



# Active Learning Meets Foundation Models: Fast Remote Sensing Data Annotation for Object Detection

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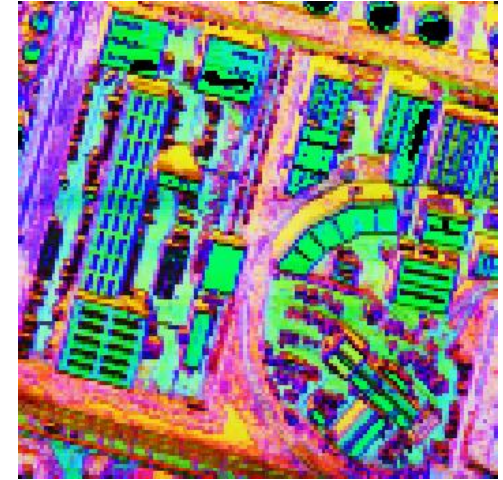
Dalton Lunga, ORNL

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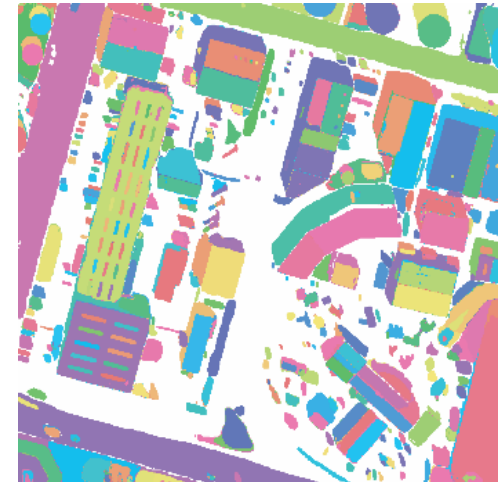
# Motivation: Foundation Models are powerful

- Feature Extractors (FM-FE):
  - ResNet, DINOv3, ...
  - Strong features
  - But no bounding boxes
- Proposal Generators (FM-PG):
  - Segment Anything
  - Good Masks
  - Weak features
- Labeling new data is expensive  
→ Combine both with AL

