# Information Retrieval and Web Search

Introduction to Information Retrieval

# Information Retrieval (IR)

- Information retrieval is a field concerned with the structure, analysis, organization, storage, searching, and retrieval of information (Salton, 1968)
- Primary focus: text
  - Scholarly papers, books, news, email, Web pages
- Other media:
  - Audio, images, video

# Types of IR

- **Search**
- Filtering or tracking
  - Detecting documents of interest
- Classification
  - Labeling documents with pre-existing labels
- Question answering
  - Beyond searching for documents, searching for answers

# Types of Search Engines

- **Web search**
- Vertical search
- Enterprise search
- Desktop search
- Peer-to-peer search

# Database Engines vs. Search Engines

- "Find accounts whose balance is greater than $100"
  - Requires data to be well-structured and well-defined
  - Typically involves not just text but numbers
  - Requires use of formal language and logic

- "Find the Canvas system of UCI" or
  "Find how to merge two lists in Python"
  "Find the graph of y=log(x)"
  - Vague and varied information needs
  - Informal and ad-hoc queries
  - Requires engine to infer **meaning** of words and sentences

# Core Issue: **Relevance**

- Textual similarity [databases stop here]
- Document context
  - Origin
  - Author
  - Popularity
  - …
- User context
  - Geographic location
  - Prior queries
  - Age
  - Preferred language
  - …
- Query context
  - Special symbols

# Retrieval Models

- Conceptual designs of what to pay attention to when matching a query and a document
  - E.g. grammar vs. raw text, what parts of context, etc.
- Good retrieval model: finds documents relevant to the person who submitted the query
- Basis for *ranking algorithms*

# Classic IR Assumptions

- Corpus: fixed document collection
- Goal: retrieve information content relevant to the information need

# Classic IR Goal

- “Relevance”
  - For each query Q, and stored document D, there exists a relevance score R(Q, D)
  - Maximize R(Q, D)
    - Context is ignored
    - User is ignored
    - Corpus is static

# Web IR

- The Web is huge
- The Web changes all the time
- There is information to avoid (adversarial IR)
- One interface for hugely divergent needs

