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Machine-assisted searching and study selection in systematic reviews

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EPPI CENTRE

Acknowledgements & declaration of interest

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- James Thomas receives funding from Cochrane and the funders below for this and related work; co-lead of Project Transform; lead EPPI-Reviewer software development.

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Objectives

- Provide an overview of text-mining technologies for searching and study selection
- Try out machine learning technologies
- Discuss methodological issues, their implementation and software options

Automation in systematic reviews – what can be done?

- Study identification:
  - Assisting search development
  - RCT classifier
  - Citation screening
  - Updating reviews
- Mapping research activity
- Data extraction
  - Risk of Bias assessment
  - Other study characteristics
  - Extraction of statistical data
- Synthesis and conclusions

Technology

Use in a review	Term recognition / text analytics	Automatic clustering	Automatic classification
Developing search strategies	☑	☑	
Obtaining sub-sets of citations		☑	☑
'Mapping' research literature quickly		☑	☑
Reducing workload during citation screening		☑	☑

Assisting search development

Purpose: to explore linkages or words in text or controlled vocabulary

Applications:

- Increase precision
- Increase sensitivity
- Aid translation across databases
- “Objective” search strategies
- Integrated search and screen systems

Sample of citations

Citation elements
(title, abstract, controlled vocabulary, body of text, etc)

Text analysis

Term extraction and automatic clustering

Word frequency counts, phrases or nearby terms in text

Generic tools

Database specific (PubMed) tools

Statistical analysis

TF-IDF

Statistical and linguistic analysis

TerMine

Automatic Clustering

Word or phrase lists
Visualisation

Revise search elements

Humans assess relevance and impact to search

Mapping research activity

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Mapping research activity

- It is possible to apply ‘keywords’ to text automatically, without needing to ‘teach’ the machine beforehand
- This relies on ‘clustering’ technology – which groups studies which use similar combinations of words
- Very few evaluations
  - Can be promising, especially when time is short
  - But users have no control on the terms actually used

Original Article

Research Synthesis Methods

Received 23 November 2012; Revised 21 March 2013; Accepted 21 April 2013; Published online in Wiley Online Library

(wileyonlinelibrary.com) DOI: 10.1002/jrsm.1082

‘Clustering’ documents automatically to support scoping reviews of research: a case study

Claire Stansfield,*† James Thomas† and Josephine Kavanagh†

Background: Scoping reviews of research help determine the feasibility and the resource requirements of conducting a systematic review, and the potential to generate a description of the literature quickly is attractive.

Aims: To test the utility and applicability of an automated clustering tool to describe and group research studies to improve the efficiency of scoping reviews.

Methods: A retrospective study of two completed scoping reviews was conducted. This compared the

