# SVM With Stochastic Parameter Selection For Bovine Leather Defect Classification

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# Topics

- Leather defects classification
- Support Vector Machines
- SVM Parameter Tunning via Simulated Annealing
- Experiments
- Results
- Conclusions and Future Work
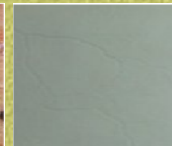
# Bovine Leather Classification



Farms



Slaughterhouses



Tanneries



Defects: wrinkles, bot fly closed wounds, vaccine abscess, bot fly open wounds, ticks marks, veining (in wetblue), open cuts (wetblue)



D1 - 200cm$^2$

D4 - 87cm$^2$

Grupon

D2 - 173cm$^2$

D3 - 15cm$^2$

# DTCOURO – Automated System for Bovine Leather Classification



Huge dataset of training images

Co-occurrence Matrix | Interaction Maps | Gabor | LBP | Color | Hough
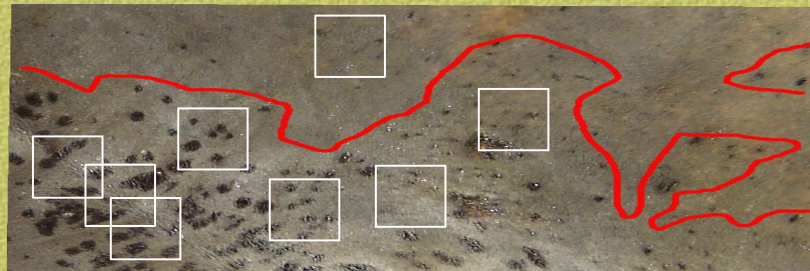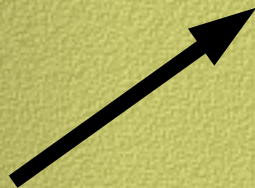
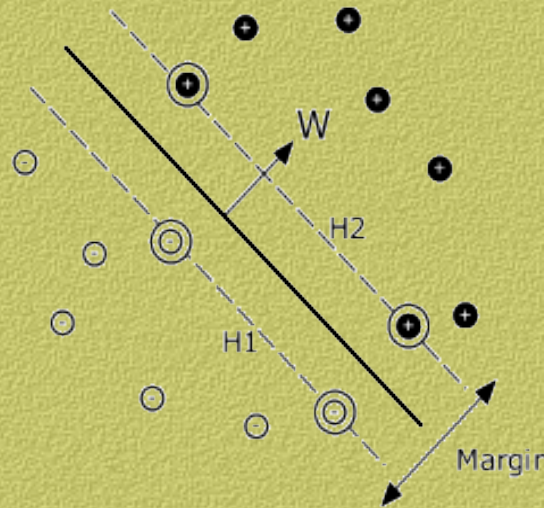Feature Extraction + Feature Selection

SVM | RBF | KNN | FF-NN | Adaptree

# Support Vector Machines



- Maximum Margin Classifier (Linearly Separable)
- Kernel functions to extend the basic idea to non-linearly separable class/vectors
- Good generalization performance (many empirical results in different machine learning situations)
- Well established theoretical support
- Parameter tunning for SVM optimal learning performance may be hard and problem dependent

