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TarViS: A Unified Approach for Target-based Video Segmentation

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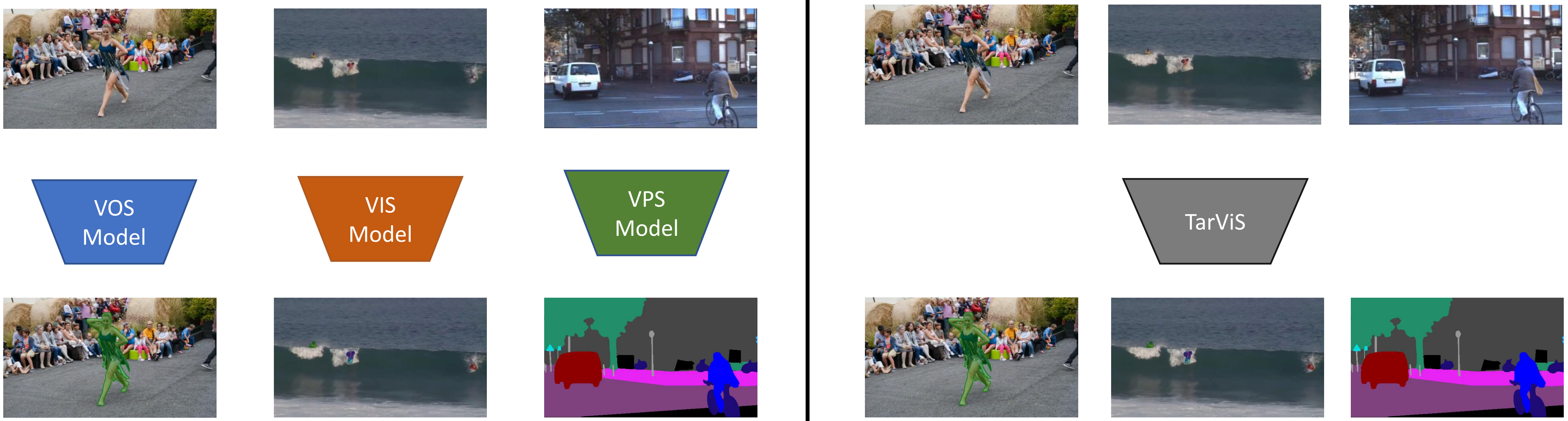
THU-AM-216

RWTH AACHEN UNIVERSITY

Carnegie Mellon University

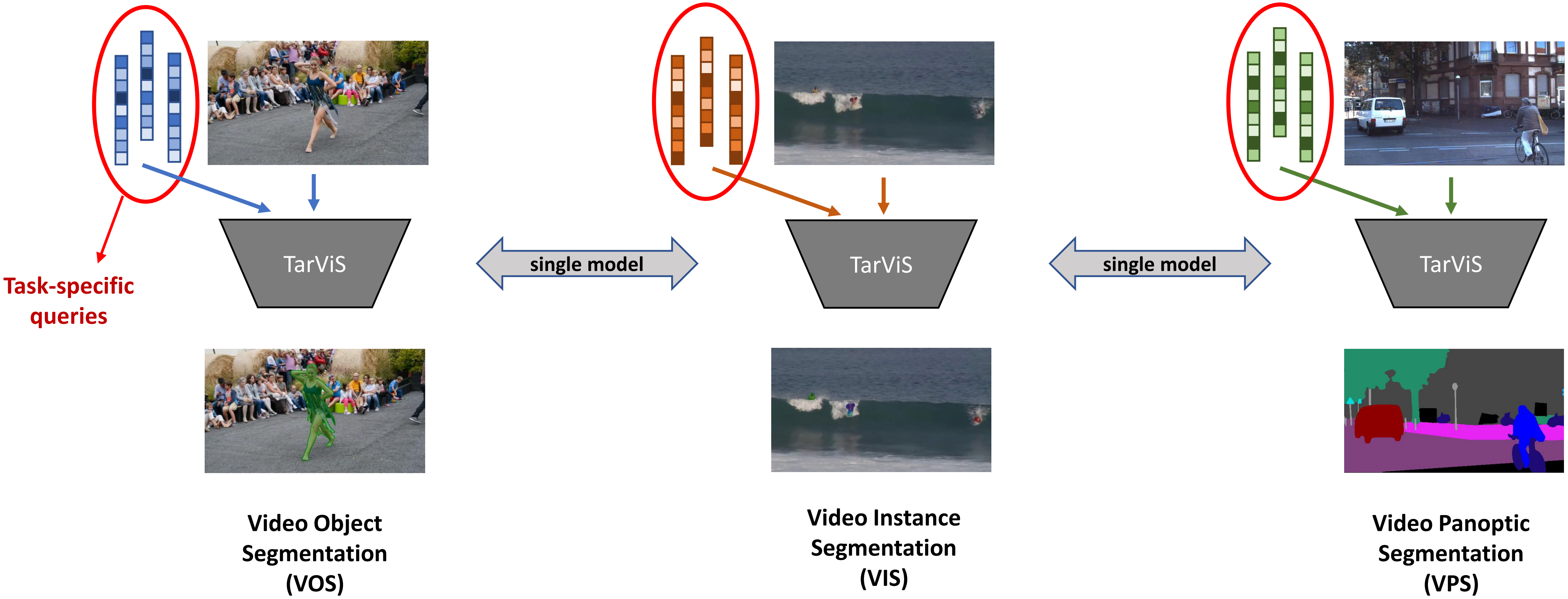
BEFORE ☹   NOW ☺



BEFORE: Video Object Segmentation (VOS) | Video Instance Segmentation (VIS) | Video Panoptic Segmentation (VPS)

NOW: Video Object Segmentation (VOS) | Video Instance Segmentation (VIS) | Video Panoptic Segmentation (VPS)

