Panoptic Approach for Image Segmentation

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Introduction:

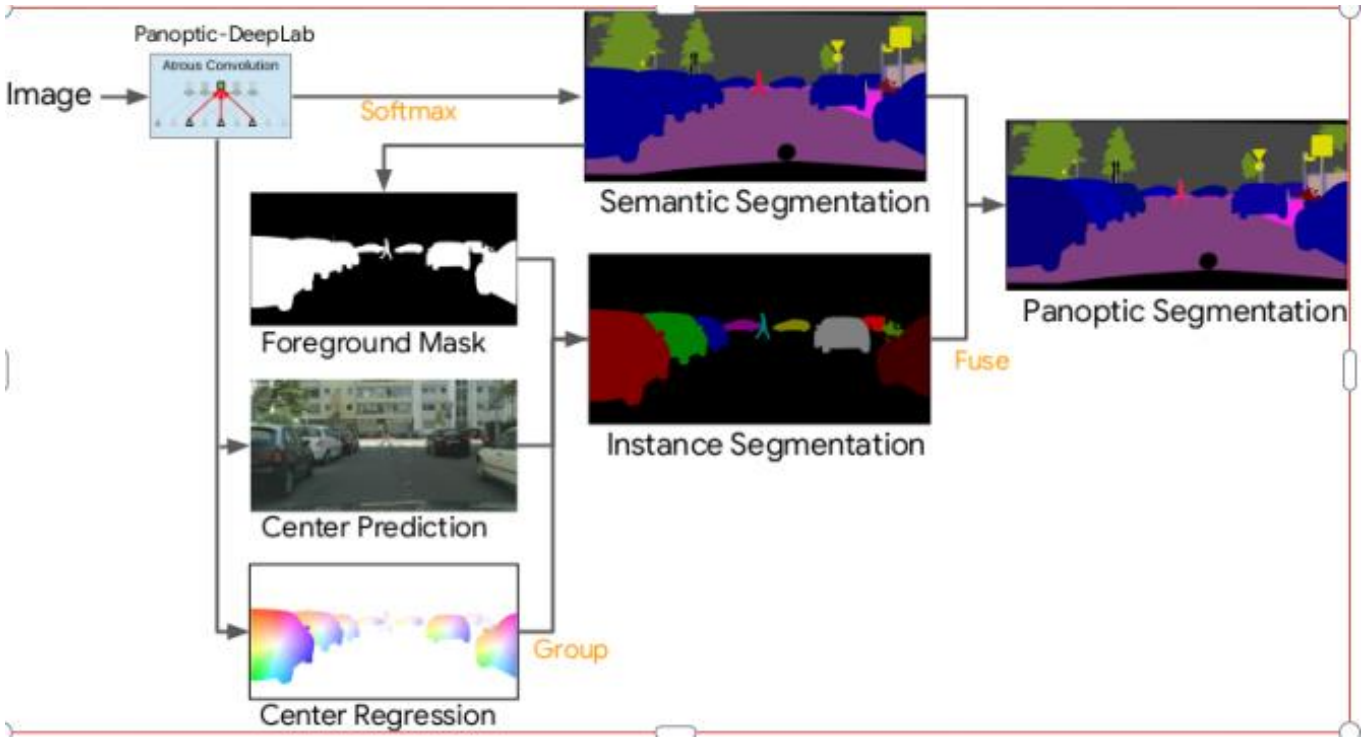
- **Semantic Segmentation**
- Segment instances without boundaries
- Segment every pixel in the input image.

- **Instance Segmentation:**
- Segment instance class with boundaries.
- Segment object in the Region of Interest(ROI)

Introduction:

Panoptic Segmentation

- Every instance that belongs to things like (people, car, etc.) need to be identified (instance segmentation), while every class that belongs to stuff class (sky, road, etc.) needs to be correctly classified (semantic segmentation).



Panoptic Segmentation:

FCN(Fully Convolutional Network) and DC (Dilated Convolution) are widely used in high precision semantic segmentation networks.

Each pixel is classified by producing the output feature map with the same image shape, except the depth channel.

Panoptic Segmentation

- The first part of the network produces class agnostic boxes(ROI), which then will be classified by the second part of the network.
- Box refinement and pixel classification will be applied for each ROI produced by the Region Proposal Network(RPN).

