

Models for Metasearch

Javed Aslam

The Metasearch Problem

Search for: chili peppers



The image shows three search engine windows side-by-side. The leftmost window is AltaVista, the middle is Excite, and the rightmost is Google. All three have searched for 'chili peppers'. The Google window shows a list of search results, with the top results being for the Red Hot Chili Peppers. The results include links to their official website, fan sites, and various articles. The search results are numbered 1 through 39.



The image shows a search engine results page for 'chili peppers'. The results are numbered 1 through 39. The top results are for the Red Hot Chili Peppers, including their official website, fan sites, and various articles. The search results are numbered 1 through 39.

Search Engines

- Provide a ranked list of documents.
- May provide relevance scores.
- May have performance information.

Search Engine: Alta Vista

The screenshot shows the Alta Vista search engine interface. The browser window title is "Communicator" and the address bar shows the URL: <http://www.altavista.com/cgi-bin/query?q=chili+peppers&k1=X00&pg=q&Translate=on&search.x=18&search.y=11>. The search bar contains the text "chili peppers" and the search button is labeled "Search". Below the search bar, there are several related search suggestions: "redhot chili peppers", "chill peppers tabs", "ret hot chili peppers", and "chill peppers lyrics". The page also features a banner for "alta vista: SHOPPING Gift of Learning Sweepstakes" and a section for "AltaVista Recommends" with links to "Music with: chili peppers" and "AltaVista Entertainment: Music". The search results section shows "58,832 pages found" and a list of results for "chili peppers".

alta vista: SHOPPING
Gift of Learning Sweepstakes
Click Here!
Click here to find out more!

Search for: chili peppers
any language Search
Help | Customize Settings | Family Filter is off

Search within these results Example: +skin +cancer -ultraviolet

Related Searches:
- redhot chili peppers - chill peppers tabs
- ret hot chili peppers - chill peppers lyrics

AltaVista Recommends

* Music with: [chili peppers](#)
* AltaVista Entertainment: [Music](#)

Find Results In: Products News Business Web Pages Images MP3/Audio Video Directories 58,832 pages found.

chili peppers - Click here for a list of Internet Keywords related to chili peppers

See editor-selected sites in: [The Red Hot Chili Peppers](#) | [Red Hot Chili Peppers Band Members](#) | [Red Hot Chili Peppers Fan Dedications](#) | [Red Hot Chili Peppers Bios and Discographies](#) | [Red Hot Chili Peppers News and Zines](#) | [Red Hot Chili Peppers Multimedia](#)

1. [Red Hot Chili Peppers](#)
This web site was created for FREE at [www.homestead.com](#). Visit [www.homestead.com](#) to get your free web site - no programming required.
URL: [www.homestead.com/musiccorner/hotchilipeppers.html](#)
[Translate](#) [More pages from this site](#) [Related pages](#)

2. [Abbey Road: Red Hot Chili Peppers Fansite](#)
For fans of pre-1992 Red Hot Chili Peppers Funk Style!...
URL: [members.xoom.com/old_rhcp/index.html](#)
[Translate](#) [Related pages](#) Facts about: [Xoom.Com Inc.](#)

3. [dotmusic - Single Review - Red Hot Chili Peppers - 'Otherside' \(WEA\)](#)
Typically groovy bassist Flea fuels the momentum
URL: [www2.dotmusic.com/reviews/Singles/Januar...eviews12638.asp](#)
[Translate](#) [Related pages](#)

4. [Red Hot Chili Peppers](#)
Buy Californication Now. Enter your email address to receive information about The Red Hot Chili Peppers. Email: Go to the RED HOT CHILI PEPPERS...
URL: [www.wbr.com/chilipeppers/index.html](#)
[Translate](#) [Related pages](#) Facts about: [Warner Brothers S...](#)

5. [Hot Chili Peppers Homepage](#)

alta vista: SHOPPING
Computer Hardware
Gifts & Flowers
Furniture

alta vista: CAREERS
Post Resume
Career Advice
Search Tips

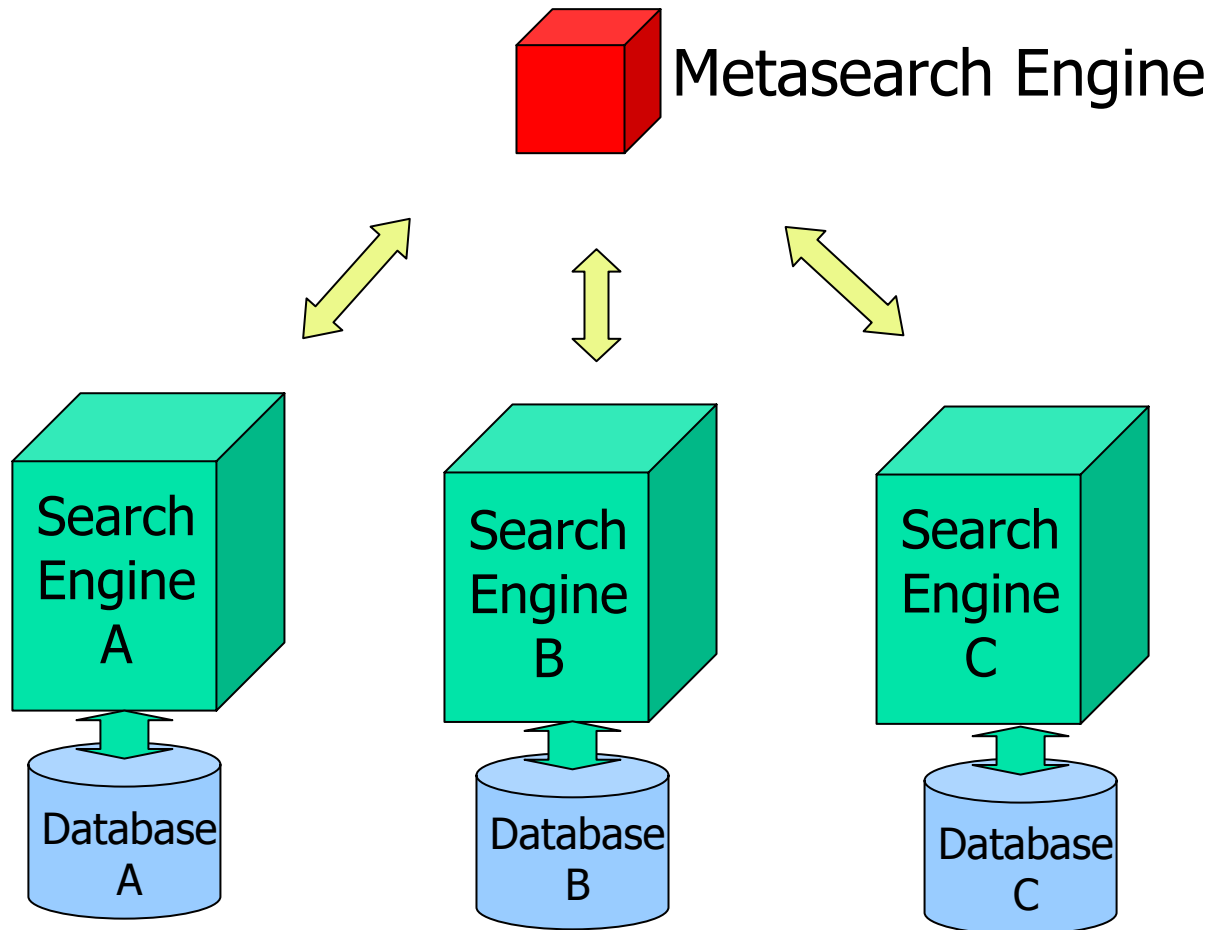
Search Engine: Ultraseek

The screenshot displays the Ultraseek search engine interface within a web browser window. The browser's address bar shows the URL: `http://ultraseek.dartmouth.edu:8765/query.html?qt=chili+peppers&rq=0&vs=0&qm=0&st=1&nh=10&lk=1&f=0&rq=0`. The page header features the Dartmouth logo (est. 1769) and navigation links for HOME, INDEX, HELP, and SEARCH. Below the header, a search bar contains the query "chili peppers" with a "GO" button. To the right of the search bar, there are links for "Help Using the Search Engine", "Searching smart", "Getting listed", and "FAQ". Below the search bar, there are checkboxes for "Select all", "chile", and "chilli". The "Other Searches" section lists various search options like "Dartmouth Name Directory (DND)", "Dartmouth Library Catalog", and "Dartmouth College Information System (DCIS)". The search results section shows "144 results found, sorted by relevance" and "Document count: chilli (46) peppers (129) chilli peppers (6)". The results are displayed in a list format, with the first three results visible. Each result includes a title, a brief description, a date, and a "Find Similar" link. The first result is "Home Plate menu 11/5 to 11/10" dated 03 Nov 00 with a 74% similarity. The second result is "my baby" dated 31 Jan 00 with a 68% similarity. The third result is "Home Plate Menu 11/12-17" dated 10 Nov 00 with a 65% similarity. The browser's status bar at the bottom shows "100%" zoom and various system icons.

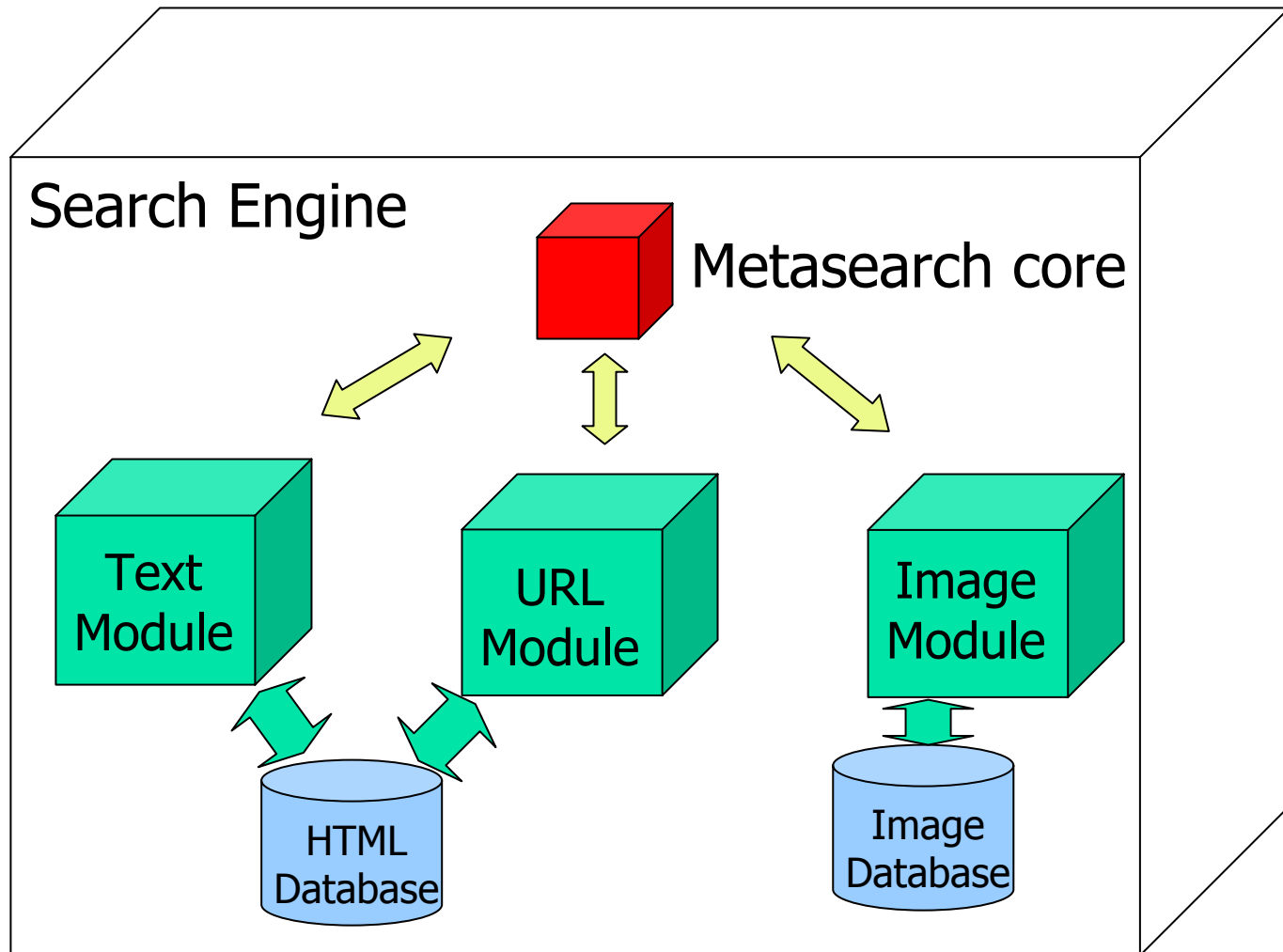
Search Engine: inq102 TREC3

```
Queryid (Num):          50
Total number of documents over all queries
  Retrieved:            50000
  Relevant:               9805
  Rel_ret:              7305
Interpolated Recall - Precision Averages:
  at 0.00               0.8992
  at 0.10               0.7514
  at 0.20               0.6584
  at 0.30               0.5724
  at 0.40               0.4982
  at 0.50               0.4272
  at 0.60               0.3521
  at 0.70               0.2915
  at 0.80               0.2173
  at 0.90               0.1336
  at 1.00               0.0115
Average precision (non-interpolated)
for all rel docs (averaged over queries)
  0.4226
Precision:
  At    5 docs:        0.7440
  At   10 docs:        0.7220
  At   15 docs:        0.6867
  At   20 docs:        0.6740
  At   30 docs:        0.6267
  At  100 docs:        0.4902
  At  200 docs:        0.3848
  At  500 docs:        0.2401
  At 1000 docs:        0.1461
R-Precision (precision after R
(= num_rel for a query) docs retrieved):
  Exact:                0.4524
```

External Metasearch



Internal Metasearch



Outline

- ✓ Introduce problem
- Characterize problem
- Survey current techniques
- Describe new approaches
 - decision theory, social choice theory
 - experiments with TREC data
- Upper bounds for metasearch
- Future work

Classes of Metasearch Problems

	no training data	training data
ranks only	Borda, Condorcet, rCombMNZ	Bayes
relevance scores	CombMNZ	LC model

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CombSUM [Fox, Shaw, Lee, et al.]

