

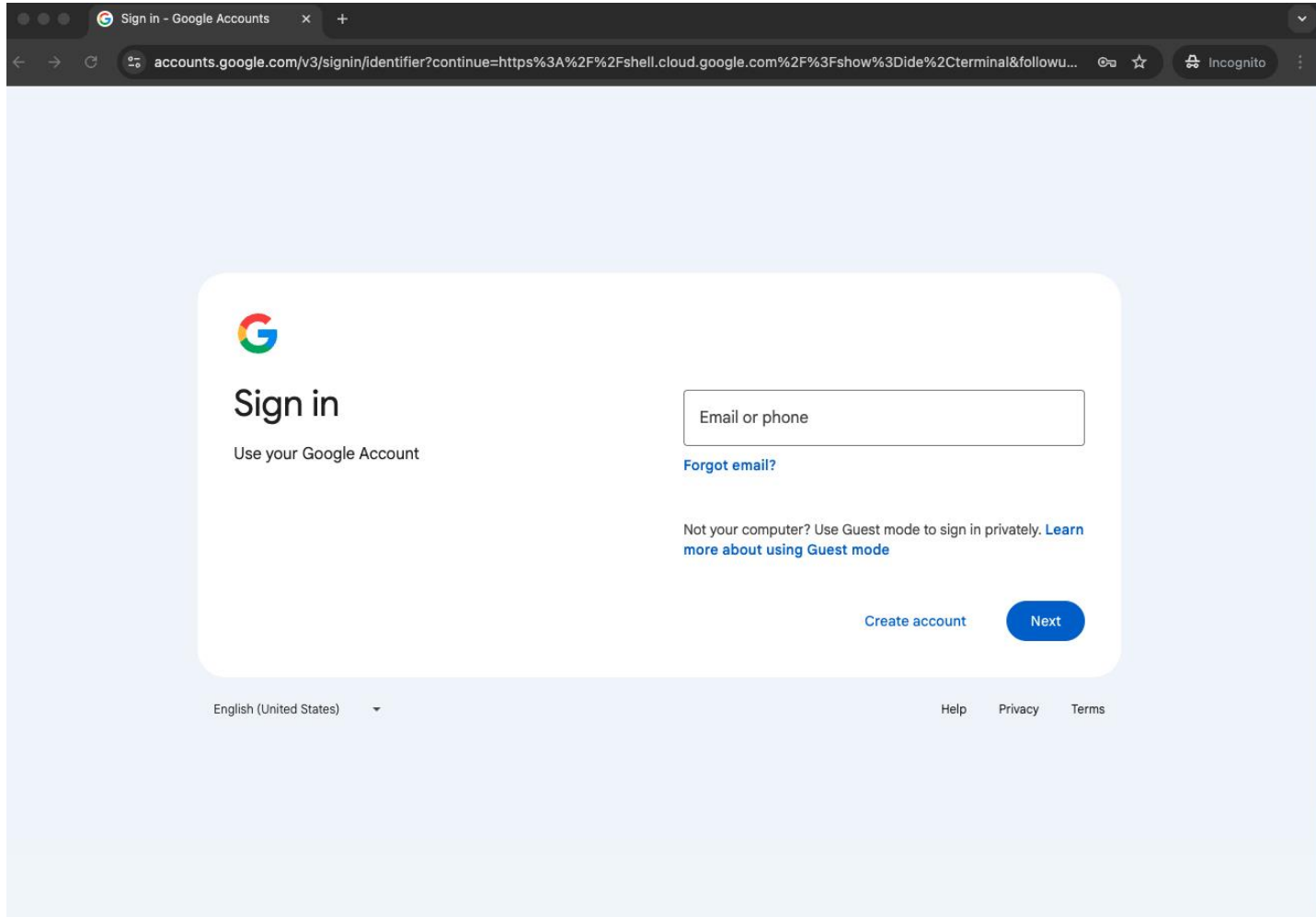
Sommersemester 2025

Vertiefte Bestimmungsübungen an Tieren (MEES003/C3)

Environmental DNA (eDNA) Metabarcoding analysis

Day 0

Go to <https://shell.cloud.google.com/?show=ide%2Cterminal>



Sign in if you have an account

If you don't want to create an account, set up the environment on your PC (see Day 0.md [Optional]).

The following cloud shell will appear:

The screenshot shows a web browser window with the address bar displaying `shell.cloud.google.com/?show=ide%2Cterminal`. The browser is in Incognito mode. The main interface is the Cloud Shell Editor, which includes a sidebar with an Explorer view showing a file tree for a user named SHUMPEI_YAMAKAWA. The tree contains directories like `ncbi-blast-2.16.0+`, `New_directory1`, `R`, `test`, and `test2`, along with a file `README-cloudshell.txt`. The main editor area displays a 'Welcome' message and a 'Get Started with Code OSS for the Web' tutorial. A sidebar on the right features a 'Welcome to Gemini Code Assist' message. At the bottom, a terminal window shows the Cloud Shell welcome message and the prompt `shumpei_yamakawa@cloudshell:~$`.

Cloud Shell

shell.cloud.google.com/?show=ide%2Cterminal

Cloud Shell Editor

File Edit Selection View Go Run ...

shumpei_yamakawa

EXPLORER

SHUMPEI_YAMAKAWA

- > ncbi-blast-2.16.0+
- > New_directory1
- > R
- > test
- > test2
- ≡ README-cloudshell.txt

OUTLINE

TIMELINE

Welcome

Get Started with Code OSS for the Web

Customize your editor, learn the basics, and start coding

☐ Just the right amount of UI

The full menu bar is available in the dropdown menu to make room for

Welcome to Gemini Code Assist

Supercharge your workflow with AI-

Layout: U.S.

cloudshell

```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
shumpei_yamakawa@cloudshell:~$
```

The following cloud shell will appear:

Cloud Shell

shell.cloud.google.com/?show=ide%2Cterminal

Cloud Shell Editor

File Edit Selection View Go Run ...

EXPLORER

SHUMPEI_YAMAKAWA

- > ncbi-blast-2.16.0+
- > New_directory1
- > R
- > test
- > test2
- ≡ README-cloudshell.txt

OUTLINE

TIMELINE

Cloud Code - No Project

Enter your commands to install the software!

Welcome to Gemini Code Assist

Supercharge your workflow with AI-Layout: U.S.

```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
shumpei_yamakawa@cloudshell:~$
```

Copy and paste the commands from Day0.md.

The screenshot shows a GitHub repository page for `FSUJENA_2025_species_determination`. The file `Day0.md` is selected in the left sidebar. The main content area shows the file's preview, which is highlighted with an orange border. The content includes instructions for installing software, creating a working directory, and running BLAST and seqkit.

Installing the software

The following software is required for the analysis. Mainly, you can just copy and paste them in your terminal and see if they are working. You need to change the directory path according to your location.

****0. Opening**

1. Creating the working directory and moving to there

```
mkdir test_meta
cd test_meta
```

2. blast

See also <https://www.ncbi.nlm.nih.gov/books/NBK569861/>

```
wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
tar -xvzf ncbi-blast-2.16.0+-x64-linux.tar.gz
cd ncbi-blast-2.16.0+/bin
pwd
#Copy the displayed path!!
echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc
#Paste the path you copied to **YOUR PATH**!!

blastp -h
#If you see the description about Blast Search, then the installation worked.
```

3. seqkit

1. Creating the working directory and moving to there

```
mkdir test_meta  
cd test_meta
```



Type “mkdir test_meta”

```
Welcome to Cloud Shell! Type "help" to get started.  
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.  
You can view your projects by running `gcloud projects list`.  
shumpei_yamakawa@cloudshell:~$ mkdir test_meta
```

+ enter

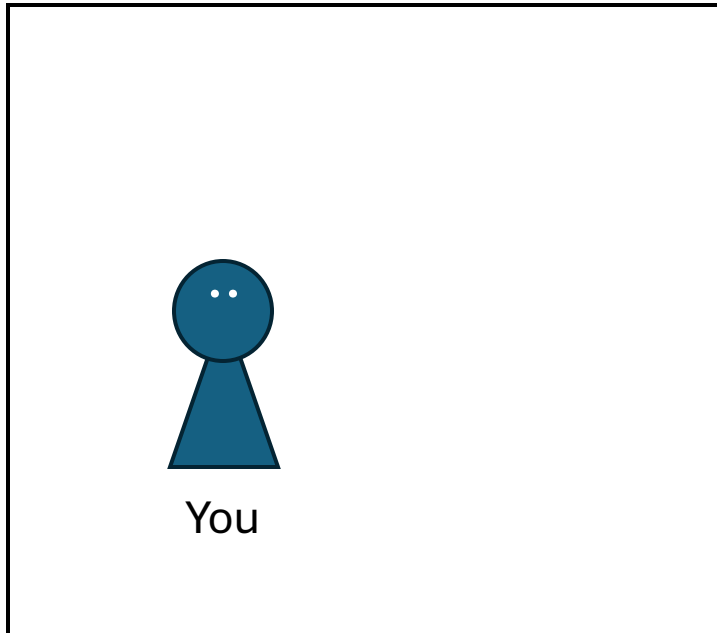
```
Welcome to Cloud Shell! Type "help" to get started.  
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.  
You can view your projects by running `gcloud projects list`.  
shumpei_yamakawa@cloudshell:~$ mkdir test_meta  
shumpei_yamakawa@cloudshell:~$
```

Type “cd test_meta” + enter

```
shumpei_yamakawa@cloudshell:~$ cd test_meta/  
shumpei_yamakawa@cloudshell:~/test_meta$
```

What you did...

Home directory

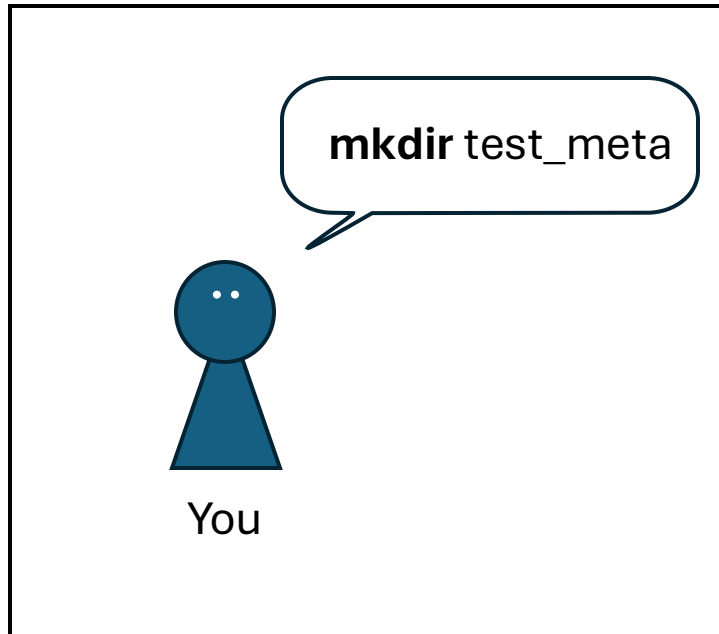


First, you are at “home directory”

(If you want to know the current your location/path, type “pwd”)

What you did...

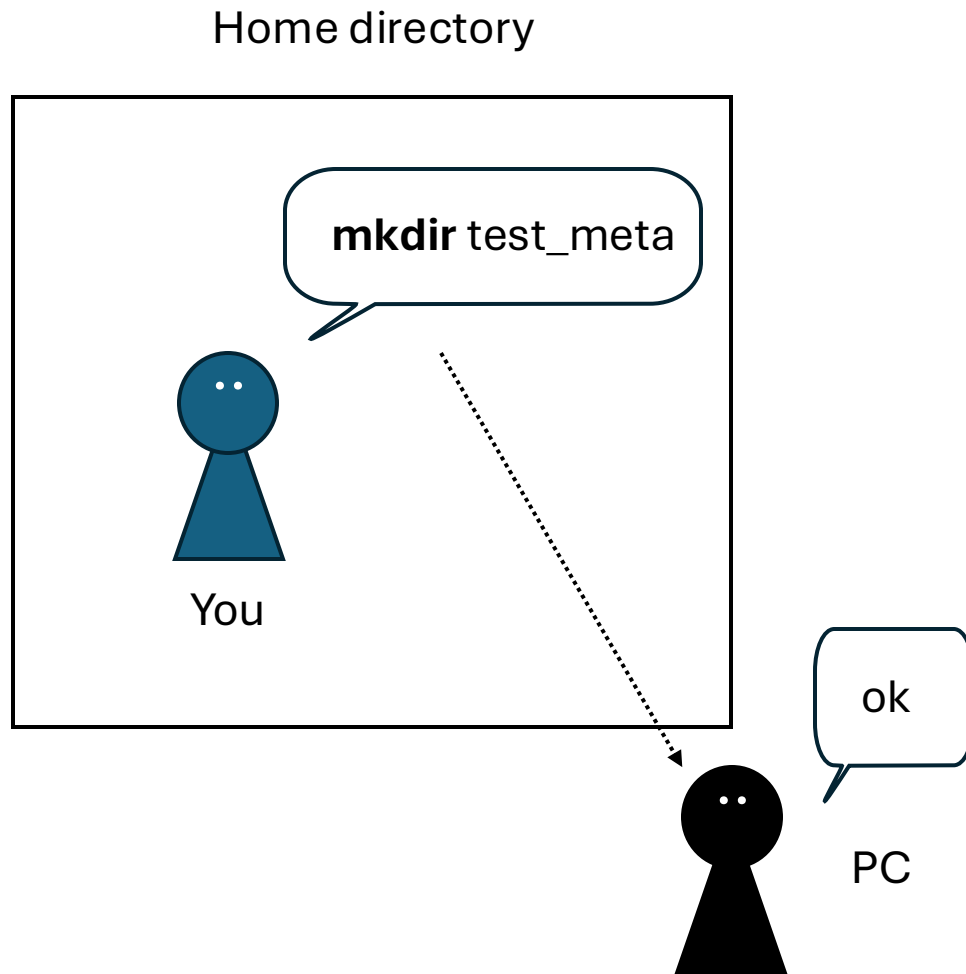
Home directory



Then, you typed “mkdir test_meta”

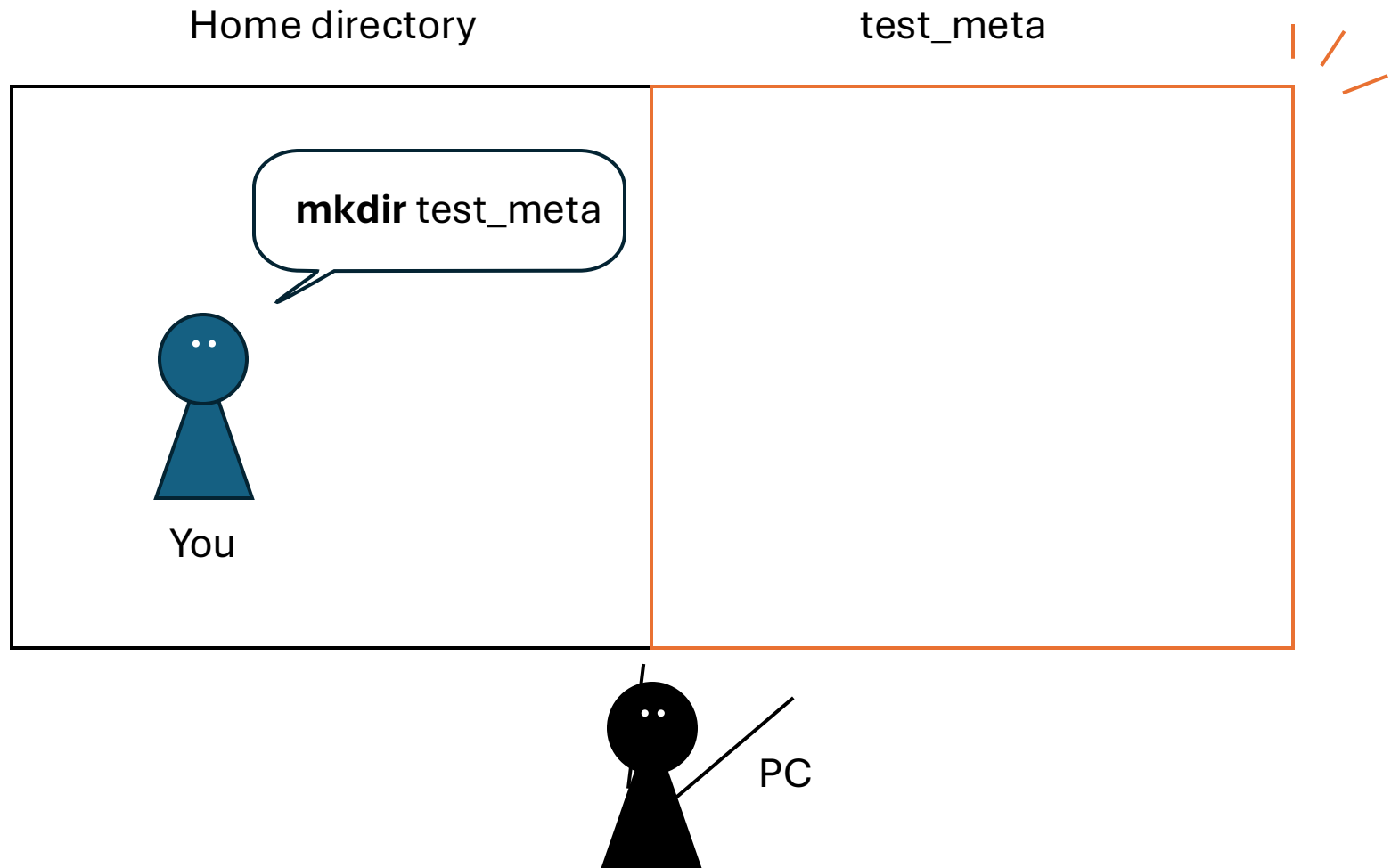
mkdir is a command to make a directory

What you did...



