Assignment 1

CS 532: Introduction to Web Science

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Question

1. Demonstrate that you know how to use "curl" well enough to correctly POST data to a form. Show that the HTML response that is returned is "correct". That is, the server should take the arguments you POSTed and build a response accordingly. Save the HTML response to a file and then view that file in a browser and take a screen shot.

Answer

The curl command is capable of solving this problem multiple ways. As stated by the Curl manual page, curl offers two options to post data:

- -F, –form, 'type='
- -d, –data, 'type='

The difference between the two is the content-type, where -F is multipart/form-data and -d is application/x-www-form-urlencoded. Meaning -F can send files and parameters, while -d can just be used to send parameters via HTTP post.

For simplicity, I chose the latter route and used -d as part of my curl commands. I also chose to include -o, –output, which outputs the response to a file. The commands are as follows:

```
1 curl -d 'name=Grant Atkins' -d 'note=Praise Web Science' http://
    www.cs.odu.edu/~gatkins/cs532/curlPost.php -o output/
    correctResponse.html
2
3 curl http://www.cs.odu.edu/~gatkins/cs532/curlPost.php -o output
    /incorrectResponse.html
```

Listing 1: Curl with and without post parameters

The first command sends two parameters in a post request to a URI, more specifically a PHP file that I created in my personal public html directory on the ODU Computer Science servers. The PHP file, as shown below in Listing 2, expects two parameters which are: name and note. Those two parameters

are then included inside of the html document response to show they were posted correctly, also the banner in which they are displayed should turn green if posted correctly like shown in Figure 1. The second command shows a curl command without post parameters to the same URI. This should show a red banner with an insult on your use of curl like shown in Figure 2.

```
<?php
$message = "";
$note = "";
$color = "purple";
if(isset($_POST["name"]) && isset($_POST["note"])){
  $message = "You rock at curl ".$_POST["name"];
  $note = $_POST["note"];
  $color = "green";
}else{
  $message = "You suck at curl";
}

?>
<html lang="en">
<head>
  <title>CurlPost Example</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-
      scale=1">
  <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
      bootstrap/3.3.7/css/bootstrap.min.css">
  <script>
  </script>
</head>

<body>
  <div class="jumbotron text-center" style="background-color:<?
      php echo $color; ?>;color:white;">
    <h1><?php echo $message; ?></h1>
    <h2><?php echo $note; ?></h2>
  </div>
</body>
```

