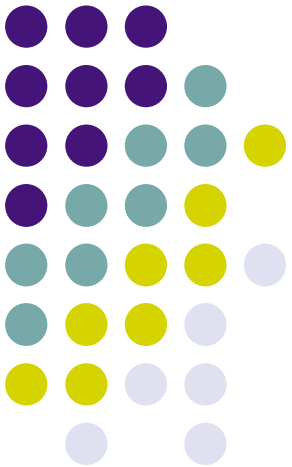
How I Spent My Summer Vacation:

Research in

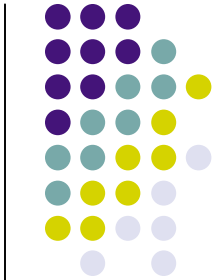
Crawling the Virtual Web



Data Sciences Summer Institute (DSSI)

- Eight-week program for graduates and undergraduates funded by the Department of Homeland Security
- Run by the Multimodal Information Access and Synthesis (MIAS) group at the University of Illinois at Urbana-Champaign
- Program consisted of classes, tutorials and three research projects: Named Entity Recognition, Image Recognition, and the Virtual Web
- http://mias.uiuc.edu/dssi/

Virtual Web Project @ UIUC

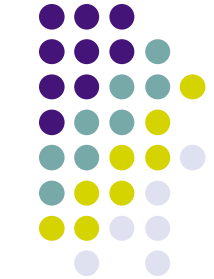


- Run by Professor Kevin Chang
- Virtual Web stored on several servers which are automatically updated periodically
  - Fetch as many URLs and web pages as possible and store them locally
  - Uses a modified version of Nutch (http://lucene.apache.org/nutch/), which runs on Lucene
- Why have a Virtual Web?
  - The web is far too large and dynamic a test-bed for many projects
    - But Virtual Web projects can easily scale to the size and scope of the real web
  - Crawling is expensive, uses web resources that everyone shares, and can violate common courtesy
    - Many webmasters become angry if their site receives too many hits from the same IP

Crawling the Web and the Virtual Web

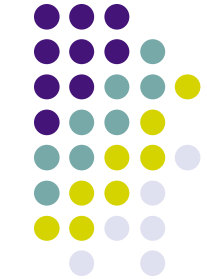
- What is a web crawler?
  - “a program or automated script which browses the World Wide Web in a methodical, automated manner” (Wikipedia)
- Web crawlers consist of one or more seed URLs or keywords, an operation and a classifier
  - Performs the operation on the URLs or keywords and classifies the results accordingly
- Want to build our own web crawlers simply by providing as input the URLs/keywords, operations and classifiers and receiving as output the crawler we want
  - Should be automatic, and intuitive

Intuitive?



