

Expanding Goldilocks to Image Modalities

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The Goldilocks Framework

Problem

Crowdsourced annotations can be ambiguous and produce disagreement, yielding unrepresentative labels.

Domain

Scalar annotations

Subproblems

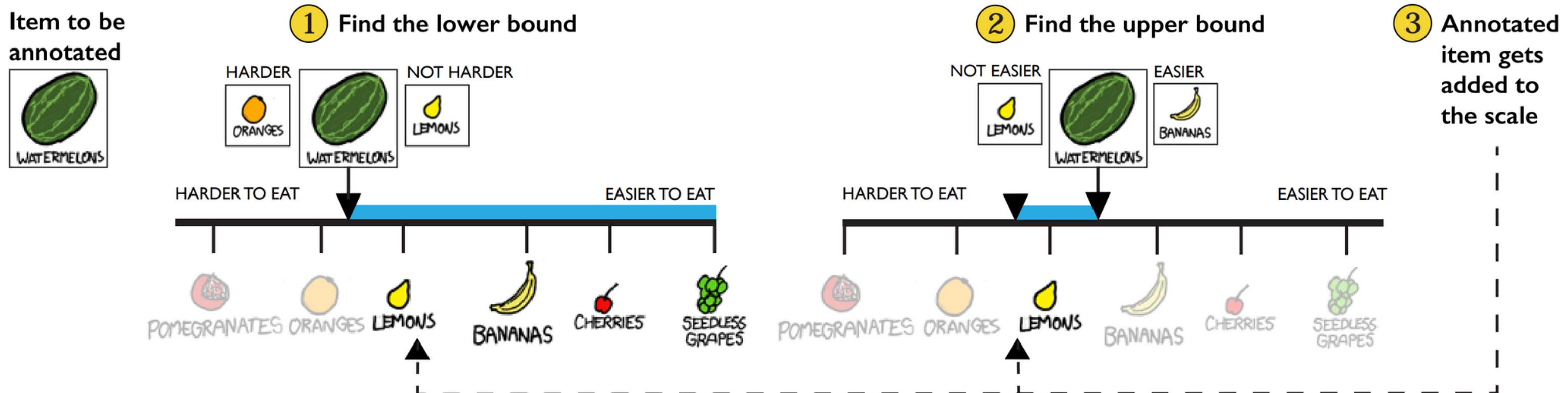
- *Holistic Representation of uncertainty*
- *Precise Search* for precision and accuracy

Principles

- Two-step bounding
- Global and local grounding

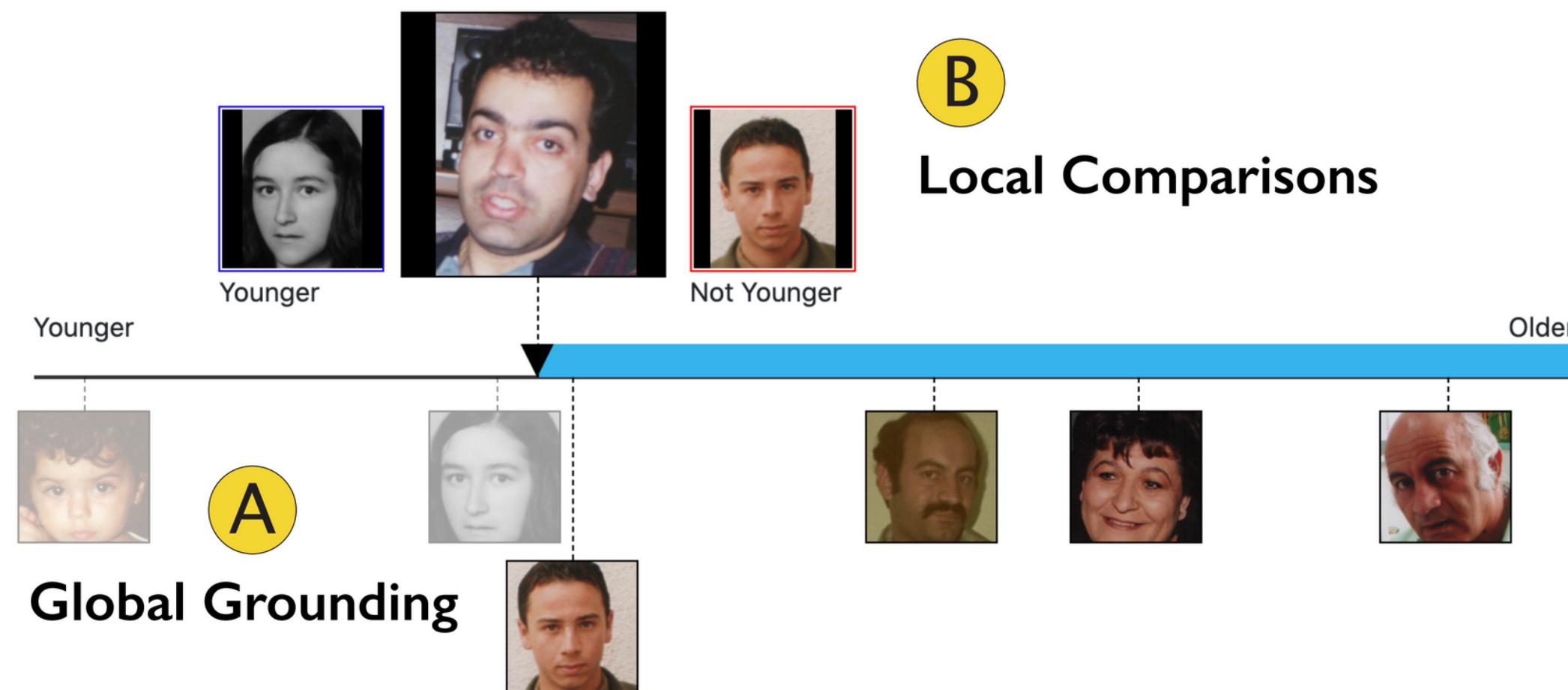
Holistic Representation

Users use a two-step annotation indicating the low and high 'limits' or 'boundaries' rather than a single scalar annotation.



