# DeepMAC model

**DeepMAC** (Deep Mask heads Above CenterNet) is a neural network architecture that is designed for the partially supervised instance segmentation task. For details see the The surprising impact of mask-head architecture on novel class segmentation paper. The figure below shows improved mask predictions for unseen classes as we use better mask-head architectures.

Just by using better mask-head architectures (no extra losses or modules) we achieve state-of-the-art performance in the partially supervised instance segmentation task.

## Code structure

- `deepmac_meta_arch.py` implements our main architecture, DeepMAC, on top of the CenterNet detection architecture.
- The proto message `DeepMACMaskEstimation` in `center_net.proto` controls the configuration of the mask head used.
- The field `allowed_masked_classes_ids` controls which classes recieve mask supervision during training.
- Mask R-CNN based ablations in the paper are implemented in the TF model garden code base.

## Prerequisites

1. Follow TF2 install instructions to install Object Detection API.
2. Generate COCO dataset by using create_coco_tf_record.py

## Configurations

We provide pre-defined configs which can be run as a TF2 training pipeline. Each of these configurations needs to be passed as the `pipeline_config_path` argument to the `object_detection/model_main_tf2.py` binary. Note that the `512x512` resolution models require a TPU `v3-32` and the `1024x1024` resolution models require a TPU `v3-128` to train. The configs can be found in the configs/tf2 directory. In the table below `X->Y` indicates that we train with masks from `X` and evaluate with masks from `Y`. Performance is measured on the `coco-val2017` set.

### Partially supervised models

| Resolution | Mask head | Train->Eval | Config name | Mask mAP |
|---|---|---|---|---|
| 512x512 | Hourglass-52 | VOC -> Non-VOC | `center_net_deepmac_512x512_voc_only.config` | 32.5 |
| 1024x1024 | Hourglass-100 | VOC -> Non-VOC | `center_net_deepmac_1024x1024_voc_only.config` | 35.5 |
| 1024x1024 | Hourglass-100 | Non-VOC -> VOC | `center_net_deepmac_1024x1024_non_voc_only.config` | 39.1 |

### Fully supervised models

Here we report the Mask mAP averaged over all COCO classes on the `test-dev2017` set .

| Resolution | Mask head | Config name | Mask mAP |
|---|---|---|---|
| 1024x1024 | Hourglass-100 | `center_net_deepmac_1024x1024_coco.config` | 39.4 |

## Demos

- DeepMAC Colab lets you run a pre-trained DeepMAC model on user-specified boxes. Note that you are not restricted to COCO classes!
- iWildCam Notebook to visualize instance masks generated by DeepMAC on the iWildCam dataset.

## Pre-trained models

- COCO Checkpoint - Takes as input Image + Boxes and produces per-box instance masks as output.

## See also

- Mask RCNN code in TF Model garden code base.
- Project website - git.io/deepmac

## Citation

```
@misc{birodkar2021surprising,
      title={The surprising impact of mask-head architecture on novel class segmentation},
      author={Vighnesh Birodkar and Zhichao Lu and Siyang Li and Vivek Rathod and Jonathan Huang},
      year={2021},
      eprint={2104.00613},
      archivePrefix={arXiv},
      primaryClass={cs.CV}
}
```