

Information and Data literacy

[\[CB41216\]](#) Thurs 8:50-10:20

PART I: Introduction

2. Basics usage of essential information systems

1st part: Common tools & Filesystem

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Some slides were made by Shuji ISOBE and Eisuke KOIZUMI from Center for Data Driven Science and AI

Login/Logout

- The machines of the ICL lab rooms are shared by many users.
- ① Switch on → ② Login
- Shutdown. Or ① Logout → ② Shutdown
- To switch of user: it suffices to logout/login (no need to shutdown).
- How to logout?
 - On a Linux OS: on the top-right corner, click on the “switch” mark , a window selection appears, then choose logout or shutdown or restart etc.
 - On a Windows OS: on the bottom-left corner, click on the [Start] menu, then [switch] then [shutdown] or [logout]

(1) Common Tool

- Common Tools : Web Browser
- Common Tools : Internet
- URL
- HTTP
- HTTPS = HTTP + SSL/TLS
- Home Page and Website
- Common Tools : Email
- Using and Writing emails
- SPAM
- Common Tools : Text Editor
- Common Tools : Office Suite
- Common Tools : Console

(2) Filesystem

- Files
- Directory
- Filesystem

- Path
- Current Directory
- Home directory
- Change directory
- Directory tree of the ICL lab

(3) Network

- Internet and Protocol
- Protocols of transmission
- Examples of protocols
- IP addresses
- Domain and DNS
- Default subnet mask
- Ifconfig (Linux) Ipconfig(Windows)

(4) CyberSecurity

- Where security matters
- Security for Web Services

• Threat 1: Phishing

- countermeasure to Phishing 1:Domain Name
- Beware of URL “Homograph” attack
- countermeasure: Checking the protocol
- Countermeasure: Encryption and authentication
- Digital authentication: certificate
- Authentication on the user side
- Checking certificates with the browser
- Encryption + Authentication = safe ? Not always !
- Authentication: Reputation of a certificate

• Threat 2: Targeted Mail Attack

- Countermeasure
- Common Pattern
- “Ransom” Attack

• Threat 3: malware

- Malware: How do we become infected ?
- Countermeasure to Malware Infection

• Threat 4: Intrusion

Common Tools :

Web Browser

- Main purpose: Access the WWW (World Wide Web) via the Internet. Internet is a mean to access WWW (in particular WWW≠internet)
- A Browser is a software application that boards implementations of the main protocols to access the internet and load webpages.
- Modern browsers contains moreover other applications that allow to read videos, animations and much more.
 - Can open a text file, a pdf file, an image, a video etc.
 - Many other plugins and extensions are available
- Browsers available on the computers of the ICL lab rooms:
 - Mozilla Firefox
 - Google Chrome

Common Tools :

Internet

- A webpage contains one or more text files written in HTML (HyperText Markup Language).
- The stylesheet of a webpage contains the layout and typesetting's format (often relying on CSS = Cascading Style Sheets codes).
- One task of a browser is to read the HTML files, analyse them to display the webpage as expected.
 - Not only text but also multimedia files (and more)
- To see the content of HTML file: `Ctrl+U` (on Firefox or Chrome)
- Hyperlink: navigate to another webpage.

URL (Uniform Resource Locator)

- A webpage is stored on a server (can be a mere laptop PC configured adequately with a router, but often is a special kind of computer and devices) located somewhere in the world.
- URI (=Uniform Resource Identifier) set of identifiers of physical or abstract resources:

ftp://ftp.is.co.za/rfc/rfc1808.txt	Document txt accessed by ftp
http://www.ietf.org/rfc/rfc2396.txt	Text document accessed by http
ldap://[2001:db8::7]/c=GB?objectClass?one	Printing query by ldap
mailto:John.Doe@example.com	Send mail to the address
news:comp.infosystems.www.servers.unix	Usenet newsgroup (depreciated)
tel:+1-816-555-1212	Telephone number

- URL (Uniform Resource Locator) = subset of URI' s but primarily identified by the method to access the documents identified.

- The difference between URI and URL is not perfectly clear judging from original documentation of 2005. Do not care of the difference.
- URL of the “Center for Data-driven Science and AI”:
`https://www.cds.tohoku.ac.jp`
- HTTP=HyperText Transfer Protocol denotes the main protocol (set of rules) to navigate (“surf”) over the internet.
- The part `www.cds.tohoku.ac.jp` is the locator of the address (the name of the domain).
- All browsers have an address bar to input the URL.

HTTP

- When you want to access a webpage hosted on a server (webserver), you (the client) send a request “I want to see your webpage” to the server (the host).
- The server replies with the data of the webpage (assuming it is authorized).
- The protocol (= set of transmission rules) of this transaction is called HTTP (HyperText Transfer Protocol).
- When a domain is preceded by `http://` then the transmission of data is assumed to follow the HTTP protocol.

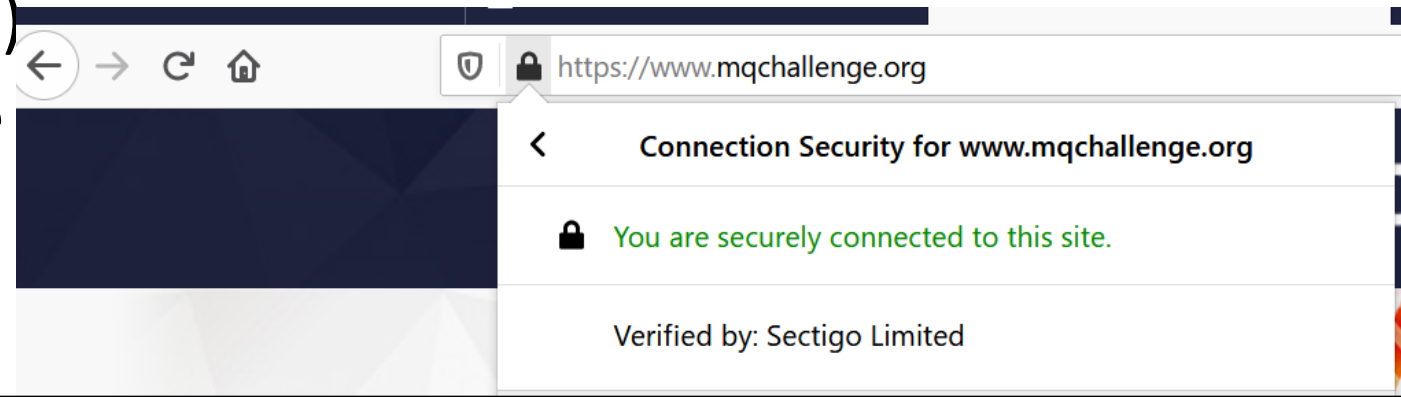
HTTPS = HTTP + SSL/TLS

(Secure Socket Layer, Transport Layer Security)

Same as HTTP, but equipped with a security protocol called SSL/TLS:

- **Layer 1:** digital authentication (are the client/server truly the ones who sent the request ?)
 - 👉 trust phase, also-called “hand-shake”.
 - 👉 prevent impersonation (pretends to be somebody else)
- **Layer 2:** exchange of a (digital) secret “key” 👉 heavily encrypted phase
- **Layer 3:** encrypted transmission of data thanks to the shared “key”
 - 👉 secret data can be transmitted over the network between the client/host *only* (the only two “key” holders who can cipher/decipher the plaintext)

The browser can help verify the legitimacy of the server calling for an https connection:



Home Page and Website

Homepage (of a browser):

- page displayed when the browser is launched

Homepage (of a website):

- A website is a collection of webpages whose URLs are under one top URL, called the homepage (or top-page)
 - Example: the homepage of Tohoku University's website is:
<http://www.tohoku.ac.jp>
 - URLs of all webpages of the TU website starts with:
`http://www.tohoku.ac.jp/...`

Common Tools :

Email

- An application that can send and receive emails is a web client (e.g outlook, thunderbird...and the oldies mute & pine)
- A webmail is a web client that can be run in the browser (e.g.: Gmail, yahoo mail etc.)

At TU:

- Adoption of Gmail (as part of G suite for Education):
- DC mail service (Digital Campus mail): all students' addresses are like:
`[prefix]@dc.tohoku.ac.jp`
- `[prefix]` can be: (1) student number, (2) authenticated general education mail address or (3) General Education address with name

Using and Writing emails

- Gmail: <https://mail.google.com/>
- **Subject:** reflects the purpose or content of the email. Be concise.
- **To:** addressee(s) of the message
- **Cc:** (Carbon Copy) secondary addressee(s)
- **Bcc** (Blind Copy Carbon): those addressees are not visible in the header of the email, hence not visible to other addressees.
- **Schedule sending:** send a (non urgent) email at a given time in the future (avoid sending professional emails outside working hours).
- **Signature:** Always sign your email by your name or with a formal signature that contains more info (can register signatures on Gmail)

- (Gmail) Sent by mistake an email ? You have a few seconds to **cancel the sending**.
- Possible to encrypt or password-protect a message or an attached file (needs beforehand agreement with addressee of course).
- Avoid attaching large files to an email. Other means exist (cloud...)
- **Manners:** The level of politeness of a professional email is at the same level as a handwritten mail.
 - Be polite, especially if you write to a hierarchal superior person.
 - Don't use too much abbreviations anyway.
- Be precise and clear: it is not a face to face communication, misunderstandings can occur more easily than you think.

SPAM

- SPAM: emails sent to an unspecified number of people regardless of the recipient.
- Content is all crap: advertising suspicious drugs, fake branded products, links redirecting to adult sites or fraudulent sites.
- When you receive an email and think it is SPAM: don't open it and **delete** it directly.
- Do not reply to SPAM. You will receive furthermore SPAM (indicates that your email address is valid). Even if inside the email is written "Even if you are not interested, please reply to this email".

Common Tools :

Text Editor

- A text file is a file that contains plain text, without any formatting.
- File Extension is .txt
- Rich text (extension .rtf) contains some limited formatting (font size, bold faces, italic faces, underlined text etc.)
- A text editor allows to create, edit, save a text file.
 - **Text editors are used for programming.** File extension changes depending of the program .c (C program), .py (Python program), .java (JAVA program) etc.
- Documents created with a word processor contains far more data than plain text.
- Text Editor in Windows: notepad (メモ帳)
- Linux: gedit, vim, emacs, carbon etc.

Common Tools :

Office Suite

- Collection of software to produce various documents and presentations with an orientation toward business.
- Windows: Microsoft office (not free, but freely available at TU).
 - MS Word: word processor (file extension: docx)
 - Excel: spreadsheets, tables (file extension: xlsx)
 - PowerPoint: presentation tools (file extension: pptx)
 - Access: Database (file extension: accd*)
- Linux: LibreOffice (free, compatible to some extent with MS office)
- Others...