Precise Search

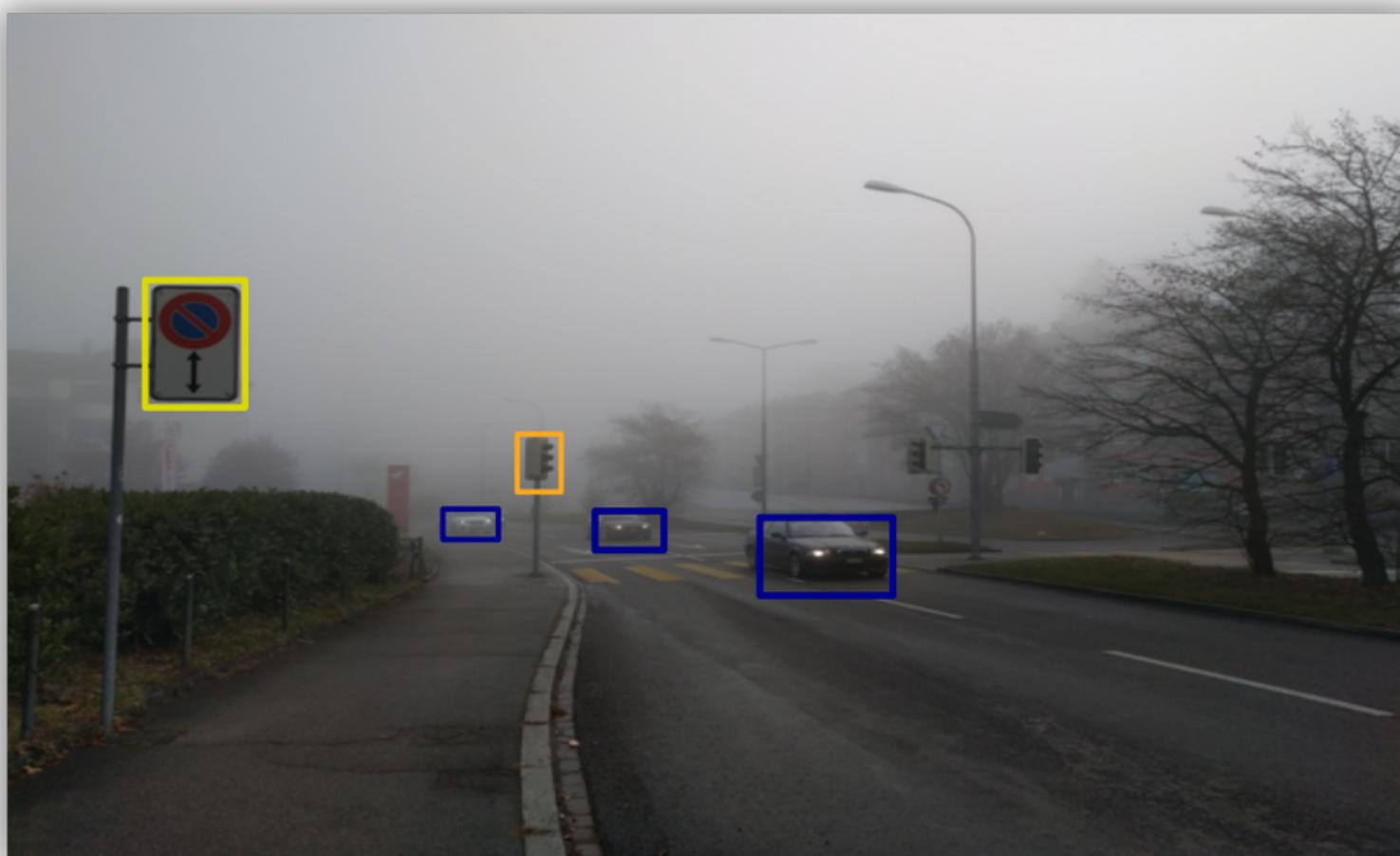
Annotators are presented with **global grounding** to identify the general region for annotation, and **local comparison** for locality-specific precision.



Other target domains suffer from the same problems!