Listing 2: PHP Script for receiving form post parameters

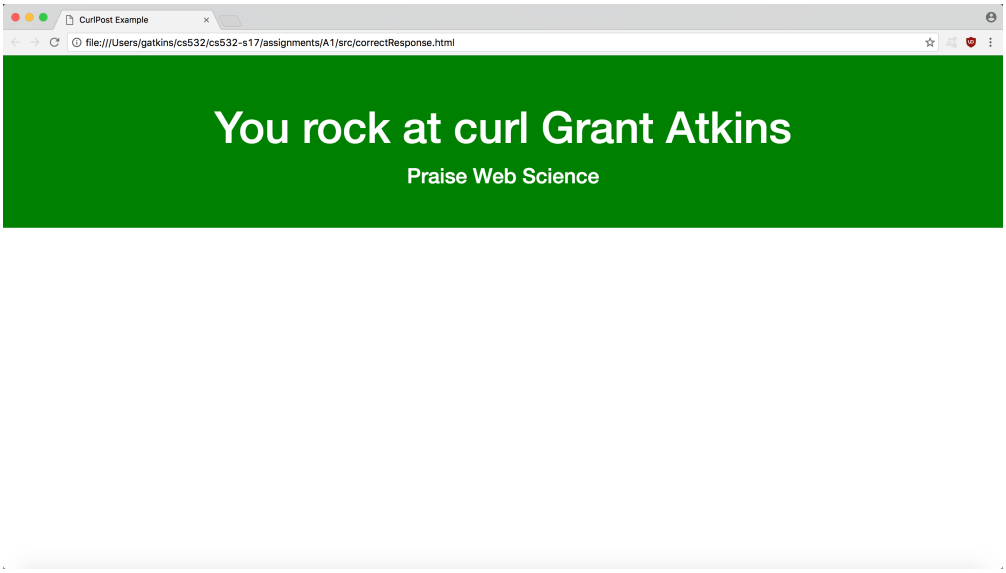

Figure 1: Correct response rendered in browser

```
1  <html lang="en">
2  <head>
3    <title>CurlPost Example</title>
4    <meta charset="utf-8">
5    <meta name="viewport" content="width=device-width, initial-
         scale=1">
6    <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
         bootstrap/3.3.7/css/bootstrap.min.css">
7    <script>
8    </script>
9  </head>
10
11 <body>
12   <div class="jumbotron text-center" style="background-color:
         green;color:white;">
13     <h1>You rock at curl Grant Atkins</h1>
14     <h2>Praise Web Science</h2>
15   </div>
16 </body>
```

Listing 3: Correct response html content outputted by curl command

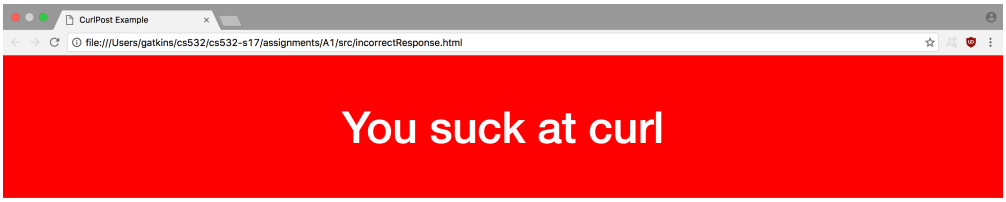

Figure 2: Incorrect response rendered in browser

```
1  <html lang="en">
2  <head>
3    <title>CurlPost Example</title>
4    <meta charset="utf-8">
5    <meta name="viewport" content="width=device-width, initial-
         scale=1">
6    <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
         bootstrap/3.3.7/css/bootstrap.min.css">
7    <script>
8    </script>
9  </head>
10
11 <body>
12   <div class="jumbotron text-center" style="background-color:red
         ;color:white;">
13     <h1>You suck at curl</h1>
14     <h2></h2>
15   </div>
16 </body>
```

Listing 4: Incorrect response html content outputted by curl command

2

Question

2. Write a Python program that:
   1. takes as a command line argument a web page
   2. extracts all the links from the page
   3. lists all the links that result in PDF files, and prints out the bytes for each of the links. (note: be sure to follow all the redirects until the link terminates with a "200 OK".)
   4. show that the program works on 3 different URIs, one of which needs to be: http://www.cs.odu.edu/~mln/teaching/cs532-s17/test/pdfs.html

Answer

```
1  #!/usr/bin/env python
2
3  import sys
4  from bs4 import BeautifulSoup
5  from urllib2 import urlopen, HTTPError, URLError, Request
6  from urlparse import urljoin, urlparse
7  from httplib import BadStatusLine
8
9
10 def findPdfs(html,baseurl):
11     """
12     Take html string as parameter and parse through links ('a'
           elements). Print final redirect url and bytes
13     Params: html string to be used by beautiful soup, baseurl
           which is passed from commandline
14     Return: Array of urls that end with pdf files
15     """
16     pdfs = []
17     soup = BeautifulSoup(html, 'html.parser')
18     for link in soup.find_all('a',href=True):
19
20         linkFound = link.get('href')
21
22         if isAbsolute(linkFound) == False:
23             linkFound = urljoin(baseurl,linkFound)
24
```

```
25          resp = request(linkFound)
26          if resp is not None:
27              contentType = resp.info().type
28              responseCode = resp.getcode()
29
30              if 'application/pdf' in contentType and responseCode
                    == 200:
31                  finalURL = resp.geturl()
32                  print "Original URI:",linkFound
33                  print "Final URI:",finalURL
34                  # might not contain it
35                  try:
36                      byteSize = resp.headers['content-length']
37                  except:
38                      byteSize = len(resp.read())
39                  print "Bytes: ", byteSize, "\n"
40                  pdfs.append(finalURL)
41      return pdfs
42
43
44  def request(uri):
45      """
46      Params: URI to be requested
47      Return: http get response
48      """
49      try:
50          reqHeaders = {'User-Agent':'Mozilla 5.10'}
51          req = Request(uri,headers=reqHeaders)
52          response = urlopen(req)
53          return response
54      except (HTTPError,ValueError,URLError) as e:
55          pass
56      except BadStatusLine:
57          # print "**Connection closed early For:**","\n",uri,"\n"
58          pass
59      except KeyboardInterrupt:
60          print ""
61          exit()
62
63
64  def isAbsolute(url):
65      """
66      Taken from stackoverflow post
67      """
68      try:
```

```
69          return bool(urlparse(url).netloc)
70      except:
71          return False
72
73
74  if __name__ == "__main__":
75
76      if len(sys.argv) == 2:
77          response = request(sys.argv[1])
78
79          if response is None:
80              print "Initial link can't be bad"
81              print "Must contain http:// or https:// and must be
                    reachable"
82              exit()
83
84          pdfs = findPdfs(response.read(),response.geturl())
85      else:
86          print "Usage: python pdfCrawl.py URI"
87          exit()
```