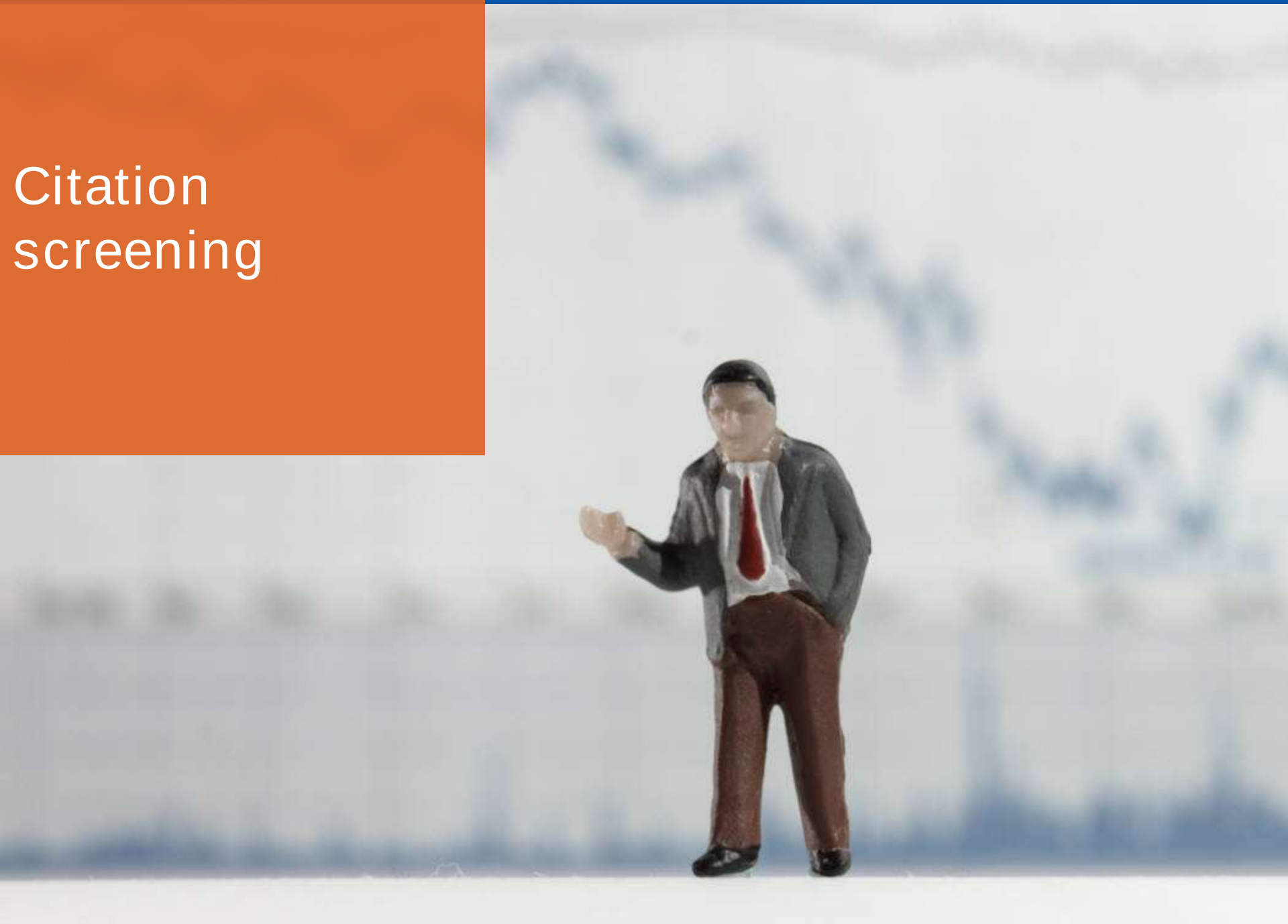
Demo – Topic modelling *pyLDAvis*

http://eppi.ioe.ac.uk/ldavis/index.html#topic=6&lambda=0.63&term=

Technologies for identifying sub-sets of citations

- Different families of techniques
  - Fairly simple approaches which examine term frequencies to group similar citations
  - More complex approaches, such as Latent Dirichlet Allocation (LDA)
- The difficult part is finding good labels to describe the clusters
  - But are labels always needed?
- Visualisations are often incorporated into tools

Citation screening



Citation screening

- Has received most R&D attention
- Diverse evidence base; difficult to compare evaluations
- ‘semi-automated’ approaches are the most common
- Possible reductions in workload in excess of 30% (and up to 97%)

O'Mara-Eves et al. Systematic Reviews 2013, 4:5
http://www.systematicreviewsjournal.com/content/4/1/5

SYSTEMATIC REVIEWS

RESEARCH Open Access

Using text mining for study identification in systematic reviews: a systematic review of current approaches

Alison O'Mara-Eves[1], James Thomas[1*], John McNaught[2], Makoto Miwa[3] and Sophia Ananiadou[2]

