

Homework 3

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Problem 1:

I ran the links on Firefox and Tor without any privacy extensions enabled.

a. <https://panopticklick.eff.org/>

For Firefox:






Test	Result
Is your browser blocking tracking ads?	 partial protection
Is your browser blocking invisible trackers?	 partial protection
Does your blocker stop trackers that are included in the so-called "acceptable ads" whitelist?	 no
Does your browser unblock 3rd parties that promise to honor Do Not Track?	 no
Does your browser protect from fingerprinting?	 your browser has a unique fingerprint

Your browser fingerprint **appears to be unique** among the 224,075 tested in the past 45 days.

Currently, we estimate that your browser has a fingerprint that conveys **at least 17.77 bits of identifying information.**

Browser Characteristic	bits of identifying information	one in x browsers have this value	value
User Agent	4.14	17.67	Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:69.0) Gecko/20100101 Firefox/69.0
HTTP_ACCEPT Headers	1.89	3.7	text/html, */*; q=0.01 gzip, deflate, br en-US,en;q=0.5
Browser Plugin Details	0.82	1.77	undefined
Time Zone	3.4	10.54	240
Screen Size and Color Depth	3.53	11.54	1366x768x24
System Fonts	5.0	31.93	Arial, Arial Black, Arial Narrow, Arial Rounded MT Bold, Book Antiqua, Bookman Old Style, Calibri, Cambria, Cambria Math, Century, Century Gothic, Century Schoolbook, Comic Sans MS, Consolas, Courier, Courier New, Garamond, Georgia, Helvetica, Impact, Lucida Bright, Lucida Calligraphy, Lucida Console, Lucida Fax, Lucida Handwriting, Lucida Sans, Lucida Sans Typewriter, Lucida Sans Unicode, Microsoft Sans Serif, Monotype Corsiva, MS Gothic, MS Outlook, MS PGothic, MS Reference Sans Serif, MS Sans Serif, MS Serif, Palatino Linotype, Segoe Print, Segoe Script, Segoe UI, Segoe UI Light, Segoe UI Semibold, Segoe UI Symbol, Tahoma, Times, Times New Roman, Trebuchet MS, Verdana, Wingdings, Wingdings 2, Wingdings 3 (via javascript)
Are Cookies Enabled?	0.26	1.2	Yes
Limited supercookie test	0.37	1.29	DOM localStorage: Yes, DOM sessionStorage: Yes, IE userData: No
Hash of canvas fingerprint	10.44	1387.99	a3bf3378e5211b0b3ab1246b665cbc7
Hash of WebGL fingerprint	4.59	24.04	9f9f79a414ddb93ae956153a9d800a02
DNT Header Enabled?	1.03	2.04	False
Language	0.98	1.97	en-US
Platform	1.32	2.49	Win32
Touch Support	0.85	1.8	Max touchpoints: 0; TouchEvent supported: false; onTouchStart supported: false

For Tor:

Test	Result
Is your browser blocking tracking ads?	 partial protection
Is your browser blocking invisible trackers?	 partial protection
Does your blocker stop trackers that are included in the so-called "acceptable ads" whitelist?	 no
Does your browser unblock 3rd parties that promise to honor Do Not Track?	 no
Does your browser protect from fingerprinting?	 your browser has a non-unique fingerprint

Within our dataset of several hundred thousand visitors tested in the past 45 days, only **one in 1383.25 browsers have the same fingerprint as yours.**

Currently, we estimate that your browser has a fingerprint that conveys **10.43 bits** of identifying information.

