New Metric to quantify Cell Segmentation

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- Intersection over Union (IoU)
  - Penalizes incomplete data
  - Penalizes irregular boundaries
  - Doesn't penalize merged cells
- Adjusted Rand Index
  - Penalizes incomplete data
  - Penalizes irregular boundaries
  - Penalizes merged cells

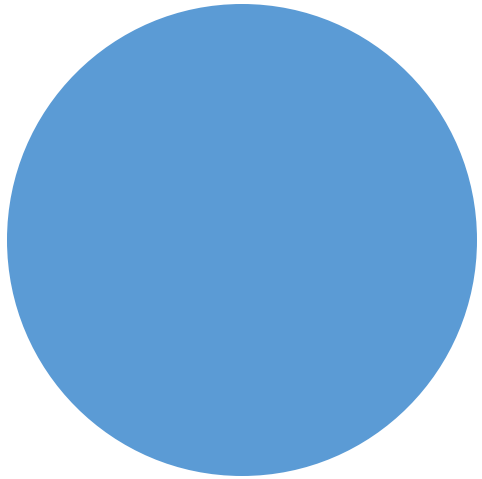
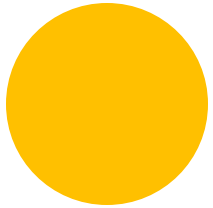
Existing Metrics

Need for new metric

- We don't want to penalize missing data from provided labels
  - Adjusted Rand Index can be modified to accommodate this.
- Don't want to penalize minor perturbations of boundary.
- Penalize **heavily** merged cells(ARI does this).

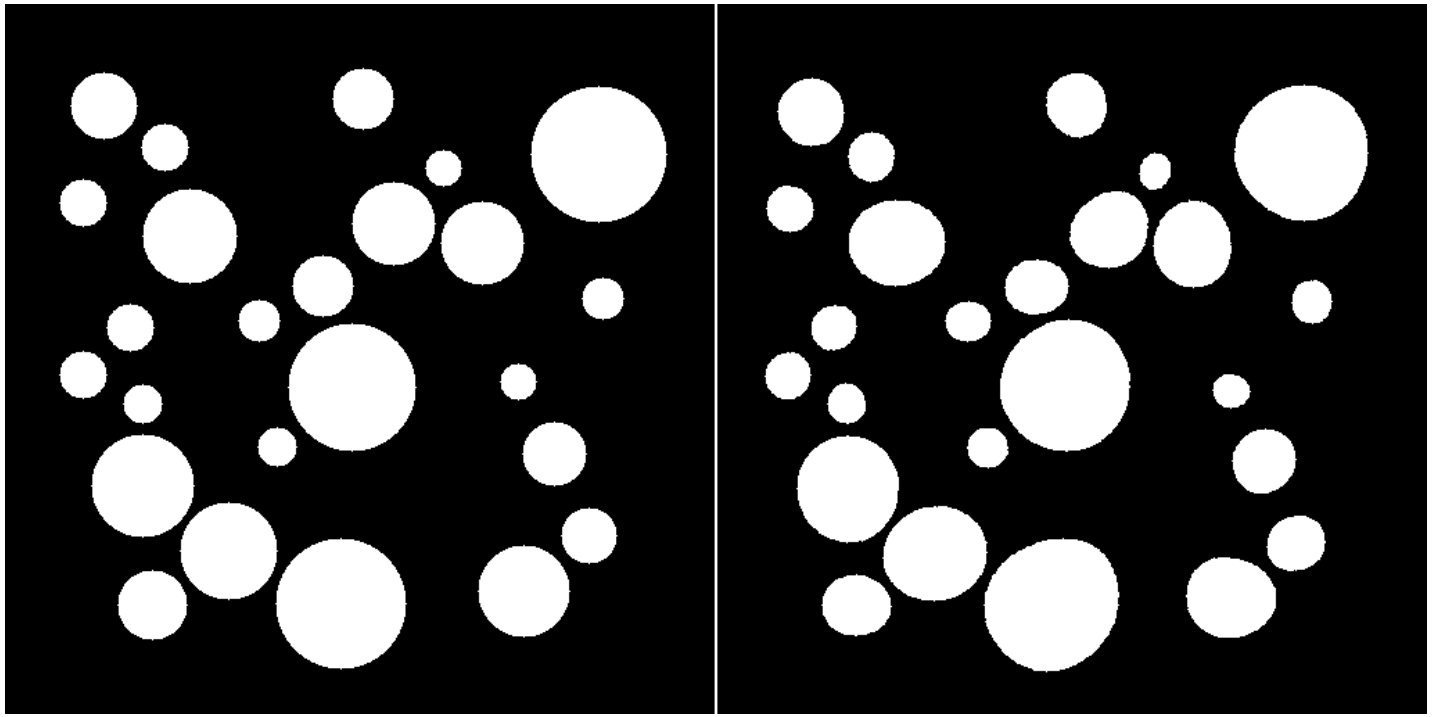
- Rather than doing IoU for entire image, just take IoU for individual cells present in provided label.
  - This way if cells gets detected, even if it is not in the label, it will not contribute to any loss or gain. (We assume that neural network does penalize accordingly. I.e. heavy loss if it detects cell where there wasn't supposed to be)