Overview



Task-specific queries
TarViS
single model
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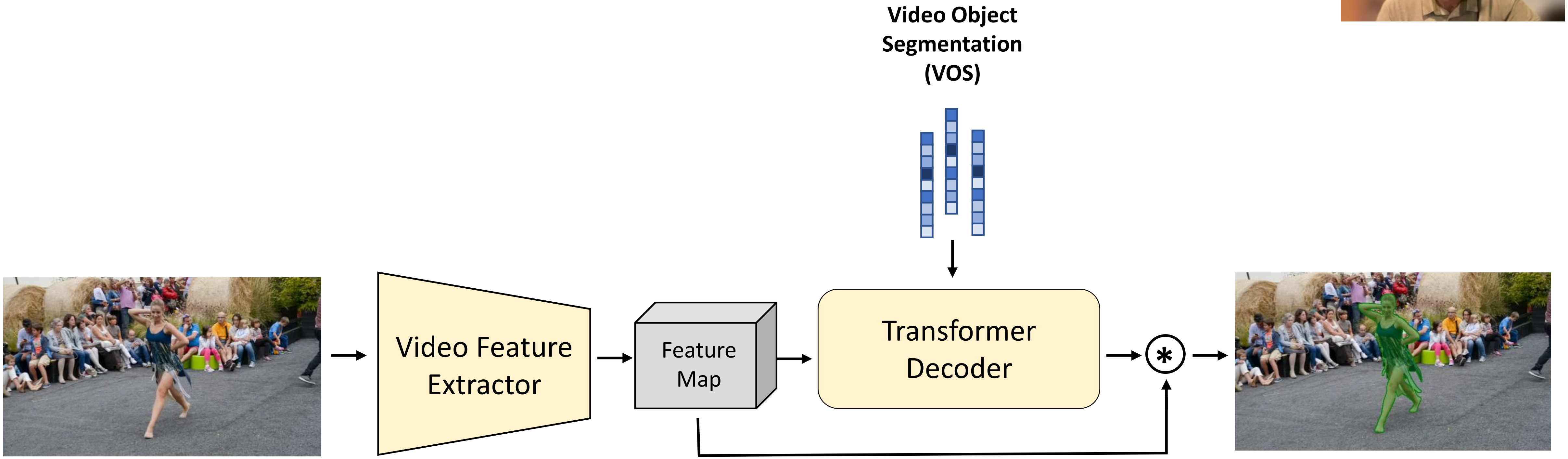
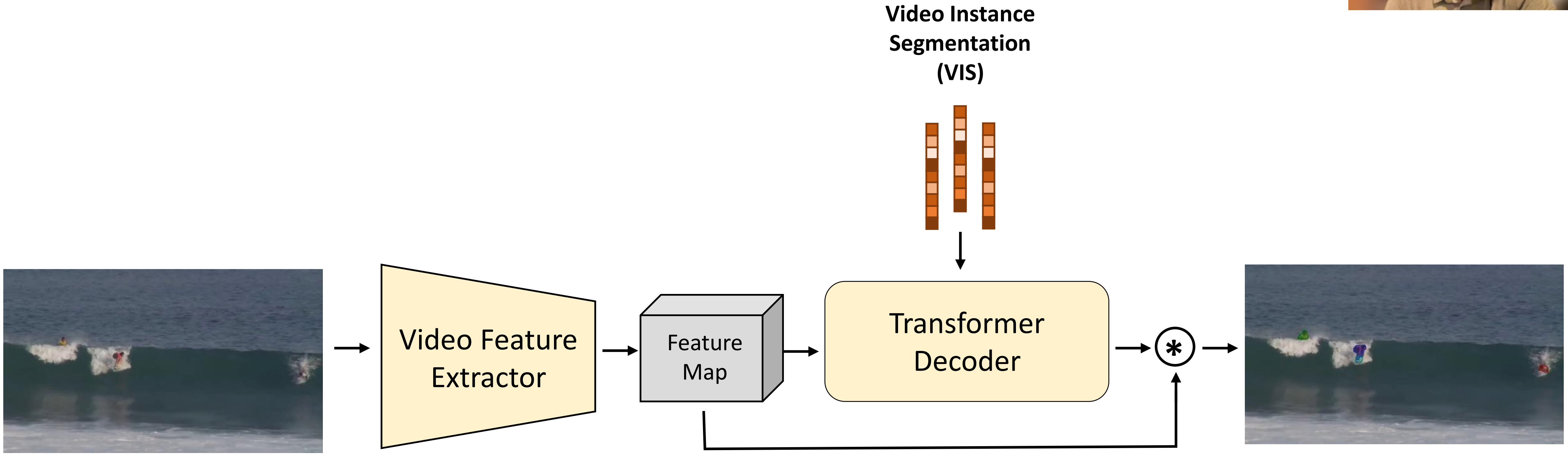
single model
TarViS
Video Object Segmentation (VOS)
Video Instance Segmentation (VIS)
Video Panoptic Segmentation (VPS)

Overview


Video Object
Segmentation
(VOS)
Video Feature
Extractor
Feature
Map
Transformer
Decoder
*

Overview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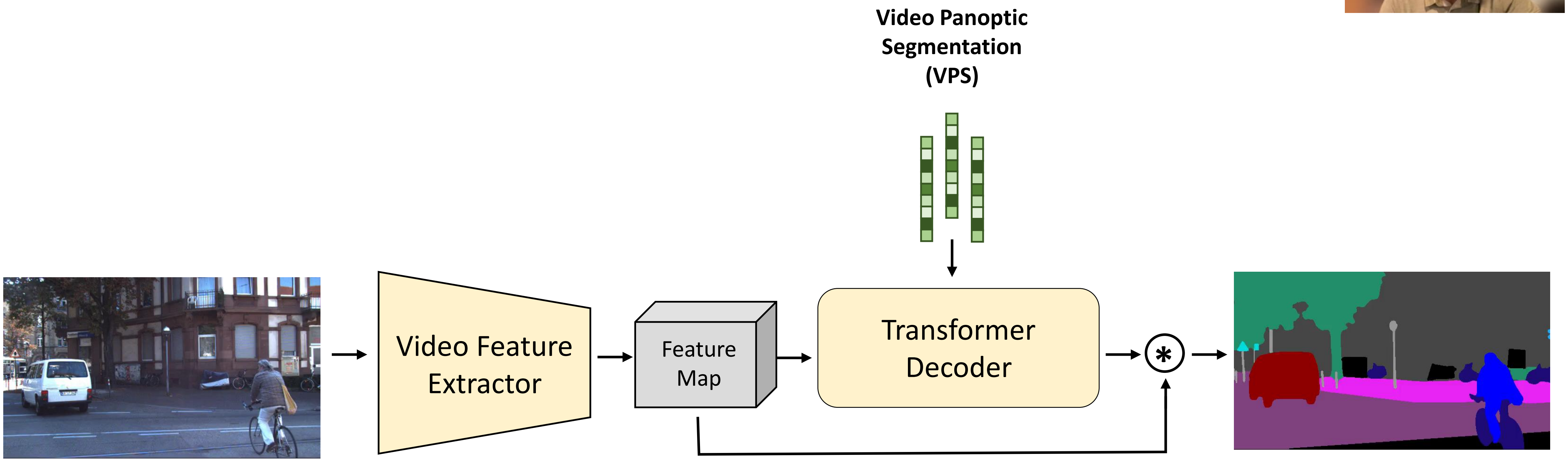

