Classification in E-Procurement

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Overview

Paper reports work done in a 3-year Knowledge Transfer Partnership

- Between @UK plc, University of Reading and Goldsmiths College
- In fact three linked KTPs

Produced e-procurement system SpendInsight

- National Audit Office says could save NHS £500m p.a.

System extended to GreenInsight

- Allows procurers to assess environmental as well as economic cost

Key to the systems : classifying products from different sources

This paper focuses on methods used to analyse the product data

Normal best method, SVM, outperformed by KNN and Naïve Bayes

The three KTPs

Three linked projects

Spidering the web for suppliers of products

– to build a catalog of web pages

Classification – to automatically classify data

- standards eClass, NSV, UNSPCC

Ranking user search queries

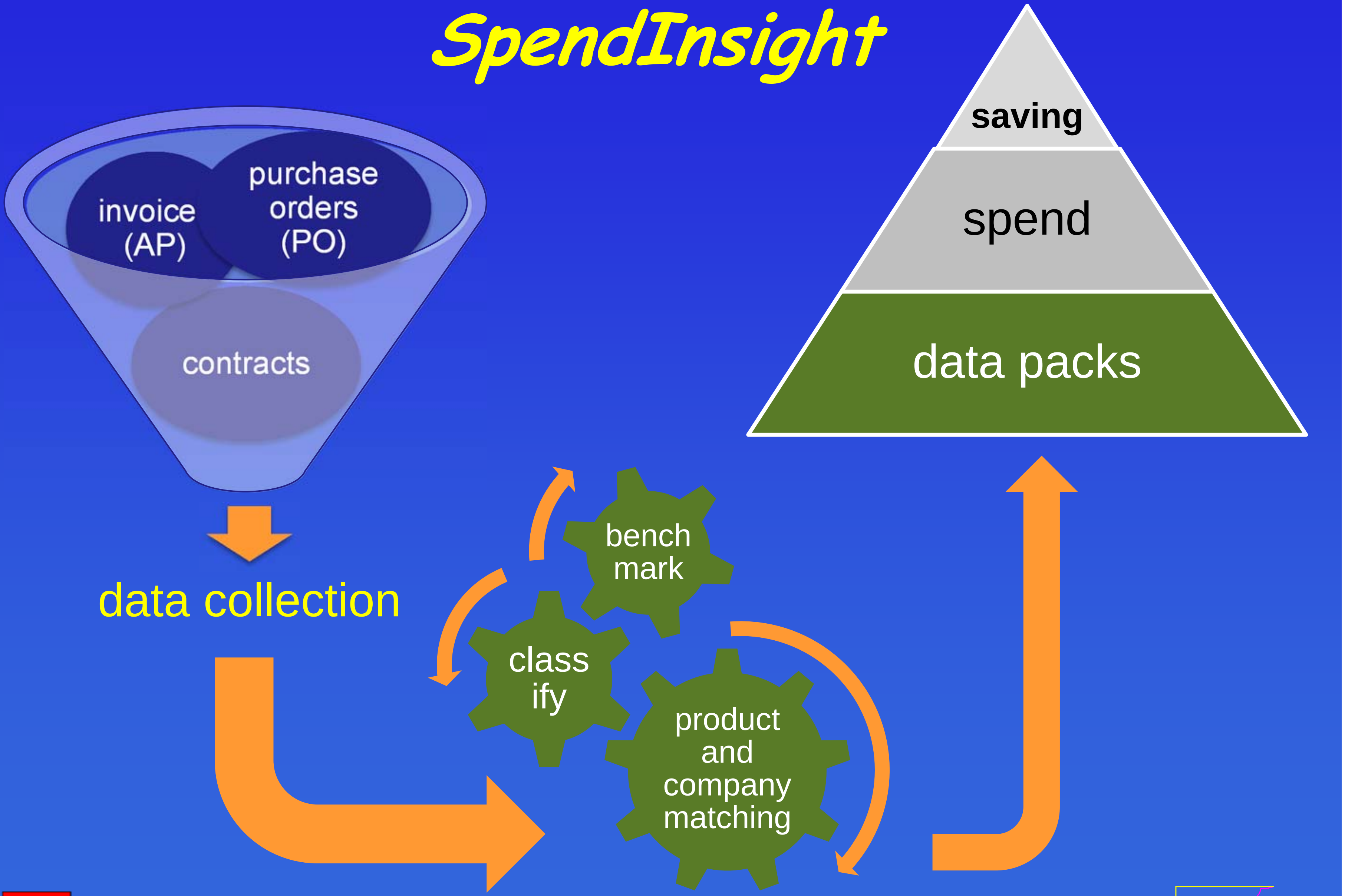
- return ordered list of matches , most relevant first

During project, opportunities arose to get data on NHS procurement

Project methods focussed on such data (though applicable elsewhere)

Led to SpendInsight system

SpendInsight



invoice (AP)

purchase orders (PO)

contracts

data collection

class ify

bench mark

product and company matching

saving

spend

data packs

Matching Products

Companies

Products

Unit of measure. Re-sellers.

