

**CSE-C3400 Information security  
Examination 2017-10-26  
Lecturer: Tuomas Aura**

*No electronic equipment or reference material is allowed in the examination.*

**1. Access control terminology**

Give an example of each of the following concepts in a civilian (i.e. non-military) information system:

- (a) principle of minimum privilege (2p)
- (b) covert channel (2p)
- (c) role inheritance (2p)

Please answer each item with one sentence.

**2. Linux permissions**

Kermit is administering a Linux server. He has become completely confused. He asks your help to understand the protection state of his computer. Here is the output of some Linux commands:

```
$ groups fred kermit ted Carrie
fred : users frogteam
kermit : users sudo frogteam
ted : users toadteam
Carrie : users
$ ls -l
-r--rw---- 1 fred frogteam 29 Oct 25 07:01 croak.txt
-rwxrwxrwx- 1 ted toadteam 29 Oct 25 07:01 plop.sh
-rw-r--rw- 1 fred toadteam 29 Oct 25 07:01 ribbit.txt
-rwsr-x--- 1 fred users 29 Oct 25 07:01 squash.sh
```

Problem:

- (a) Show the protection state for the above objects in the form of an access control matrix where the subjects are the individual users. If the matrix cannot accurately express the protection state, write a note explaining why. (4p)
- (b) Why are the permissions for `plop.sh` particularly dangerously configured? (1p)
- (c) What is the meaning of the character 's' on the last output row? (1p)

Note that these permissions are an artificial example and not realistic in any way.

**3. Remote electronic voting**

Explain the election process and security mechanisms in the Estonian E-voting system or a similar remote electronic voting system that is based on the double-envelope scheme.

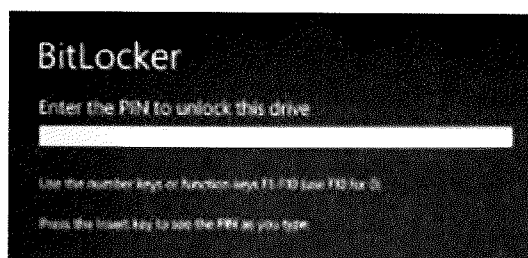
Notes: It is a good idea to draw a diagram of the election process. Describe just one possible process, not many variants. This is not a threat analysis question. Do not write lists of threats, assets etc. Focus on the security mechanism and what they achieve. Even residual threat analysis is not required.

(6p)

Please turn the paper  
for the remaining parts  
of the examination.

#### 4. Data encryption

In your role as a penetration tester, you have been asked to infiltrate the Euro Shopper factory and retrieve the secret energy drink formula from a computer in the factory control room. You have taken a job in the factory as cleaner. This allows you to roam the facility with relative freedom in the evenings, after everyone else goes home. So far, you have discovered the location of the computer. It is a desktop PC that runs Windows, and the factory employees power down the computer before leaving work. Next, you sneak into the office in the evening and power up the computer. The following text appears on the screen: "BitLocker – Enter the PIN to unlock this drive".



Problem: What different ways are there for you to get access to the secret files, preferably without getting caught?

You may also get some points for explaining why certain methods do not work.

(6p)

#### 5. Network security

In appendix 1, there is a pretty-printed certificate chain. Explain in detail, how a web browser would use this chain to authenticate a web site.

Notes: You do not need to explain the details of the TLS handshake protocol. "rsaEncryption" in this context means the RSA algorithm for any purpose, which may be encryption or signature.