Common Tools :


Console

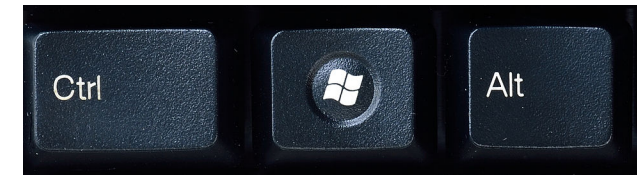
- GUI (=Graphical User Interface) is a graphical layer that facilitates the communication between the computer and the user (ex: file explorer to manipulate filesystems)
- CLI (= Command Line Interface) (also known as CUI – Character User Interface): a console (a.k.a terminal) is an application to talk to the computer with the keyboard only (without any GUI).
- Input a command in the console for each kind of manipulation.
- Can navigate, create, delete, move files. Run a program etc.

GUI (Graphical User Interface)

- Pros: easy to understand and use, intuitive.
- Cons: Memory usage, limited features.

CLI (Command Line Interface)

- Pros: work in any system, no need of a graphic card, of a large memory, of a modern OS. Low memory. More features.
- Cons: need to learn the commands. Not intuitive.
- Most programmers or system administrators use CLI.
- Linux & MacOS: Terminal (Unix based)
- Windows: Command (MS-DOS based)
- Run a console (Linux & Windows): push the  key and type `cmd`



```
C:\Users\Xav\GoogleDrive\Tohoku\INFB>dir
ドライブ C のボリューム ラベルは TIH0377400B です
ボリューム シリアル番号は 18DD-0AD4 です
```

```
C:\Users\Xav\GoogleDrive\Tohoku\INFB のディレクトリ
```

```
2021/04/08 05:55 <DIR> .
2021/04/08 05:55 <DIR> ..
2021/03/30 10:47          96,977 command-Windows.PNG
2021/03/25 10:57    2,494,459 CyberEthics.pptx
2021/04/08 01:00    233,094 Guidance.pptx
2021/03/06 11:09 <DIR> Handout-AcadSkill-I-production
2021/03/06 11:09 <DIR> Handout-AcadSkill-II-thinking
2021/04/06 11:47 <DIR> Handout-AcadSkill-III-data
2021/03/09 14:42 <DIR> Handout-Intro
2021/03/09 14:42 <DIR> Handout-socialSkill
2021/03/25 10:57 <DIR> Joho-Kiso-B(G30)
2021/03/30 10:24      5,783 mistakes.odt
2020/01/13 15:34 <DIR> r2
2020/01/13 15:14    79,395 r2.zip
          5 個のファイル          2,909,708 バイト
          9 個のディレクトリ 326,794,366,976 バイトの空き領域
```

```
C:\Users\Xav\GoogleDrive\Tohoku\INFB>
```

- Command Console on **Windows**.
- `dir` lists the content of a folder

```
[xav@localhost INFB]$ ls -l
```

```
合計 2876
```

```
-rwxrwxrwx. 1 xav xav 2494459 3月 25 10:57 CyberEthics.pptx
-rwxrwxrwx. 1 xav xav 233094 4月 8 01:00 Guidance.pptx
drwxrwxrwx. 1 xav xav 4096 3月 5 15:09 Handout-AcadSkill-I-production
drwxrwxrwx. 1 xav xav 4096 3月 5 15:14 Handout-AcadSkill-II-thinking
drwxrwxrwx. 1 xav xav 4096 4月 6 11:42 Handout-AcadSkill-III-data
drwxrwxrwx. 1 xav xav 4096 3月 5 15:09 Handout-Intro
drwxrwxrwx. 1 xav xav 4096 3月 5 15:20 Handout-socialSkill
drwxrwxrwx. 1 xav xav 4096 3月 25 20:38 'Joho-Kiso-B(G30)'
-rwxrwxrwx. 1 xav xav 96977 3月 30 10:47 command-Windows.PNG
-rwxrwxrwx. 1 xav xav 5783 3月 30 10:24 mistakes.odt
drwxrwxrwx. 1 xav xav 4096 1月 27 2020 r2
-rwxrwxrwx. 1 xav xav 79395 1月 13 2020 r2.zip
[xav@localhost INFB]$
```

Terminal on **Linux**

`ls` lists the content of a directory

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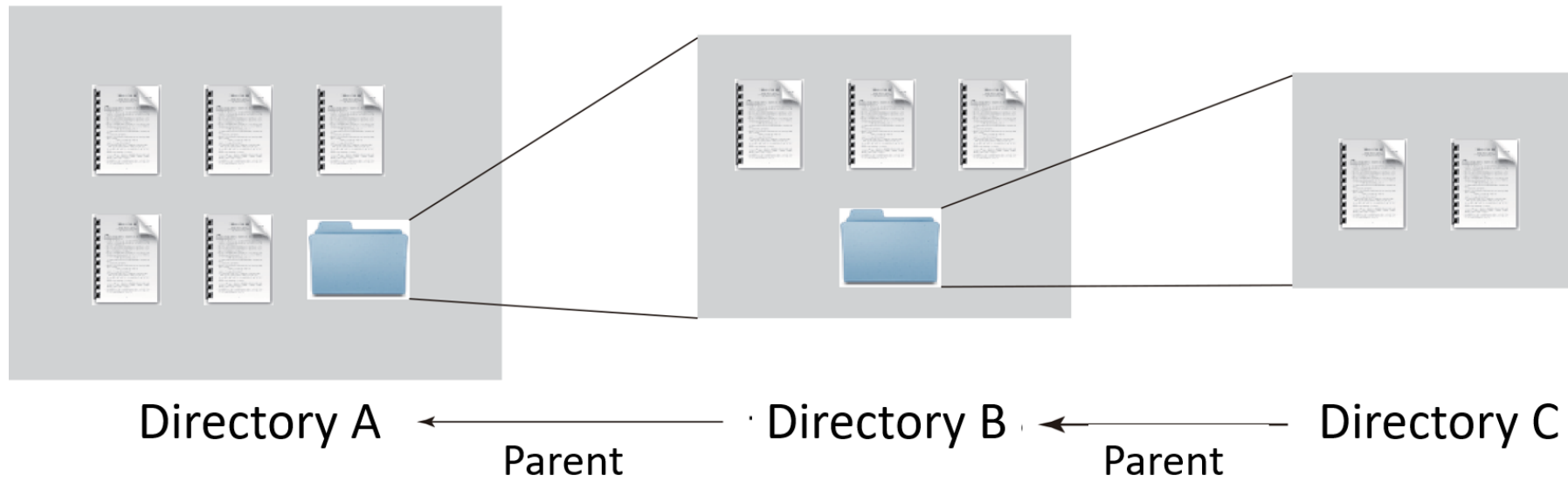
Files

- Most data are stored into **files**
- Most files have a name and an extension.
- The extension gives a characteristic about the file, and an indication of the program that should open the file.

Extension	What it is ?
txt	Plain text
doc	MS Word file
html, htm	HTML file
jpg, jpeg	Picture file using jpeg compression
py	python
tex	LaTeX
exe	Executable file (Windows)
.....	<i>many more</i>

Directory

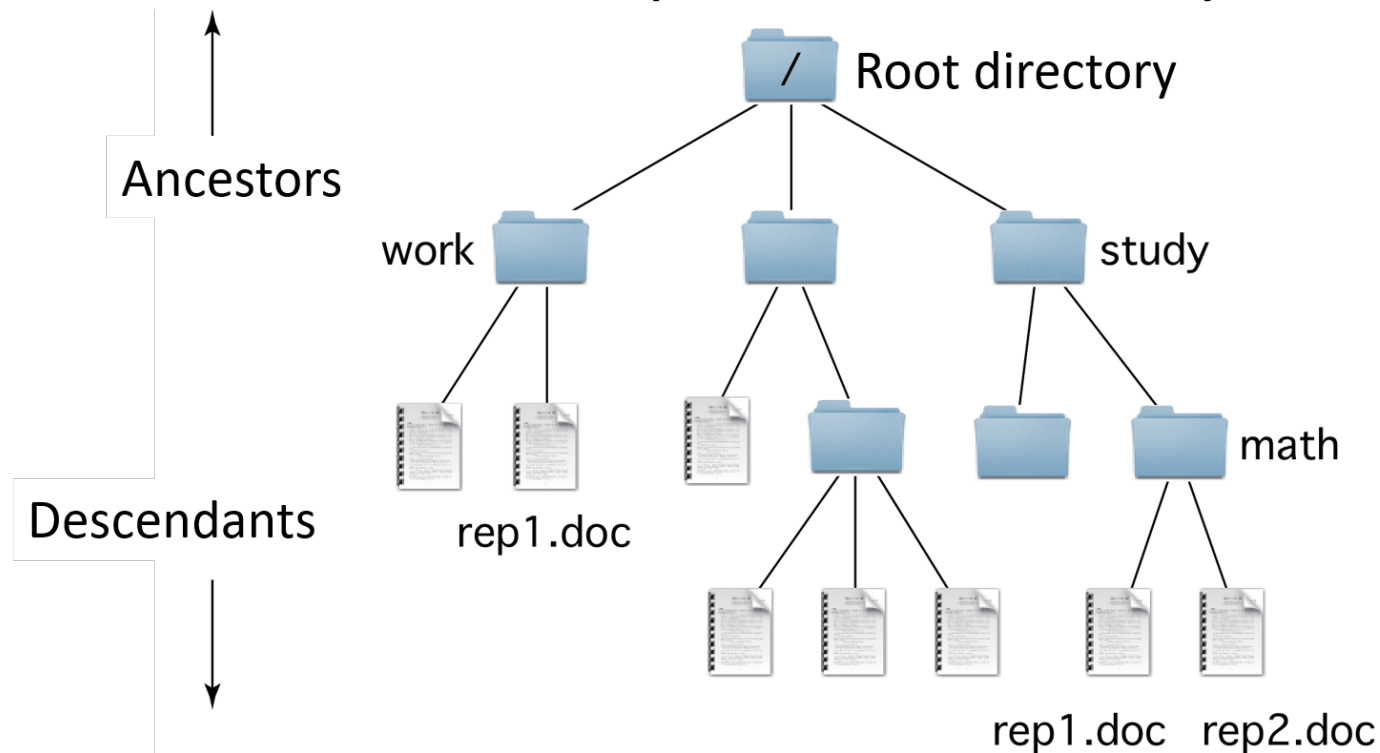
- Directories (“Folders” in Windows) contain various files or other directories.
- A directory B inside a directory A is called a **child** directory, and A is called the **parent** directory of B.



Filesystem

- Directories are organized by the filesystem
- In Linux, there is one unique directory that is the ancestor of all other directories called the root directory. (in Windows, there are several letters that are root directories of the particular disk they belong to).