Video Panoptic
Segmentation
(VPS)
Video Feature
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Overview

Video Object Segmentation (VOS)

1. DAVIS

Video Instance Segmentation (VIS)

3. YouTube-VIS
4. OVIS

Point Exemplar-guided Tracking (PET)

2. BURST

Video Panoptic Segmentation (VPS)

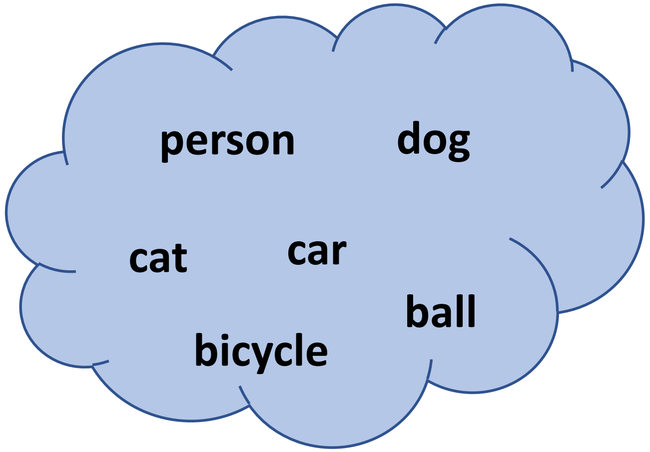
5. KITTI-STEP
6. CityscapesVPS
7. VIPSeg

Unified Task Definition

- Video segmentation tasks can be conceptually unified
- All of them require segmenting a set of ‘targets’ from the input video

- <u>Video Instance Segmentation:</u>

All objects belonging to these classes…



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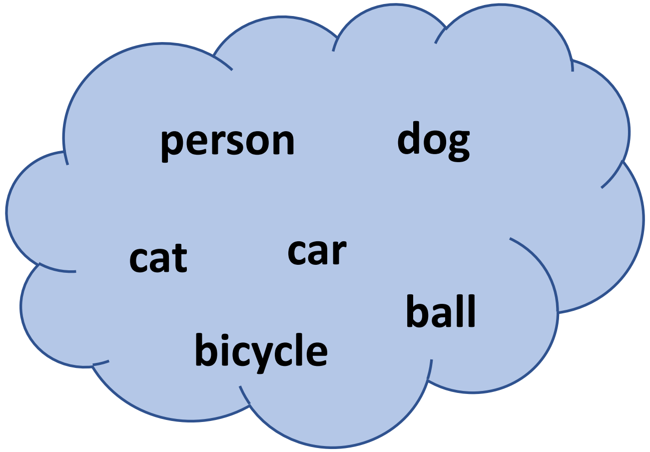
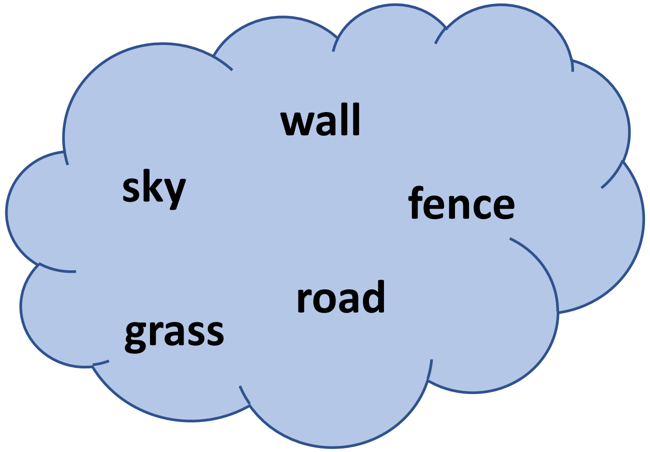


thing classes

All parts of the…



stuff classes

Unified Task Definition

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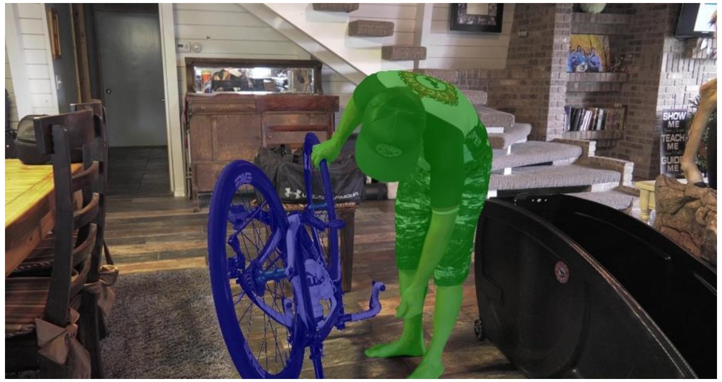
- <u>Video Object Segmentation (VOS):</u>

