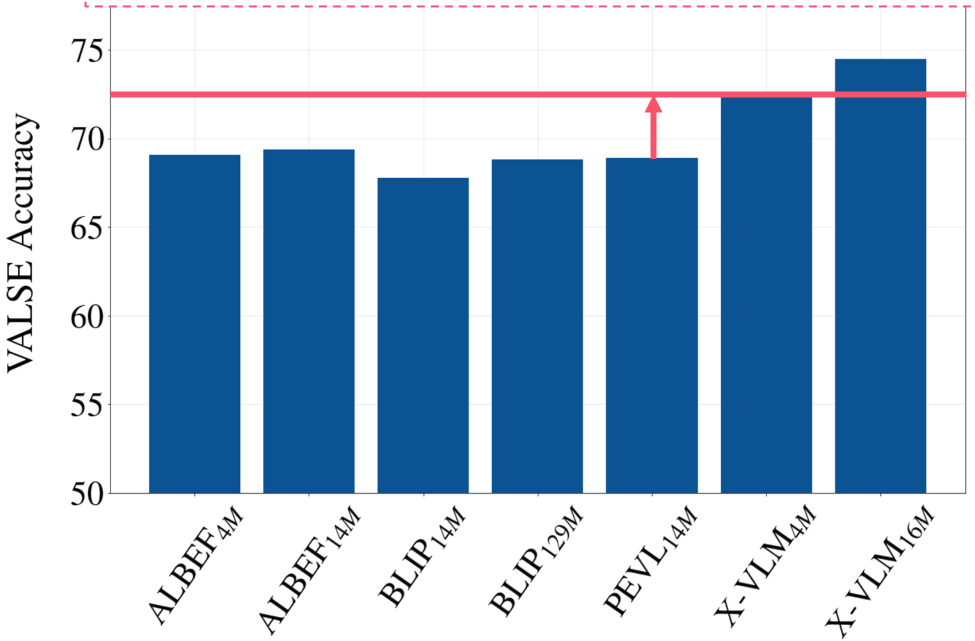
Localisation can help fine-grained understanding
But localisation loss matters!



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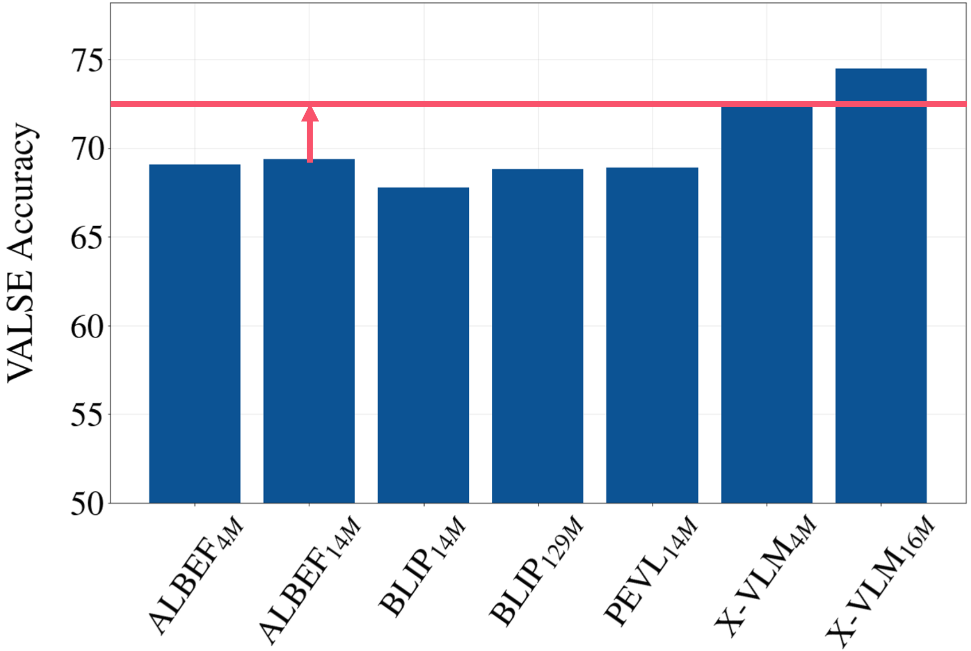
More data does not help as much as modelling



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- Object detection
  - COCO_{OD}
  - VG_{OD}
- Region description
  - VG_{RD}

