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A Brief History of Interactive Information Retrieval Research and (Some) Practice

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Why *Interactive* IR and not just IR?

- IR is inherently an interactive activity
  - Closed stack – open stack libraries
  - Interaction partners: searcher; intermediary; information resource
- Influence of evaluation of IR systems
  - Cranfield paradigm
  - Replicability

Cranfield's Basic Constructs

- Relevance as a measurable and replicable operationalization of usefulness in the accomplishment of a task
- The "all and only" searcher model – the practice of science librarianship
- Replicability and the single query – single response evaluation context

Test Collections and What's Tested

- Test collection:
  - Set of documents; set of information problems (IPs); set of relevance judgments
- What's tested; IR system's:
  - Document representation (indexing); sometimes IP representation (query construction); matching procedures between document representations and queries; indirectly, formal model of IR
- How these are tested:
  - Recall & precision performance for one query and response for each IP, averaged over all IPs in the test collection

Relevance Feedback – The Exception

- Rocchio's (1971 – really late 1960s) recognition of difficulty for searcher to construct an "ideal query"
- Constructing "ideal query" through interpreting searcher's responses to search results
- Interaction here consists of searcher telling the system what documents are relevant and not relevant – i.e. acting as a thermostat

The Upshot

- Research in how to make people's interactions with IR systems bifurcated into two different fields
- Information retrieval research
  - Mostly in CS departments, in Cranfield paradigm
- Information seeking research
  - Mostly in LIS departments, without reference to systems
- Therefore, the need to distinguish Interactive IR research with the adjective

But, IIR practice and research lived on

- In IR practice
  - Operational IR systems eventually had to contend with people searching using the systems
- In IR research
  - Attempting to make operational IR systems accessible and useable, and maybe even effective, and to measure these aspects of the IR interaction

Early Operational IR Systems

- "Batch-mode" searching
  - Multiple collected queries run against tapes of indexed document collections
- MEDLARS first large-scale IR system (1964)
  - Based on tapes used for publishing Index Medicus
  - Search specialists from medical schools trained at NLM
  - Interaction between intermediary and researcher (or research group representative) to construct complex query
  - Relevance judgments a requirement; query reformulation

Going Online

- Online IR systems: systems in which the searcher interacts directly with the system by submitting a query and getting a response
- Research in how to go from batch-mode systems to online systems
  - Technical problems of moving from batch to interactive mode
  - Issues of supporting interaction of searcher with system
- Research at the System Development Corporation and at Lockheed resulted in prototype online IR systems: Orbit and Dialog respectively

Early Online IR Systems

- Designed for use by “search intermediaries”
  - Experts in how to use online IR systems
  - Possibly experts in interacting with end users
- Medline first large-scale online IR system (1972)
  - Orbit + MEDLARS+ = Elhill + TWX = Medline
- System components were, effectively
  - Database (doc citation + index terms); search intermediary; search system interface; search system matching algorithm – always exact match, Boolean
- Search interfaces were complex, command line, terse

Operating Modes of Early Online IR Systems

- Direct access to IR system by intermediaries only; connection cost is a major constraint; results are citation lists
- “Remote” mode:
  - search request form filled out by end user; intermediary uses form to conduct search; results of search sent to end user
- “Interactive” mode:
  - End user makes appointment with intermediary; form is filled out; end user and intermediary develop search strategy and query; query sent to system; results returned; more collaboration; more queries; more results

Robert Taylor and Online Searching

- Taylor (1968)'s four levels of information need and five information "filters"
  - Need levels: Visceral; Conscious; Formal; Compromised
  - Filters: Topic; Motivation/Use; Searcher history and characteristics; Match between description and system; Desired answer type
- Based on observation of librarians' interactions with patrons requiring information (in medical libraries)
- Hypothesis that use of filters leads to "good"results
- Intermediaries educated in technical aspects of searching, and, to some extent, in effective use of filters

Early Research in Online IR Interfaces

- Key document: *Interactive bibliographic search: the user/computer interface*, D.E. Walker (ed.). AFIPS Press, 1971.
  - Report of a Workshop, with contributed papers
  - Contributors responded to “Design Challenges” by John Bennett
  - Representation of major research in 1960s
  - One of the earliest (maybe *the* earliest) HCI meeting

Bennett's Design Challenges

- **Searcher characteristics.**
- How can varying levels of user expertise be supported? Can the behavioral characteristics inherent in searchers be correlated with interactive display techniques to give meaning to ease of use? What level of help should be provided to the user?

Bennett's Design Challenges

- **Conceptual framework.**
- What is the appropriate level of interaction that should be provided? Should the system govern search formulation or should it allow the searcher to construct a search formulation? Should the user provide a complete information need statement and await system results? Should some combination of these techniques be provided? Are Boolean expressions necessary for searching? How can the search power of Boolean operations be provided without teaching searchers how to deal with their formalism? Under what conditions should feedback be provided? How should feedback be implemented? How useful are audio and spatial cues to searchers?

Bennett's Design Challenges

- **System evaluation.**
- How well does the IR system meet user needs? What measures can be used to objectively compare different IR systems and different interface features? What has been learned from feedback obtained from searchers using currently available systems?