Notice the
tree structure



Path

- A path allows to locate a file or a directory.
- The **absolute path** is the succession of directories from the root directory to the file or directory considered.
- In the last page example, the (absolute) path of the file `rep1.doc` in the directory `math/` is:

`/study/math/rep1.doc`

- Remark that the path of the root directory is simply `/`
- A **relative path** of a file or directory is simply the path of a file or directory from a given directory (not necessary root).
- In the previous page, the path of the file `rep1.doc` relative to the directory `work/` is `work/rep1.doc`

Current Directory

Linux

- Display the current Directory:

`pwd`

```
[xav@localhost INFB]$ pwd
/home/xav/Volume/GoogleDrive/Tohoku/INFB
[xav@localhost INFB]$
```

Path of current
directory

Windows 10

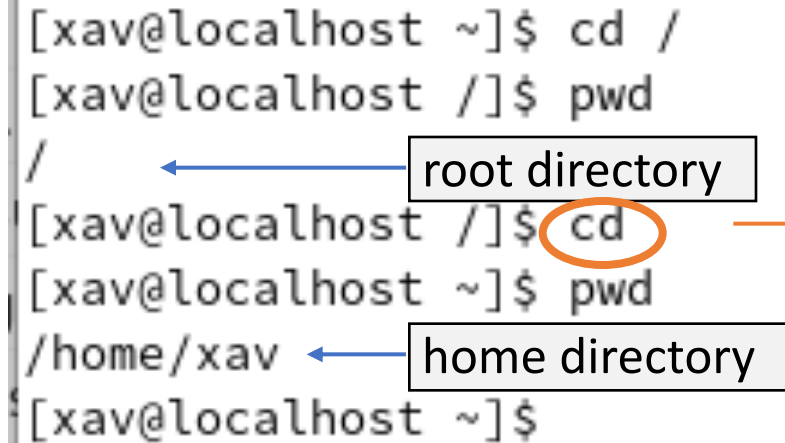
- Display the current Directory: `cd`

```
C:\Users\Xav\GoogleDrive\OnGoingWork> cd
C:\Users\Xav\GoogleDrive\OnGoingWork
C:\Users\Xav\GoogleDrive\OnGoingWork>
```

Home directory

Linux: cd

```
[xav@localhost ~]$ cd /  
[xav@localhost /]$ pwd  
/  
[xav@localhost /]$ cd  
[xav@localhost ~]$ pwd  
/home/xav  
[xav@localhost ~]$
```



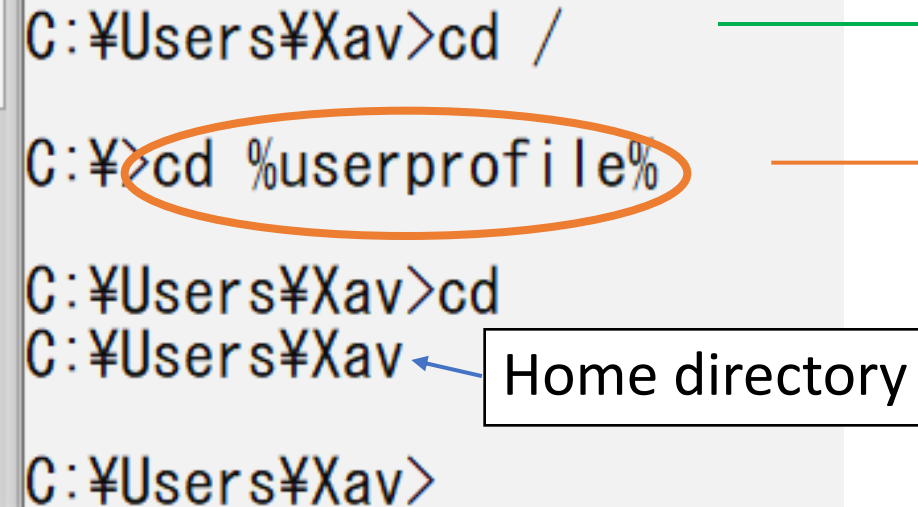
Move to the root directory

Move to home directory

Windows (10): it's longer...

cd %userprofile%

```
C:\Users\Xav>cd /  
C:\>cd %userprofile%  
C:\Users\Xav>cd  
C:\Users\Xav  
C:\Users\Xav>
```



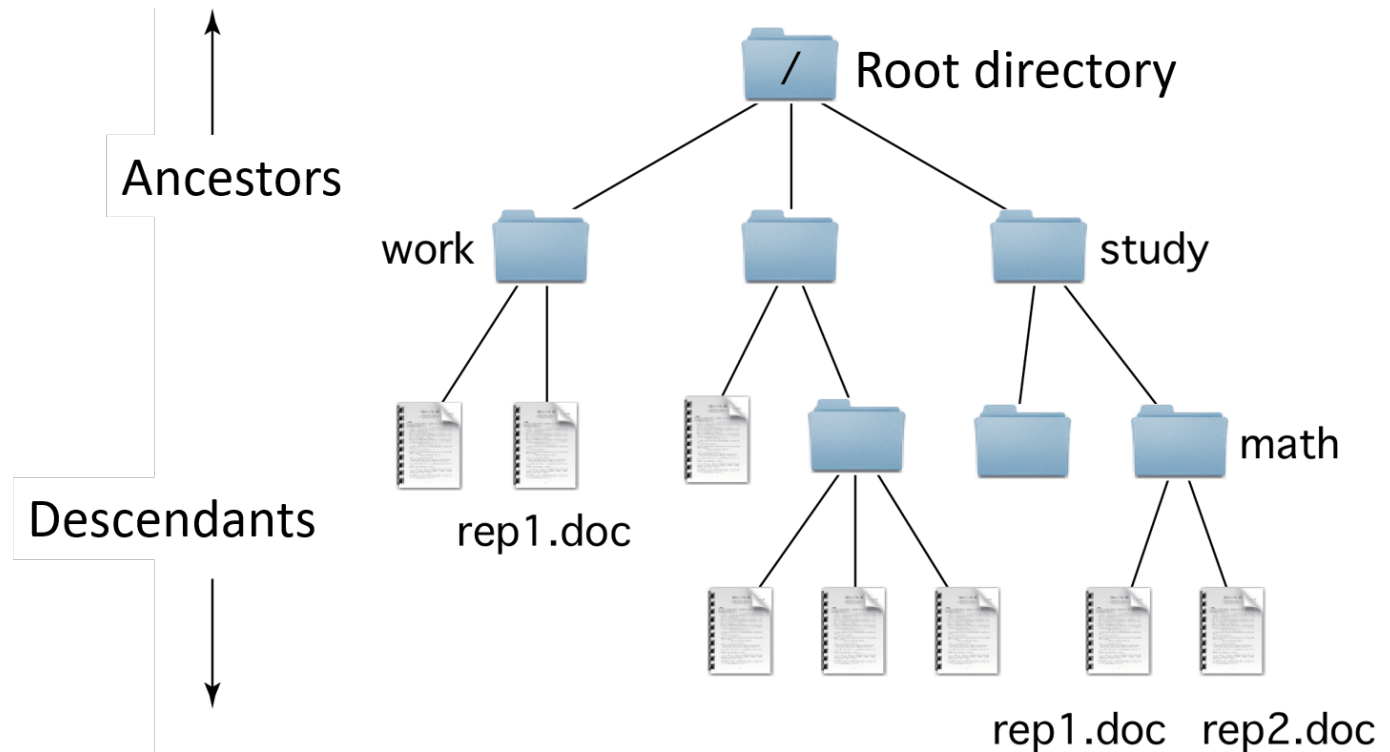
Move to root of C: disk

Move to home directory

Change directory

- **Linux and Windows:** `cd new path`
- **Parent directory:** `..` (two dots)
- **Example:** The path of `work/rep1.doc` relative to the current directory `/study/math/` is `../../work/rep1.doc`
- From `/study/math/` the path `../../..` corresponds to the root.

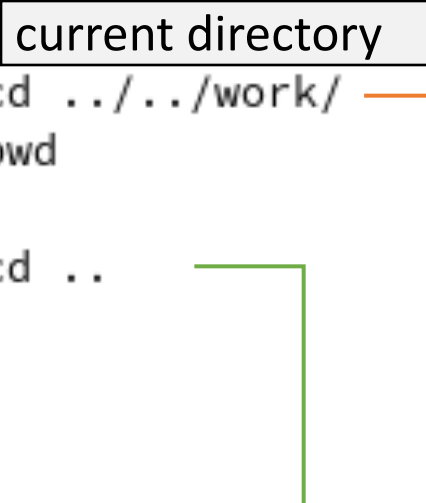
Windows: Change disk:
type the letter `d :` \



Change directory on Linux and Windows

Linux

```
[xav@localhost math]$ pwd
/study/math
[xav@localhost math]$ cd ../../work/
[xav@localhost work]$ pwd
/work
[xav@localhost work]$ cd ..
[xav@localhost /]$ pwd
/
[xav@localhost /]$
```

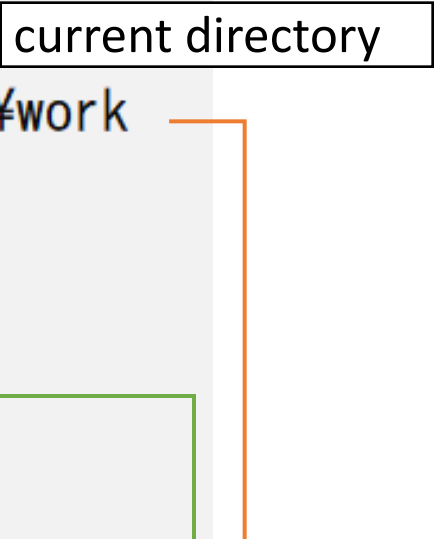


Change directory

Move to parent directory

Windows

```
C:\study\math>cd
C:\study\math
C:\study\math>cd ..\..\work
C:\work>cd
C:\work
C:\work>cd ..
C:>
```

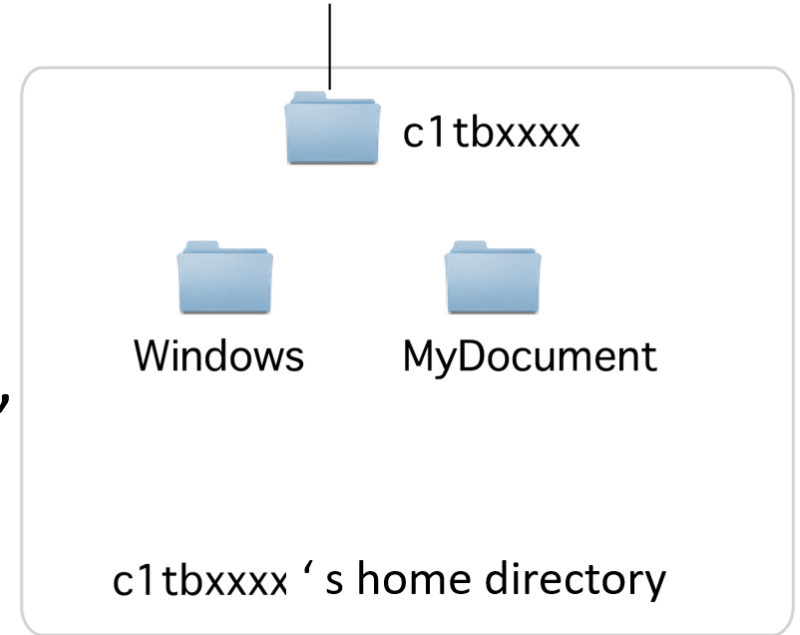


Change directory

Move to parent directory

Directory tree of the ICL lab computers

- Assume you are the user `c1tbxxxx`.
- Your home directory is created on the memory space that is allocated to you.
- Your home directory is: `c1tbxxxx`.
- It is situated under the (absolute) path `/home/users/` (directory of all users), then under a directory `c1` (all users `c1xxxxxx`) and finally under the child directory `c1tb` (all users `c1tbxxxx`).
- On your account the path is relative to `/home/users/c1/c1tb/c1tbxxxx`