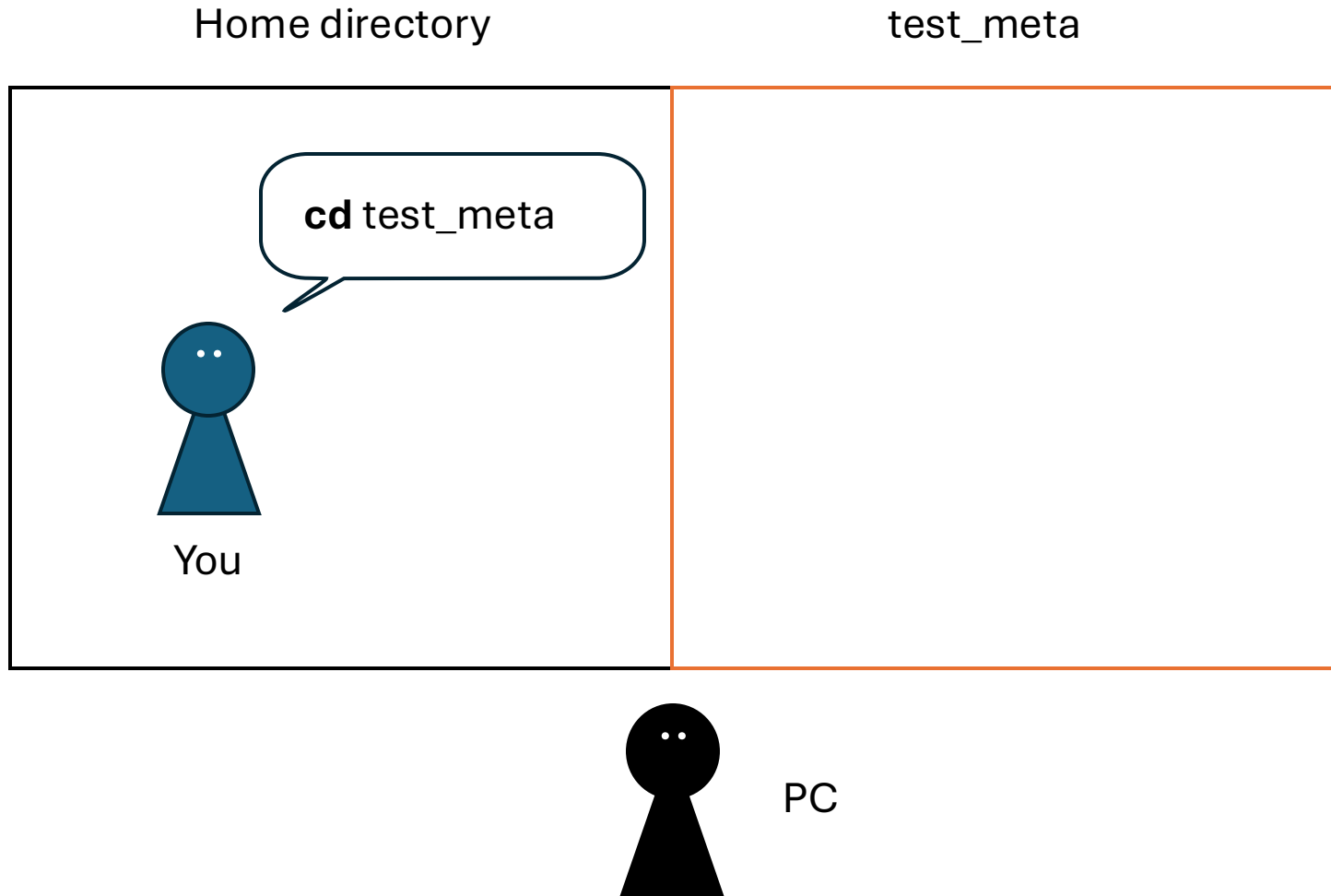
PC recognizes this command

What you did...



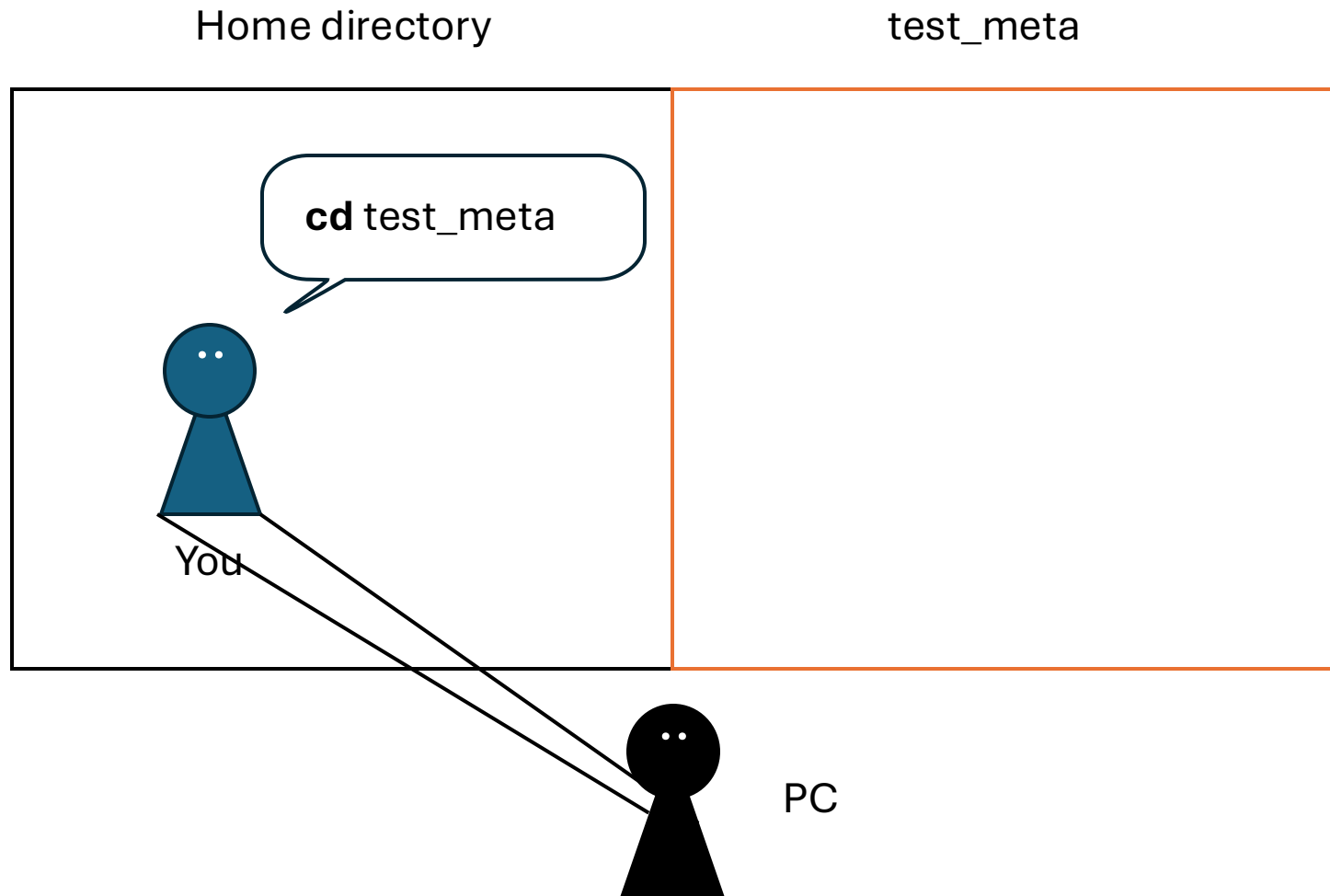
and made a directory

What you did...



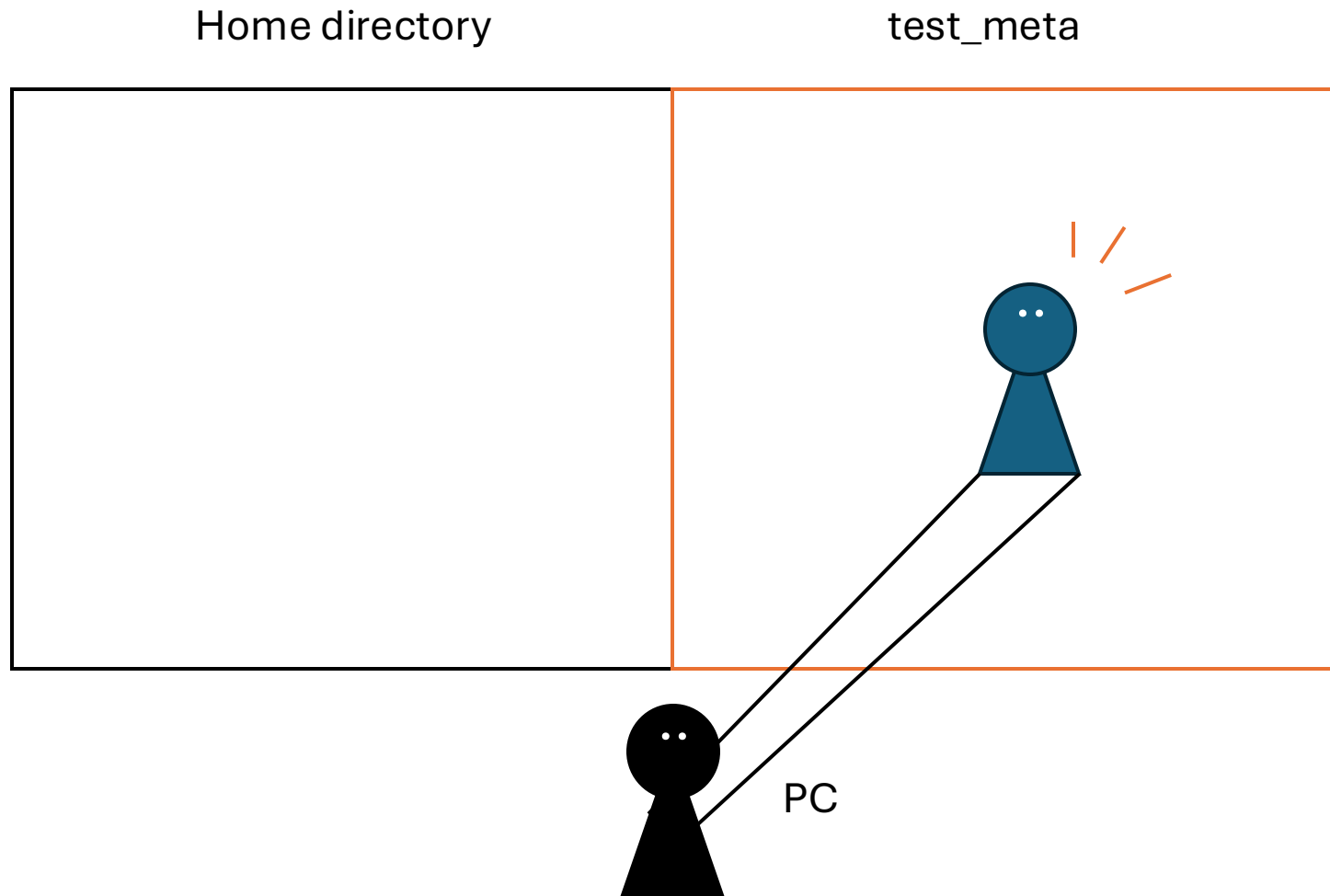
“cd” is “change directory”

What you did...

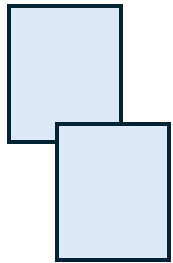


“cd” is “change directory”

What you did...



“cd” is “change directory”



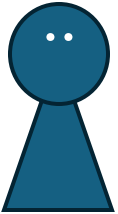
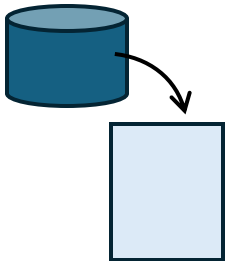
I wan to copy the
file

= cp



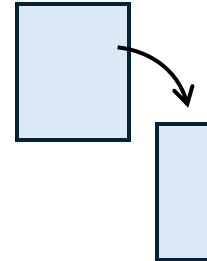
I wan to delete
the file

= rm



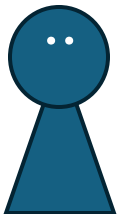
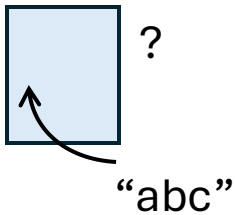
Download the
file from url

= wget



Edit the file
content

= awk



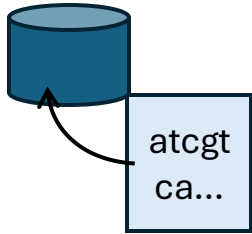
Search specific
words in the file

= grep

Various basic commands are
already prepared

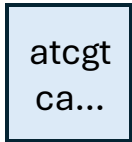
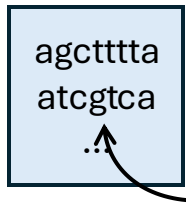
See the official tutorial:

<https://ubuntu.com/tutorials/command-line-for-beginners#1-overview>



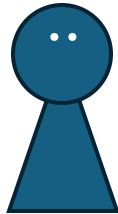
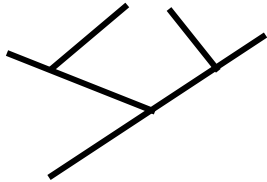
I want to make a
Blast database

= makeblastdb



Search specific
sequences

= seqkit grep



Make a
phylogenetic tree

= raxml

Need to download specific
software for bioinformatic analysis

2. blast

See also <https://www.ncbi.nlm.nih.gov/books/NBK569861/>

```
wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
tar -xvzf ncbi-blast-2.16.0+-x64-linux.tar.gz
cd ncbi-blast-2.16.0+/bin
pwd
#Copy the displayed path!!
echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc
#Paste the path you copied to **YOUR PATH**!!

blastp -h
#If you see the description about Blast Search, then the installation worked.
```



All Databases

Search

NCBI Home

Resource List (A-Z)

All Resources
Chemicals & Bioassays
Data & Software
DNA & RNA
Domains & Structures
Genes & Expression
Genetics & Medicine
Genomes & Maps
Homology
Literature
Proteins
Sequence Analysis
Taxonomy
Training & Tutorials
Variation

Welcome to NCBI

The National Center for Biotechnology Information advances science and health by providing access to biomedical and genomic information.

[About the NCBI](#) | [Mission](#) | [Organization](#) | [NCBI News & Blog](#)

Submit

Deposit data or manuscripts into NCBI databases



Download

Transfer NCBI data to your computer



Learn

Find help documents, attend a class or watch a tutorial



Develop

Use NCBI APIs and code libraries to build applications



Analyze

Identify an NCBI tool for your data analysis task



Research

Explore NCBI research and collaborative projects



Popular Resources

PubMed
Bookshelf
PubMed Central
BLAST
Nucleotide
Genome
SNP
Gene
Protein
PubChem

NCBI News & Blog

NCBI Taxonomy Update Classification

Starting April 28, 2025 | 2024 was announced so

PubMed Central's Update Search Preview Now Av

As previously announced, we are announcing the PubMed

Coming Soon! Enhance Homepage

Many people visit NCBI every day, multiple times

Basic Local Alignment Search Tool

BLAST finds regions of similarity between biological sequences. The program compares nucleotide or protein sequences to sequence databases and calculates the statistical significance.

[Learn more](#)

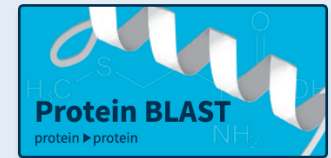
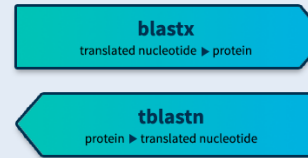
Mon, 17 Mar 2025

Improvements include upgrading to GCP Artifact Registry and better handling of job completion status in kubernetes version 1.30+.

ElasticBLAST 1.4.0 is now available!

[More BLAST news...](#)

Web BLAST



BLAST > [blast-help](#) > Download BLAST Software and Databases

Was this cor

BLAST+ executables

What are the next steps?

Magic-BLAST

IgBLAST

SRPRISM

Databases

BLAST+ executables

Do you have difficulties running high volume BLAST searches? Do you have sequence data to search and cannot use the NCBI BLAST web site? Do you have your own research pipeline? Have security or sending searches outside of your organization? If you answered yes to any of these questions, read on!

The NCBI provides a suite of command-line tools to run BLAST called BLAST+. This allows users to perform BLAST searches on their own server without size, volume and database restrictions. BLAST+ can be used with a command line so it can be integrated directly into your workflow.

What are the next steps?

Download and install BLAST+. Installers and source code are available from <https://ftp.ncbi.nlm.nih.gov/blast/executables/blast+/LATEST/>. Download the databases you need, (see database section below), or create your own. Start searching.

For more details, please see the [BLAST+ user manual](#), the [BLAST Help manual](#), the [BLAST releases notes](#), and the article in BMC Bioinformatics ([PubMed link](#)). See our [versioning policy](#).

The BLAST+ suite is the currently supported package. The older C toolkit executables are no longer supported. See our [versioning policy](#).

We are always listening and welcome your feedback at [BLAST Support Center](#).