- Normalize scores: $[0,1]$.
- For each doc:
 - sum relevance scores given to it by each system (use 0 if unretrieved).
- Rank documents by score.
- Variants: MIN, MAX, MED, ANZ, MNZ

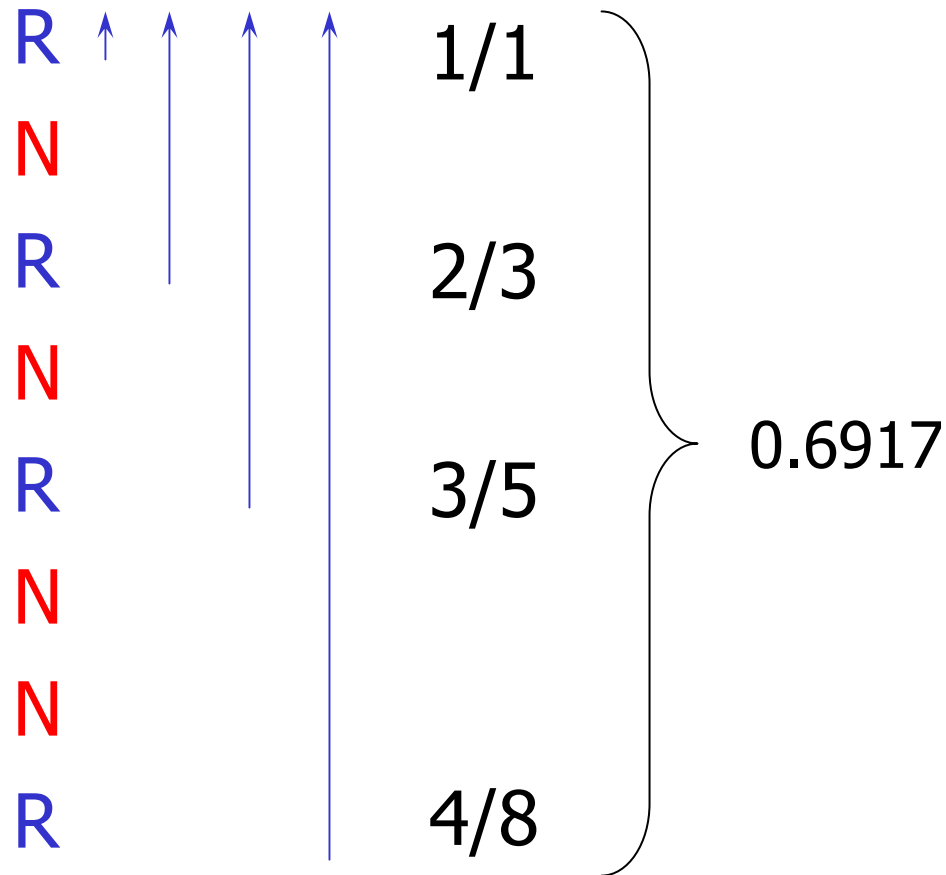
CombMNZ [Fox, Shaw, Lee, et al.]

- Normalize scores: $[0,1]$.
- For each doc:
 - sum relevance scores given to it by each system (use 0 if unretrieved), and
 - multiply by number of systems that retrieved it (MNZ).
- Rank documents by score.

How well do they perform?

- Need *performance metric*.
- Need *benchmark data*.

Metric: Average Precision



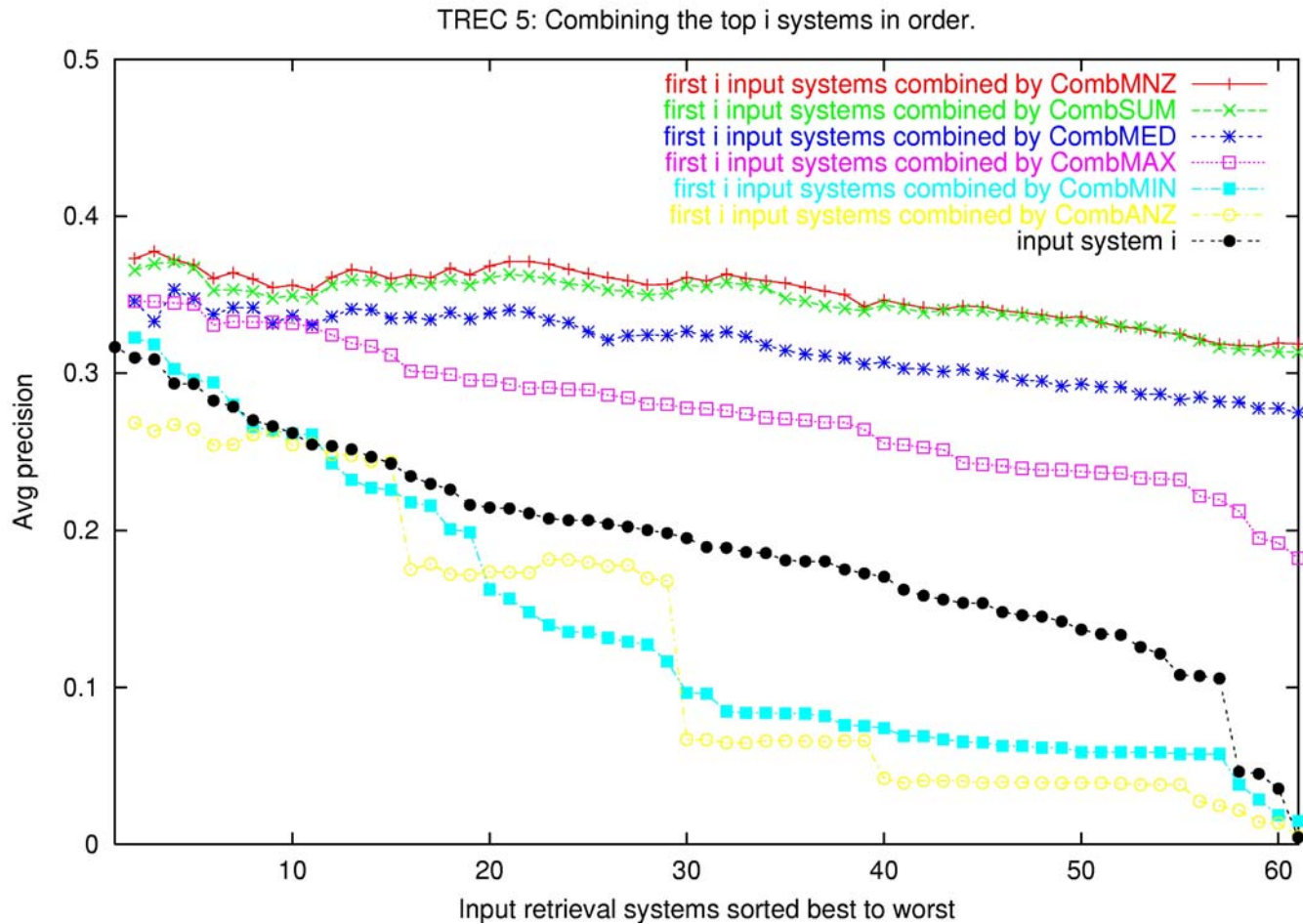
Benchmark Data: TREC

- Annual *Text Retrieval Conference*.
- Millions of documents (AP, NYT, etc.)
- 50 queries.
- Dozens of retrieval engines.
- Output lists available.
- Relevance judgments available.

Data Sets

Data set	Number systems	Number queries	Number of docs
TREC3	40	50	1000
TREC5	61	50	1000
Vogt	10	10	1000
TREC9	105	50	1000

CombX on TREC5 Data

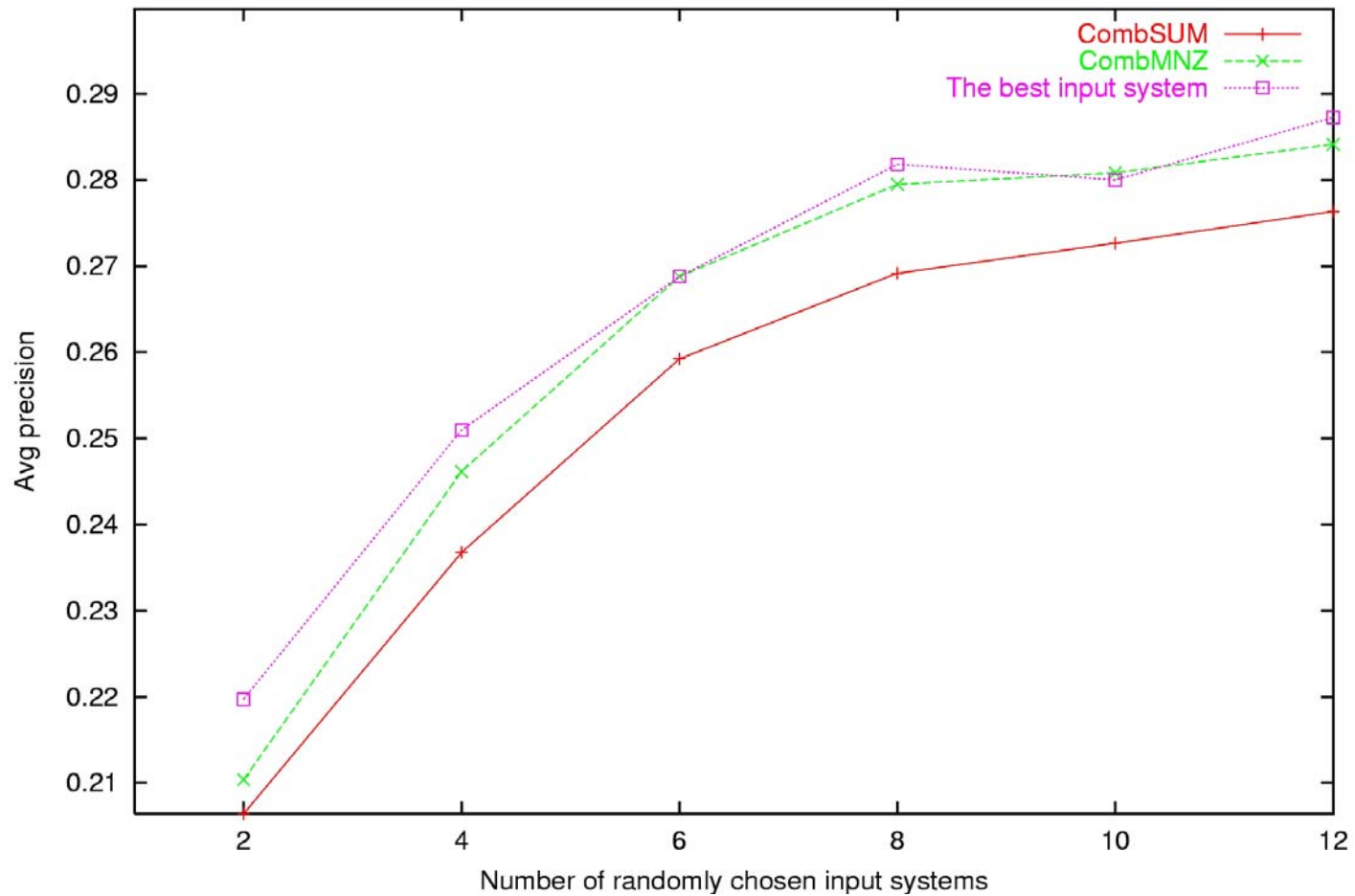


Experiments

- Randomly choose n input systems.
- For each query:
 - combine, trim, calculate avg precision.
- Calculate mean avg precision.
- Note best input system.
- Repeat (statistical significance).

CombMNZ on TREC5

TREC 5: avg precision over 200 random sets of systems.



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New Approaches [Aslam, Montague]

- Analog to *decision theory*.
 - Requires only rank information.
 - Training required.
- Analog to *election strategies*.
 - Requires only rank information.
 - No training required.

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Decision Theory

- Consider two alternative explanations for some observed data.
 - Medical example:
 - Perform a set of blood tests.
 - Does patient have disease or not?
- Optimal method for choosing among the explanations: *likelihood ratio test*.
[Neyman-Pearson Lemma]

Metasearch via Decision Theory

- Metasearch analogy:
 - *Observed data* – document rank info over all systems.
 - *Hypotheses* – document is relevant or not.

- Ratio test:
$$O_{rel} = \frac{\Pr[rel \mid r_1, r_2, \dots, r_n]}{\Pr[irr \mid r_1, r_2, \dots, r_n]}$$

Bayesian Analysis

$$P_{rel} = \Pr[rel | r_1, r_2, \dots, r_n]$$

$$P_{rel} = \frac{\Pr[r_1, r_2, \dots, r_n | rel] \cdot \Pr[rel]}{\Pr[r_1, r_2, \dots, r_n]}$$

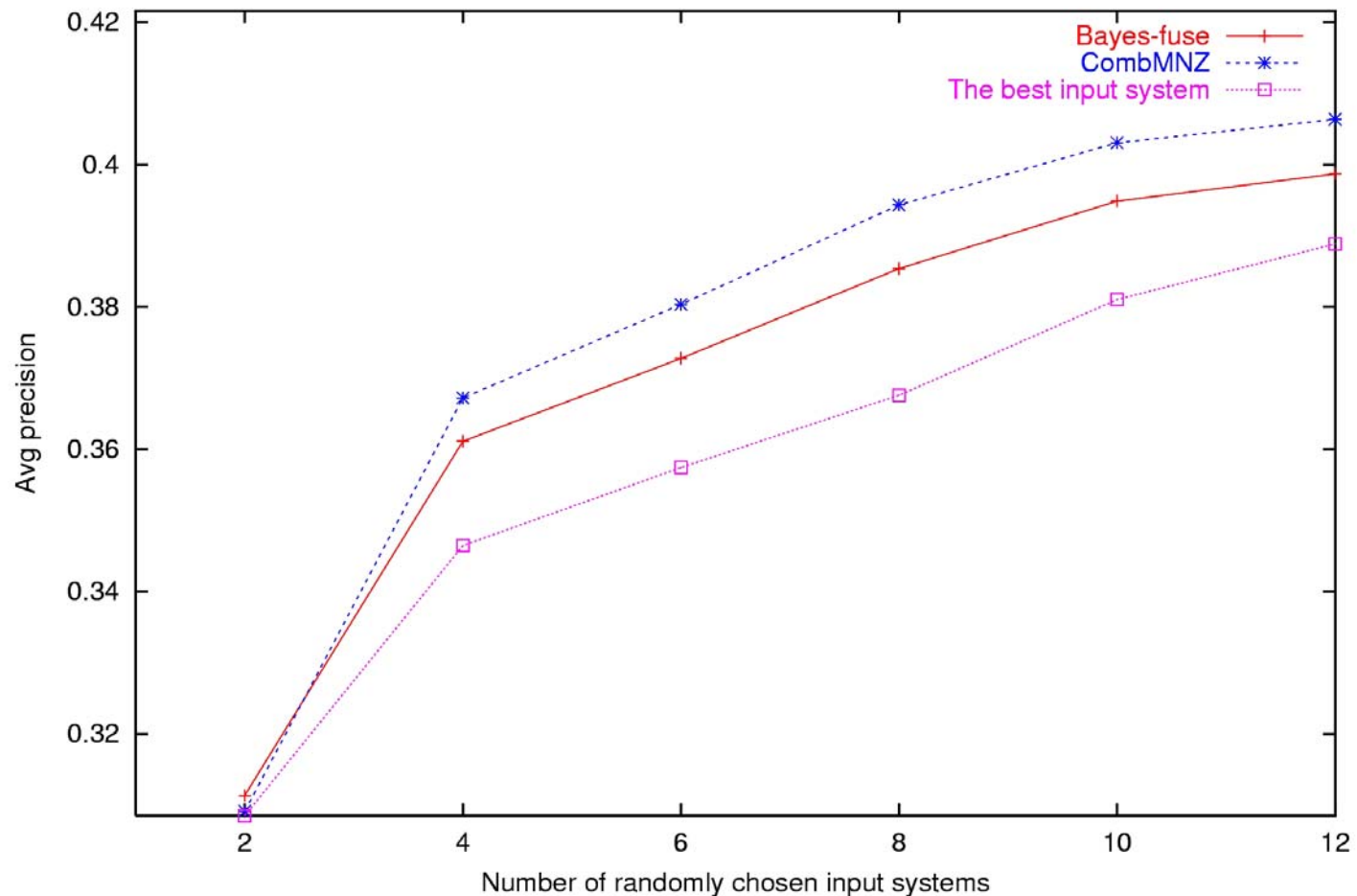
$$O_{rel} = \frac{\Pr[r_1, r_2, \dots, r_n | rel] \cdot \Pr[rel]}{\Pr[r_1, r_2, \dots, r_n | irr] \cdot \Pr[irr]}$$