Abstract

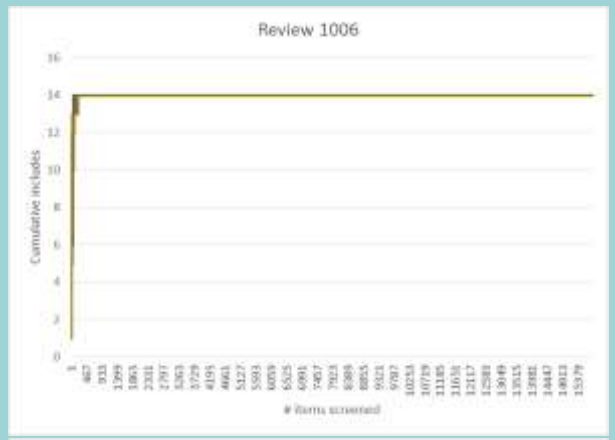
Background: The large and growing number of published studies, and their increasing rate of publication, makes the task of identifying relevant studies in an unbiased way for inclusion in systematic reviews both complex and time consuming. Text mining has been offered as a potential solution: through automating some of the screening process, reviewer time can be saved. The evidence base around the use of text mining for screening has not yet been pulled together systematically; this systematic review fills that research gap. Focusing mainly on non-technical issues, the review aims to increase awareness of the potential of these technologies and promote further collaborative research between the computer science and systematic review communities.

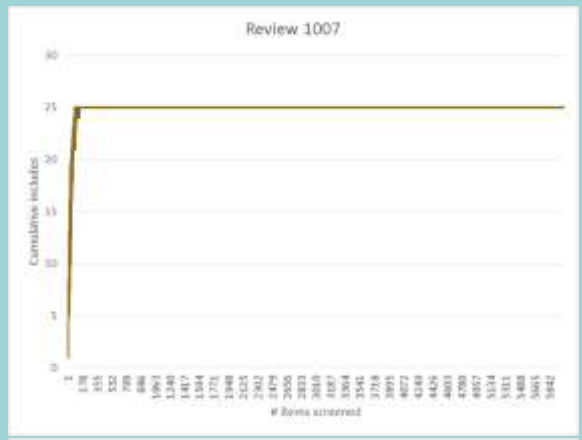
Methods: Five research questions led our review: what is the state of the evidence base; how has workload reduction been evaluated; what are the purposes of semi-automation and how effective are they; how have key contextual problems of applying text mining to the systematic review field been addressed; and what challenges to

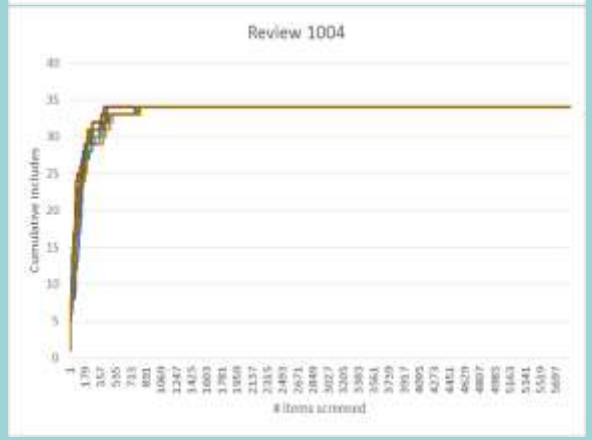
Summary of conclusions

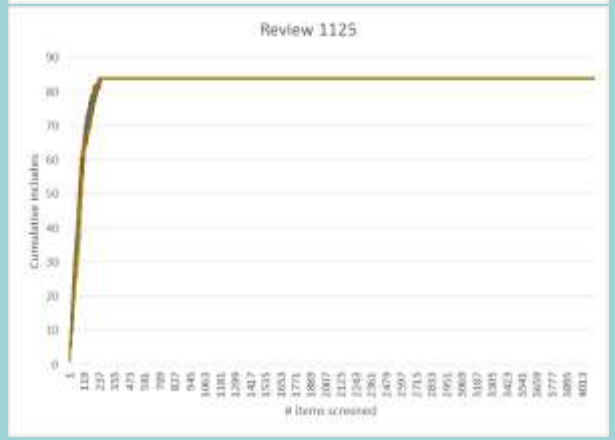
- Screening prioritisation
  - ‘safe to use’
- Machine as a ‘second screener’
  - Use with care
- Automatic study exclusion
  - Highly promising in many areas, but performance varies significantly depending on the domain of literature being screened

Does it work? e.g. reviews from Cochrane Heart Group









What is a classifier?