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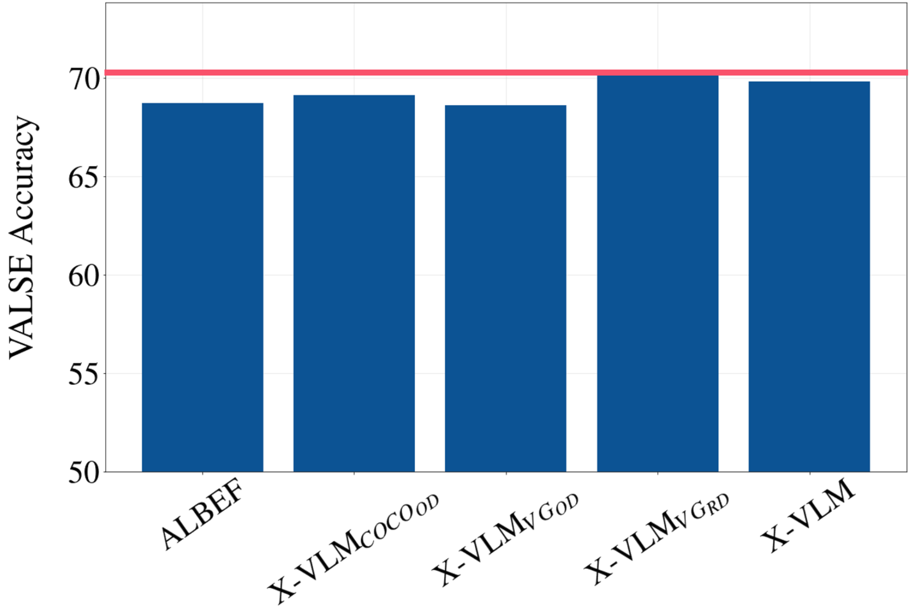
- Region description
  - VG_{RD}

VG_{RD} is the most useful dataset

Similar performance to training on all datasets



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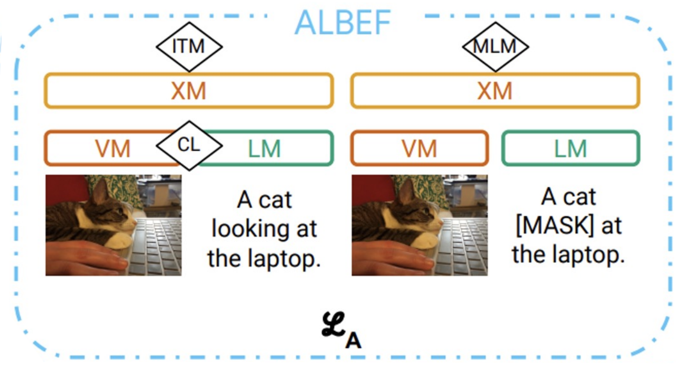

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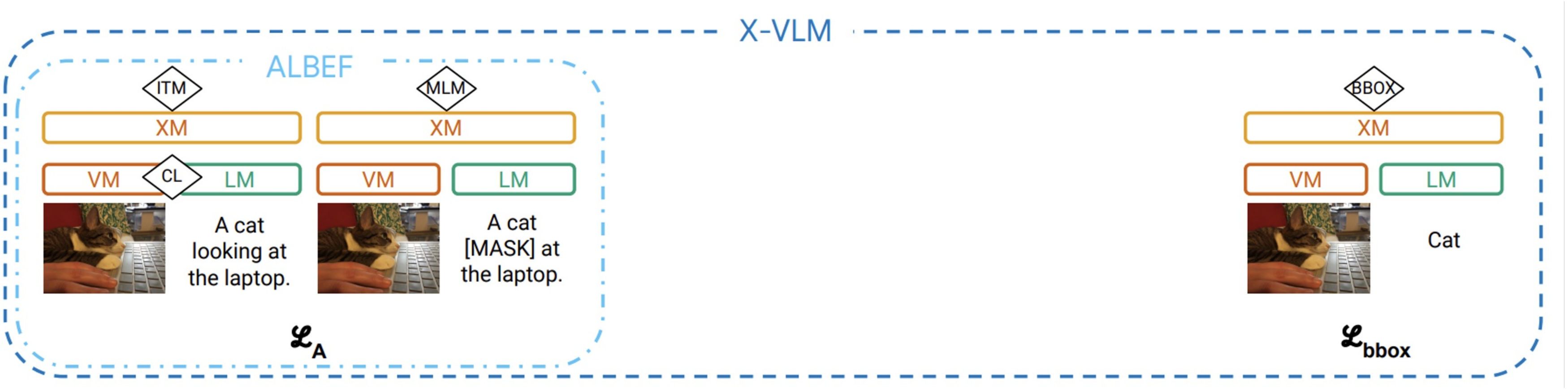