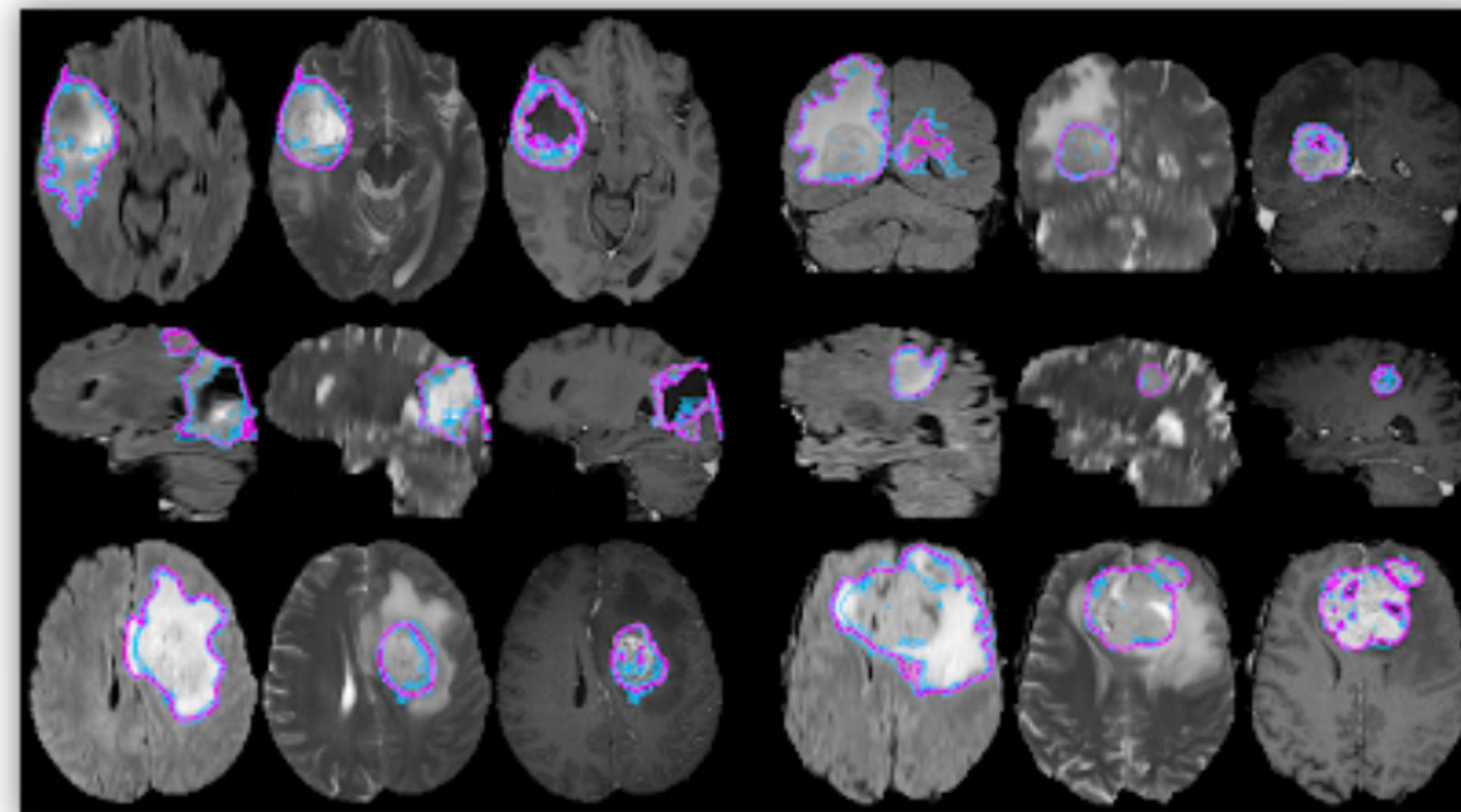
- Segmentation mask target (e.g. semantic segmentation)
- Text target (e.g. translation)
- Discrete target (e.g. categorization)

