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CS47300: Web Information Search and Management

Web Search

Prof. Chris Clifton

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Some slides courtesy
Manning, Raghavan, and Schütze

Indiana Center for Database Systems ™

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Challenge: “The need behind the query”

- Semantic analysis
  - Query language determination
    - Auto filtering
    - Different ranking (if query in Japanese do not return English)
  - Hard & soft (partial) matches
    - Personalities (triggered on names)
    - Cities (travel info, maps)
    - Medical info (triggered on names and/or results)
    - Stock quotes, news (triggered on stock symbol)
    - Company info
    - Etc.
  - Natural Language reformulation
  - Integration of Search and Text Analysis

Answering “the need behind the query”: Context

- Context determination
  - spatial (user location/target location)
  - query stream (previous queries)
  - personal (user profile)
  - explicit (user choice of a vertical search,)
  - implicit (use Google from France, use google.fr)
- Context use
  - Result restriction
    - Kill inappropriate results
  - Ranking modulation
    - Use a “rough” generic ranking, but personalize later

The spatial context: Geo-search

- Two aspects
  - Geo-coding -- encode geographic coordinates to make search effective
  - Geo-parsing -- the process of identifying geographic context.
- Geo-coding
  - Geometrical hierarchy (squares)
  - Natural hierarchy (country, state, county, city, zip-codes, etc)
- Geo-parsing
  - Pages (infer from phone nos, zip, etc). About 10% can be parsed.
  - Queries (use dictionary of place names)
  - Users
    - Explicit (tell me your location -- used by NL, registration, from ISP)
    - From IP data
  - Mobile phones
    - Many sources of highly accurate location

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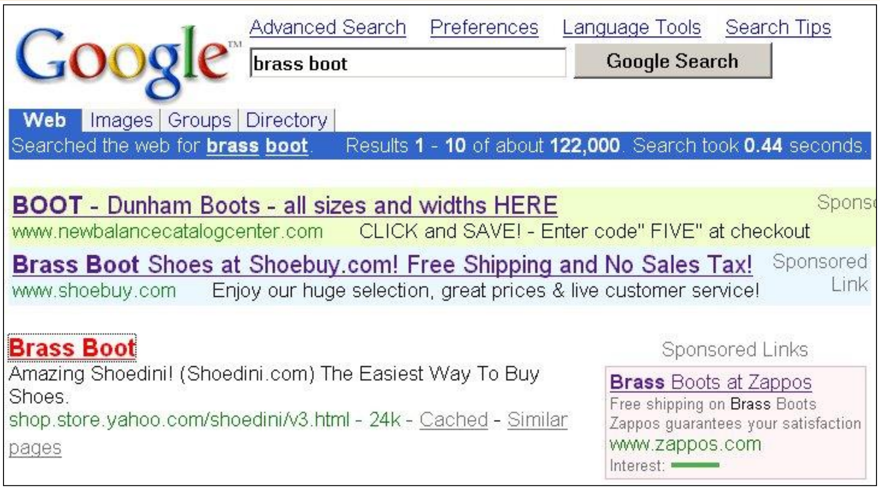
Context transfer



Advanced Search Preferences Language Tools Search Tips

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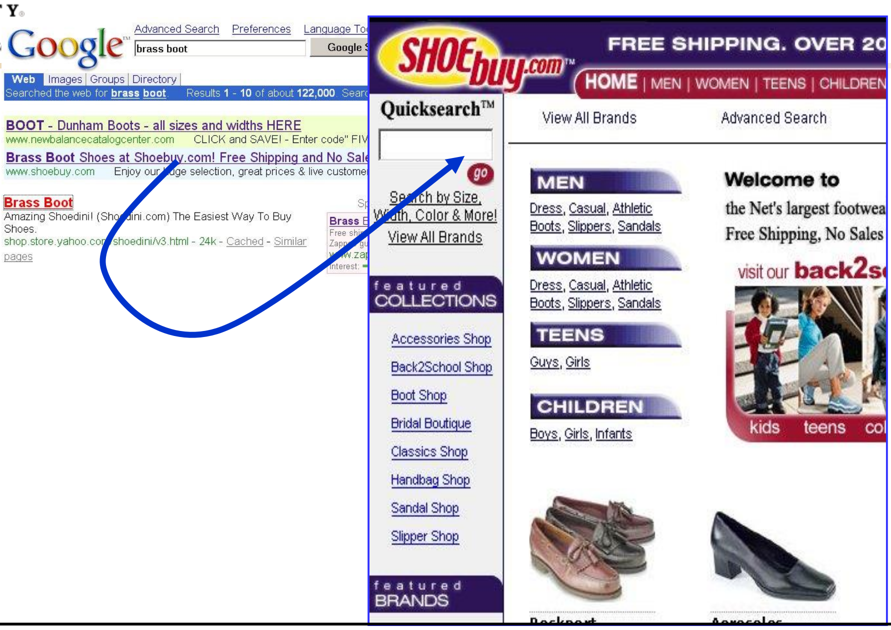