(6p)

## Appendix 1

**Certificate:**  
**Data:**  
 Version: 3 (0x2)  
 Serial Number:  
 0c:e7:e0:e5:17:d8:46:fe:8f:e5:60:fc:1b:f0:30:39  
 Signature Algorithm: sha1WithRSAEncryption  
 Issuer: C=US, O=DigiCert Inc, OU=www.digicert.com, CN=DigiCert Assured ID Root CA  
 Validity  
 Not Before: Nov 10 00:00:00 2006 GMT  
 Not After : Nov 10 00:00:00 2031 GMT  
 Subject: C=US, O=DigiCert Inc, OU=www.digicert.com, CN=DigiCert Assured ID Root CA  
 Subject Public Key Info:  
 Public Key Algorithm: rsaEncryption  
 Public-Key: (2048 bit)  
 Modulus:  
 00:ad:0e:15:ce:e4:43:80:5c:b1:87:f3:b7:60:f9:  
 71:12:a5:ae:dc:26:94:88:aa:f4:ce:f5:20:39:28:  
 58:60:0c:f8:80:da:a9:15:95:32:61:3c:b5:b1:28:  
 84:8a:8a:dc:9f:0a:0c:83:17:7a:8f:90:ac:8a:e7:  
 79:53:5c:31:84:2a:f6:0f:98:32:36:76:cc:de:dd:  
 3c:a8:a2:ef:6a:fb:21:f2:52:61:df:9f:20:d7:1f:  
 e2:b1:d9:fe:18:64:d2:12:5b:5f:f9:58:18:35:bc:  
 47:cd:a1:36:f9:6b:7f:d4:b0:38:3e:cl:1b:c3:8c:  
 33:d9:d8:2f:18:fe:28:0f:b3:a7:83:d6:c3:6e:44:  
 c0:61:35:96:16:fe:59:9c:8b:76:6d:d7:f1:a2:4b:  
 0d:2b:ff:0b:72:da:9e:60:d0:8e:90:35:c6:78:55:  
 87:20:a1:cf:e5:6d:0a:0c:49:7c:31:98:33:6c:22:  
 e9:87:d0:32:5a:a2:ba:13:82:11:ed:39:17:9d:99:  
 3a:72:a1:e6:fa:a4:d9:d5:17:31:75:ae:85:7d:22:  
 ae:3f:01:46:86:f6:28:79:c8:b1:da:e4:57:17:c4:  
 7e:1c:0e:b0:b4:92:a6:56:b3:bd:b2:97:ed:aa:a7:  
 f0:b7:c5:a8:3f:95:16:d0:ff:a1:96:eb:08:5f:18:  
 77:4f  
 Exponent: 65537 (0x10001)  
 X509v3 extensions:  
 X509v3 Key Usage: critical  
 Digital Signature, Certificate Sign, CRL Sign  
 X509v3 Basic Constraints: critical  
 CA:TRUE  
 X509v3 Subject Key Identifier:  
 45:EB:A2:AF:F4:92:CB:82:31:2D:51:8B:A7:A7:21:9D:F3:6D:C8:0F  
 X509v3 Authority Key Identifier:  
 Keyid:45:EB:A2:AF:F4:92:CB:82:31:2D:51:8B:A7:A7:21:9D:F3:6D:C8:0F  
 Signature Algorithm: sha1WithRSAEncryption  
 a2:0e:bc:df:e2:ed:f0:e3:72:73:7a:64:94:bf:f7:72:66:d8:  
 32:e4:42:75:62:ae:87:eb:f2:d5:d9:de:56:b3:9f:cc:ce:14:  
 28:b9:0d:97:60:5c:12:4c:58:e4:d3:3d:83:49:45:58:97:35:  
 69:1a:a8:47:ea:56:c6:79:ab:12:d8:67:81:84:df:7f:09:3c:  
 94:e6:b8:26:2c:20:bd:3d:b3:28:89:f7:5f:ff:22:e2:97:84:  
 1f:e9:65:ef:87:e0:df:c1:67:49:b3:5d:eb:b2:09:2a:eb:26:  
 ed:78:be:7d:3f:2b:f3:b7:26:35:6d:5f:89:01:b6:49:5b:9f:  
 01:05:9b:ab:3d:25:c1:cc:b6:7f:c2:f1:6f:86:c6:fa:64:68:  
 eb:81:2d:94:eb:42:b7:fa:8c:1e:dd:62:f1:be:50:67:b7:6c:  
 bd:f3:f1:1f:6b:0c:36:07:16:7f:37:7c:a9:5b:6d:7a:f1:12:  
 46:60:83:d7:27:04:be:4b:ce:97:be:c3:67:2a:68:11:df:80:  
 e7:0c:33:66:bf:13:0d:14:6e:f3:7f:1f:63:10:1e:fa:8d:1b:  
 25:6d:6c:8f:a5:b7:61:01:b1:d2:a3:26:a1:10:71:9d:ade:2:  
 c3:f9:c3:99:51:b7:2b:07:08:ce:2e:e6:50:b2:a7:fa:0a:45:  
 2f:a2:f0:f2