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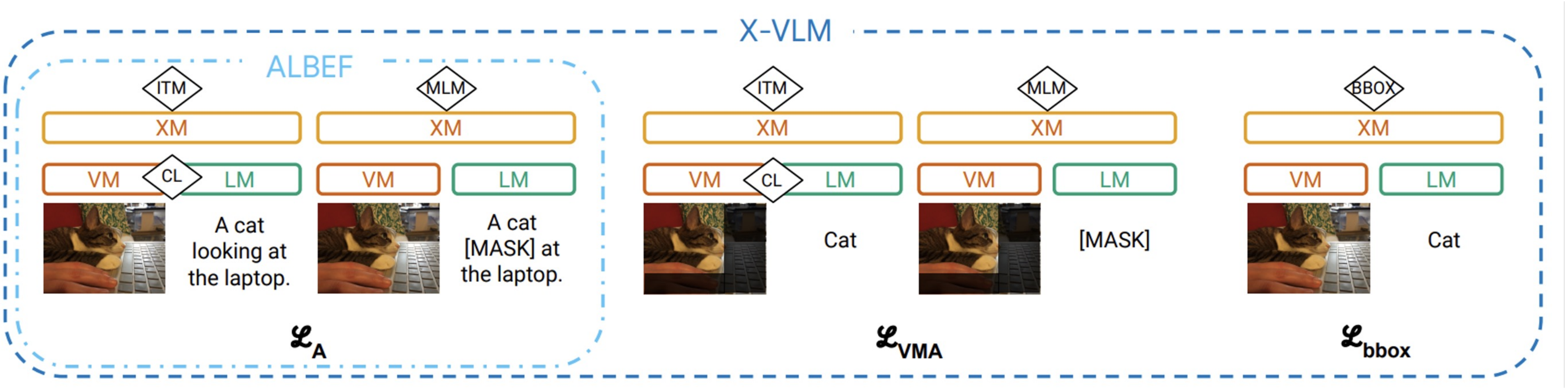

object-centric visual view: an image region (not the whole image) is used

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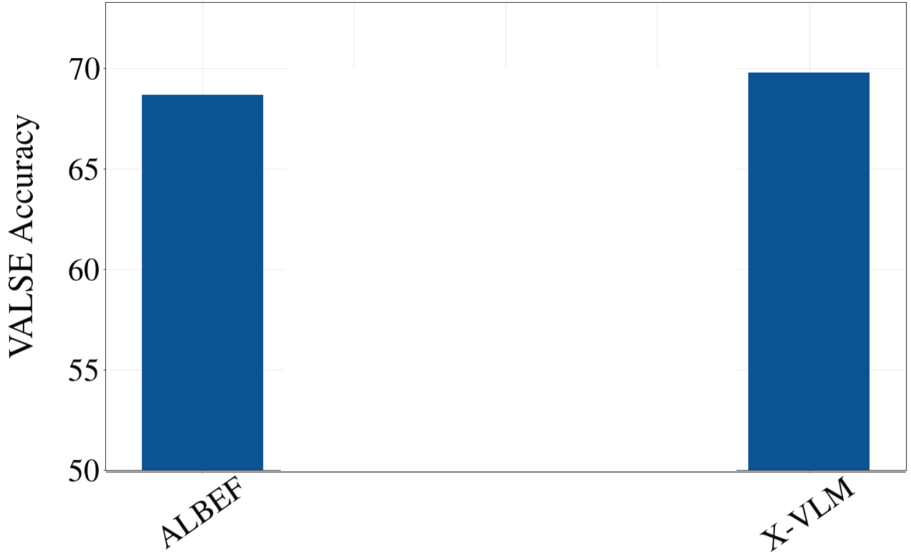

