Impact Studies and Sensitivity Analysis in Medical Data Mining

with ROC-based Genetic Learning

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Yet another learning criterion

Bradley 97, Provost et al. 98

Usual predictive accuracy $\frac{a+d}{a+b+c+d}$

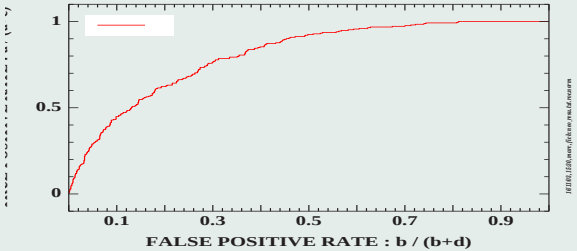
$\hat{tc} \cdot tc$	positive	negative
positive	a	b
negative	c	d

Drawbacks

- skewed distributions (positive $<<$ negative)
- misclassification costs

Receiver Operating Characteristics (ROC) Curve:

True Positive Rate vs False Positive Rate



Optimizing the Area Under the ROC Curve

Mozer et al. NIPS 01, Flach et al., ICML 02

- Search space : Linear hypotheses — baseline: SVMs
- Criterion:
  $h \longrightarrow$ Order on examples
  Quality(h) = Sum ranks positive examples — *to minimize*

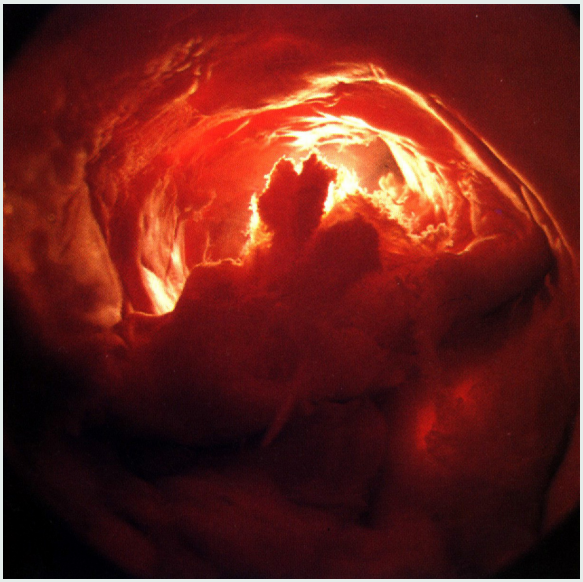
NP-complete optimization $\longrightarrow$ Evolutionary Computation