Standalone and API BLAST



Download BLAST

Get BLAST databases and executables



Use BLAST API

Call BLAST from your application



Use BLAST in the cloud

Start an instance at a cloud provider

BLAST Genomes

Enter organism common name, scientific name, or tax id

Search

Human

Mouse

Rat

Microbes

```
wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
```

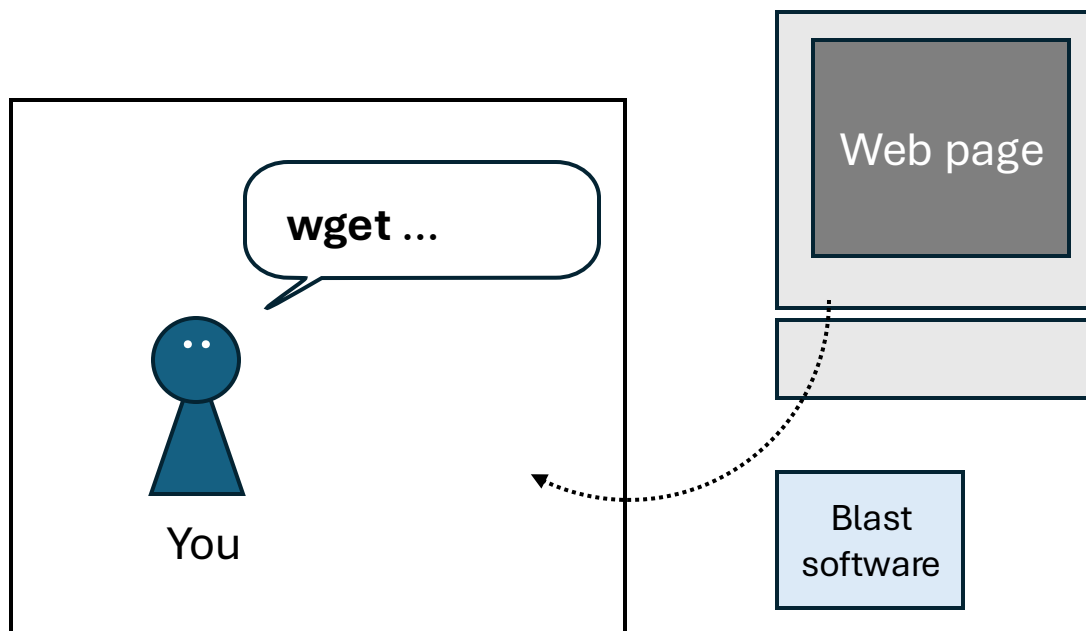


shumpei_yamakawa@cloudshell:~/test_meta\$ wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
--2025-06-04 13:38:44-- https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
Resolving ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)... 130.14.250.12, 130.14.250.13, 130.14.250.31, ...
Connecting to ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)|130.14.250.12|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 257516053 (246M) [application/x-gzip]
Saving to: 'ncbi-blast-2.16.0+-x64-linux.tar.gz'

ncbi-blast-2.16.0+-x64-linux.tar.gz 100%[=====>] 245.59M 25.3MB/s in 9.9s

2025-06-04 13:38:54 (24.9 MB/s) - 'ncbi-blast-2.16.0+-x64-linux.tar.gz' saved [257516053/257516053]

shumpei_yamakawa@cloudshell:~/test_meta\$



```
wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
```



↓

```
shumpei_yamakawa@cloudshell:~/test_meta$ wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
--2025-06-04 13:38:44-- https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
Resolving ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)... 130.14.250.12, 130.14.250.13, 130.14.250.31, ...
Connecting to ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)|130.14.250.12|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 257516053 (246M) [application/x-gzip]
Saving to: 'ncbi-blast-2.16.0+-x64-linux.tar.gz'

ncbi-blast-2.16.0+-x64-linux.tar.gz      100%[=====>] 245.59M  25.3MB/s   in 9.9s

2025-06-04 13:38:54 (24.9 MB/s) - 'ncbi-blast-2.16.0+-x64-linux.tar.gz' saved [257516053/257516053]


shumpei_yamakawa@cloudshell:~/test_meta$
```

↓

Type “ls” (see the contents in the current directory)

```
shumpei_yamakawa@cloudshell:~/test_meta$ ls
ncbi-blast-2.16.0+-x64-linux.tar.gz
```

```
wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
```



```
shumpei_yamakawa@cloudshell:~/test_meta$ wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
--2025-06-04 13:38:44-- https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
Resolving ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)... 130.14.250.12, 130.14.250.13, 130.14.250.31, ...
Connecting to ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)|130.14.250.12|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 257516053 (246M) [application/x-gzip]
Saving to: 'ncbi-blast-2.16.0+-x64-linux.tar.gz'

ncbi-blast-2.16.0+-x64-linux.tar.gz      100%[=====>] 245.59M  25.3MB/s   in 9.9s

2025-06-04 13:38:54 (24.9 MB/s) - 'ncbi-blast-2.16.0+-x64-linux.tar.gz' saved [257516053/257516053]

shumpei_yamakawa@cloudshell:~/test_meta$
```



Type “ls” (see the contents in the current directory)

```
shumpei_yamakawa@cloudshell:~/test_meta$ ls
ncbi-blast-2.16.0+-x64-linux.tar.gz
```



Compressed archive file

```
wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
```



↓

```
shumpei_yamakawa@cloudshell:~/test_meta$ wget https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
--2025-06-04 13:38:44-- https://ftp.ncbi.nlm.nih.gov/blast/executables/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
Resolving ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)... 130.14.250.12, 130.14.250.13, 130.14.250.31, ...
Connecting to ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)|130.14.250.12|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 257516053 (246M) [application/x-gzip]
Saving to: 'ncbi-blast-2.16.0+-x64-linux.tar.gz'

ncbi-blast-2.16.0+-x64-linux.tar.gz      100%[=====>] 245.59M  25.3MB/s  in 9.9s

2025-06-04 13:38:54 (24.9 MB/s) - 'ncbi-blast-2.16.0+-x64-linux.tar.gz' saved [257516053/257516053]

shumpei_yamakawa@cloudshell:~/test_meta$
```

↓

Type “ls” (see the contents in the current directory)

```
shumpei_yamakawa@cloudshell:~/test_meta$ ls
ncbi-blast-2.16.0+-x64-linux.tar.gz
```

↑

Compressed archive file

↓

```
tar -xvzf ncbi-blast-2.16.0+-x64-linux.tar.gz
```

Command for decompressing

ncbi-blast-2.16.0+-x64-linux.tar.gz

shumpei_yamakawa@cloudshell:~/test_meta\$ tar -xvzf ncbi-blast-2.16.0+-x64-linux.tar.gz

ncbi-blast-2.16.0+/

ncbi-blast-2.16.0+/ChangeLog

ncbi-blast-2.16.0+/bin/

ncbi-blast-2.16.0+/bin/rpsblast

ncbi-blast-2.16.0+/bin/blastn_vdb

ncbi-blast-2.16.0+/bin/blast_vdb_cmd

ncbi-blast-2.16.0+/bin/makeprofiledb

ncbi-blast-2.16.0+/bin/blastp

ncbi-blast-2.16.0+/bin/deltablast

ncbi-blast-2.16.0+/bin/blastx

ncbi-blast-2.16.0+/bin/rpstblastn

ncbi-blast-2.16.0+/bin/psiblast

ncbi-blast-2.16.0+/bin/tblastx

ncbi-blast-2.16.0+/bin/tblastn_vdb

ncbi-blast-2.16.0+/bin/blast_formatter_vdb

ncbi-blast-2.16.0+/bin/segmasker

ncbi-blast-2.16.0+/bin/convert2blastmask

ncbi-blast-2.16.0+/bin/blastdbcmd

ncbi-blast-2.16.0+/bin/get_species_taxids.sh

ncbi-blast-2.16.0+/bin/dustmasker

ncbi-blast-2.16.0+/bin/cleanup-blastdb-volumes.py

ncbi-blast-2.16.0+/bin/blastn

ncbi-blast-2.16.0+/bin/windowmasker

ncbi-blast-2.16.0+/bin/makeblastdb

ncbi-blast-2.16.0+/bin/blastdb_aliastool

ncbi-blast-2.16.0+/bin/update_blastdb.pl

ncbi-blast-2.16.0+/bin/makembindex

ncbi-blast-2.16.0+/bin/blast_formatter

ncbi-blast-2.16.0+/bin/legacy_blast.pl

ncbi-blast-2.16.0+/bin/blastdbcheck

ncbi-blast-2.16.0+/bin/tblastn

ncbi-blast-2.16.0+/LICENSE

ncbi-blast-2.16.0+/BLAST_PRIVACY

ncbi-blast-2.16.0+/ncbi_package_info

ncbi-blast-2.16.0+/README

ncbi-blast-2.16.0+/doc/

ncbi-blast-2.16.0+/doc/README.txt

shumpei_yamakawa@cloudshell:~/test_meta\$ ls

ncbi-blast-2.16.0+ ncbi-blast-2.16.0+-x64-linux.tar.gz

shumpei_yamakawa@cloudshell:~/test_meta\$

Path set*

- ① `cd ncbi-blast-2.16.0+/bin`
- ② `pwd`
#Copy the displayed path!!
- ③ `echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc`
#Paste the path you copied to **YOUR PATH**!!

①

```
shumpei_yamakawa@cloudshell:~/test_meta$ cd ncbi-blast-2.16.0+/bin
```



②

```
shumpei_yamakawa@cloudshell:~/test_meta/ncbi-blast-2.16.0+/bin$ pwd
```

* If you want to know more about path setting, see the attached slides

Path set

- ① `cd ncbi-blast-2.16.0+/bin`
- ② `pwd`
#Copy the displayed path!!
- ③ `echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc`
#Paste the path you copied to **YOUR PATH**!!

①

```
shumpei_yamakawa@cloudshell:~/test_meta$ cd ncbi-blast-2.16.0+/bin
```



②

```
shumpei_yamakawa@cloudshell:~/test_meta/ncbi-blast-2.16.0+/bin$ pwd  
/home/shumpei_yamakawa/test_meta/ncbi-blast-2.16.0+/bin
```

↑
YOUR PATH

Path set

- ① `cd ncbi-blast-2.16.0+/bin`
- ② `pwd`
#Copy the displayed path!!
- ③ `echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc`
#Paste the path you copied to **YOUR PATH**!!

①

```
shumpei_yamakawa@cloudshell:~/test_meta$ cd ncbi-blast-2.16.0+/bin
```



②

```
shumpei_yamakawa@cloudshell:~/test_meta/ncbi-blast-2.16.0+/bin$ pwd  
/home/shumpei_yamakawa/test_meta/ncbi-blast-2.16.0+/bin
```



```
echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc
```

Path set

- ① `cd ncbi-blast-2.16.0+/bin`
- ② `pwd`
#Copy the displayed path!!
- ③ `echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc`
#Paste the path you copied to **YOUR PATH**!!

①

```
shumpei_yamakawa@cloudshell:~/test_meta$ cd ncbi-blast-2.16.0+/bin
```



②

```
shumpei_yamakawa@cloudshell:~/test_meta/ncbi-blast-2.16.0+/bin$ pwd  
/home/shumpei_yamakawa/test_meta/ncbi-blast-2.16.0+/bin
```



```
echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc
```



Substitute your path and remove ***

```
echo 'export PATH="/home/shu.../bin:$PATH"' >> ~/.bashrc; source ~/.bashrc
```

Path set

- ① `cd ncbi-blast-2.16.0+/bin`
- ② `pwd`
#Copy the displayed path!!
- ③ `echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc`
#Paste the path you copied to **YOUR PATH**!!

①

```
shumpei_yamakawa@cloudshell:~/test_meta$ cd ncbi-blast-2.16.0+/bin
```



②

```
shumpei_yamakawa@cloudshell:~/test_meta/ncbi-blast-2.16.0+/bin$ pwd  
/home/shumpei_yamakawa/test_meta/ncbi-blast-2.16.0+/bin
```



③

```
in$ echo 'export PATH="/home/shumpei_yamakawa/test_meta/ncbi-blast-2.16.0+/bin:$PATH"' >> ~/.bashrc; source ~/.bashrc
```

```
blastp -h
```

```
#If you see the description about Blast Search, then the installation worked.
```

```
shumpei_yamakawa@cloudshell:~/test_meta/ncbi-blast-2.16.0+/bin$ blastp -h
USAGE
  blastp [-h] [-help] [-import_search_strategy filename]
    [-export_search_strategy filename] [-task task_name] [-db database_name]
    [-dbsize num_letters] [-gilist filename] [-seqidlist filename]
    [-negative_gilist filename] [-negative_seqidlist filename]
    [-taxids taxids] [-negative_taxids taxids] [-taxidlist filename]
    [-negative_taxidlist filename] [-no_taxid_expansion] [-ipglist filename]
    [-negative_ipglist filename] [-entrez_query entrez_query]
    [-db_soft_mask filtering_algorithm] [-db_hard_mask filtering_algorithm]
    [-subject subject_input_file] [-subject_loc range] [-query input_file]
    [-out output_file] [-evaluate evaluate] [-word_size int_value]
    [-gapopen open_penalty] [-gapextend extend_penalty]
    [-qcov_hsp_perc float_value] [-max_hsps int_value]
    [-xdrop_ungap float_value] [-xdrop_gap float_value]
    [-xdrop_gap_final float_value] [-searchsp int_value] [-seg SEG_options]
    [-soft_masking soft_masking] [-matrix matrix_name]
    [-threshold float_value] [-culling_limit int_value]
    [-best_hit_overhang float_value] [-best_hit_score_edge float_value]
    [-subject_besthit] [-window_size int_value] [-lcase_masking]
    [-query_loc range] [-parse_deflines] [-outfmt format] [-show_gis]
    [-num_descriptions int_value] [-num_alignments int_value]
    [-line_length line_length] [-html] [-sorthits sort_hits]
    [-sorthsps sort_hsps] [-max_target_seqs num_sequences]
    [-num_threads int_value] [-mt_mode int_value] [-ungapped] [-remote]
    [-comp_based_stats compo] [-use_sw_tback] [-version]
```

DESCRIPTION

Protein-Protein BLAST 2.16.0+

Use '-help' to print detailed descriptions of command line arguments

```
shumpei_yamakawa@cloudshell:~/test_meta/ncbi-blast-2.16.0+/bin$
```

3. seqkit

The software for manipulating the sequence files. See also <https://bioinf.shenwei.me/seqkit/>

```
cd ~/test_meta
#move to the test directory
wget https://github.com/shenwei356/seqkit/releases/download/v2.10.0/seqkit_linux_amd64.tar.gz
tar -xvzf seqkit_linux_amd64.tar.gz
mkdir seqkit_dir
mv seqkit seqkit_dir/
cd seqkit_dir
pwd
#Copy the displayed path!!
echo 'export PATH="**YOUR PATH**:$PATH"' >> ~/.bashrc; source ~/.bashrc
#Paste the path you copied to **YOUR PATH**!!

seqkit -h
#If you see the description about seqkit Search, then the installation worked.

cd ~/
#Go back to the home directory
```

Repeat the steps above

Simply follow the script...

4. update/developer environments

```
sudo apt update
sudo apt install -y \
    liblapack-dev \
    libblas-dev \
    gfortran \
    libpng-dev \
    libgsf-dev \
    libtiff5-dev \
    libjpeg-dev \
    libxml2-dev \
    libcurl4-openssl-dev \
    libxt-dev \
    libfftw3-dev \
    libreadline-dev \
    zlib1g-dev \
    libx11-dev \
    libncurses-dev \
    libbz2-dev \
    liblzma-dev
```



Simply follow the script...