These specific objects with the first-frame masks…

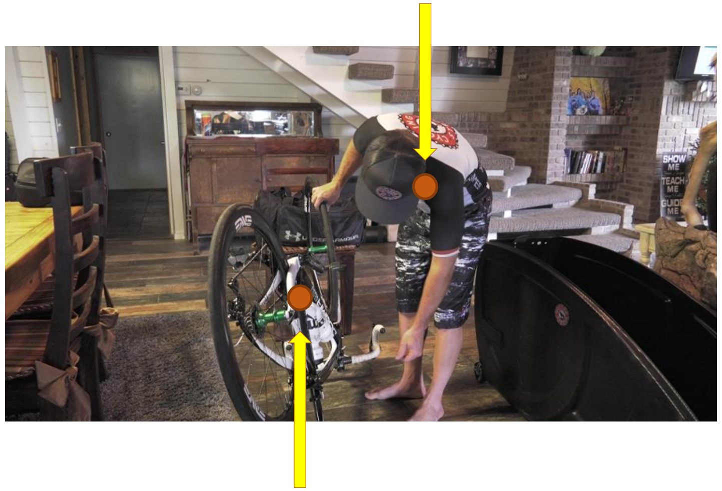


Unified Task Definition

- Video segmentation tasks can be conceptually unified
- All of them require segmenting a set of ‘targets’ from the input video

- <u>Point Exemplar-guided Tracking:</u>

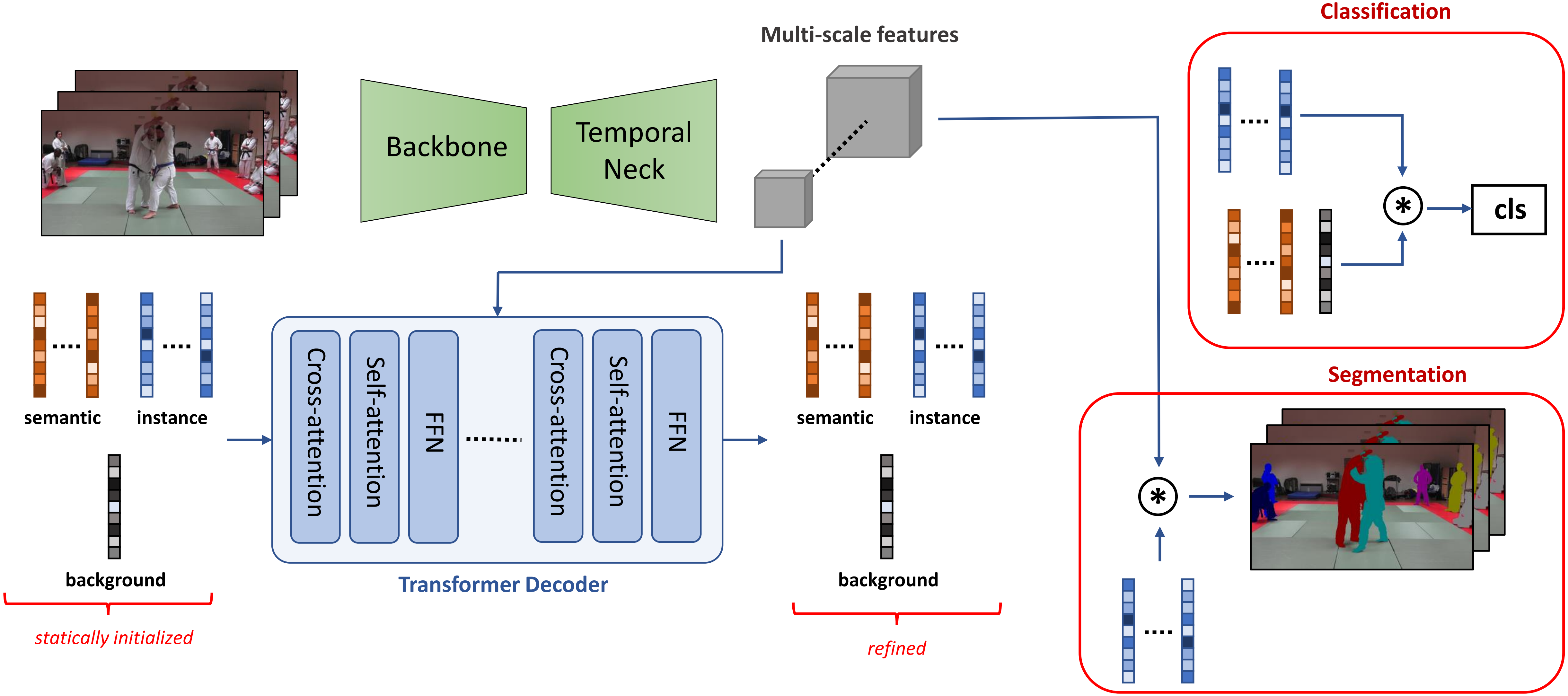
These specific objects with the first-frame points…



