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# Image Retrieval Using Natural Language and Content-Based Techniques

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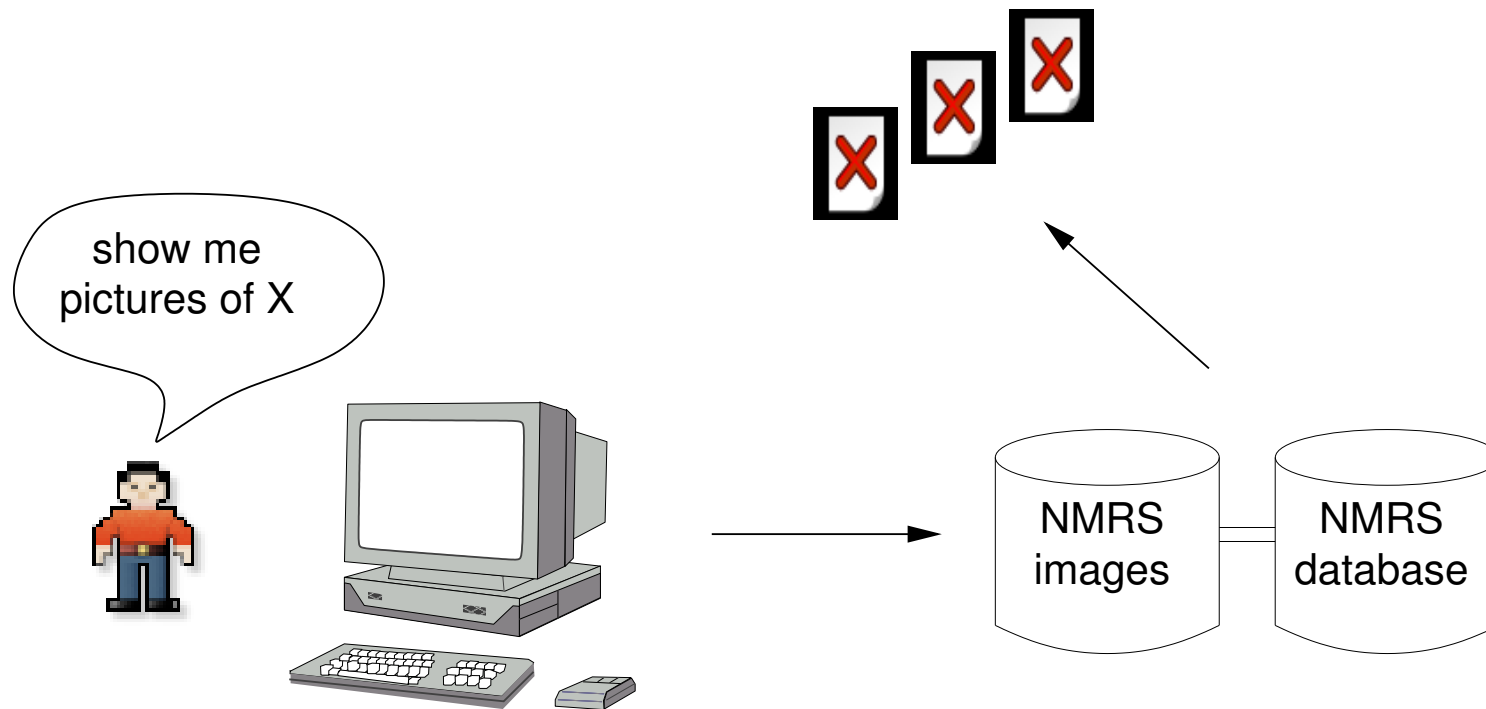
9 December 2003



## Agenda

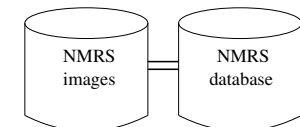
- The Task — what was the aim of the project?
- The Data — National Monuments Record of Scotland
- The Tools — combining and comparing methods
- Demo — CANTRIP in operation
- Evaluation and further work

# Aim of the Project: Image Retrieval



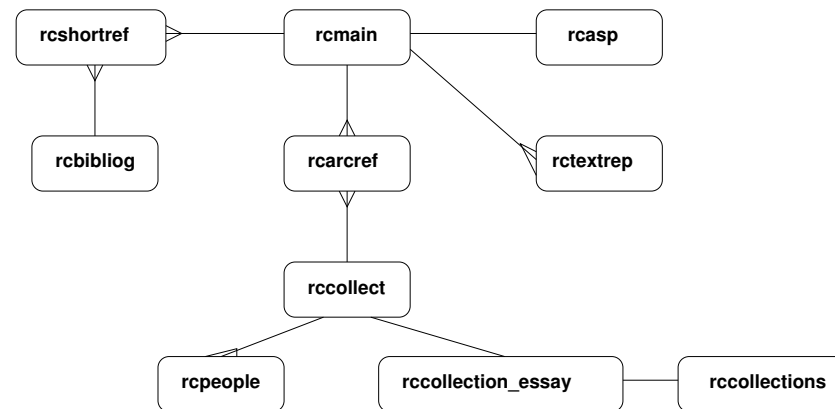
## NMRS - National Monuments Record of Scotland