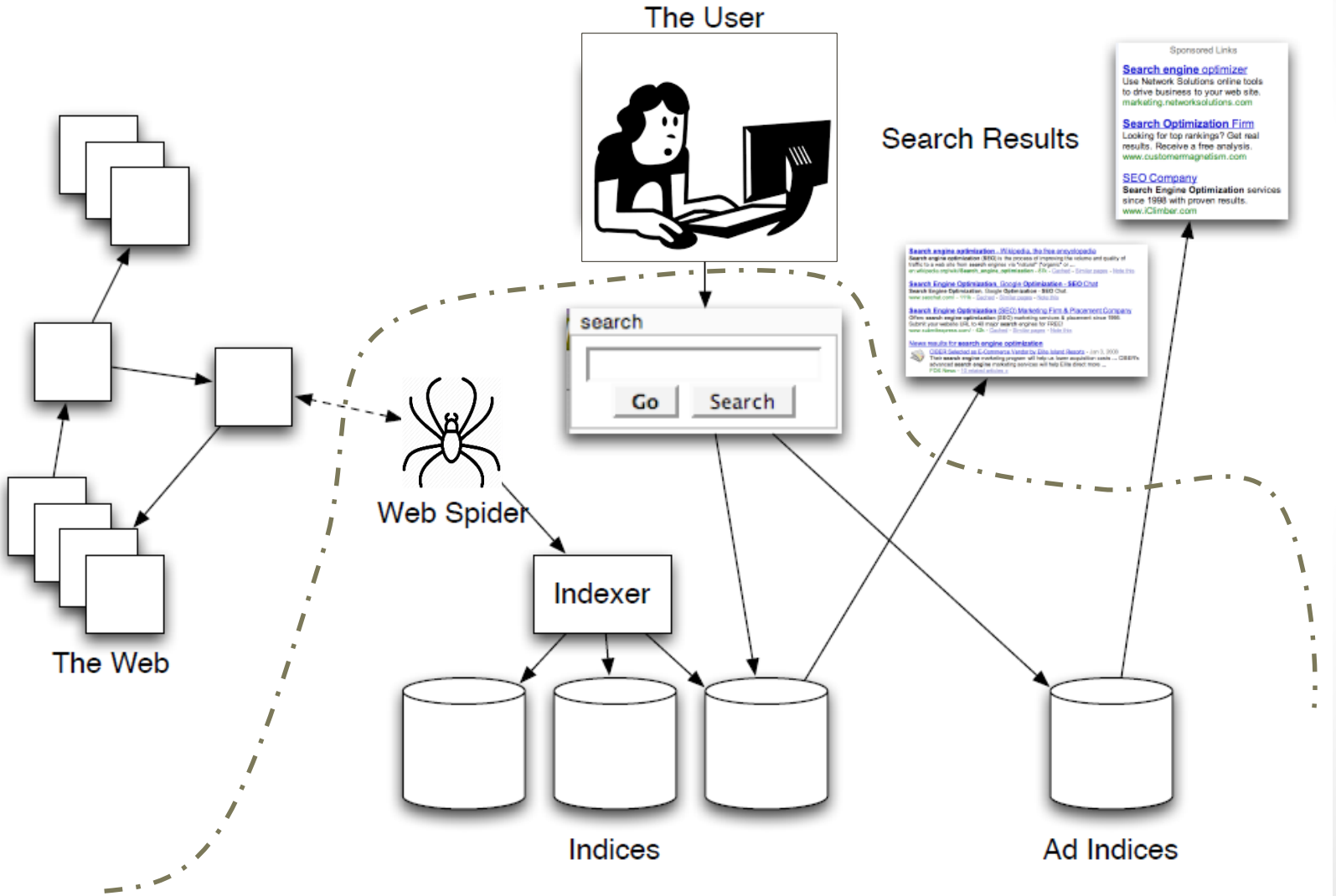
# Web Search Engines

- Practical and useful applications of IR
- Must crawl terabytes of web pages and provide sub-second response to queries
- Big Issues in the design, additionally to IR issues:
  - Performance
    - Response time
    - Query throughput
    - Indexing speed
  - Speed in discovery and integration of new documents
  - Coverage
  - Freshness
  - Spam

# Search Engineers

- Develop and maintain search engines
- Design or optimize content for search engines