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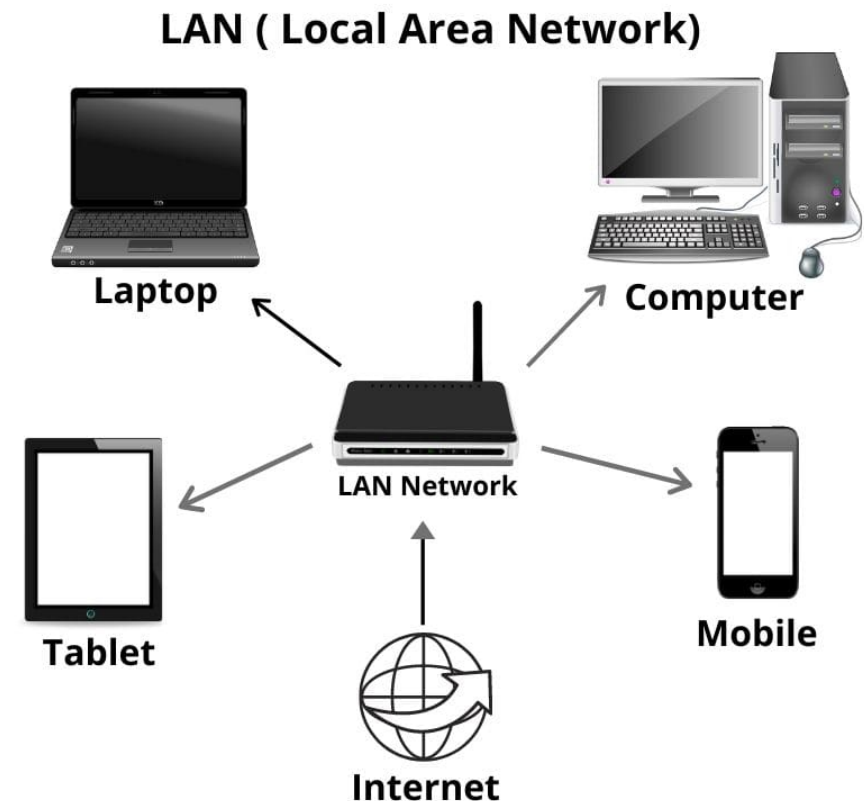
• Threat 4: Intrusion

Internet and Protocol

- **Internet:** refers to the interconnection of all networks based on a set of common protocols agreed worldwide.
- Internet allows to unify all networks into one unique huge network.

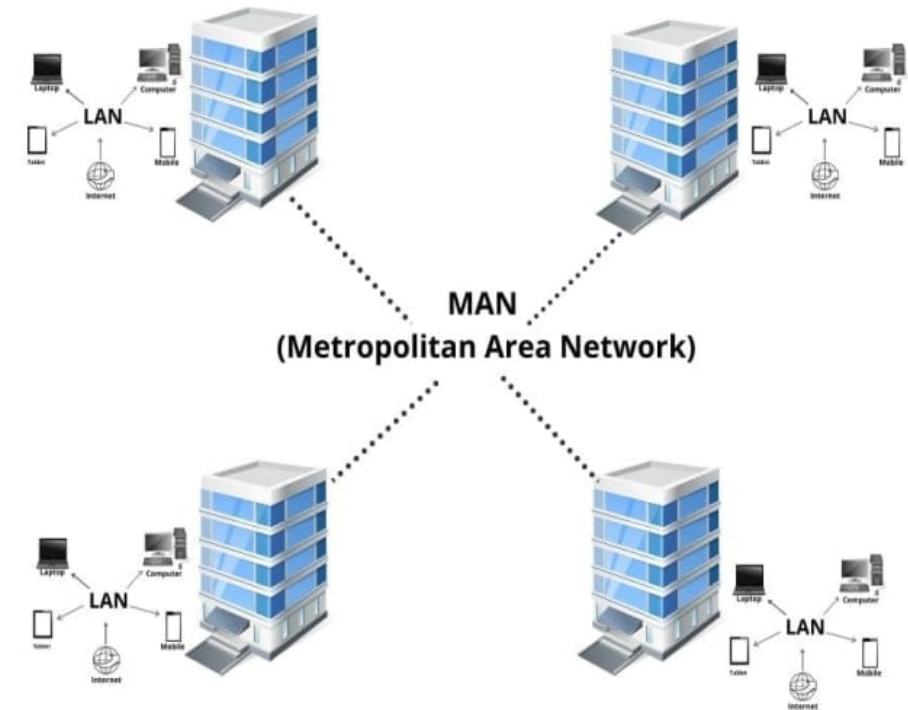
Local Area Network (LAN):

- Devices connected together inside a same place (small building or school, ..)
- Communications outside the LAN are set by the sysadmin (system administrator).



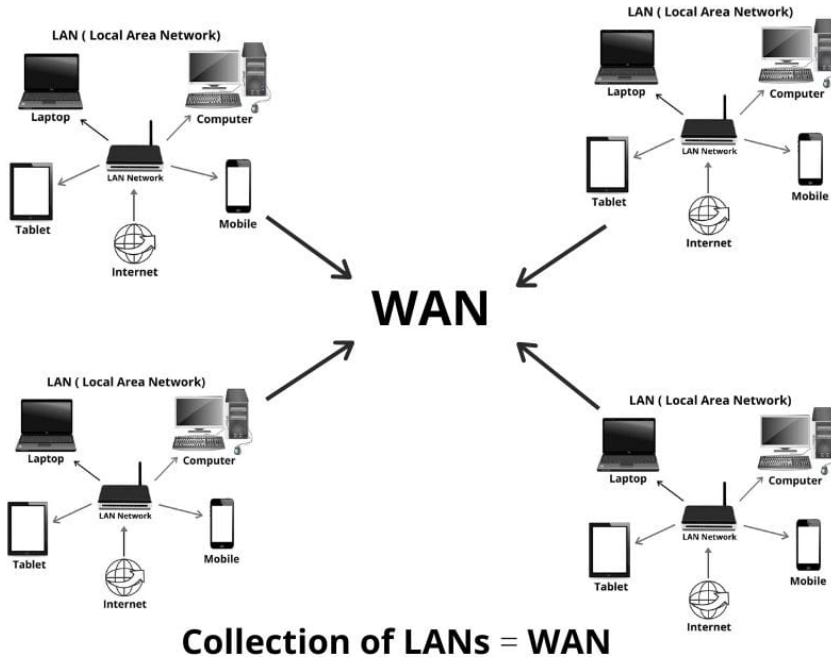
Metropolitan Area Network (MAN)

- MAN connects some related LAN subnetworks into a same big network
 - ex: all departments of a company and its local branches
 - ex: departments of a large university



Digitalworld839.com

WAN (Wide Area Network)



Digitalworld839.com

Wide Area Network (WAN):

WAN connects a collection of LAN networks over a wide area (ex: Internet)

Protocols of transmission

Protocol:

- set of rules, agreed in advance (standardised) between all parties, to send and receive data across a network.
- A LAN network can connect to a WAN network (and thus internet) through such protocols.
- The protocols include the kind of cables (ethernet cable, optical etc.) and the devices (switch, router) to be used across the networks traversed.

Packet:

- format of the data sent across the network that contains the message to be sent.
- The message is encapsulated by several layers that comply with the various protocols and devices crossed when navigating through the web.

Examples of protocols

TCP/IP: set of protocols for data transmission over the internet.

Examples of protocols contained in TCP/IP:

- SMTP (Simple Mail Transfer Protocol) : send emails
- POP (Post Office Protocol) : receive emails
- IMAP (Instant Message Access Protocol) : receive emails
- HTTP (HyperText Transfer Protocol) : webpage's data transmission
- FTP (File Transfer protocol)
-

IP addresses

- Sequence of four 8bits numbers (between 0 and 255).
- IP addresses have two parts:
 - Network address (first part, or suffix). Address of a LAN.
 - Host address (last part, or prefix). Address of a device inside the LAN.

- Subnet mask:

- Determines how many bits of the IP address make the Network address.

- Common: 255.255.255.0

The network can host around 250 IP addresses
(network address is then the first 24 bits)

- Also common: 255.255.0.0

The network can host up to 250*250 IP addresses
(network address is then the first 16 bits)

192.168.1.101

Network address

Host address

130.34.41.135

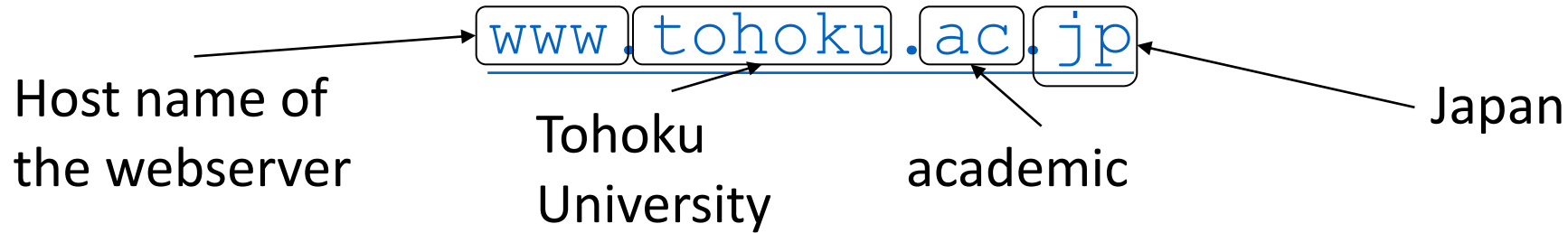
Network address
(Tohoku Univ.)

Host address
(server of
websites)

Domain and DNS

- Type http://130.34.41.135/ in the address bar of your browser.