Browser Characteristic	bits of identifying information	one in x browsers have this value	value
User Agent	3.88	14.76	Mozilla/5.0 (Windows NT 6.1; rv:60.0) Gecko/20100101 Firefox/60.0
HTTP_ACCEPT Headers	1.89	3.7	text/html, */*; q=0.01 gzip, deflate, br en-US,en;q=0.5
Browser Plugin Details	0.82	1.77	undefined
Time Zone	2.66	6.31	0
Screen Size and Color Depth	6.94	122.98	1000x600x24
System Fonts	6.37	82.94	Arial, Arial Black, Arial Narrow, Cambria Math, Courier, Courier New, Georgia, Helvetica, Lucida Console, MS Gothic, MS PGothic, MS Sans Serif, MS Serif, Segoe UI, Segoe UI Light, Segoe UI Semibold, Tahoma, Times, Times New Roman, Verdana, Wingdings 2, Wingdings 3 (via javascript)
Are Cookies Enabled?	0.26	1.2	Yes
Limited supercookie test	0.37	1.29	DOM localStorage: Yes, DOM sessionStorage: Yes, IE userData: No
Hash of canvas fingerprint	2.87	7.33	a273d6a847f0e2a57fa0161158f12fed
Hash of WebGL fingerprint	6.12	69.76	224a8abee799ed8381e06293de4565f6
DNT Header Enabled?	1.03	2.04	False
Language	0.98	1.97	en-US
Platform	1.32	2.49	Win32
Touch Support	0.85	1.8	Max touchpoints: 0; TouchEvent supported: false; onTouchStart supported: false

b. <https://amiunique.org/>

For Firefox:

My browser fingerprint

Are you unique?

All time : Yes! (You can be tracked!)

The following informations reveal your OS, browser, browser version as well as your timezone and preferred language. Moreover, we show the proportion of users sharing the same elements.



Version 69

UTC-4

en

All time : 56.30%

All time : 41.10%

All time : 0.79%

All time : 5.25%

All time : 65.85%

All time : However, your full fingerprint is unique among the 1316773 collected so far.

Similarity ratio duration : ☒ 7 days ☐ 15 days ☐ 30 days ☐ 90 days ☐ All time


HTTP headers attributes

Similarity ratio ⓘ		
Attribute	All time	Value
User agent ⓘ	0.39%	Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:69.0) Gecko/20100101 Firefox/69.0
Accept ⓘ	52.78%	text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Content encoding ⓘ	62.02%	gzip, deflate, br
Content language ⓘ	27.55%	en-US,en;q=0.5
Upgrade Insecure Requests ⓘ	16.00%	1
Referer ⓘ	9.31%	https://amiunique.org/

Javascript attributes

Similarity ratio ⓘ		
Attribute	All time	Value
User agent ⓘ	0.31%	Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:69.0) Gecko/20100101 Firefox/69.0
Platform ⓘ	39.41%	Win32
Cookies enabled ⓘ	80.95%	yes
Timezone ⓘ	5.25%	240
Content language ⓘ	6.58%	en-US,en
Canvas ⓘ	0.14%	Cwm fjordbank glyphs vext quiz, 😊 Cwm fjordbank glyphs vext quiz, 😊
List of fonts (JS) ⓘ	0.18%	Arial, Bahnschrift, Brush Script MT, Calibri, Cambria, Cambria Math, Candara, Comic Sans MS, Consolas, Constantia and 54 others
Do Not Track ⓘ	49.24%	NC
Use of local storage ⓘ	79.04%	yes
Use of session storage ⓘ	79.06%	yes

Screen width ⓘ	2.29%	1000
Screen height ⓘ	0.91%	600
Screen depth ⓘ	75.27%	24
Screen available top ⓘ	12.20%	0
Screen available Left ⓘ	13.34%	0
Screen available Height ⓘ	0.14%	600
Screen available width ⓘ	0.56%	1000
Screen left ⓘ	5.67%	0
Screen top ⓘ	5.95%	0
List of plugins ⓘ	8.00%	none
BuildID ⓘ	0.58%	20100101
Audio formats ⓘ	9.89%	audio/aac audio/flac audio/mpeg audio/mp4; codecs="mp4a.40.2" audio/ogg; codecs="flac" audio/ogg; codecs="vorbis"

		audio/webm; codecs="vorbis" audio/webm; codecs="opus"
Video formats ⓘ	11.00%	video/mp4; codecs="flac" video/ogg; codecs="theora" video/ogg; codecs="opus" video/webm; codecs="vp9, opus" video/webm; codecs="vp8, vorbis"
WebGL Vendor ⓘ	27.02%	Google Inc.
WebGL Renderer ⓘ	1.39%	ANGLE (Intel(R) HD Graphics 520 Direct3D11 vs_5_0 ps_5_0)
WebGL Data ⓘ	1.47%	
WebGL Parameters ⓘ	0.63%	3178 different parameters
List of fonts (Flash) ⓘ	61.53%	Flash not detected
Screen resolution (Flash) ⓘ	61.53%	Flash not detected
Language (Flash) ⓘ	61.53%	Flash not detected
Platform (Flash) ⓘ	61.53%	Flash not detected
Use of Adblock ⓘ	49.51%	no

For Tor:

My browser fingerprint

Are you unique?

