

CN550 Class Project: Benchmark Problems

Circle-in-the-Square (CIS)

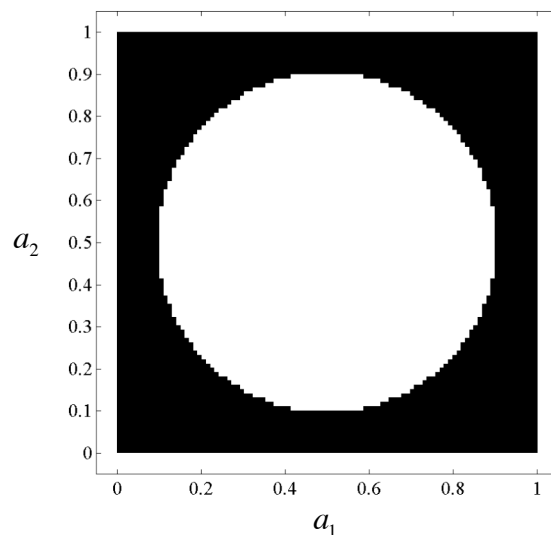
Description

The CIS benchmark is a two-dimensional, noise-free, two-category classification task. A circle with area 0.5 (radius slightly less than 0.4) is drawn in the center of a unit square.

Learning systems, given training points (a_1, a_2) in random order, learn to distinguish between two classes: inside the circle (IN - class 1), and outside the circle (OUT - class 0).

Problem *CIS-small* trains on 100 randomly chosen points, and problem *CIS-large* trains on 1,000 points.

The test set is a regular 100×100 grid.



Reference

Carpenter, Gail A., Grossberg, Stephen, Markuzon, Natalya, Reynolds, John H., & Rosen, David B. (1992) Fuzzy ARTMAP: A neural network architecture for incremental supervised learning of analog multidimensional maps. *IEEE Transactions on Neural Networks*, **3**, 698–713.

Data

CIS exemplar structure in the datasets

Field #	Description	Range
1	a_1 (x)-coordinate	real-values in [0,1]
2	a_2 (y)-coordinate	real values in [0,1]
3	IN/OUT of circle (output)	binary (1 IN / 0 OUT)

Word (text) files:

CIS-small (train 100 points) http://cns.bu.edu/~gail/550_CIS_train_100inputs.doc

CIS-large (train 1,000 points) http://cns.bu.edu/~gail/550_CIS_train_1000inputs.doc

CIS-small (test 10,000 points) http://cns.bu.edu/~gail/550_CIS_test_10,000inputs.doc

Matlab and .txt files: <http://cns.bu.edu/cn550/classproject/data/CIS/>

CIS response plot visualization and ROC curves

http://cns.bu.edu/~gail/550_Evaluation,Visualization.doc

function cis_vis.m

Pass the Matlab function `cis_vis(x)` a 10,000 element vector of 0 (OUT) and 1 (IN) values representing your classifier's predictions on the 10,000-point test set. The order of the vector must correspond to the order of the test points in the file `550_CIS_test_10,000inputs.doc`.

Evaluation and Visualization

Matlab routines

http://cns.bu.edu/~gail/550_Evaluation,Visualization.doc (Word document) or
<http://cns.bu.edu/cn550/classproject/contrib/>

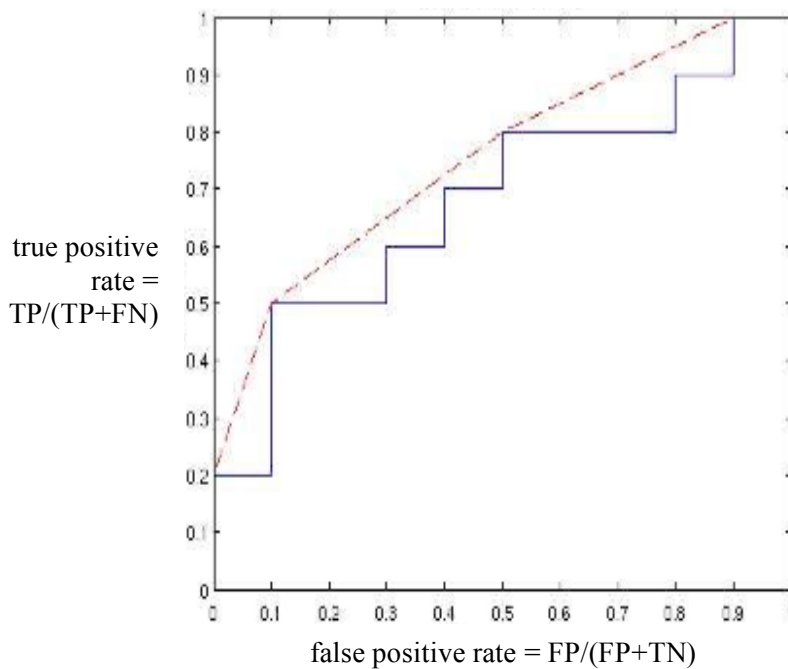
Evaluation criteria

- % correct
- C-index
- Response plot (CIS)

- Confusion matrix.

confusion matrix	# actual +	# actual -	total
# predicted +	TP: true +	FP: false +	TP + FP
# predicted -	FN: false -	TN: true -	TN + FN
total	TP + FN	FP + TN	whole test set

- ROC curve. See: http://en.wikipedia.org/wiki/Roc_curve



A sample *ROC curve* generated using the Matlab code. Real values (i.e., not class labels) predicted by the classifier and the true class labels are used to compute the ROC curve. The dashed line shows the ROC convex hull.

The ROC curve is parameterized by an output threshold $\gamma \in [0,1]$.

A system predicts + if its positive prediction output $\sigma > \gamma$.

$\gamma = 0$: All predictions are +

$\gamma = 1$: All predictions are -

The *c-index* $\in [0,1]$ is the area under the ROC curve. Chance prediction produces a diagonal ROC curve and a c-index of 0.5.