- It directs to the homepage of Tohoku University



- IP address is not convenient to remember for human.
- `www.` denotes host name (directly followed by the **domain name**)
- Conversion (IP address ↔ domain name) is organized by the service called DNS (**Domain Name Service**)

Default subnet mask

- When you typed http://130.34.41.135/ in the address bar, no subnet mask was given.
 - How did the browser recognize the network address part from the host address part inside that IP address?
- 👉 If no subnet mask is provided, the first 8bit number determines a **default subnet mask** according to the following rule:

	first 8bits number xxxx	Default mask	Network address	Host address
Class A	$0 \leq \text{xxxx} \leq 127$	255.0.0.0	First 8 bits	Last 24bits
Class B	$128 \leq \text{xxxx} \leq 191$	255.255.0.0	First 16bits	Last 16bits
Class C	$192 \leq \text{xxxx} \leq 223$	255.255.255.0	First 24bits	Last 8 bits
D, E	<i>Not used much</i>			

Ifconfig (Linux) Ipconfig (Windows)

Linux console: ifconfig

IP address is 10.34.49.193

Subnet mask: 255.255.255.0

Network address: 10.34.49

Host address: 193

```
[xav@localhost ~]$ ifconfig
enp0s31f6: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
    inet 10.34.49.193  netmask 255.255.255.0  broadcast 10.34.49.255
    inet6 fe80::412d:46c4:6221:1075  prefixlen 64  scopeid 0x20<link>
    ether 70:85:c2:04:7a:85  txqueuelen 1000  (Ethernet)
    RX packets 153447  bytes 169092890 (161.2 MiB)
    RX errors 0  dropped 10966  overruns 0  frame 0
    TX packets 86378  bytes 9468114 (9.0 MiB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
    device interrupt 16  memory 0xdf400000-df420000
```

コマンド プロンプト

C:\Users\xav> ipconfig

Wireless LAN adapter Wi-Fi:

接続固有の DNS サフィックス	...	:	
リンクローカル IPv6 アドレス	...	:	fe80::c460:af97:9ae3:5377%5
IPv4 アドレス	...	:	192.168.0.109
サブネット マスク	...	:	255.255.255.0
デフォルト ゲートウェイ	...	:	192.168.0.1

Windows console: ipconfig

IP address is 192.168.0.109

Subnet mask: 255.255.255.0

Network address: 192.168.0

Host address: 109

(1) Common Tool

- Common Tools : Web Browser
- Common Tools : Internet
- URL
- HTTP
- HTTPS = HTTP + SSL/TLS
- Home Page and Website
- Common Tools : Email
- Using and Writing emails
- SPAM
- Common Tools : Text Editor
- Common Tools : Office Suite
- Common Tools : Console

(2) Filesystem

- Files
- Directory
- Filesystem

- Path
- Current Directory
- Home directory
- Change directory
- Directory tree of the ICL lab

(3) Network

- Internet and Protocol
- Protocols of transmission
- Examples of protocols
- IP addresses
- Domain and DNS
- Default subnet mask
- Ifconfig (Linux) Ipconfig(Windows)

(4) CyberSecurity

- Where security matters
- Security for Web Services

• Threat 1: Phishing

- countermeasure to Phishing 1:Domain Name
- Beware of URL “Homograph” attack
- countermeasure: Checking the protocol
- Countermeasure: Encryption and authentication
- Digital authentication: certificate
- Authentication on the user side
- Checking certificates with the browser
- Encryption + Authentication = safe ? Not always !
- Authentication: Reputation of a certificate

• Threat 2: Targeted Mail Attack

- Countermeasure
- Common Pattern
- “Ransom” Attack

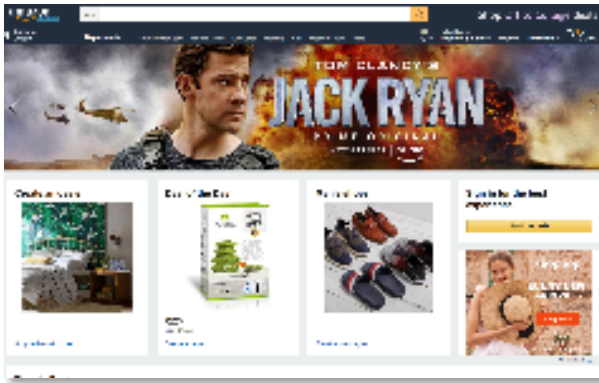
• Threat 3: malware

- Malware: How do we become infected ?
- Countermeasure to Malware Infection

• Threat 4: Intrusion

Where security matters

There are many situations of security concerns in our daily “cyberspace life.”



Online Shopping



Online Banking



Online Communication

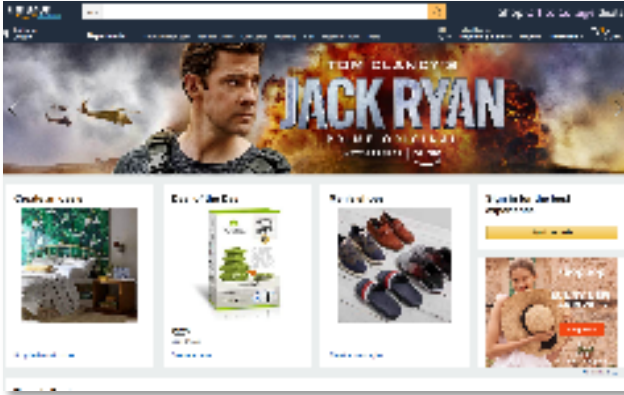


Campus Life



Cloud Services

Security for Web Services



Online Shopping



Online banking



Any potential risk?

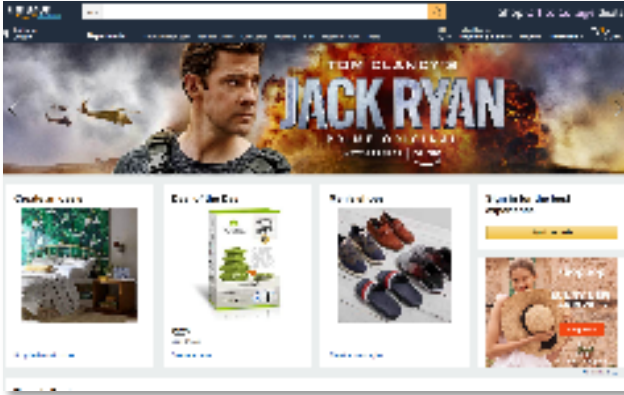
- These sites request you to send your **secret information**.
 - ★ Name, address, phone number, card number, account number



Potential Risk ① Eavesdropping

Any communication over the Internet can be eavesdropped if it is not protected by some means (e.g. encryption.)

Security for Web Services



Online Shopping



Online banking



Any potential risk?

- These sites request you to send your **secret information**.
 - ★ Name, address, phone number, card number, account number

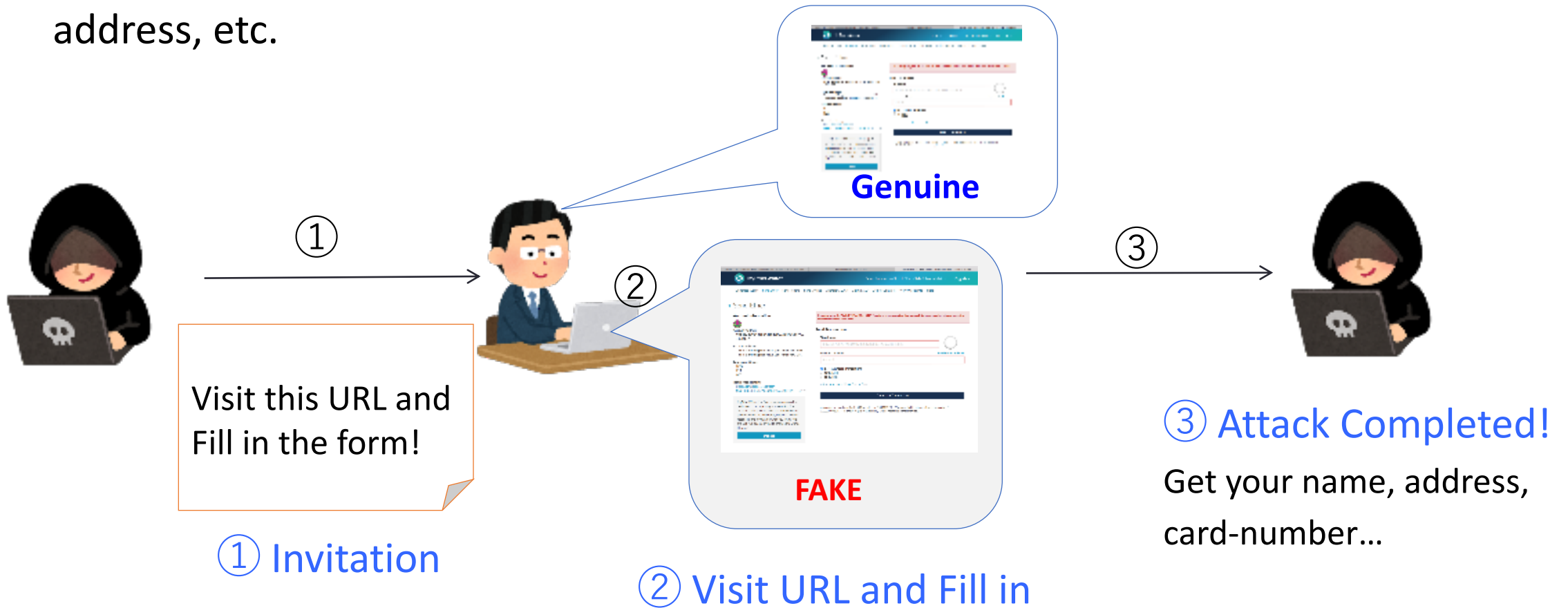


Potential Risk ② **Phishing**

What if the site is a “faked” one?

Threat 1: Phishing attack

- Invite the “victims” to a fake website.
- Let them input their personal/secret information, such as credit-card number, address, etc.



How does phishing work?

Why such an attack is possible?

- **FACT:** It is **NOT** hard (even for non-specialists) to build up a fake site which is indistinguishable from the genuine one on their appearance.
- If we weren't aware of that fact, we wouldn't expect in the first place that the website is fake.
 - ★ We wouldn't be aware of the **potential risk**.
- Concept of threats in the cyberspace is more abstract (virtual)
 - 👉 unaware users may act less carefully in the cyberspace.
 - ★ Are you always careful whenever you click on a link?

Phishing: example

Existing Example: Shinsei Bank (Japan)



Shinsei Bank login page (left). The page features a blue header with the Shinsei Bank logo and navigation links. Below the header is an orange banner with the text "新生パワーダイレクト". A red-bordered box contains a warning message in Japanese. The main content area is divided into four numbered steps: 1. Enter branch and account numbers, 2. Select security card, 3. Enter PIN, and 4. Enter password. Each step includes a text input field and a "確認" (Confirm) button. A "ログイン" (Login) button is at the bottom.