All time : Almost! (You can most certainly be tracked.)

The following informations reveal your OS, browser, browser version as well as your timezone and preferred language. Moreover, we show the proportion of users sharing the same elements.



Version 60

UTC0

en

All time : 56.30%

All time : 41.10%

All time : 5.98%

All time : 9.81%

All time : 65.85%

All time : But only 14 browsers out of the 1316777 observed browsers (<0.01 %) have exactly the same fingerprint as yours.

Similarity ratio duration : ☒ 7 days ☐ 15 days ☐ 30 days ☐ 90 days ☐ All time

HTTP headers attributes

Similarity ratio ⓘ		
Attribute	All time	Value
User agent ⓘ	2.25%	Mozilla/5.0 (Windows NT 6.1; rv:60.0) Gecko/20100101 Firefox/60.0
Accept ⓘ	52.78%	text/html,application/xhtml+xml,application/xml;q=0.9;*/;q=0.8
Content encoding ⓘ	62.02%	gzip, deflate, br
Content language ⓘ	27.55%	en-US,en;q=0.5
Upgrade Insecure Requests ⓘ	16.00%	1
Referer ⓘ	9.31%	https://amiunique.org/

Javascript attributes

Similarity ratio ⓘ		
Attribute	All time	Value
User agent ⓘ	0.41%	Mozilla/5.0 (Windows NT 6.1; Win64; x64; rv:60.0) Gecko/20100101 Firefox/60.0
Platform ⓘ	39.41%	Win32
Cookies enabled ⓘ	80.95%	yes
Timezone ⓘ	9.81%	0
Content language ⓘ	6.57%	en-US,en
Canvas ⓘ	6.00%	
List of fonts (JS) ⓘ	0.05%	Arial, Arial Black, Arial Narrow, Cambria Math, Courier, Courier New, Georgia, Helvetica, Lucida Console, Malgun Gothic and 12 others
Do Not Track ⓘ	49.24%	NC
Use of local storage ⓘ	79.04%	yes
Use of session storage ⓘ	79.06%	yes

Screen width ⓘ	9.19%	1366
Screen height ⓘ	10.40%	768
Screen depth ⓘ	75.27%	24
Screen available top ⓘ	12.20%	0
Screen available Left ⓘ	13.34%	0
Screen available Height ⓘ	0.80%	728
Screen available width ⓘ	1.32%	1366
Screen left ⓘ	5.67%	0
Screen top ⓘ	5.95%	0
List of plugins ⓘ	8.00%	none
BuildID ⓘ	4.91%	20181001000000
Audio formats ⓘ	9.89%	audio/aac audio/flac audio/mpeg audio/mp4; codecs="mp4a.40.2" audio/ogg; codecs="flac" audio/ogg; codecs="vorbis" audio/ogg; codecs="opus" audio/wav; codecs="1"

		audio/ogg; codecs="opus" audio/wav; codecs="1" audio/webm; codecs="vorbis" audio/webm; codecs="opus"
Video formats ⓘ	11.00%	video/mp4; codecs="flac" video/ogg; codecs="theora" video/ogg; codecs="opus" video/webm; codecs="vp9, opus" video/webm; codecs="vp8, vorbis"
WebGL Vendor ⓘ	26.76%	Not supported
WebGL Renderer ⓘ	26.76%	Not supported
WebGL Data ⓘ	17.96%	Not supported
WebGL Parameters ⓘ	2.80%	15 different parameters
List of fonts (Flash) ⓘ	61.53%	Flash not detected
Screen resolution (Flash) ⓘ	61.53%	Flash not detected
Language (Flash) ⓘ	61.53%	Flash not detected
Platform (Flash) ⓘ	61.53%	Flash not detected
Use of Adblock ⓘ	49.51%	no

Major differences in fingerprints between Tor and Firefox:

Using panopticlick, it is observed that while Firefox has a unique fingerprint, Tor has a non-unique fingerprint, and it shares it with other browsers among the 224075 browsers compared. This is measured in terms of identifying bits(entropy) which is 17.77 for Firefox and 10.43.

