Once the stream is open, you can read one line at a time as follows:

```
String data = reader.readLine();
```

You can also create the reader using a scanner:
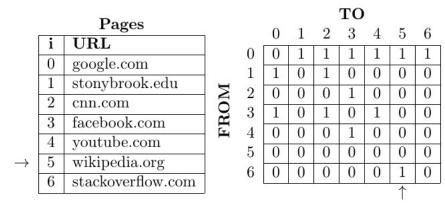
```
Scanner scanner = new Scanner(new File(fileName));
```

Check the documentation for [BufferedReader](#) or [Scanner](#).

Page Rank Algorithm

PageRank is an algorithm developed by Larry Page (of Google fame) to attempt to order web pages based on relevance. The idea is very simple - the more hyperlinks pointing to a page, the more "popular" that page is in the web graph, and the more relevant the page is (note that this is an extremely simplified version - the actual algorithm involves many more complex operations to implement this basic idea). In this assignment, you will implement PageRank in it's most basic form - the rank of a WebPage is equal to the number of directed edges pointing *towards* the page in the `WebGraph`.

When a user enters a keyword, the program should look through all the `WebPages` in the `WebGraph` to find which ones are tagged with the keyword, and add them to a list. After all of the `WebPages` have been added, they should be sorted according to their PageRank in a descending fashion (ties can be broken arbitrarily). Note that the PageRank of `WebPage` 'p' can be easily calculated by adding all of the entries in the column 'i' of the adjacency matrix `links`, where 'i' is the index of 'p' in the `pages` Collection. For example, the PageRank of "wikipedia.org" in the graph below would be calculated by summing the 5'th column of the adjacency matrix, which would yield a PageRank of 2.

PageRank of "wikipedia.org" is 2.

After all the pages have been added and sorted, the URLs should be printed to the console. To make sure that the algorithm is working correctly, you should print out the total ranking (e.g. '1' for the highest PageRank, '2' for the second highest, etc.) as well as the actual PageRank value along with the URLs in tabular form.

GUI EXTRA CREDIT (OPTIONAL):

In addition to performing all the functions described above, the GUI must have clickable headers on all lists which sort by that column when clicked. Clicking again on that column should reverse the sorting order.

Sample Input/Output:

// Comment in green, input in red, output in black

```
// Load WebGraph from file. PageRanks should be calculated and initialized.
Loading WebGraph data...
Success!

Menu:
    (AP) - Add a new page to the graph.
    (RP) - Remove a page from the graph.
    (AL) - Add a link between pages in the graph.
    (RL) - Remove a link between pages in the graph.
    (P)  - Print the graph.
    (S)  - Search for pages with a keyword.
    (Q)  - Quit.

Please select an option: P

    (I) Sort based on index (ASC)
    (U) Sort based on URL (ASC)
    (R) Sort based on rank (DSC)
```

Please select an option: I

```
Index       URL              PageRank  Links          Keywords
---------------------------------------------------------------------------------
  0    | google.com        |    2    | 1, 2, 3, 4, 5, 6 | search, knowledge, tech
  1    | stonybrook.edu    |    1    | 0, 2          | university, seawolf, knowledge, journalism
  2    | cnn.com           |    3    | 3             | news, current, world, journalism
  3    | facebook.com      |    3    | 0, 2, 4       | social, friends, tech
  4    | youtube.com       |    2    | 3             | video, music, cats, tech
  5    | wikipedia.org     |    2    |               | knowledge, encyclopedia
  6    | stackoverflow.com |    1    | 5             | forum, knowledge, social
```

// Menu not printed in sample I/O.

Please select an option: S
Search keyword: knowledge

```
Rank    PageRank     URL
---------------------------------------------
  1  |     2      | google.com
  2  |     2      | wikipedia.org
  3  |     1      | stonybrook.edu
  4  |     1      | stackoverflow.com
```

// Menu not printed in sample I/O.

Please select an option: AL
Enter a source URL: wikipedia.org
Enter a destination URL: stonybrook.edu

Link successfully added from wikipedia.org to stonybrook.edu!

// Menu not printed in sample I/O.

Please select an option: AL
Enter a source URL: stackoverflow.com
Enter a destination URL: stonybrook.edu

Link successfully added from stackoverflow.com to stonybrook.edu!

// Menu not printed in sample I/O.

Please select an option: P

// Sub-menu not printed in sample I/O.

Please select an option: I

```
Index       URL              PageRank  Links          Keywords
---------------------------------------------------------------------------------
  0    | google.com        |    2    | 1, 2, 3, 4, 5, 6 | search, knowledge, tech
  1    | stonybrook.edu    |    3    | 0, 2          | university, seawolf, knowledge, journalism
  2    | cnn.com           |    3    | 3             | news, current, world, journalism
  3    | facebook.com      |    3    | 0, 2, 4       | social, friends, tech
  4    | youtube.com       |    2    | 3             | video, music, cats, tech
  5    | wikipedia.org     |    2    | 1             | knowledge, encyclopedia
  6    | stackoverflow.com |    1    | 1, 5          | forum, knowledge, social
```

// Menu not printed in sample I/O.

Please select an option: S
Search keyword: knowledge

```
Rank    PageRank     URL
---------------------------------------------
  1  |     3      | stonybrook.edu
  2  |     2      | google.com
  3  |     2      | wikipedia.org
  4  |     1      | stackoverflow.com
```

// Menu not printed in sample I/O.

Please select an option: AP
Enter a URL: tumblr.com
Enter keywords (space-separated): blog art social friends

tumblr.com successufly added to the WebGraph!

