INST 754

Final Project

Cyber Risk Insight: Analyzing IT Vulnerabilities and Predicting Threat Periods

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Cyber Security Overview

- CVE - Common Vulnerabilities and Exposures
- CVEs are a fundamental part of many cybersecurity practices and are used in numerous security products and services.
- They are essential for understanding the landscape of cybersecurity threats and for ensuring that systems are protected against known vulnerabilities.

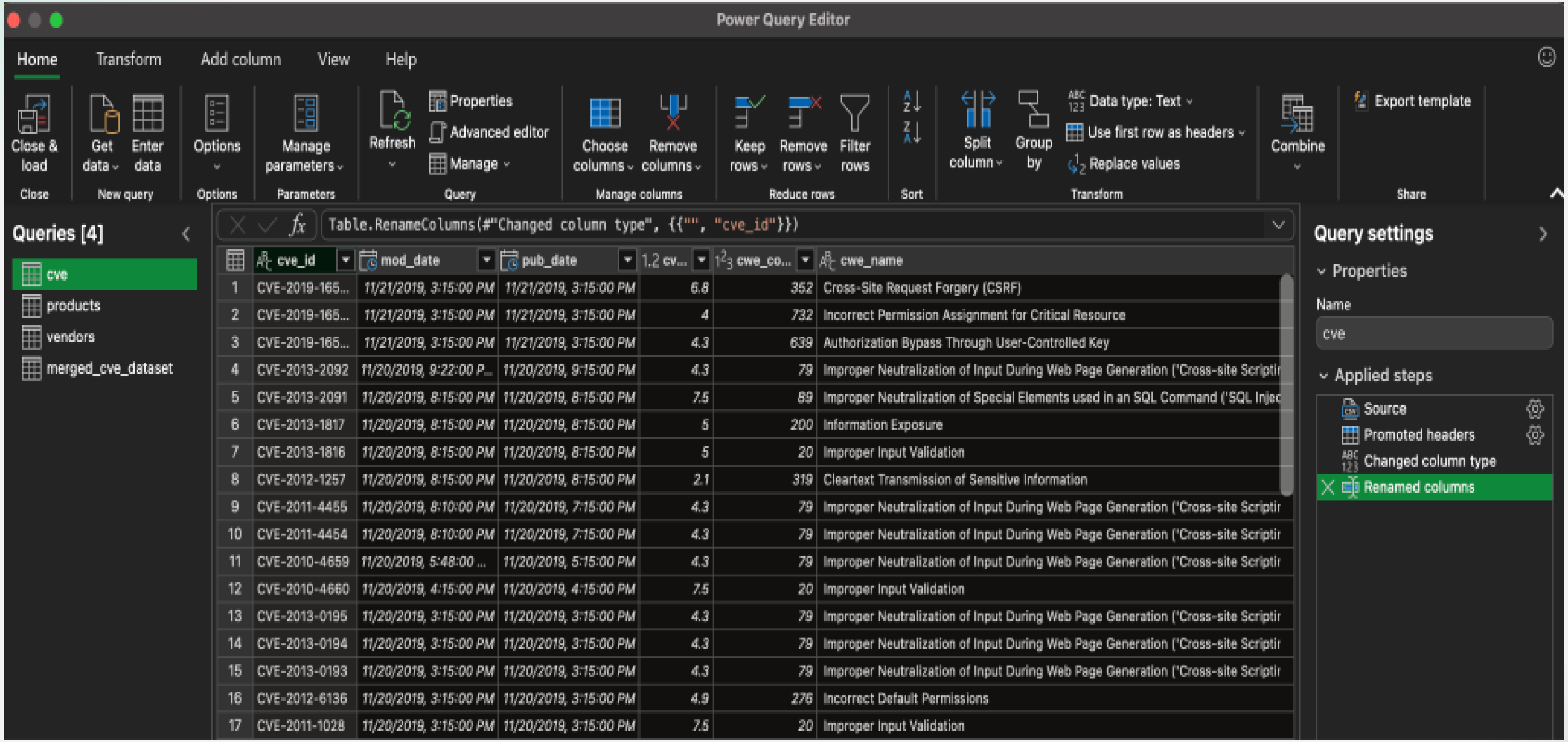
Dataset

- The Common Vulnerabilities and Exposures (CVE) are publicly available datasets that provide references to all the publicly-known information security vulnerabilities and exposures.
- It is maintained by The National Cybersecurity FFRDC operated by the MITRE corporation.
- The analysis will utilize four datasets: CVE, Products, Vendor_Product, and Vendors. These datasets provide detailed information on known software vulnerabilities, including their severity levels, which are measured using the Common Vulnerability Scoring System (CVSS).

ETL Process

- We applied transformations to each dataset using Power BI Query Editor. This involved assigning headers, renaming columns, and modifying data types.
- Additionally, we merged the Products and Vendors datasets using 'cve_id' as the key column and subsequently integrated this merged dataset with the CVE dataset, again using 'cve_id' as the joining column.
- After completing the Extract, Transform, Load (ETL) process, we conducted data cleaning by removing null values from columns. This process yielded a refined dataset containing 241,979 rows and 15 columns.

ETL Process Steps



Queries [4]

- cve
- products
- vendors
- merged_cve_dataset

```
Table.RenameColumns(#"Changed column type", {{"", "cve_id"}})
```

	cve_id	mod_date	pub_date	1.2 cv...	1²3 cwe_co...	cwe_name
1	CVE-2019-165...	11/21/2019, 3:15:00 PM	11/21/2019, 3:15:00 PM	6.8	352	Cross-Site Request Forgery (CSRF)
