# Link Analysis

Introduction to Information Retrieval
INF 141
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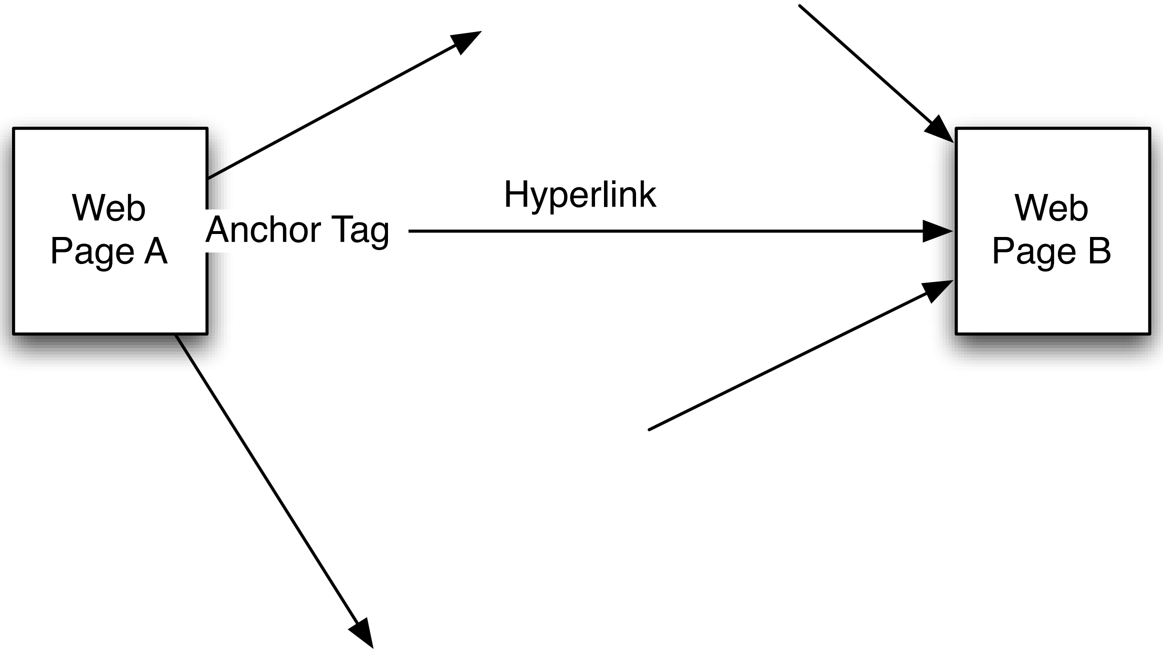
Content adapted from Hinrich Schütze
http://www.informationretrieval.org

# Outline

- The web as a directed graph

# The web as a directed graph



- Assumption 1: A hyperlink between pages denotes author perceived relevance (quality signal)
- Assumption 2: The anchor of the hyperlink describes the target page (textural context)

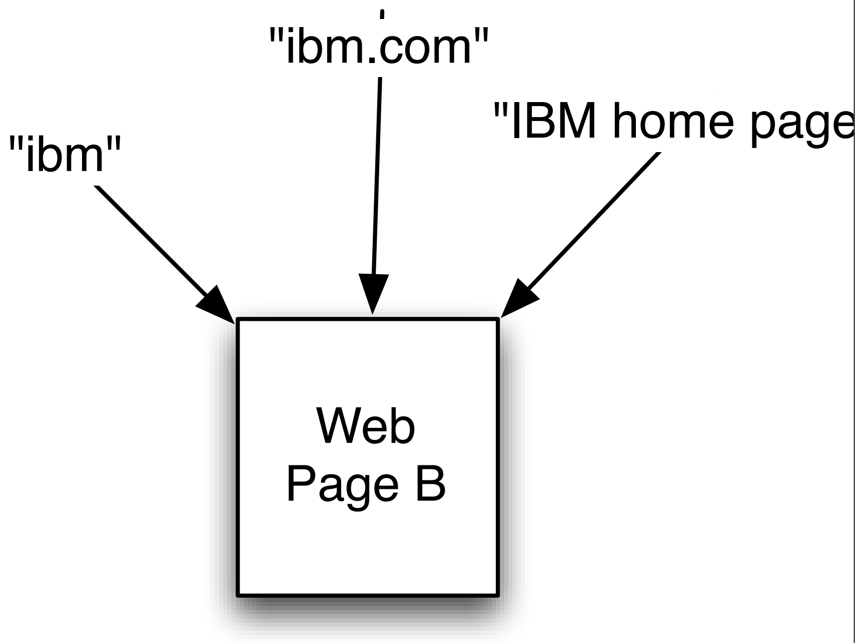
# The web as a directed graph

- Assumption 1: A hyperlink between pages denotes author perceived relevance (quality signal)
- Assumption 2: The anchor of the hyperlink describes the target page (textural context)

- Where might these assumptions not hold?