5. R

R is a programming language and software environment for statistical computing, data analysis, and visualization. See also <https://www.r-project.org/>

```
cd ~/test_meta
#move to the test directory

# update indices
sudo apt update -qq
# install two helper packages we need
sudo apt install --no-install-recommends software-properties-common dirmngr
# add the signing key (by Michael Rutter) for these repos
# To verify key, run gpg --show-keys /etc/apt/trusted.gpg.d/cran_ubuntu_key.asc
# Fingerprint: E298A3A825C0D65DFD57CBB651716619E084DAB9
wget -qO- https://cloud.r-project.org/bin/linux/ubuntu/marutter_pubkey.asc | sudo tee -a /etc/apt/trusted.gpg.d/cran_
# add the repo from CRAN -- lsb_release adjusts to 'noble' or 'jammy' or ... as needed
sudo add-apt-repository "deb https://cloud.r-project.org/bin/linux/ubuntu $(lsb_release -cs)-cran40/"
# install R itself
sudo apt install --no-install-recommends r-base
```

During installing, you may see the following...

```
=xbQ3
-----END PGP PUBLIC KEY BLOCK-----
Repository: 'deb https://cloud.r-project.org/bin/linux/ubuntu noble-cran40/'
Description:
Archive for codename: noble-cran40/ components:
More info: https://cloud.r-project.org/bin/linux/ubuntu
Adding repository.
Press [ENTER] to continue or Ctrl-c to cancel.□
```

-> enter

```
libblas3 liblapack3 libpaper-utils libpaper1 libcurl3-gnutls libcurl3-nss libcurl4-openssl-dev libcurl4
r-cran-kernsmooth r-cran-lattice r-cran-mass r-cran-matrix r-cran-mgcv
0 upgraded, 27 newly installed, 0 to remove and 50 not upgraded.
Need to get 56.8 MB of archives.
After this operation, 94.2 MB of additional disk space will be used.
Do you want to continue? [Y/n] □
```

-> Y

```
shumpei_yamakawa@cloudshell:~$ R
```

Enter -> go to “R console”

```
shumpei_yamakawa@cloudshell:~$ R

R version 4.5.0 (2025-04-11) -- "How About a Twenty-Six"
Copyright (C) 2025 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

>
```

Start installing R packages

6. dada2: the R package for metabarcoding analysis

R provides a lot of the "packages" which are designed for specific analysis, and the package "dada2" performs to "infer exact amplicon sequence variants (ASVs) from amplicon data (<https://benjjneb.github.io/dada2/>)". This package needs to be installed in R console.

```
# install the softwares
install.packages(c("RcppEigen", "png", "deldir", "interp", "latticeExtra"))
if (!requireNamespace("BiocManager", quietly = TRUE))
  install.packages("BiocManager")
BiocManager::install("ShortRead")
BiocManager::install("dada2")
library(dada2)
packageVersion("dada2")
#Can you see the version of dada2? If so, dada2 was correctly installed!
```




```
shumpei_yamakawa@cloudshell:~$ R
```

Enter -> go to "R console"

```
shumpei_yamakawa@cloudshell:~$ R

R version 4.5.0 (2025-04-11) -- "How About a Twenty-Six"
Copyright (C) 2025 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

>
```

Start installing R packages

6. dada2: the R package for metabarcoding analysis

R provides a lot of the "packages" which are designed for specific analysis, and the package sequence variants (ASVs) from amplicon data (<https://benjjneb.github.io/dada2/>). This package

```
# install the softwares
install.packages(c("RcppEigen", "png", "deldir", "interp", "latticeExtra"))
if (!requireNamespace("BiocManager", quietly = TRUE))
  install.packages("BiocManager")
BiocManager::install("ShortRead")
BiocManager::install("dada2")
library(dada2)
packageVersion("dada2")
#Can you see the version of dada2? If so, dada2 was correctly installed!
```

During installation, you may be prompted to select "Yes" or "No."
Choose "Yes."

```
shumpei_yamakawa@cloudshell:~$ R

R version 4.5.0 (2025-04-11) -- "How About a Twenty-Six"
Copyright (C) 2025 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> q()
Save workspace image? [y/n/c]: n
shumpei_yamakawa@cloudshell:~$
```

Type “q()” to escape from R console

Appendix

Public tutorial

<https://ubuntu.com/tutorials/command-line-for-beginners#1-overview>

<https://opensource.com/article/17/6/set-path-linux>

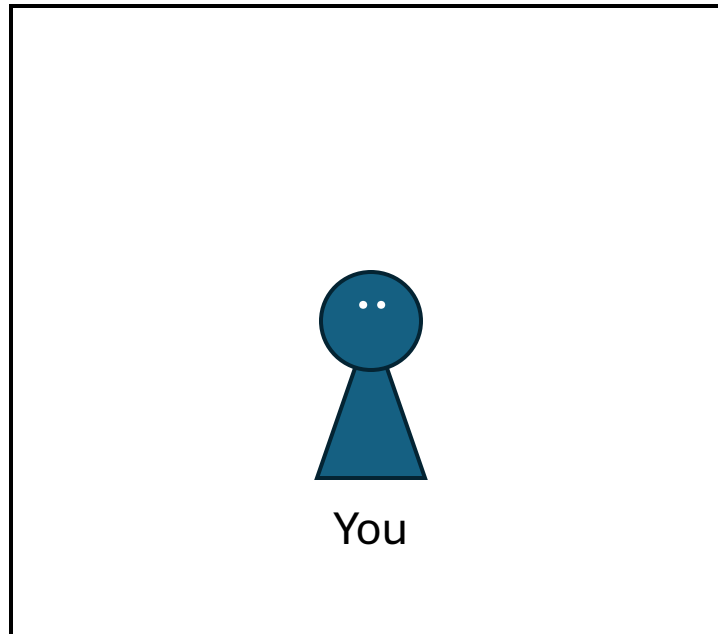
Illustrated guides about basic usage of linux

1. Location and directory structure
2. Installing software

1. Location and directory structure

```
Welcome to Cloud Shell! Type "help" to get started.  
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.  
You can view your projects by running `gcloud projects list`.  
Your home disk usage is at 95%.  
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.  
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.  
shumpei_yamakawa@cloudshell:~$
```

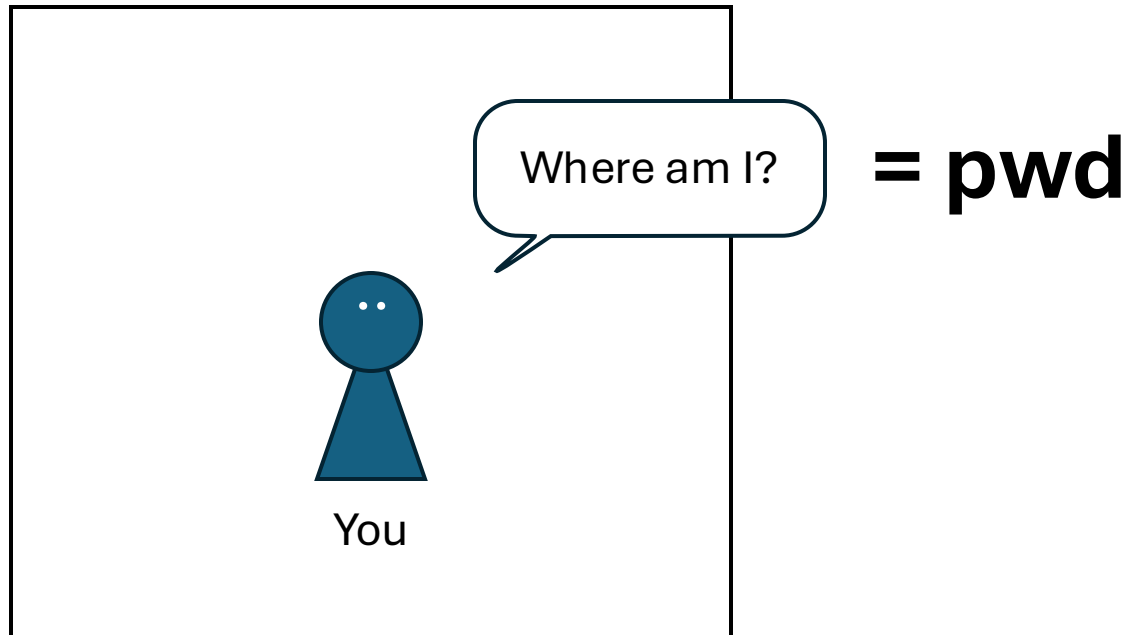
Home directory



“type pwd -> enter”

```
Welcome to Cloud Shell! Type "help" to get started.  
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.  
You can view your projects by running `gcloud projects list`.  
Your home disk usage is at 95%.  
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.  
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.  
shumpei_yamakawa@cloudshell:~$ pwd
```

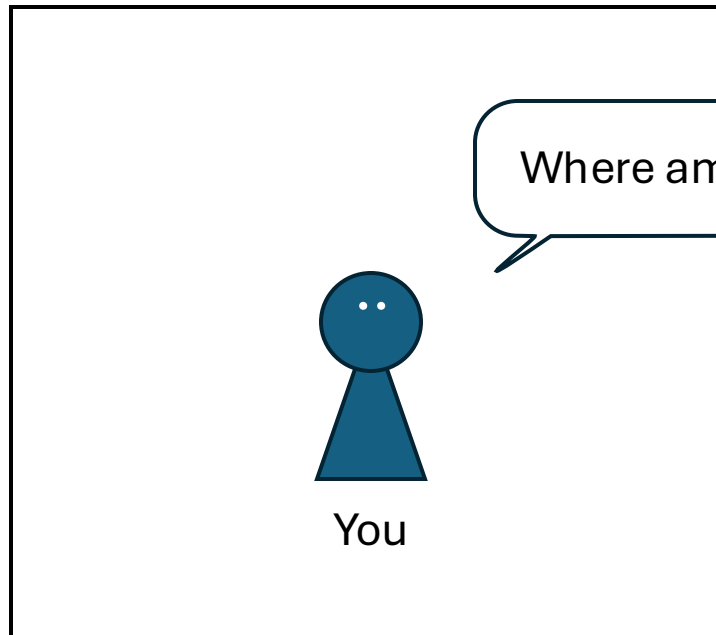
Home directory



```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
Your home disk usage is at 95%.
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.
shumpei_yamakawa@cloudshell:~$ pwd
/home/shumpei_yamakawa
shumpei_yamakawa@cloudshell:~$
```

your current address
(PATH)

Home directory

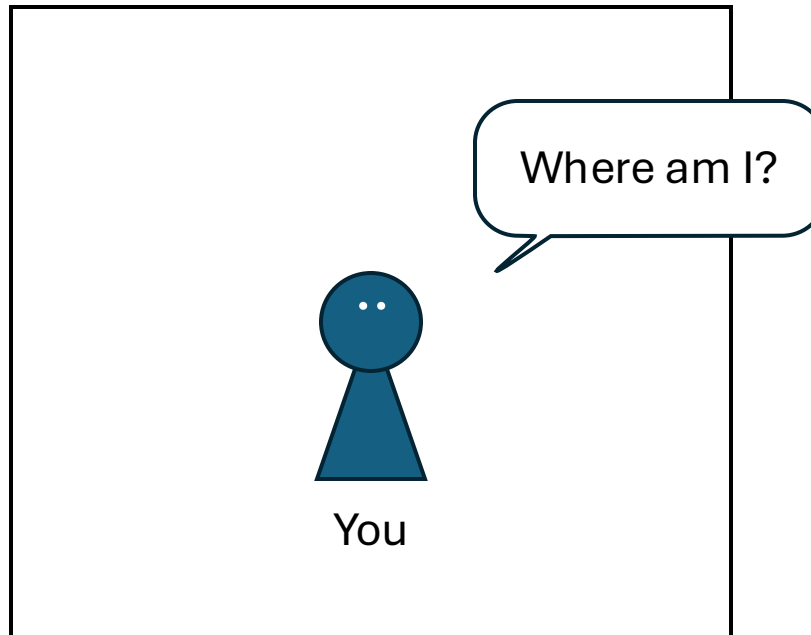


Where am I?

= **pwd**

```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
Your home disk usage is at 95%.
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.
shumpei_yamakawa@cloudshell:~$ pwd
/home/shumpei_yamakawa
shumpei_yamakawa@cloudshell:~$
```

Home directory:
/home/shumpei_yamakawa

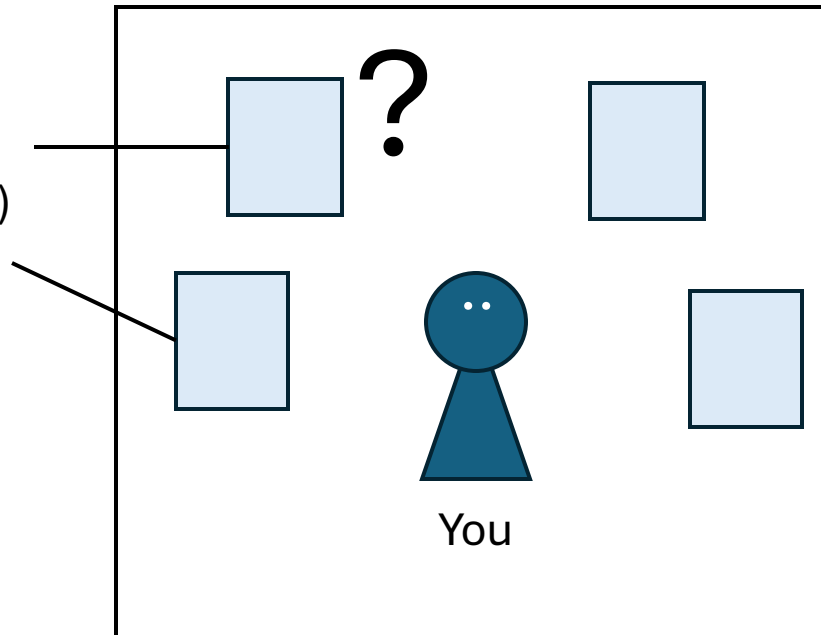


*the name of the directory depends on your account name


```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
Your home disk usage is at 95%.
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.
shumpei_yamakawa@cloudshell:~$ pwd
/home/shumpei_yamakawa
shumpei_yamakawa@cloudshell:~$
```

Home directory:
/home/shumpei_yamakawa

Files
(ex. text files)

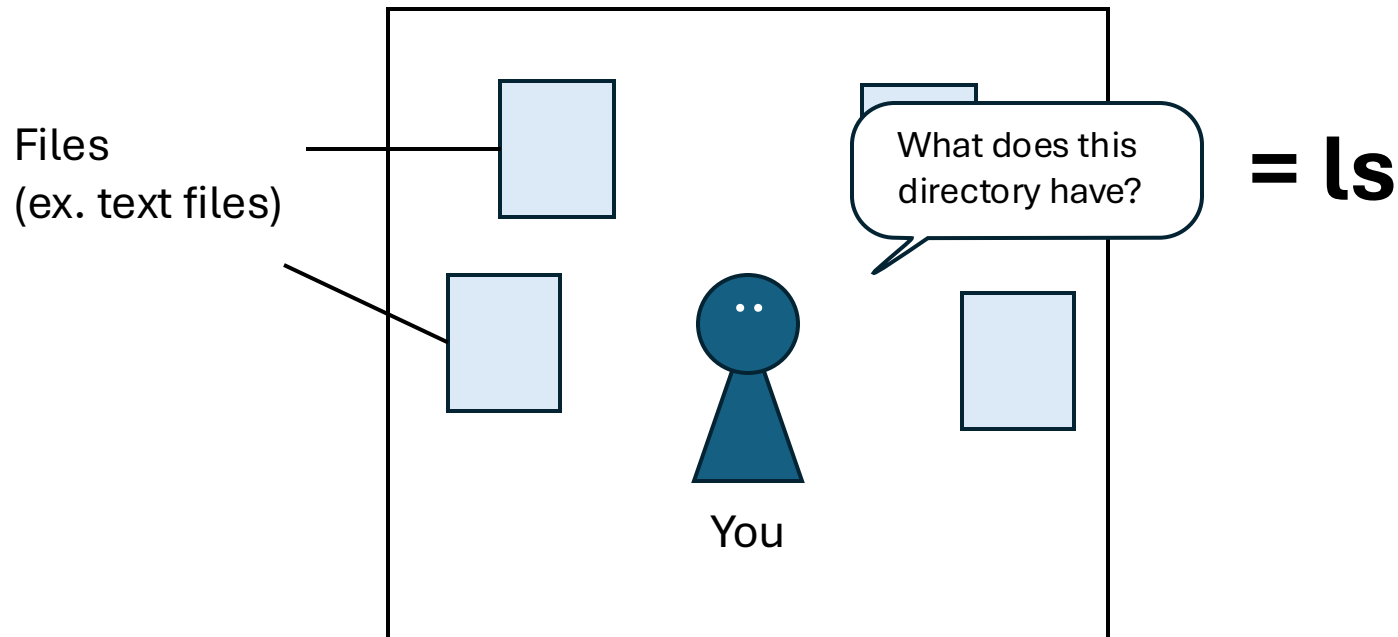


*the name of the directory depends on your account name

“type ls -> enter”

```
Welcome to Cloud Shell! Type "help" to get started.  
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.  
You can view your projects by running `gcloud projects list`.  
Your home disk usage is at 95%.  
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.  
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.  
shumpei_yamakawa@cloudshell:~$ pwd  
/home/shumpei_yamakawa  
shumpei_yamakawa@cloudshell:~$ ls
```

Home directory:
/home/shumpei_yamakawa

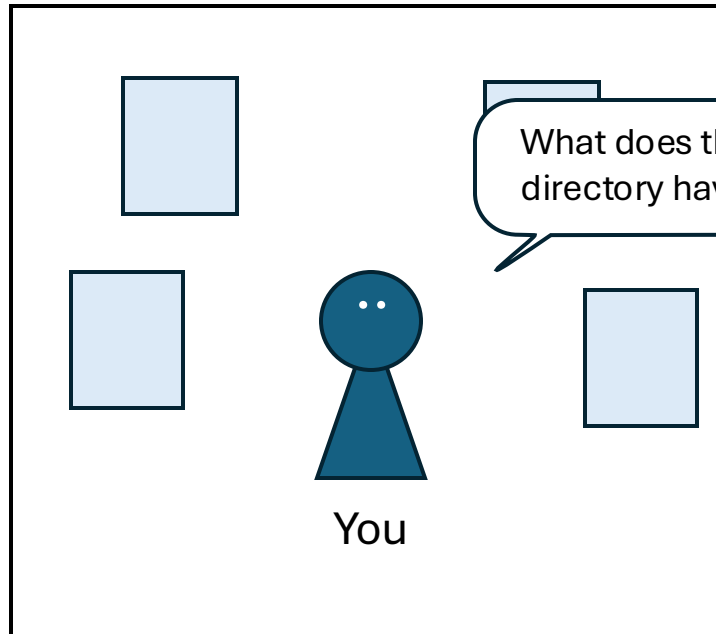


*the name of the directory depends on your account name

```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
Your home disk usage is at 95%.
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.
shumpei_yamakawa@cloudshell:~$ pwd
/home/shumpei_yamakawa
shumpei_yamakawa@cloudshell:~$ ls
README-cloudshell.txt
shumpei_yamakawa@cloudshell:~$
```

