Lecture 10 – Supply Chain Security

[COSE451] Software Security

Instructor: Seunghoon Woo

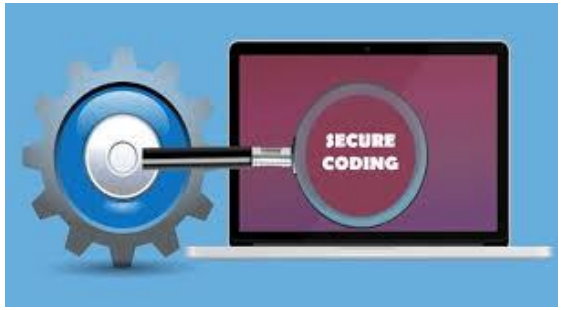
Spring 2024

Overview

- **Supply chain security**
- **Software Bill of Materials (SBOM)**

Supply chain security

- **Supply chain security**



Secure coding

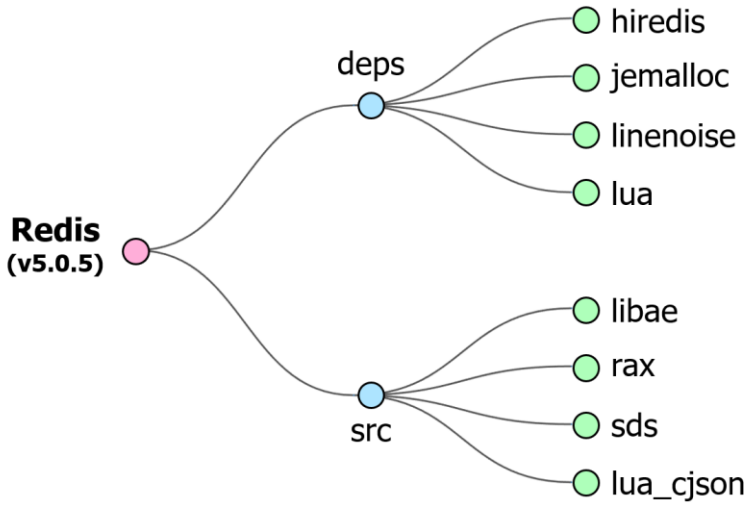
Vulnerability detection

DevSecOps

…

Software Bill of Materials (SBOM)

- **Software Bill of Materials (SBOM)**
  - A type of metadata that describes and lists all SW components
  - Various standards: SPDX, CycloneDX, SWID



Softw BOM)


```
{
    "bomFormat": "CycloneDX",
    "specVersion": "1.5",
    "serialNumber": "...",
    "version": 1,
    "metadata":
    {
        "timestamp": "2024-05-23T06:44:11Z",
        "tools": "...",
        "authors": "...",
        "component":
        {
            "name": "redis",
            "type": "application",
            "bom-ref": "root"
        }
    },
    "components":
    [
        {
            "name": "hiredis",
            "version": "v1.1.0",
            "licenses":
            [
                {
                    "license":
                    {
                        "id": "BSD-3-Clause",
                        "url": "https://spdx.org/licenses/BSD-3-Clause.html"
                    }
                }
            ],
            "purl": "pkg:github/redis/hiredis@v1.1.0",
            "type": "library",
            "bom-ref": "4947|659035"
        },
        {
            "name": "lua",
            "version": "v5.1.1",
```

Software Bill of Materials (SBOM)

- **Software Bill of Materials (SBOM)**
  - SBOM can be used when developing, purchasing, or operating a system, etc.
  - Benefits
    - [Developers]
      - They often create products using components of public SW (OSS) and third-party SW
      - The SW development company can identify whether the corresponding component is the latest version through SBOM and quickly respond to new security vulnerabilities
    - [SW Buyers & Users]
      - They can use SBOM to transparently perform security vulnerability or license analysis, and these two analyzes can be used to evaluate the overall risk level of the product

Software Bill of Materials (SBOM)

- **Minimum Requirements**
  - The minimum standard for global supply is presented by the U.S. NTIA

Element	Description
Supplier Name	The name of the entity that created, defined, and identified the component.
Timestamp	Record of date and time of conversion to SBOM data
Author Name	Name of the entity generating SBOM data for the component.
Component Name	Name assigned to the SW unit as defined by the original supplier.
Version String	Identifier used to specify changes in SW from a previous version.
Unique Identifier	Identifier used to identify components or serve as look-up keys in related DBs.
Relationship	Specifies the relationship that upstream component.