Item level detail

allows like-for-like comparison, which means that opportunities for savings can be detected such as:

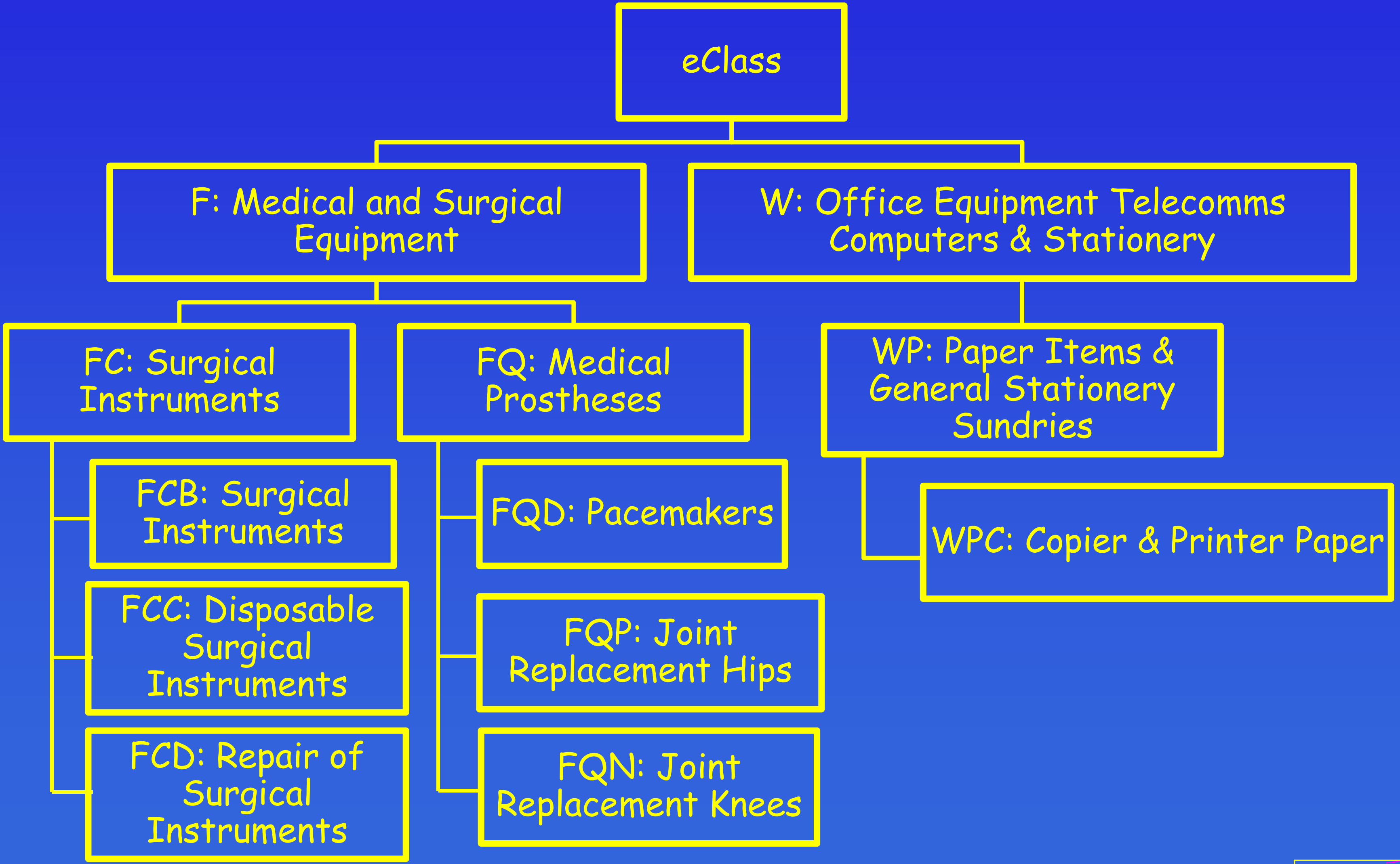
price variance,

price benchmark, and

contract opportunities and contract leakage.