Home directory:
/home/shumpei_yamakawa

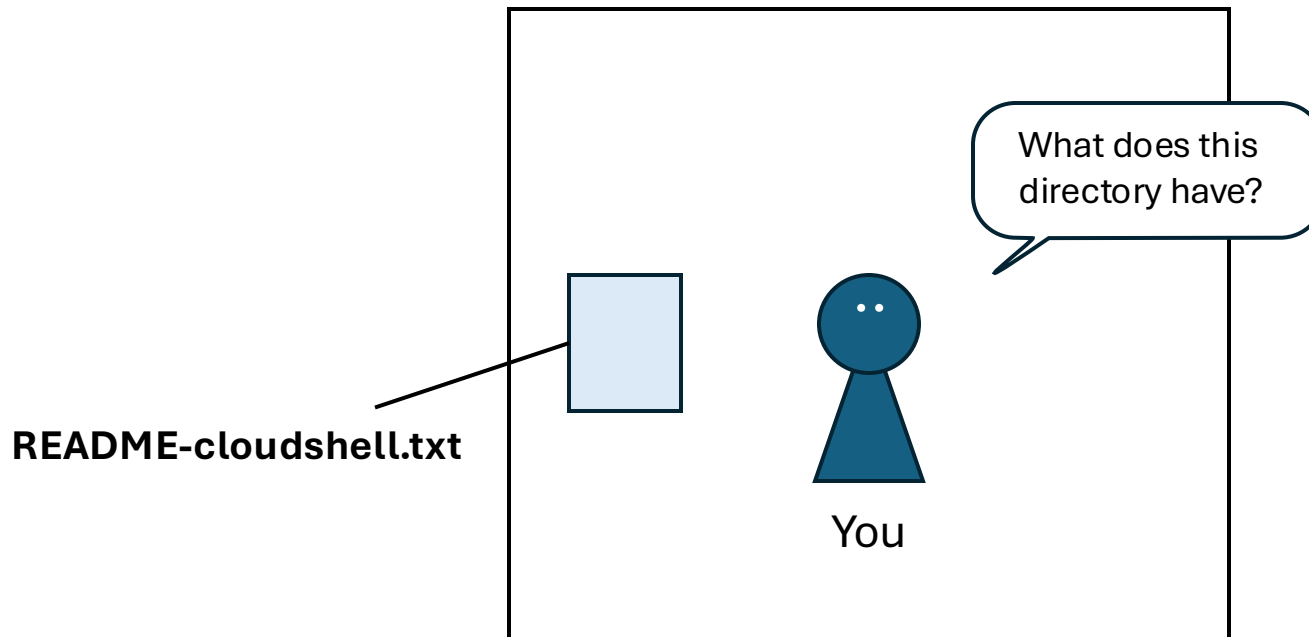
You have
"README-cloudshell.txt"



= ls

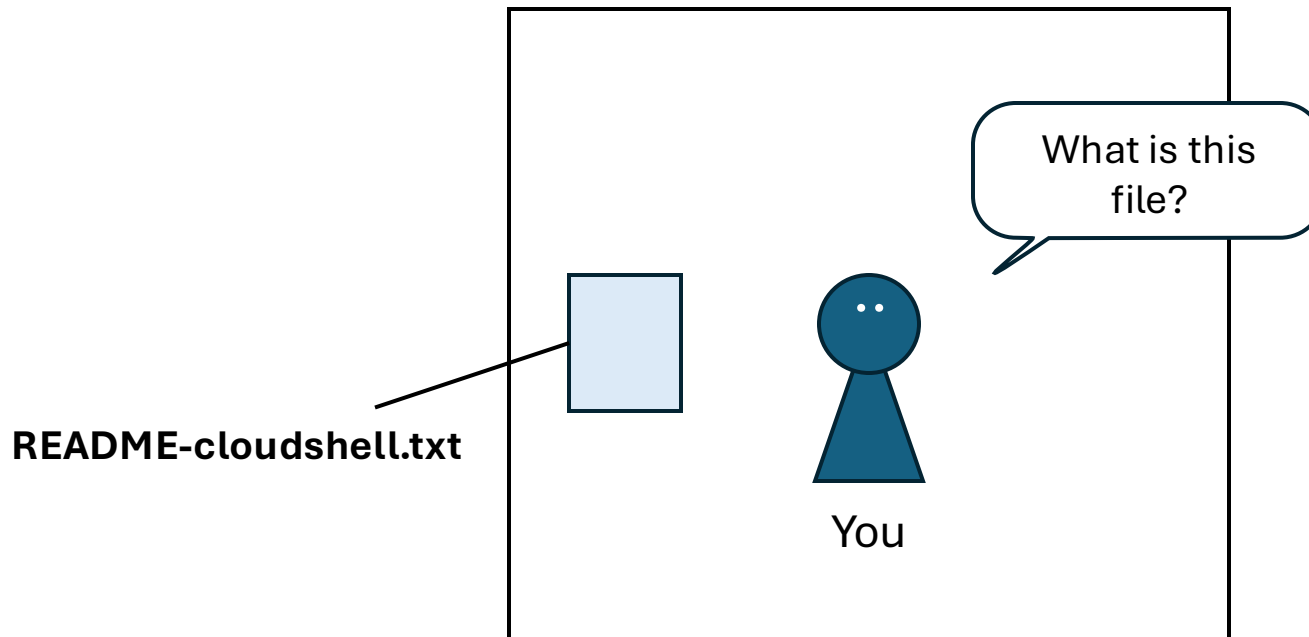
```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
Your home disk usage is at 95%.
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.
shumpei_yamakawa@cloudshell:~$ pwd
/home/shumpei_yamakawa
shumpei_yamakawa@cloudshell:~$ ls
README-cloudshell.txt
shumpei_yamakawa@cloudshell:~$
```

Home directory:
/home/shumpei_yamakawa



```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
Your home disk usage is at 95%.
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.
shumpei_yamakawa@cloudshell:~$ pwd
/home/shumpei_yamakawa
shumpei_yamakawa@cloudshell:~$ ls
README-cloudshell.txt
shumpei_yamakawa@cloudshell:~$
```

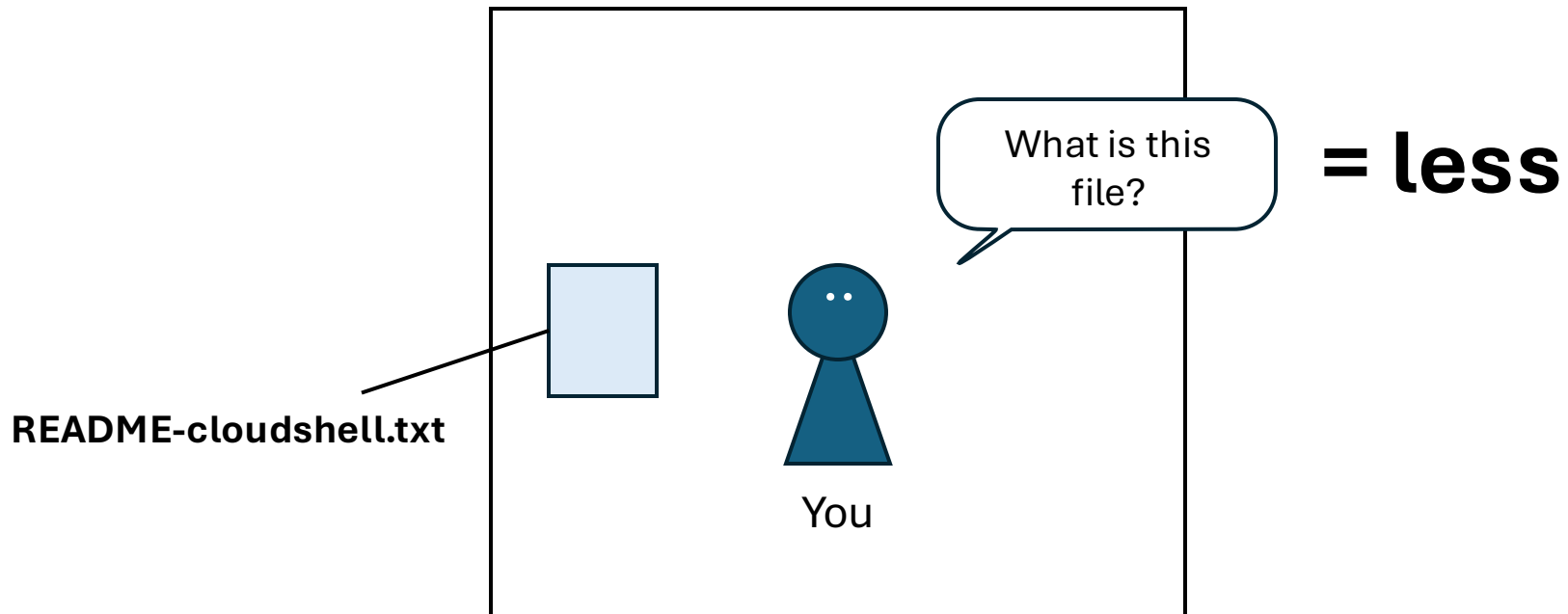
Home directory:
/home/shumpei_yamakawa



Type “less {file name}” and enter

```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
Your home disk usage is at 95%.
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.
shumpei_yamakawa@cloudshell:~$ pwd
/home/shumpei_yamakawa
shumpei_yamakawa@cloudshell:~$ ls
README-cloudshell.txt test
shumpei_yamakawa@cloudshell:~$ less README-cloudshell.txt
```

Home directory:
/home/shumpei_yamakawa



```
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use `gcloud config set project [PROJECT_ID]`.
You can view your projects by running `gcloud projects list`.
Your home disk usage is at 95%.
You can find suggestions to clear space at https://cloud.google.com/shell/docs/quotas-limits#clearing\_disk\_space.
Upgrade to Cloud Workstations for a secure development environment without these limits: https://cloud.google.com/workstations.
shumpei_yamakawa@cloudshell:~$ pwd
/home/shumpei_yamakawa
shumpei_yamakawa@cloudshell:~$ ls
README-cloudshell.txt  test
shumpei_yamakawa@cloudshell:~$ less README-cloudshell.txt
```

enter

```
Welcome to Google Cloud Shell, a tool for managing resources hosted on Google Cloud Platform!
The machine comes pre-installed with the Google Cloud SDK and other popular developer tools.

Your 5GB home directory will persist across sessions, but the VM is ephemeral and will be reset
approximately 20 minutes after your session ends. No system-wide change will persist beyond that.

Type "gcloud help" to get help on using Cloud SDK. For more examples, visit
https://cloud.google.com/shell/docs/quickstart and https://cloud.google.com/shell/docs/examples

Type "cloudshell help" to get help on using the "cloudshell" utility. Common functionality is
aliased to short commands in your shell, for example, you can type "dl <filename>" at Bash prompt to
download a file. Type "cloudshell aliases" to see these commands.

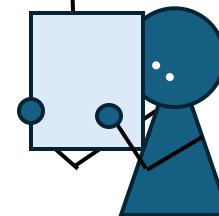
Type "help" to see this message any time. Type "builtin help" to see Bash interpreter help.

README-cloudshell.txt (END)
```

Type "q"

```
shumpei_yamakawa@cloudshell:~$ less README-cloudshell.txt
shumpei_yamakawa@cloudshell:~$
```

README-cloudshell
.txt



What is this
file?

“cat” is also an option to look at the file content

```
shumpei_yamakawa@cloudshell:~$ cat README-cloudshell.txt
```

```
Welcome to Google Cloud Shell, a tool for managing resources hosted on Google Cloud Platform!  
The machine comes pre-installed with the Google Cloud SDK and other popular developer tools.
```

```
Your 5GB home directory will persist across sessions, but the VM is ephemeral and will be reset  
approximately 20 minutes after your session ends. No system-wide change will persist beyond that.
```

```
Type "gcloud help" to get help on using Cloud SDK. For more examples, visit  
https://cloud.google.com/shell/docs/quickstart and https://cloud.google.com/shell/docs/examples
```

```
Type "cloudshell help" to get help on using the "cloudshell" utility. Common functionality is  
aliased to short commands in your shell, for example, you can type "dl <filename>" at Bash prompt to  
download a file. Type "cloudshell aliases" to see these commands.
```

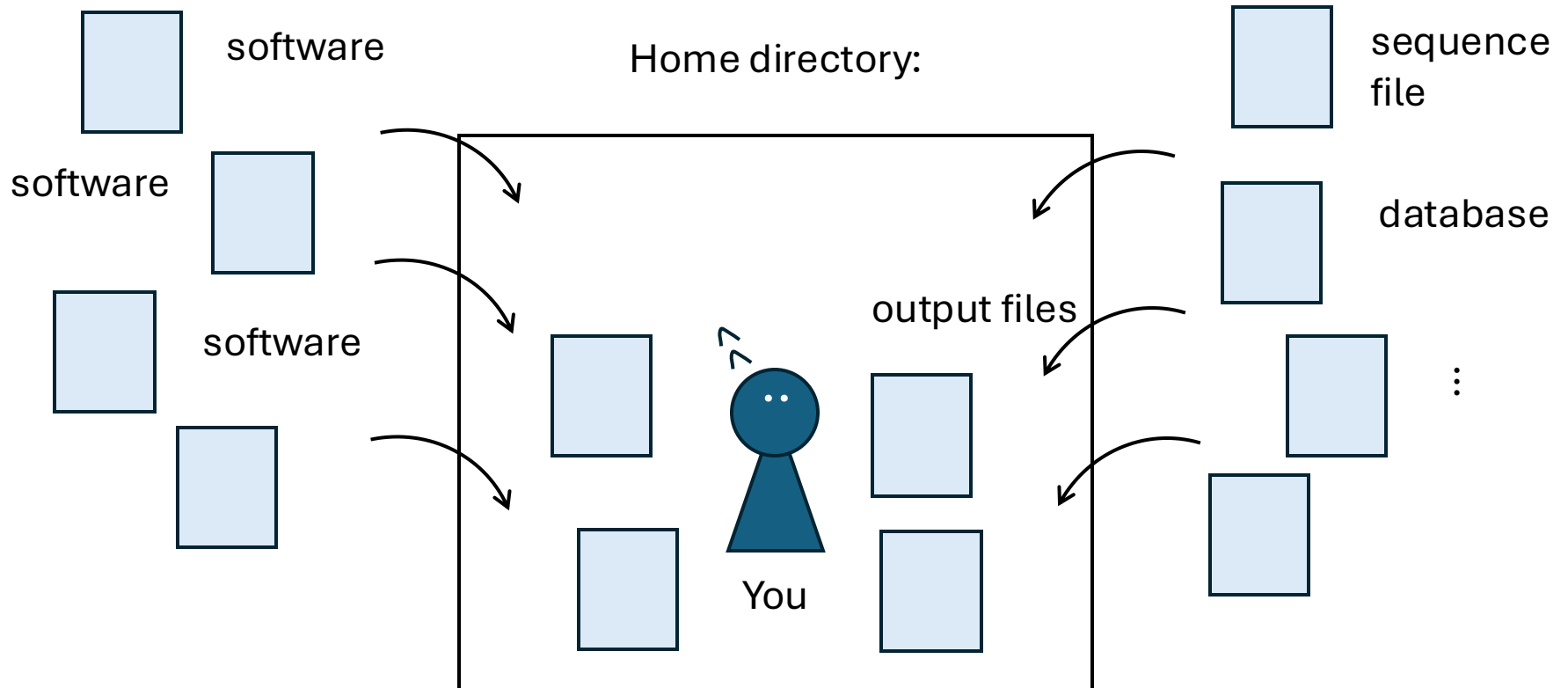
```
Type "help" to see this message any time. Type "builtin help" to see Bash interpreter help.
```

```
shumpei_yamakawa@cloudshell:~$ █
```

Less vs cat

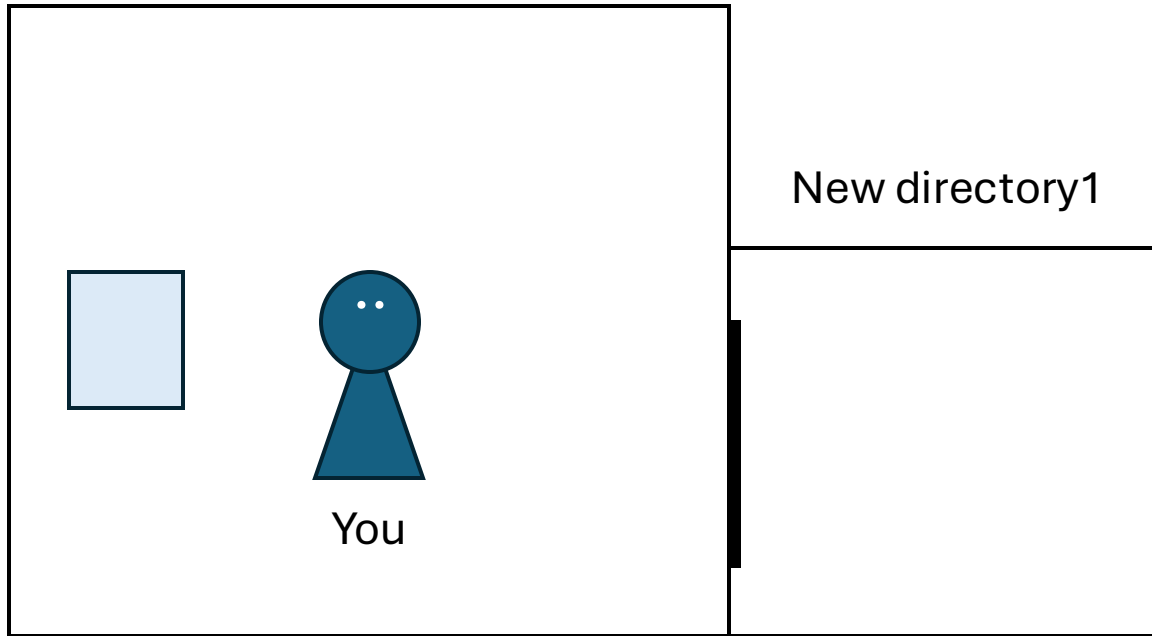
- less: in different output page For big data
- cat: in standard output For small data and to “concatenate”