Listing 5: Python script that searches for links that end in pdf files

This script was written in python, and requires version 2.7 which is currently the default for mac computers and ODU CS department's servers. My solution took an iterative approach doing one URI at a time and waiting for each response until moving onto the next URI found. This program takes advantage of the built in libraries:

- sys
- urllib2
- urlparse
- httplib

It also uses the third party library Beautiful Soup to parse html content received using this program.

The script is run like so:

```
python pdfCrawl.py URI
```

Once `pdfCrawl.py` is run it first checks if there is indeed a URI provided via command line arguments. Then it will pass the first argument after script name to the function `request` , which takes a properly formatted URI and performs an HTTP get request using the urllib2 library. When performing this request, the urllib2 library takes into consideration: infinite loops from 300 responses, incorrect formatted URIs, no response code at all, and 400 response codes for client errors [1]. I also included the use of the httplib library into this function because there were sometimes special errors when the get request could never fulfill a connection to the server. If none of these errors occurred the request function would return the HTTP get response, otherwise it would return nothing.

After the first request was made it would be passed to `findPdfs` function which would use Beautiful Soup to find all the html *a* elements that contained *href* tags to another URI [2]. I would then iterate through each of the URIs found on the page and request again each of those URIs to determine if the URI would point to pdf file. If the final URI provided a content-type of *application/pdf* and a response code of 200 it was considered a pdf file.

One of the cases that came up is whether a URI found in the html document was absolute or relative. Using a script provided from a Stackoverflow.com post, I created a function that would that determined that determined if a string was relative or absolute [5]. If it was relative, it would be merged with the original final URI provided from command line to create an absolute URI . There was one case that actually didn't return content-length, meaning I had to count the bytes from the response's content instead of getting it from the header information. When the `findPdfs` function ends it returns an array of pdfs that can be used for further use.

The URIs I used for this problem were:

- http://www.cs.odu.edu/ mln/teaching/cs532-s17/test/pdfs.html
- http://www.cs.odu.edu/ zeil
- http://www.cs.odu.edu/ nadeem/classes/cs752-S11/