$$O_{rel} \cong \frac{\Pr[rel] \cdot \prod_i \Pr[r_i | rel]}{\Pr[irr] \cdot \prod_i \Pr[r_i | irr]}$$

$$LO_{rel} \sim \sum_i \log \frac{\Pr[r_i | rel]}{\Pr[r_i | irr]}$$

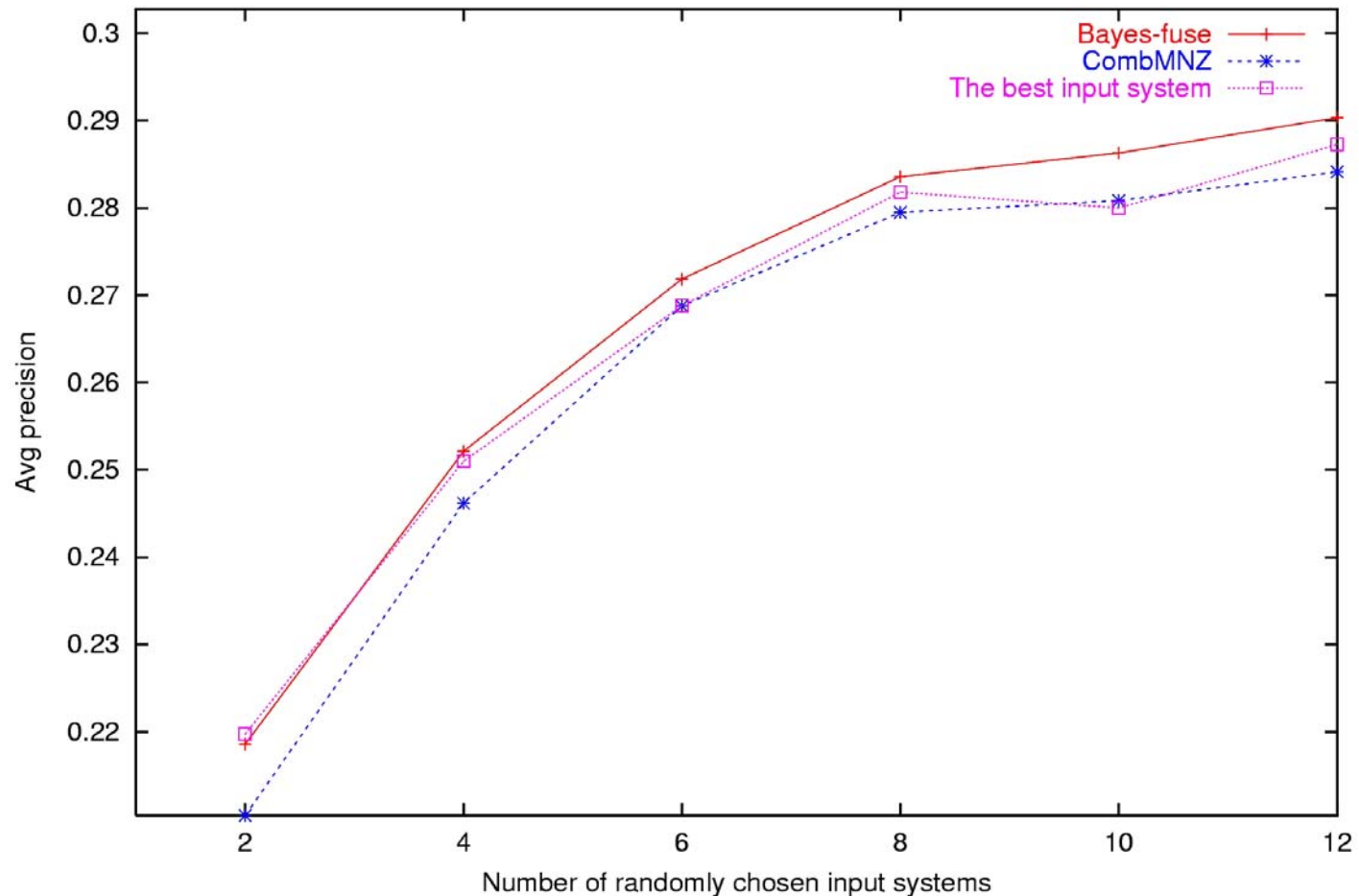
Bayes on TREC3

TREC 3: avg precision over 200 random sets of systems.



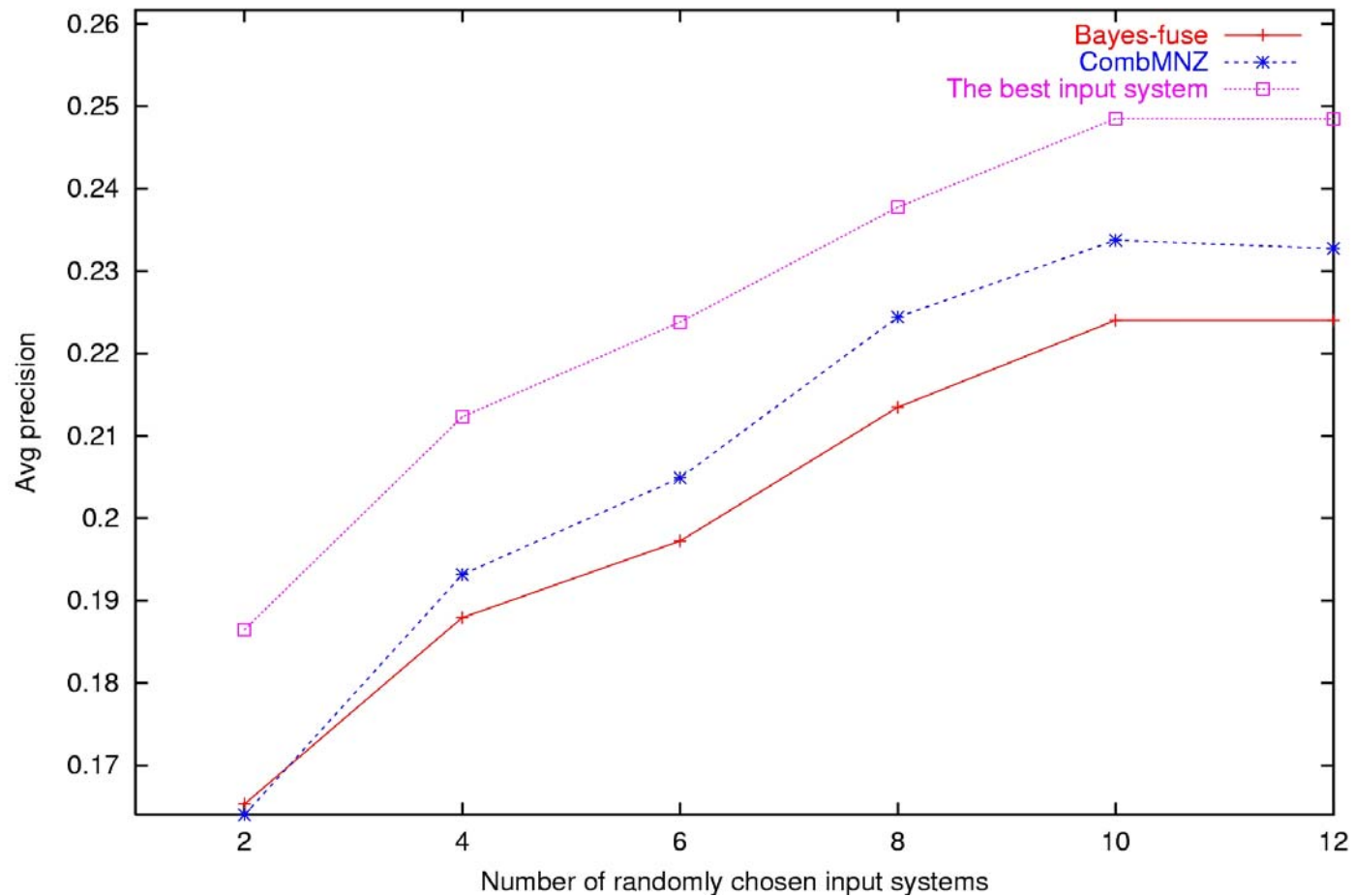
Bayes on TREC5

TREC 5: avg precision over 200 random sets of systems.



Bayes on TREC9

TREC 9: avg precision over 200 random sets of systems.



Beautiful theory, but...

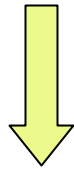
*In theory, there is no difference between theory and practice;
in practice, there is.*

–variously: Chuck Reid, Yogi Berra

Issue: *independence assumption...*

Naïve-Bayes Assumption

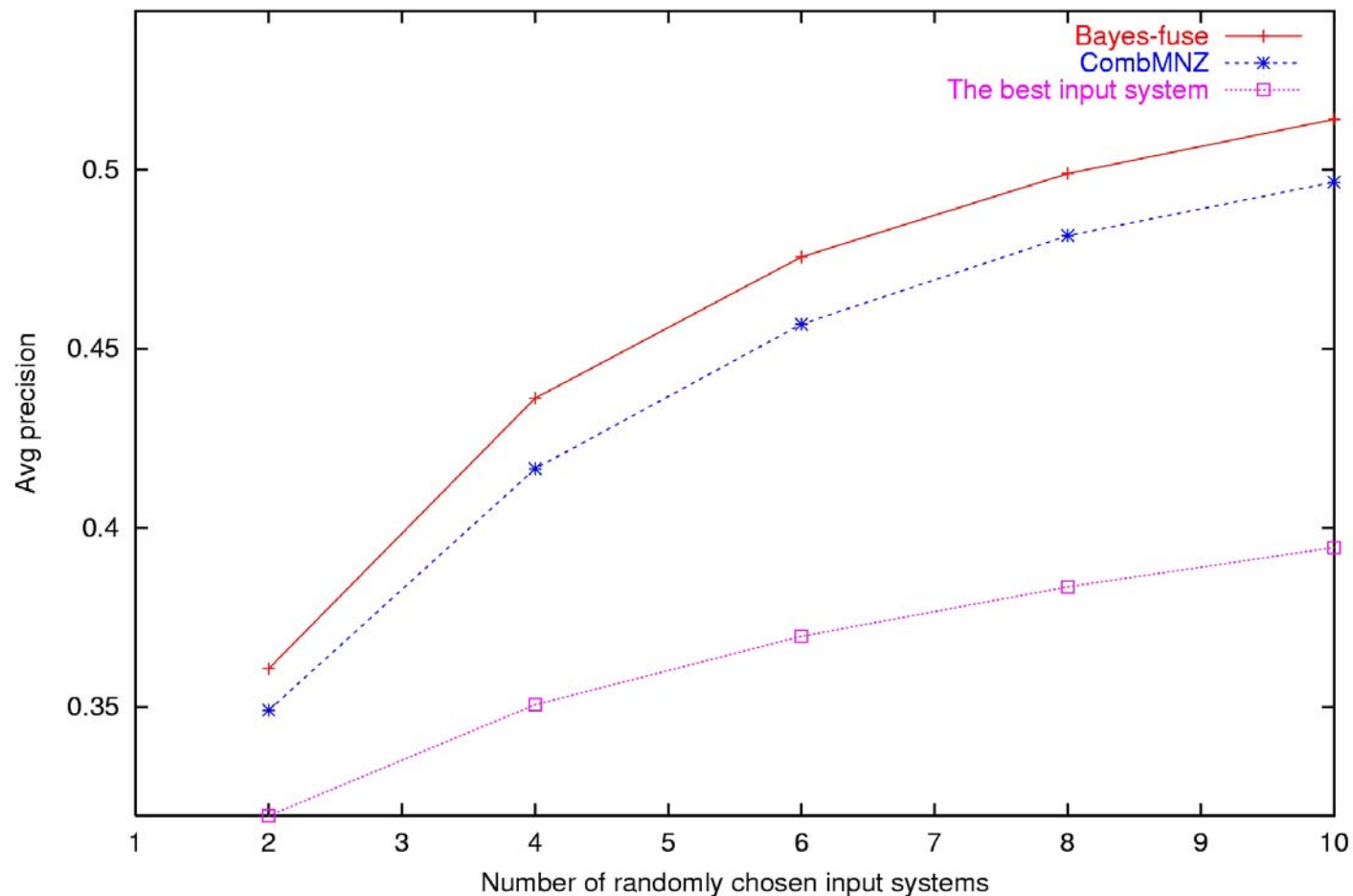
$$O_{rel} = \frac{\Pr[r_1, r_2, \dots, r_n \mid rel] \cdot \Pr[rel]}{\Pr[r_1, r_2, \dots, r_n \mid irr] \cdot \Pr[irr]}$$



$$O_{rel} \cong \frac{\Pr[rel] \cdot \prod_i \Pr[r_i \mid rel]}{\Pr[irr] \cdot \prod_i \Pr[r_i \mid irr]}$$

Bayes on Vogt Data

TREC 5 subset: avg precision over between 1 and 200 random sets of systems.



New Approaches [Aslam, Montague]

- Analog to *decision theory*.
 - Requires only rank information.
 - Training required.
- Analog to *election strategies*.
 - Requires only rank information.
 - No training required.

Classes of Metasearch Problems

	no training data	training data
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relevance scores	CombMNZ	LC model

Election Strategies

- Plurality vote.
- Approval vote.
- Run-off.
- Preferential rankings:
 - instant run-off,
 - Borda count (positional),
 - Condorcet method (head-to-head).

Metasearch Analogy

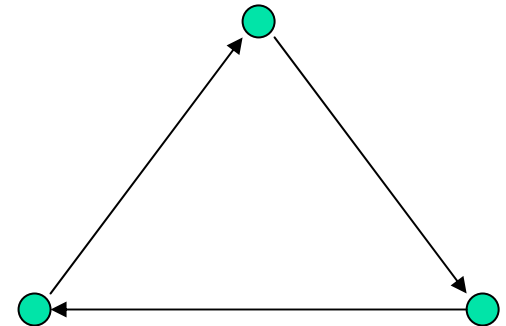
- Documents are *candidates*.
- Systems are *voters* expressing preferential rankings among candidates.