New Metric (Separate Intersection over Union)

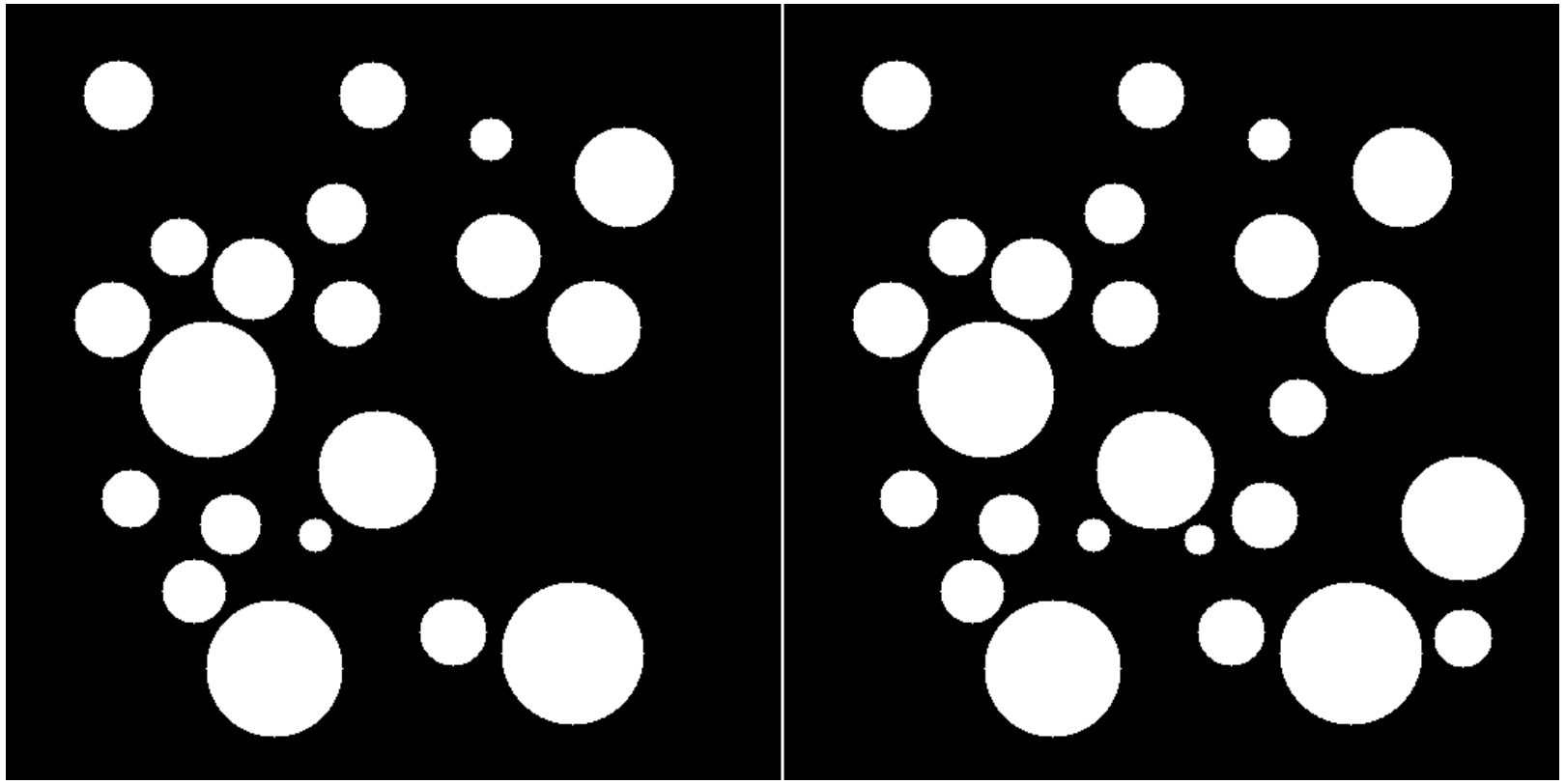
Experiments

Experiment 1(Perturbations)