I ran my script and then saved the output to text files, they are as follows:

```
1 Original URI: http://www.cs.odu.edu/~mln/pubs/ht-2015/hypertext
    -2015-temporal-violations.pdf
2 Final URI: http://www.cs.odu.edu/~mln/pubs/ht-2015/hypertext
    -2015-temporal-violations.pdf
```

```
3  Bytes:  2184076
4
5  Original URI: http://www.cs.odu.edu/~mln/pubs/tpdl-2015/tpdl
       -2015-annotations.pdf
6  Final URI: http://www.cs.odu.edu/~mln/pubs/tpdl-2015/tpdl-2015-
       annotations.pdf
7  Bytes:  622981
8
9  Original URI: http://arxiv.org/pdf/1512.06195
10 Final URI: https://arxiv.org/pdf/1512.06195.pdf
11 Bytes:  1748961
12
13 Original URI: http://www.cs.odu.edu/~mln/pubs/tpdl-2015/tpdl
       -2015-off-topic.pdf
14 Final URI: http://www.cs.odu.edu/~mln/pubs/tpdl-2015/tpdl-2015-
       off-topic.pdf
15 Bytes:  4308768
16
17 Original URI: http://www.cs.odu.edu/~mln/pubs/tpdl-2015/tpdl
       -2015-stories.pdf
18 Final URI: http://www.cs.odu.edu/~mln/pubs/tpdl-2015/tpdl-2015-
       stories.pdf
19 Bytes:  1274604
20
21 Original URI: http://www.cs.odu.edu/~mln/pubs/tpdl-2015/tpdl
       -2015-profiling.pdf
22 Final URI: http://www.cs.odu.edu/~mln/pubs/tpdl-2015/tpdl-2015-
       profiling.pdf
23 Bytes:  639001
24
25 Original URI: http://www.cs.odu.edu/~mln/pubs/jcdl-2014/jcdl
       -2014-brunelle-damage.pdf
26 Final URI: http://www.cs.odu.edu/~mln/pubs/jcdl-2014/jcdl-2014-
       brunelle-damage.pdf
27 Bytes:  2205546
28
29 Original URI: http://bit.ly/1ZDatNK
30 Final URI: http://www.cs.odu.edu/~mln/pubs/jcdl-2015/jcdl-2015-
       temporal-intention.pdf
31 Bytes:  720476
32
33 Original URI: http://www.cs.odu.edu/~mln/pubs/jcdl-2015/jcdl
       -2015-mink.pdf
34 Final URI: http://www.cs.odu.edu/~mln/pubs/jcdl-2015/jcdl-2015-
       mink.pdf
```

```
35 Bytes:  1254605
36
37 Original URI: http://www.cs.odu.edu/~mln/pubs/jcdl-2015/jcdl
       -2015-arabic-sites.pdf
38 Final URI: http://www.cs.odu.edu/~mln/pubs/jcdl-2015/jcdl-2015-
       arabic-sites.pdf
39 Bytes:  709420
40
41 Original URI: http://www.cs.odu.edu/~mln/pubs/jcdl-2015/jcdl
       -2015-dictionary.pdf
42 Final URI: http://www.cs.odu.edu/~mln/pubs/jcdl-2015/jcdl-2015-
       dictionary.pdf
43 Bytes:  2350603
```

Listing 6: Output from http://www.cs.odu.edu/ mln/teaching/cs532-s17/test/pdfs.html

```
1 Original URI: http://www.cs.odu.edu/~zeil/vita.pdf
2 Final URI: http://www.cs.odu.edu/~zeil/vita.pdf
3 Bytes:  91987
```