Do not stack too many files in the home directly



Hierarchical structure is ideal

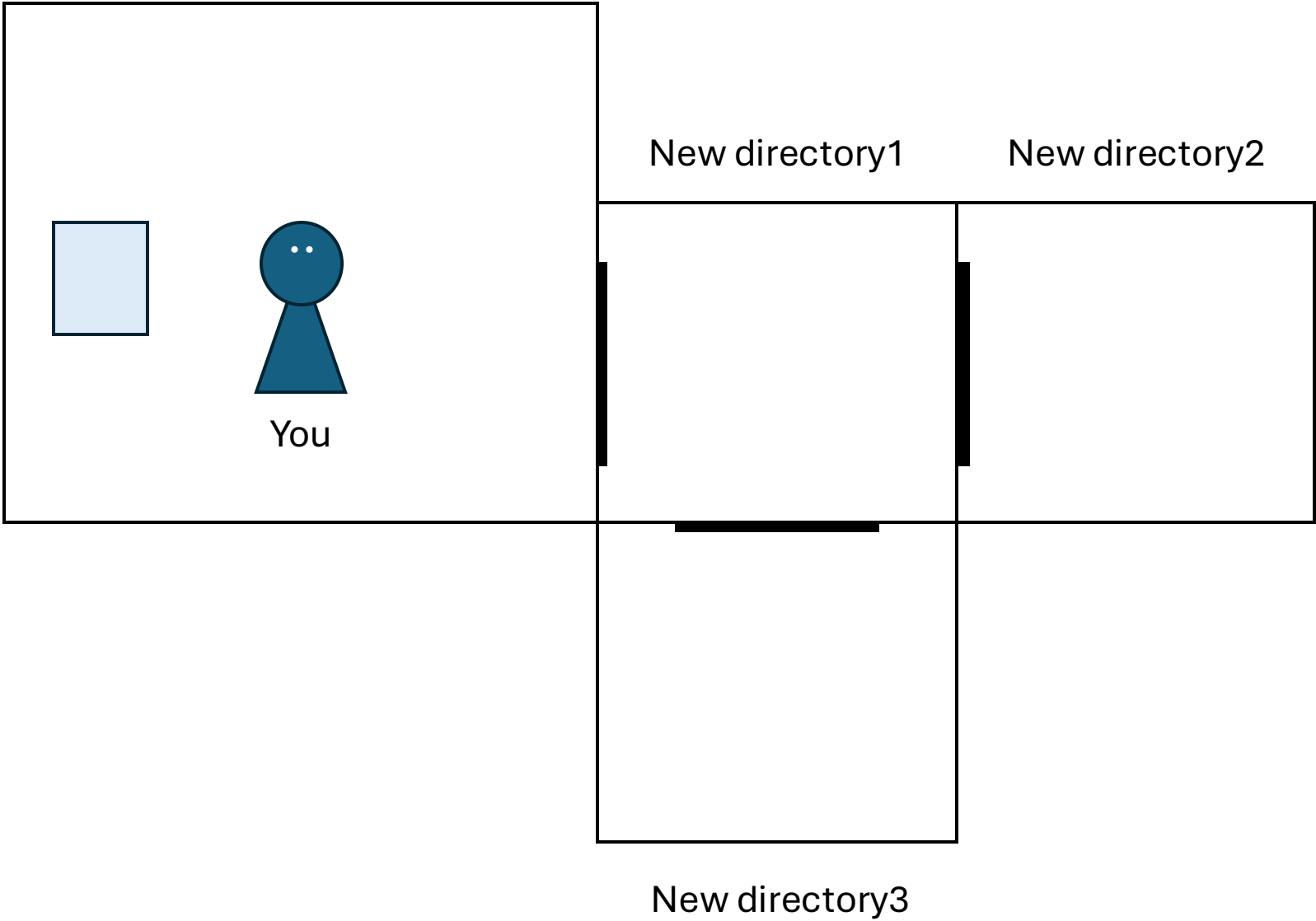
Home directory



New directory1

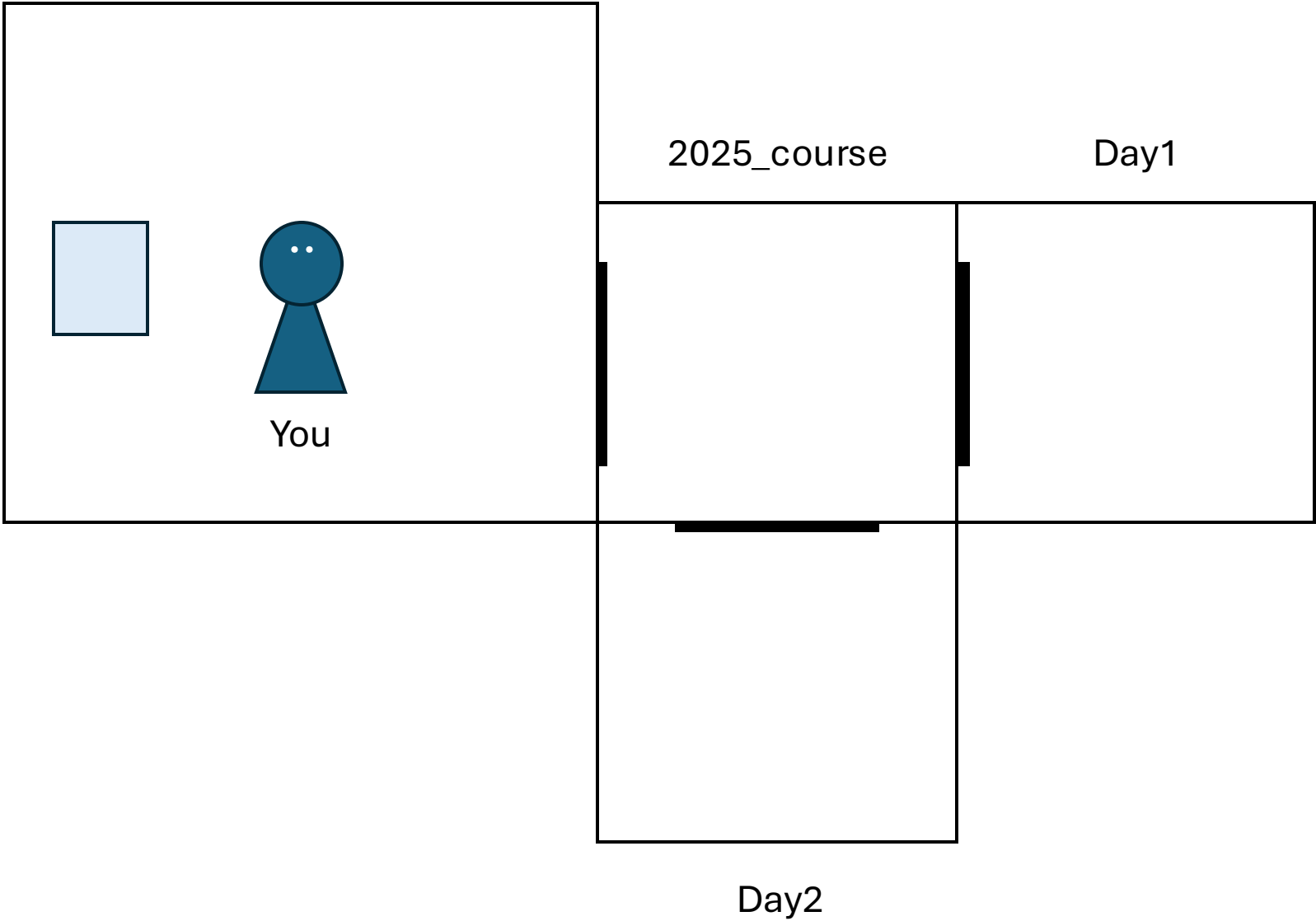
Hierarchical structure is ideal

Home directory



Hierarchical structure is ideal

Home directory



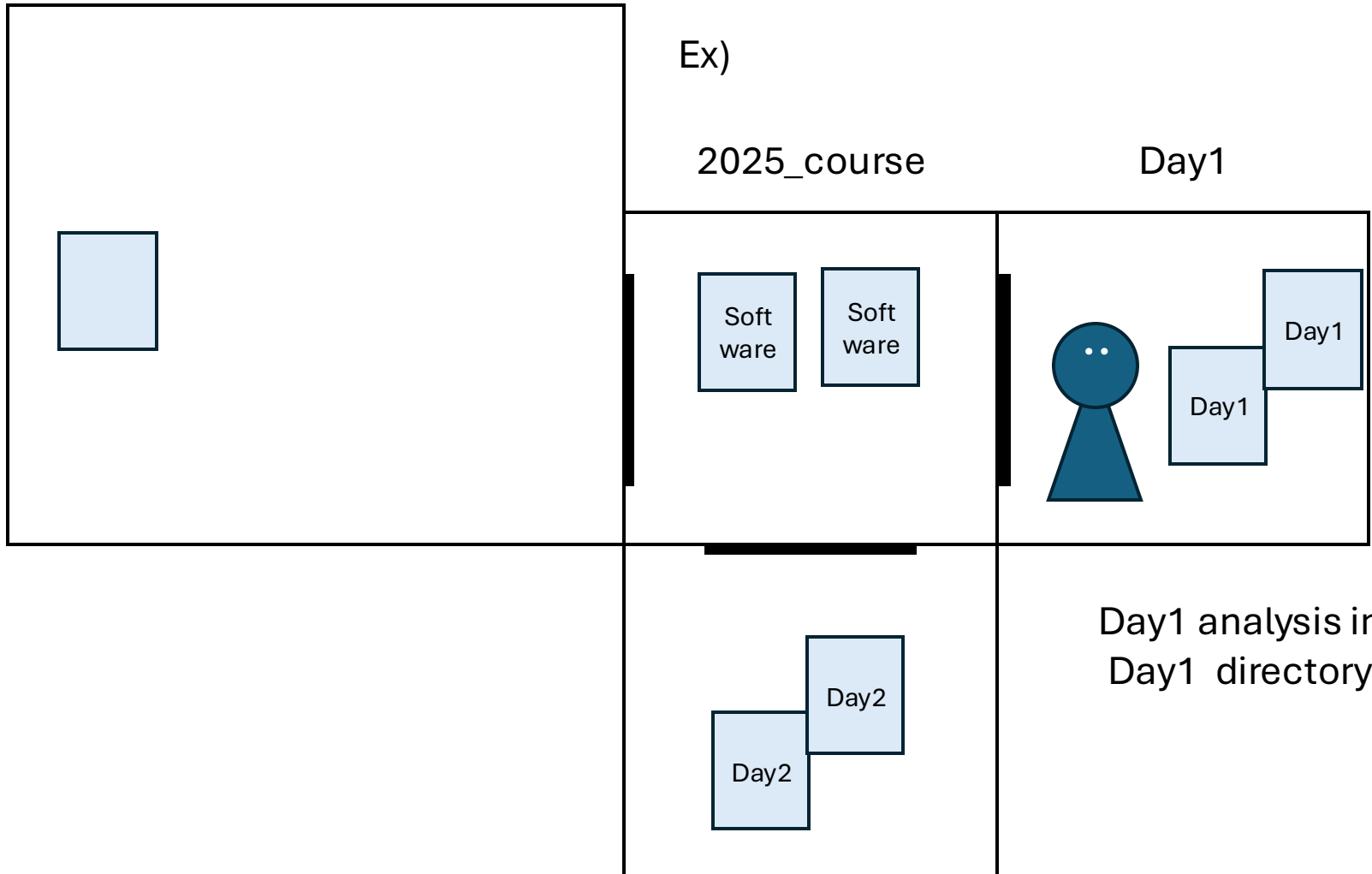
Hierarchical structure is ideal

Home directory

Ex)

2025_course

Day1



Day1 analysis in
Day1 directory

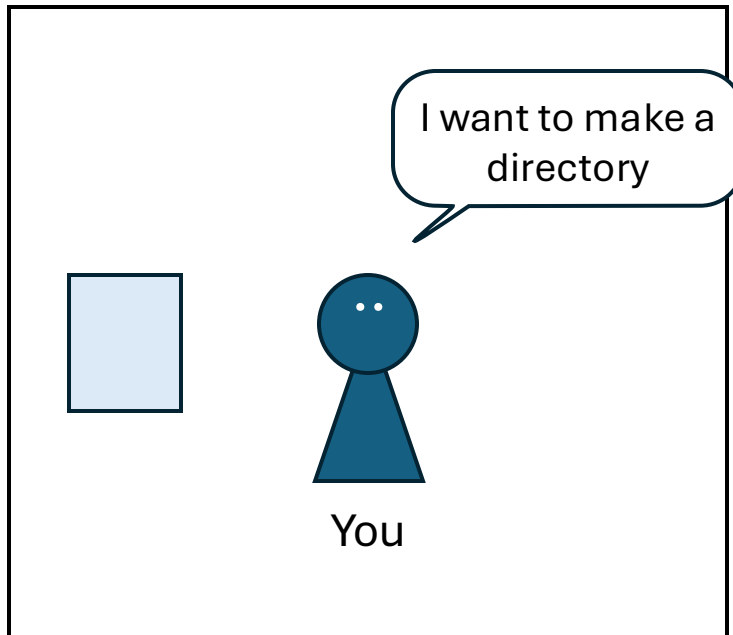
Day2

```
shumpei_yamakawa@cloudshell:~$ mkdir New_directory1
```



Home directory

Any name is okay

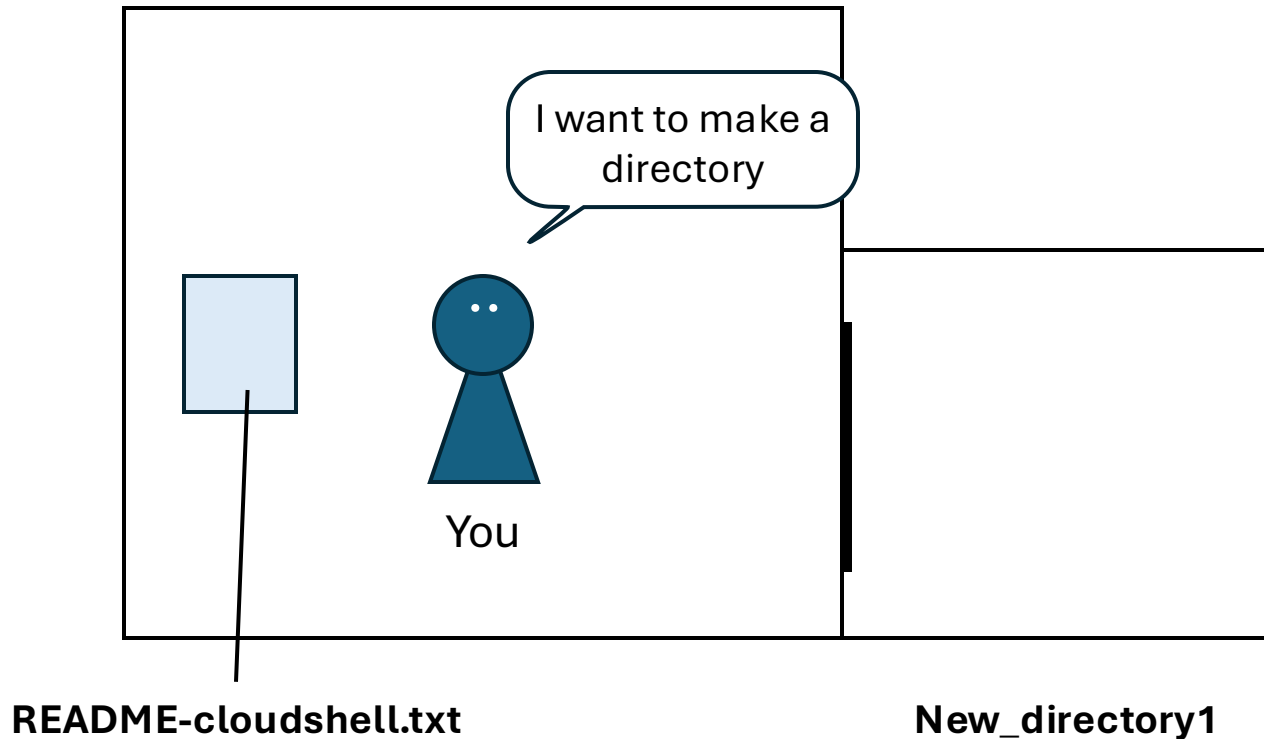


= mkdir

Check the directory by the command ls

```
shumpei_yamakawa@cloudshell:~$ mkdir New_directory1  
shumpei_yamakawa@cloudshell:~$ ls  
New_directory1  README-cloudshell.txt
```

Home directory



Check the directory by the command ls

```
shumpei_yamakawa@cloudshell:~$ cd New_directory1
```