As studied in class, the user agent header is one of the main components in generating a browser fingerprint, and Firefox uses a longer user agent with identifying information with 4.14 bits while Tor uses 3.88 bits.

The hash of the canvas fingerprint also differs in both browsers with Firefox revealing five times more information than Tor. As the canvas fingerprint of Tor has a better similarity ratio, the fingerprint is also made more non-unique.

However, the hash of the WebGL fingerprint has more entropy in Tor which is around 6.12 and 4.59 in Firefox. This means that Firefox has a more similar WebGL fingerprint to other browsers, but overall this doesn't seem to make a significant impact.

Using amunique, gives us a more detailed report. Firefox does not share its fingerprint with any other 1316773 browsers collected so far, whereas Tor shares its fingerprint with 14 other browsers. Tor doesn't have a unique fingerprint, but it isn't all that common either.

Tor also has a better similarity ratio than Firefox when it comes to the user agent header, the WebGL renderer and data. Also, the hash of the canvas fingerprint also has a better fingerprint in Tor. Hence, we can hypothesize that due to these factors, Tor is more non-unique than Firefox.

The user agent for Tor has a similarity of 2.25% while Firefox has a similarity ratio of 0.39%. The timezones are also different for both browsers, with Tor having a different time zone than the real one, making it more similar to other browsers.

The canvas hash is around 6% in Tor while it is 0.14% in Firefox. As the canvas is more similar in Tor, it contributes to its non-unique fingerprint.

As Tor is minimized, the screen dimensions are also different in Tor than in Firefox. They have a better similarity ratio. The BuildID is different also for both browsers.

WebGL renderer, parameters, vendor, and data are all different for Tor, with all of them being not supported, except for the parameters, which are 15 in number. They are all present with the actual values in Firefox, and all this unique data makes its fingerprint unique.

Takeaways:

- Tor is better at preserving privacy as it has a non-unique fingerprint and hence it does not leak data about the user as much as Firefox.
- Tor also has the default window minimized to prevent screen size dimensions being incorporated into the fingerprint, so as to be more similar to other fingerprints.
- A lot of the information collected in generated a browser fingerprint is represented as completely different values so as to generate a different fingerprint, which shares it with other browsers.
- Bottom line is, Tor is more privacy preserving.

Problem 2:

For the desktop, I installed the Ghostery extension on a Firefox browser, and enabled the 'block everything' option. I disabled the Smart Blocking option as it automatically unblocks some trackers to optimize page performance.

Site	# of trackers on desktop	# of trackers on mobile	Desktop specific trackers	Mobile specific trackers
cnn.com	28	41	<p>Advertising:</p> <ol style="list-style-type: none"> 1. Integral Ad Science 2. Google Publisher Tags 3. Bing Ads 4. Outbrain 5. Amplify 6. Twitter Advertising 7. NetRatings SiteCensus 8. Outbrain <p>Customer Interaction:</p> <ol style="list-style-type: none"> 1. Usabilla <p>Essential:</p> <ol style="list-style-type: none"> 1. Google Tag Manager <p>Site Analytics:</p> <ol style="list-style-type: none"> 1. Index Exchange 2. Optimizely Geographical Targeting 	<p>Advertising:</p> <ol style="list-style-type: none"> 1. BlueKai 2. Index Exchange 3. eXelate 4. Rocket Fuel 5. DataXu 6. LinkShare 7. MediaMath 8. Simpli.fi 9. TradeDesk 10. Adform 11. MaxPoint Interactive 12. Sonobi 13. Tapad 14. PowerLinks 15. Eyeota 16. YieldMo 17. BidSwitch 18. Google Dynamic Remarketing 19. Clearstream TV 20. CogoCast 21. Bidtellect 22. Twitter Conversion Tracking 23. Mediawallah <p>Customer Interaction:</p> <ol style="list-style-type: none"> 1. Zemanta <p>Essential:</p> <ol style="list-style-type: none"> 1. Digital Point <p>Site Analytics:</p> <ol style="list-style-type: none"> 1. Navegg 2. Bombora 3. Twitter Analytics 4. Arbor