2	CVE-2019-165...	11/21/2019, 3:15:00 PM	11/21/2019, 3:15:00 PM	4	732	Incorrect Permission Assignment for Critical Resource
3	CVE-2019-165...	11/21/2019, 3:15:00 PM	11/21/2019, 3:15:00 PM	4.3	639	Authorization Bypass Through User-Controlled Key
4	CVE-2013-2092	11/20/2019, 9:22:00 P...	11/20/2019, 9:15:00 PM	4.3	79	Improper Neutralization of Input During Web Page Generation ('Cross-site Scriptir
5	CVE-2013-2091	11/20/2019, 8:15:00 PM	11/20/2019, 8:15:00 PM	7.5	89	Improper Neutralization of Special Elements used in an SQL Command ('SQL Injec
6	CVE-2013-1817	11/20/2019, 8:15:00 PM	11/20/2019, 8:15:00 PM	5	200	Information Exposure
7	CVE-2013-1816	11/20/2019, 8:15:00 PM	11/20/2019, 8:15:00 PM	5	20	Improper Input Validation
8	CVE-2012-1257	11/20/2019, 8:15:00 PM	11/20/2019, 8:15:00 PM	2.1	319	Cleartext Transmission of Sensitive Information
9	CVE-2011-4455	11/20/2019, 8:10:00 PM	11/20/2019, 7:15:00 PM	4.3	79	Improper Neutralization of Input During Web Page Generation ('Cross-site Scriptir
10	CVE-2011-4454	11/20/2019, 8:10:00 PM	11/20/2019, 7:15:00 PM	4.3	79	Improper Neutralization of Input During Web Page Generation ('Cross-site Scriptir
11	CVE-2010-4659	11/20/2019, 5:48:00 ...	11/20/2019, 5:15:00 PM	4.3	79	Improper Neutralization of Input During Web Page Generation ('Cross-site Scriptir
12	CVE-2010-4660	11/20/2019, 4:15:00 PM	11/20/2019, 4:15:00 PM	7.5	20	Improper Input Validation
13	CVE-2013-0195	11/20/2019, 3:15:00 PM	11/20/2019, 3:15:00 PM	4.3	79	Improper Neutralization of Input During Web Page Generation ('Cross-site Scriptir
14	CVE-2013-0194	11/20/2019, 3:15:00 PM	11/20/2019, 3:15:00 PM	4.3	79	Improper Neutralization of Input During Web Page Generation ('Cross-site Scriptir
15	CVE-2013-0193	11/20/2019, 3:15:00 PM	11/20/2019, 3:15:00 PM	4.3	79	Improper Neutralization of Input During Web Page Generation ('Cross-site Scriptir
16	CVE-2012-6136	11/20/2019, 3:15:00 PM	11/20/2019, 3:15:00 PM	4.9	276	Incorrect Default Permissions
17	CVE-2011-1028	11/20/2019, 3:15:00 PM	11/20/2019, 3:15:00 PM	7.5	20	Improper Input Validation