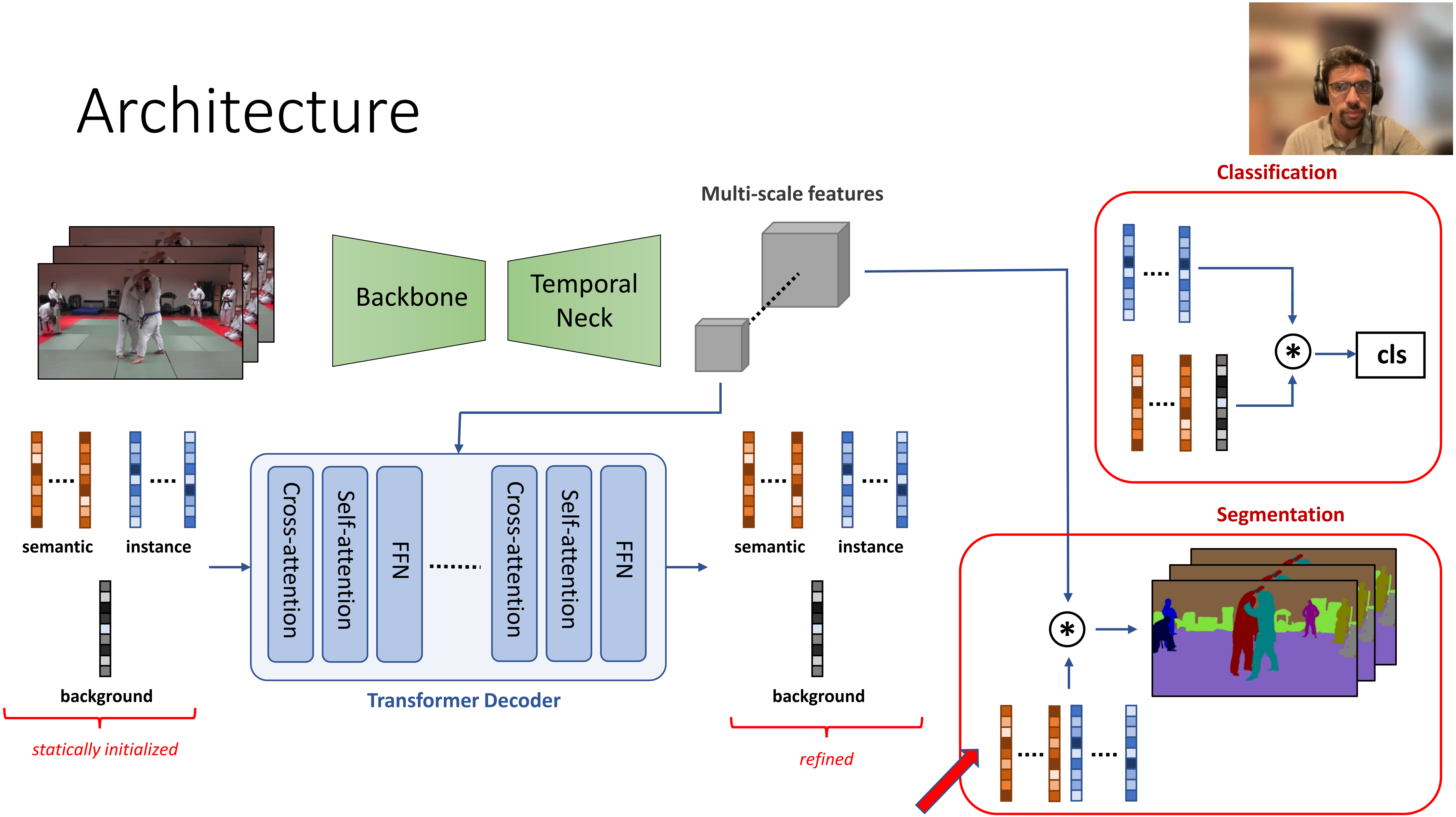
Unified Task Definition

- Architecture is largely task-agnostic
- Encode the task-specific targets as dynamic network inputs (queries)
- Can theoretically tackle any segmentation task