Key is to classify …

Classification Examples



eClass

F: Medical and Surgical Equipment

FC: Surgical Instruments

FCB: Surgical Instruments

FCC: Disposable Surgical Instruments

FCD: Repair of Surgical Instruments

FQ: Medical Prostheses

FQD: Pacemakers

FQP: Joint Replacement Hips

FQN: Joint Replacement Knees

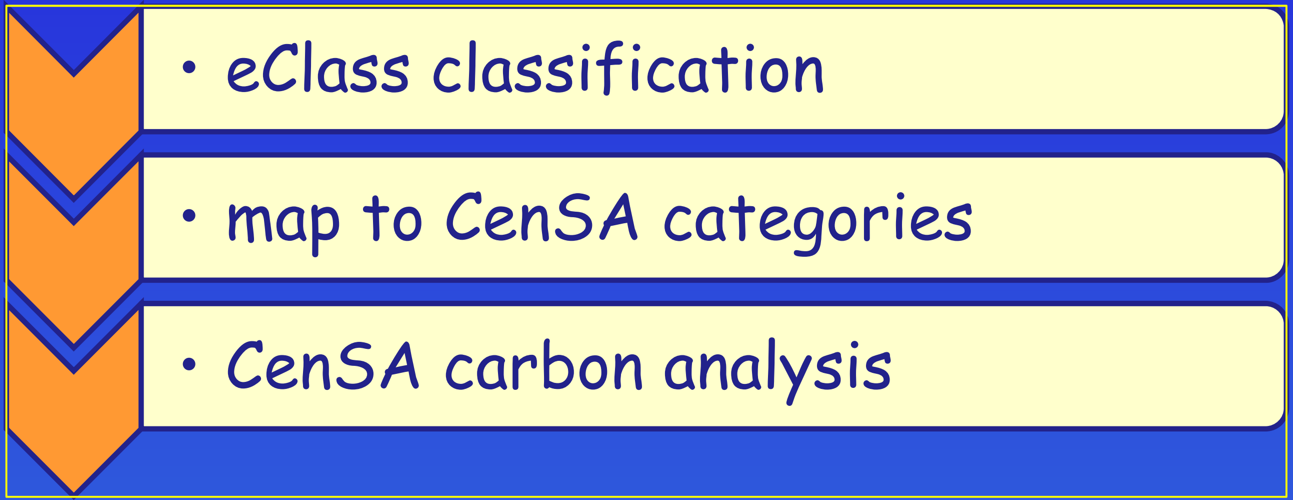
W: Office Equipment Telecomms Computers & Stationery

WP: Paper Items & General Stationery Sundries

WPC: Copier & Printer Paper

Extension for Carbon Footprint

Spend analysis



- eClass classification
- map to CenSA categories
- CenSA carbon analysis

Carbon analysis

Centre for Sustainability Accounting
www.censa.org.uk

E-procurers can assess both economic & environmental cost

Also possible to assess finacial cost of being green

Product Classification

Work from Purchase Order (PO) lines

- 87 NHS trusts … 2,179,122 PO lines
- 909 distinct labels
- Each line has short description, may be mislabelled

More difficult that standard classification

- very many classes
- short textural descriptions
- often not employing correct grammar
- with irrelevant / subsidiary information

Need to automatically classify

Methods Tried

K-nearest Neighbour (prelminary tests show K best at 5)

Rocchio – equal balalnce of negative and positive prototypes

Naïve Bayes – Bernoulli model

Support Vector Machine – linear models

Two Null hypotheses – as control (random or most often used)