Query settings

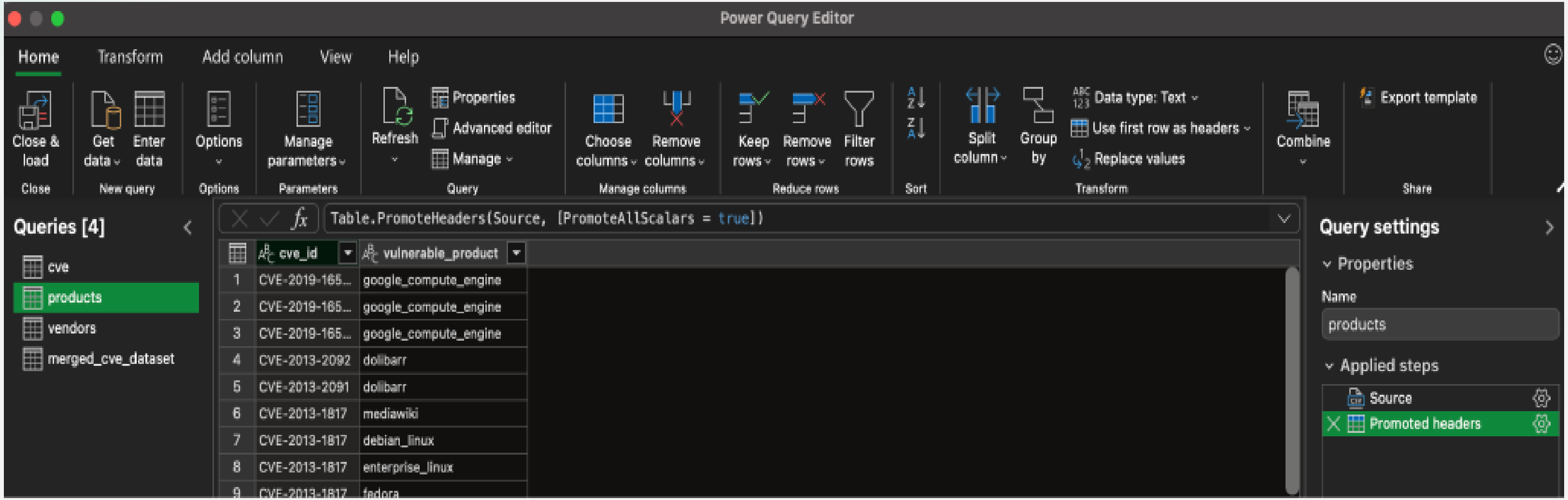
Properties

Name: cve

Applied steps

- Source
- Promoted headers
- Changed column type
- Renamed columns

ETL Process Steps



Queries [4]
- cve
- products
- vendors
- merged_cve_dataset

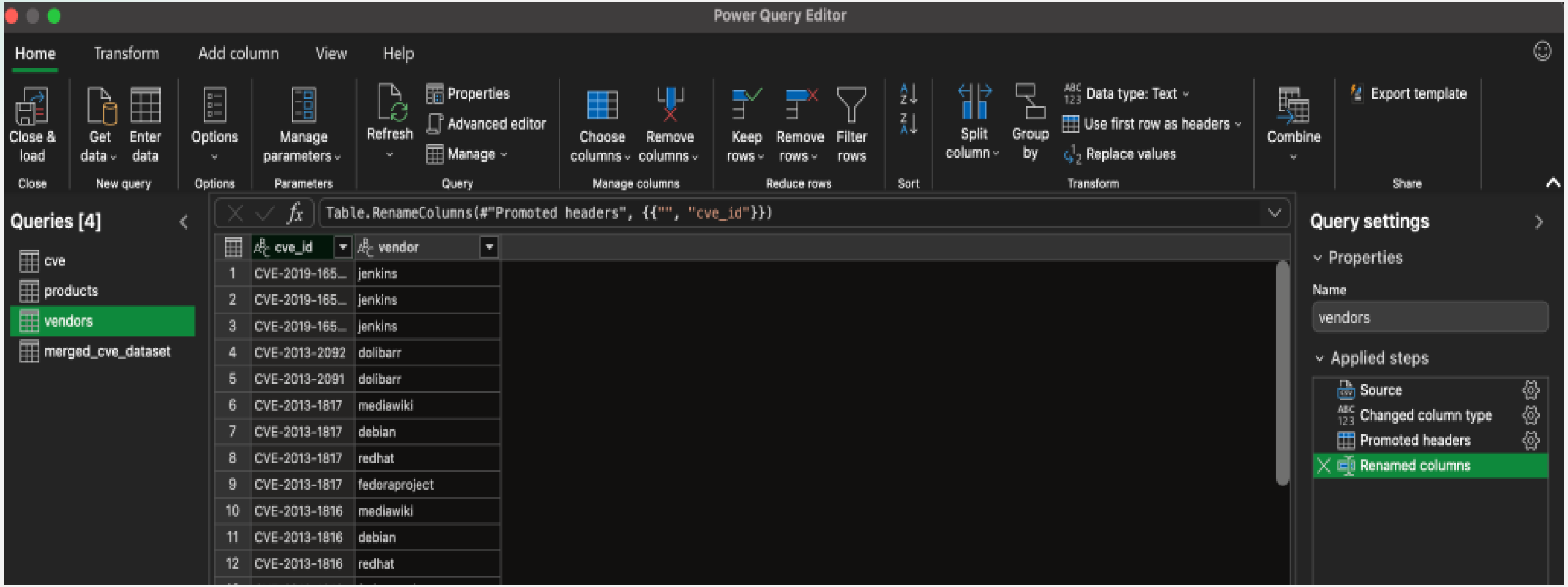
```
Table.PromoteHeaders(Source, [PromoteAllScalars = true])
```

	cve_id	vulnerable_product
1	CVE-2019-165...	google_compute_engine
2	CVE-2019-165...	google_compute_engine
3	CVE-2019-165...	google_compute_engine
4	CVE-2013-2092	dolibarr
5	CVE-2013-2091	dolibarr
6	CVE-2013-1817	mediawiki
7	CVE-2013-1817	debian_linux
8	CVE-2013-1817	enterprise_linux
9	CVE-2013-1817	fedora

Name: products

Applied steps
- Source
- Promoted headers

ETL Process Steps



```
Table.RenameColumns(#"Promoted headers", {{"", "cve_id"}})
```