Feature Extractors

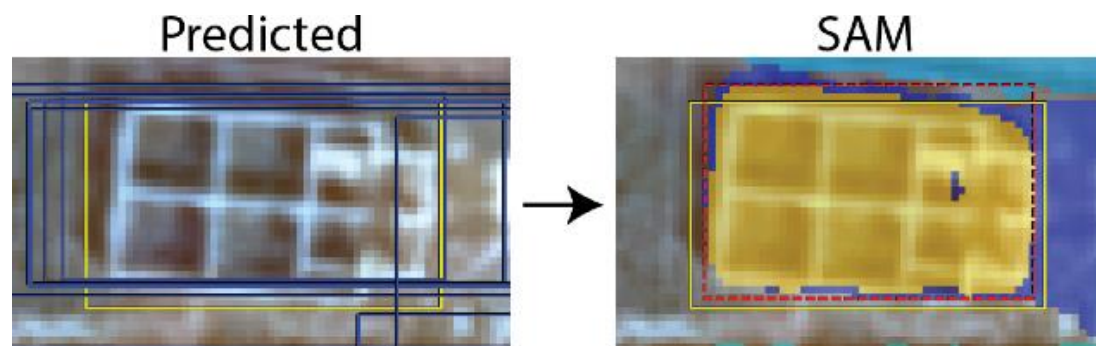


Proposal Generators

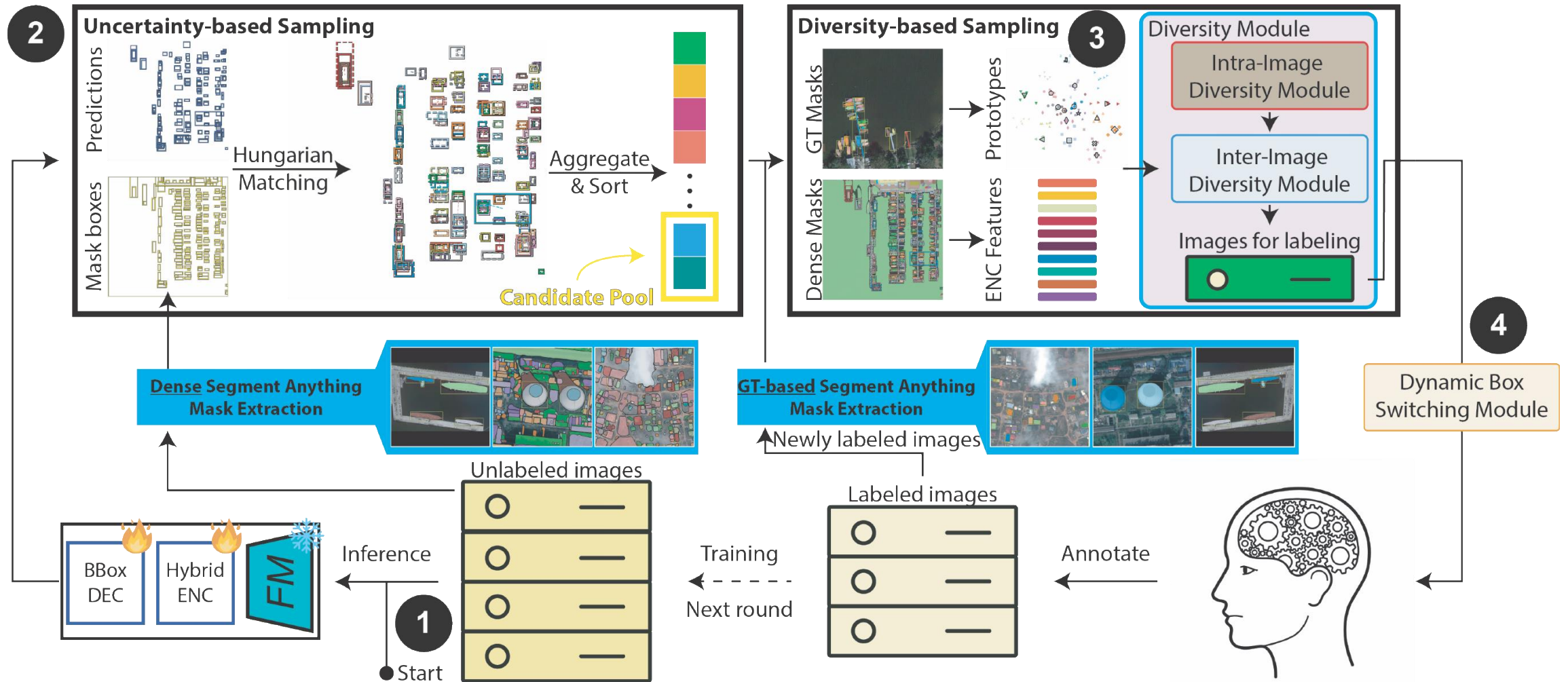


# Key Contributions

- Combine Foundation Models with AL
  - Reduce annotation effort by leveraging pretrained knowledge
- Dual Source Uncertainty (FM-PG + Detector)
  - Integrate proposals from the FM-PG and the detector predictions
- Mask-Guided Diversity (FM-PG + FM-FE)
  - Ensures diverse and informative samples
- Dynamic Box Switching (FM-PG)
  - Combats cold-start issues