Software Bill of Materials (SBOM)

- **Vulnerability examination**
  - Both version-based and code-based vulnerability detection techniques can be linked to SBOM!

Software Bill of Materials (SBOM)

- **Vulnerability examination: Version-based approach**


```
"components":
[
    {
        "name": "hiredis",
        "version": "v1.1.0",
        "licenses":
        [
            {
                "license":
                {
                    "id": "BSD-3-Clause",
                    "url": "https://spdx.org/licenses/BSD-3-Clause.html"
                }
            }
        ],
        "purl": "pkg:github/redis/hiredis@v1.1.0",
        "type": "library",
        "bom-ref": "4947|659035"
    },
    {
        "name": "lua",
        "version": "v5.1.1",
```

Software Bill of Materials (SBOM)

- **Vulnerability examination: Code-based approach**
  - During the SBOM creation process, code-based vulnerability information is often recorded together

Sof…OM)

- **Vulnerabi…**
  - During th…nformation is often rec…

```
"vulnerabilities":
[
    {
        "bom-ref": "054F26F0-3B28-7002-0000-000000000000|BCA423CCCC4949785C804
        "id": "CVE-2020-14147",
        "source":
        {
            "name": "NVD",
            "url": "https://nvd.nist.gov/vuln/detail/CVE-2020-14147"
        },
        "references":
        [
            {
                "id": "CVE-2020-14147",
                "source":
                {
                    "name": "NVD",
                    "url": "https://nvd.nist.gov/vuln/detail/CVE-2020-14147"
                }
            }
        ],
        "ratings":
        [
            {
                "source":
                {
                    "name": "NVD",
                    "url": "https://nvd.nist.gov/vuln-metrics/cvss/v2-calculat
                },
                "score": 4,
                "method": "CVSSv2",
                "vector": "AV:N/AC:L/Au:S/C:N/I:N/A:P"
```

Software Bill of Materials (SBOM)

- **License comparability**
  - Because SBOM also contains component license information, it can also respond to license comparability/violation issues

```
"components":
[
    {
        "name": "hiredis",
        "version": "v1.1.0",
        "licenses":
        [
            {
                "license":
                {
                    "id": "BSD-3-Clause",
                    "url": "https://spdx.org/licenses/BSD-3-Clause.html"
                }
```

Software Bill of Materials (SBOM)