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Boots, Slippers, Sandals

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Boots, Slippers, Sandals

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Guys, Girls

CHILDREN
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Context transfer

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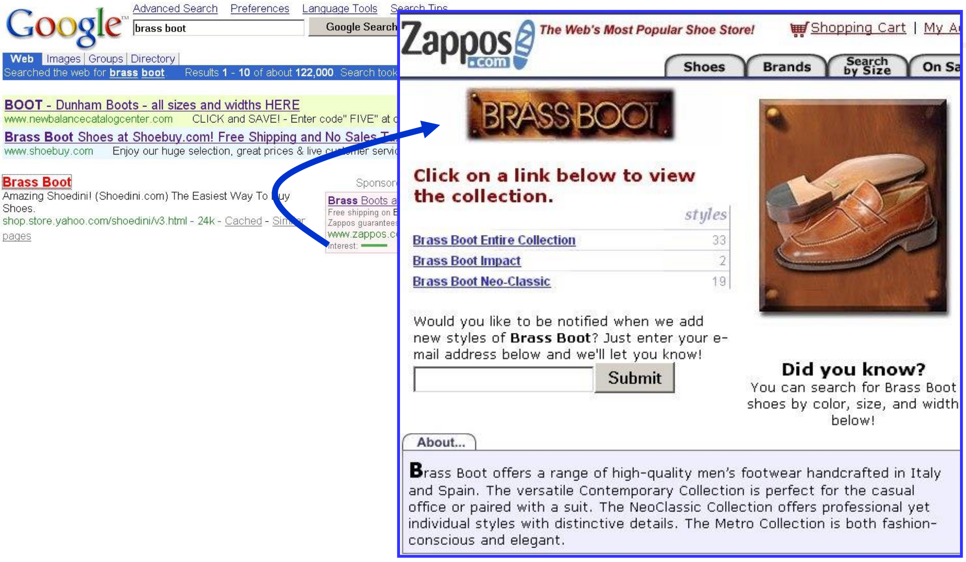

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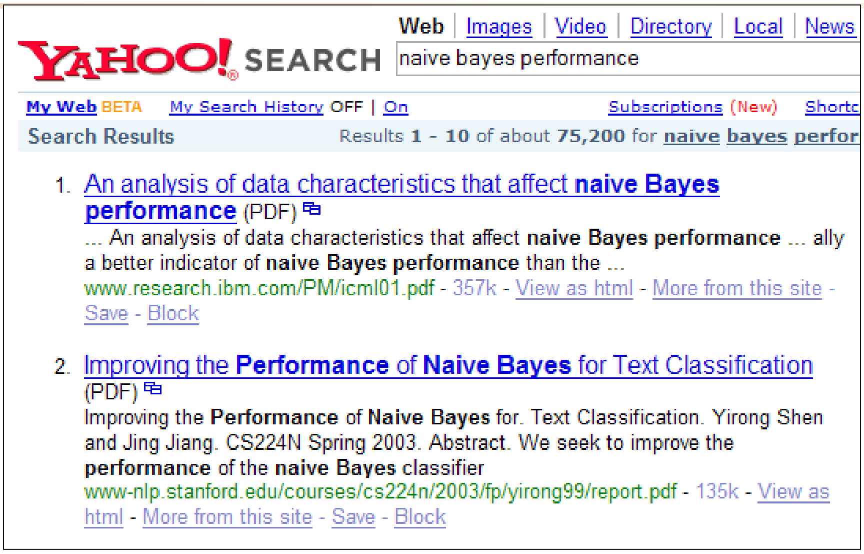
Transfer from search results