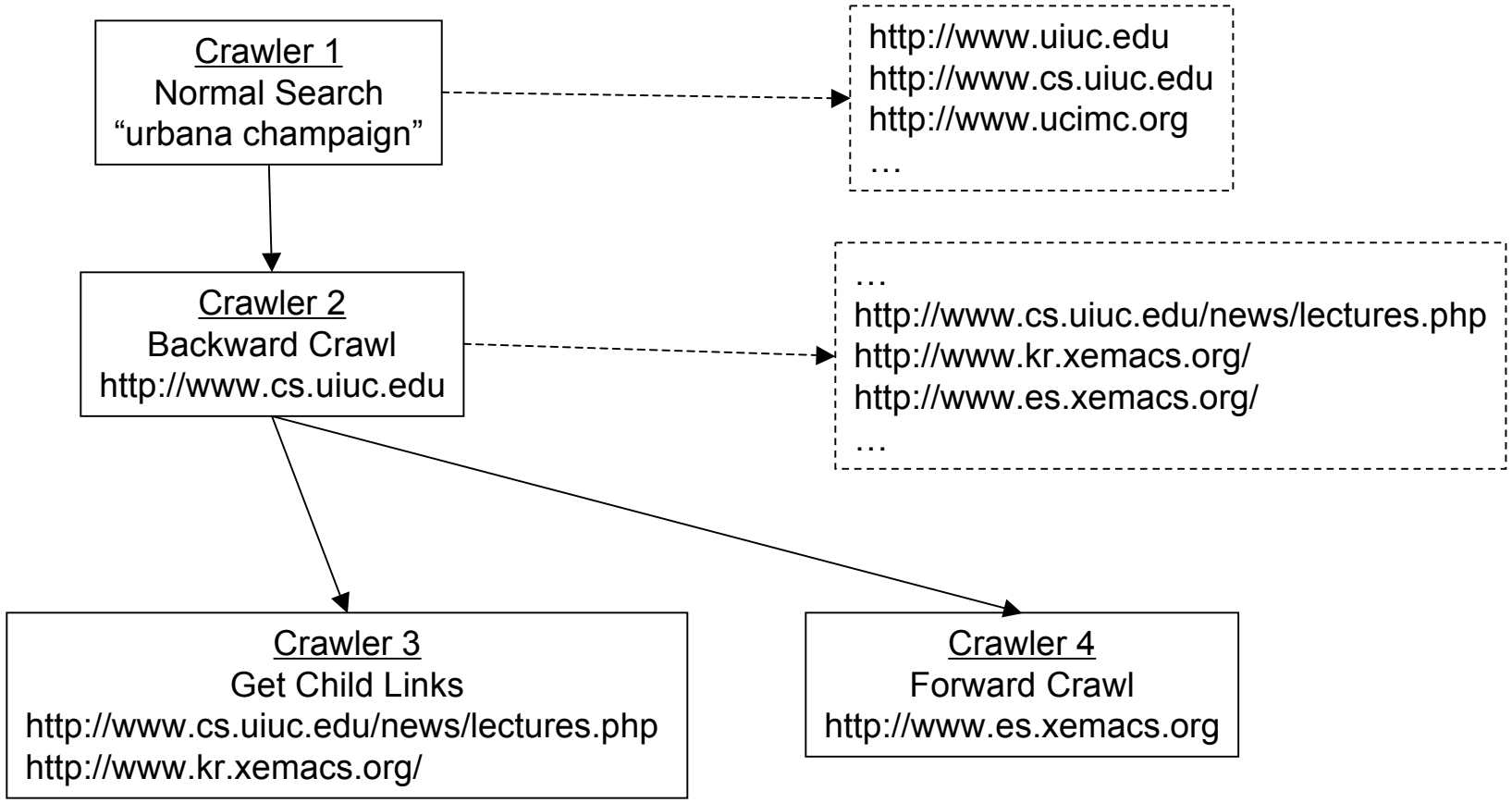
- Consider the web as a graph, with pages as nodes and the links between them as edges
  - Or better yet, states and transitions
- Web crawling should function in the exact same way
  - Multiple crawlers should be linked together similarly as states and transitions
  - User should be allowed to *visualize* the crawler graph they wish to construct

The (Proposed) Visual Crawler



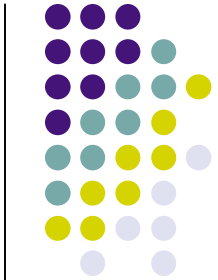
- Every web crawler consists of one or more “mini-crawlers”, which perform an operation with the seed URLs/keywords and classify the results
- Seeds can be URL or keyword results from a previous mini-crawler
  - This creates the *transition* between two mini-crawlers
  - Any mini-crawler can connect to any other mini-crawler, creating loops and duplicate mini-crawlers
- Inspired by Yahoo! Pipes (http://pipes.yahoo.com/pipes/)