# Workflow


The User
Search Results
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Use Network Solutions online tools to drive business to your web site.
marketing.networksolutions.com
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Looking for top rankings? Get real results. Receive a free analysis.
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SEO Company
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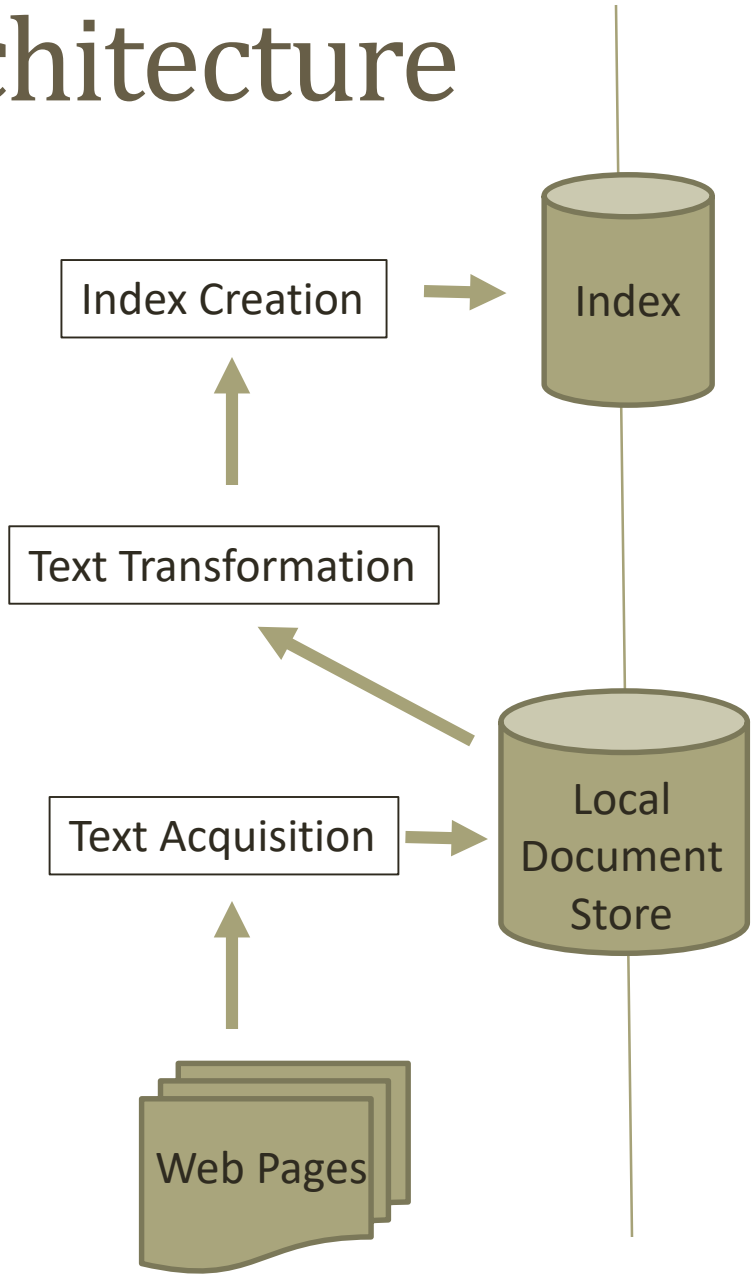
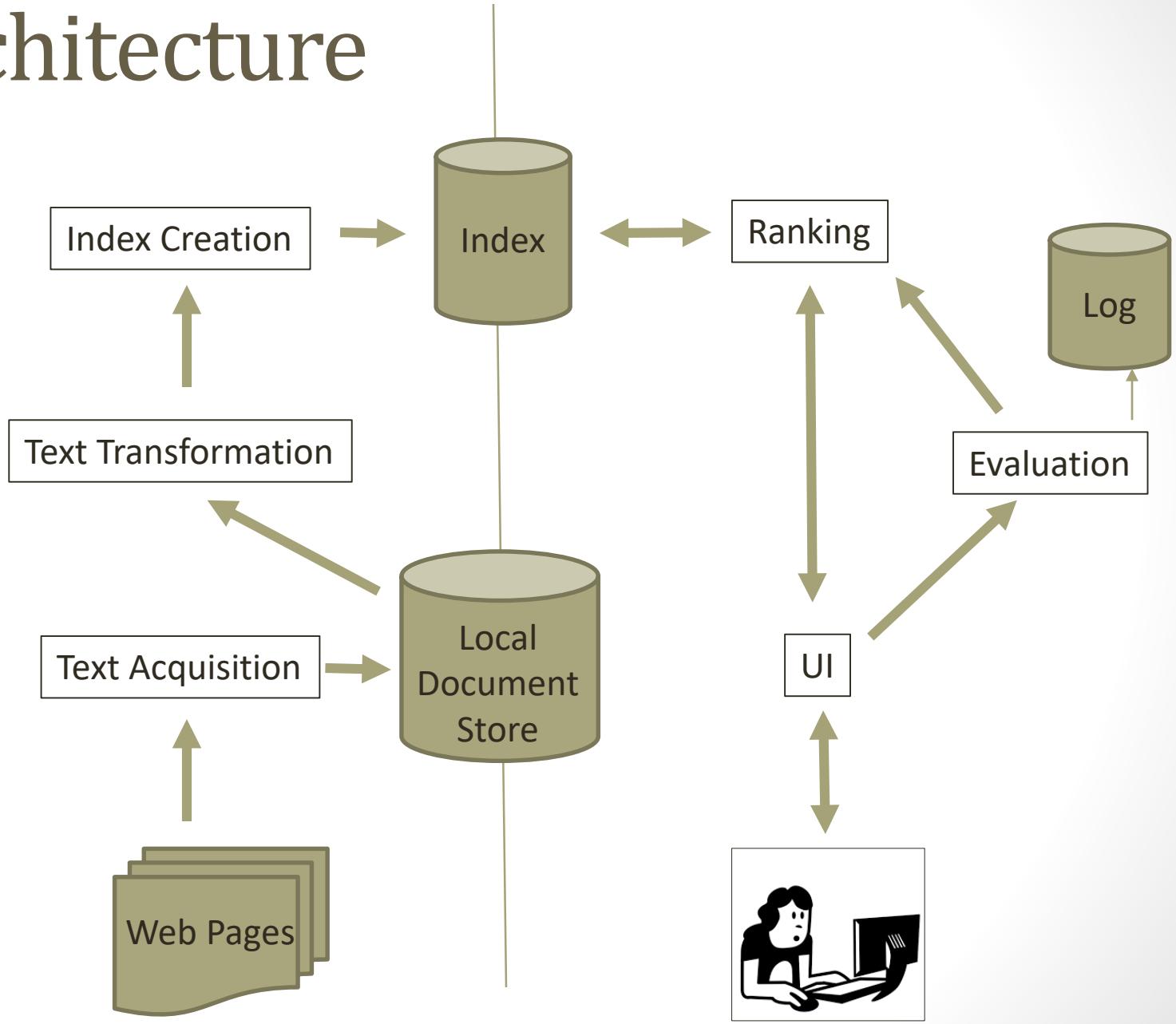
# Architecture