			3. Segment 4. Optimizely 5. Gigya 6. Omniture (Adobe Analytics) Unknown: 1. jsDelivr 2. Optimizely	Social Media: 1. Facebook Connect
alibaba.com	2	1	Site Analytics: 1. Google Analytics	
espn.com	9	12	Site Analytics: 1. ESPN Analytics Unknown: 1. espncdn.com	Advertising: 1. NetRatings SiteCensus Site Analytics: 1. Chartbeat 2. ScoreCard Research Bacon

Problem 3:

The following options were disabled:

- Send a "Do Not Track" request with your browsing traffic
- Preload pages for faster browsing and searching: Uses cookies to remember your preferences, even if you don't visit those pages
- Block third-party cookies: Prevent third-party websites from saving and reading cookie data

uBlock Origin and Ghostery were disabled.

List of third party domains:

Site: macys.com

List of third party domains:

akamaihd.net
macysassets.com
mathtag.com
linksynergy.com
exelator.com
rlcdn.com
doubleclick.net
pippio.com
akstat.io
smarterhq.io
tapad.com
sonobi.com
lijit.com
spotxchange.com
powerlinks.com
addthis.com
advertising.com
adsrvr.org
yahoo.com
ibmcloud.com
amazon-adsystem.com

Site: cnn.com

List of third party domains:

doubleclick.net
googlesyndication.com
adsafeprotected.com
amazon-adsystem.com
criteo.com
casalemedia.com
moatads.com
ml314.com
pubmatic.com
chartbeat.net
googletagservices.com
doubleverify.com
2mdn.net
media-amazon.com
ampproject.org

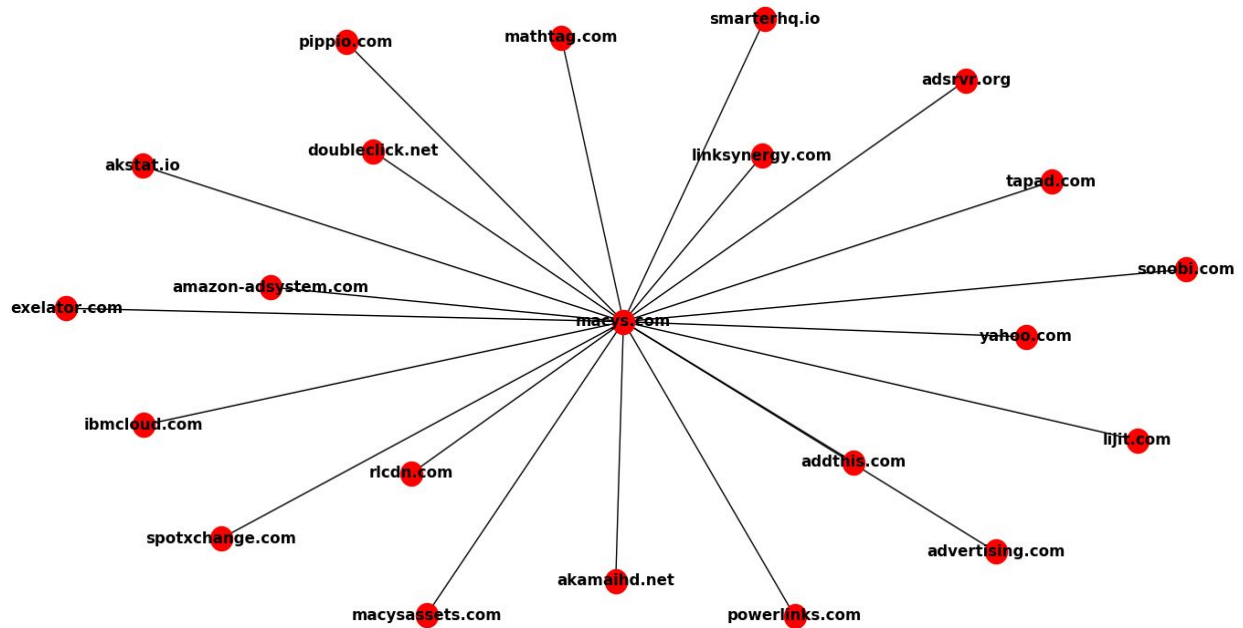
google.com
ssl-images-amazon.com
turner.com
bouncex.net
bounceexchange.com