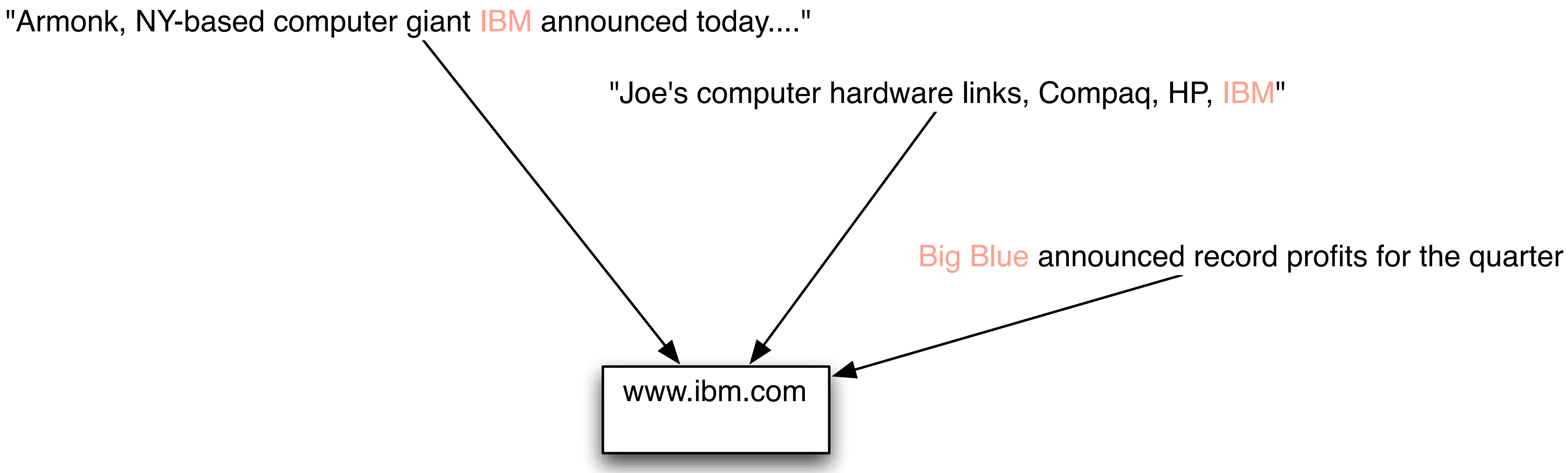
# The web as a directed graph

- Anchor Text
  - WWW Worm -McBryan94
- For IBM how do you distinguish between
  - IBM's home page (mostly graphics)
  - IBM's copyright page (high TF for "ibm)
  - Rival spam page (high TF for "ibm")
  - ?
- A million pieces of anchor text with "ibm" send a strong signal



# Indexing anchor text also

- When indexing a document D
  - include anchor text from links pointing to D


"Armonk, NY-based computer giant IBM announced today...."

"Joe's computer hardware links, Compaq, HP, IBM"

Big Blue announced record profits for the quarter

# Indexing anchor text

- Anchor text is often a better description of a page’s content than the page itself.
- Can be weighted more highly than the text
  - If enough anchor text is available
  - Same technique as zone weighting
    - create a “zone” for anchor text
- Indexing anchor text can have unexpected side effects
  - Google bombs, miserable failure
  - nigritude ultramarine follow-on

# Anchor text

- Other applications
  - Weighting links in the graph
  - Generating page descriptions from anchor text

## PageRank

- Citation analysis:
  - Analysis of citations in the scientific literature
  - Example citation:
    - “Miller (2001) has shown that physical activity alters the metabolism of estrogens”