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naive bayes performance

Search Results

Results **1** - **10** of about **75,200** for **naive bayes perfor**

1. An analysis of data characteristics that affect **naive Bayes performance** (PDF)
   ... An analysis of data characteristics that affect **naive Bayes performance** ... ally a better indicator of **naive Bayes performance** than the ...
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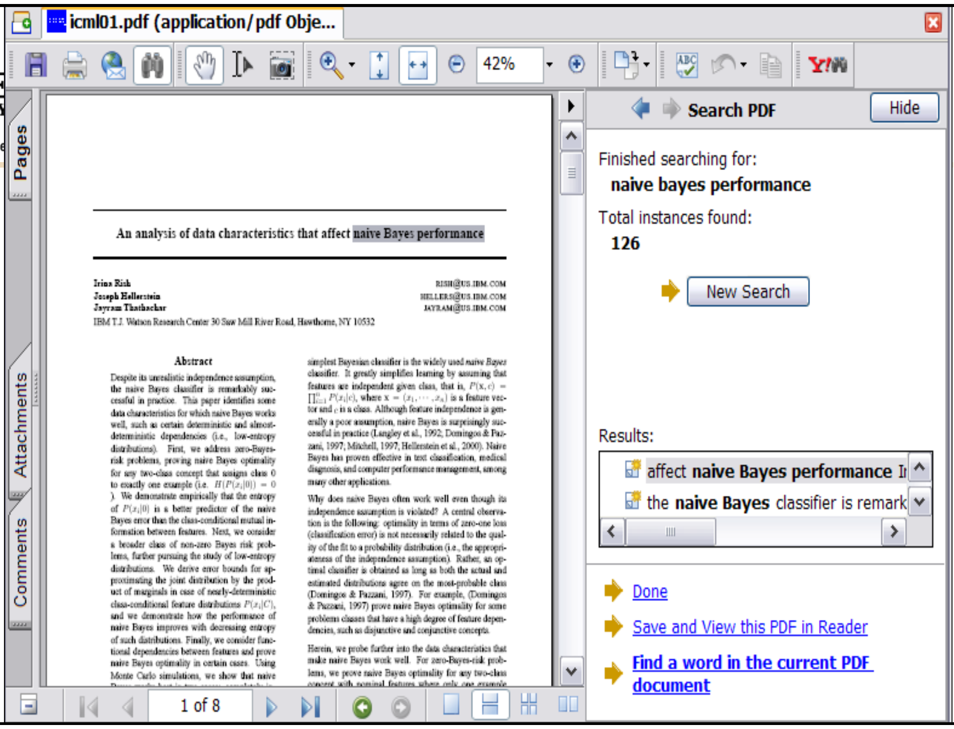
2. Improving the **Performance** of **Naive Bayes** for Text Classification (PDF)
   Improving the **Performance** of **Naive Bayes** for. Text Classification. Yirong Shen and Jing Jiang. CS224N Spring 2003. Abstract. We seek to improve the **performance** of the **naive Bayes** classifier
   www-nlp.stanford.edu/courses/cs224n/2003/fp/yirong99/report.pdf - 135k - View as html - More from this site - Save - Block



An analysis of data characteristics that affect naive Bayes performance

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Abstract

Despite its unrealistic independence assumption, the naive Bayes classifier is remarkably successful in practice. This paper identifies some data characteristics for which naive Bayes works well, such as certain deterministic and almost-deterministic dependencies (i.e., low-entropy distributions). First, we address zero-Bayes-risk problems, proving naive Bayes optimality for any two-class concept that assigns class 0 to exactly one example (i.e. $H(P(x_i|0)) = 0$). We demonstrate empirically that the entropy of $P(x_i|0)$ is a better predictor of the naive Bayes error than the class-conditional mutual information between features. Next, we consider a broader class of non-zero Bayes risk problems, further pursuing the study of low-entropy distributions. We derive error bounds for approximating the joint distribution by the product of marginals in case of nearly-deterministic class-conditional feature distributions $P(x_i|C)$, and we demonstrate how the performance of naive Bayes improves with decreasing entropy of such distributions. Finally, we consider functional dependencies between features and prove naive Bayes optimality in certain cases. Using Monte Carlo simulations, we show that naive

