| Data Fingerpint | → | Rule based Parameters | → | Fixed Parameters | → | Empricial Optimiztion |

**Data Fingerpint**
- Distribution of Spacings
- Median Shape
- Intensity Distribution
- Image Modality
- Object Sizes

**Rule based Parameters**
- Full Resolution Model — Triggers → Low Resolution Model
- Resampling Strategy
- Intensity Normalization
- Image Target Spacing
- Patch Size ⇄ Network Topology & FPN Levels
- Anchor Sizes ⇄ IoU Maximisation

**Fixed Parameters**
- Network Blueprint
- Anchor Matching
- Loss Functions
- Optimizer & Learning Rate
- Data Augmentation

**Empricial Optimiztion**
- Model NMS IoU Threshold
- Ensemble WBC IoU Threshold
- Model Min Probability
- Min Object Size
- Model Selection

| Parameter | Description |
|---|---|
| Resampling Strategy | **Image**: We use the same image resampling procedure as nnU-Net<br>**Annotation**: Annotations are resampled with nearest neighbor |
| Network Topology & FPN Levels & Patch Size | The anisotric axis of the patch size is initialized with the median shape of the anisotropic axis of the dataset. The isotropic axes are initialized with the minimum size of the isotropic axes of the dataset.<br>The patch size is decreased while adapting the network architecture and feature pyramid network levels until the memory constrains are fulfilled. The batch size is fixed to four. |
| Anchor Optimization | The anchor sizes are determined by maximising the IoU of the best fitting anchor on the given object sizes extracted from the training set. Optimization of three anchor sizes per axis is performed via differential evolution. |
| Low Resolution Model | The low resolution configuration will be triggered if the 99.5 percentile of object sizes along any axes exceeds the patch size of the full resolution model. If the low resolution configuration is triggered, the target spacing along each axes will be increased by two to incorporate more contextual information. |
| Architecture Template | Retina U-Net with an encoder which consists of plain convolutions, ReLU and instance normalization blocks. The detection heads used for anchor classification and regression consist of three convolutions with group norm. |
| Anchor Matching | Adaptive Training Sample Selection (ATSS) is used to match anchors and ground truth boxes. The center of the anchor boxes do not need to lie within the ground truth box. |
| Loss Functions | **Detection Branch**: To balance positive and negative anchors, hard negative mining is used while selecting 1/3 positive and 2/3 negative anchors. The classification branch is trained with the Binary Cross-Entropy loss and the Generalized IoU Loss is used for anchor regression.<br>**Segmentation Branch**: The segmentation branch is trained with the Dice and Cross-Entropy loss to distinguish foreground and background pixels. |
| Optimizer & Learning Rate | All configurations are trained for 60 epochs with 2500 mini batches per epoch and half of the batch is forced to contain at least one object. SGD with Nesterov momentum 0.9 is used. At the beginning of the training the learning rate is linearly ramped up from 1e-6 to 1e-2 over the first 4000 iterations. Poly learning rate schedule is used until epoch 50. The last 10 epochs are trained with a cyclic learning rate fluctuating between 1e-3 and 1e-6 during every epoch. We snapshot the model weights after each epoch for Stochastic Weight Averaging. |
| Data Augmentation | We use the same augmentation strategy as nnU-Net without simulating low resolution samples. |
| Empirical Parameter Optimization | Parameters which are only required during the inference procedure are empirically optimized by evaluating the performance on the validation set. This includes: the IoU threshold required for the NMS of the model, the IoU threshold required to perform WBC, a minimum probability for predictions of the model, a minimum object size. |
| Model Selection | If the low resolution model was triggered, only the best model as determined by the five fold cross-validation will be used for the test set. |

→ Symbolizes a dependency     ---→ Denotes sequential procedures