Semantic Seg. Examples



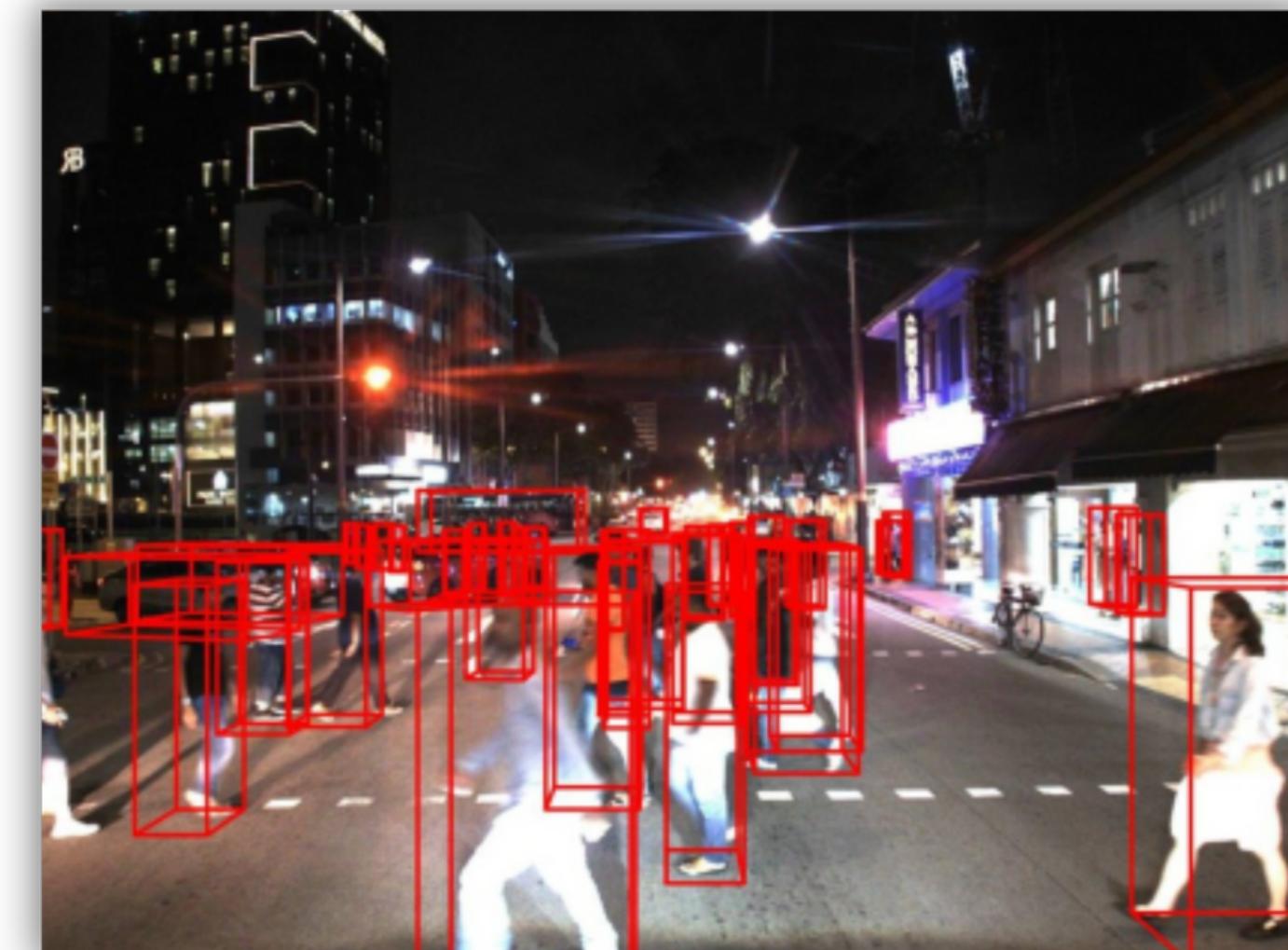
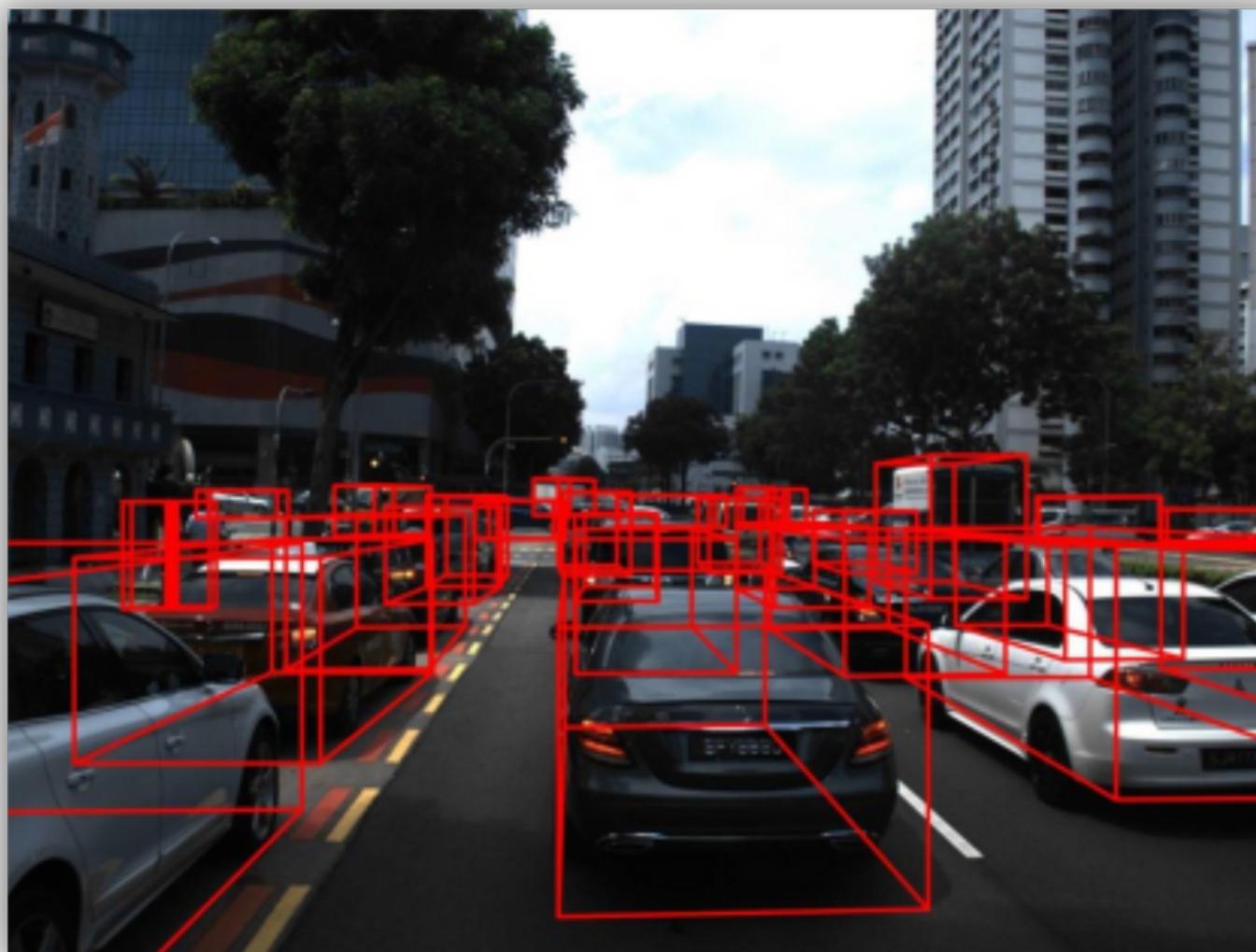
Foggy Cityscapes Dataset

Semantic Seg. Examples



BraTS (Brain Tumor) Dataset

Semantic Seg. Examples



A*3D Autonomous Driving Dataset

Uncertainty

Existence Uncertainty

Should this marking/segmentation exist at all?