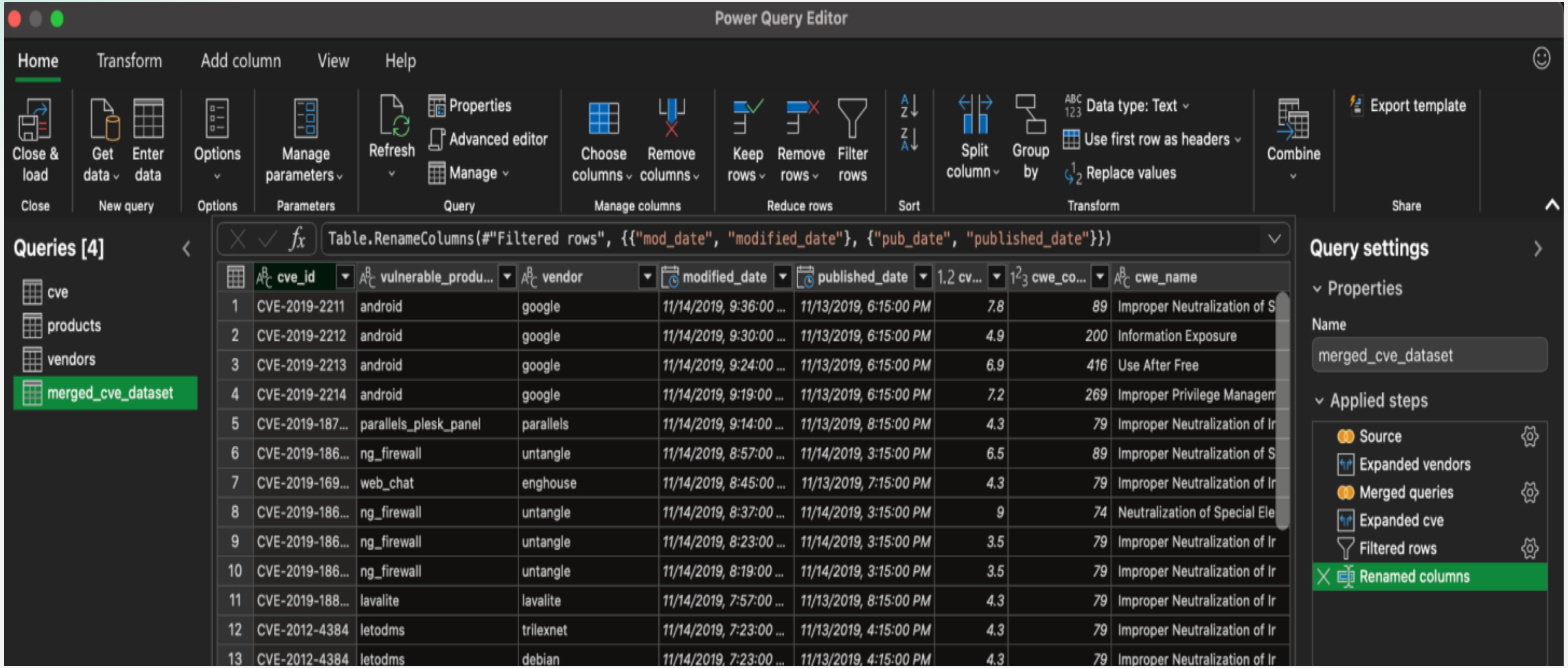
	cve_id	vendor
1	CVE-2019-165...	jenkins
2	CVE-2019-165...	jenkins
3	CVE-2019-165...	jenkins
4	CVE-2013-2092	dolibarr
5	CVE-2013-2091	dolibarr
6	CVE-2013-1817	mediawiki
7	CVE-2013-1817	debian
8	CVE-2013-1817	redhat
9	CVE-2013-1817	fedoraproject
10	CVE-2013-1816	mediawiki
11	CVE-2013-1816	debian
12	CVE-2013-1816	redhat

Name: vendors

Applied steps:

- Source
- Changed column type
- Promoted headers
- Renamed columns

ETL Process Steps



Queries [4]