Condorcet Voting

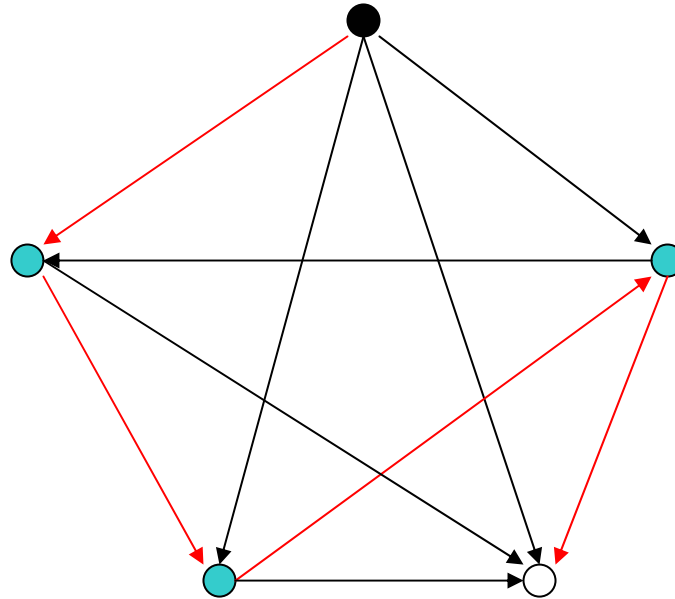
- Each ballot ranks all candidates.
- Simulate head-to-head run-off between each pair of candidates.
- Condorcet winner: candidate that beats all other candidates, head-to-head.

Condorcet Paradox

- Voter 1: A, B, C
- Voter 2: B, C, A
- Voter 3: C, A, B
- Cyclic preferences: cycle in Condorcet graph.
- Condorcet consistent path: Hamiltonian.
- For metasearch: any CC path will do.



Condorcet Consistent Path

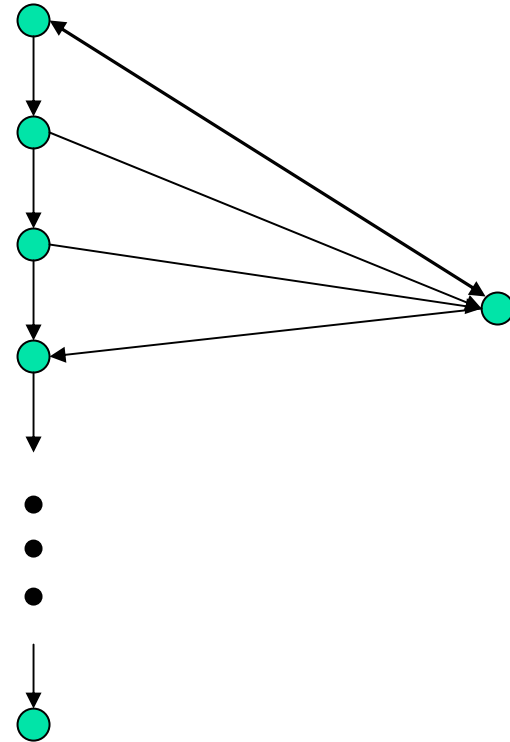


Hamiltonian Path Proof

Base Case:



Inductive Step:

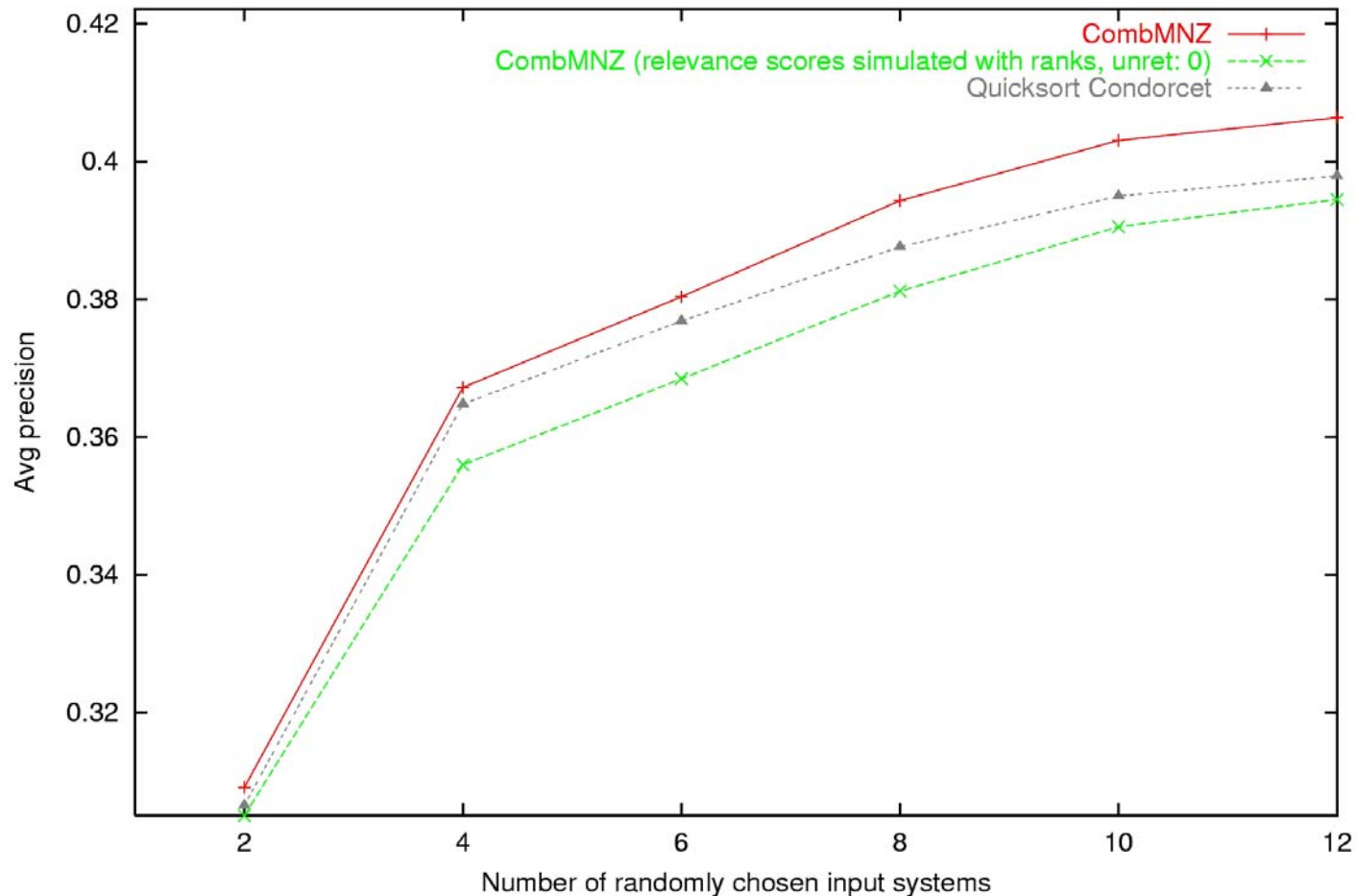


Condorcet-fuse: Sorting

- Insertion-sort suggested by proof.
- Quicksort too; $O(n \log n)$ comparisons.
 - n documents.
- Each comparison: $O(m)$.
 - m input systems.
- Total: $O(m n \log n)$.
- *Need not compute entire graph.*

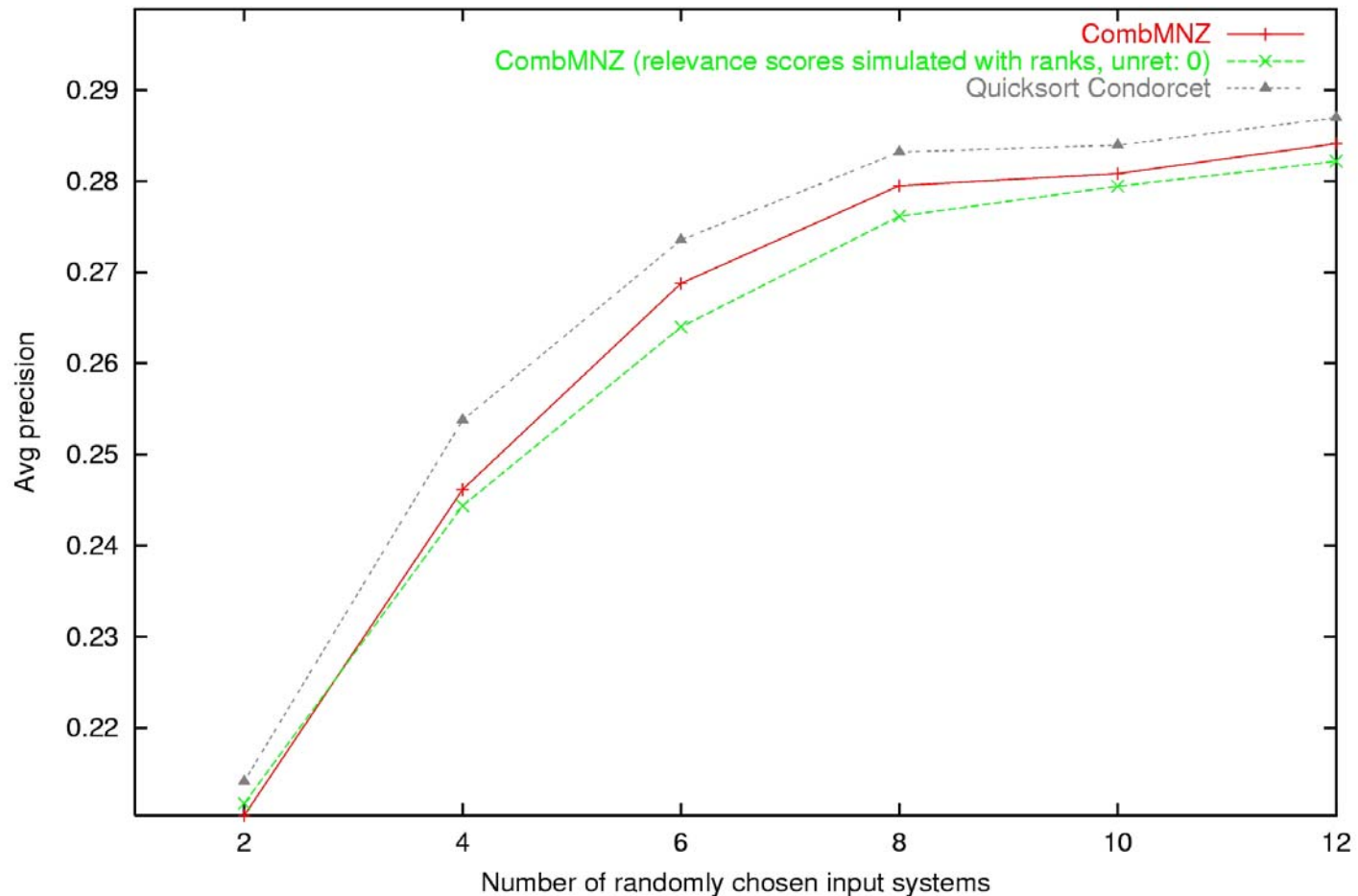
Condorcet-fuse on TREC3

TREC 3: avg precision over 200 random sets of systems.



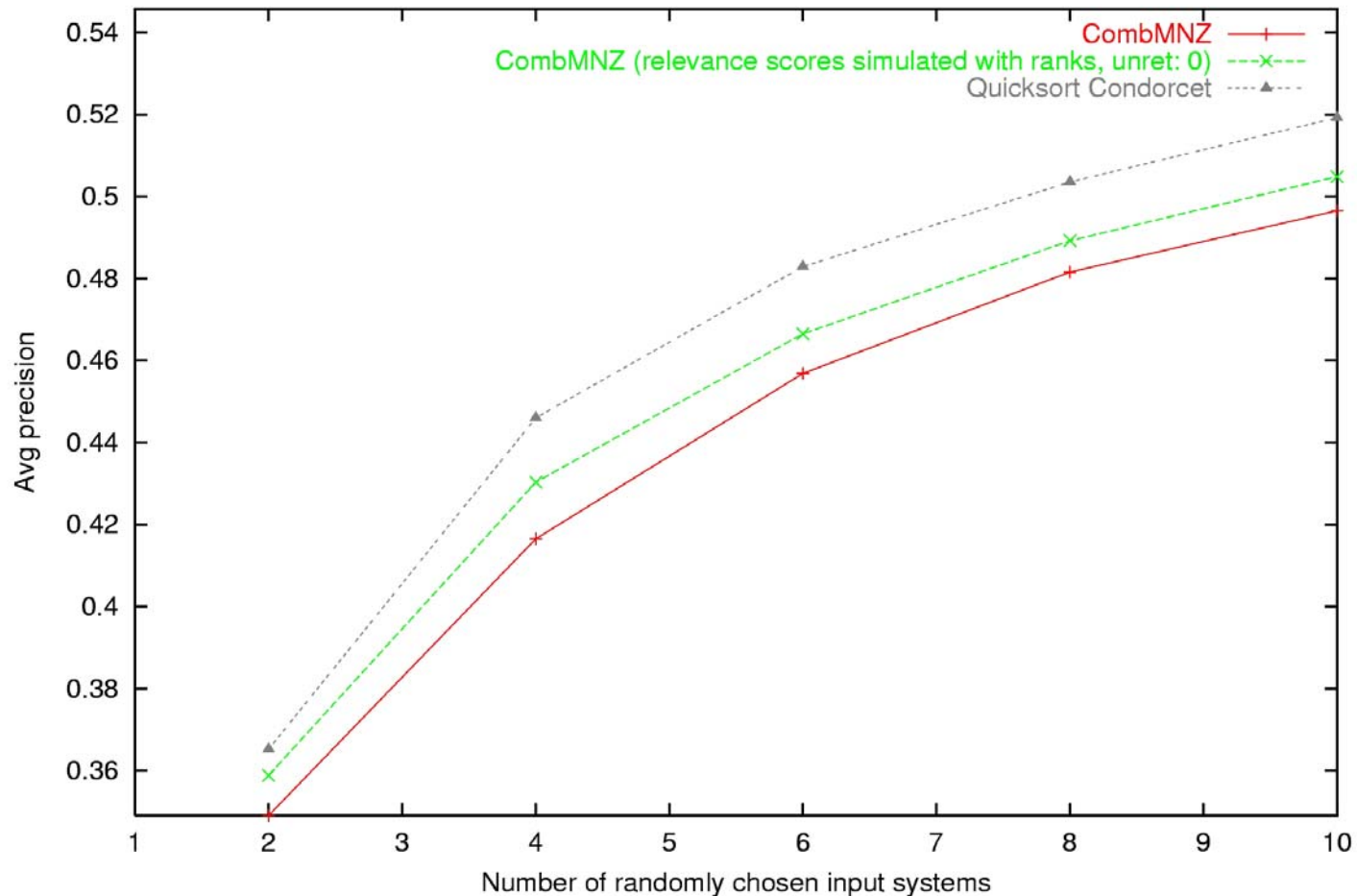
Condorcet-fuse on TREC5

TREC 5: avg precision over 200 random sets of systems.