What does a classifier do?

- It takes as its input the title and abstract describing a publication
- It outputs a ‘probability’ score – between 0 and 1 which indicates how likely the publication is to being the ‘positive class’ (e.g. is an RCT)
- Classification is an integral part of the ‘evidence pipeline’

Demo – Topic modelling and classification in RobotAnalyst

http://www.nactem.ac.uk/robotanalyst/

RobotAnalyst

- Systematic review software designed by National Centre for Text Mining at the University of Manchester:
  - Topic modelling, term extraction, search in text and metadata,
  - Automatic classification based on user's decisions
- Currently being evaluated (users welcome! – contact NaCeTM); to be released soon

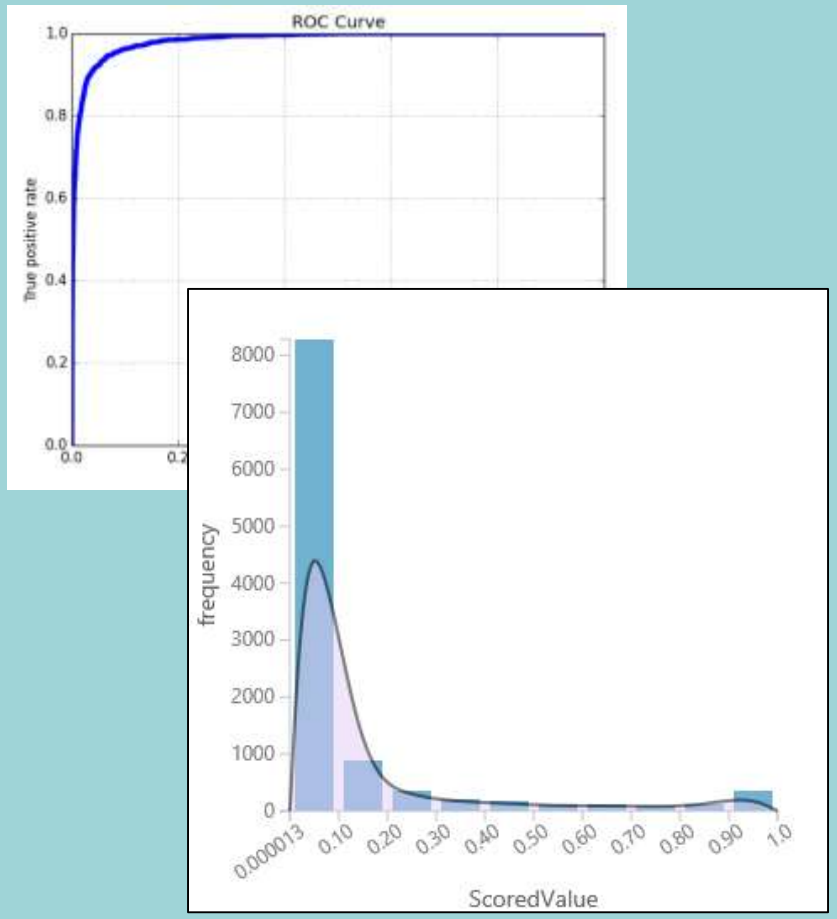
http://www.nactem.ac.uk/robotanalyst/

Pre-built or build your own

- Pre-built in EPPI-Reviewer
  - Developed from established datasets
  - RCT model
  - Systematic review model
  - Economic evaluation
- Build your own