- cve
- products
- vendors
- merged_cve_dataset

```
Table.RenameColumns(#"Filtered rows", {{"mod_date", "modified_date"}, {"pub_date", "published_date"}})
```

	cve_id	vulnerable_produ...	vendor	modified_date	published_date	1.2 cv...	1²3 cwe_co...	cwe_name
1	CVE-2019-2211	android	google	11/14/2019, 9:36:00 ...	11/13/2019, 6:15:00 PM	7.8	89	Improper Neutralization of S
2	CVE-2019-2212	android	google	11/14/2019, 9:30:00 ...	11/13/2019, 6:15:00 PM	4.9	200	Information Exposure
3	CVE-2019-2213	android	google	11/14/2019, 9:24:00 ...	11/13/2019, 6:15:00 PM	6.9	416	Use After Free
4	CVE-2019-2214	android	google	11/14/2019, 9:19:00 ...	11/13/2019, 6:15:00 PM	7.2	269	Improper Privilege Managem
5	CVE-2019-187...	parallels_plesk_panel	parallels	11/14/2019, 9:14:00 ...	11/13/2019, 8:15:00 PM	4.3	79	Improper Neutralization of Ir
6	CVE-2019-186...	ng_firewall	untangle	11/14/2019, 8:57:00 ...	11/14/2019, 3:15:00 PM	6.5	89	Improper Neutralization of S
7	CVE-2019-169...	web_chat	enghouse	11/14/2019, 8:45:00 ...	11/13/2019, 7:15:00 PM	4.3	79	Improper Neutralization of Ir
8	CVE-2019-186...	ng_firewall	untangle	11/14/2019, 8:37:00 ...	11/14/2019, 3:15:00 PM	9	74	Neutralization of Special Ele
9	CVE-2019-186...	ng_firewall	untangle	11/14/2019, 8:23:00 ...	11/14/2019, 3:15:00 PM	3.5	79	Improper Neutralization of Ir
10	CVE-2019-186...	ng_firewall	untangle	11/14/2019, 8:19:00 ...	11/14/2019, 3:15:00 PM	3.5	79	Improper Neutralization of Ir
11	CVE-2019-188...	lavalite	lavalite	11/14/2019, 7:57:00 ...	11/13/2019, 8:15:00 PM	4.3	79	Improper Neutralization of Ir
12	CVE-2012-4384	letodms	trilexnet	11/14/2019, 7:23:00 ...	11/13/2019, 4:15:00 PM	4.3	79	Improper Neutralization of Ir
13	CVE-2012-4384	letodms	debian	11/14/2019, 7:23:00 ...	11/13/2019, 4:15:00 PM	4.3	79	Improper Neutralization of Ir

