

COMP 4601A

Fall 2023 - Lab #3

Objectives

The goal for this lab is to implement a basic web crawler, crawl some pages, and build a graph representation of those pages. You will also create a basic RESTful server to allow a client to find information about your crawler's output.

Demonstrating/Submitting

There will be two ways to receive credit for completed labs, outlined below:

1. Attend an in-person lab or office hours and demonstrate your completed lab before the deadline. You will have to show that the goals of the lab have been completed and answer some questions about the lab and your code (see the lab reflection questions for some examples). Your grade will depend on the level of completion, as well as the quality of your design and answers. Only one partner is required for demonstration, though all partner's are encouraged to take part. **If you demonstrate your lab this way, you don't need to submit anything on Brightspace.**
2. Record a video demonstration that is <10 minutes long. Ensure that your discussion in the video makes it clear that you have understood the content that the lab covers and that you demonstrate all the required functionality. Submit a ZIP containing a copy of your code (don't include database files, etc.), your answers to the lab reflection questions, and a copy of your demonstration video (either link to a public URL in your README or include the video file directly) to Brightspace. **If you are working with a partner, only one of you should make a submission. Include the names of all group members in the README file.**

Lab Description

To begin this lab, implement a basic web crawler (e.g., using the [crawler](#) package) that can discover and read pages by branching out from a given seed URL. Your crawler must:

1. Store the content from each page within a database.
2. Store a representation of the network of pages (i.e., which pages link to other pages) within the database. You may store this data in any format you decide is appropriate, such as incoming/outgoing link information stored within each page document, stored as a separate document, stored as a separate collection with link documents, etc.. It is advisable to read the remainder of the requirements below to inform your decisions on data structure and storage.

3. Avoid crawling the same page more than once (i.e., do not re-visit pages).

Implement a basic RESTful server that will allow a client to find information about the data your crawler generates. Your server must support accessing the following resources:

1. GET /popular – Returns the 10 pages with the highest number of incoming links (i.e., the pages that receive links from other pages the most). The information within the response must allow the client to then request data about any of these 10 pages (see below for required information for each single page resource).
2. If the client requests information about a single page X, the response must contain:
 - a. The URL that this resource corresponds to (note: the ID of the page in your RESTful system does not have to match the URL of the page it belongs to)
 - b. A list of the pages that link to the page X

To test your crawler and server, clear your existing database data and start your search from this seed URL: <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-0.html>. This dataset contains 1000 interlinked documents, so if your crawler does not re-visit pages, it should finish running in a relatively short time. The pages with the largest number of incoming links for this dataset are included at the end of the document so you can validate the output of your RESTful server.

While developing/testing, it may be useful to cap the number of pages the crawler visits to a smaller number. An example dataset with only 10 pages can be crawled by starting at the URL <https://people.scs.carleton.ca/~davidmckenney/tinyfruits/N-0.html>. For the purposes of this lab, it is acceptable to store all intermediary data (e.g., network structure) in RAM if you wish, but all of this data must be saved into the database once the crawl is complete.

To receive full grades for this lab, you must demonstrate:

1. Your crawled data is stored in a database
2. Your server produces correct output for the /popular endpoint
3. You can view the data for specific page resources

Lab Reflection Questions

1. How have you represented the graph of pages in your database?
2. How do you keep track of the incoming/outgoing links during the crawl?
3. Describe the selection policy of your web crawler.
4. Does your crawler store all network information while running and then save it to the database, or does it update the database after each page is visited? Describe any advantages/disadvantages of each approach?

Top 10 Pages by Incoming Links:

1. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-1.html> (74)
2. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-4.html> (54)

3. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-3.html> (48)
4. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-0.html> (37)
5. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-9.html> (32)
6. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-12.html> (30)
7. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-15.html> (28)
8. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-20.html> (27)
9. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-6.html> (25)
10. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-42.html> (23)

List of Links for Each Top 10 Page:

1. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-1.html> (74):

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-0.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-10.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-102.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-108.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-111.html>
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<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-2.html>
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<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-25.html>
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<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-956.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-979.html>

2. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-4.html> (54):

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-1.html>
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3. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-3.html> (48):

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<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-991.html>

4. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-0.html> (37):

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<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-877.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-912.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-937.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-945.html>

5. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-9.html> (32):

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-107.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-11.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-12.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-131.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-147.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-148.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-173.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-22.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-220.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-258.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-26.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-27.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-278.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-295.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-3.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-30.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-38.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-41.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-472.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-5.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-551.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-566.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-582.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-607.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-613.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-64.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-676.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-714.html>

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-797.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-88.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-91.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-950.html>

6. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-12.html> (30):

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-1.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-101.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-113.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-119.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-180.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-246.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-252.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-257.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-259.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-277.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-33.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-333.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-356.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-361.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-379.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-430.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-445.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-448.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-459.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-487.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-545.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-558.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-601.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-615.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-669.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-722.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-741.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-77.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-9.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-95.html>

7. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-15.html> (28):

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-11.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-166.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-187.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-19.html>

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-230.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-247.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-289.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-301.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-326.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-344.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-350.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-351.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-397.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-411.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-445.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-534.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-609.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-645.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-665.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-67.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-674.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-68.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-7.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-729.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-74.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-791.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-924.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-981.html>

8. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-20.html> (27):

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-0.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-142.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-144.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-175.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-192.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-197.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-21.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-28.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-280.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-3.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-416.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-533.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-54.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-569.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-573.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-596.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-62.html>

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-664.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-708.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-742.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-8.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-802.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-808.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-852.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-886.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-936.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-999.html>

9. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-6.html> (25):

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-10.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-151.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-163.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-172.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-229.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-255.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-292.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-303.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-377.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-4.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-526.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-533.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-56.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-560.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-590.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-61.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-63.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-641.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-657.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-67.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-699.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-7.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-888.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-906.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-93.html>

10. <https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-42.html> (23):

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-0.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-118.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-14.html>

<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-146.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-152.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-171.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-173.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-175.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-180.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-201.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-21.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-24.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-243.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-274.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-282.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-318.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-322.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-347.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-441.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-476.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-58.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-687.html>
<https://people.scs.carleton.ca/~davidmckenney/fruitgraph/N-812.html>