Site: bankofamerica.com

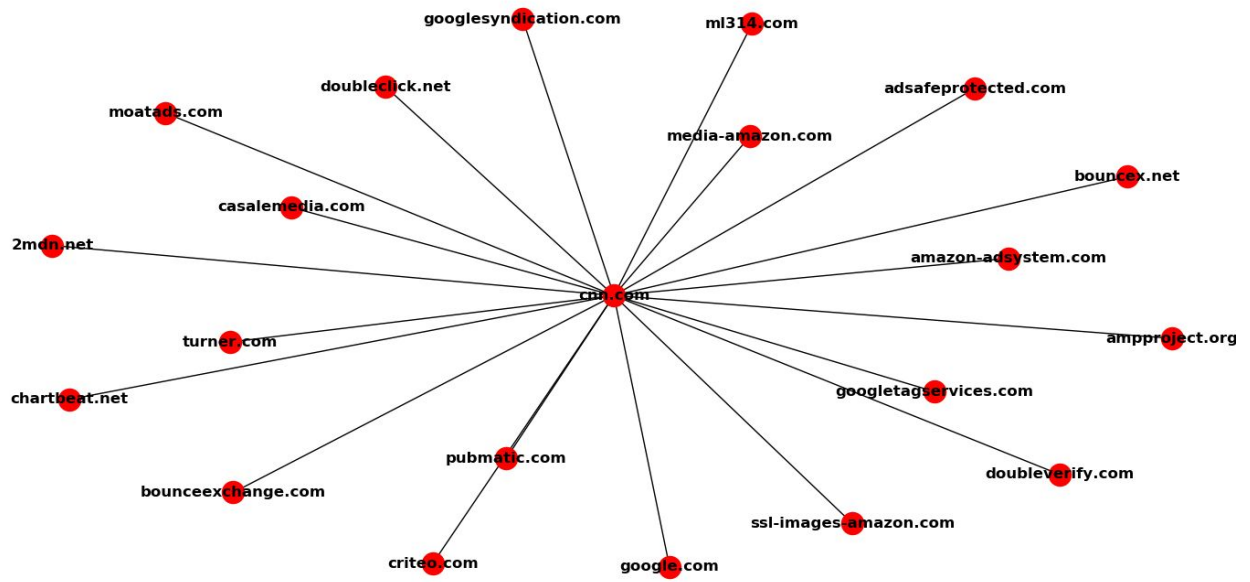
List of third party domains:
bac-assets.com

Graphs:

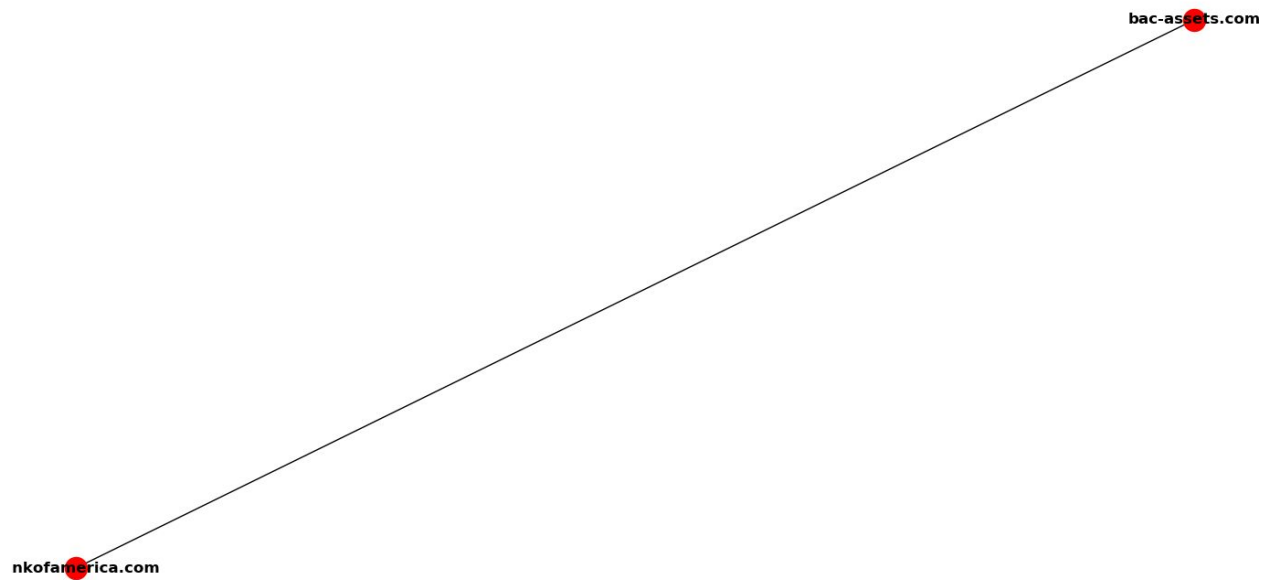
macys.com:



cnn.com:



bankofamerica.com:



Problem 4:

```
Nida@Nida MINGW64 ~/Desktop/Privacy/hw3 (master)
$ python nsyed_Q4.py
```

Site	Total HTTP Requests	HTTP Requests Blocked	3rd party domains blocked
macys.com	41	0	doubleclick.net googlesyndication.com pubmatic.com 2mdn.net ampproject.org turner.com adsafeprotected.com google.com moatads.com
cnn.com	179	64	
bankofamerica.com	11	0	

Problem 5:

a. List the top 5 countries hosting Tor relays:

List of top 5 countries hosting Tor relays

Country: DE
of Tor relays: 1275
Country: US
of Tor relays: 1079
Country: FR
of Tor relays: 783
Country: NL
of Tor relays: 378
Country: CA
of Tor relays: 257

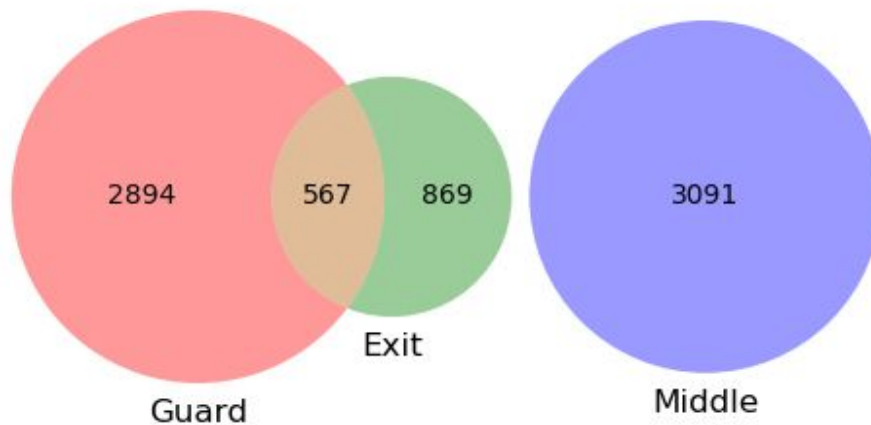
b. List the top 5 bandwidth-contributing relays:

List of top 5 bandwidth-contributing relays

Relay Node: Unnamed 213.239.204.62 static.213-239-204-62.clients.your-server.de 9001
Bandwidth: 188000
Relay Node: Unnamed 145.239.255.86 ns3102095.ip-145-239-255.eu 9001
Bandwidth: 182000
Relay Node: Unnamed 145.239.66.236 ns3082025.ip-145-239-66.eu 9001
Bandwidth: 180000
Relay Node: Unnamed 78.46.151.57 static.57.151.46.78.clients.your-server.de 9001
Bandwidth: 178000

Relay Node: Unnamed 144.76.107.124 static.124.107.76.144.clients.your-server.de 9001
Bandwidth: 160000

c. Venn diagram of the number of relays that act as guard, exit or middle relay & cumulative bandwidth for each category.



d. Cumulative bandwidths:

Cumulative bandwidths

Bandwidth of all guard relays: 65053472
Bandwidth of all exit relays: 16205309
Bandwidth of all guard and exit relays: 14427840
Bandwidth of all middle relays: 8495412