Query settings

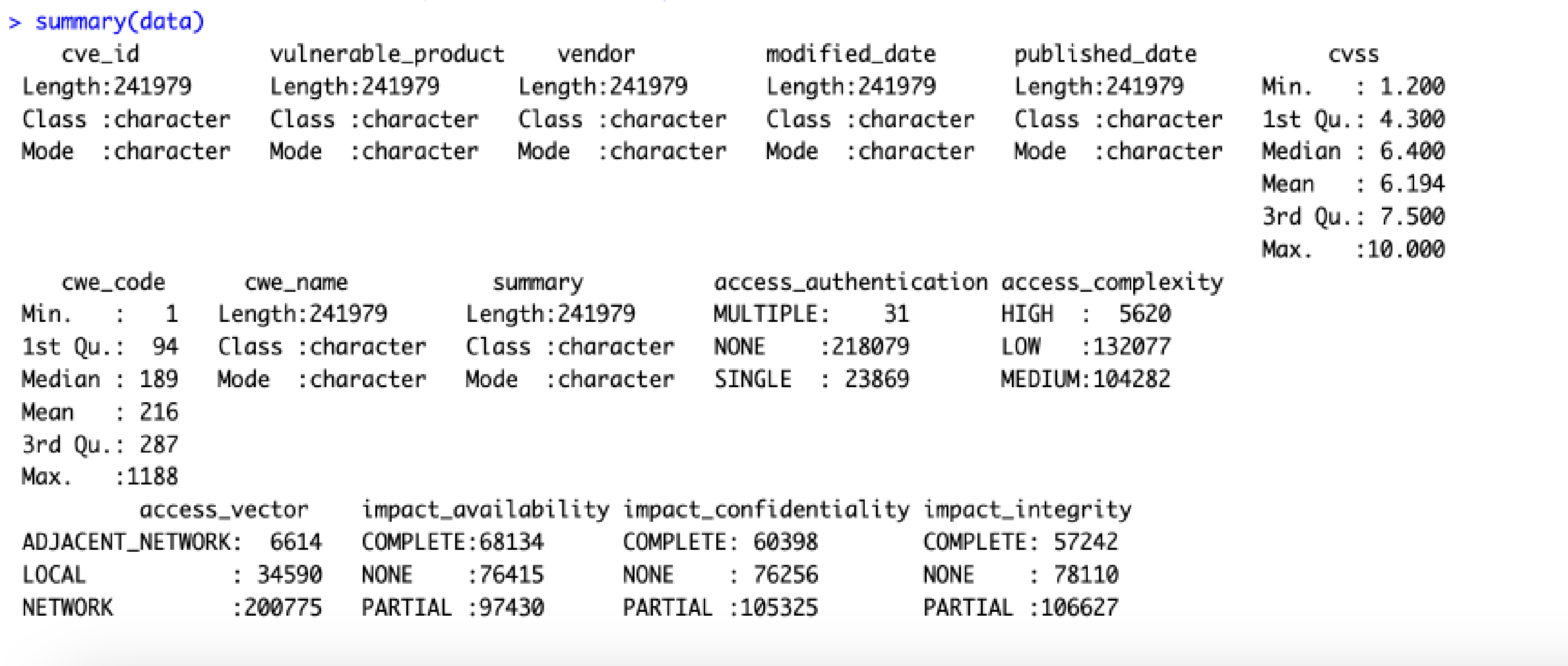
Properties

Name: merged_cve_dataset

Applied steps

- Source
- Expanded vendors
- Merged queries
- Expanded cve
- Filtered rows
- Renamed columns

Descriptive Statistical Analysis



```
> summary(data)
    cve_id          vulnerable_product    vendor          modified_date      published_date          cvss       
 Length:241979      Length:241979      Length:241979      Length:241979      Length:241979      Min.   : 1.200  
 Class :character   Class :character   Class :character   Class :character   Class :character   1st Qu.: 4.300  
 Mode  :character   Mode  :character   Mode  :character   Mode  :character   Mode  :character   Median : 6.400  
                                                                                                Mean   : 6.194  
                                                                                                3rd Qu.: 7.500  
                                                                                                Max.   :10.000  
    cwe_code        cwe_name           summary          access_authentication access_complexity
 Min.   :   1   Length:241979      Length:241979      MULTIPLE:    31         HIGH  :  5620    
 1st Qu.:  94   Class :character   Class :character   NONE    :218079         LOW   :132077   
 Median : 189   Mode  :character   Mode  :character   SINGLE  : 23869         MEDIUM:104282   
 Mean   : 216                                                                                 
 3rd Qu.: 287                                                                                 
 Max.   :1188                                                                                 
          access_vector     impact_availability impact_confidentiality impact_integrity
 ADJACENT_NETWORK:  6614   COMPLETE:68134      COMPLETE: 60398        COMPLETE: 57242  
 LOCAL           : 34590   NONE    :76415      NONE    : 76256        NONE    : 78110  
 NETWORK         :200775   PARTIAL :97430      PARTIAL :105325        PARTIAL :106627  
```

Data Visualization

Here are the research questions that our dataset will be answering:

1. Time Series Analysis of High/Severe Vulnerabilities over time.
2. Vulnerabilities by Access Complexity, Impact, CVSS scores.
3. Identifying Vendors/Products based on Vulnerability.

Data Visualization

LIVE DEMO

Thank you!!