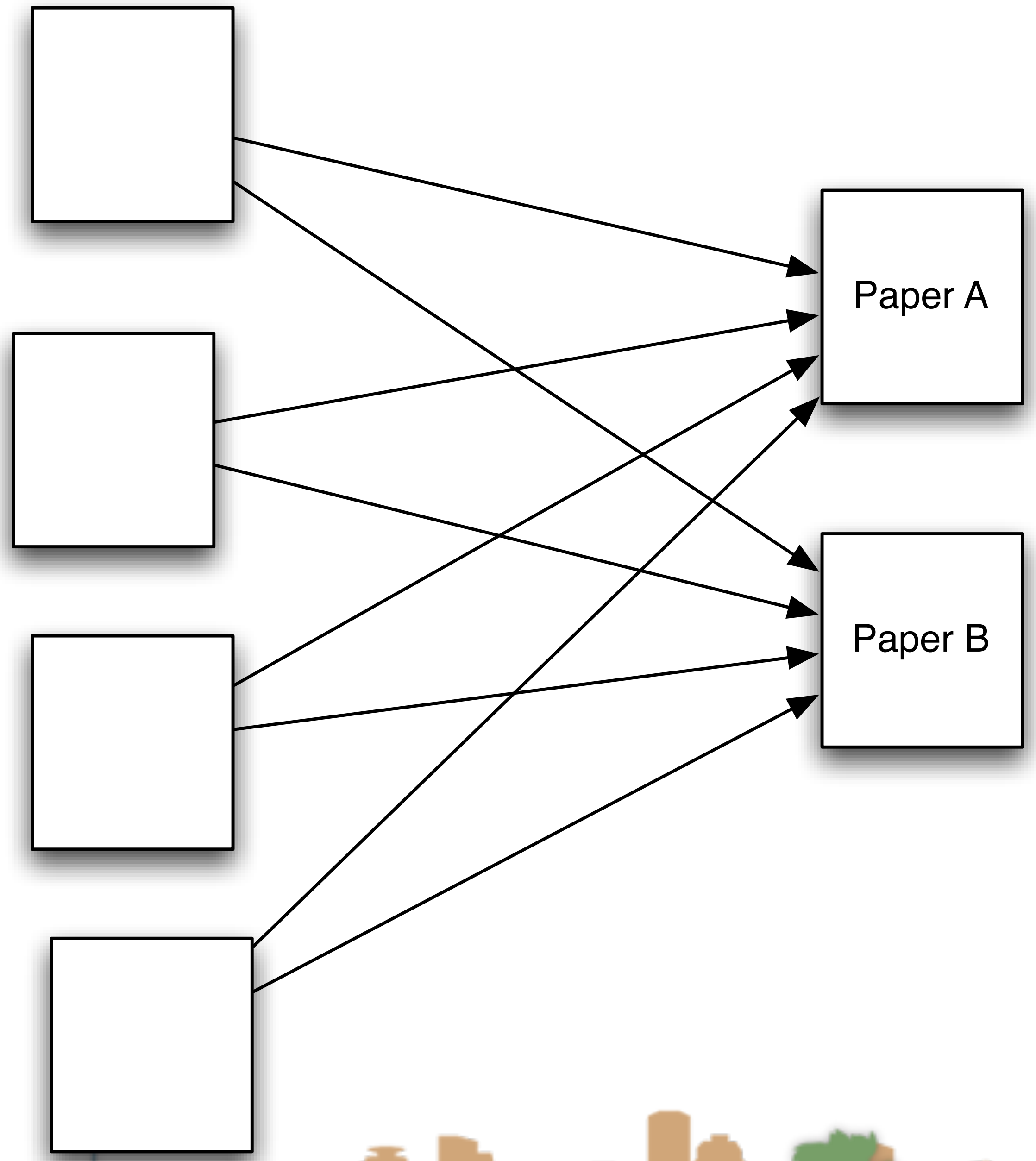
# The web as a directed graph

- Link Analysis/PageRank has its origins in bibliometrics
  - “Measurement of influence among publications based on citations”
  - Just as citing a paper confers authority upon it, linking to a page confers authority to it.