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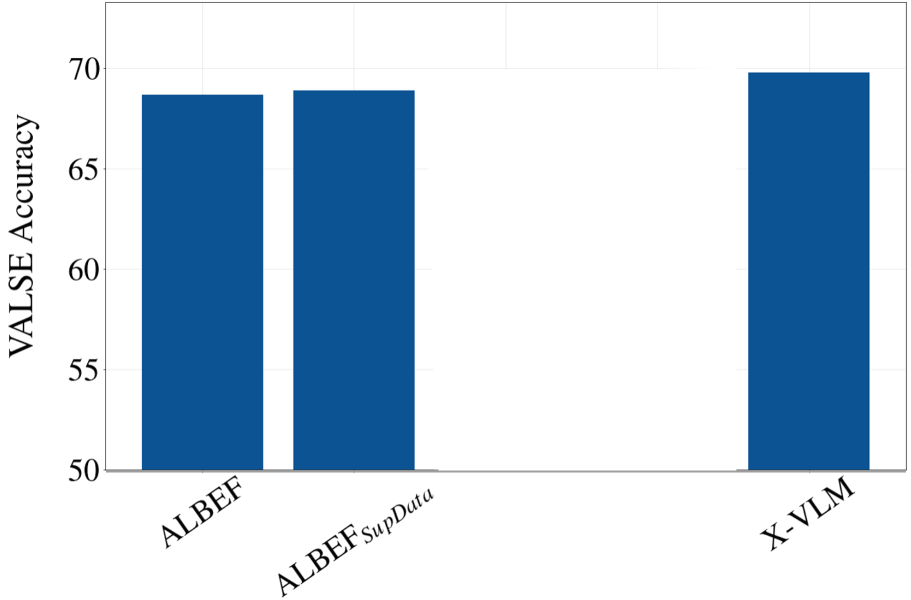

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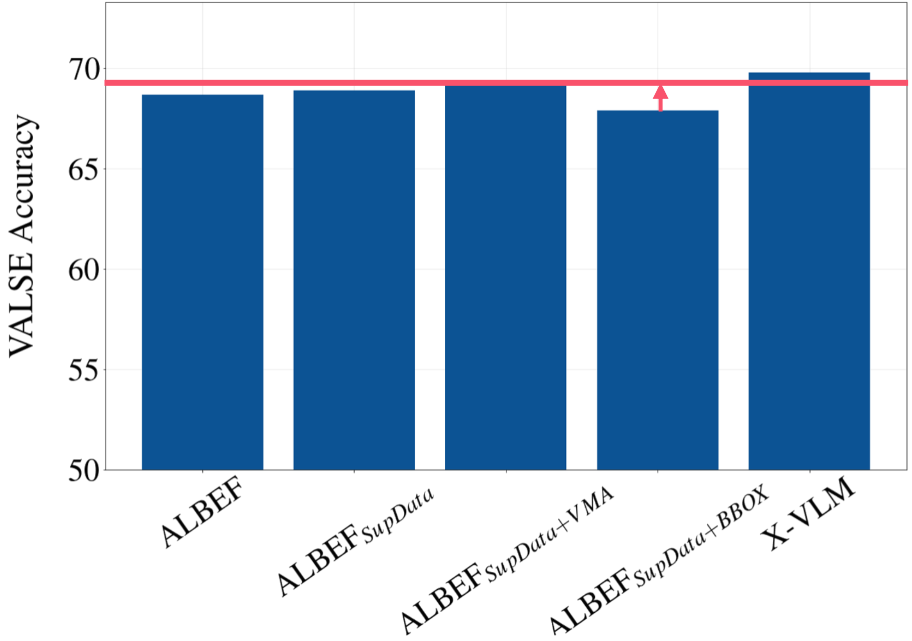

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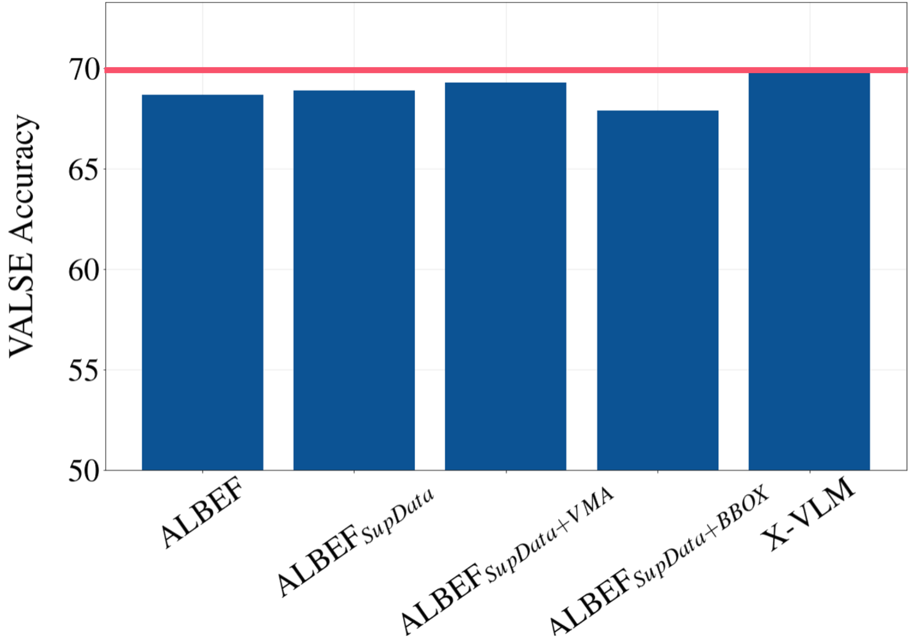
- L_{VMA} + L_{BBOX} is best