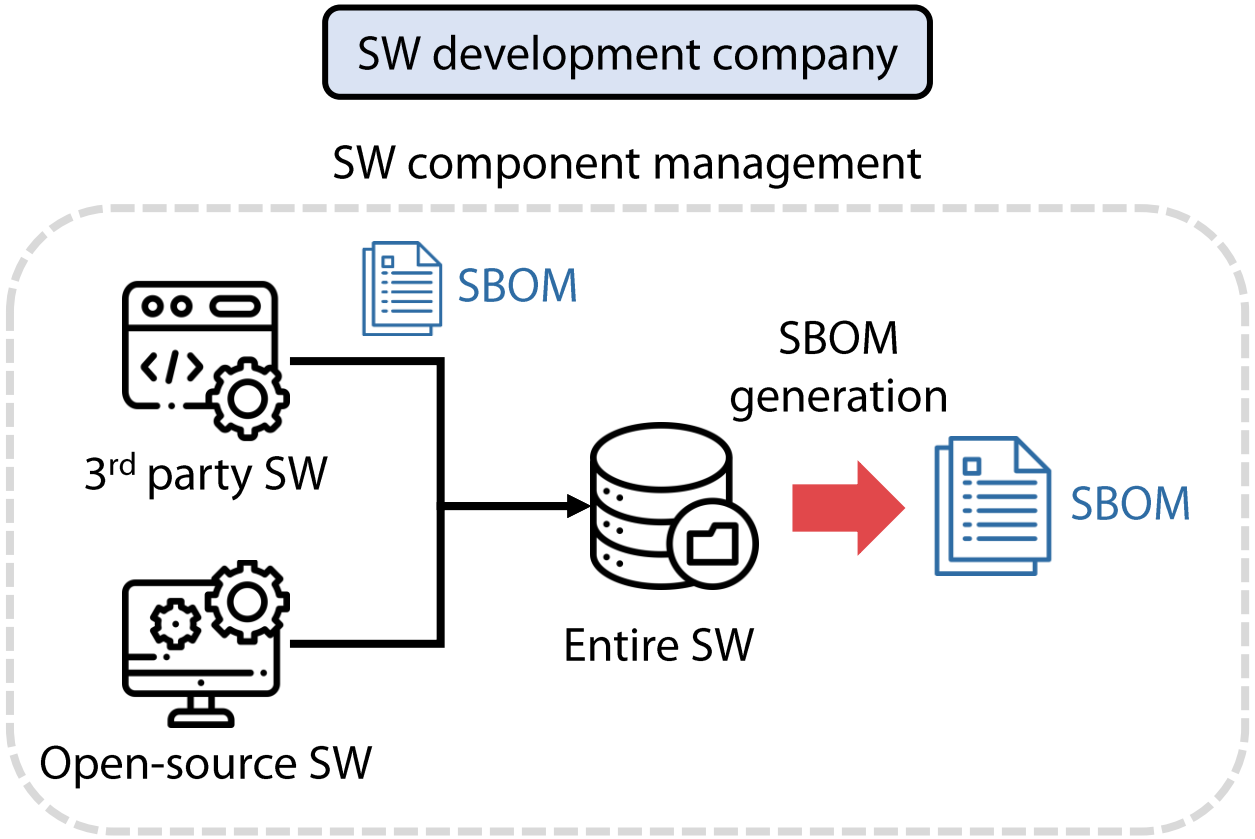

```
  "SPDXID" : "SPDXRef-Package-161423",
  "copyrightText" : "NOASSERTION",
  "downloadLocation" : "https://www.kernel.org/pub/linux/kernel/v2.6",
  "filesAnalyzed" : false,
  "homepage" : "https://www.kernel.org",
  "licenseConcluded" : "GPL-2.0",
  "licenseDeclared" : "GPL-2.0",
  "licenseInfoFromFiles" : [ "GPL-2.0" ],
  "name" : "Linux Kernel",
  "originator" : "Organization: \"\"",
  "supplier" : "Person: \"\"",
  "versionInfo" : "2.6"
}, {
  "SPDXID" : "SPDXRef-Package-161422",
  "copyrightText" : "Bite Chalk is free for personal use only. Please, talk with the author for
  "downloadLocation" : "https://www.maisfontes.com/bite-chalk-normal.font",
  "filesAnalyzed" : false,
  "homepage" : "https://www.maisfontes.com/bite-chalk.font",
  "licenseConcluded" : "LicenseRef-Non-Commercial-Use-Only-Font-License",
  "licenseDeclared" : "LicenseRef-Non-Commercial-Use-Only-Font-License",
  "licenseInfoFromFiles" : [ "LicenseRef-Non-Commercial-Use-Only-Font-License" ],
  "name" : "BiteChalk Font",
  "originator" : "Organization: \"\"",
  "supplier" : "Person: \"\"",
  "versionInfo" : ""
} ],
```

Software Bill of Materials (SBOM)

- **How to generate SBOM?**
  1. Take advantage of automated tools
  2. Manual examination..