Architecture



Architecture



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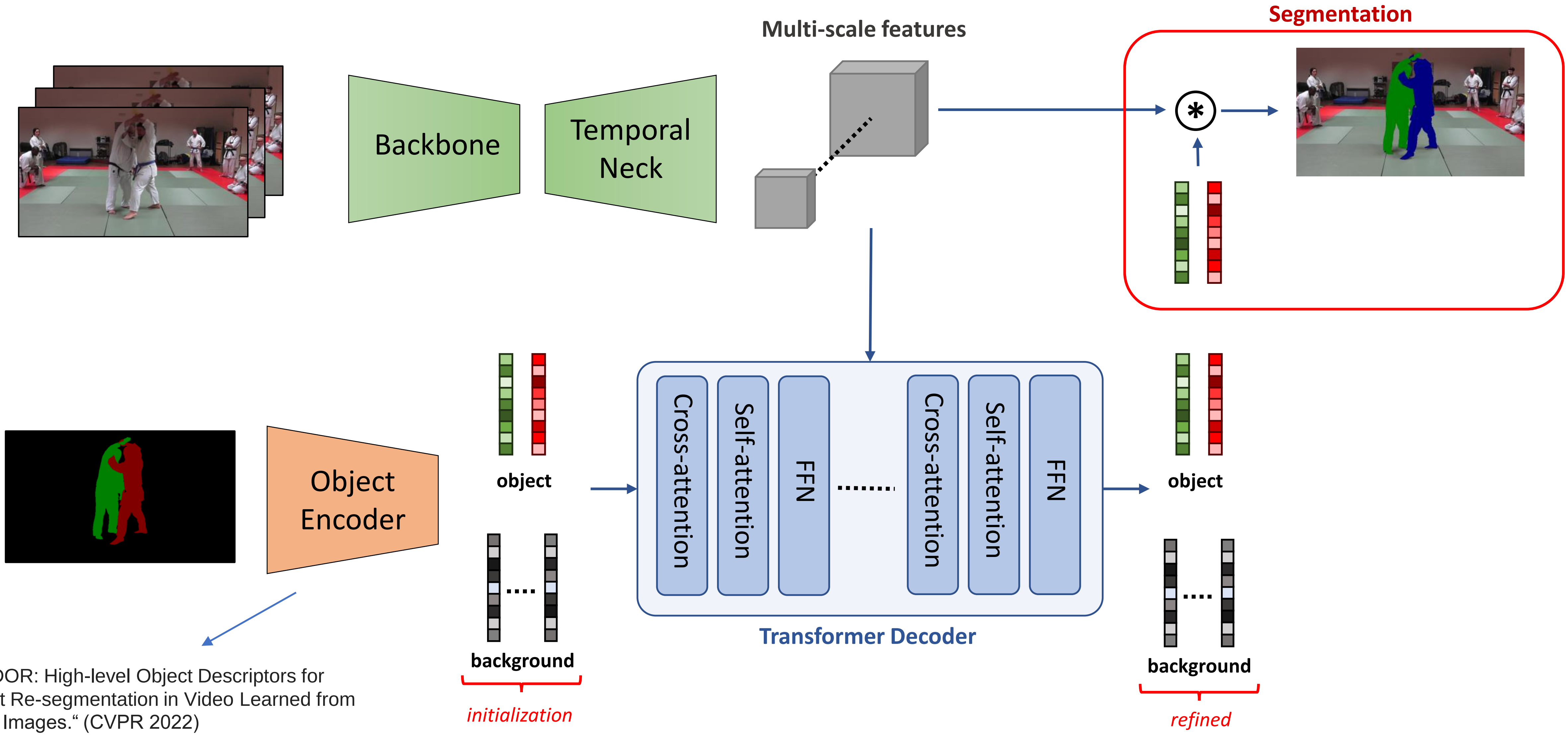
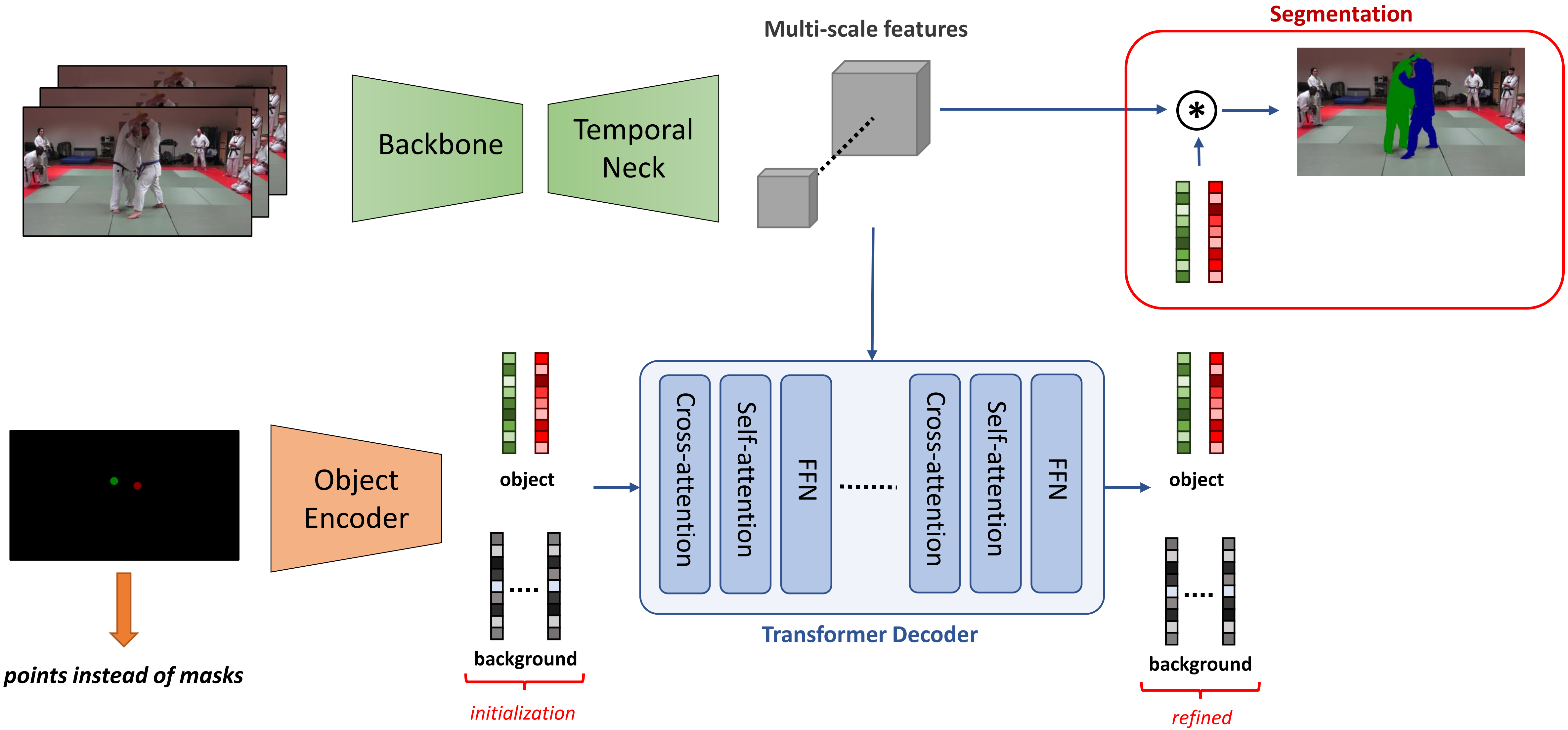


"HODOR: High-level Object Descriptors for Object Re-segmentation in Video Learned from Static Images." (CVPR 2022)

Architecture



Temporal Neck

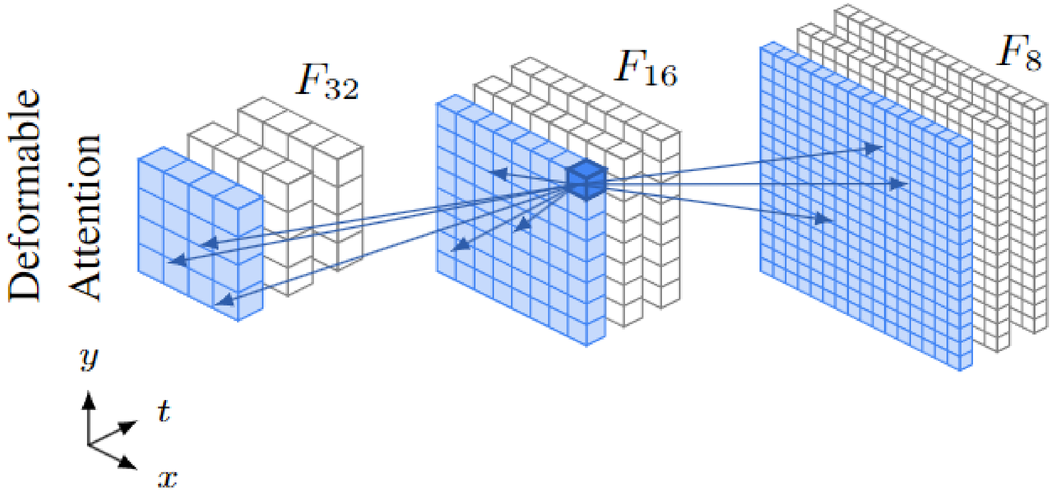
- Masks generated by computing dot-product
- Good mask quality conditioned on consistent video features
- Backbone: Per-image network e.g. ResNet or Swin
- Motivation for temporal neck: incorporate temporal context in video features