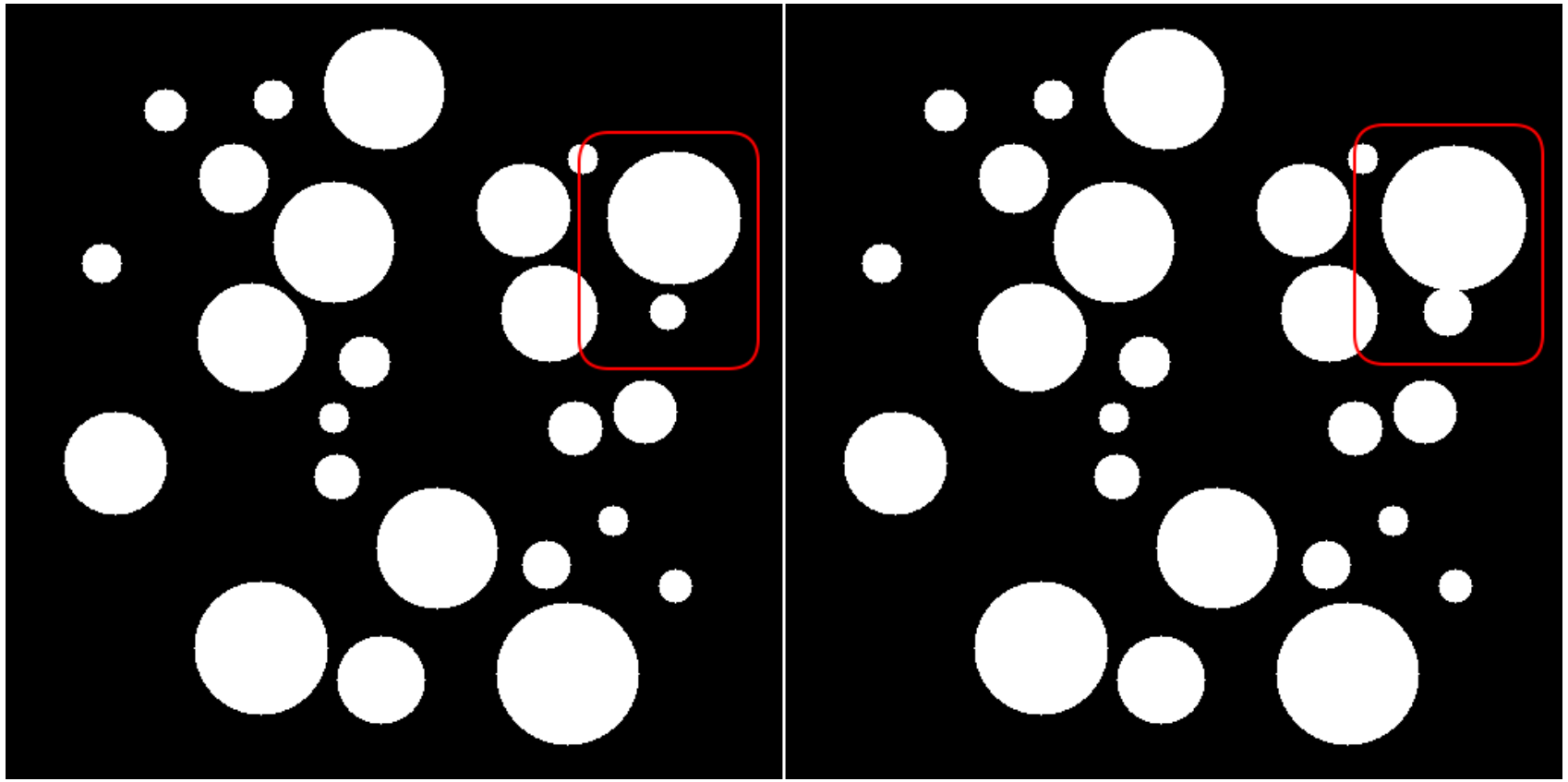
Metric	average score
IoU	0.83
ARI	0.86
fg_ARI	0.86
fgfg_ARI	0.75
New Metric	0.94