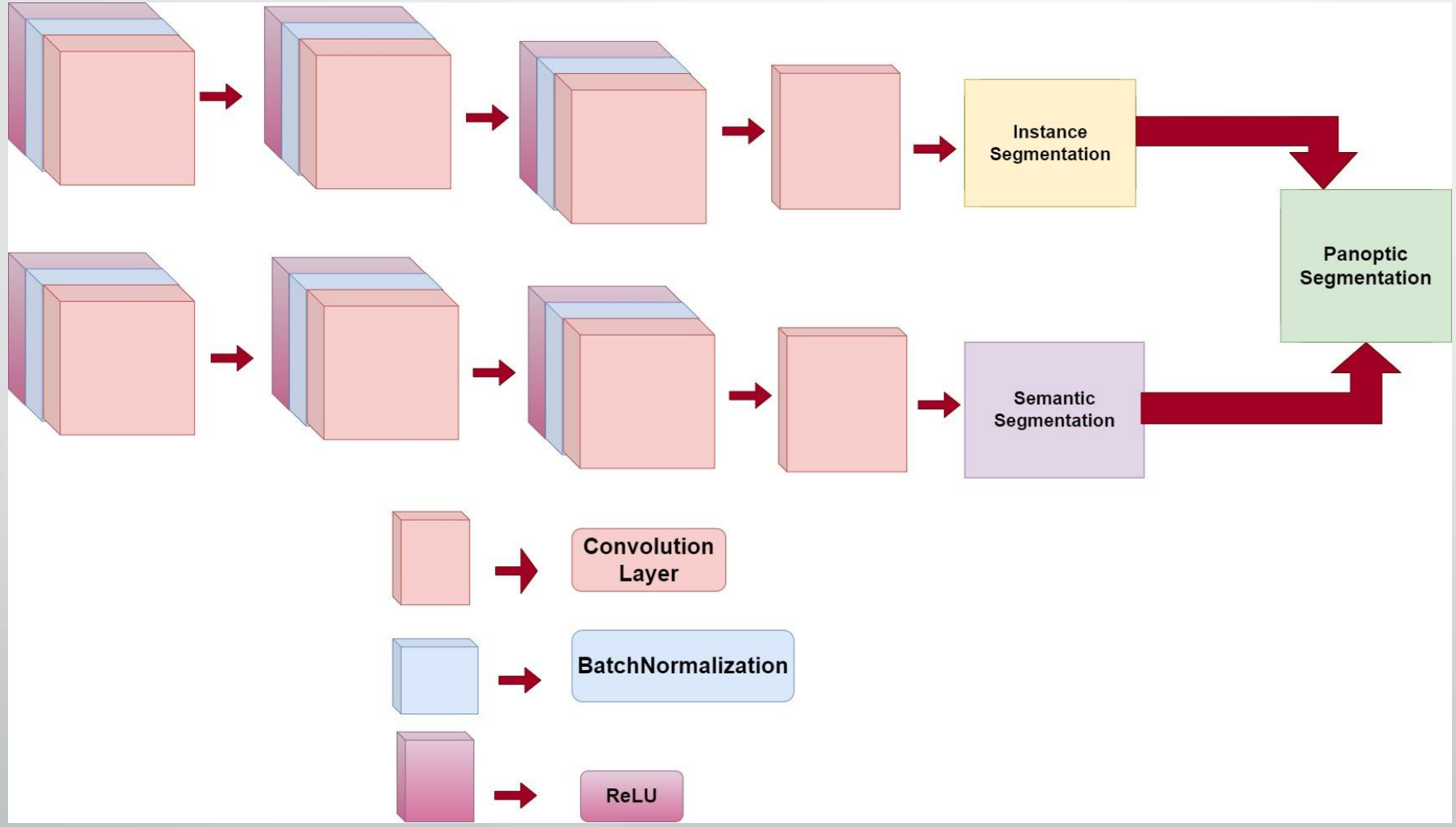
Problem statement

- The task of panoptic segmentation introduces challenges that preceding methods are unsuited to solve.
- Top-down methods of segmentation are usually slow in speed, results into multiple sequential processes in the pipeline.
- Bottom-up methods naturally resolve the conflict by predicting non-overlapping segments. Panoptic segmentation is a bottom up approach which resolves the problem of Top-down segmentation.
- Solution: Panoptic segmentation combines semantic context mask and instance segmentation mask obtained from training self-designed convolutional neural network to get the panoptic mask for the real-world images.

Goal

- It aims to create a comprehensive scene understanding by categorizing every pixel into distinct groups(such as objects, things, and stuff) while also distinguishing between separate instances of those objects.
- In essence, panoptic segmentation provides a holistic view of visual scenes, combining semantic context with instance-specific details.
- The goal of the panoptic segmentation is to unify semantic segmentation and instance segmentation into a single coherent task.

Methodology



Discussion

Dataset Description
Dataset used COCO 50k images.
Cityscape dataset 50k.
ADE 20k image dataset.
Dataset split
Train the model 70% of the data.
For the Validation to give 10% of the data to the model.
Testing the model give the 20% of the data.

Challenges

- In this work particularly in terms of computational demands and ensuring model convergence.
- One significant hurdle was managing the extensive computational resources needed for the training our sophisticated model.
- Overcome this, we optimized our training pipeline, which allowed us to train efficiently without compromising on model accuracy.

Application

- **Scene Understanding**: It enables a more detailed understanding of complex scenes by combining both semantic and instance information.
- **Autonomous Vehicles**: In self-driving cars, panoptic segmentation helps identify objects and their boundaries accurately.
- **Object Tracking**: It aids in tracking individual objects across frames in videos.
- **Robotics**: Robots can benefit from precise objects segmentation for manipulation tasks.

Conclusion

Future Work

Real-Time Performance: Balancing accuracy and speed.

Robustness: Handling challenging scenarios.

Domain Adaptation: Generalizing across diverse dataset.

Efficient Architectures: Reducing computational complexity.

References:

- Cheng, Bowen, Maxwell D. Collins, Yukun Zhu, Ting Liu, Thomas S. Huang, Hartwig Adam, and Liang-Chieh Chen. "Panoptic-deeplab: A simple, strong, and fast baseline for bottom-up panoptic segmentation." In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*, pp. 12475-12485. 2020.
- Scene Parsing through ADE20K Dataset. Bolei Zhou, Hang Zhao, Xavier Puig, Sanja Fidler, Adela Barriuso and Antonio Torralba. Computer Vision and Pattern Recognition (CVPR), 2017.


Thank You