simplest Bayesian classifier is the widely used *naive Bayes* classifier. It greatly simplifies learning by assuming that features are independent given class, that is, $P(\mathrm{x}, c) = \prod_{i=1}^{n} P(x_i|c)$, where $\mathrm{x} = (x_1, \cdots, x_n)$ is a feature vector and c is a class. Although feature independence is generally a poor assumption, naive Bayes is surprisingly successful in practice (Langley et al., 1992; Domingos & Pazzani, 1997; Mitchell, 1997; Hellerstein et al., 2000). Naive Bayes has proven effective in text classification, medical diagnosis, and computer performance management, among many other applications.

Why does naive Bayes often work well even though its independence assumption is violated? A central observation is the following: optimality in terms of zero-one loss (classification error) is not necessarily related to the quality of the fit to a probability distribution (i.e., the appropriateness of the independence assumption). Rather, an optimal classifier is obtained as long as both the actual and estimated distributions agree on the most-probable class (Domingos & Pazzani, 1997). For example, (Domingos & Pazzani, 1997) prove naive Bayes optimality for some problems classes that have a high degree of feature dependencies, such as disjunctive and conjunctive concepts.

Herein, we probe further into the data characteristics that make naive Bayes work well. For zero-Bayes-risk problems, we prove naive Bayes optimality for any two-class

Finished searching for:
naive bayes performance

Total instances found:
126

Results:
affect **naive Bayes performance** I
the **naive Bayes** classifier is remark

Done

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  - personal (user profile)
  - explicit (user choice of a vertical search, e.g., Amazon or eBay)
  - implicit (use Google from France, use google.fr)

- Context use
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Result Restriction

- Geographic restrictions
  - Holocaust denial in Germany
  - Imagery that may be illegal in some jurisdictions, accepted in others
- Age restrictions
  - COPPA

"On the Internet, nobody knows you're a dog."

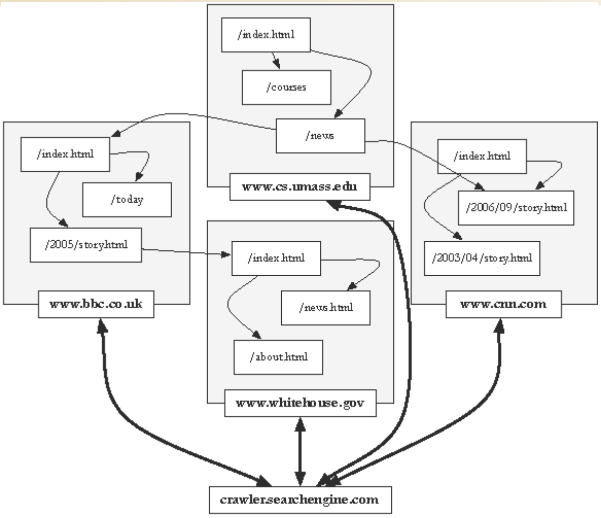
Web Crawler

- Finds and downloads web pages automatically
  - provides the collection for searching
- Web is huge and constantly growing
- Web is not under the control of search engine providers
- Web pages are constantly changing
- Crawlers also used for other types of data

Retrieving Web Pages

- Web crawler client program connects to a *domain name system* (DNS) server
- DNS server translates the hostname into an *internet protocol* (IP) address
- Crawler then attempts to connect to server host using specific *port*
- After connection, crawler sends an HTTP request to the web server to request a page
  - usually a GET request

Crawling the Web



Web Crawler

- Starts with a set of *seeds*, which are a set of URLs given to it as parameters
- Seeds are added to a URL request queue
- Crawler starts fetching pages from the request queue
- Downloaded pages are parsed to find link tags that might contain other useful URLs to fetch
- New URLs added to the crawler's request queue, or *frontier*

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Sec. 20.2.1

Processing steps in crawling

- Pick a URL from the frontier
- Fetch the document at the URL
- Parse the URL
  - – Extract links from it to other docs (URLs)
- Check if URL has content already seen
  - – If not, add to indexes
- For each extracted URL
  - – Ensure it passes certain URL filter tests
  - – Check if it is already in the frontier (duplicate URL elimination)

Which one?