① ご注意ください

② 3桁の店番と、下記の口座番号を半角で入力してください。

③ セキュリティーカードを選択する

④ パワーダイレクトパスワード

ログイン



Shinsei Bank login page (right). The page features a blue header with the Shinsei Bank logo and navigation links. Below the header is an orange banner with the text "新生パワーダイレクト". A red-bordered box contains a warning message in Japanese. The main content area is divided into four numbered steps: 1. Enter branch and account numbers, 2. Select security card, 3. Enter PIN, and 4. Enter password. Each step includes a text input field and a "確認" (Confirm) button. A "ログイン" (Login) button is at the bottom.

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④ パワーダイレクトパスワード

ログイン

Which is the genuine one?

It is almost impossible to distinguish their appearance.

countermeasure to Phishing 1: Domain Name

Genuine URL of ISTU

`https://istu3g.dc.tohoku.ac.jp/istu3g/auth/login`

↑ Protocol ↑ Tohoku Univ's Domain { Folder Names and Paths in the server }

URL of a (Possibly) Fake Site

`https://hoge hoge.ne.jp/tohoku/istu3g/login`

↖ **NOT** Tohoku Univ's Domain

↑ ↑
These are merely folder names. Anyone can claim "tohoku" and "istu3g" identities here.

Beware of URL “Homograph” attack

- Checking the URL is a good start but...
- ...there are tricks for faking URLs.
- Several letters in the URL are replaced with different ones, but they look almost the same.
- It is hard to distinguish the faked URL from the genuine one.

www.apple.com → www.appie.com
www.apple.com
www.apple.com ← *hard to find a fake*

countermeasure to Phishing 2: Checking the protocol

- Sensitive data shall be encrypted: **HTTPS** protocol see [this](#) slide)

Key Features of HTTPS

- ***Encryption***: prevent eavesdropping
- ***Certificates Verification (digital authentication)***: verify the validity of the server's identification.

Why “encryption” is needed?

- Any communication over the Internet is exposed to the risk of **being eavesdropped** if no countermeasure is implemented

countermeasure to Phishing 2: Checking the protocol

If the website requests us to input secret information such as ID/PW but does not implement the **HTTPS** protocol, it may be a fake one, or simply insecure.



Is encryption sufficient? The answer is “NO.”

Phishing countermeasure 3: Encryption and authentication

Why is encryption not sufficient ?

- ① The server you are now connecting to is **NOT** necessarily the genuine one.
- ② Even malicious attackers can establish an HTTPS channel with you.

The second countermeasure: authenticate the host of the webpage

Besides encryption, HTTPS implements a layer of digital authentication.

If the authentication succeeds, one can be convinced that it is the “genuine” server *with high (but not total) confidence*.

Principle of digital authentication: certificate

The server hosting the website asks for a **certificate** to an authority:



Service Provider

① Request to issue certificate



Certificate Authority (CA)

- ② Examine the request
- ③ Generate the certificate

④ Issue the certificate



⑤ Install the certificate on the server.

Principle of digital authentication: Certificate issuance

Certificate



- Issued by a **Certificate Authority (CA)** , carries its signature
 - The CA generates this **digital signature** by using its “**secret signing key**.”
 - This **digital signature** is **uniquely attributed** to the document (here a website) to be signed.
 - Without this secret key, it is **infeasible** to forge a valid signature.

Crucial Premise ①: *Only the CA can generate a valid signature.*

Crucial Premise ②: *The operation of authentication can be done **by anyone** with the “**verification public key**” uniquely associated to the **secret signing key**.*

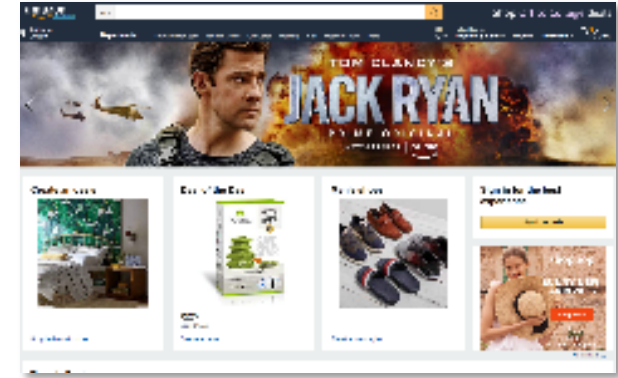
These premises can, to some great extent, be realized by “**Public-Key Cryptography**.”

Authentication on the user side



User

① Request for connection



Website

③ Verify the signature
of the certificate

② Present the attributed certificate



Signed with the CA's
Secret signing key

Use the “**public verification key**”, which
is built in major web browsers

Checking certificates with the browser

🔒 https://istu3g.dc.tohoku.ac.jp/istu3g/auth/login 133%

学インターネットスクール
School of Tohoku University

ID	<input type="text"/>	?
Password	<input type="password"/>	

Login

教員・TA 向け
ISTU チュートリアル
ISTU tutorial for teacher and teaching assistant

東北大学生のための
教育系情報システムオンラインガイド
Online Guide: Systems & Services for Students in Tohoku University

本システムは、8月末で停止予定です。新しいISTUについては、[こちら](#)をご覧ください。

オンライン授業の情報を[こちら](#)にまとめましたのでご覧ください。

Encryption + Authentication = safe ? Not always

Problem: *What if the CA is not trustworthy?*

FACT: Establishing a CA can be done by anyone, even by the malicious attackers (if they make some effort.)



A “valid” certificate is insufficient, because it may be issued by untrusted (or even malicious) CA or be “self-signed.”

It is risky to accept such “self-signed signatures.”

Authentication Reputation of a certificate

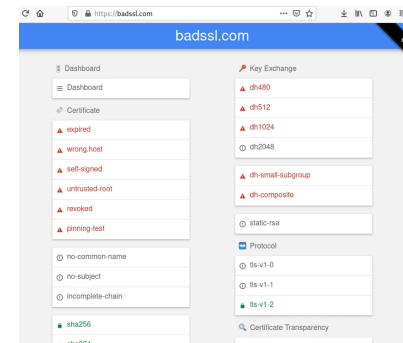
Problem: *What if the CA is not trustworthy?*

A Simple Countermeasure:

We accept those CAs which have been **socially** acknowledged as trustworthy authorities : builds a reputation.

The current major browsers show the warning when they detect the certificates issued by *untrusted* or *unknown* CAs.

Example: `badssl.com` hosts (on purpose) sites with invalid CA. Let's examine how **firefox** reacts when a connection is attempted.



Threats on the network 2:

Targeted Mail Attack



- ① Defining the target
e.g. students in Tohoku Univ.



- ② Send “invitation” mails.
disguising authentic ones
“Oh, it’s from my teacher.”

- ③ Click on the URL (to the hell)
and send secret data



- ④ Attack completed
Your secret has been handed
to the attacker!

宛先: alexander@dc.tohoku.ac.jp ▾

Cc:

Bcc:

返信先:

件名: About your term-paper

差出人: Shuji ISOBE – s-isobe@m.tohoku.ac.jp

Dear alexander

I have evaluated that your term-paper should be more refined and be re-submitted.
Follow the instruction below and re-submit your term-paper.
The deadline is Nov. 10.

Shuji ISOBE
Center for Information Technology in Education

Instruction for re-submission:

1. Visit the following website:
<http://www.math.tohoku-u.ac.jp/Isobe/info-B/submission-form.html>
2. Login with your ID and PW.
3. Follow the instruction on the screen.

existing address

look suspicious

Invitation to the hell

Targeted Mail Attack (with attachment)



- ① Defining the target
e.g. students in Tohoku Univ.



- ② Send “invitation” mails.



- ③ Open the attachment.



Malicious program infection
(but hard to be aware of)



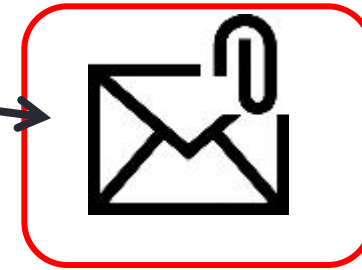
- ④ Attack completes and goes on

...



From: yourteacher@tohoku.ac.jp
Subj: Assignment report

Hey! It's your assignment.
Read the attachment zip file for
the detail.



Targeted Mail Attack

Is it a kind of “SPAM”?

The targeted attack is not the same as the simple spams.

attacker



- Target the “victim” specifically
- Persistent, specific purpose
- Advanced, and carefully designed and prepared tricks

target



- Tend to accept “invitations” more easily.
 - ✦ They disguise themselves as trustworthy messages.
- Hard to detect (even by “antivirus”)

The targeted attack is not like indiscriminate SPAM. They have specific purpose and target.

Countermeasure 1

Point ① Is “FROM” trustworthy?

The “FROM” header can be forged.



Even if “FROM” claims “tohoku.ac.jp” domain, it might come from any other domain.

The sender’s account might have been hijacked



The “real” attacker scatters the invitations from the “hijacked” account.

“FROM” is not necessarily trustworthy.

宛先: alexander@dc.tohoku.ac.jp ▾

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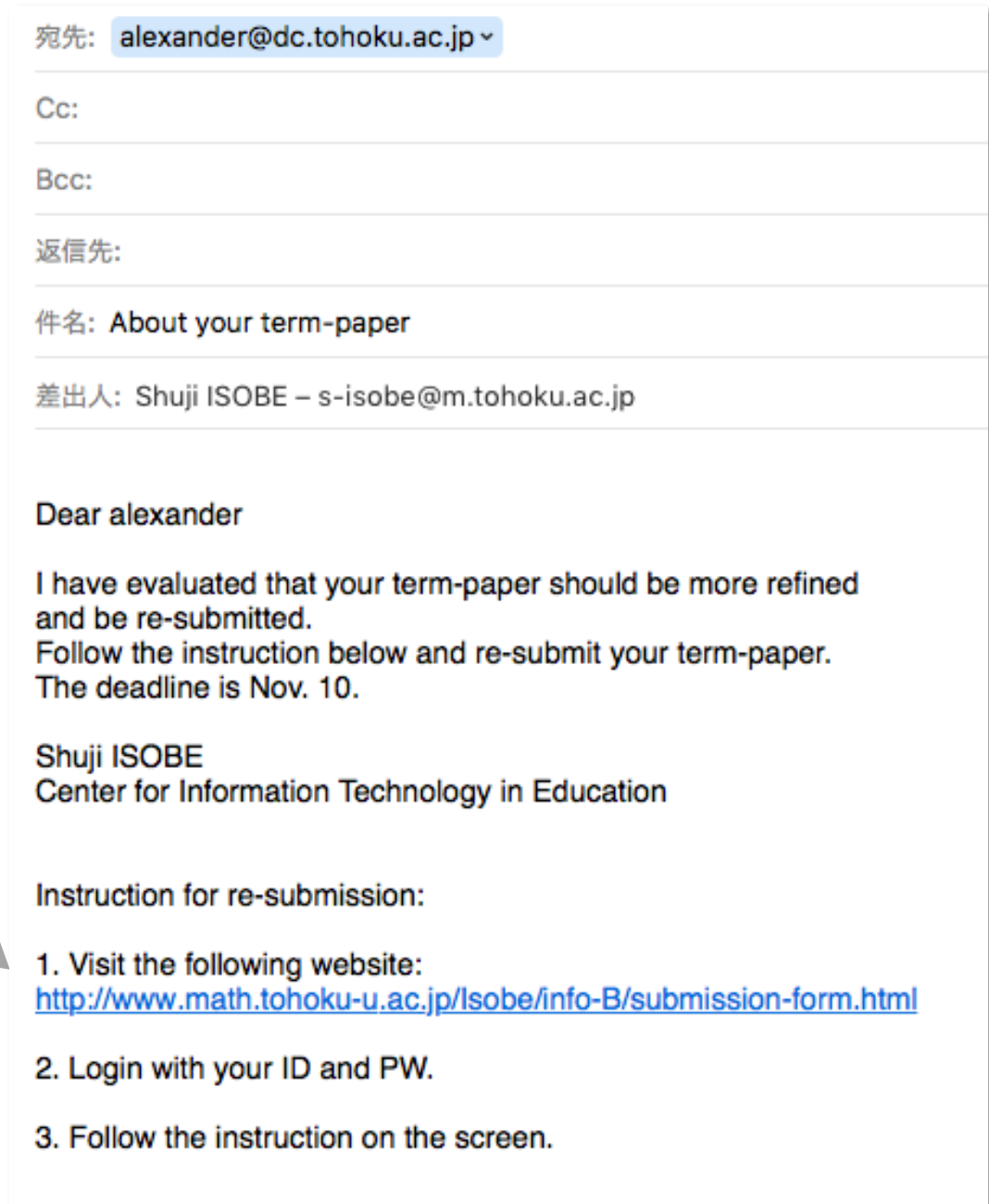
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2. Login with your ID and PW.
3. Follow the instruction on the screen.