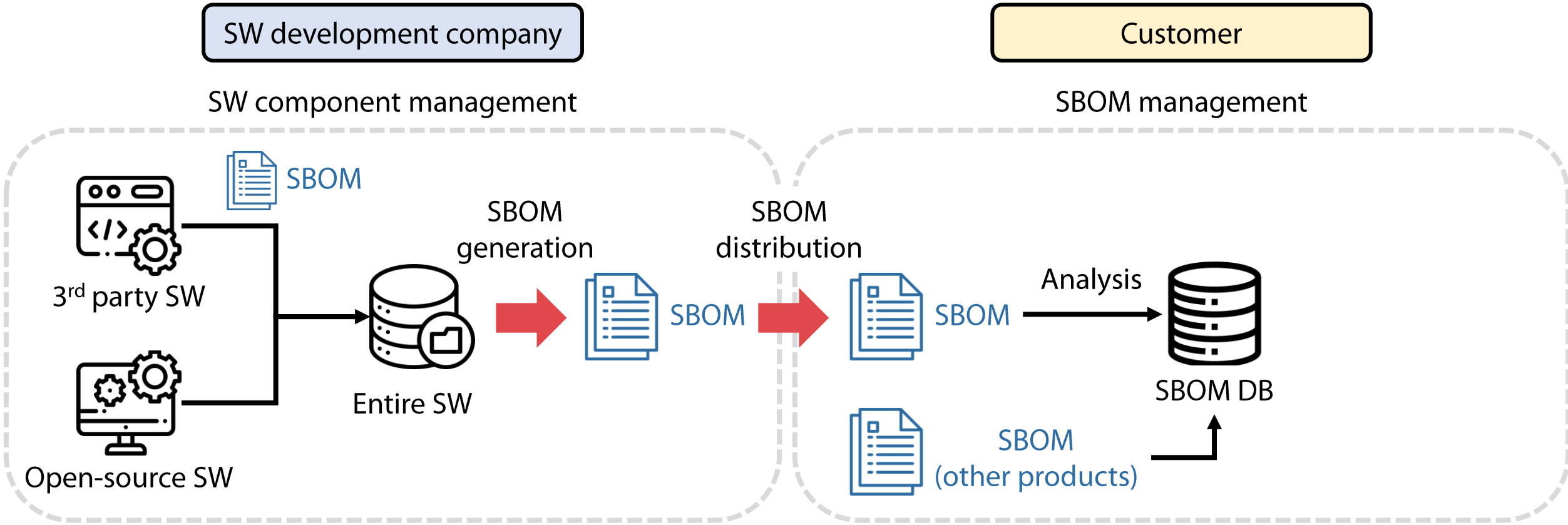
Software Bill of Materials (SBOM)

- **SBOM distribution**



Software Bill of Materials (SBOM)

- **SBOM distribution**



Software Bill of Materials (SBOM)

- **References**
  - https://www.federalregister.gov/documents/2021/05/17/2021-10460/improving-the-nations-cybersecurity
    - (EN) Executive Order 14028: Improving the Nation's Cybersecurity
  - https://www.kisa.or.kr/2060204/form?postSeq=15&page=1
    - (KR) 소프트웨어 공급망 보안 가이드라인 1.0