# SVM Parameter Tunning via Simulated Annealing



choose start       travel up and down
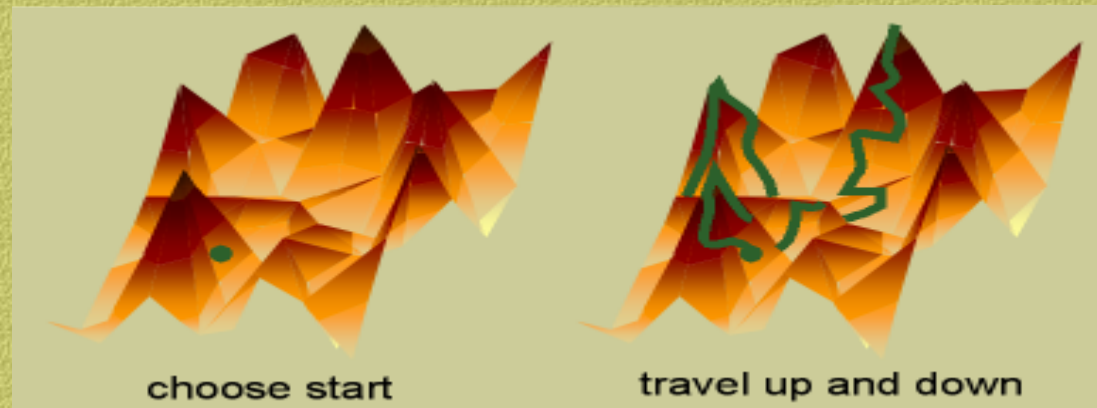
Images from Anne Smith's website: http://biology.st-andrews.ac.uk/vannesmithlab/

- SA: Local improvement stochastic search that admits "bad steps" to escape local minima/maxima

- Not too bad steps are taken more often than the steps that are too bad

- As the search proceeds, bad steps are taken less often

- SVM Parameter Tunning: Automatically find parameters values that maximize Correct Classification Rate (or any other performance measure) through local improvement
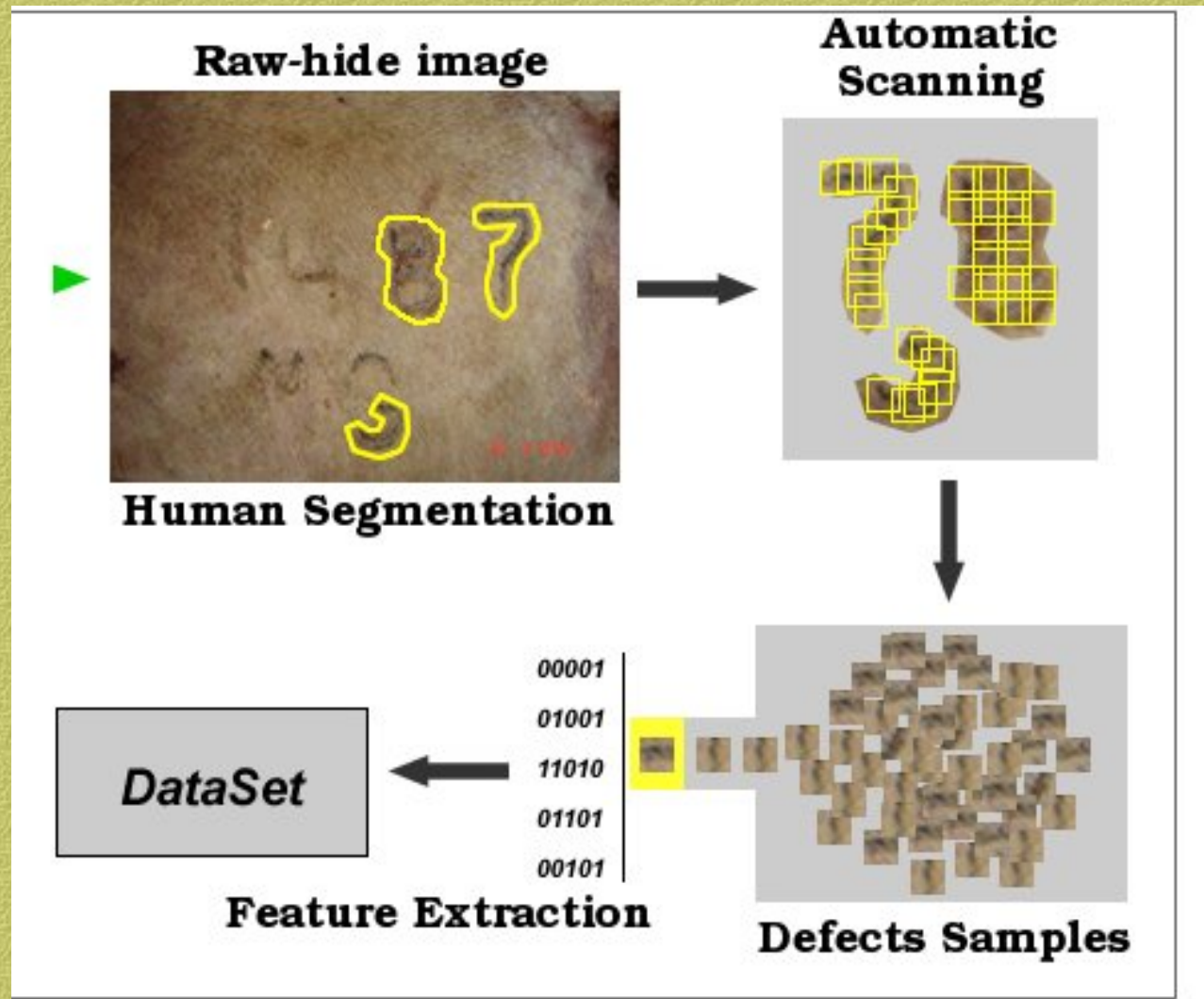
# Experiments