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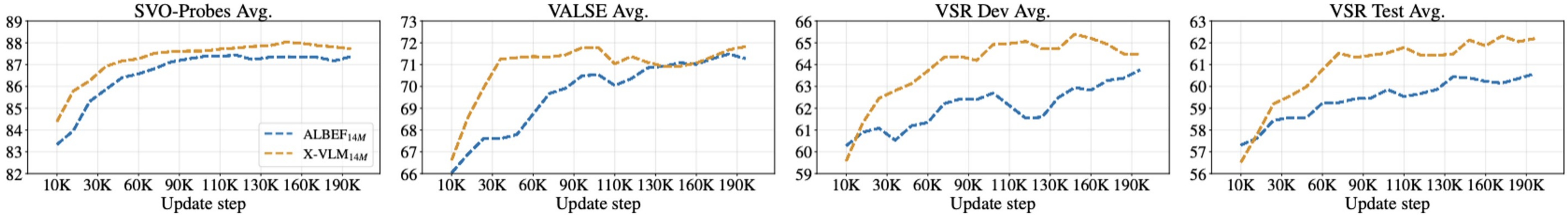
Different Skills, Different Patterns

Public



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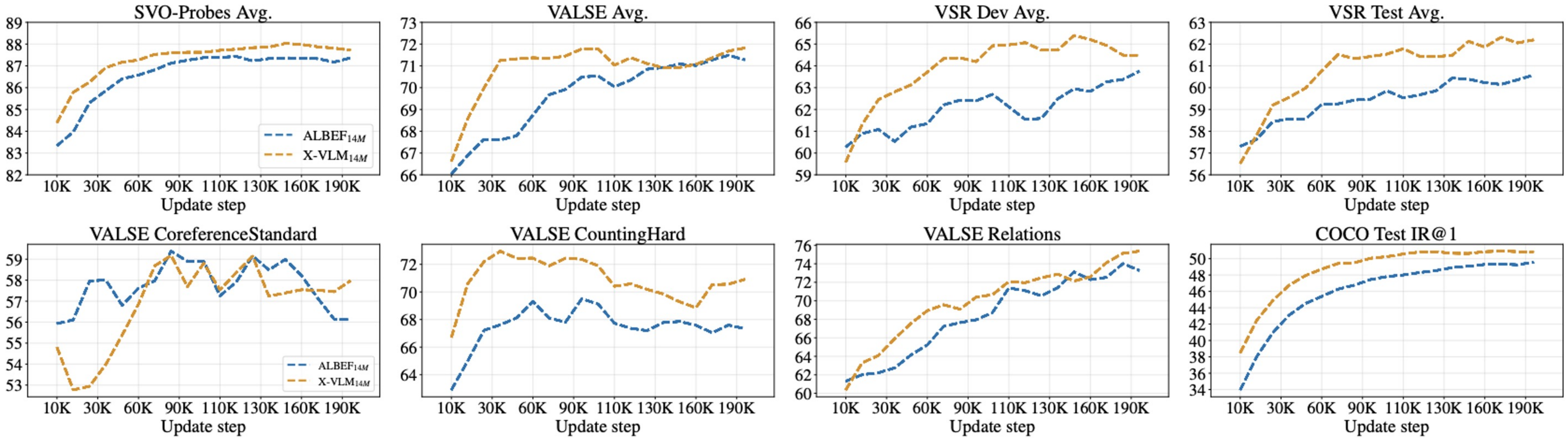

A single checkpoint might not be adequate for all skills!

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Conclusion

Strong multimodal models trained at scale struggle with fine-grained understanding

- **Supervised losses** are promising
- As is **descriptive language** (region descriptions)

Fine-grained skills are learned at different times

- Pay attention to learning dynamics!
- How can we consistently improve over all fine-grained skills?