Bachelor Thesis

Comparison of Hamming- and Variation of Information-Loss based structured learning on the Multicut Problem

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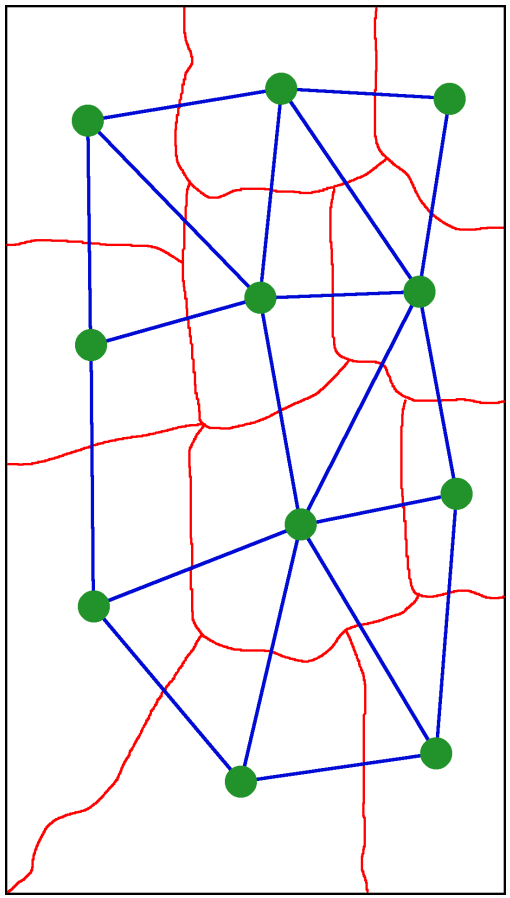
Segmentation

Motivation Variation of Information

- Hamming Loss strongly dependend on exact path of segmentation
- But: Path of segmentation often not unique

- Idea VOI: Consider labels of segmentation and penanlize area-dependend

Region Adjacency Graph (RAG)



- Image partitioned into Superpixel (SP) via SLIC [2]
- Each Superpixel $\hat{=}$ Node in RAG
- Nodes of adjacent SP are linked by an Edge

Multicut Problem (MP)

$$\begin{aligned} \min_{y} \quad & \sum_{y_e \in E} \langle w, \beta_e \rangle \cdot y_e \\ \text{s.t.} \quad & y - \sum_{y_i \in P(y)} y_i \leq 0 \qquad \forall\, y \in E \end{aligned}$$

- w: Weights to be learned
- β_e: Features of edge e
- y_e: Activity of edge e
- Constraint to enforce consistency

Stochastic Gradient with RF Feature

- Varying configurations:
  - Domain Feature Space
  - Constraint on RF Feature
  - Subgradient Descent with/without RF Feature
- Results:
  - Decrease of VOI Loss leads to decline of Hamming Loss in Trainingsset
  - Rate of decrease sensible to configuration, besides strong fluctuations due to stochastic process
  - Loss decrease on Trainingset $\propto$ Loss increase on Testset $\Rightarrow$ Overfit of training data

Stochastic Gradient without RF Feature

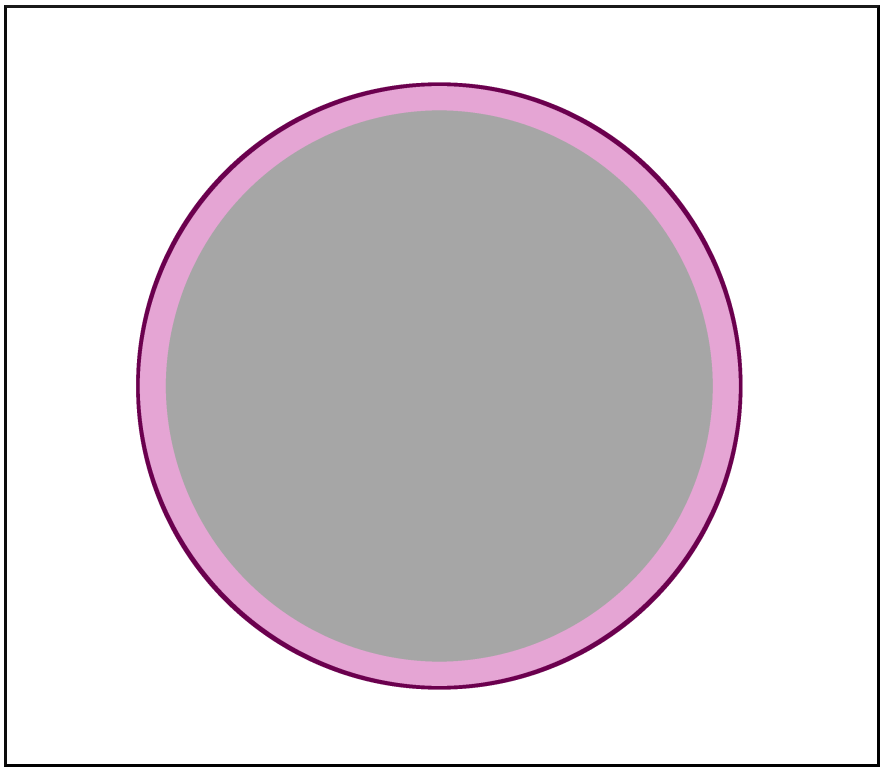
- Varying configurations:
  - Domain Feature Space
  - Constraint on N^4 Feature
- Results:
  - VOI Loss decrease on Trainingset of approximately 4%
  - Change of Loss on Testset within 1σ range of error