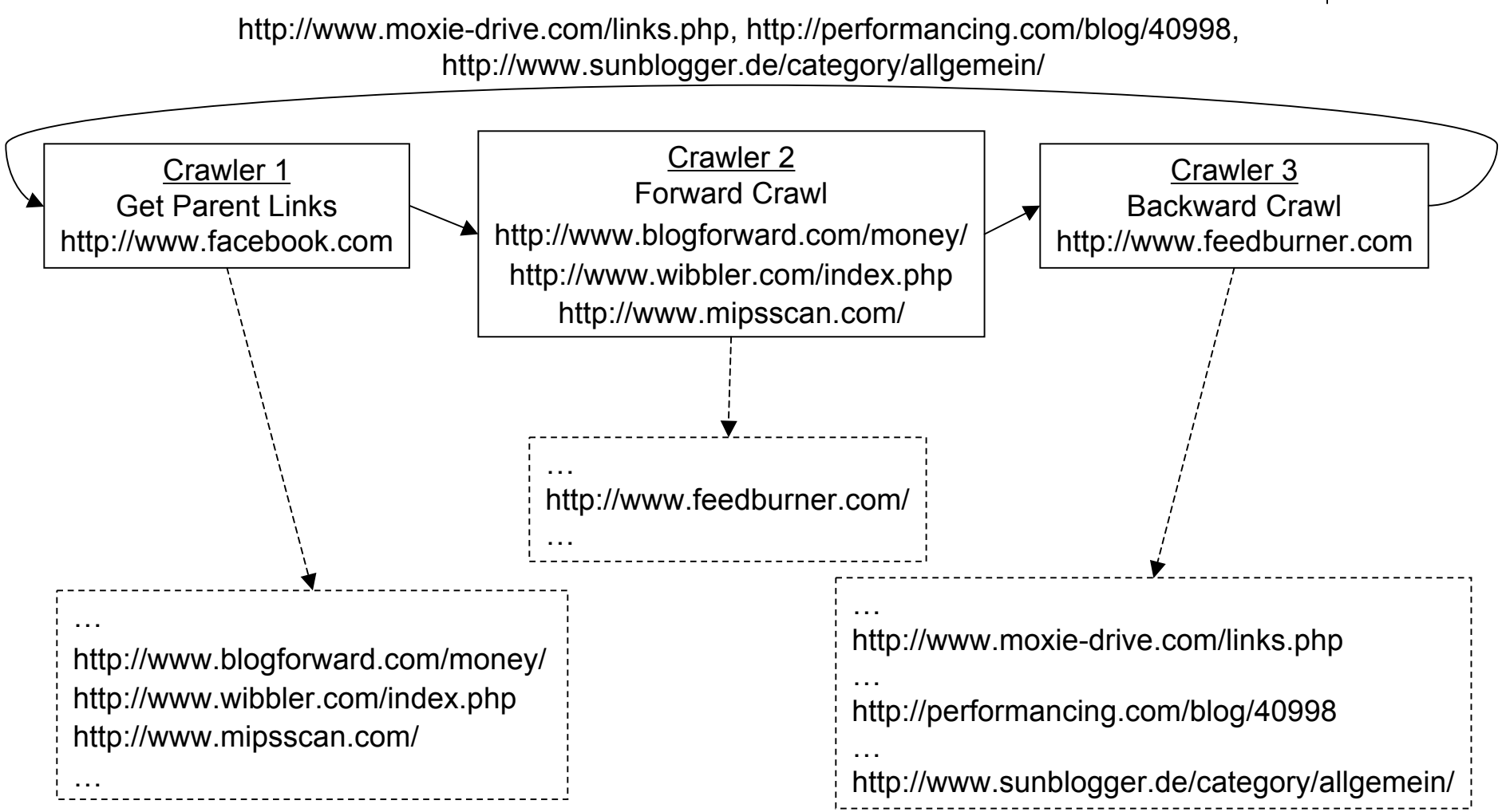
An Example



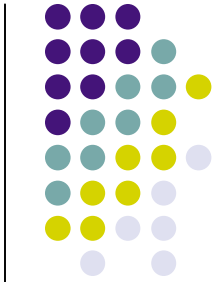
…and so on

Another Example



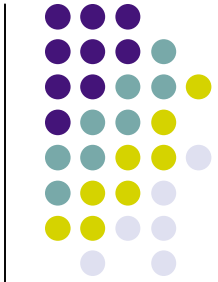


What I Built



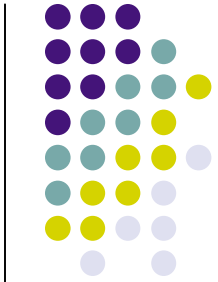
- Nowhere near finished ☺
- Written in Java 6 with Swing
- Not yet fully automated
  - Users still need to specify each mini-crawler and connect them somewhat manually
    - The GUI provides the states of the graph and the user provides the connections between them
  - Doesn't contain classifiers
  - Runs on top of the code used to build crawlers, so not a "pure" visual crawler
    - But still, much more intuitive and, in the future, efficient
      - Visual crawlers make it easier to reuse crawlers in a drag-and-drop fashion, as opposed to re-writing the code (remember Yahoo! Pipes?)

Web Crawlers as Finite State Push-Down Automata



- Can the visual crawler build *all* possible web crawlers?
  - Yes, if the crawler is perfect and complete
    - A perfect visual crawler can do all possible operations
    - Number of operations is finite, web is finite, therefore number of possible crawlers is finite
- Finite number of operations and crawlers => finite number of transitions between operations
  - Crawlers consisting of mini-crawlers are equivalent to states and transitions, remember?
  - Multiple transitions are possible for every state, so the automaton needs information to determine which transition to take
    - Thus a stack is required, especially since crawlers will not necessarily be linear in structure

Who Cares?



- A better model for web crawling means we can build better web crawlers, and search the web more effectively
- Improving web searches is a fundamental goal of Information Retrieval