- archaeological and architectural site surveys
- collection started in 1908
- text, photos, maps, drawings, architects' plans,...
- 250,000 site records; 750,000 linked archive items
- 140Mb text; approx 16 million words
- hierarchical thesaurus (incomplete)



## Subset of NMRS used

- 50,000 digitised images + site and collection fields associated with them

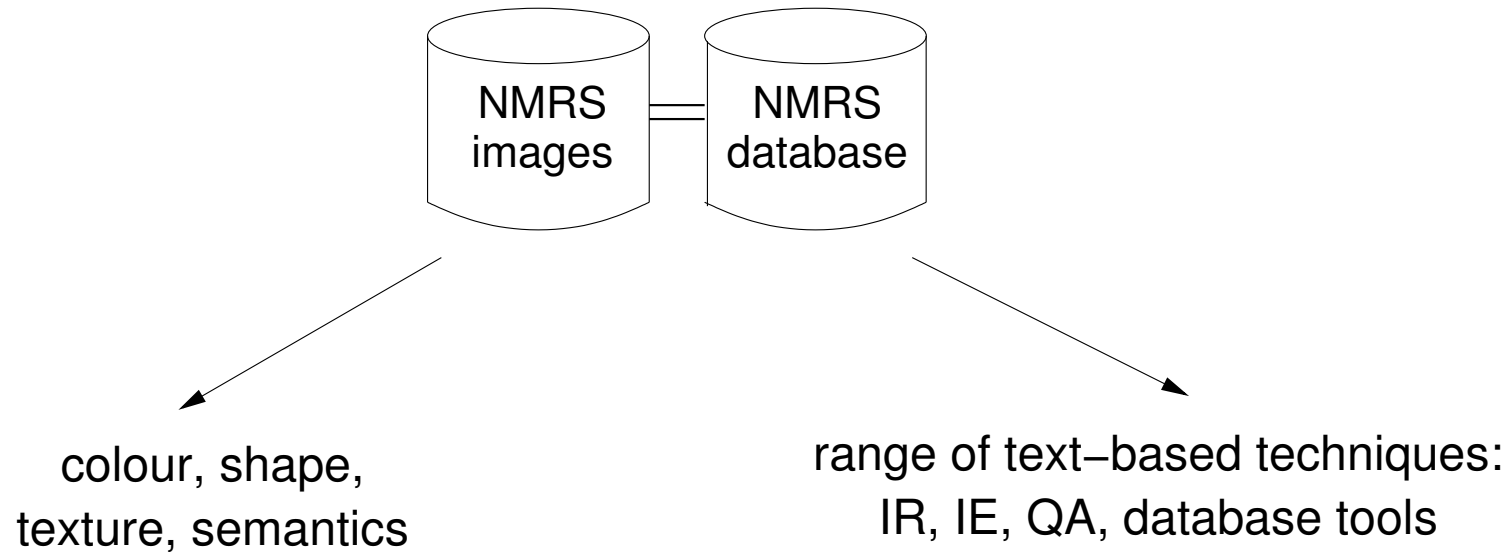


- access to data: [www.rcahms.gov.uk](http://www.rcahms.gov.uk) - CANMORE and CANMAP
- downloads for research available - contact Diana Murray, RCAHMS



## Variety of Approaches

Start with physical image content or with text descriptions?



## Characteristics of image collection

- 29% of images have no caption
- a further 15–20% have non-specific captions, eg “view from north”
- more than 50% of images are black & white
- large number of overlapping categories, and lack of visual similarity within category, eg cist burial sites don’t all look the same, nor do castles
- therefore -
  - used text from across whole database, to supplement captions
  - used CBIR to support text-based methods, not *vice versa*

## Combination of methods...



- IR — inverted indexes with TF-IDF weighting
  - *TF-IDF weight = term frequency × inverse document frequency*
  - high TF-IDF weight  $\Rightarrow$  good for discriminating between different documents
- IE — finding Named Entities
  - people, places, organisations, dates, numeric amounts
  - domain-specific phrases like “unenclosed settlement” or “cruck-framed”

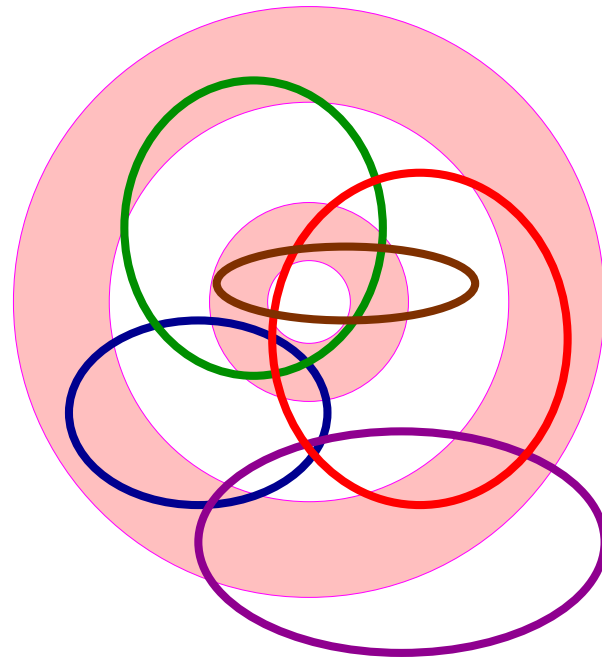
## ...combination of methods

- QA — from question answering: query expansion
  - find preferred or related terms from thesaurus
  - user asks for “greenhouse”, system also searches for “glasshouse” and “botanic garden”
- Database tools — structured queries against fields, with SQL
  - distinguish between type of site and name of site etc
  - use inverted indexes on individual text fields in database
- SIMPLicity, semantics-sensitive CBIR package (Wang et al, 2001)