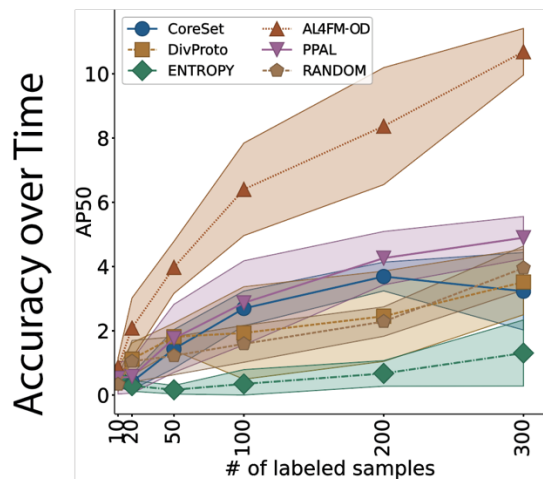
# Method Overview



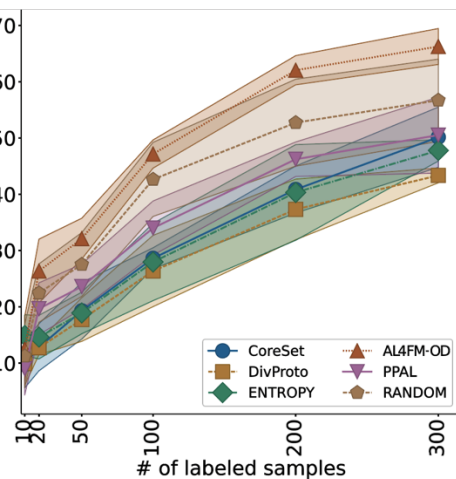


# Key Results

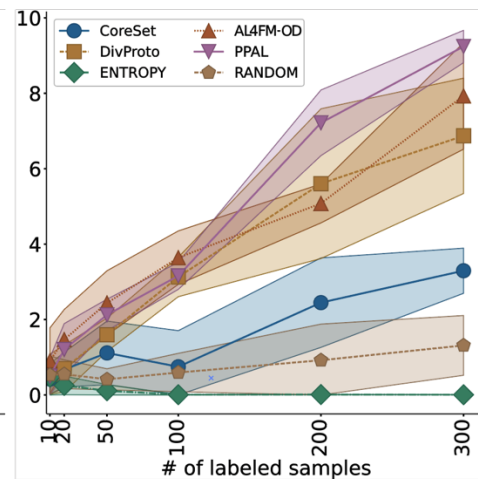
DIOR



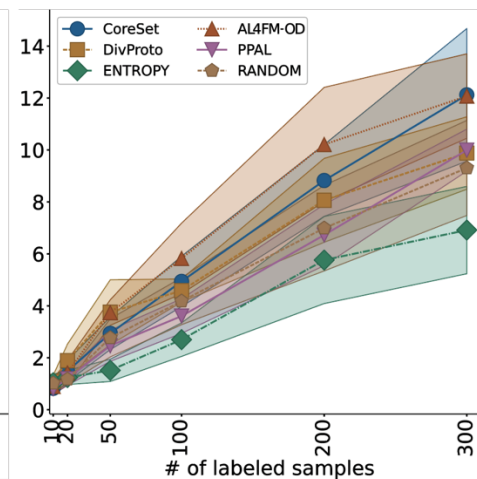
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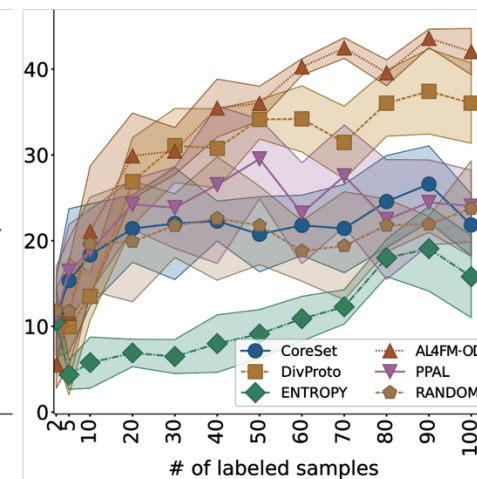
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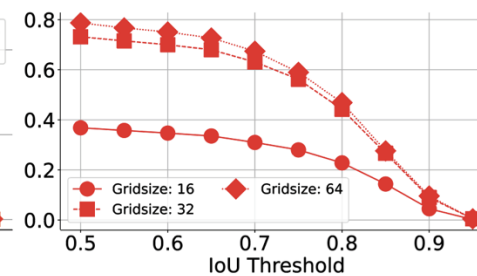
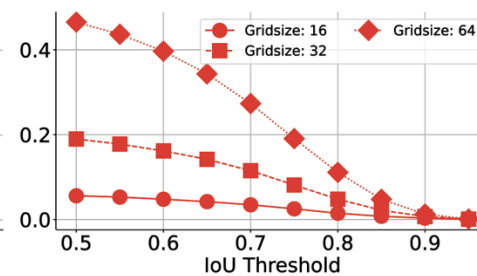
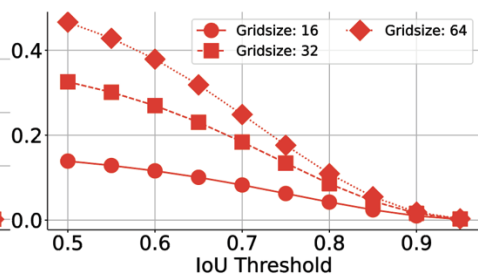
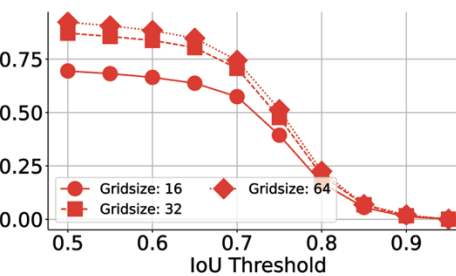
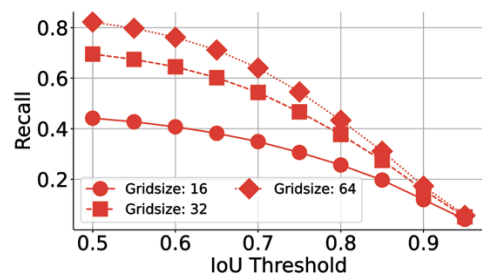
FAIR1M