Temporal Neck

- Based on deformable deformable attention encoder
- Multi-scale features from backbone are iteratively refined
- Contains 6 layers. Each layer contains two parts:

1. Deformable attention separately within each image frame

2. Self-attention within grid-like cells across all frames



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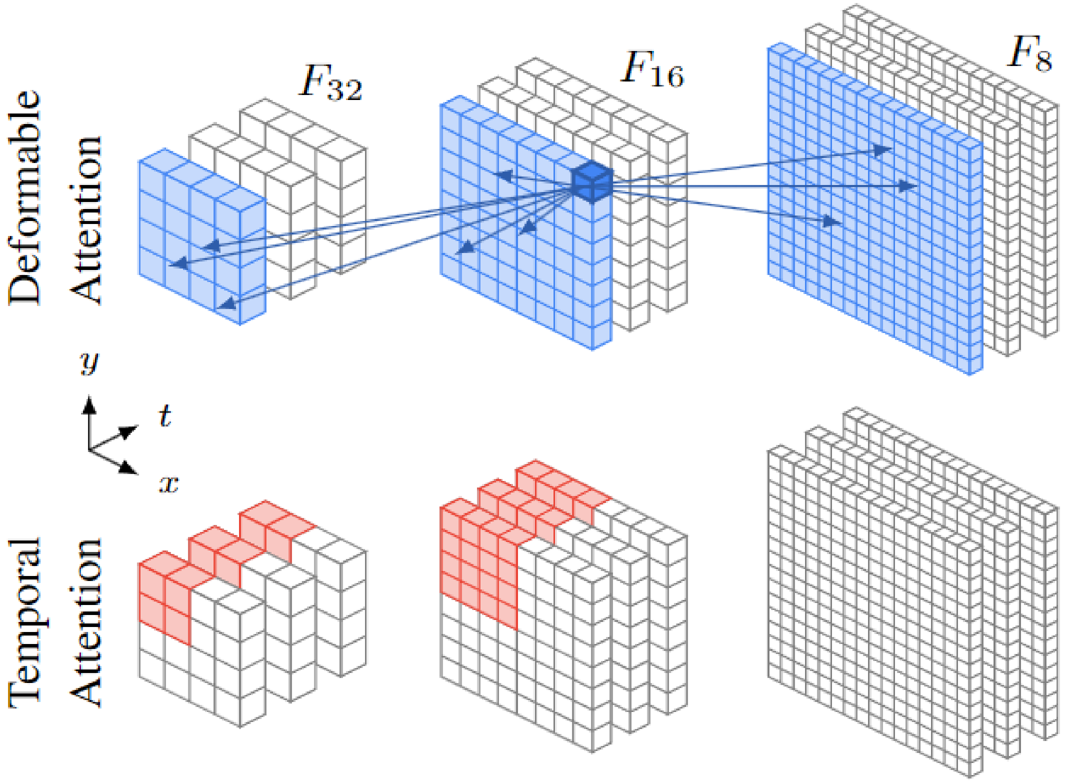

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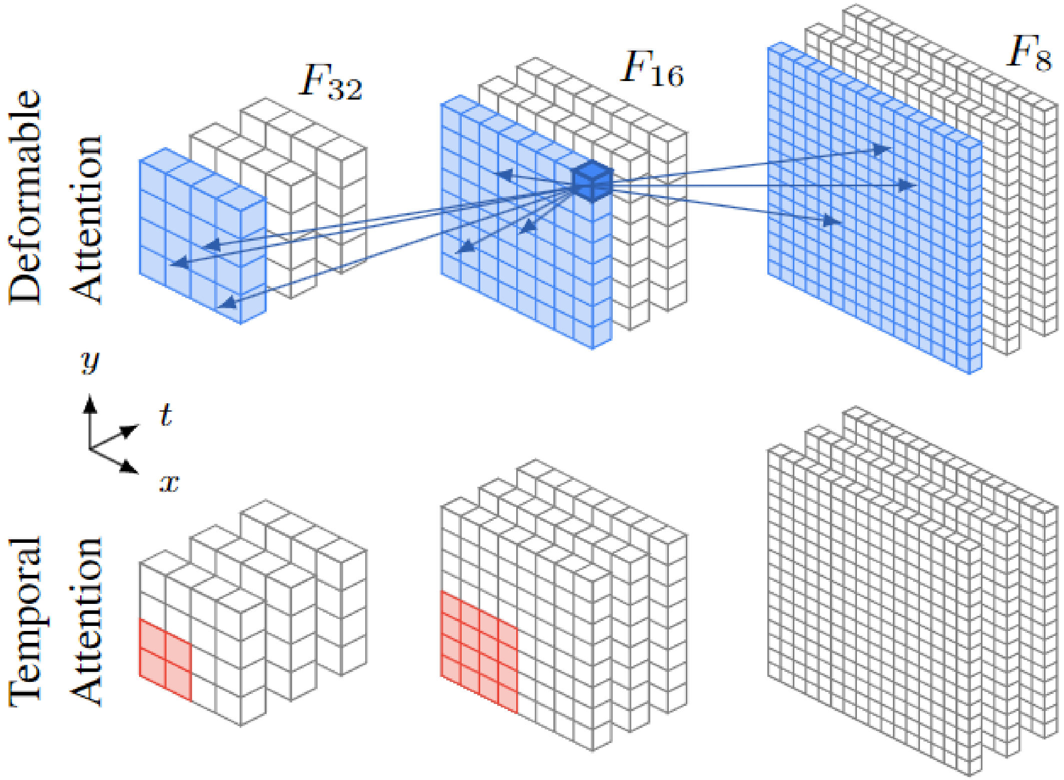