## Combining and Evaluating

TF-IDF  
+  
NER

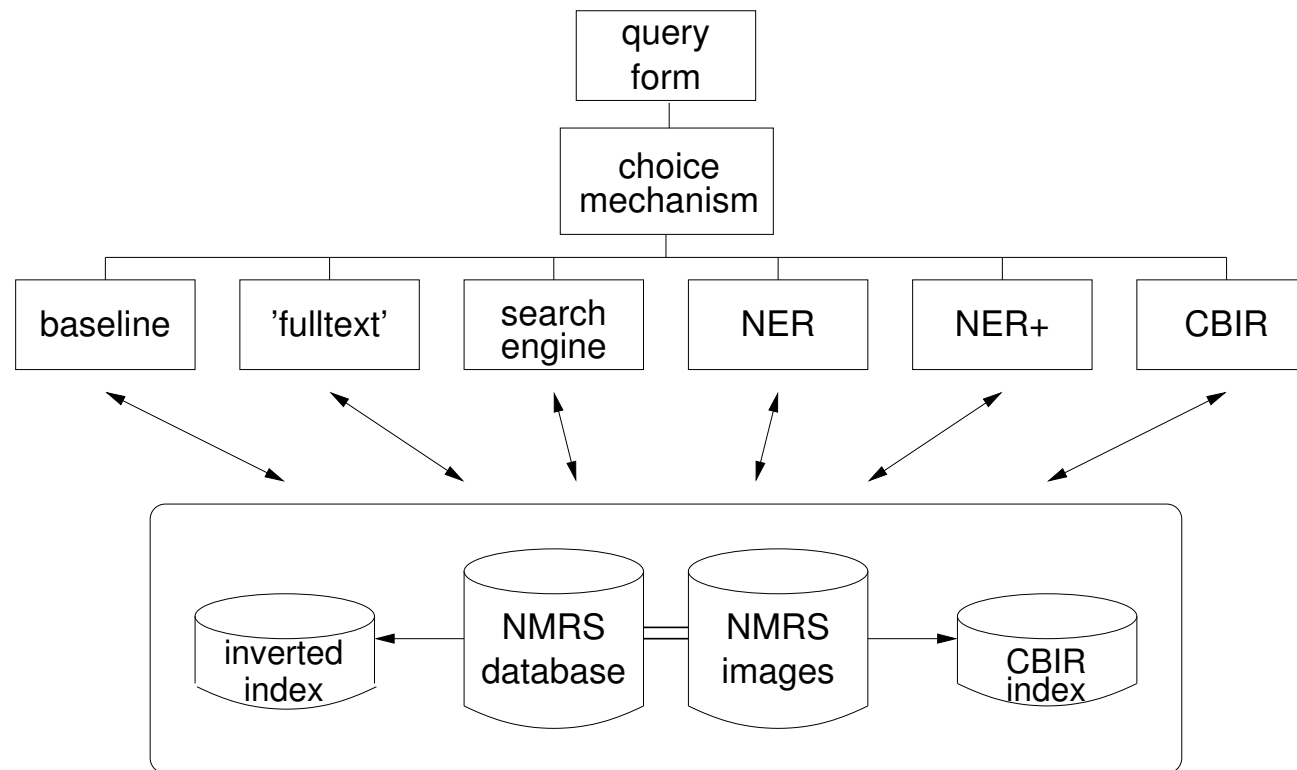


CBIR +  
text-based IR

relational structure + unstructured text

# Implementation

Six versions of CANTRIP, to test different approaches





Demo time...

Example: *Searching for “earth house”, a non-preferred term for “souterrain”*

## Results

	<b>Time</b>	<b>Precision</b>	<b>Recall</b>	<b>Score</b>	<b>Accuracy</b>
NER+	5.77	66.88%	100.00%	100.25	52.28%
fulltext	1.96	48.13%	100.00%	72.69	40.30%
search engine	3.17	29.38%	75.00%	48.63	29.84%
baseline	1.63	37.50%	62.50%	40.13	26.14%
NER	5.00	31.56%	75.00%	39.06	25.68%
CBIR	7.98	60.28%	36.11%	23.63	18.97%



## Further work

- Improve NER and evaluate its accuracy
- Make use of NE categories, eg change interface to use *who*, *what*, *where*, *when* queries
- Improve presentation of results, turning tagged NEs into hypertext links
- Further experimentation with term weighting, for related and preferred terms
- Practicalities: database independence, index maintenance