Evaluation on Irvine repository — Artificial Evolution VI, 2004

Compared to linear SVMs: similar performances
smaller computational cost

Application to Medical Data Mining

Identify Atherosis Risk



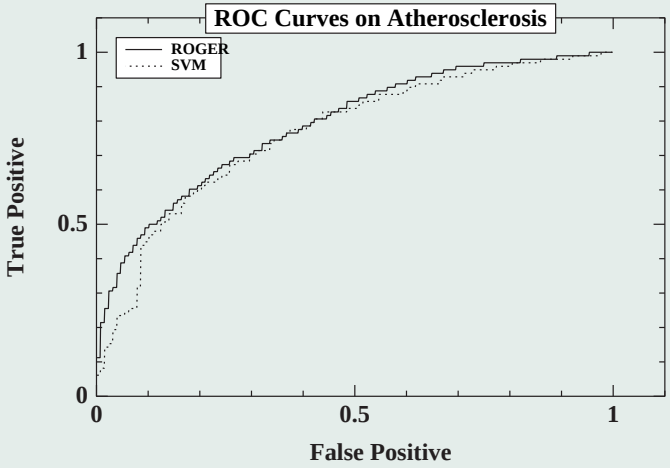
PKDD Challenge

2002, 2003

Atherosclerosis

Experimental setting 2/3 training, 1/3 test $\times$ 10

On each training set, 21 independent runs
Display the median ROC curve



ROGER: ROC-based Genetic LearneR *vs* SVMTorch

Influence Analysis - The tobacco factor

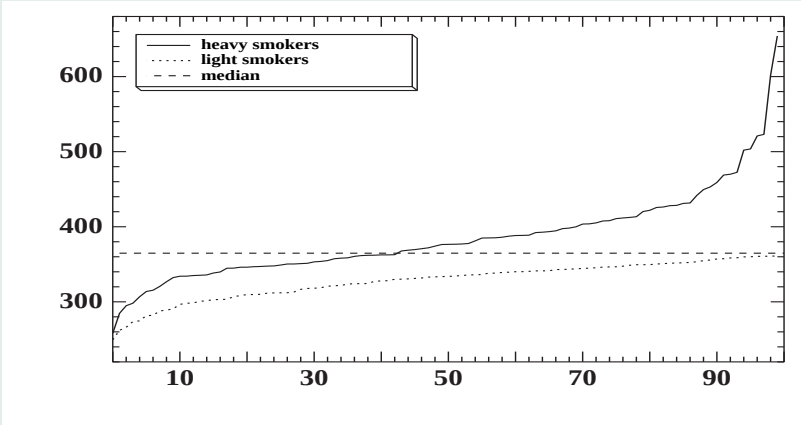
Procedure

A = { 100 non smokers }

B = { 100 heaviest smokers }

Sort individuals in A (in B) by increasing risk

Plot (i, risk(i))



Influence Analysis - The alcool factor

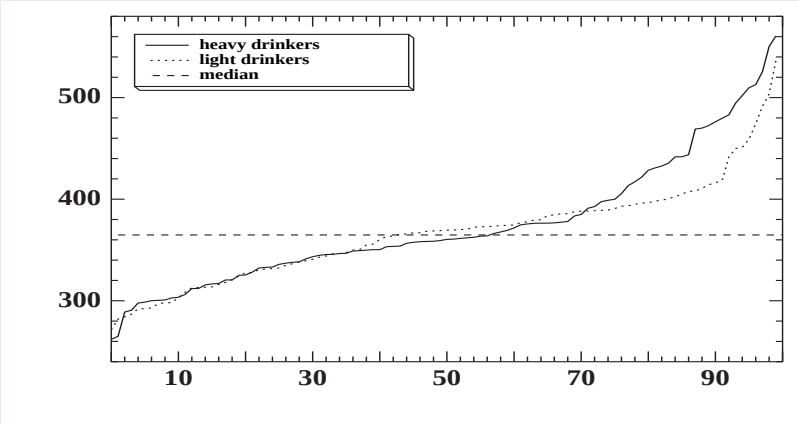
Procedure

A = { 100 light drinkers }

B = { 100 heavy drinkers }

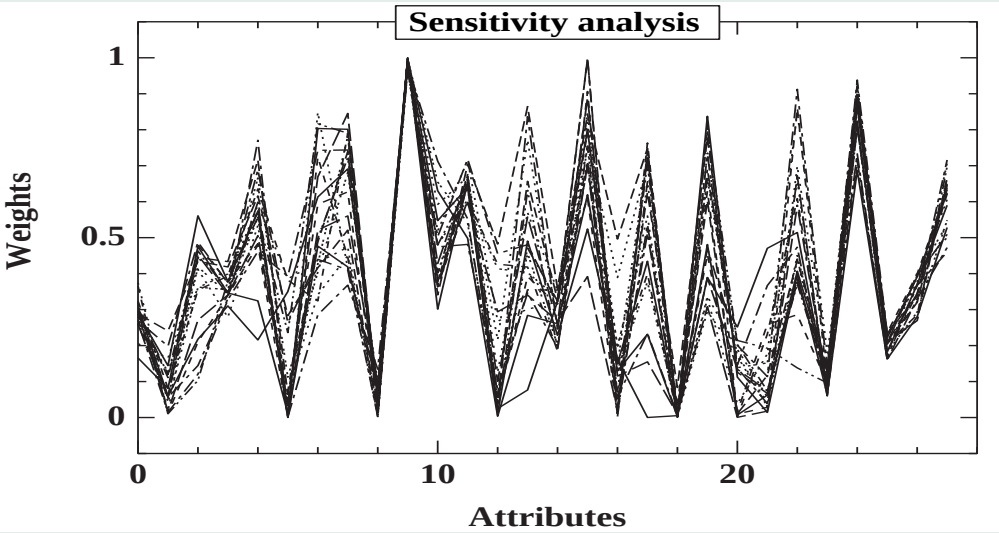
Sort individuals in A (in B) by increasing risk

Plot (i, risk(i))



no light drinkers in the db...

Sensitivity Analysis - For free



21 runs, 21 solutions, 21 curves: $(i, weight(attribute_i))$

Conclusions - Perspectives

Present

- Good predictive performances
- Affordable complexity
- UNDERSTANDABLE RESULTS

Using Vision to Think, Card et al. 2001

Future

- Extend to kernel spaces
- Use for constructive induction