**Certificate:**  
**Data:**  
 Version: 3 (0x2)  
 Serial Number:  
 08:70:bc:c5:af:3f:db:95:9a:91:cb:6a:ee:ef:e4:65  
 Signature Algorithm: sha256WithRSAEncryption  
 Issuer: C=US, O=DigiCert Inc, OU=www.digicert.com, CN=DigiCert Assured ID Root CA  
 Validity  
 Not Before: Nov 18 12:00:00 2014 GMT  
 Not After : Nov 18 12:00:00 2024 GMT  
 Subject: C=NL, ST=Noord-Holland, L=Amsterdam, O=TERENA, CN=TERENA SSL CA 3  
 Subject Public Key Info:  
 Public Key Algorithm: rsaEncryption  
 Public-Key: (2048 bit)  
 Modulus:  
 00:c5:76:0f:0f:d9:43:29:3b:6c:6d:d1:47:ad:de:  
 10:bf:23:c2:78:a8:4a:77:35:f1:23:5b:e0:4c:1e:  
 41:e7:c2:31:00:bd:88:37:45:75:dd:b9:02:10:80:  
 1e:8f:ed:64:23:04:45:a7:a0:39:3b:81:4d:cf:63:  
 3f:c2:49:ff:22:9e:88:b0:d2:96:b9:5c:8a:74:1f:  
 92:2a:2a:f2:12:c8:b7:68:54:b5:58:41:81:40:68:  
 06:1a:4f:85:29:fb:b5:4d:3c:0f:4f:3f:40:96:1b:  
 ce:a8:cc:5e:35:ff:64:98:f5:75:dd:74:54:05:a0:  
 36:11:04:12:24:55:63:ef:94:77:2e:77:f1:15:76:  
 ee:d3:a4:59:45:21:9f:a8:be:d1:27:ed:0a:e8:ab:  
 38:ca:3f:87:d1:da:f1:8f:b9:0b:1f:44:e7:e0:ad:  
 f3:95:c2:16:4d:ec:84:a3:3a:92:d4:cf:c6:7d:e6:  
 bd:cb:1a:40:4f:b3:54:b1:f3:8f:6f:0d:1e:e3:be:  
 49:a3:56:e4:07:bc:8d:a7:ce:ld:b0:5b:57:56:d1:  
 c4:1c:fc:98:65:d1:cd:46:2f:91:94:bf:45:85:49:  
 f8:6d:52:87:1c:02:56:01:27:16:ab:72:2e:f4:71:  
 e4:61:b5:20:a0:fa:26:69:6a:0a:f1:ab:9f:6d:b7:  
 cf:25  
 Exponent: 65537 (0x10001)  
 X509v3 extensions:  
 X509v3 Basic Constraints: critical  
 CA:TRUE, pathlen:0  
 X509v3 Key Usage: critical  
 Digital Signature, Certificate Sign, CRL Sign  
 Authority Information Access:  
 OCSP - URI:http://ocsp.digicert.com  
 CA Issuers - URI:http://cacerts.digicert.com/DigiCertAssuredIDRootCA.crt  
 X509v3 CRL Distribution Points:  
 Full Name:

```

URI:http://crl3.digicert.com/DigiCertAssuredIDRootCA.crl
Full Name:
URI:http://crl4.digicert.com/DigiCertAssuredIDRootCA.crl
X509v3 Certificate Policies:
Policy: X509v3 Any Policy
CPS: https://www.digicert.com/CPS
X509v3 Subject Key Identifier:
67:FD:88:20:14:27:98:C7:09:D2:25:19:BB:E9:51:11:63:75:50:62
X509v3 Authority Key Identifier:
keyid:45:EB:A2:AF:F4:92:CB:82:31:2D:51:8B:A7:A7:21:9D:F3:6D:C8:0F
Signature Algorithm: sha256WithRSAEncryption
a9:28:35:7a:c4:7b:d6:da:27:1e:ac:98:cf:27:36:4f:11:32:
74:74:e6:40:dd:1d:cd:f2:69:77:35:af:b3:8c:5d:c6:04:bf:
15:f4:23:67:8b:b9:6f:97:04:eb:46:9d:c2:cd:c9:d1:a4:ae:
81:2e:c9:ba:b1:e8:80:d0:1c:c9:39:c1:56:76:59:6c:9c:7d:
e3:a9:f0:d3:d1:34:d8:3c:49:59:8b:1a:98:ce:bf:c6:f2:d8:
30:35:ff:e9:6f:5d:a0:af:3a:ee:66:53:ae:aa:8c:69:c8:be:
9a:a7:a0:7b:d8:82:4b:33:13:c8:07:f3:77:d7:f3:64:cd:9e:
63:f9:42:27:53:ae:10:33:89:72:37:15:fl:be:f7:1e:35:a2:
ce:c3:2d:f2:d7:b2:e6:0b:c7:69:c0:e5:1f:5f:7c:69:9b:7e:
ce:26:1a:33:44:c3:ba:77:05:3b:ba:5d:3f:41:89:fa:16:3b:
ee:04:6e:5b:ac:56:4b:ef:8c:70:f2:4a:7b:57:bd:19:6e:8b:
36:07:54:26:2d:86:09:94:1f:5f:37:ab:f0:23:3f:8f:2c:5f:
96:9e:47:71:a8:44:de:a9:b9:85:2f:b5:34:60:a5:5f:09:a0:
9a:43:1d:d4:bf:2d:44:d6:8d:da:fd:75:cb:5f:16:a0:0e:61:
c2:70:3d:36

Certificate:
Data:
Version: 3 (0x2)
Serial Number:
02:72:71:c2:fe:ca:5c:4e:3b:1c:cc:a8:67:97:c4:1e
Signature Algorithm: sha256WithRSAEncryption
Issuer: C=NL, ST=Noord-Holland, L=Amsterdam, O=TERENA, CN=TERENA SSL CA 3
Validity
Not Before: Jan 15 00:00:00 2016 GMT
Not After : Jan 23 12:00:00 2019 GMT
Subject: C=FI, ST=Uusimaa, L=Espoo, O=Aalto University Foundation, OU=Department of
Computer Science, CN=www.cs.hut.fi
Subject Public Key Info:
Public Key Algorithm: rsaEncryption
Public-Key: (2048 bit)
Modulus:
00:ce:7a:5c:cd:45:da:fb:51:db:8f:13:fb:ea:39:
cd:3f:db:e6:18:45:8d:75:12:b6:3b:8a:be:df:4f:
5c:c0:42:2c:1a:7a:d4:ca:d5:35:ff:e3:f3:a5:7f:
a9:71:df:2e:95:c8:3e:cb:9e:b9:e1:22:b8:70:7c:
7f:f4:9c:67:61:da:a6:01:56:8a:f4:e5:97:01:9f:
dc:dc:4a:2b:36:f7:91:0e:fe:a9:e3:91:c3:cf:0b:
22:94:bf:55:ea:de:d4:cb:8c:7f:c4:5f:4e:3c:e7:
16:30:d6:5a:c3:fe:ab:71:39:a0:d9:2b:f7:6e:54:
7a:8c:c3:e6:c5:59:37:3d:51:40:66:36:38:2b:4d:
7d:a6:c2:5f:f8:e7:al:d9:07:1f:c6:2e:01:ba:b3:
a8:52:a5:8e:b8:da:48:3a:2d:e7:3a:d4:ee:e7:d5:
fe:d6:06:f5:9e:50:bd:d3:99:2a:65:7e:09:74:0f:
40:d7:87:e3:bc:0f:39:90:69:7f:0c:1a:af:1e:8b:
88:e9:4f:99:29:f4:4b:14:36:f3:ee:46:32:91:ca:
37:ea:21:37:ef:13:f2:99:42:ad:f3:93:2c:97:1f:
26:84:7c:73:00:27:ad:cf:fe:bb:10:6e:e9:b3:29:
c4:dd:f4:fl:56:21:95:el:2f:96:8a:76:bf:89:6e:
52:3b
Exponent: 65537 (0x10001)
X509v3 extensions:
X509v3 Authority Key Identifier:
keyid:67:FD:88:20:14:27:98:C7:09:D2:25:19:BB:E9:51:11:63:75:50:62
X509v3 Subject Key Identifier:
DD:21:81:30:50:E5:D6:D2:E7:1F:8C:BB:C5:0C:31:C7:60:50:C4:91
X509v3 Subject Alternative Name:
DNS:www.cs.hut.fi, DNS:www.cse.tkk.fi
X509v3 Key Usage: critical
Digital Signature, Key Encipherment
X509v3 Extended Key Usage:
TLS Web Server Authentication, TLS Web Client Authentication
X509v3 CRL Distribution Points:
Full Name:
URI:http://crl3.digicert.com/TERENASSLCA3.crl
Full Name:
URI:http://crl4.digicert.com/TERENASSLCA3.crl
X509v3 Certificate Policies:
Policy: 2.16.840.1.114412.1.1
CPS: https://www.digicert.com/CPS
Policy: 2.23.140.1.2.2
Authority Information Access:
OCSP - URI:http://ocsp.digicert.com
CA Issuers - URI:http://cacerts.digicert.com/TERENASSLCA3.crt
X509v3 Basic Constraints: critical
CA:FALSE
Signature Algorithm: sha256WithRSAEncryption
88:25:ff:0c:a6:6d:55:01:b3:fc:64:35:16:c5:56:c4:e1:bb:
0e:94:83:85:07:7a:6e:96:2e:50:6a:8a:b9:8c:00:a9:c8:f9:
ba:cc:6e:ec:da:ab:0a:e3:77:c0:d8:f6:91:d2:b2:8e:7a:5b:
4c:1c:e5:82:d1:49:a0:95:e3:c8:d4:d8:ce:62:59:43:b3:db:
d6:e6:c9:ad:e3:63:d2:24:d7:d6:49:a8:20:92:df:01:79:03:
d2:54:93:98:06:e0:cd:13:79:29:ea:a6:9c:63:83:37:06:3f:
36:71:ed:a4:62:54:ec:b4:61:40:41:f1:66:3f:32:3c:f0:33:
98:4b:84:43:d0:0c:ec:08:71:51:8e:32:66:64:4f:cf:41:d7:
e0:ac:53:fe:b5:cd:f2:5a:43:19:69:b7:f4:7a:c8:b2:fb:57:
54:1b:ab:04:ce:18:e6:54:1c:52:d0:a6:7a:ad:db:43:ac:82:
ad:37:71:d3:be:4e:97:26:0e:9a:8e:3f:c6:0e:52:bc:fa:b7:
f7:91:01:d9:cf:36:e5:72:58:29:6f:fb:29:6b:78:87:98:49:
85:42:3a:ea:57:09:2a:92:52:2a:c2:18:11:1a:ef:62:29:65:
de:5a:47:7b:49:41:d0:ee:c5:a6:73:0a:9f:f2:14:ed:95:1b:
b0:b6:7f:8b

```