Countermeasure 2

Point ② Examine the contents

Is there anything unnatural?

- Language usage
- Message itself sounds strange
- suspicious URL (why not “tohoku.ac.jp” domain? Why not ISTU?)
- suspicious attachment (if exists)



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2. Login with your ID and PW.
3. Follow the instruction on the screen.

Arrows from the list on the left point to: 'Language usage' points to the email body text; 'Message itself sounds strange' points to the email body text; 'suspicious URL (why not “tohoku.ac.jp” domain? Why not ISTU?)' points to the URL in the instructions; 'suspicious attachment (if exists)' points to the email body text.

Countermeasure 3

Point ③ Verify signatures

Many socially-trusted organizations sends to the customers emails with **signatures (certificates)**.

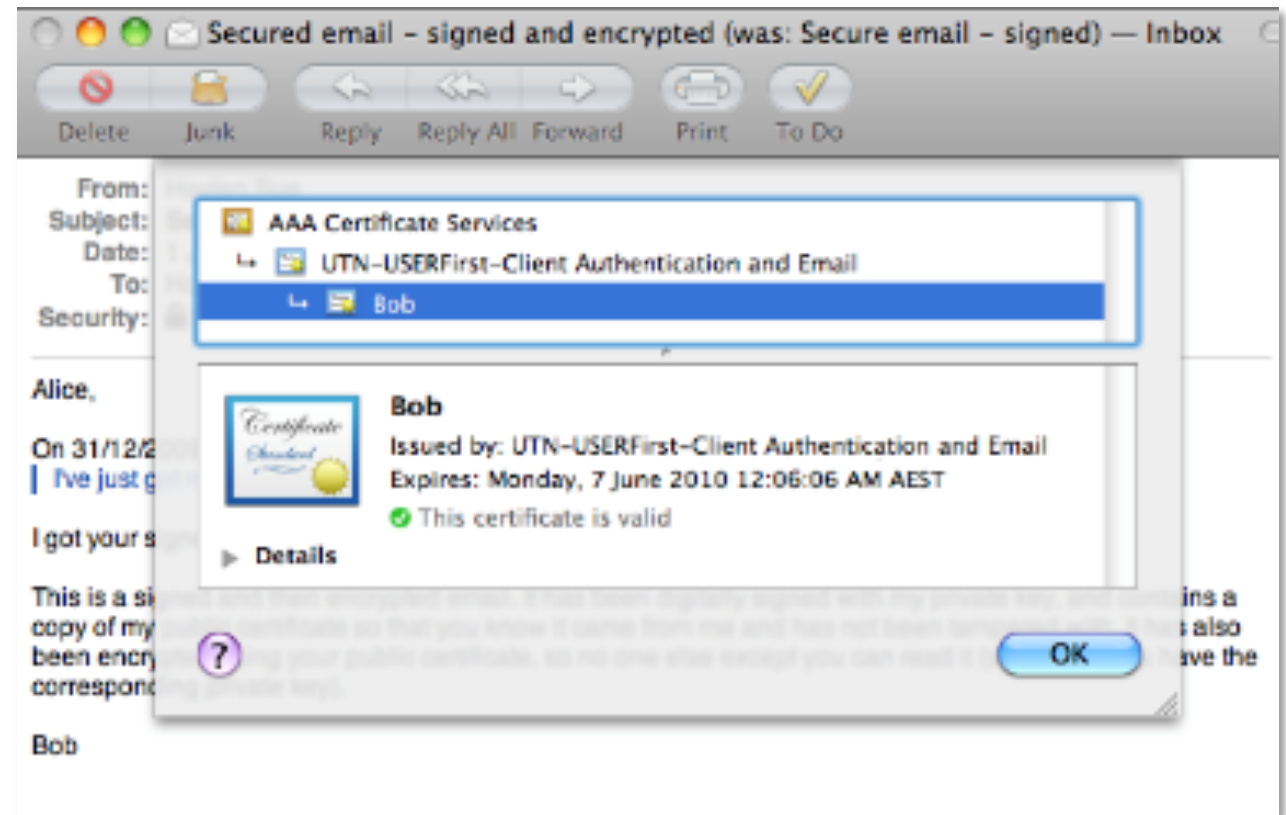


One can verify the signatures, as in the case of HTTPS communication.

(Repeat)

Be careful of “self-signed signatures” and “untrusted CA’s signatures.”

If no signature is attached, it may be worth suspecting it.



Common pattern of Targeted Mail Attack

Typical “Invitations”

- Your SNS accounts (or other accounts, such as net bank, Tohokudai-ID, Apple ID etc.) were hijacked (or locked). Please visit the following website and update your password.
- A suspicious behavior has been detected on your account. Please visit ...
- We improve the security of the online banking system. Visit the following link ...
- Our service suffered from information leakage incident lately. Please visit ...

Be careful, especially if the “invitation” includes

- ***request for visiting unknown or suspicious hyperlinks***
- ***request for typing passwords or secret codes***

“Ransom” Attack

Overview of the attack

- ① Your PC is infected with a malware.
- ② The malware “locks” your PC, for example, by locking the screen or encrypting the folders of your computer.

➡ You can no longer operate your PC unless it is unlocked.

- ③ The malware (attacker) requires you to pay a “ransom” in order to “unlock” your PC.



A ransomware “WannaCry”
is now scaring you!

Threats on the network 3: malware

Malware (malicious software)

- Causes damage to data (destruction or corruption) and systems
- Gains unauthorized access to network or secret data
- **Virus:** piece of malicious code that attaches to a clean (often executable) code in the system. When a user executes the program, it damages core functionalities of the system etc.
- **Worms:** Starts from one machine, spreads over the network.
- **Spyware:** Program hiding in the background that spies the computer. Collect information about the user.
- **Trojans:** (reference to Greek soldiers hidden in a giant horse) hides inside or disguises itself as a legitimate software. Creates backdoors in the system to give other malware easy access to the system.
- **Ransomware:** blocks the network/system unless a ransom is paid.

Malware: How do we become infected ?

① Visiting “infected” websites.



- tampering the website
- embedding the malware's code

- A single browsing can cause infection.

Even “legitimate” sites may be affected.

How can we prevent??



Malware: How do we become infected ?

② Downloading/Executing

- Visit some websites (e.g. invited by some email.)
- Click some link to download some file
- Open the file, or executing the program

Infection!



- You are convinced that these programs are innocent, or even useful/necessary.
- Those malicious programs may even disguise themselves as “security tools.”

(fake security tools)



a “fake” security tool

Malware: How do we become infected ?

③ Other possible infection routes

- Open the files attached to some email
 - ➡ automatic opening is risky
- Insert (infected) USB devices or other removable media, and copy files
 - ➡ off-line infection
- File sharing services
 - Even small number of infected files may cause severe damage.
- Macros
 - e.g. Macros built in the office-suite files may behave as malware.

Countermeasure to Malware Infection

- **(Repeat)** There is *no* perfect countermeasure.
 - But, there are some *basic* countermeasures to take.
- ① DO NOT download or execute unexamined files.
 - ② Before opening the attachment files of emails, ask yourself whether or not the files are trustworthy.
 - ③ DO NOT leave the security holes unfixed.
 - ➡ apply the “security patch” programs released by the *trusted vender*.
 - ④ Use security suites such as “antivirus” or software firewalls.
 - ➡ e.g. detection of various malwares, monitoring communication

Threats 4: Intrusion

- Password or ID leakage (vulnerable password: dictionary attack)
- Breach in the network architecture.
 - Example: Scan ports attack. A port is an address of a service within a system (\neq IP address \rightarrow address within the network).
The attack scans all ports and find open ports.
Try to find breaches, weakens guarding services to open doors
- Vulnerability in the implementation of a security service:
 - Example: buffer overflow. The place where a program writes data when still in execution is called a buffer. It has limited size. If the overflow is not planned in the implementation, malware can take advantage of an overflow.

(1) Common Tool

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- HTTPS = HTTP + SSL/TLS
- Home Page and Website
- Common Tools : Email
- Using and Writing emails
- SPAM
- Common Tools : Text Editor
- Common Tools : Office Suite
- Common Tools : Console

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- Directory
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• Threat 2: Targeted Mail Attack

- Countermeasure
- Common Pattern
- “Ransom” Attack

• Threat 3: malware

- Malware: How do we become infected ?
- Countermeasure to Malware Infection

• Threat 4: Intrusion

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- Internet
- URL (Uniform Resource Locator)
- HTTP
- HTTPS = HTTP + SSL/TLS
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- Targeted Attacks mail

- Text Editor
- Office Suite
- Console

Filesystem (20-25)

- Files
- Directory
- Filesystem
- Path
- Current directory, home directory
- Directory tree of the ICL lab computers

Network (26-37)

- Internet and Protocol
- Protocols of transmission
- Examples of protocols
- IP addresses
- Domain and DNS
- Default subnet mask
- Ifconfig (Linux) Ipconfig (Windows)
- Threats on the network 1: malware
- Threats 2: Intrusion
- Threats 3: Phishing websites

Targeted Attacks mail

- Unlike SPAM, some emails you receive may look legitimate regarding the institution to which belongs the email address.
- Example: you are student at Tohoku University.
You receive an email that looks like “From Administration” or from another student and say “Important Matters”.
For some reasons, it asks for some personal data.
Or it has a file attached , and asks you to open it for more details.
- These attacks are more clever than SPAM and can be particularly vicious.