Precision Uncertainty

What is the boundary/shape/region of the marking?



ExDark Dataset – "Motorcycle" Class?

Uncertainty

Existence Uncertainty

Should this
marking/segmentation
exist at all?

Precision Uncertainty

What is the
boundary/shape/region
of the marking?



Foggy Cityscapes – "Sign"/"Pole" or "Tree"?

Uncertainty

Existence Uncertainty

Should this marking/segmentation exist at all?

Precision Uncertainty

What is the boundary/shape/region of the marking?



ExDark Dataset – "Cat" Class

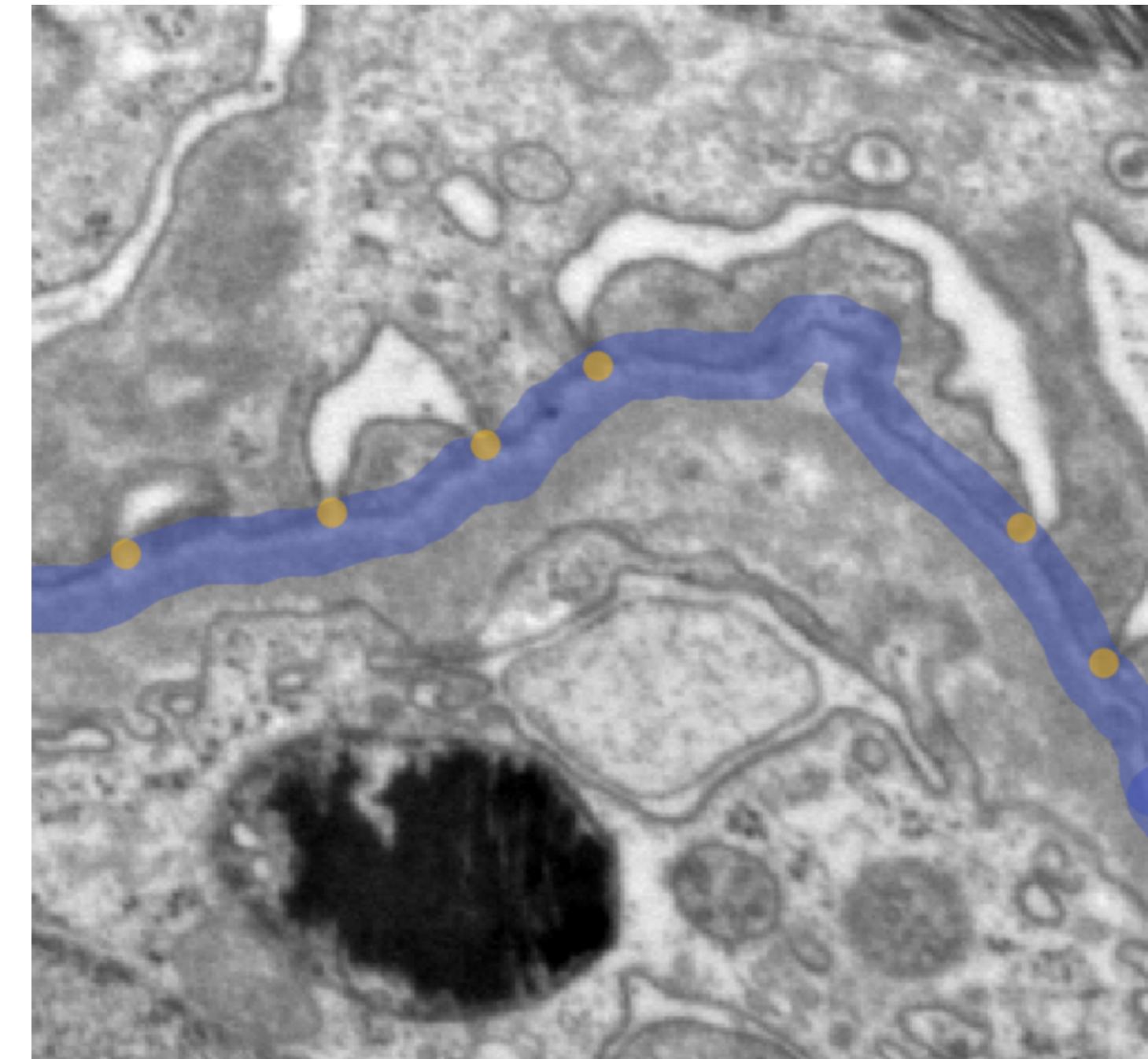
Uncertainty

Existence Uncertainty

Should this marking/segmentation exist at all?

Precision Uncertainty

What is the boundary/shape/region of the marking?