The Cognitive Viewpoint

- General trend in many disciplines in the mid- to late 1970s:
  - *Cognitive Science* founded in 1975; *International Workshop on the Cognitive Viewpoint (CC 1977)*, Ghent University
- "Any processing of information (by humans), whether perceptual or symbolic, is mediated by a system of categories or concepts which, for the information processing device, are of model of [its] world." de Mey, 1977

IIR Research and the Cognitive Viewpoint

- Royal School of Librarianship, Copenhagen
  - Jens Rasmussen; Annelise Mark Pejtersen; Peter Ingwersen
  - BOOKHOUSE (a real system, based on empirical data)
  - Search procedures in the library analysed from the cognitive point of view (influence of knowledge structures on behavior)
- University College, London
  - ASK hypothesis (Inherent inability to specify what one doesn't know)
  - B.C. Brookes's Fundamental Equation of Information Science: $K(S) + I = K(S + \Delta S)$

Alternative IR System and Searcher Models

- Robert N. Oddy's THOMAS (1977)
  - Information retrieval through man-machine dialogue
  - Supporting incremental information seeking through network representation of database
- ASK for information retrieval
  - Combine THOMAS and ASK hypothesis
  - Incremental representation of searcher's ASK through dynamic search session

IIR Research in the 1980s – Influence of OPACS

- Need to develop IR systems for naïve end users
  - Efforts to make interfaces, e.g. Boolean query formation, “user friendly”, or at least possible for such end users to use
- First large-scale studies of people’s interactions with IR systems; origins of search log analysis
- Okapi system at Central London Poly; Steve Walker, Natalie Mitev, Steve Robertson
  - Implementing Probability Ranking Principle in an IIR framework

IIR Research in the 1980s – "Intelligent" Intermediaries

- Software systems to emulate functions of human intermediaries for end-user searching
  - Technical vs. intellectual functions
  - User modeling for supporting interactive searching
  - Evidence for Taylor's filters; pro and con (see, e.g. Nordlie, 1999)
  - Complex experimental systems were built, e.g. Vickery & Brooks, 1987
- Systems which observe search behavior in order to offer new types of tailored support
  - Meadow, Hewitt & Aversa, 1982
- Inconclusive results led to demise of this specific line of research
  - Based upon empirical studies of a very specific situation
  - Exceedingly difficult to implement
  - Influenced subsequent research

IIR Research in the late 1980s - early1990s

- New user models, e.g. Bates (1989)'s Berry Picking Model (c.f. Oddy, 1977)
- Influence of Dervin & Nilan (1986)'s ARIST Information needs & uses chapter.
- Beginnings of moves to find direct influences of research in information seeking on IR system design

Some Operational & Research IIR Systems in late 1980s, early 1990s

- BRAQUE – European Space Agency, system to support BRowsing And QUErying; operational
- I3R – Experimental system implementing aspects of user modeling in distributed expert framework
- PLEXUS – Quasi-operational intelligent intermediary system implementing multiple intermediary functions

IIR Research in mid 1990s – early 2000s

- Move from complex modeling to supporting interaction with collections of information objects and with information objects directly (c.f. Oddy, 1977!!)
- Employing theories of cognition, communication in (proposals for) IIR system design
- Information foraging theory (Pirolli & Card, 1999)
- *Task* (motivating and search) as fundamental concept in IIR

Evaluation of IIR Systems, mid 1990s – early 2000s

- TREC Interactive Track
  - tentative beginnings in 1993; explicit track in TREC 3, 1994; ran for 12 years (longest running TREC Track)
- Usability evaluation; application of HCI evaluation metrics and methods
- Recognition of need for new IR evaluation paradigm, measures and methods
  - Move from relevance to other criteria for determining measures of system performance

Trends in IIR in Late 1990s - Early 2000s

- Web search engines!
- SIGIR begins to accept papers with the word “user” in their titles and/or abstracts!
- IliX! and HCIR!
- CHIIR!!

CHEERS! And Thanks for Listening.

Some Important References for History of IIR

- Taylor, R.S. (1968) Question-negotiation and information seeking in libraries. *College & Research Libraries*, 29, 178–194.
- *Interactive bibliographic search: the user/computer interface*, D.E. Walker (ed.). AFIPS Press, 1971.
- Oddy, R.N. (1977) Information retrieval through man-machine dialogue. *Journal of Documentation*, 33, 1–14.
- Savage-Knepshield, P.A. & Belkin, N.J. (1999) Interaction in information retrieval: trends over time. *JASIST*, 50(12):1067–1082.
- Bourne, C.P. & Bellardo-Hahn, T. (2003) A history of online retrieval services. Cambridge, MA: MIT Press.
- Cool, C. & Belkin, N. J. (2011). Interactive information retrieval: history and background. In I. Ruthven & D. Kelly (Eds.*) Interactive Information Seeking, Behaviour and Retrieval* (pp 1-14). London: Facet Publishing.
- Kelly, D. & Sugimoto, C. R. (2013). A systematic review of interactive information retrieval evaluation studies, 1967-2006. *JASIST*, 64(4), 745-770.