Threats 3: Phishing websites

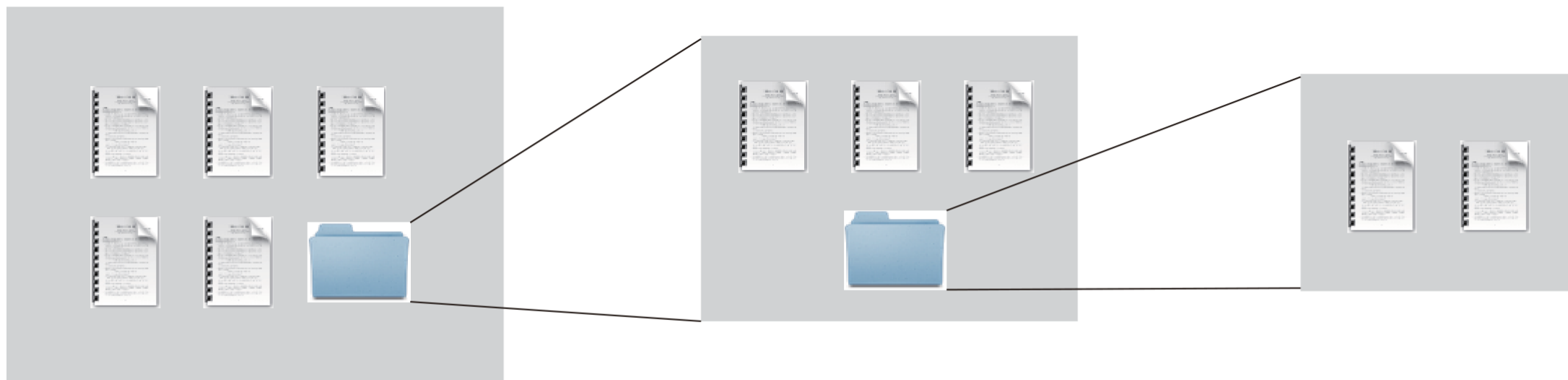
- False website that imitates famous websites (banks etc.)
- Users get confused and believe it is the authentic website.
 - ☞ they may give personal information (credit card number etc.)
 - ☞ these data are collected mostly for malicious purposes.
- An invitation to a phishing website is often sent through a “phishing email”, which also imitates an email from a famous institution.
This email contains links to a phishing website.
- (web) Scam: emails that try to connect you through human sensibility
(ex: promises friendship from an attractive person
ex: takes advantage of the loneliness of elderly persons etc.)

How does malware spread ?

- Fraudulent email attachments. Or by clicking on a link in such an email.
- Delivered via instant messaging or social media
- Find a breach in a vulnerable software implementation. Etc.

Protection against malware.

- On the individual level:
 - 👉 First of all, be aware of threats.
 - 👉 Beware of weird emails, untrusted invitations on social media etc.
 - 👉 Perform regular updates of software (correction of breaches)
- Computer level
 - 👉 Install an antivirus (target not only viruses. Contains a catalogue of reported malware for inspection, and eventually destruction).
Necessary but only protect against known and reported malware.



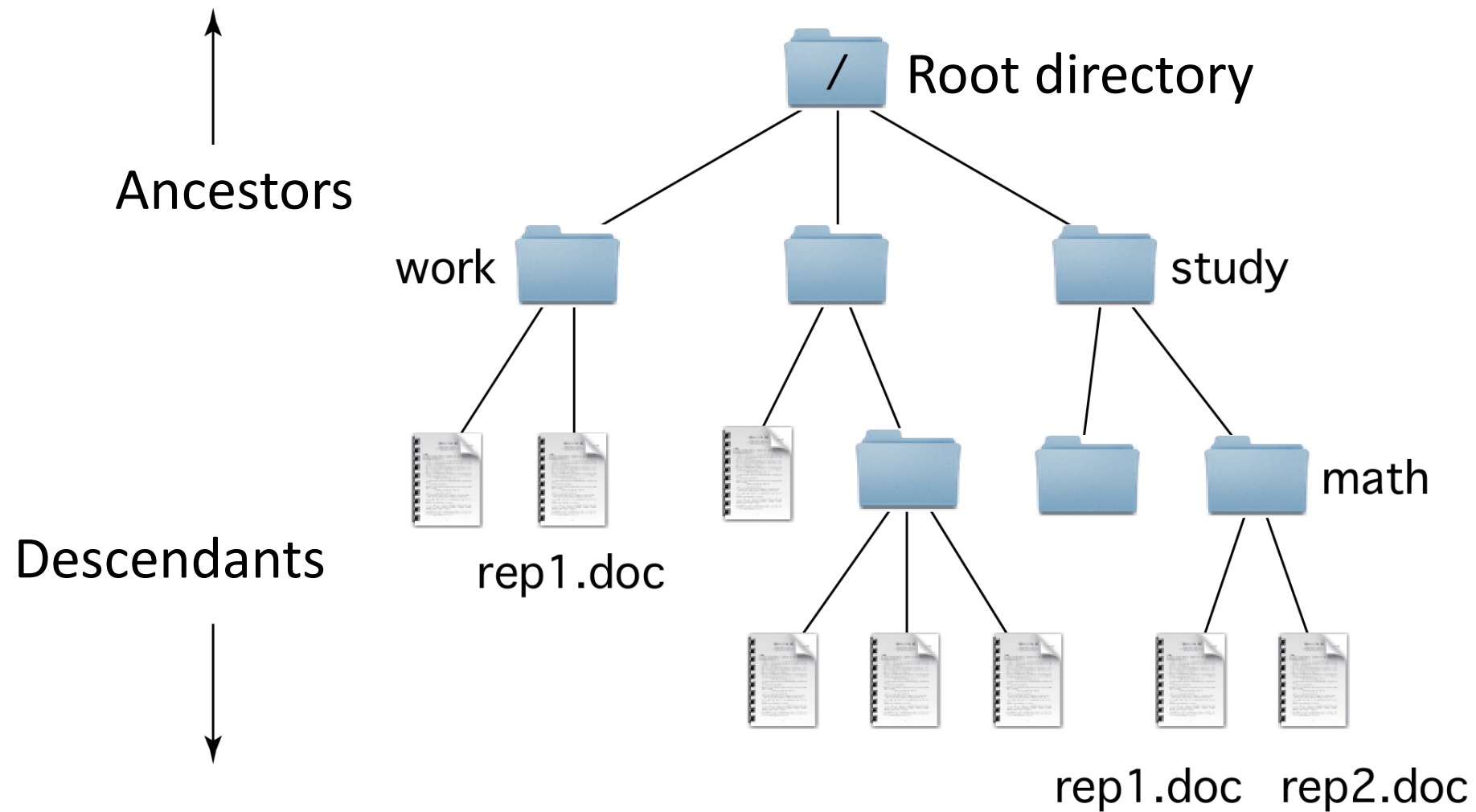
Directory A

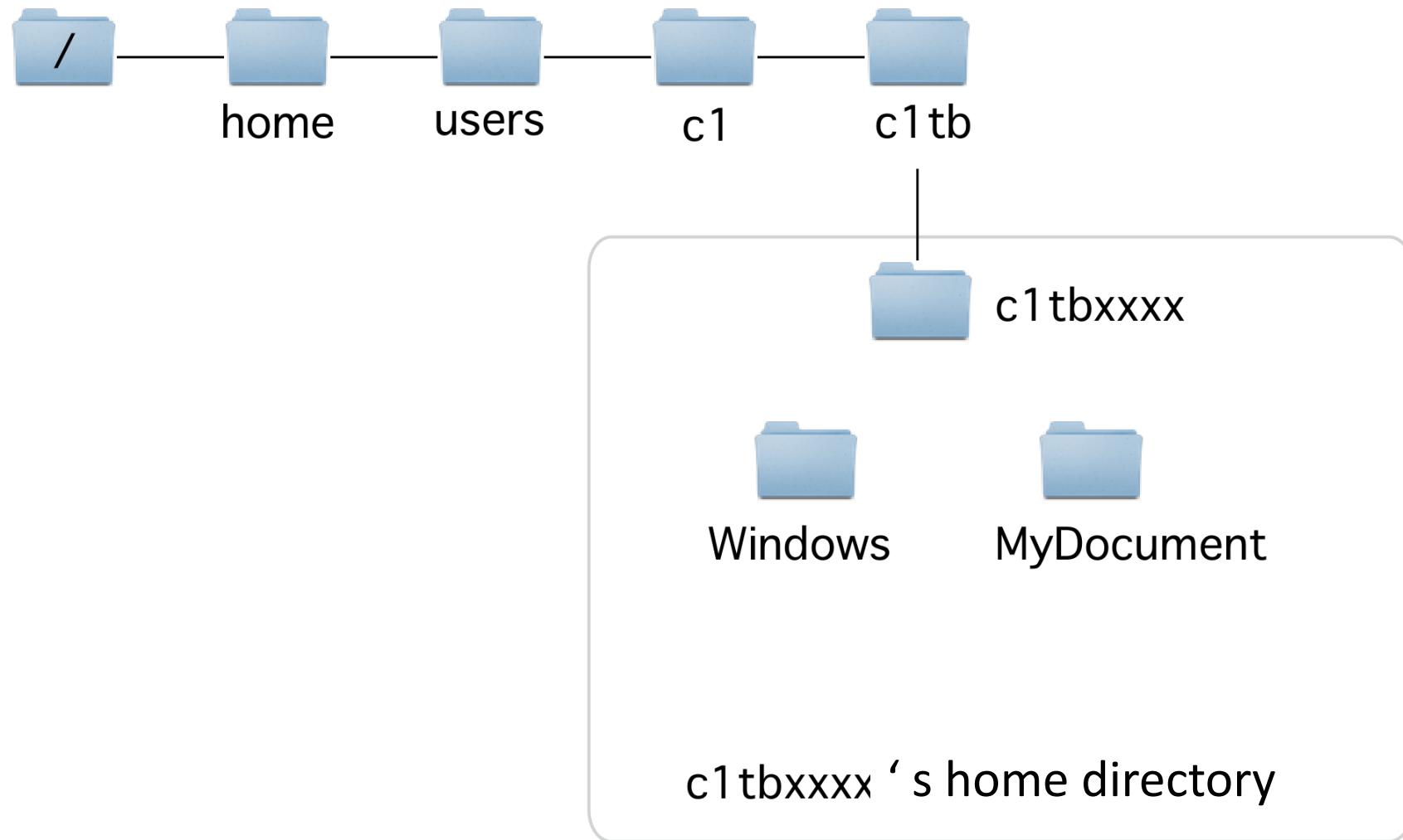
Parent

Directory B

Parent

Directory C





File Manager

- GUI to manipulate files (Windows: Explorer).