Preprocessing Steps



# Architecture




Preprocessing Steps

Querying Process

# Text Acquisition

- Crawler
- Feeds
- Text conversion
- Document Store

# Text Transformation

- Parser = Tokenizer + Structure
- Stopping
- Stemming
- Link Analysis
- Information Extraction (text structure)
- Classifier (topic, non-content, spam, etc.)

# Index Creation

- Corpus statistics
- Term weighting
- Index inversion (doc → term ➔ term → doc)
- Index distributions (for large indexes)

# User Interaction

- Query input
- Query transformation
- Results output

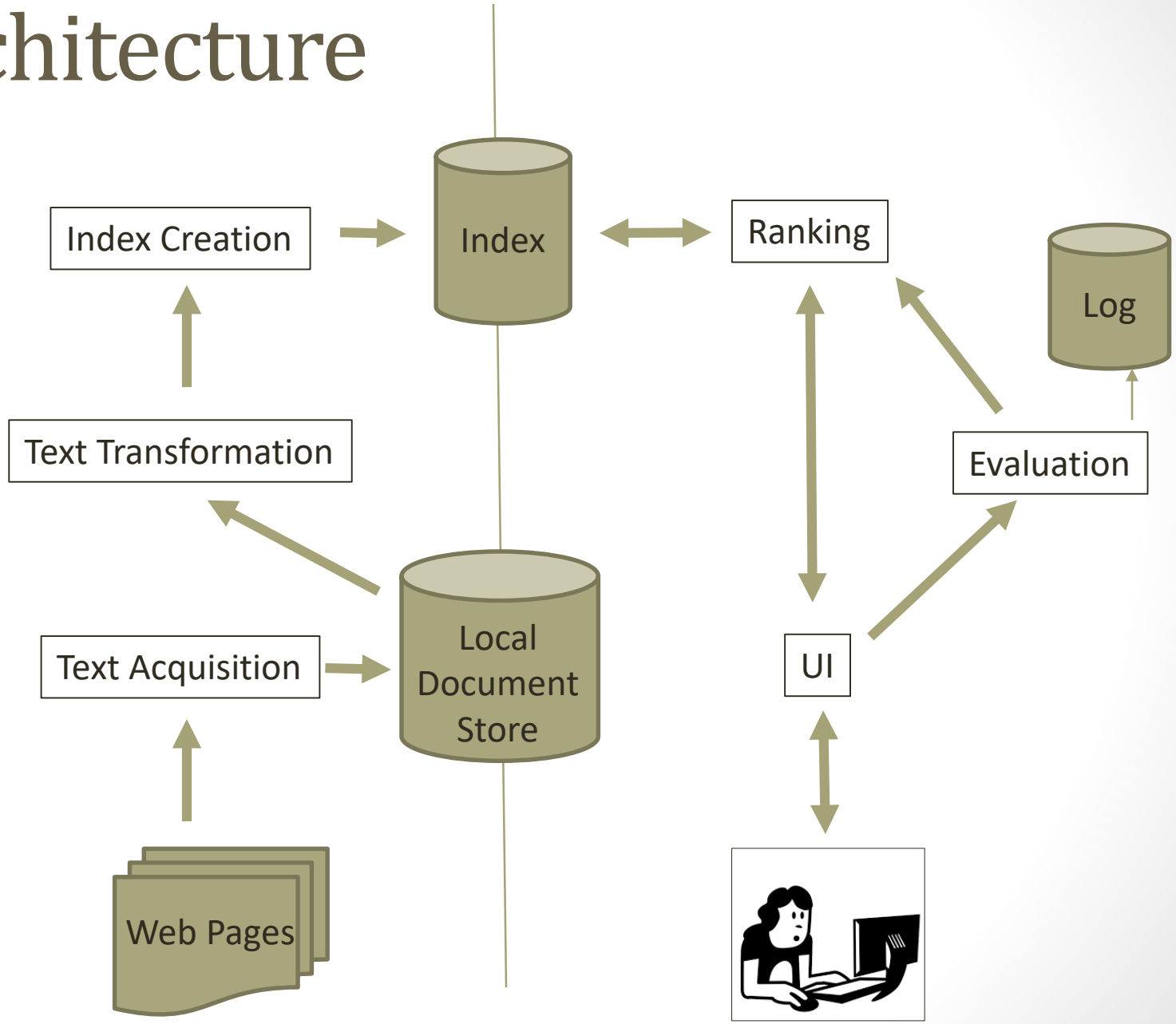
# Ranking

- Scoring: how well each doc matches the query
- Performance optimization
- Distribution