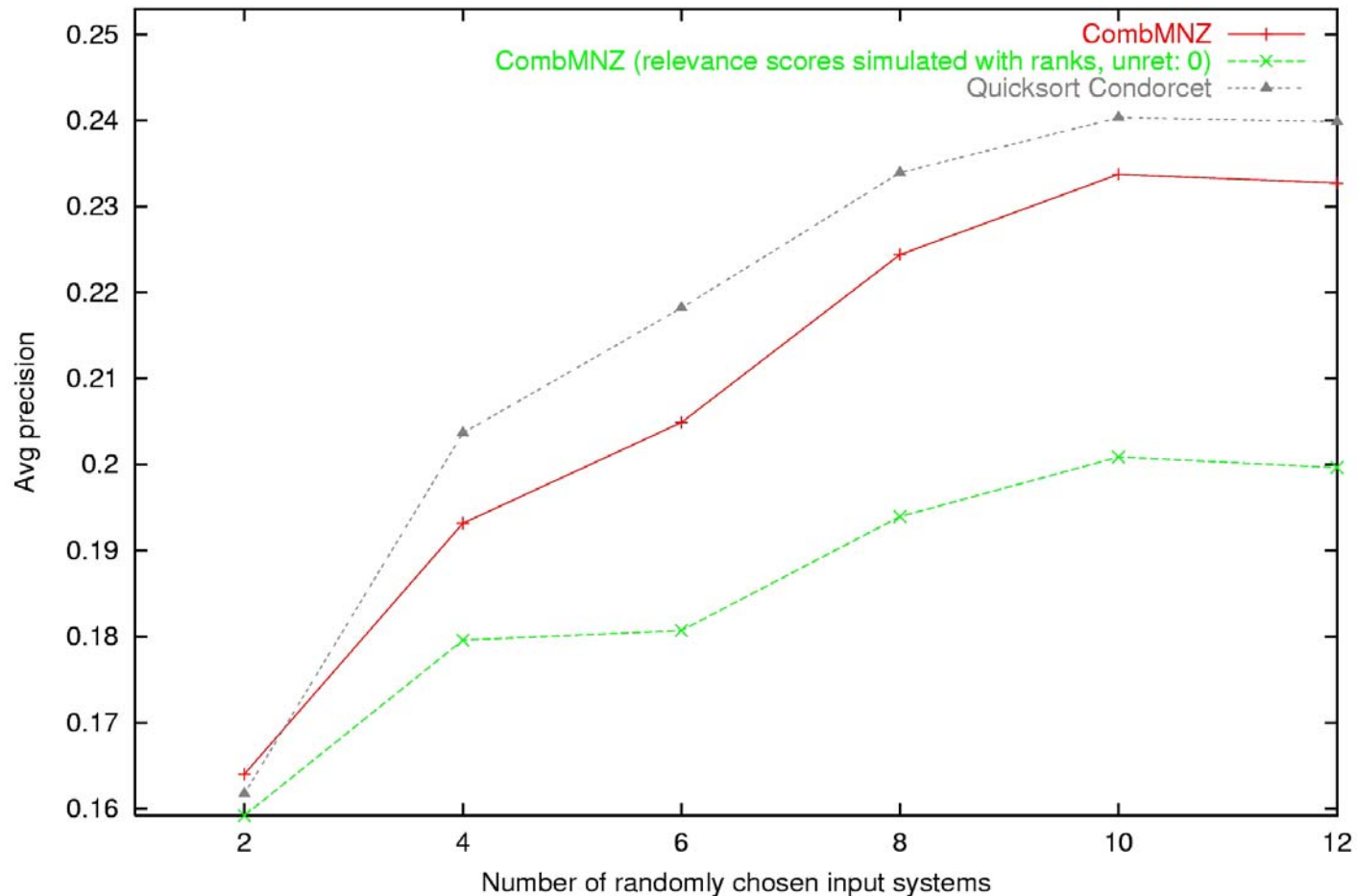
Condorcet-fuse on Vogt

TREC 5 subset: avg precision over between 1 and 200 random sets of systems.



Condorcet-fuse on TREC9

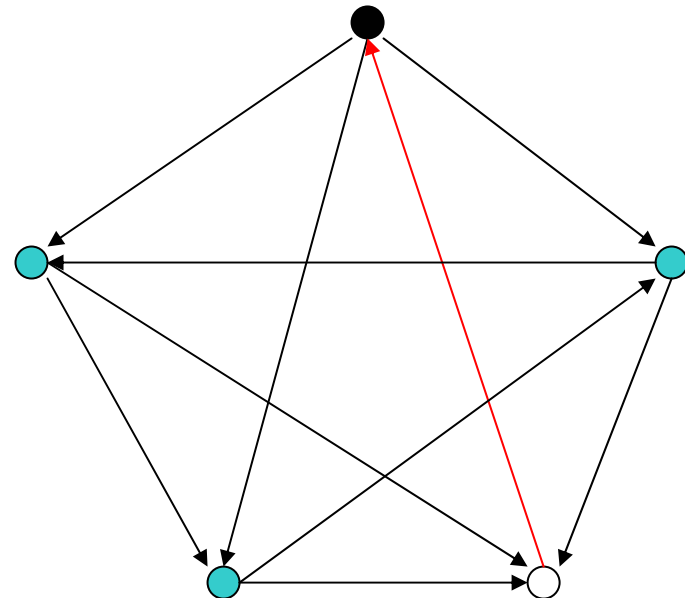
TREC 9: avg precision over 200 random sets of systems.



Breaking Cycles

SCCs are properly ordered.

How are ties within an SCC broken? (Quicksort)



Outline

- ✓ Introduce problem
- ✓ Characterize problem
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 - ✓ decision theory, social choice theory
 - ✓ experiments with TREC data
- Upper bounds for metasearch
- Future work

Upper Bounds on Metasearch

- How good can metasearch be?
- Are there fundamental limits that methods are approaching?
- Need an analog to running time lower bounds...

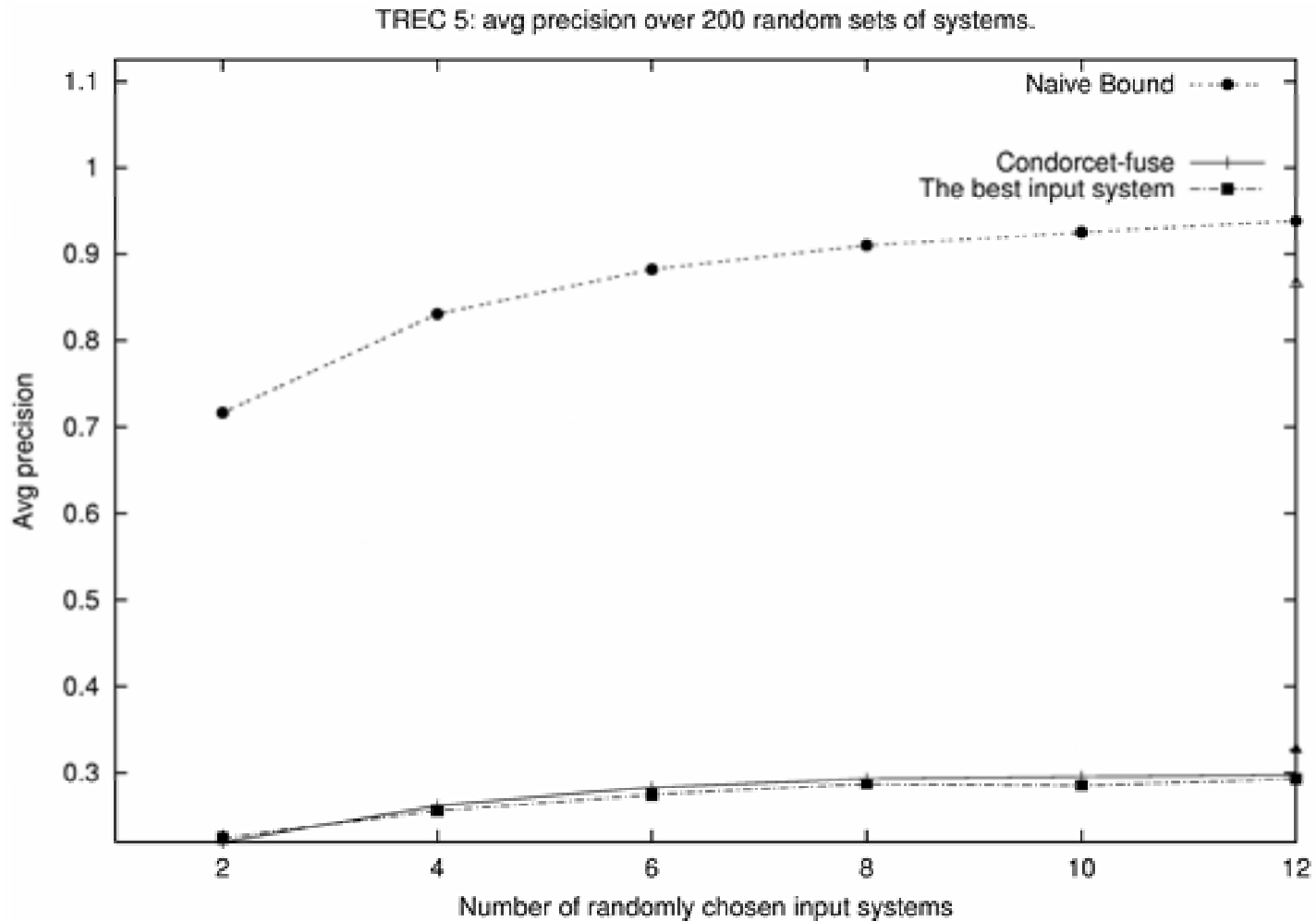
Upper Bounds on Metasearch

- Constrained oracle model:
 - omniscient metasearch oracle,
 - constraints placed on oracle that any reasonable metasearch technique must obey.
- What are “reasonable” constraints?

Naïve Constraint

- *Naïve* constraint:
 - Oracle may only return docs from underlying lists.
 - Oracle may return these docs in any order.
 - Omniscient oracle will return relevant docs above irrelevant docs.

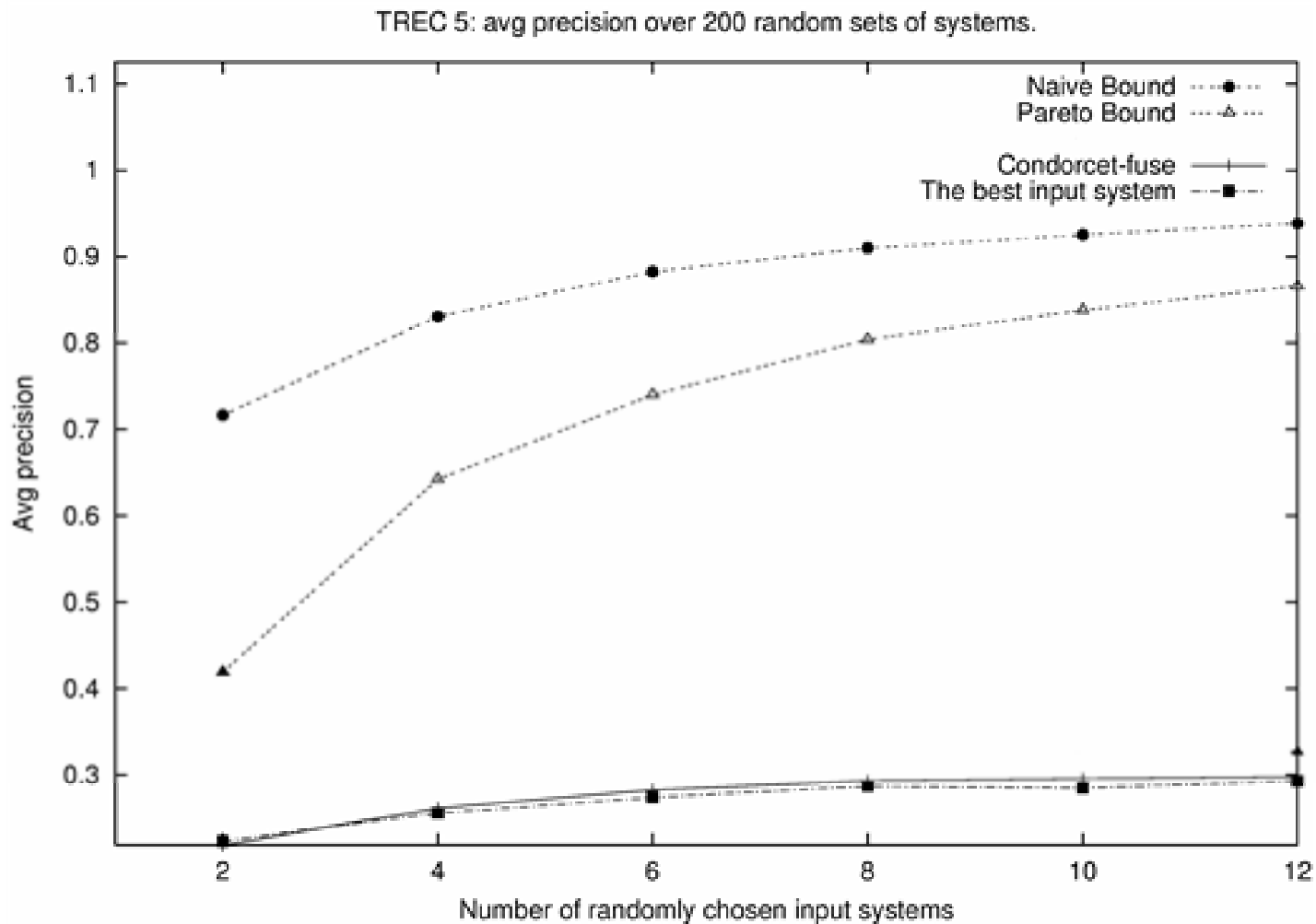
TREC5: Naïve Bound



Pareto Constraint

- *Pareto* constraint:
 - Oracle may only return docs from underlying lists.
 - Oracle must respect *unanimous* will of underlying systems.
 - Omniscient oracle will return relevant docs above irrelevant docs, subject to the above constraint.