Listing 7: Output from http://www.cs.odu.edu/ zeil

```
1 Original URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/
      s11/material/Sample_Review_1.pdf
2 Final URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/s11/
      material/Sample_Review_1.pdf
3 Bytes:  51693
4
5 Original URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/
      s11/material/Lec-01_Course-Introduction.pdf
6 Final URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/s11/
      material/Lec-01_Course-Introduction.pdf
7 Bytes:  2647409
8
9 Original URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/
      s11/material/Lec-02_PHY-Fundamentals.pdf
10 Final URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/s11/
      material/Lec-02_PHY-Fundamentals.pdf
11 Bytes:  1737882
12
13 Original URI: http://www.cs.ucsb.edu/~ebelding/courses/284/s06/
      papers/80211_adhoc.pdf
14 Final URI: http://www.cs.ucsb.edu/~ebelding/courses/284/s06/
      papers/80211_adhoc.pdf
```

```
15 Bytes: 723511
16
17 Original URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/
       s11/material/Lec-03_MAC-I.pdf
18 Final URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/s11/
       material/Lec-03_MAC-I.pdf
19 Bytes: 1624694
20
21 Original URI: http://home.eng.iastate.edu/~daji/papers/ton07.pdf
22 Final URI: http://home.eng.iastate.edu/~daji/papers/ton07.pdf
23 Bytes: 1068921
24
25 Original URI: http://research.microsoft.com/en-us/um/people/
       padmanab/papers/imc2005.pdf
26 Final URI: http://research.microsoft.com/en-us/um/people/
       padmanab/papers/imc2005.pdf
27 Bytes: 193593
28
29 Original URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/
       s11/material/Lec-03_MAC-I.pdf
30 Final URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/s11/
       material/Lec-03_MAC-I.pdf
31 Bytes: 1624694
32
33 Original URI: http://citeseerx.ist.psu.edu/viewdoc/download;
       jsessionid=E018BA1D3D65453E8DA2B92041291AC5?doi
       =10.1.1.10.6560&rep=rep1&type=pdf
34 Final URI: http://citeseerx.ist.psu.edu/viewdoc/download;
       jsessionid=E018BA1D3D65453E8DA2B92041291AC5?doi
       =10.1.1.10.6560&rep=rep1&type=pdf
35 Bytes: 299641
36
37 Original URI: http://www.csc.ncsu.edu/faculty/rhee/export/
       zmacsensys.pdf
38 Final URI: http://www4.ncsu.edu/~rhee/export/zmacsensys.pdf
39 Bytes: 283575
40
41 Original URI: http://h10032.www1.hp.com/ctg/Manual/c00186949.pdf
42 Final URI: http://h10032.www1.hp.com/ctg/Manual/c00186949.pdf
43 Bytes: 313323
44
45 Original URI: http://citeseerx.ist.psu.edu/viewdoc/download?doi
       =10.1.1.3.1887&rep=rep1&type=pdf
46 Final URI: http://citeseerx.ist.psu.edu/viewdoc/download?doi
       =10.1.1.3.1887&rep=rep1&type=pdf
```

```
47 Bytes:  107248
48
49 Original URI: http://sing.stanford.edu/pubs/sing-10-00.pdf
50 Final URI: http://sing.stanford.edu/pubs/sing-10-00.pdf
51 Bytes:  1213250
52
53 Original URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/
       s11/material/Lec-05_mac_CSMACN.pdf
54 Final URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/s11/
       material/Lec-05_mac_CSMACN.pdf
55 Bytes:  2725911
56
57 Original URI: http://www.csc.ncsu.edu/faculty/rhee/export/
       zmacsensys.pdf
58 Final URI: http://www4.ncsu.edu/~rhee/export/zmacsensys.pdf
59 Bytes:  283575
60
61 Original URI: http://www.cse.wustl.edu/~lu/papers/sensys07.pdf
62 Final URI: http://www.cse.wustl.edu/~lu/papers/sensys07.pdf
63 Bytes:  540100
64
65 Original URI: http://pages.cs.wisc.edu/~suman/courses/838/f06/
       zigbee-myers-talk.pdf
66 Final URI: http://pages.cs.wisc.edu/~suman/courses/838/f06/
       zigbee-myers-talk.pdf
67 Bytes:  790715
68
69 Original URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/
       s11/material/Moral.pdf
70 Final URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/s11/