E.g., only crawl .edu, obey robots.txt, etc.

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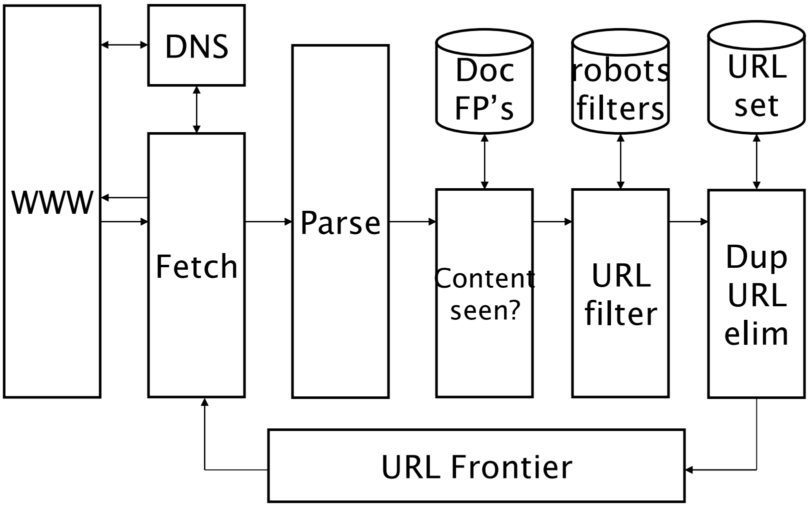
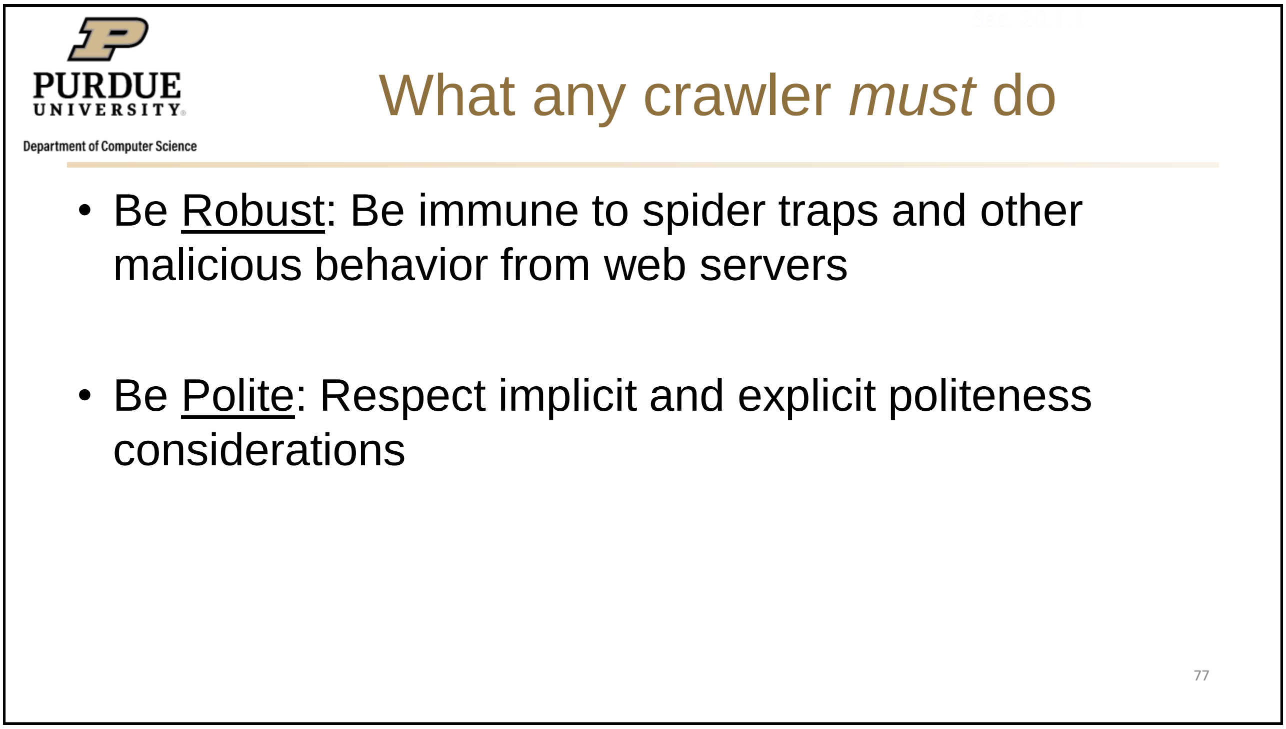
Basic crawl architecture