Next Lecture

- **Defense strategies**

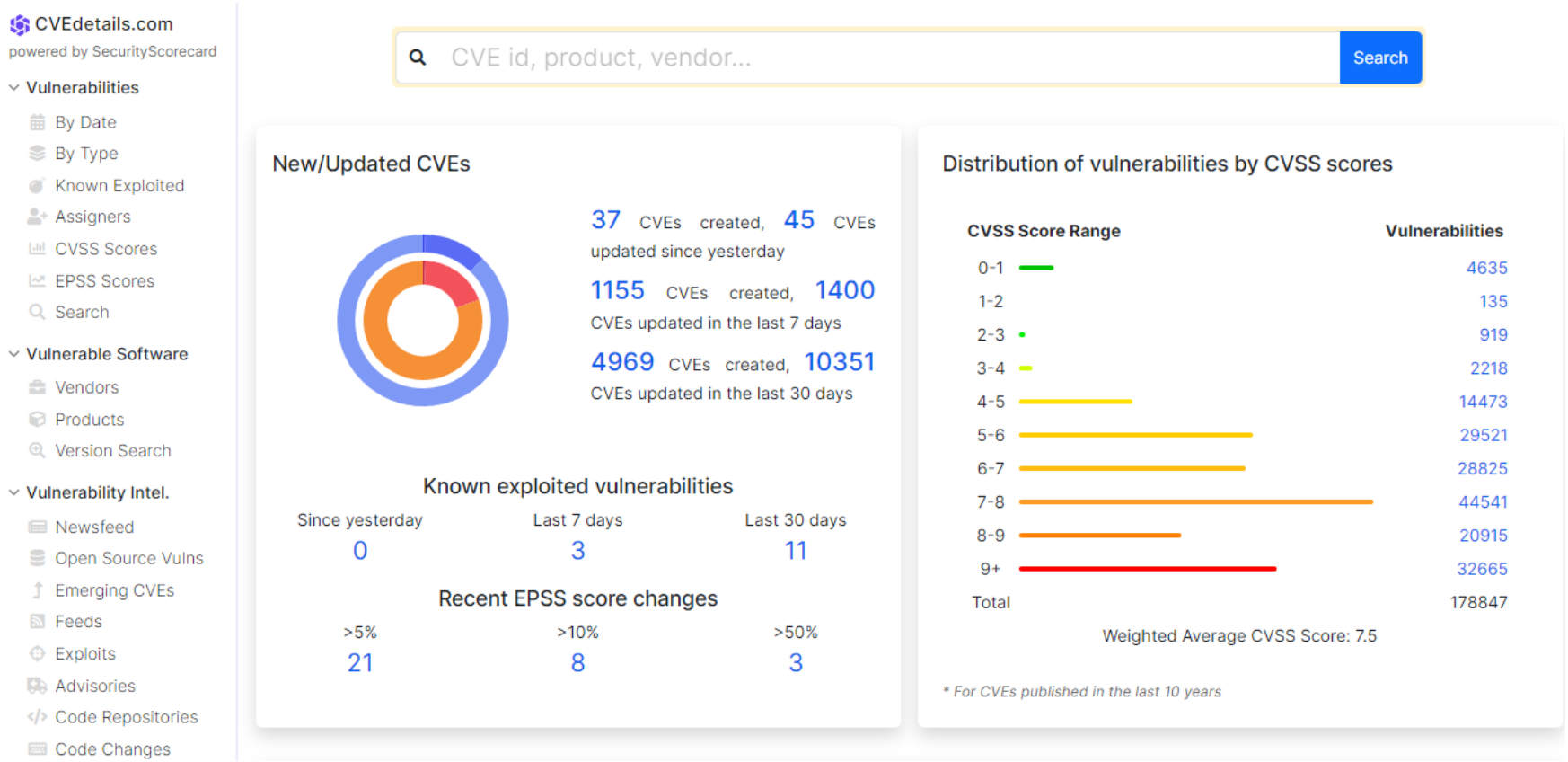
Assignment II(Edited)

- **Due date:** June ~~14th~~ 19th 11:59 PM
- **To be submitted:**
  - Please compress the following three items into a single file (.zip) and submit it

1. Source code with vulnerabilities
   - For real-world OSS, only submit the files containing vulnerabilities
2. Source code with patches applied
3. Report
   - As shown in this material, you must include the following information (e.g., using screenshots)
     - where the vulnerability was located
     - how the vulnerability was triggered
     - how it was patched
     - confirmation that the vulnerability is no longer triggered

Assignment II(Appendix)