// Menu not printed in sample I/O.

Please select an option: AL

Enter a source URL: **facebook.com**
Enter a destination URL: **tumblr.com**

Link successfully added from facebook.com to tumblr.com!

// Menu not printed in sample I/O.

Please select an option: **P**

// Submenu not printed in sample I/O.

Please select an option: **I**

```
Index      URL              PageRank  Links              Keywords
-----------------------------------------------------------------------------------------
  0   | google.com        |    2   | 1, 2, 3, 4, 5, 6  | search, knowledge, tech
  1   | stonybrook.edu    |    3   | 0, 2              | university, seawolf, knowledge, journalism
  2   | cnn.com           |    3   | 3                 | news, current, world, journalism
  3   | facebook.com      |    3   | 0, 2, 4, 7        | social, friends, tech
  4   | youtube.com       |    2   | 3                 | video, music, cats, tech
  5   | wikipedia.org     |    2   | 1                 | knowledge, encyclopedia
  6   | stackoverflow.com |    1   | 1, 5              | forum, knowledge, social
  7   | tumblr.com        |    1   |                   | blog, art, social, friends
```

// Menu not printed in sample I/O.

Please select an option: **S**
Search keyword: **social**

```
Rank   PageRank    URL
----------------------------------------------
  1  |    3      | facebook.com
  2  |    1      | tumblr.com
  3  |    1      | stackoverflow.com
```

// Menu not printed in sample I/O.

Please select an option: **S**
Search keyword: **news**

```
Rank   PageRank    URL
----------------------------------------------
  1  |    3      | cnn.com
```

// Menu not printed in sample I/O.

Please select an option: **RL**
Enter a source URL: **google.com**
Enter a destination URL: **cnn.com**

Link removed from google.com to cnn.com!

// Menu not printed in sample I/O.

Please select an option: **S**
Search keyword: **news**

```
Rank   PageRank    URL
----------------------------------------------
  1  |    2      | cnn.com
```

// Menu not printed in sample I/O.

Please select an option: **RP**
Enter a URL: **youtube.com**

youtube.com has been removed from the graph!

// Menu not printed in sample I/O.

Please select an option: **P**

// Submenu not printed in sample I/O.

Please select an option: **I**

// Note that the link numbers have changed for indices > 4.

```
Index      URL              PageRank  Links              Keywords
-----------------------------------------------------------------------------------------
  0   | google.com        |    2   | 1, 3, 4, 5        | search, knowledge, tech
```

```
    1  |  stonybrook.edu      |   3   |  0, 2        |  university, seawolf, knowledge, journalism
    2  |  cnn.com             |   2   |  3           |  news, current, world, journalism
    3  |  facebook.com        |   2   |  0, 2, 6     |  social, friends, tech
    4  |  wikipedia.org       |   2   |  1           |  knowledge, encyclopedia
    5  |  stackoverflow.com   |   1   |  1, 4        |  forum, knowledge, social
    6  |  tumblr.com          |   1   |              |  blog, art, social, friends
```

// Menu not printed in sample I/O.

Please select an option: P

// Submenu not printed in sample I/O.

Please select an option: U

```
Index      URL                PageRank   Links        Keywords
-------------------------------------------------------------------------------------------
    2  |  cnn.com             |   2   |  3           |  news, current, world, journalism
    3  |  facebook.com        |   2   |  0, 2, 6     |  social, friends, tech
    0  |  google.com          |   2   |  1, 3, 4, 5  |  search, knowledge, tech
    5  |  stackoverflow.com   |   1   |  1, 4        |  forum, knowledge, social
    1  |  stonybrook.edu      |   3   |  0, 2        |  university, seawolf, knowledge, journalism
    6  |  tumblr.com          |   1   |              |  blog, art, social, friends
    4  |  wikipedia.org       |   2   |  1           |  knowledge, encyclopedia
```

// Menu not printed in sample I/O.

Please select an option: P

// Submenu not printed in sample I/O.

Please select an option: R

```
Index      URL                PageRank   Links        Keywords
-------------------------------------------------------------------------------------------
    1  |  stonybrook.edu      |   3   |  0, 2        |  university, seawolf, knowledge, journalism
    0  |  google.com          |   2   |  1, 3, 4, 5  |  search, knowledge, tech
    2  |  cnn.com             |   2   |  3           |  news, current, world, journalism
    3  |  facebook.com        |   2   |  0, 2, 6     |  social, friends, tech
    4  |  wikipedia.org       |   2   |  1           |  knowledge, encyclopedia
    5  |  stackoverflow.com   |   1   |  1, 4        |  forum, knowledge, social
    6  |  tumblr.com          |   1   |              |  blog, art, social, friends
```

// Special Cases:

// Menu not printed in sample I/O.

Please select an option: S // Searching for non existent keyword.
Search keyword: dogs

No search results found for the keyword dogs.

// Menu not printed in sample I/O.

Please select an option: AP // Duplicate URLs.
Enter a URL: facebook.com
Enter keywords (space-separated): social friends tech

Error: facebook.com already exists in the WebGraph. Could not add new WepPage.

// Menu not printed in sample I/O.

Please select an option: AL // Non-existent URLs.
Enter a source URL: instagram.com
Enter a destination URL: facebook.com

Error: instagram.com could not be found in the WebGraph.

// Menu not printed in sample I/O.

Please select an option: Q

Goodbye.

Course Info | Schedule | Sections | Announcements | Homework | Exams | Help/FAQ | Grades | HOME