TREC5: Pareto Bound

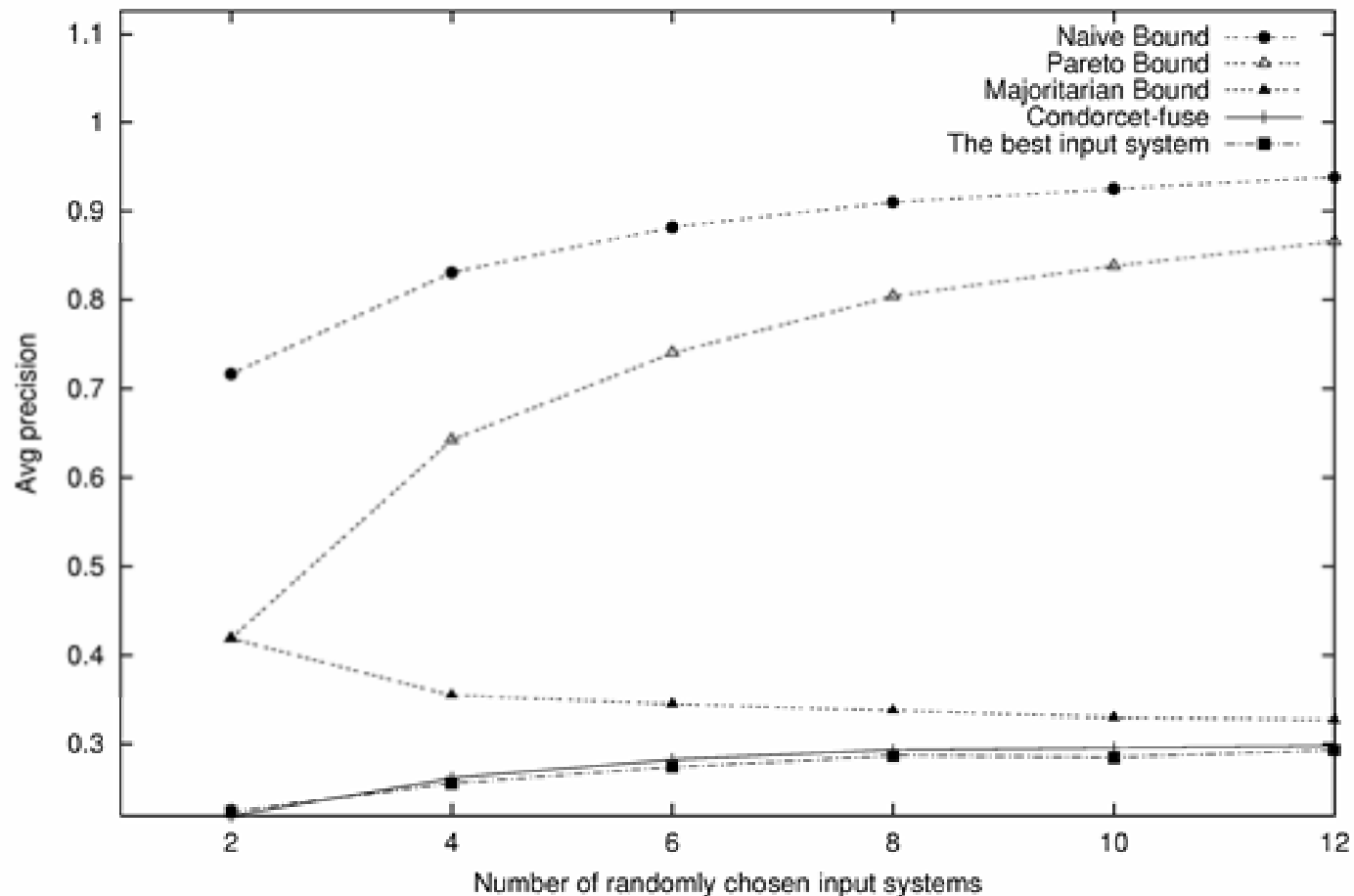


Majoritarian Constraint

- *Majoritarian* constraint:
 - Oracle may only return docs from underlying lists.
 - Oracle must respect *majority* will of underlying systems.
 - Omniscient oracle will return relevant docs above irrelevant docs and break cycles optimally, subject to the above constraint.

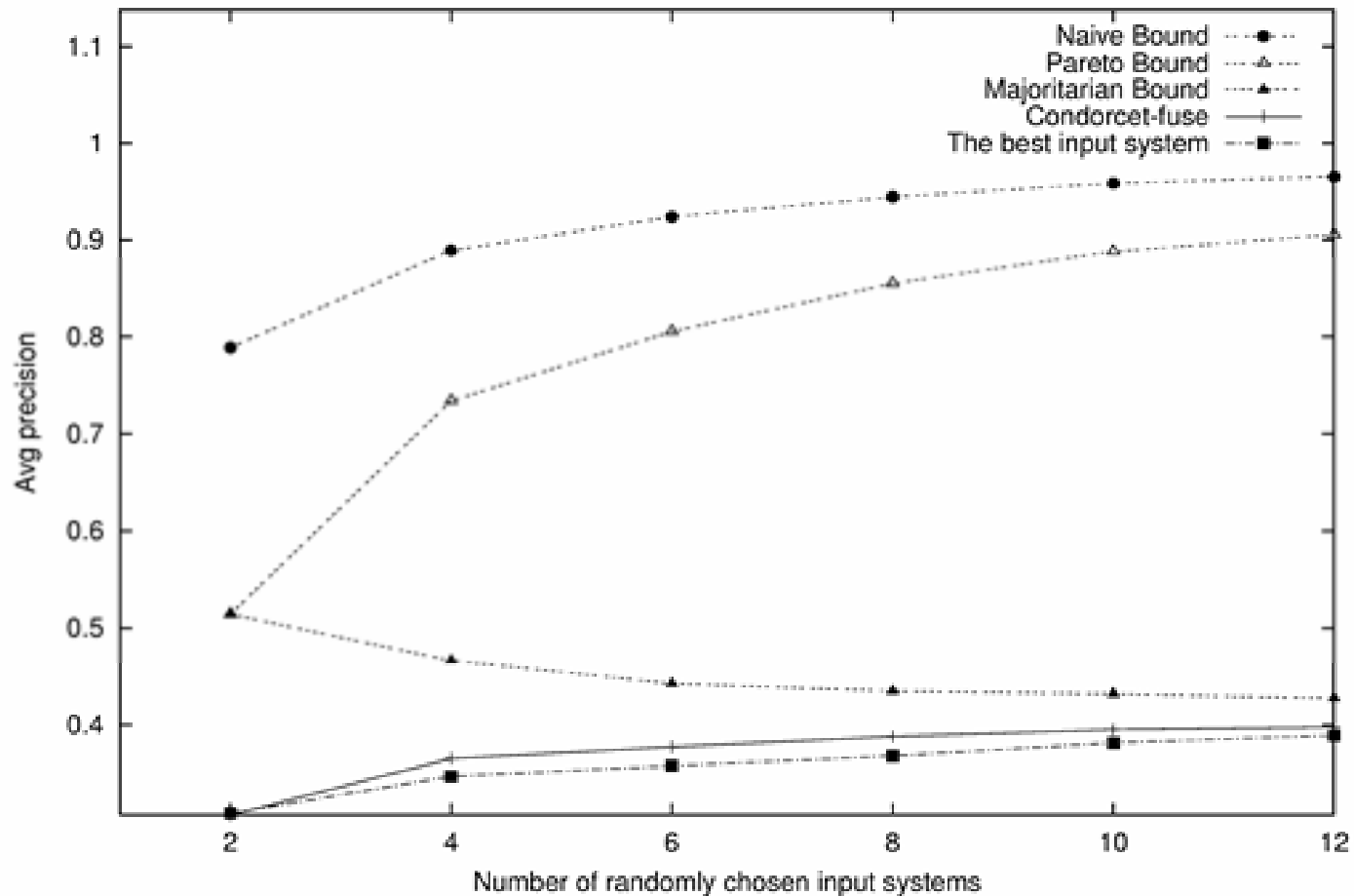
TREC5: Majoritarian Bound

TREC 5: avg precision over 200 random sets of systems.



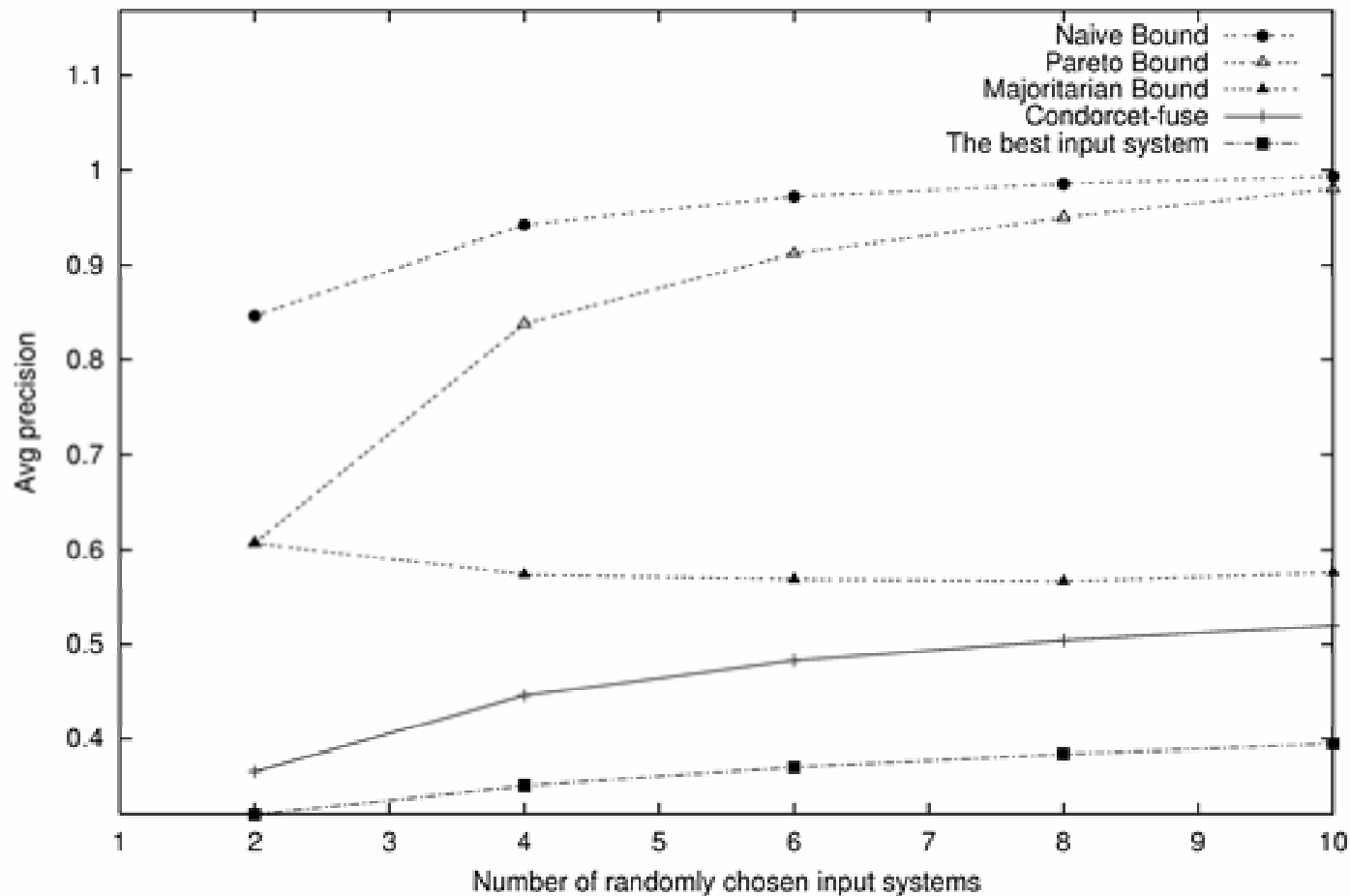
Upper Bounds: TREC3

TREC 3: avg precision over 200 random sets of systems.



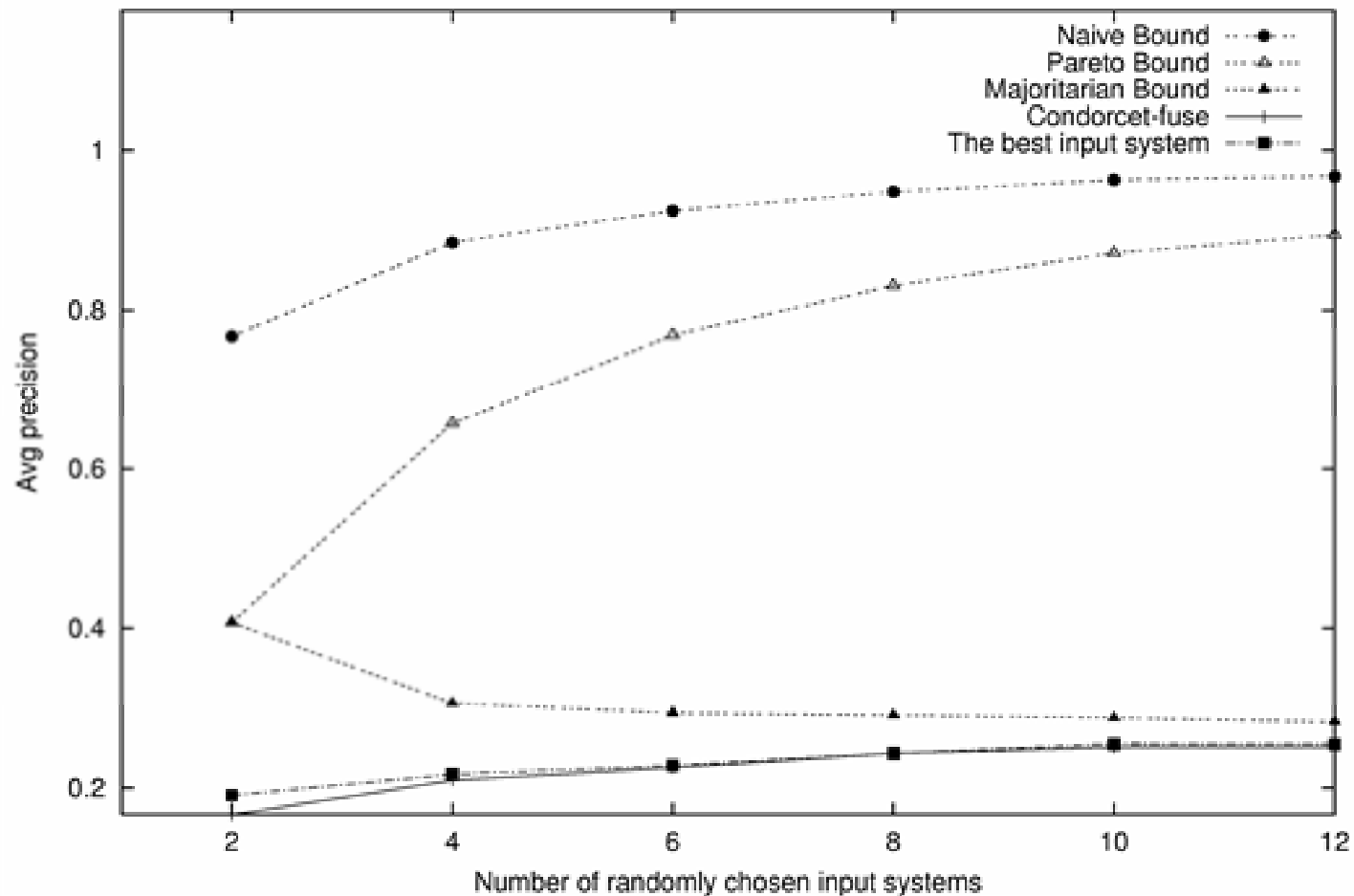
Upper Bounds: Vogt

TREC 5 subset: avg precision over between 1 and 200 random sets of systems.