Waffle Homes

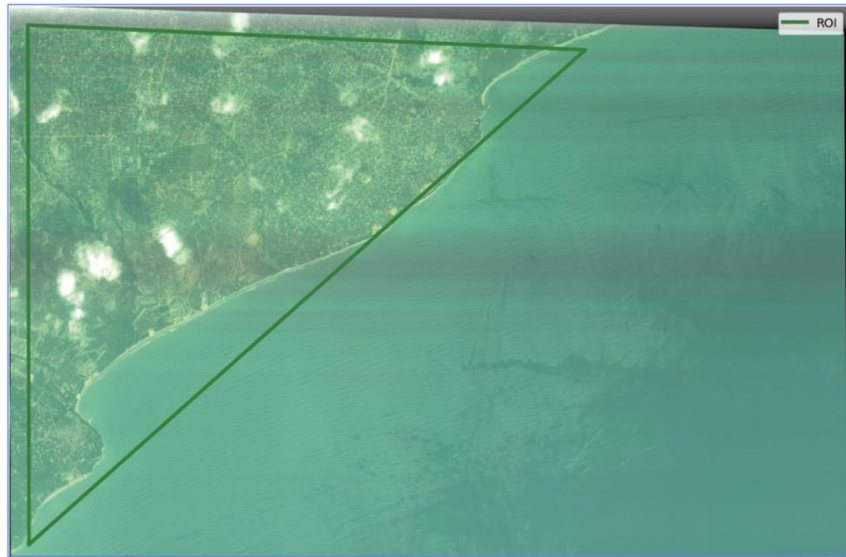


SAM Recall



# User Interface & User Study

## Area of Interest



## User Interface



## User Study Results

### Interaction Results

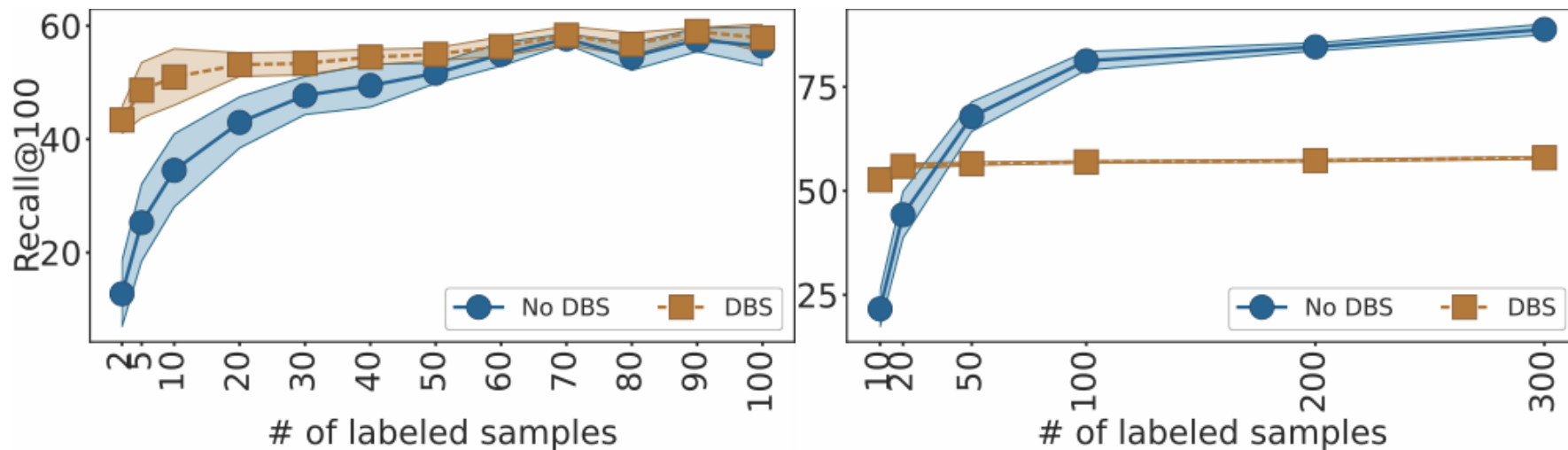
	Random	Ours
Avg. # of image annotated	10.67	<b>11.75</b>
Avg. # of accepted boxes	13.33	<b>51.75</b>
Avg. # of drawn boxes	196	<b>185</b>
Avg. total annotations	209	<b>235</b>

### Final Dataset Results

	Random	Ours
AP <sub>50</sub>	0.28±0.03	<b>0.34±0.04</b>
AP <sub>75</sub>	0.11±0.05	<b>0.17±0.05</b>