Experiment 2(Extra cells)



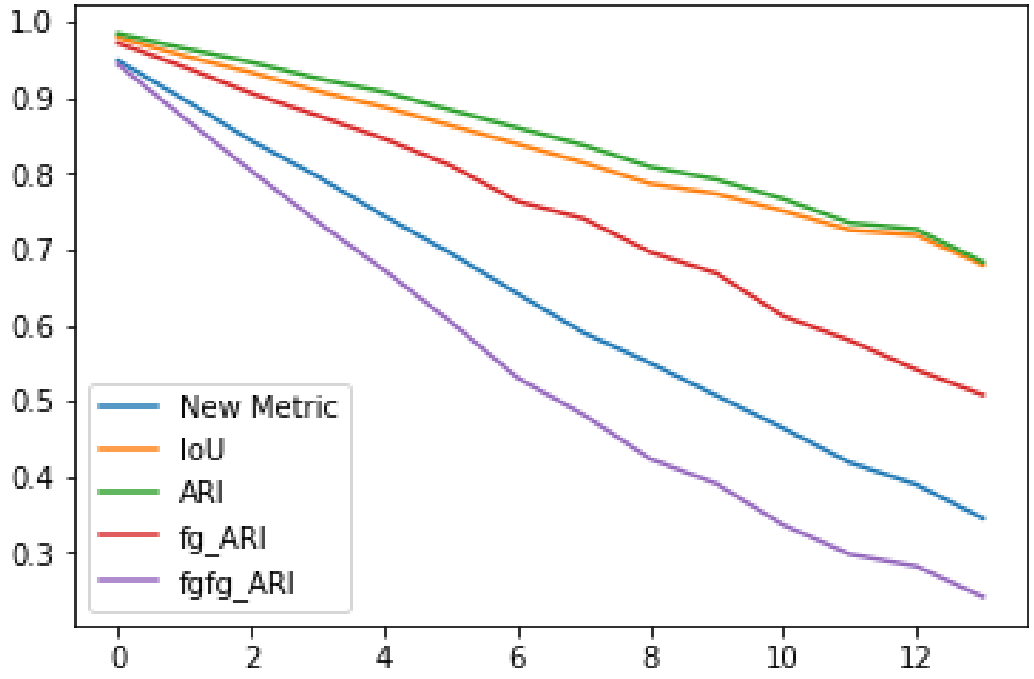
Metric	avg on normal	avg on perturbed
IoU	0.87	0.73
ARI	0.90	0.78
fg_ARI	1.0	0.86
fgfg_ARI	0.91	0.63
New Metric	1.0	0.94

Experiment 3(Merge two cells)