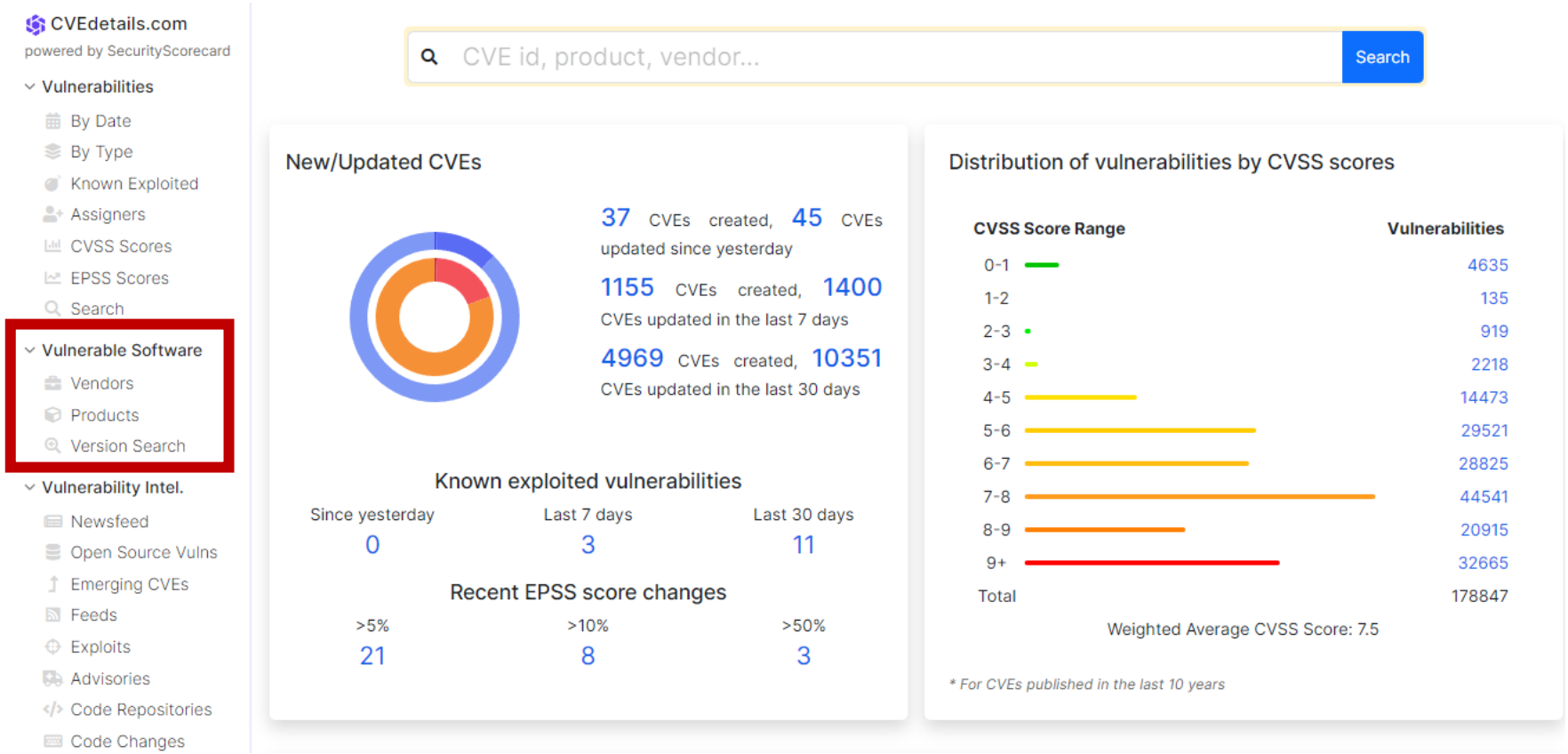
- **CVEdetails**



https://www.cvedetails.com/

Assignment II(Appendix)