Pre-built classifier

- An RCT classifier was built using more than 280,000 records from Cochrane Crowd
- 60% of the studies have scores < 0.1
- If we trust the machine, and automatically exclude these citations, we're left with 99.897% of the RCTs (i.e. we lose 0.1%)
- Is that good enough?
- Systematic review community needs to discuss appropriate uses of automation



Demo - pre-built RCT classifier *EPPI-Reviewer 4*

http://eppi.ioe.ac.uk/eppireviewer4/

Testing models for TRoPHI register of health promotion controlled trials

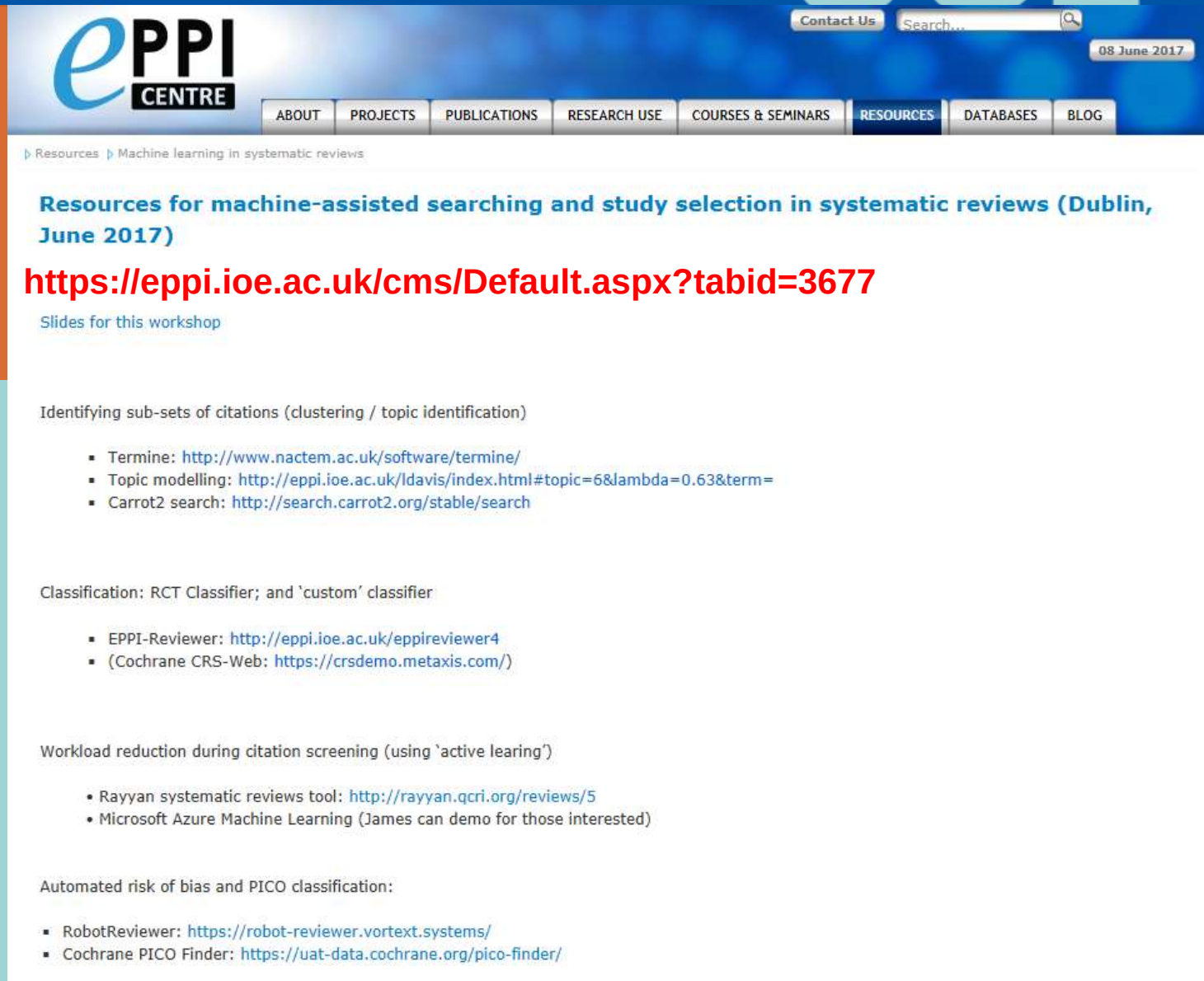
N=9,431 records

Items scored 11-99:	Pre-built RCT classifier		Build your own classifier			
			Best		Second best	
	RCTs	NonRCTs	RCTs	NonRCTs	RCTs	NonRCTs
Precision	12%	3%	17%	5%	12%	4%
Recall	99%	86%	99%	99%	99%	100%
Screening reduction	43%		**58%**		41%	

Demo – Triaging studies using Cochrane CRS

https://crsdemo.metaxis.com/

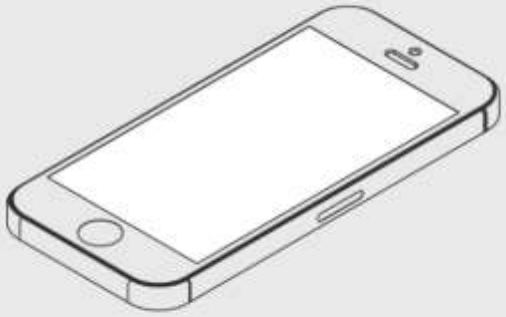
A few tools to try…



Discussion

https://www.mentimeter.com/app

Go to **www.menti.com** and use the code **80 60 84**



1 Grab your phone

2 Go to www.menti.com

3 Enter the code 80 60 84 and vote!

What methods and processes will need to be developed to use these tools?

What are your concerns?

What do you think are the potential benefits?