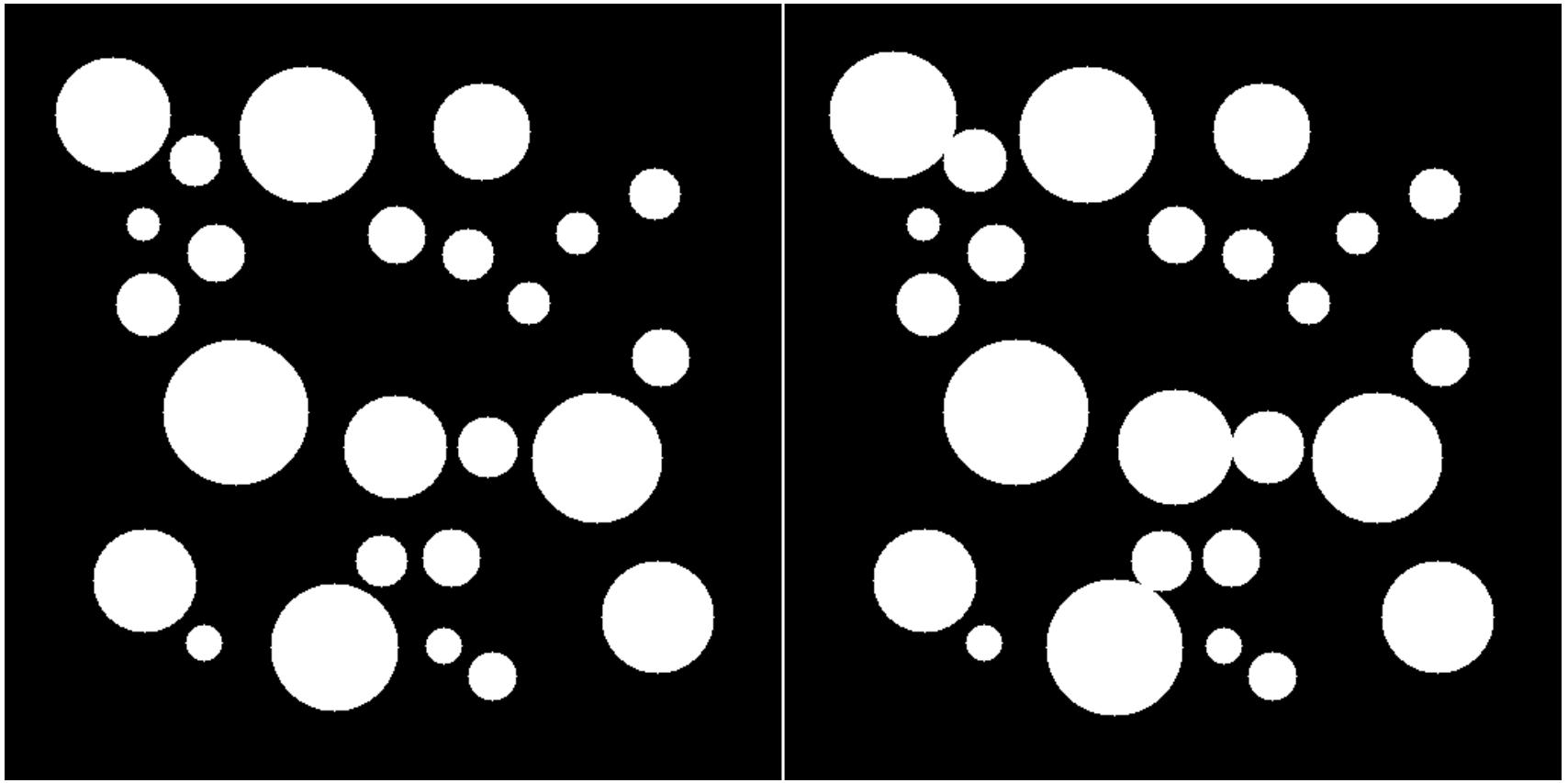


Metric	score
IoU	0.97
ARI	0.98
fg_ARI	0.97
fgfg_ARI	0.94
New Metric	0.94

Experiment 4(Merge n cells)



Experiment 5(Merge random n cells)



Metric	avg Score
IoU	0.88
ARI	0.90
fg_ARI	0.84
fgfg_ARI	0.67
New Metric	0.74