↑
Directory or PATH that
you want to go

Home directory

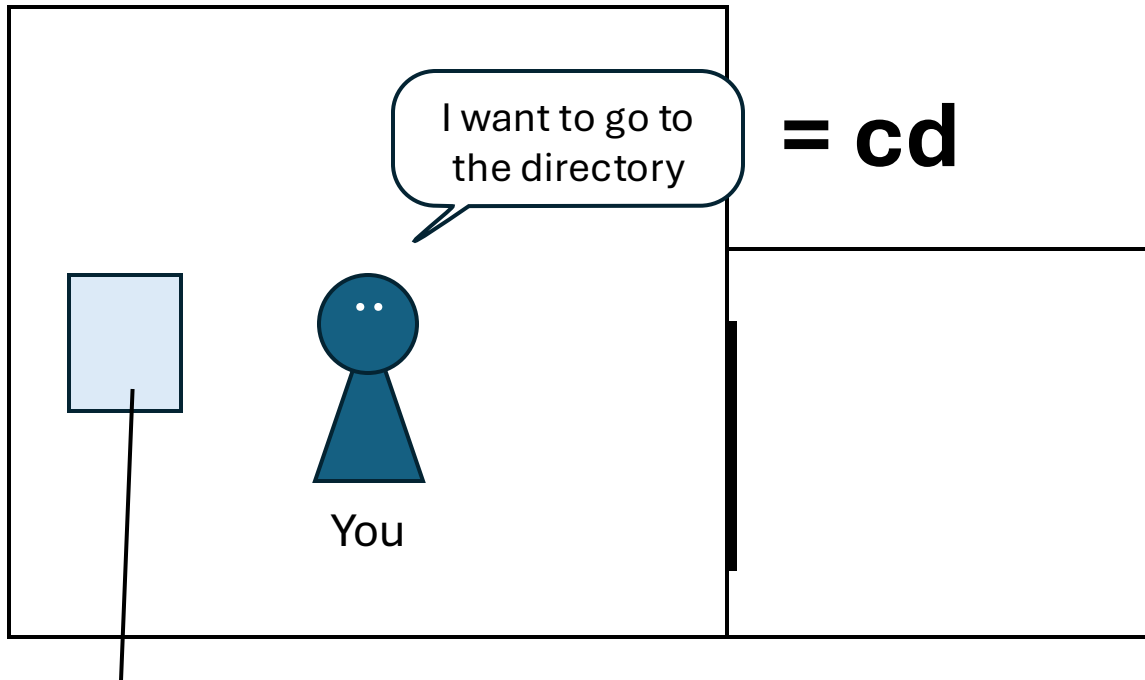
I want to go to
the directory

= cd

You

README-cloudshell.txt

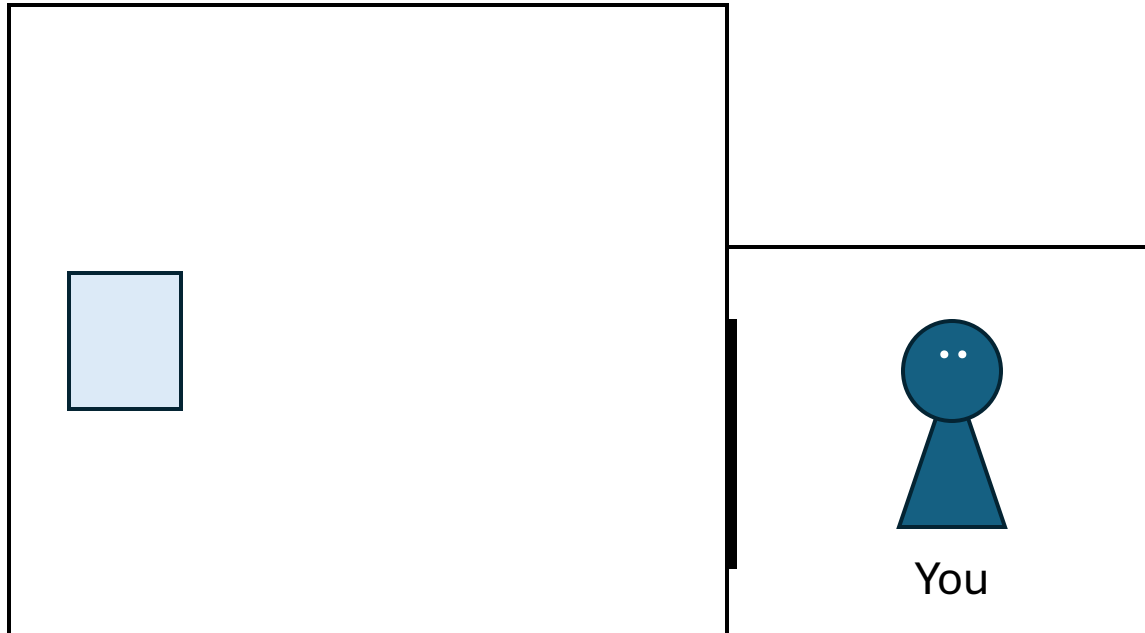
New_directory1



Check the directory by the command ls

```
shumpei_yamakawa@cloudshell:~$ cd New_directory1/  
shumpei_yamakawa@cloudshell:~/New_directory1$ pwd  
/home/shumpei_yamakawa/New_directory1
```

Home directory



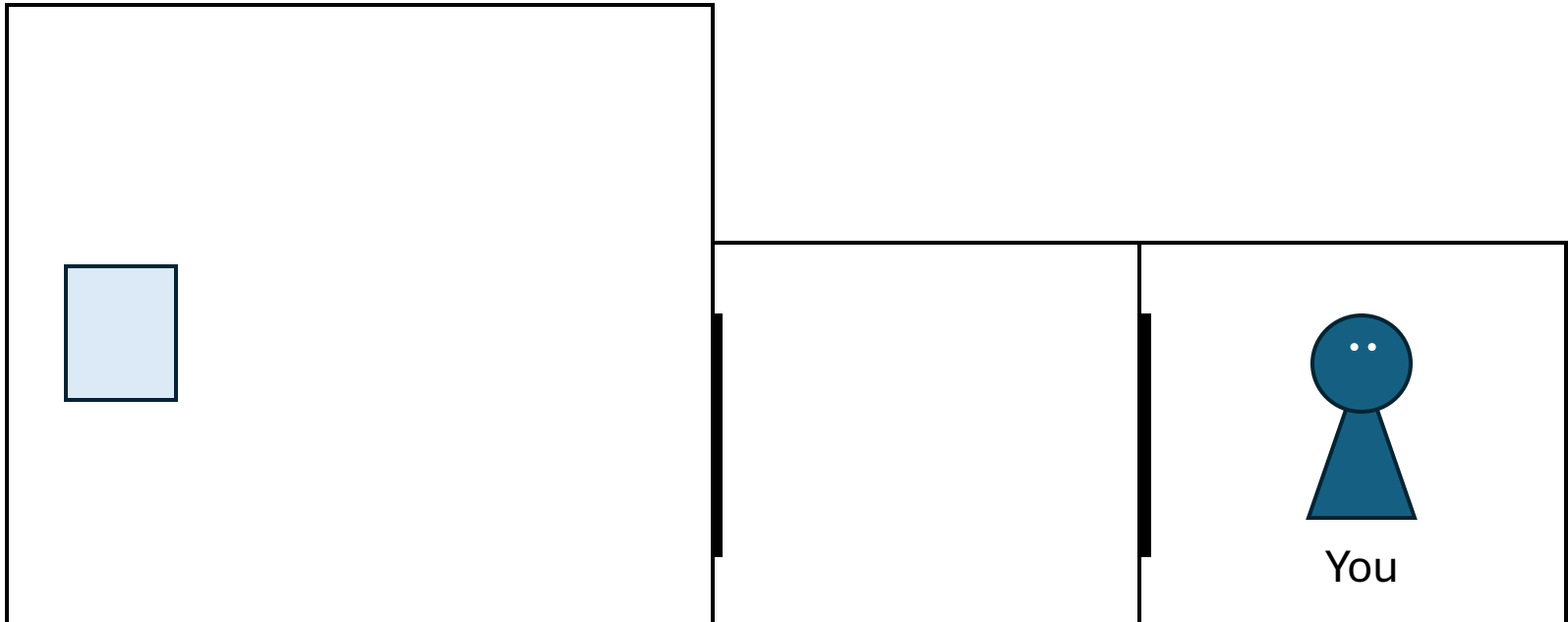
New_directory1

**/home/shumpei_yama
kawa/**

**/home/shumpei_yama
kawa/New_directory1**

Exercise1

Make a new directory and move into there



Home directory

/home/shumpei_yama
kawa/

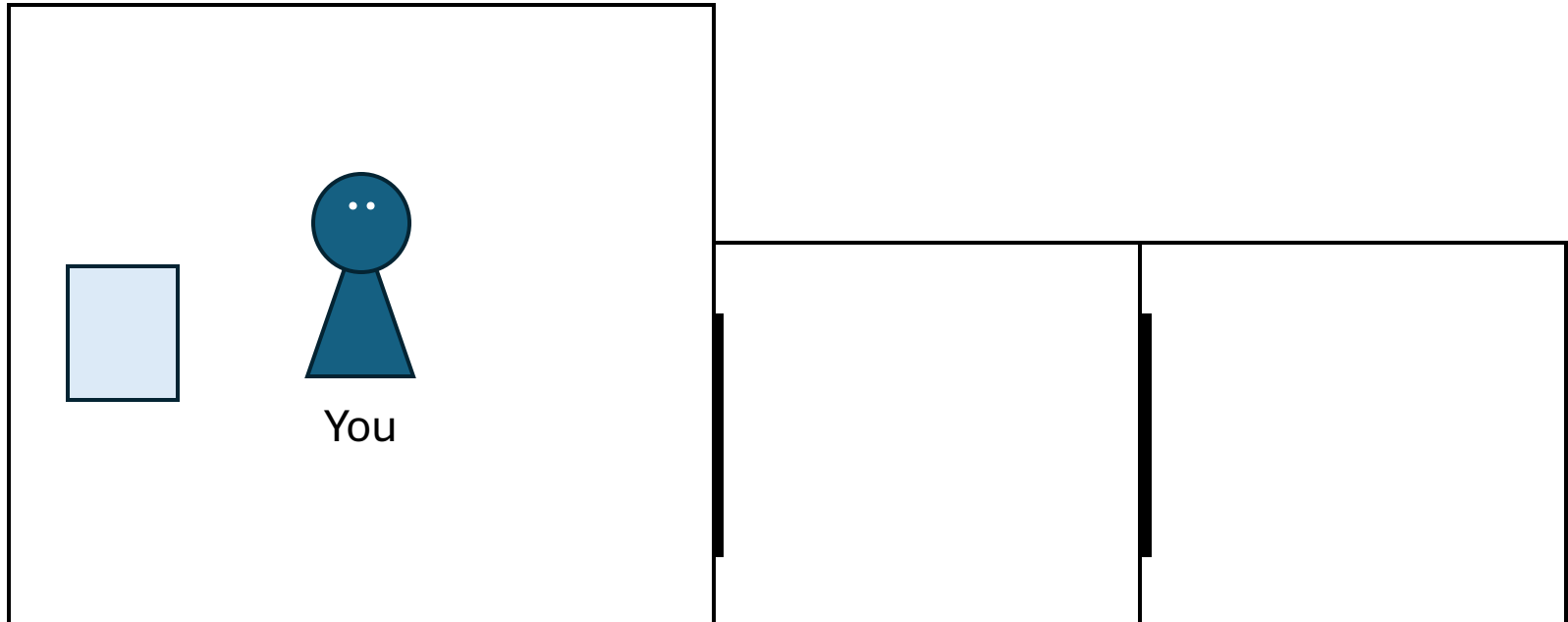
New_directory1

/home/shumpei_yama
kawa/New_directory1

New_directory2

Exercise2

Go back to the home directory



Home directory

/home/shumpei_yama
kawa/

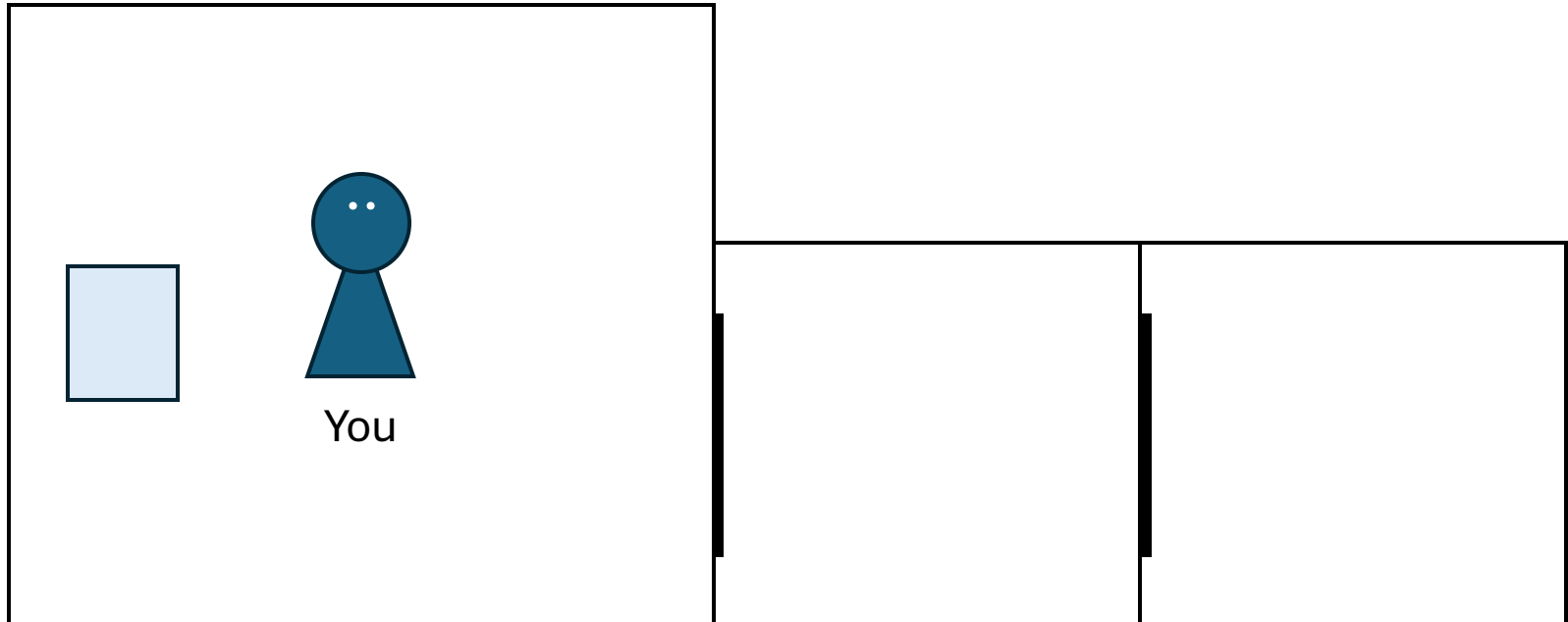
New_directory1

/home/shumpei_yama
kawa/New_directory1

New_directory2

Exercise2

Go back to the home directory



Home directory

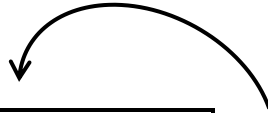
/home/shumpei_yama
kawa/

New_directory1

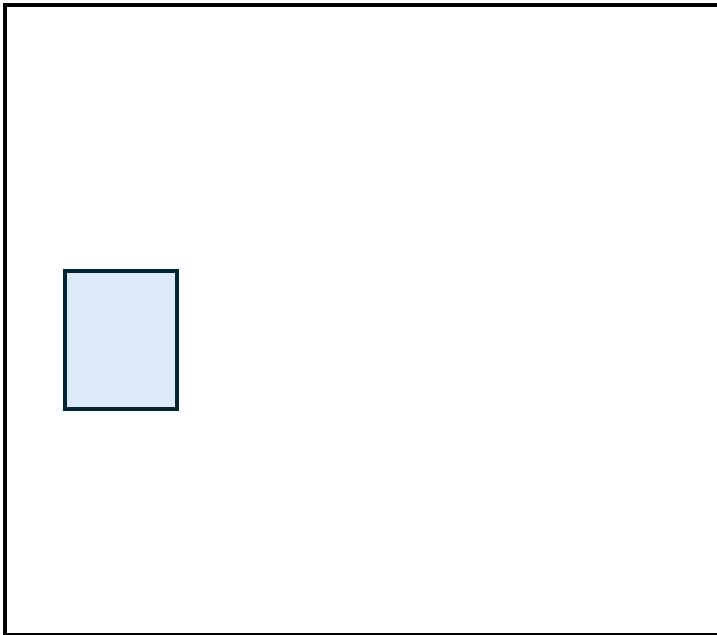
/home/shumpei_yama
kawa/New_directory1

New_directory2

cd ..

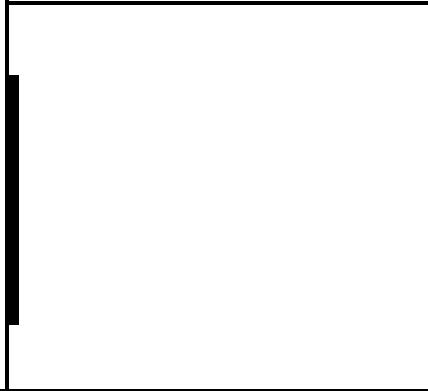


cd ..