AR <sub>100</sub>	0.35±0.04	<b>0.43±0.03</b>

# Limitations

Dynamic Box Switching Module



SAM Segmentation

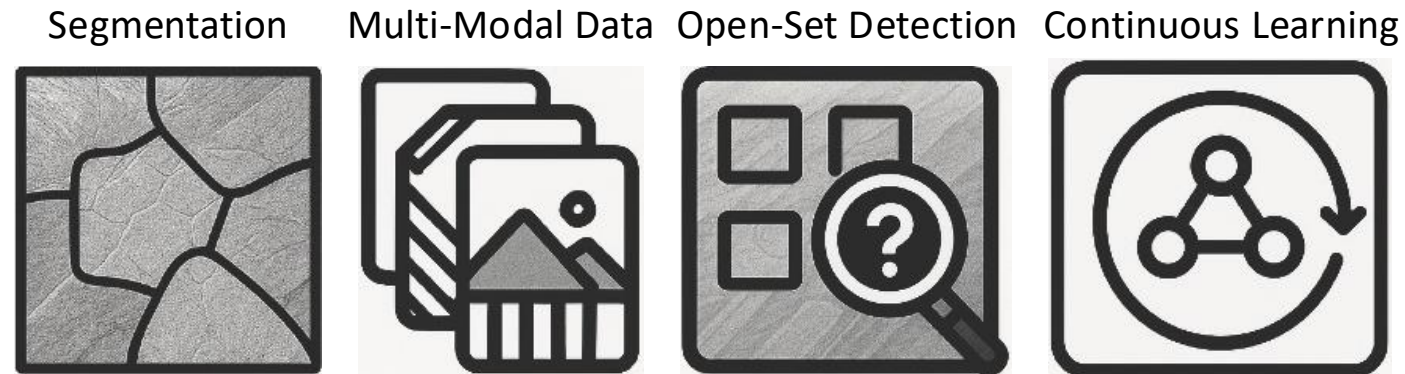




# Conclusion & Future Work

- Foundation models can reduce annotation needs
- Mask-Guided diversity sampling beats box-based sampling
- Dynamic Box Switching handles cold start well
- User study confirms less effort and higher annotation quality

## Future Work







GeoAI Group



CVL



GitHub



# Thank you

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