Research registers

Review types

Efficiency

Topic modelling and mapping

Skills

Reduce recall

Software

Information Literacy

Availability

Risk

Processes

Opportunities

Transparency

Acceptability

Selected bibliography

- SR Toolbox http://systematicreviewtools.com/
- Paynter R, et al. (2016). EPC Methods: An Exploration of the Use of Text-Mining Software in Systematic Reviews. AHRQ Research White Paper.
- O'Mara-Eves A, et al. (2015). Using text mining for study identification in systematic reviews: a systematic review of current approaches. Syst Rev 4: 5.
- Thomas J, et al. (2011). Applications of text mining within systematic reviews. Res Synth Meth 2(1): 1-14.
- Shemilt I, et al. (2016) Use of cost-effectiveness analysis to compare the efficiency of study identification methods in systematic reviews. Syst Rev 5: 140.
- Stansfield C, et al. (in press) Text mining for search term development in systematic reviewing: a discussion of some methods and challenges. Res Synth Meth.
- Stansfield C, et al. (2015) Reducing systematic review workload using text mining: opportunities and pitfalls. J. EAHIL 11(3): 8-10.

Thank you

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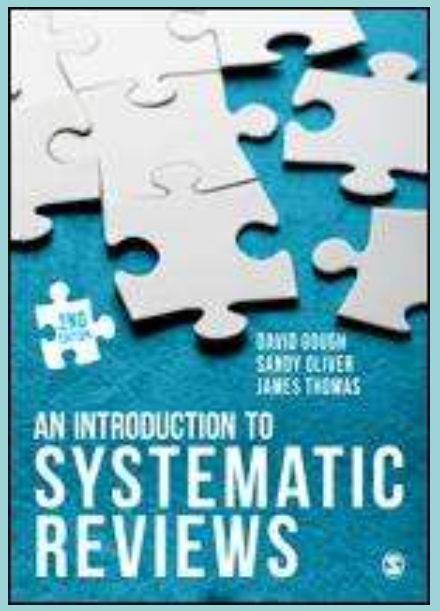

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