# Evaluation

- Logging
- Ranking analysis
- Performance analysis

# Architecture

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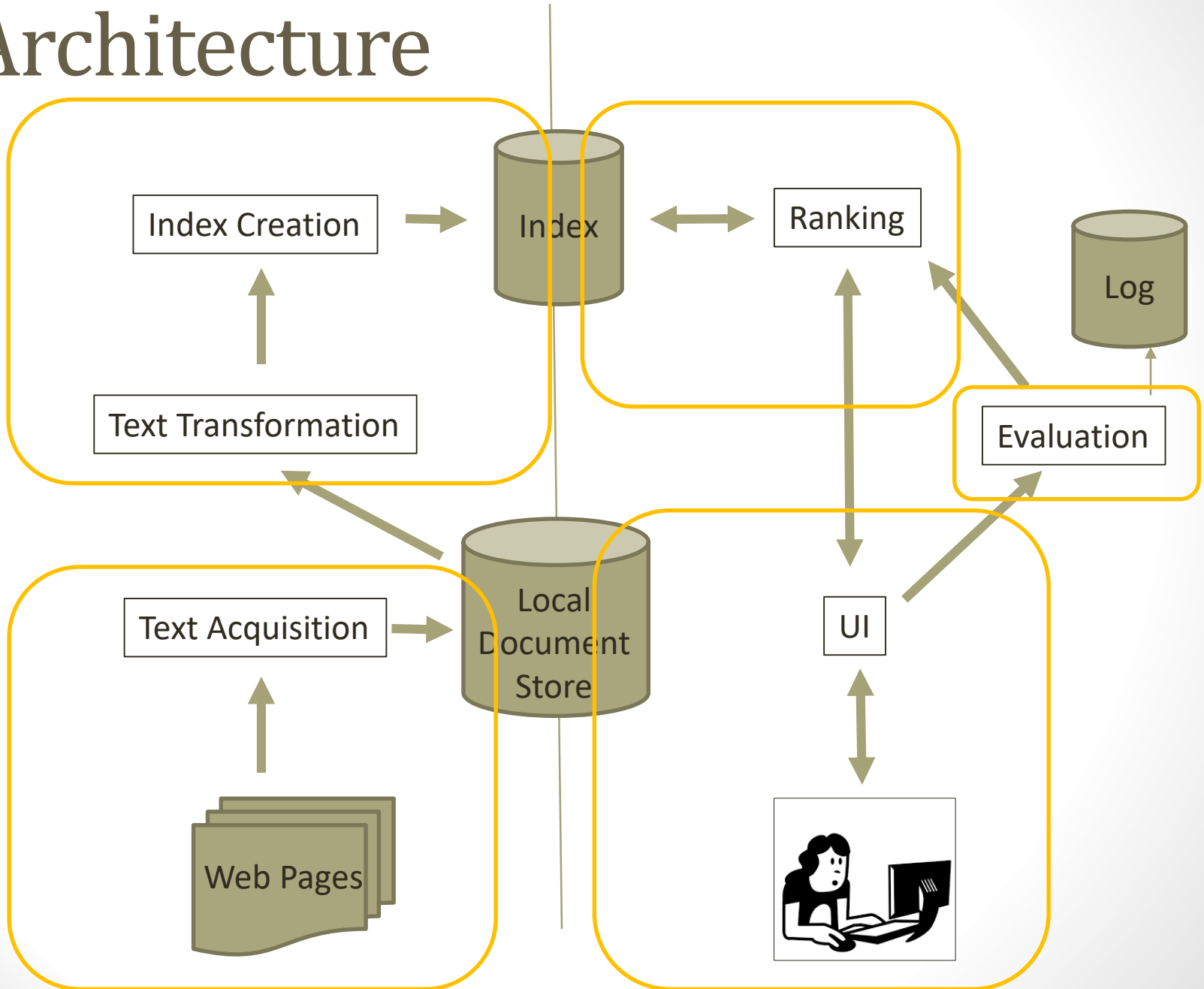


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