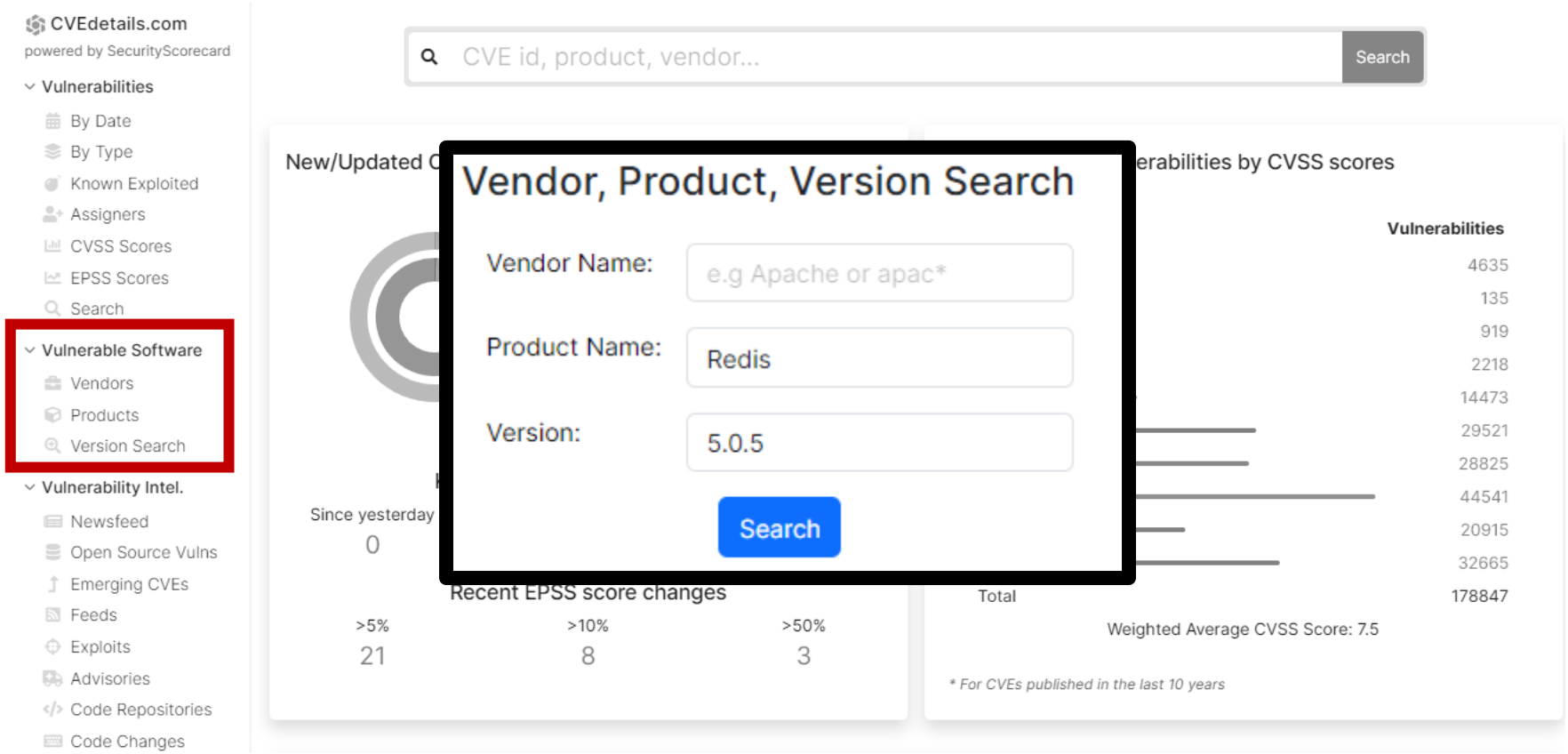
- **CVEdetails**



https://www.cvedetails.com/

Assignment II(Appendix)