Internal UW Medicine Dataset – Kidney Cells

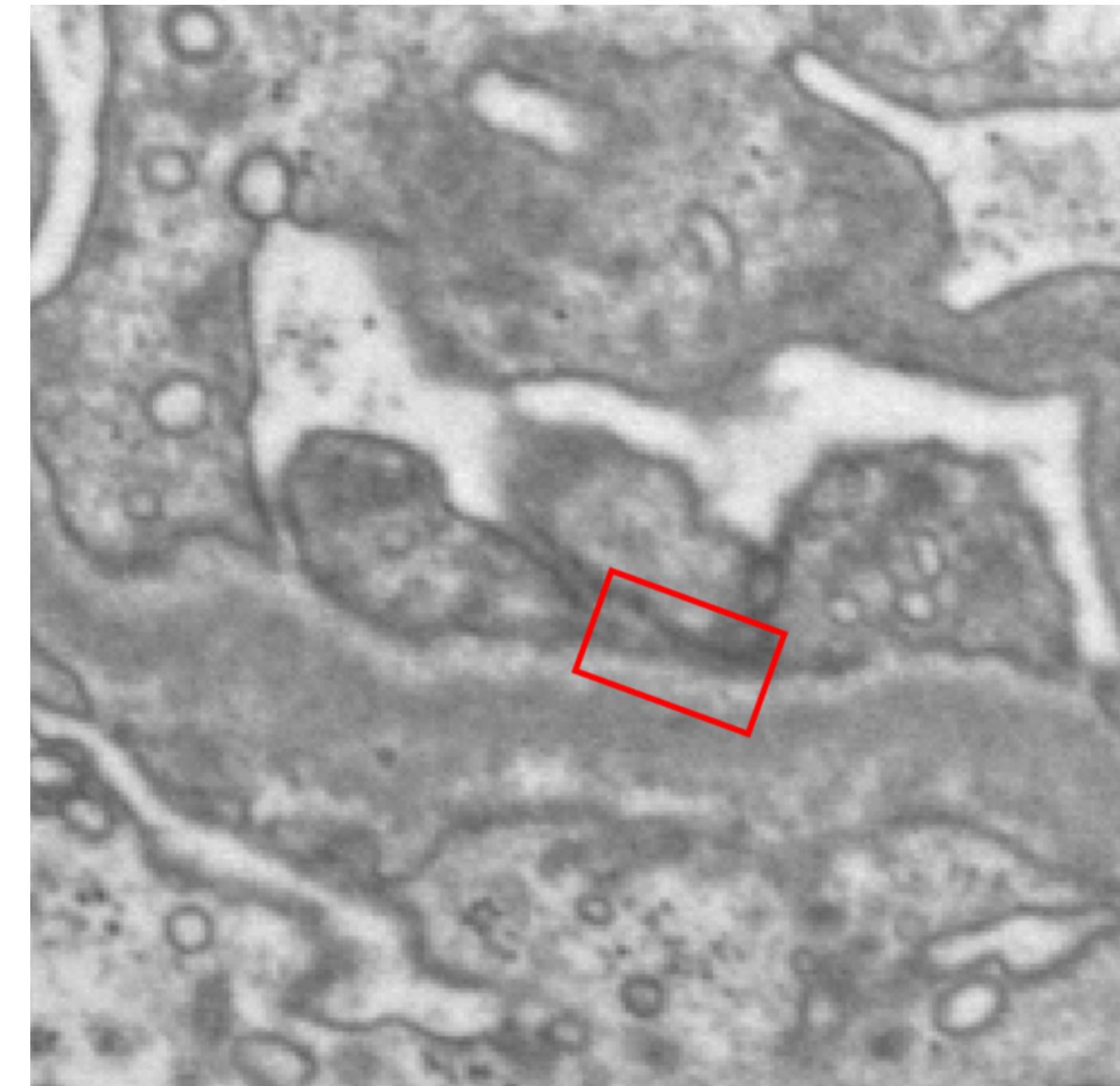
Uncertainty

Existence Uncertainty

Should this marking/segmentation exist at all?

Precision Uncertainty

What is the boundary/shape/region of the marking?



Internal UW Medicine Dataset – Kidney Cells

Importance of Addressing Uncertainty in Semantic Seg.

- Enable richer representation of visual ambiguity; make the ground truth more like the 'truth'
- Improve model performance and robustness for minority classes and in high-precision & ambiguous environments
 - Facial recognition for dark faces/scenes
 - Medical datasets
 - Challenging autonomous driving scenes

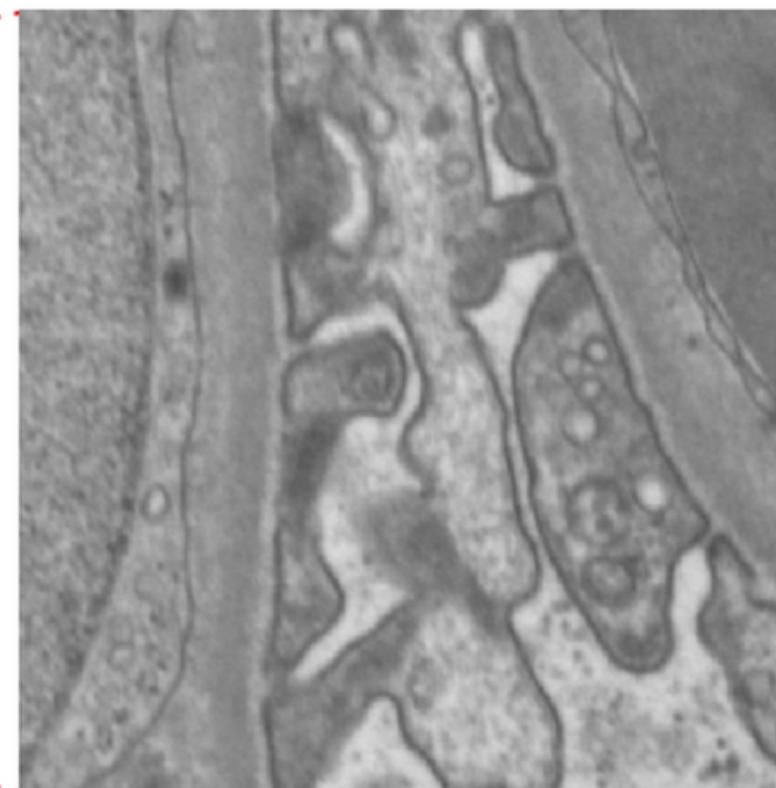
Unique Challenges

Image target domains are much more high-dimensional than scalar target domains.