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What any crawler *must* do

- Be Robust: Be immune to spider traps and other malicious behavior from web servers
- Be Polite: Respect implicit and explicit politeness considerations

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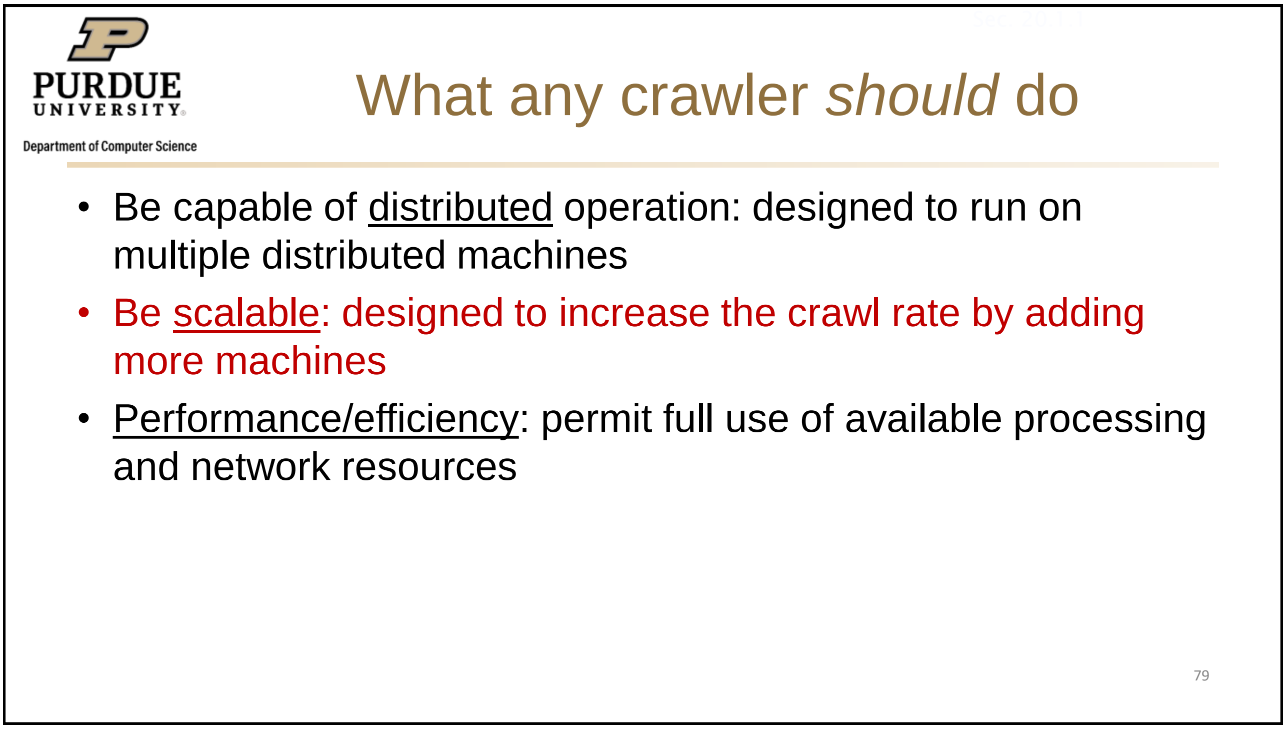

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What any crawler *should* do

- Be capable of distributed operation: designed to run on multiple distributed machines
- Be scalable: designed to increase the crawl rate by adding more machines
- Performance/efficiency: permit full use of available processing and network resources

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