- **CVEdetails**



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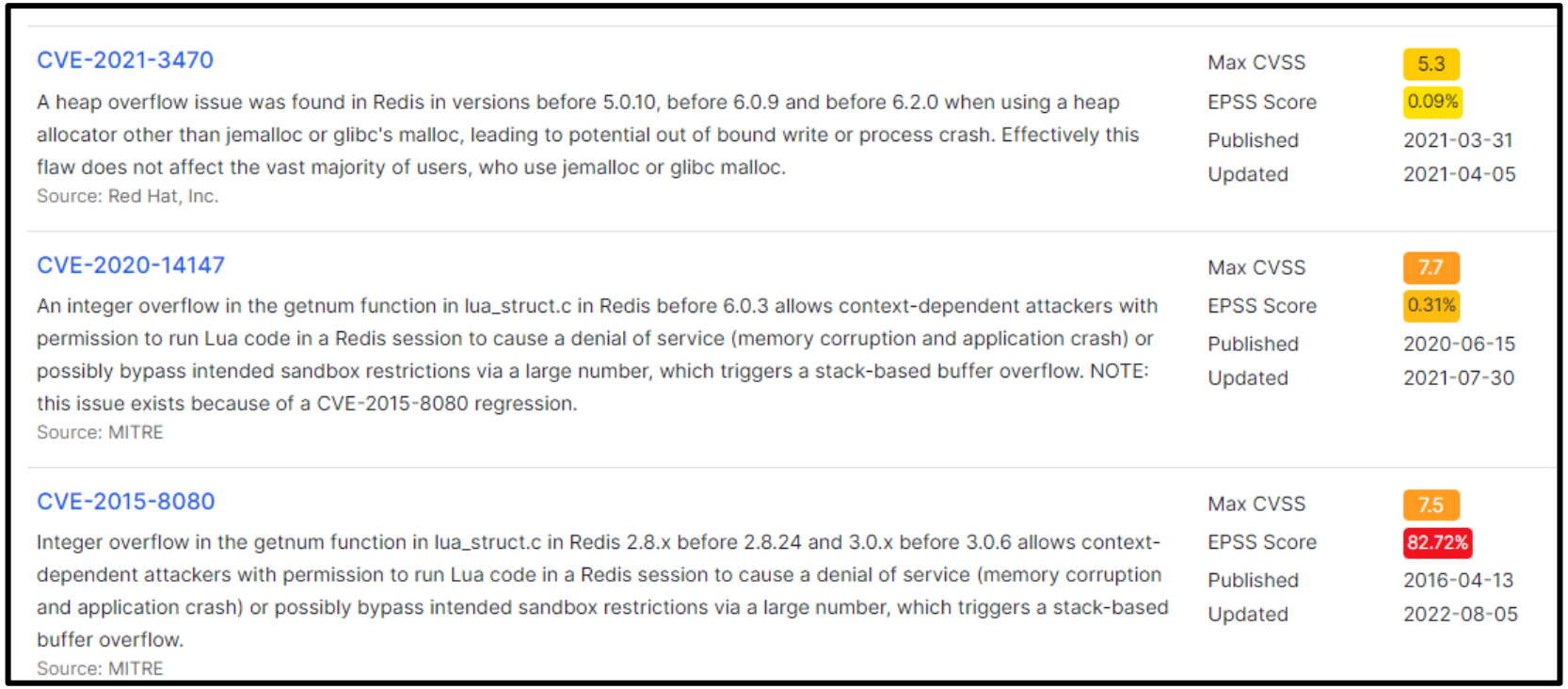
Assignment II(Appendix)

- **CVEdetails**



CVE-2021-3470

A heap overflow issue was found in Redis in versions before 5.0.10, before 6.0.9 and before 6.2.0 when using a heap allocator other than jemalloc or glibc's malloc, leading to potential out of bound write or process crash. Effectively this flaw does not affect the vast majority of users, who use jemalloc or glibc malloc.

Source: Red Hat, Inc.

Max CVSS	5.3
EPSS Score	0.09%
Published	2021-03-31
Updated	2021-04-05

CVE-2020-14147

An integer overflow in the getnum function in lua_struct.c in Redis before 6.0.3 allows context-dependent attackers with permission to run Lua code in a Redis session to cause a denial of service (memory corruption and application crash) or possibly bypass intended sandbox restrictions via a large number, which triggers a stack-based buffer overflow. NOTE: this issue exists because of a CVE-2015-8080 regression.

Source: MITRE

Max CVSS	7.7
EPSS Score	0.31%
Published	2020-06-15
Updated	2021-07-30

CVE-2015-8080

Integer overflow in the getnum function in lua_struct.c in Redis 2.8.x before 2.8.24 and 3.0.x before 3.0.6 allows context-dependent attackers with permission to run Lua code in a Redis session to cause a denial of service (memory corruption and application crash) or possibly bypass intended sandbox restrictions via a large number, which triggers a stack-based buffer overflow.

Source: MITRE

Max CVSS	7.5
EPSS Score	82.72%
Published	2016-04-13
Updated	2022-08-05

https://www.cvedetails.com/