- What is a 'bound'?
- Many different ways to annotate (e.g. bounding boxes, pixel-level, etc.)
- Many more factors contributing to uncertainty



Images are large entities. We should break down an image into user-selected patches.

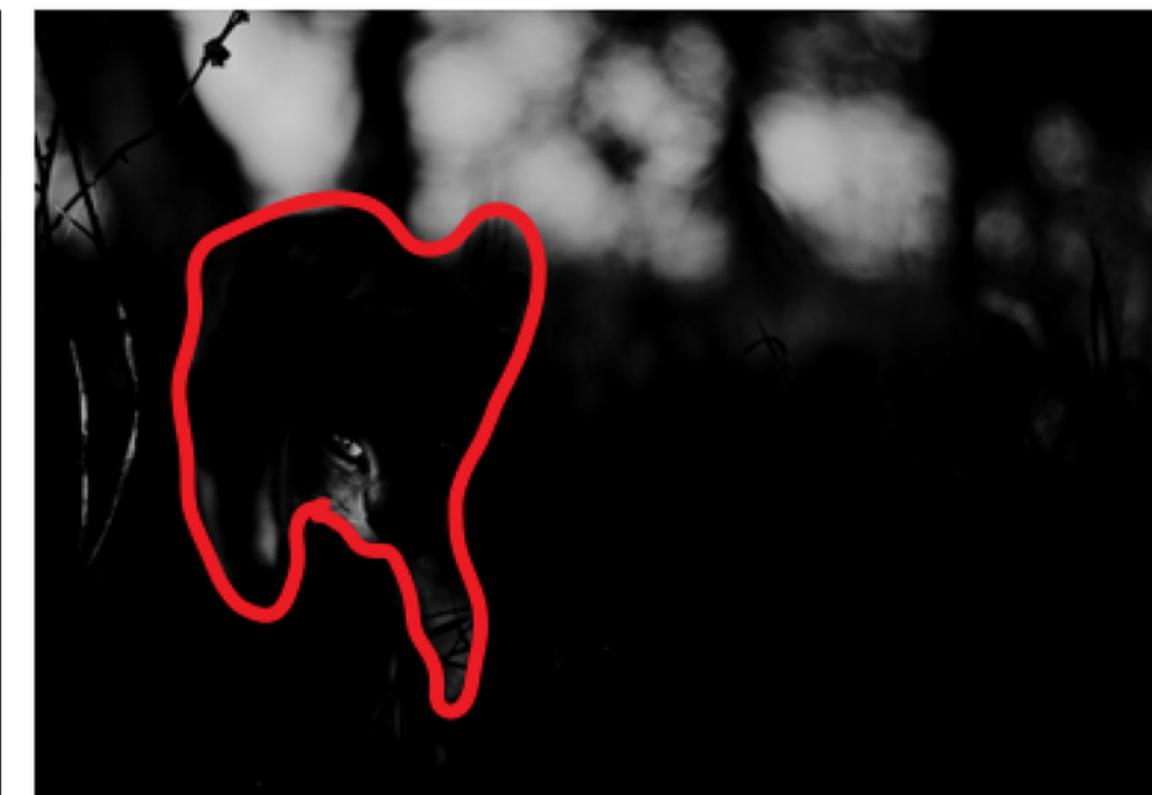
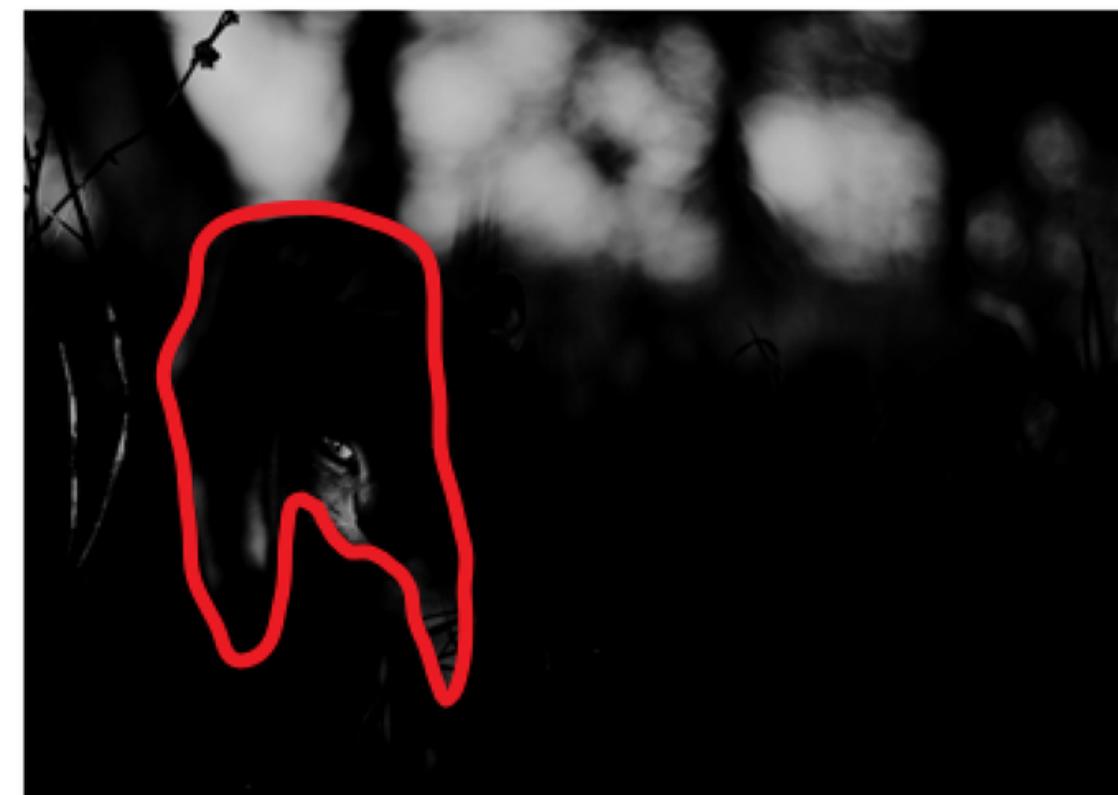