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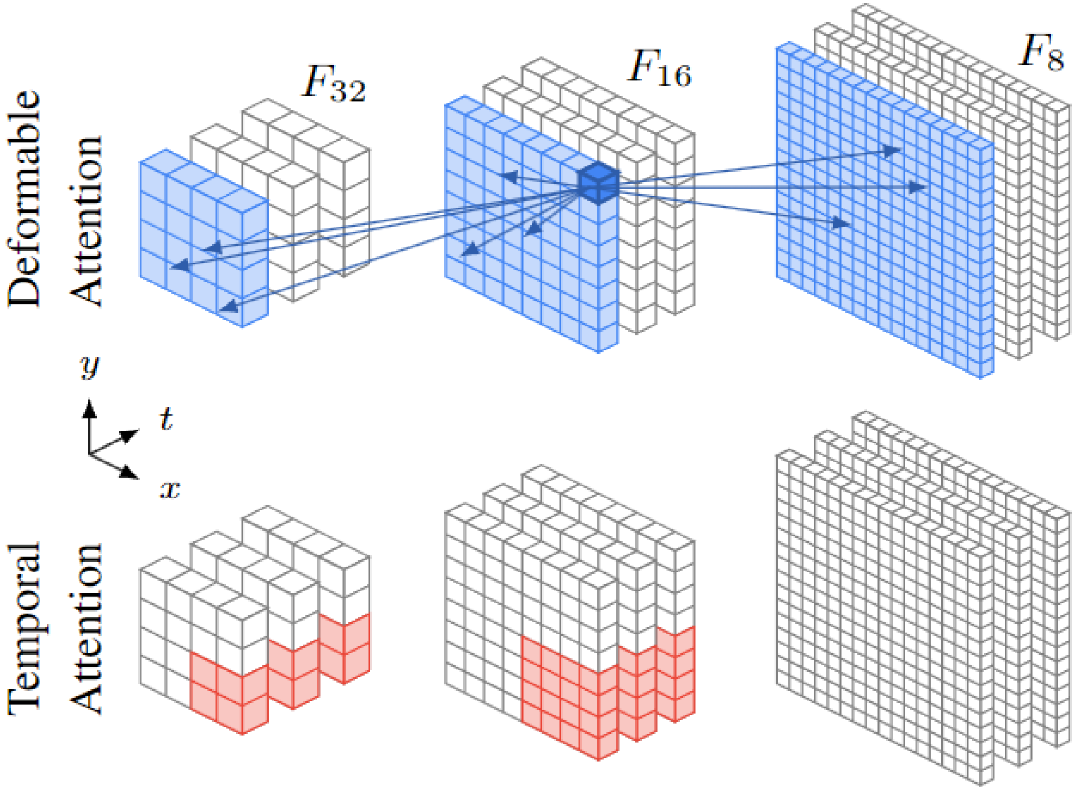


Benchmark Results

Video Instance Segmentation (VIS)

YouTube-VIS 2021 (val)

Method	AP	AP50	AP75	AR1	AR10
VITA	57.5	80.6	61.0	47.7	62.6
TarViS	60.2	81.4	67.6	47.6	64.8
Difference	+2.7	+0.8	+6.6	-0.1	+1.8

OVIS (val)

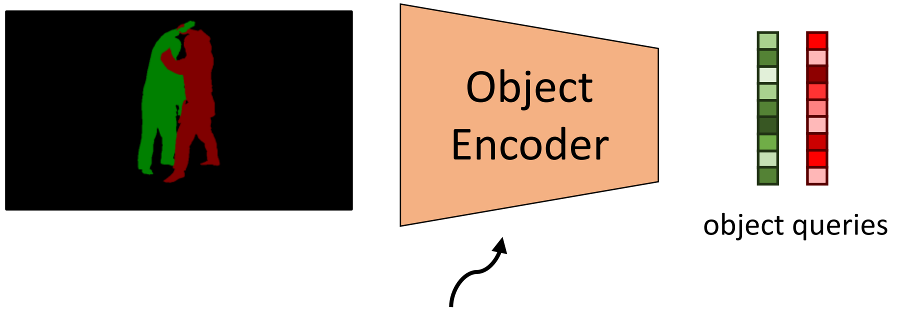
Method	AP	AP50	AP75	AR1	AR10
IDOL	42.6	65.7	45.2	17.9	49.6
TarViS	43.2	67.8	44.6	18.0	50.4
Difference	+0.6	+2.1	-0.8	+0.1	+0.8

Benchmark Results

Video Object Segmentation (VOS)

DAVIS (val)

Method	J&F	J	F
XMem	86.2	82.9	89.5
TarViS	85.3	81.7	88.5
Difference	-0.9	-1.2	-1.0



Benchmark Results

Point Exemplar-guided Tracking (PET)

BURST (val)

Method	$HOTA_{all}$	$HOTA_{com}$	$HOTA_{unc}$
STCN+M2F	24.4	44.0	19.5
TarViS	37.5	51.7	34.0
Difference	+12.9	+7.7	+14.5

BURST (test)

Method	$HOTA_{all}$	$HOTA_{com}$	$HOTA_{unc}$
STCN+M2F	24.9	39.5	22.0
TarViS	36.1	47.1	33.8
Difference	+11.2	+7.6	+11.8

Benchmark Results

Video Panoptic Segmentation (VPS)

KITTI-STEP (val)

Method	STQ	AQ	SQ
Mask Propagation	67.0	63.0	71.0
TarViS	72.0	72.0	73.0
Difference	+5.0	+9.0	+2.0

CityscapesVPS (val)

Method	VPQ	VPQ^{th}	VPQ^{st}
VIP-DeepLab	63.1	49.5	73.0
TarViS	58.9	43.7	69.9
Difference	-4.2	-5.8	-3.1

Benchmark Results

Video Panoptic Segmentation (VPS)

VIPSeg (val)

Method	VPQ	VPQ^{th}	VPQ^{st}	STQ
Clip-PanoFCN	22.9	25.0	20.8	31.5
TarViS	48.0	58.2	39.0	52.9
Difference	+25.1	+33.2	+18.2	+21.4

Qualitative Results (OVIS)

Qualitative Results (KITTI-STEP)

Qualitative Results (DAVIS)

Qualitative Results (BURST)

Conclusion

- TarViS: A unified approach for video segmentation tasks
- Network is task-agnostic: formulate task as queries
- High quality results on 7 benchmarks spanning 4 different tasks
- Pre-trained models + source code available on GitHub

https://github.com/Ali2500/TarViS