Tested on Reuters data set and on PO data

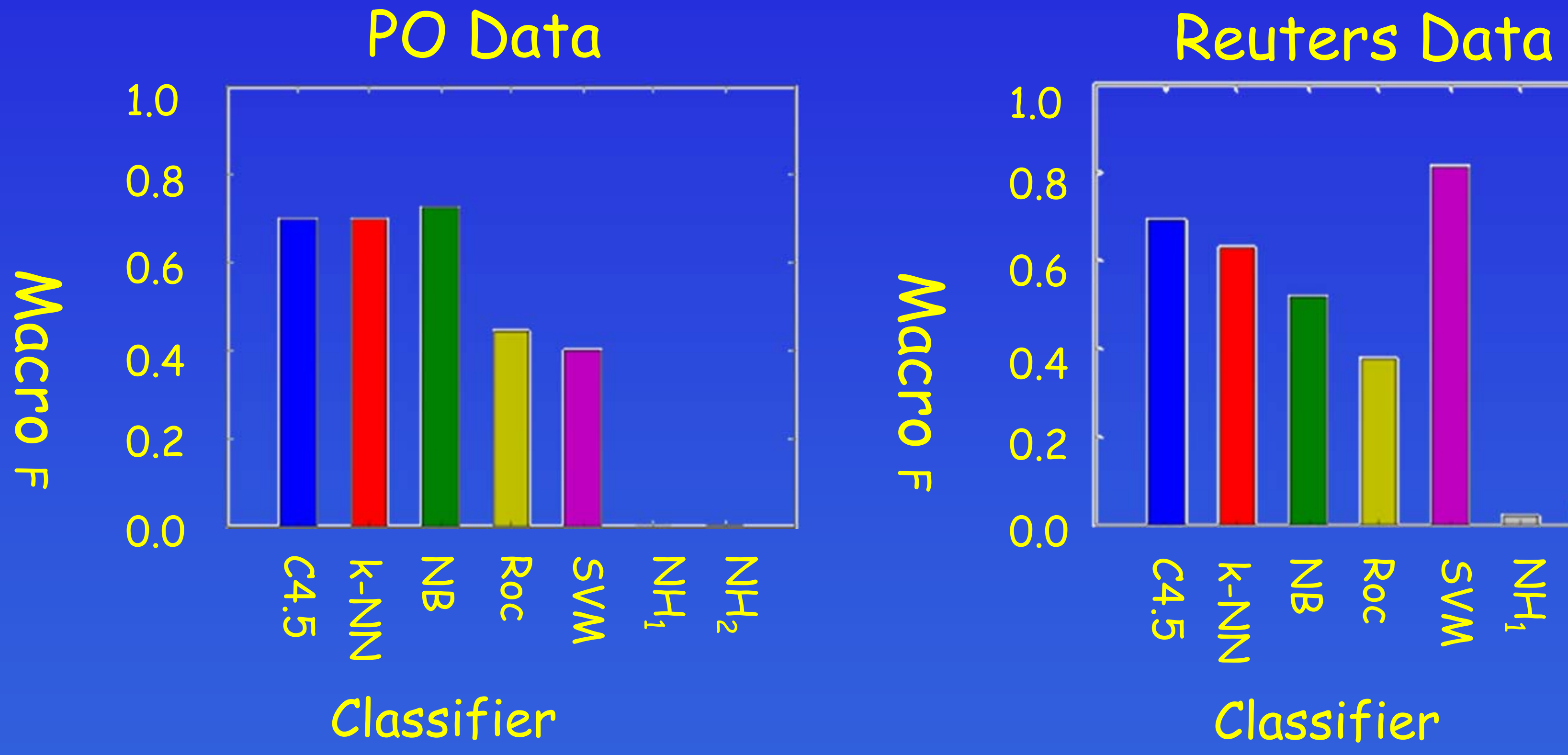
Performance assessed by F measure – mean of precision / recall

Macro averaged (across all classes)

Micro averaged (sum of each class)

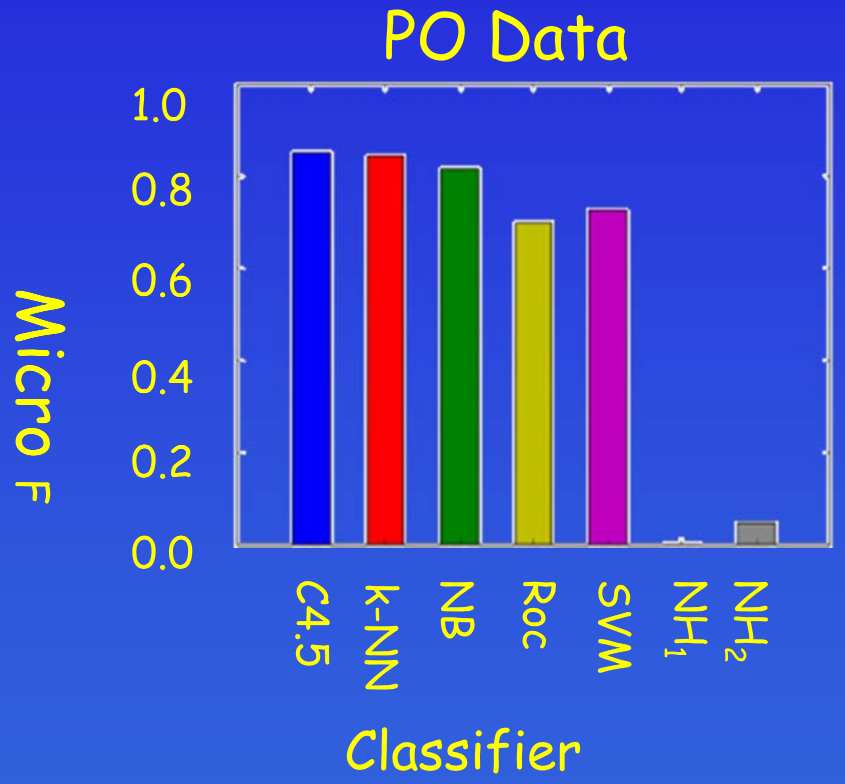
$$p_C = \frac{TP_C}{TP_C + FP_C} \qquad r_C = \frac{TP_C}{TP_C + FN_C}$$