       material/Moral.pdf
71 Bytes:  418388
72
73 Original URI: http://portal.acm.org/ft_gateway.cfm?id=989487&
       type=pdf&coll=&dl=ACM&CFID=15151515&CFTOKEN=6184618
74 Final URI: http://delivery.acm.org/10.1145/990000/989487/p222-so
       .pdf?ip=128.82.17.156&id=989487&acc=ACTIVE%20SERVICE&key=
       B33240AC40EC9E30%2E9EA977942CF5A36F%2E4D4702B0C3E38B35%2
       E4D4702B0C3E38B35&CFID=892728580&CFTOKEN=12861955&__acm__
       =1485275670_70d469714eb0fa91b5245531e7f80f8b
75 Bytes:  238849
76
77 Original URI: http://portal.acm.org/ft_gateway.cfm?id=1140286&
       type=pdf&coll=&dl=ACM&CFID=15151515&CFTOKEN=6184618
78 Final URI: http://delivery.acm.org/10.1145/1150000/1140286/p63-
```

```
    mishra.pdf?ip=128.82.17.156&id=1140286&acc=ACTIVE%20SERVICE&
    key=B33240AC40EC9E30%2E9EA977942CF5A36F%2E4D4702B0C3E38B35%2
    E4D4702B0C3E38B35&CFID=892728602&CFTOKEN=54630644&__acm__
    =1485275672_d8a18a61b43ec52850bc1038657b09b7
79  Bytes:  227192
80
81  Original URI: http://www.google.com/url?sa=t&source=web&cd=2&ved
    =0CB4QFjAB&url=http%3A%2F%2Fciteseerx.ist.psu.edu%2Fviewdoc%2
    Fdownload%3Bjsessionid%3D6B0972E63A8F1577EFFDB76884E97752%3
    Fdoi%3D10.1.1.12.6578%26rep%3Drep1%26type%3Dpdf&ei=
    _1ZQTbjXEYH-8Aa4xfytDg&usg=AFQjCNGykWNj3G7Rl09eVNHnVk9v5-BRFw
82  Final URI: http://citeseerx.ist.psu.edu/viewdoc/download;
    jsessionid=6B0972E63A8F1577EFFDB76884E97752?doi
    =10.1.1.12.6578&rep=rep1&type=pdf
83  Bytes:  203451
84
85  Original URI: http://ccr.sigcomm.org/online/files/p135-chandra.
    pdf
86  Final URI: http://ccr.sigcomm.org/online/files/p135-chandra.pdf
87  Bytes:  1573870
88
89  Original URI: http://portal.acm.org/ft_gateway.cfm?id=1023742&
    type=pdf&coll=&dl=ACM&CFID=15151515&CFTOKEN=6184618
90  Final URI: http://delivery.acm.org/10.1145/1030000/1023742/p216-
    bahl.pdf?ip=128.82.17.156&id=1023742&acc=ACTIVE%20SERVICE&key
    =B33240AC40EC9E30%2E9EA977942CF5A36F%2E4D4702B0C3E38B35%2
    E4D4702B0C3E38B35&CFID=892728641&CFTOKEN=45286051&__acm__
    =1485275677_8e1147d1848f4693c08792abdaeabfc0
91  Bytes:  326607
92
93  Original URI: http://portal.acm.org/ft_gateway.cfm?id=1147554&
    type=pdf&coll=&dl=ACM&CFID=15151515&CFTOKEN=6184618
94  Final URI: http://delivery.acm.org/10.1145/1150000/1147554/p301-
    wang.pdf?ip=128.82.17.156&id=1147554&acc=ACTIVE%20SERVICE&key
    =B33240AC40EC9E30%2E9EA977942CF5A36F%2E4D4702B0C3E38B35%2
    E4D4702B0C3E38B35&CFID=892728655&CFTOKEN=39639930&__acm__
    =1485275677_2840e702eac9fe87e953ebc4240b6dc7
95  Bytes:  909703
96
97  Original URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/
    s11/material/Lec-07_mac-rate-control.pdf
98  Final URI: http://www.cs.odu.edu/~nadeem/classes/cs752-S11/s11/
    material/Lec-07_mac-rate-control.pdf
99  Bytes:  2941244
100
```

```
101 Original URI: http://www.ee.duke.edu/~romit/pubs/capture-Secon07
        .pdf
102 Final URI: http://people.ee.duke.edu/~romit/pubs/capture-Secon07
        .pdf
103 Bytes:  128942
104
105 Original URI: http://www.ee.duke.edu/~romit/pubs/beamcast.pdf
106 Final URI: http://people.ee.duke.edu/~romit/pubs/beamcast.pdf
107 Bytes:  2204185
108
109 Original URI: http://portal.acm.org/ft_gateway.cfm?id=989483&
        type=pdf&CFID=7885191&CFTOKEN=48457240
110 Final URI: http://delivery.acm.org/10.1145/990000/989483/p187-
        zhao.pdf?ip=128.82.17.156&id=989483&acc=ACTIVE%20SERVICE&key=
        B33240AC40EC9E30%2E9EA977942CF5A36F%2E4D4702B0C3E38B35%2
        E4D4702B0C3E38B35&CFID=892729367&CFTOKEN=78401715&__acm__
        =1485275766_50d240888f3c288839e2a76727714b73
111 Bytes:  152155
112
113 Original URI: http://portal.acm.org/ft_gateway.cfm?id=581866&
        type=pdf&CFID=7885191&CFTOKEN=48457240
114 Final URI: http://delivery.acm.org
        /10.1145/590000/581866/01026005.pdf?ip=128.82.17.156&id