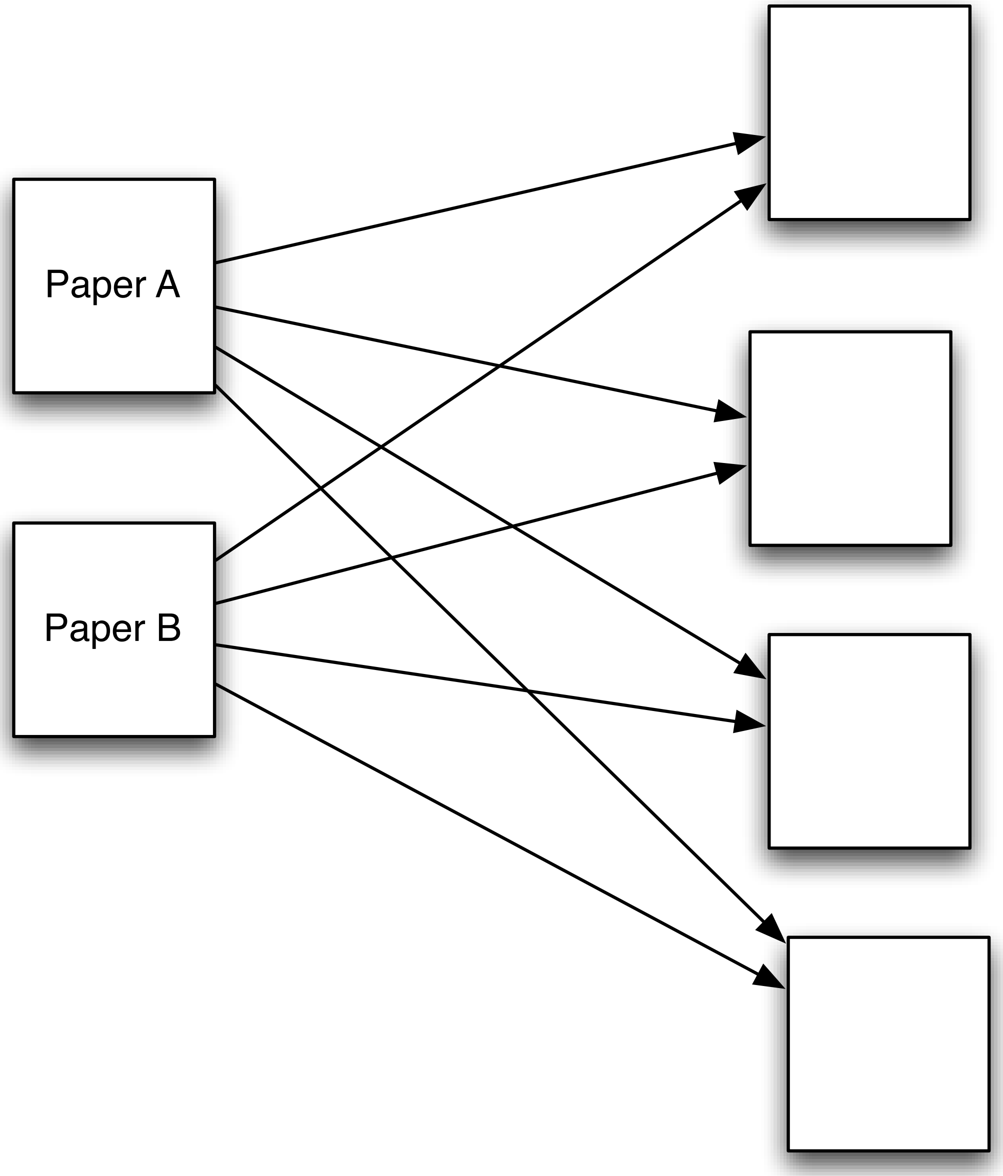
# Bibliometrics

- Two ways of measuring similarity of scientific articles:
  - Cocitation similarity: The two articles are cited by the same articles
  - Bibliographic coupling similarity: The two articles site the same articles

# Co-citation similarity



# Bibliographic coupling similarity



# Bibliometrics

- Citation frequency can be used to measure impact
  - Each article gets one vote
  - Not a very accurate measure
- Better measure: weighted citation frequency/ citation rank
  - An article's vote is weighted according to its citation impact.
  - Sounds circular, but can be formalized in a well-defined way
  - This is basically PageRank
  - Invented for citation analysis in the 1960's by Pinsker and Narin

# Link Analysis

## Key Observation

- A citation in scientific literature is like a link on the web