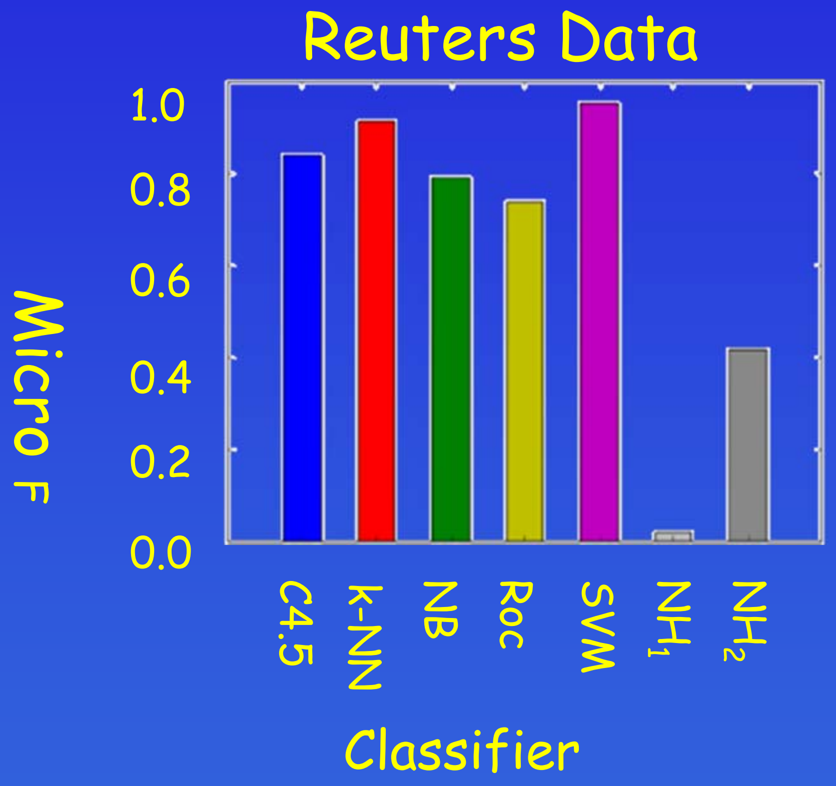
Macro-Average F Measure



SVM best on standard text, but not on PO

Micro-Average F Measure





SVM best on standard text, but not on PO

Why SVMs do worse

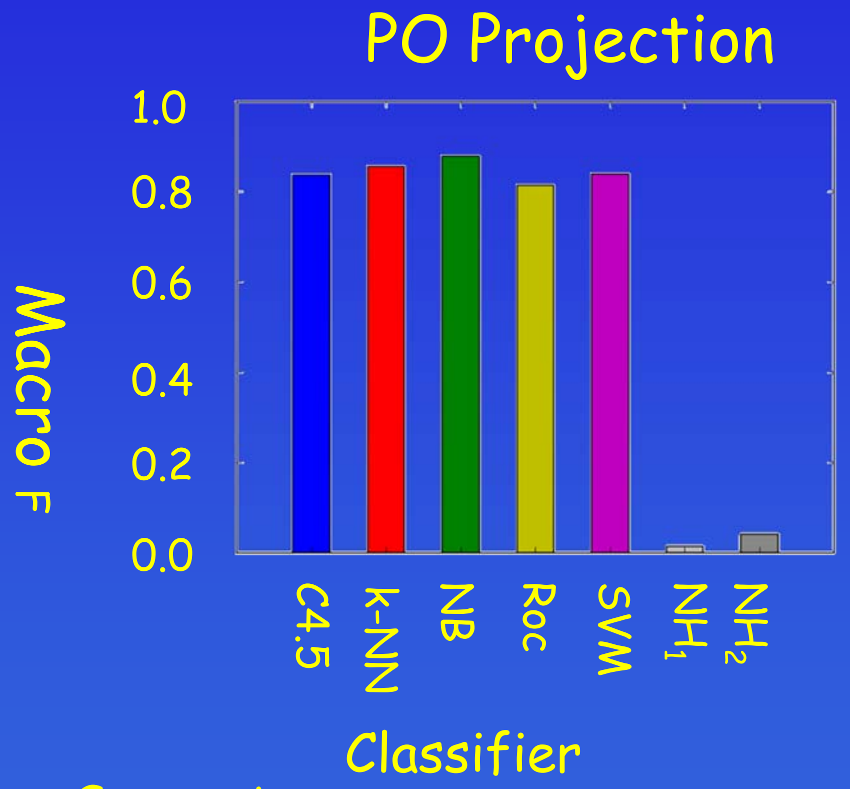
Consider key differences

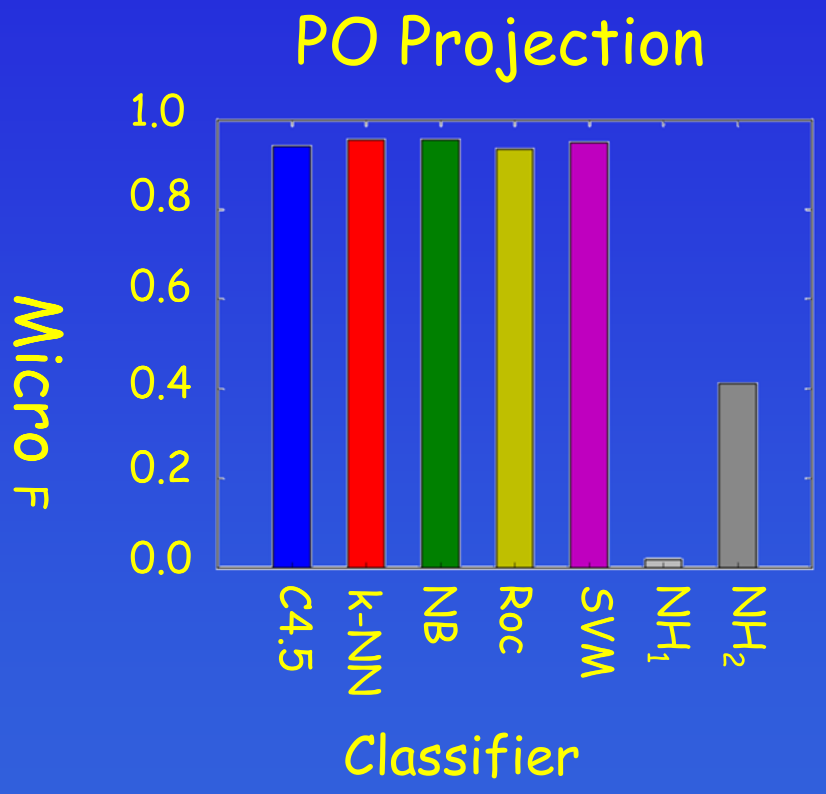
- PO has 2,179,122 documents, Reuters has 9,495
- PO has 909 classes, Reuters has 66
- PO ~ 8.04 features per doc, Reuters ~62.78
- Each feature in the PO data appears in an average of 325.59 documents: in Reuters the figure is 19.38
- PO data contains appreciable label noise (where classes are misclassified), the Reuters data does not.

To evaluate significances of these

- Project PO data into Reuters, so share characteristics.

Projecting PO Data into Reuters





Suggest

SVM good as retained performance from basic Reuters data

C4.5, KNN, NB retained performance from PO data

Conclusions and Further Work

Classification of the PO Data has been achieved

And the results integrated into SpendInsight and GreenInsight

Savings are being made in NHS and elsewhere

SVM is not the best method for the classification

May be because of class distribution or noise

Further work needed to investigate

C4-5, KNN and Naïve Bayes work well

Further work done by Roberts on pre-processing [in PhD thesis]

And on identifying problem classes (see CIS2010 paper)

Thanks to @UK, rest of KTP team and UK Govt.