Cross Validation Measurement 10

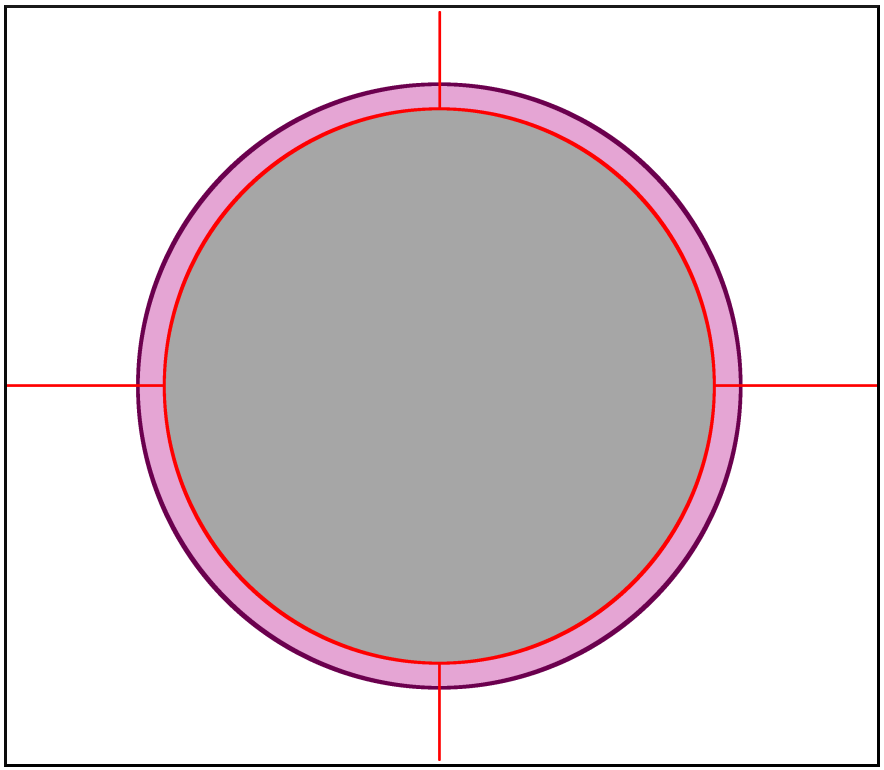
- Cross validation to minimize measurement errors
- Results on Testset:
  - $\mathcal{L}_H$: $\frac{StochGrad}{SubGrad} = 0.989 \pm 0.005$
  - $\mathcal{L}_{VOI}$: $\frac{StochGrad}{SubGrad} = 1.0025 \pm 0.0084$

  $\rightarrow$ No significant change

Explanation by SLIC

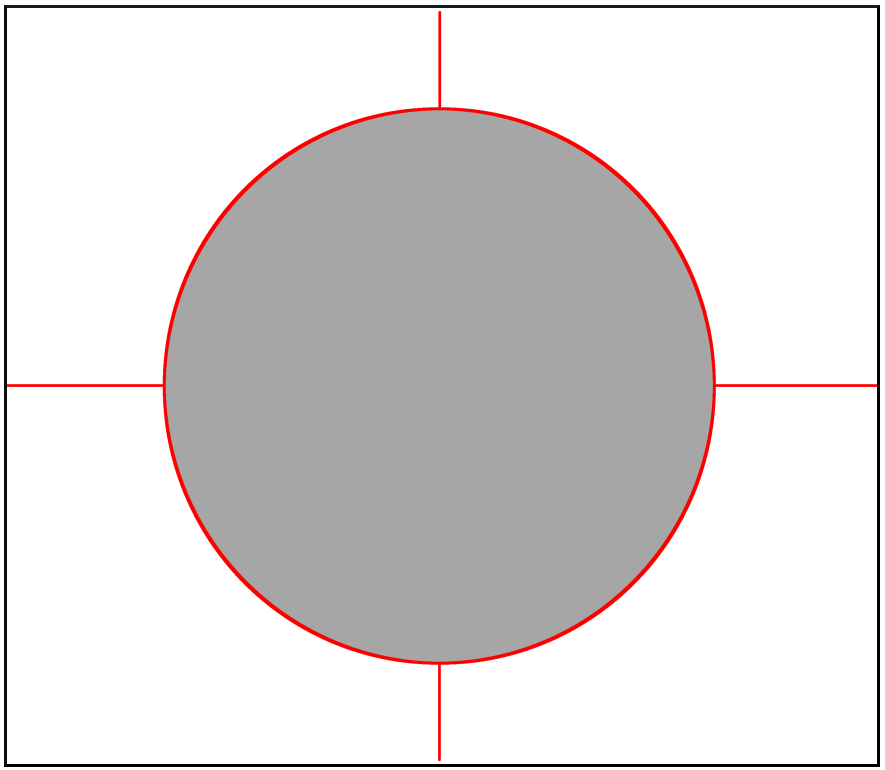


Explanation by SLIC



Ground Truth Edge
Ground Truth Area
Structure
Super Pixel Edges
Background

Explanation by SLIC



Structure
Super Pixel- &
Ground Truth Edges

Conclusion

- Stochastic Gradient with RF Feature leads to Overfit of training data
- No significant change without RF Feature
  - Bad Ground Truth compensated by SLIC
  - SLIC provides just important edges
    $\rightarrow$ Difficulty of exact segmentation path is gone
  - Examination on Pixel-level would be interesting

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Questions