- 15 different raw-hide pieces (600x450 Colored Images)
- 14722 samples (20x20 pixels each) from tick marks, brand marks, cuts and scabies (most common defects in Brazil)
- Feature Extraction: Interaction Maps, Co-occurrence matrices and Color (RGB, HSB) Histogram Attributes
- 5-Fold Crossvalidation

# Experiments

# Experiments

**Experiment 1: Correct Classification Rate (CCR) Before and After SA Tunning**
• Platt's Sequential Minimal Optimization Algorithm – SMO (Weka's Implementation)
• Standard Regularized Support Vector Classifier - *C*-SVC (LibSVM implementation ported to Weka)
• Parameters:
   * *C* – Error penalty (some vectors – outliers - may cross the "separation hyperplane")
   * *Gamma* – RBF scale parameter

**Experiment 2: CCR and Training Time classifiers comparition**
• SMO, *C*-SVC (LibSVM), Feed-Forward Neural Networks, Adaboost (using KNN and C4.5 as weak classifiers)

# Results

**Experiment 1**: Correct Classification Rate (CCR) Before and After SA Tunning

|        | Exec. Time | Best C | Best Gamma | CCR Weka's Default | CCR After SA Tunning | Absolute Improvement |
|--------|-----------|--------|-----------|-------------------|---------------------|---------------------|
| SMO    | 10 hours  | 24.165 | 0.931     | 88,95%            | 93,10%              | 4,15                |
| LIBSVM | 4 hours   | 49.494 | 1.008     | 76,16%            | 99,59%              | 23,43               |

**Experiment 2**: CCR and Training Time classifiers comparition

| Algorithm | Training time (s) | Accuracy (%) |
|-----------|-------------------|--------------|
| LibSVM    | 172.43            | **99.47**    |
| MLP       | 7322.86           | 99.24        |
| A.(K-NN)  | **0.07**          | 95.75        |
| A.(C4.5)  | 52,4              | 95.43        |
| SMO       | 2433.62           | 93.10        |

# Conclusions and Future Work

- Important problem (Leather defects detection) has been presented to VC community

- Machine Learning techniques seem to be applicable

- Automatic parameters optimization improved results

- LibSVM tunned by Simulated Annealing has shown best performance in the results

- Experiments will be conducted on larger datasets that are been constructed by DTCOURO's project

# Additional Information

www.gpec.ucdb.br/pistori
www.gpec.ucdb.br/dtcouro (in portuguese)

# Acknowledgments



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