        =581866&acc=ACTIVE%20SERVICE&key=B33240AC40EC9E30%2
        E9EA977942CF5A36F%2E4D4702B0C3E38B35%2E4D4702B0C3E38B35&CFID
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121 Original URI: http://portal.acm.org/ft_gateway.cfm?id=1614353&
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127 Bytes:  259166
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129 Original URI: http://www.cise.ufl.edu/~helmy/papers/Gender-based
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137 Original URI: http://www.cs.umass.edu/~dganesan/papers/MobiSys10
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141 Original URI: http://www.winlab.rutgers.edu/~suhas/
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149 Original URI: http://db.csail.mit.edu/pubs/mobicom06.pdf
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173 Original URI: http://www.cs.ucsb.edu/~ebelding/txt/wmcsa99.pdf
174 Final URI: http://people.cs.ucsb.edu/ebelding/sites/people/
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175 Bytes: 224182
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177 Original URI: http://www.eecs.harvard.edu/~htk/publication/2000-
    mobi-karp-kung.pdf
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    routing_mass_web.pdf
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Listing 8: Output from http://www.cs.odu.edu/ nadeem/classes/cs752-S11/

3

Question

3. Consider the "bow-tie" graph in the Broder et al. paper (fig 9): http://www9.org/w9cdrom/160/160.html

   Now consider the following graph:

   A --> B
   B --> C
   C --> D
   C --> A
   C --> G
   E --> F
   G --> C
   G --> H
   I --> H
   I --> K
   L --> D
   M --> A
   M --> N
   N --> D
   O --> A
   P --> G

   For the above graph, give the values for:

   IN:
   SCC:
   OUT:
   Tendrils:
   Tubes:
   Disconnected:

Answer

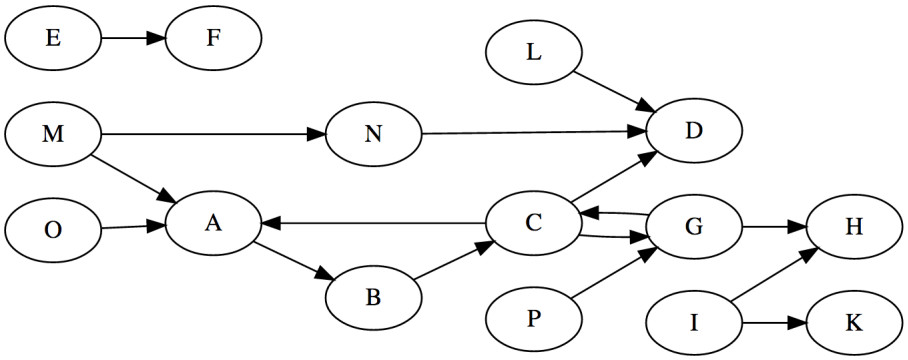

Figure 3: Graph representation generated with WebGraphviz [6]

IN: M, O, P

These values are considered the *IN* values due to the fact that they can reach values that are considered to be in the SCC and also because they can't be reached from the SCC [4].

SCC: A, B, C, G

These values are considered the *SCC* values because they are at the "heart of the graph." They either are all nodes that can reach another node along directed links. This can consist of links from the outside in, nodes inside the *SCC* pointing to other nodes inside, or nodes point from the inside out [4].

OUT: D, H

These values are part of the *OUT* because they are accessible from the *SCC* but they cannot link back into it [4].

Tendrils: I, K, L

These values don't reference the *SCC* at any point, but do have links to the *OUT* nodes and therefore they are considered the *tendrils* [4].

Tubes: N

This value isn't part of the heart of the graph but it does connect an *IN* node to an *OUT* node in one step, not touching the *SCC* in the process [4].

Disconnected: E, F

These two values are as their title describes - disconnected. They aren't part of the *SCC* and don't connect to anything else on the graph.

References

[1] "20.6. Urllib2 - Extensible Library for Opening URLs." 20.6. Urllib2 - Extensible Library for Opening URLs ? Python 2.7.13 Documentation. N.p., n.d. Web. 24 Jan. 2017. https://docs.python.org/2/library/urllib2.html.

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[4] "Graph Structure in the Web." N.p., n.d. Web. 24 Jan. 2017. http://www9.org/w9cdrom/160/160.html.

[5] Lalinsk, Luk. "How Can I Check If a URL Is Absolute Using Python?" Stack Overflow. N.p., n.d. Web. 24 Jan. 2017. http://stackoverflow.com/questions/8357098/how-can-i-check-if-a-url-is-absolute-using-python.

[6] "Webgraphviz." Webgraphviz. N.p., n.d. Web. 24 Jan. 2017. http://www.webgraphviz.com/.