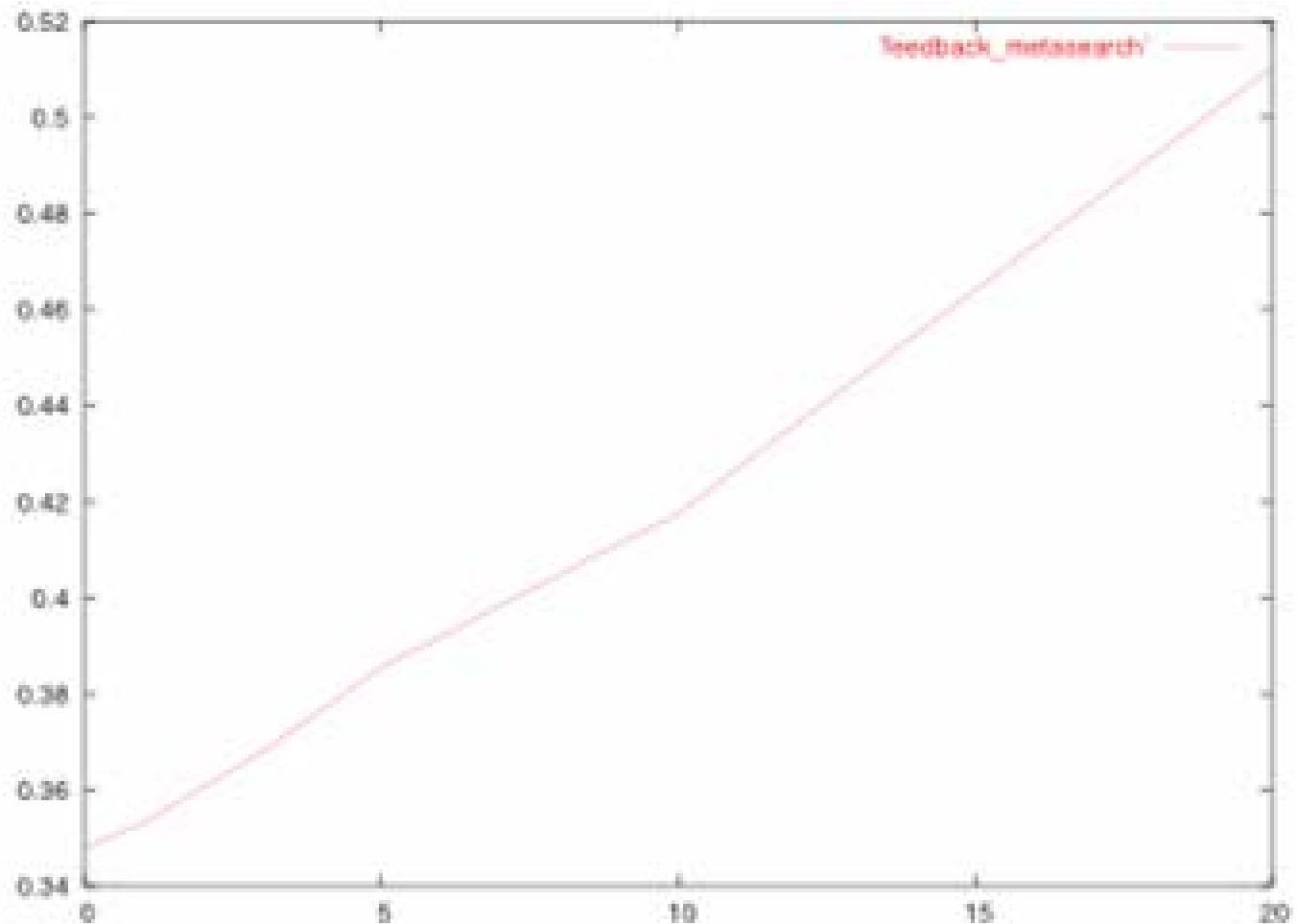


Upper Bounds: TREC9

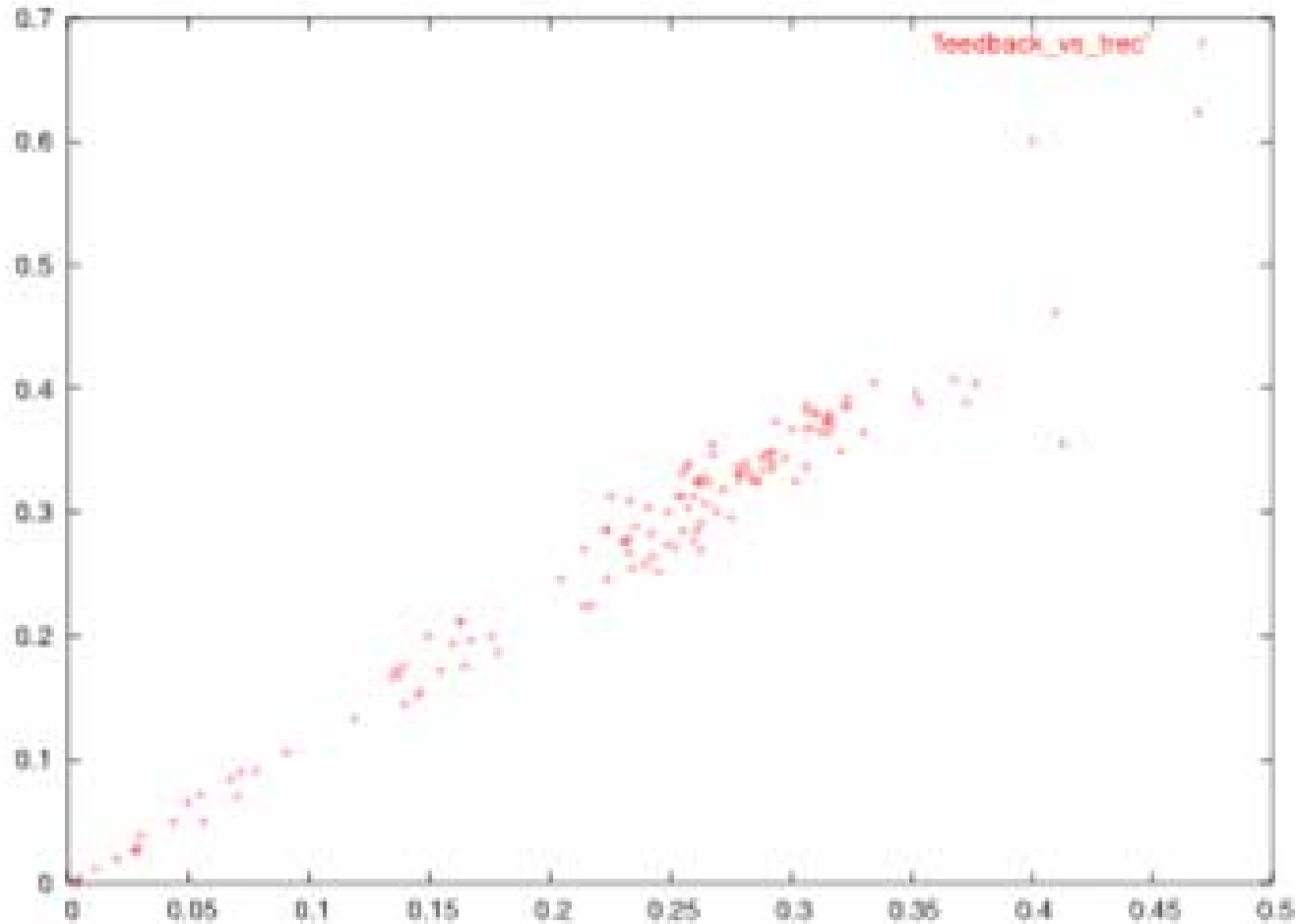
TREC 9: avg precision over 200 random sets of systems.



TREC8: Avg Prec vs Feedback



TREC8: System Assessments vs TREC



Metasearch Engines

- Query multiple search engines.
- May or may not combine results.

Metasearch: Dogpile

The screenshot shows a web browser window with the Dogpile metasearch engine interface. The address bar shows the search URL: <http://search.dogpile.com/taxis/search?q=chili+peppers&geo=no&fs=web&nav=custom&engines=goto&engines=Looksmart&engines=tl>. The page features the Dogpile logo and navigation links. A search bar contains the query "chili peppers". Below the search bar, there are several search results from Looksmart and GoTo engines. The Looksmart results include links to Amazon, Electric Library, and various recipe and music sites. The GoTo results are partially visible at the bottom.

File Edit View Go Communicator Help

Bookmarks Location: <http://search.dogpile.com/taxis/search?q=chili+peppers&geo=no&fs=web&nav=custom&engines=goto&engines=Looksmart&engines=tl> What's Related

Home
Custom Search
Dogpile Remote
Search at Home
Help with Syntax
Tell a Friend
Go Shopping

DOGPILE
Web Metasearch Results

SmarterKids.com Visit the Ask Our Teachers column at SmarterKids.com.
Education Center

Spend web time wisely. Shop smarter. Hear My Mail from Weblev! Find old classmates here! ClassMates.com

Buy books about "chili peppers" at Amazon.com Search for "chili peppers" on Electric Library

Are you looking for: Red Hot Chili Peppers Peppers Chili Hot Peppers
Red Hot Chili Peppers Tabs Canning Recipes Peppers Red Hot Chili Peppers Lyrics Salsa Recipes Free

Dogpile Suggests ClassMates.com Remember your promise to "keep in touch" at graduation? With over 8.5 million registered high school alumni, chances are you'll find your old friends.

Search engine: [Looksmart](#) found 117 results.
The query string sent was [-chili +peppers](#)

- [The Red Hot Chili Peppers](#)
Find photos, lyrics, updates, tour info, and news on alternative-funk-rock band the Red Hot Chili Peppers.
[Looksmart category - Red Hot Chili Pepper](#)
- [Red Hot Chili Peppers Audio and Video](#)
Watch videos and listen to music by this rock/funk band.
[Looksmart category - Red Hot Chili Peppers](#)
- [Chili and Hot Sauces](#)
Shop for mouth-burning chili sauces, Tabasco, hot salsas and other pepper-inspired sauces.
[Looksmart category - Chili & Hot Sauces](#)
- [Chili and Hot Sauces](#)
Find chili and other hot sauce recipes, including salsas, dips, spices, and rubs, and visit the Pepper Fool.
[Looksmart category - Chili & Hot Sauces](#)
- [Red Hot Chili Peppers - Screens and Themes](#)
Promotional screensaver for the funk-rock band features falling chili peppers.
[Looksmart category - Red Hot Chili Peppers Multimedia](#)

[Next set of results from Looksmart](#)

Search engine: [GoTo.com](#) found 10 or more results.

Metasearch: Metacrawler

The screenshot shows the Metacrawler search engine interface. At the top, there is a search bar with the text "chili peppers" and a "Search" button. Below the search bar, there are several search results listed, including "Red Hot Chili Peppers", "Chili", "Hot Peppers", "Canning Recipes Peppers", "Red Hot Chili Peppers Lyrics", and "Salsa Recipes Free". The interface also features a "View Related" section with buttons for "Web Pages", "Directory Listings", "Audio/MP3", "Images", "News Groups", and "Auctions". The search results are displayed in a list format, with each result including a title, a brief description, and a link to the source. The interface is designed to be user-friendly and easy to navigate.

File Edit View Go Communicator Help

Bookmarks Location: <http://search.metacrawler.com/crawler?general=chili+peppers&method=0&redirect=web&rp=20&hp=10®ion=0&timeout=0&sort=...> What's Related

metacrawler®

chili peppers

any all phrase

Search

The Web

Are you looking for:

[Red Hot Chili Peppers](#) [Peppers](#) [Chili](#) [Hot Peppers](#)

[Red Hot Chili Peppers Tabs](#) [Canning Recipes Peppers](#) [Red Hot Chili Peppers Lyrics](#) [Salsa Recipes Free](#)

Searching for

Discovery Health

Get Auto Insurance answers

Find!

View Related: [Web Pages](#) [Directory Listings](#) [Audio/MP3](#) [Images](#) [News Groups](#) [Auctions](#)

Results for "chili peppers" 1 to 20 of 122 results page: [1](#) - [2](#) - [3](#) - [4](#) - [5](#) - [6](#) - [7](#) [next](#)

View by: [Relevance](#) | [Site](#) | [Source](#) [Email results to a friend](#)

MetaCrawler Suggests [ClassMates.com](#), where you can find your High School Friends!

You just searched these search engines: AltaVista, Infoseek, LookSmart, Lycos, GoTo, Thunderstone, DirectHit, Google, Internet Keywords, FindWhat, Sprinks by About

Red Hot Chili Peppers
AltaVista: Buy Californication Now. Enter your email address to receive information about The Red Hot Chili Peppers. Email: Go to the RED HOT CHILI PEPPERS...
Infoseek: Video clips and photos of the band, plus lyrics and interview.
Google: Buy Californication Now. Enter your email address to receive 1000. <http://www.wbr.com/chilipeppers/index.html> (AltaVista, Infoseek, Google) | [More Like This](#)

Red Hot Chili Peppers
This web site was created for FREE at www.homestead.com. Visit www.homestead.com to get your free web site - no programming required.
424. <http://www.homestead.com/musiccorner/hotchilipeppers.html> (AltaVista) | [More Like This](#)

redhot:chilipeppers online
click here to skip intro...
424. <http://redhotchilipeppers.com/> (Google) | [More Like This](#)

The Red Hot Chili Peppers
Find photos, lyrics, updates, tour info, and news on alternative-funk-rock band the Red Hot Chili Peppers.
424. http://www.looksmart.com/ezs1f..._aes315010aes312562?uniq=6986 (LookSmart) | [More Like This](#)

Lycos Music: Red Hot Chili Peppers - Biography
Biography - Trolling in L.A.'s club circuit for years, the Red Hot Chili Peppers finally pounded their Funk/rap/rock into the mainstream with the 1998 LP Mother's Milk. Making bedfellows of their native L.A. Punk
424. <http://kick.hotbot.com/direct...i4%2Bpepperssource+LCO5MCIW1> (Lycos) | [More Like This](#)

GlassShop.com - Handmade Blown Glass Chili Peppers
Our standard offering includes four gorgeous 4-6 inch long blown glass chili peppers. Check 'em out! They make a great gift item.
424. <http://www.glassshop.com/main.html> (FindWhat) | [More Like This](#)

Chili Pepper smoked Trout
Chili Pepper smoked Trout recipe.
424. <http://ba.about.com/library...rwalk/terms%2Bchili%2Bpeppers> (Sprinks by About) | [More Like This](#)

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Metasearch: Profusion

The screenshot shows a web browser window with the Profusion metasearch engine. The browser's address bar displays the URL: `http://www.profusion.com/cgi-bin/nph-ProFusion.pl?queryterm=chili+peppers&option=all&display=10&totalverify=0&auto=auto&...`. The search bar contains the text "chili peppers" and a "Web Search" button. Below the search bar, the "Search Results" section shows a list of 10 results, each with a score, a title, a summary, and a URL. The results are as follows:

Score	Title	Summary	URL
1.0000	Red Hot Chili Peppers	This web site was created for FREE at www.homestead.com. Visit www.homestead.com to get your free web site - no programming required.	http://www.homestead.com/music/merch/hotchilipeppers.html
0.9667	Abbey Road: Red Hot Chili Peppers Fansite	For fans of pre-1992 Red Hot Chili Peppers Funk Style!...	http://members.soon.com/old_rhcc/index.html
0.9333	dotmusic - Single Review - Red Hot Chili ...	Typically groovy bassist Flea fuels the momentum	http://www2.dotmusic.com/reviews/singles/nearly2000/reviews12658...
0.9000	Red Hot Chili Peppers	Buy Californication Now. Enter your email address to receive information about The Red Hot Chili Peppers. Email: Go to the RED HOT CHILI PEPPERS...	http://www.wbr.com/chilipeppers/index.html
0.8781	Chili Pepper Rub for Brisket Recipe	Chili Pepper Rub for Brisket recipe.	http://bbq.about.com/llbrsrsr/cb70823a.htm
0.8667	Red Hot Chili Peppers - Screens and Themes	Promotional screensaver for the funk-rock band features falling chili peppers. More like this: Red Hot Chili Peppers Multimedia	http://www.screensandthemes.com/Previews-Downloads/Screen-Savers/...
0.8667	Briguy's Red Hot Chili Peppers & John ...	Bootlegs of great classic rock, the Red Hot Chili Peppers, and John Frusciante. I've got stuff from both the Californication era and the pre-heroin...	http://members.aol.com/californicationbootlegs.html
0.8342	Chili Pepper smoked Trout	Chili Pepper smoked Trout recipe.	http://bbq.about.com/llbrsrsr/cb70823a.htm
0.8333	Chili Peppers	Did You Know ...? Home The Legend Legend Form A few items for those interested in chili peppers: Scoville Test For Capsaicin - A Thermal...	http://www.cbbersauce.com/knowledge.htm
0.8000	Hot Chili Peppers Homepage	Hot Chili Peppers Homepage (German)...	http://www.hotchilipeppers.com/

Characterizing Metasearch

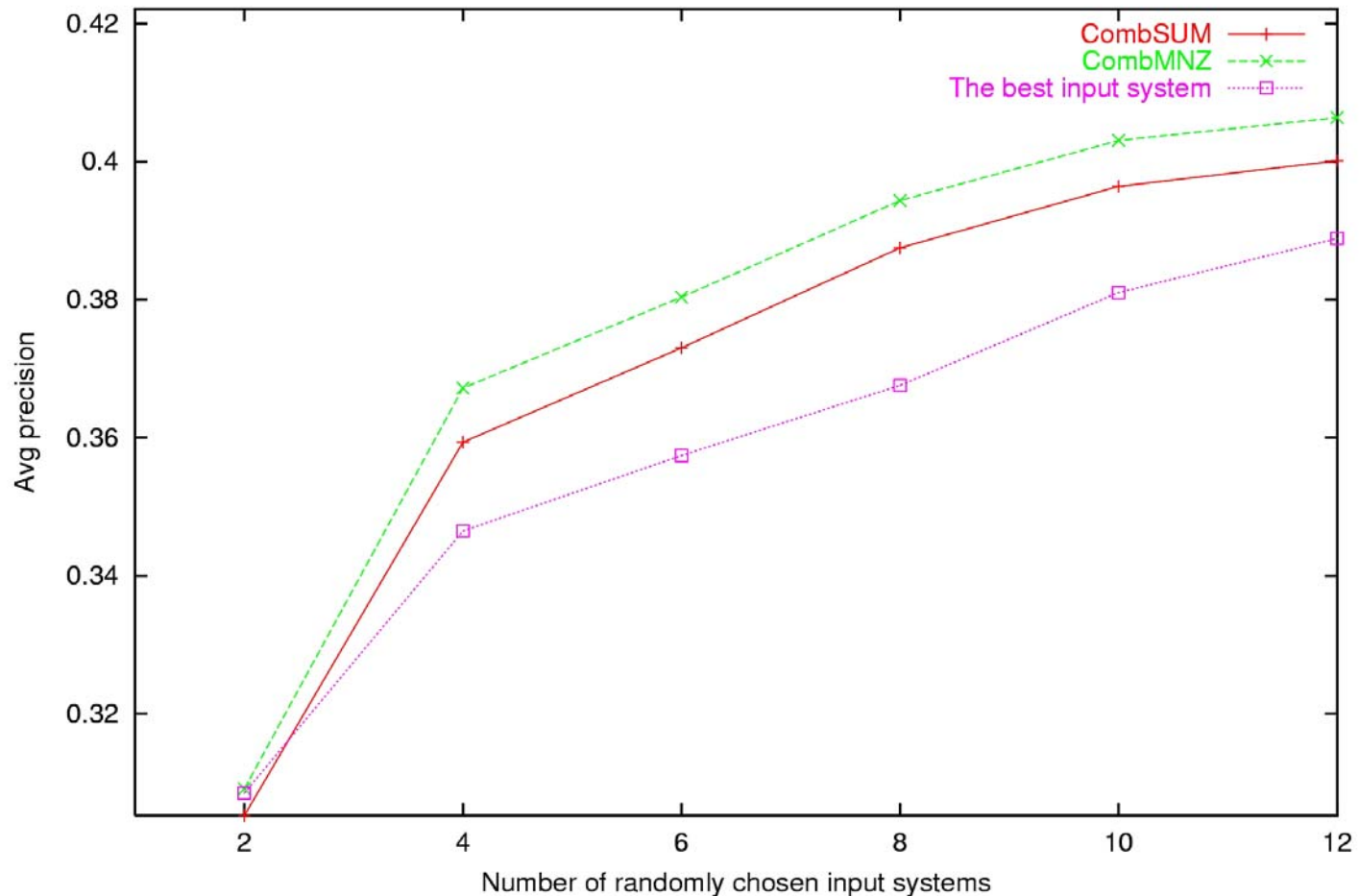
- Three axes:
 - common *vs.* disjoint database,
 - relevance scores *vs.* ranks,
 - training data *vs.* no training data.

Axis 1: DB Overlap

- High overlap
 - data fusion.
- Low overlap
 - collection fusion (distributed retrieval).
- *Very different techniques for each...*
- This work: data fusion.

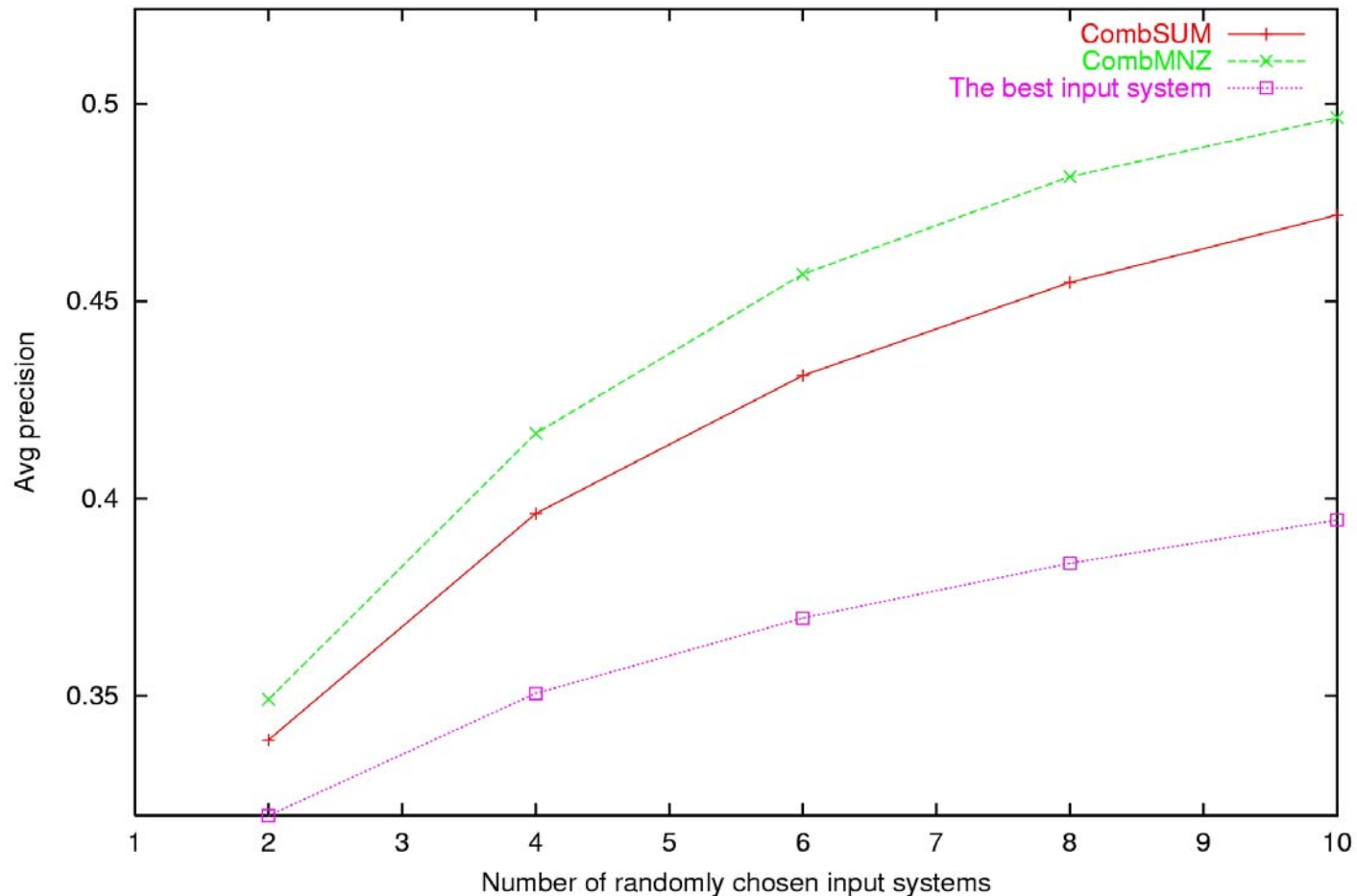
CombMNZ on TREC3

TREC 3: avg precision over 200 random sets of systems.



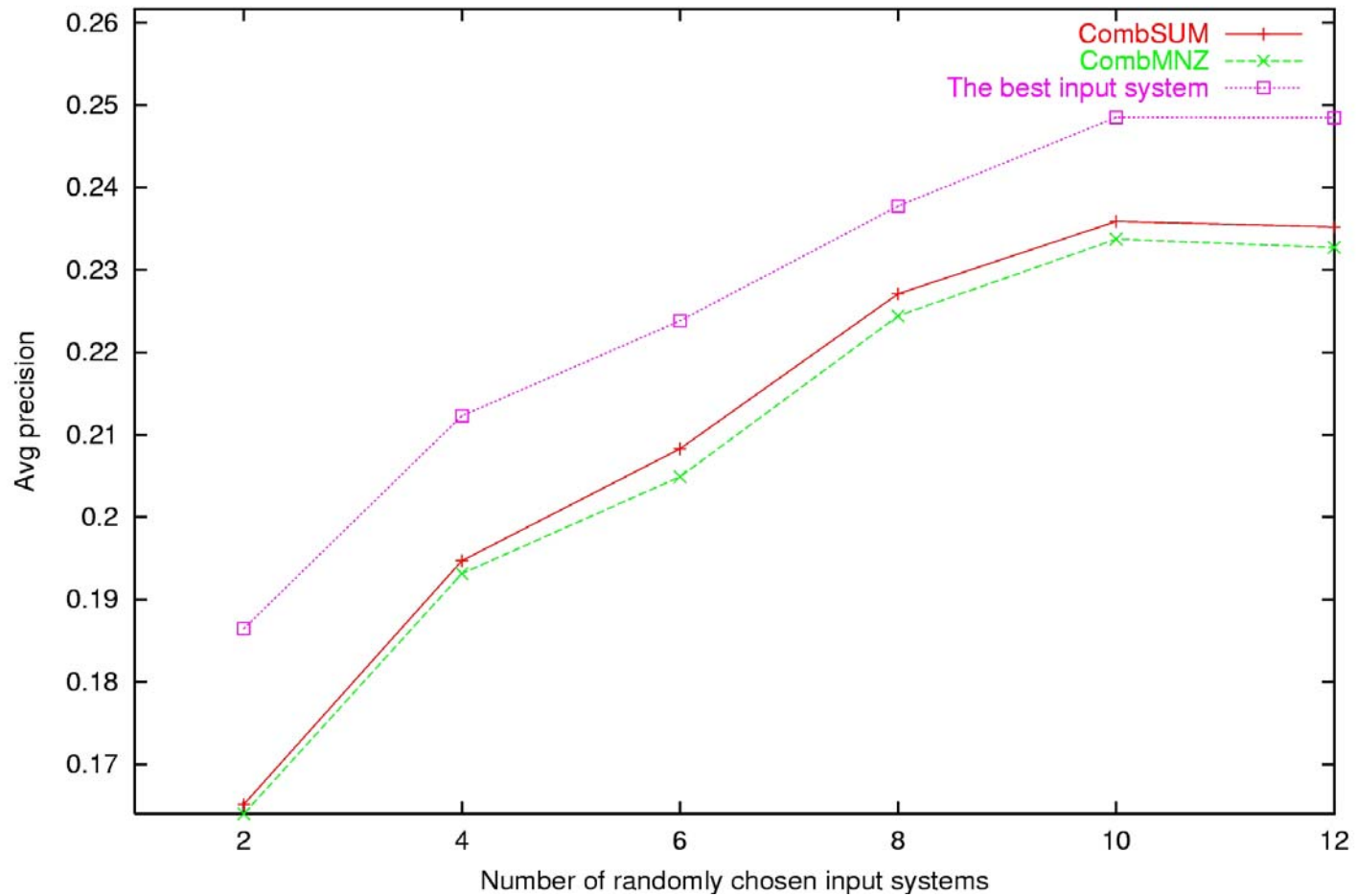
CombMNZ on Vogt

TREC 5 subset: avg precision over between 1 and 200 random sets of systems.



CombMNZ on TREC9

TREC 9: avg precision over 200 random sets of systems.



Borda Count

- Consider an n candidate election.
- For each ballot:
 - assign n points to top candidate,
 - assign $n-1$ points to next candidate,
 - ...
- Rank candidates by point sum.

Borda Count: Election 2000

- Ideological order: **Nader**, **Gore**, **Bush**.
 - Ideological voting:
 - Bush voter: Bush, Gore, Nader.
 - Nader voter: Nader, Gore, Bush.
 - Gore voter:
 - Gore, Bush, Nader.
 - Gore, Nader, Bush.
- } 50/50, 100/0

Election 2000: Ideological Florida Voting

	Gore	Bush	Nader
50/50	14,734,379	13,185,542	7,560,864
100/0	14,734,379	14,639,267	6,107,138

Gore Wins

Borda Count: Election 2000

- Ideological order: Nader, Gore, Bush.
- Manipulative voting:
 - Bush voter: Bush, Nader, Gore.
 - Gore voter: Gore, Nader, Bush.
 - Nader voter: Nader, Gore, Bush.

Election 2000: Manipulative Florida Voting

Gore	Bush	Nader
11,825,203	11,731,816	11,923,765

Nader Wins

Future Work

- Bayes
 - approximate dependence.
- Condorcet
 - weighting, dependence.
- Upper bounds
 - other constraints.
- Meta-retrieval
 - Metasearch is approaching fundamental limits.
 - Need to incorporate user feedback: learning...