Holistic Representation



- Allow the annotator to draw multiple linked annotation hypotheses for the same object
- New hypotheses can be derived by 'morphing' the existing hypothesis
- Act as 'bounds' that can be interpolated between

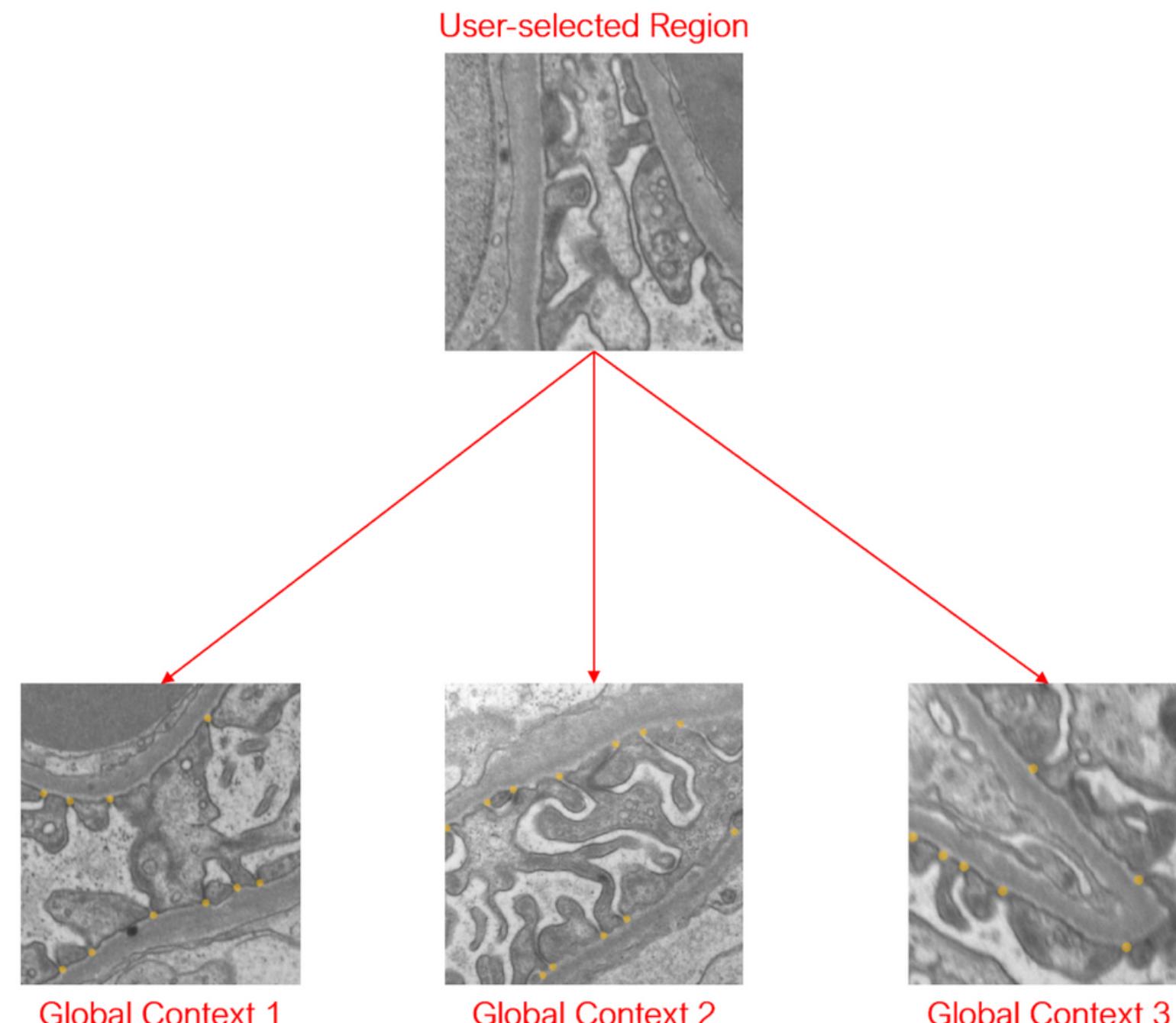
Holistic Representation



Example 'morphing' to mark multiple possible hypotheses

Images: ExDark (Exclusively Dark) Dataset

Precise Search



Global Grounding

Each user-selected region is compared to other regions that have *similar image content* but *varying annotations*.

Local Grounding

Each user-selected region is compared to other regions that have *similar image content* and *similar annotations*.

Thanks!