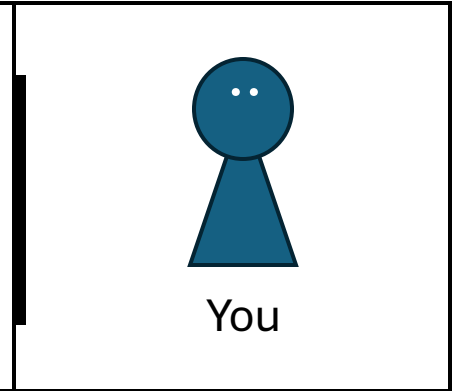
Home directory

/home/shumpei_yama
kawa/



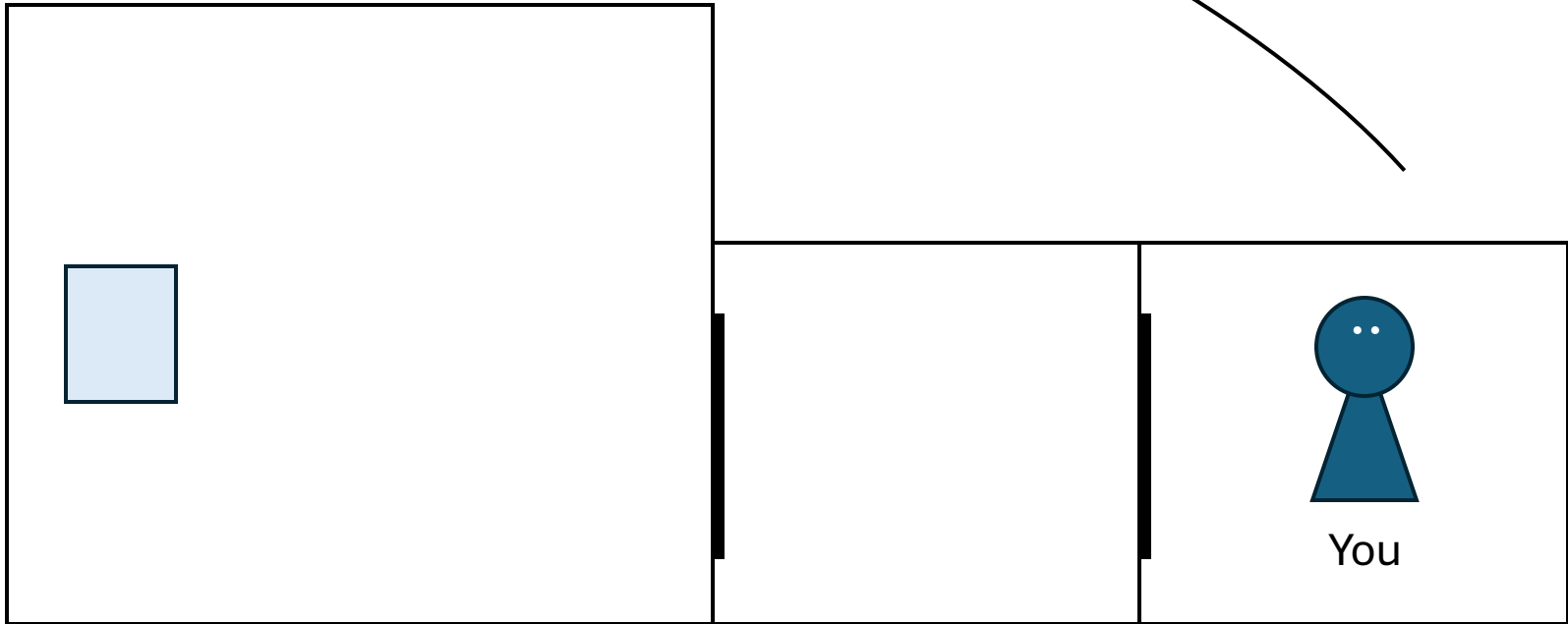
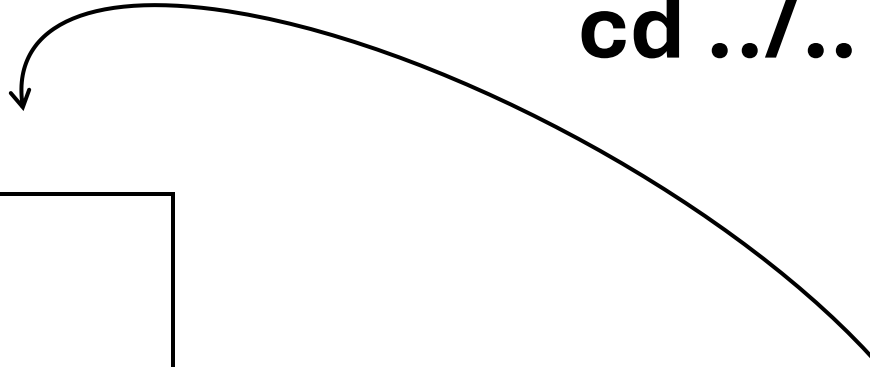
New_directory1

/home/shumpei_yama
kawa/New_directory1



New_directory2

cd ../..



Home directory

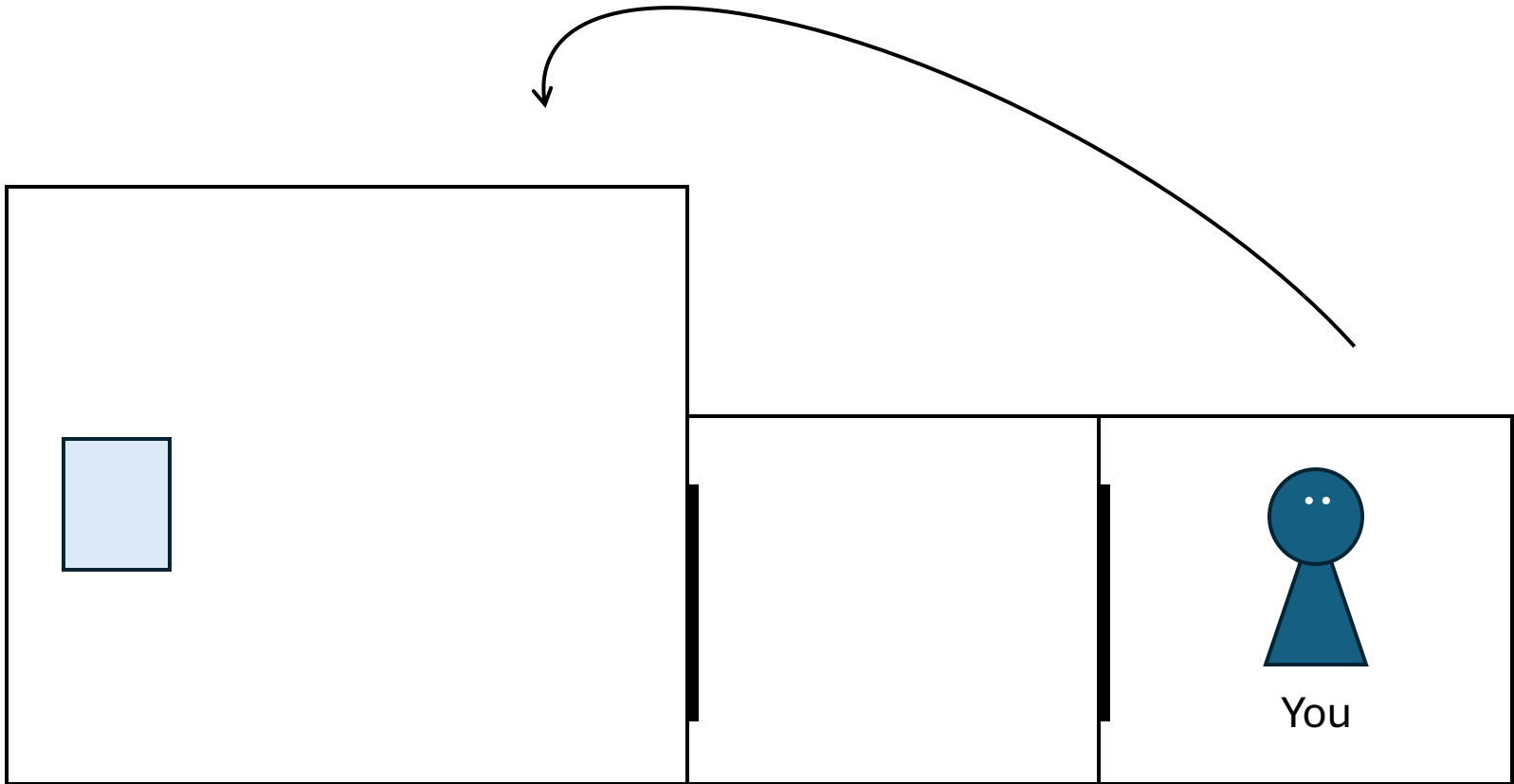
/home/shumpei_yama
kawa/

New_directory1

/home/shumpei_yama
kawa/New_directory1

New_directory2

cd /home/shumpei_yamakawa



Home directory

/home/shumpei_yama
kawa/

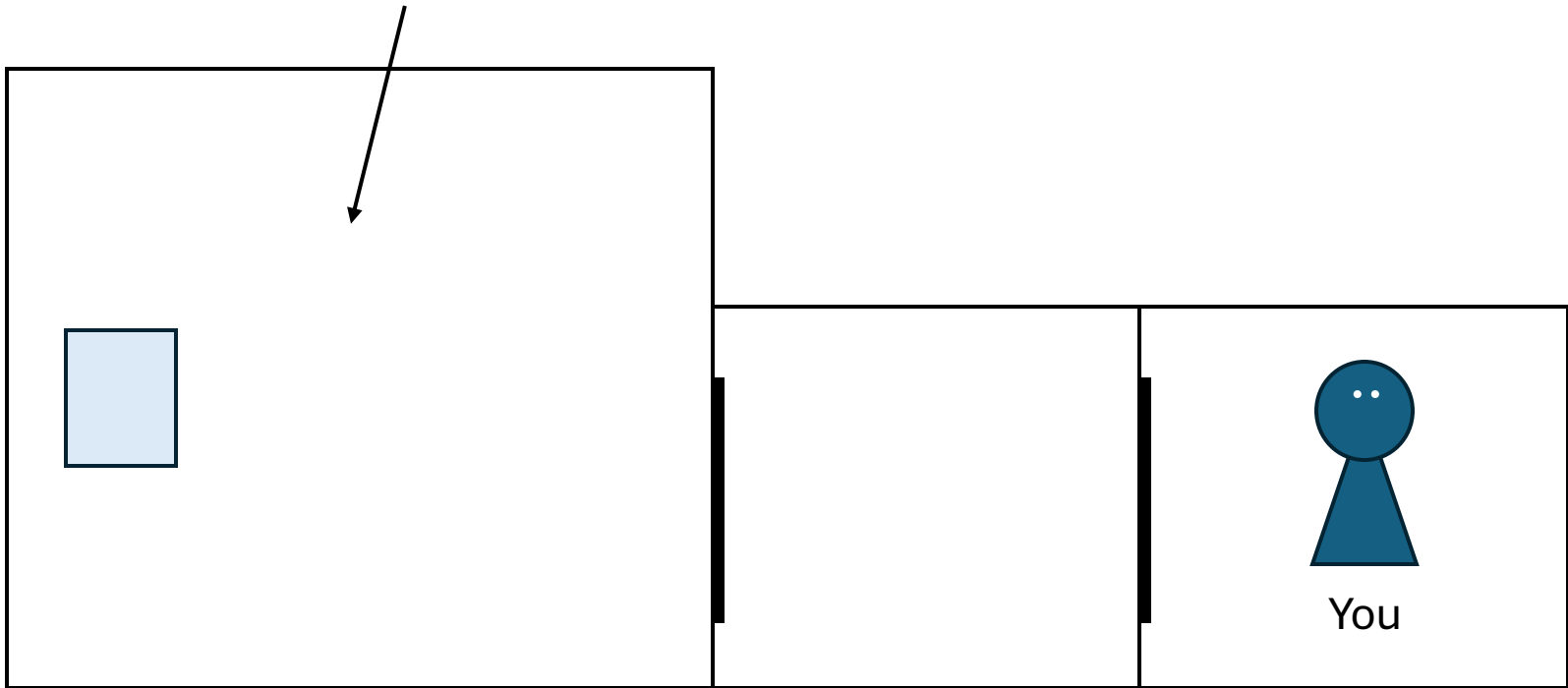
New_directory1

/home/shumpei_yama
kawa/New_directory1

New_directory2

Absolute path `../..`

Relative path `/home/shumpei_yamakawa`



Home directory

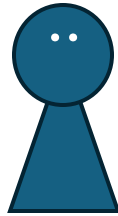
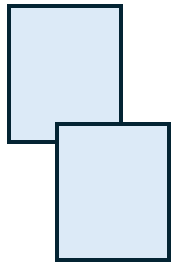
`/home/shumpei_yama
kawa/`

New_directory1

`/home/shumpei_yama
kawa/New_directory1`

New_directory2

2. Basic commands and specific analysis software



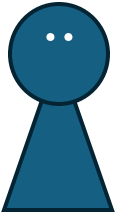
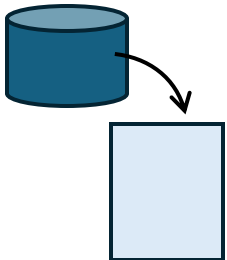
I wan to copy the
file

= cp



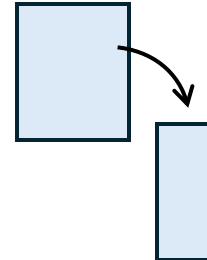
I wan to delete
the file

= rm



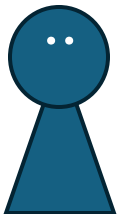
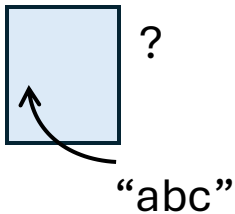
Download the
file from url

= wget



Edit the file
content

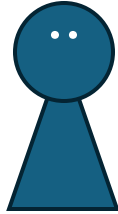
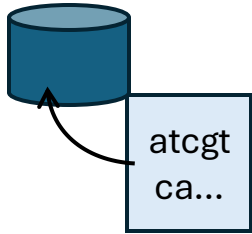
= awk



Search specific
words in the file

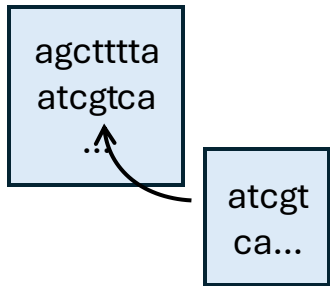
= grep

Various basic commands
are already prepared



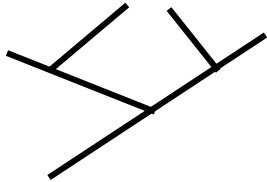
I want to make a
Blast database

= makeblastdb



Search specific
sequences

= seqkit grep



Make a
phylogenetic tree

= raxml

Need to download
specific software for
bioinformatic analysis

/usr/bin/

Executable files (binary)

```
aa-enabled          enc2as              leasgroy            pinentry-curses    ss
aa-essc             encguess            libnetcfg            ping                ssh
aa-features-abi     env                 libtoolize            ping4               ssh-add
aclocal              envsubst            link                  ping6               ssh-agent
aclocal-1.16         eqn                  linux32                pinky               ssh-argv0
acpid                eb                   linux64                pip                 ssh-copy-id
add-apt-repository   ar3.2                linux-check-removal    pip3.12             ssh-keygen
addpart              arno                 linux-update-symlinks pip3.12             ssh-keyscan
add2line             atags                linux-version          pkaction            stat
alllogd-auth-proxy  atags.emans         ln                      pkcheck             statbuf
anthoscli            atags                lneato                 pkgconf             strace
apropos              expand                lnstat                 pkg-config          strace-log-merge
apt                  apt-get             locale                 pkll                steamrip
apt-add-repository   apt-key             locale-check           pkttyagent          strings
apt-cache            apt-cdrom           localelect             pl2pm               strip
apt-cdrom            apt-config          localdef               pldd                stty
apt-get              apt-key             local-extract          pmap                su
apt-mark             apt-mark            logger                 pod2html            sudo
ar                   ar                  login                  pod2man             sudoedit
arch                 arch                 logintest              pod2text             sudoedit
as                   autoconf            logname                pod2usage            sudoreplay
as                   as                  look                   podchecker           sum
as                   as                   ls                     ps                   supervisorctl
as                   as                   lsattr                 preconv             supervisorord
as                   as                   lsblk                  preenv              sync
as                   as                   lsb_release            printf               syntax_suggest3.2
as                   as                   lscgroup               printf              systemd
as                   as                   lscpu                  printenv             systemd
as                   as                   lsmem                  printenv             systemd-ac-power
as                   as                   lsof                    ps                   systemd-analyze
as                   as                   lslog                   pslog               systemd-ask-passw
as                   as                   lsmem                  pslog               systemd-cat
as                   as                   lsmem                  pslog               systemd-cgls
as                   as                   lsmem                  pslog               systemd-cgroup
as                   as                   lsmem                  pslog               systemd-confext
as                   as                   lsmem                  pslog               systemd-creds
as                   as                   lsmem                  pslog               systemd-cryptenro
as                   as                   lsmem                  pslog               systemd-cryptsetup
as                   as                   lsmem                  pslog               systemd-daemon
as                   as                   lsmem                  pslog               systemd-detect-vi
as                   as                   lsmem                  pslog               systemd-escape
as                   as                   lsmem                  pslog               systemd-firstboot
as                   as                   lsmem                  pslog               systemd-hwdb
as                   as                   lsmem                  pslog               systemd-identif
```

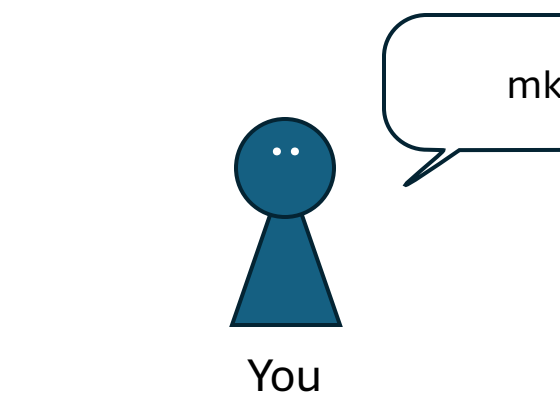


You

/usr/bin/home/

Files for the basic commands such as
Cat, less, makdir, pwd etc are included
in this directory

**Executable files
(binary)**

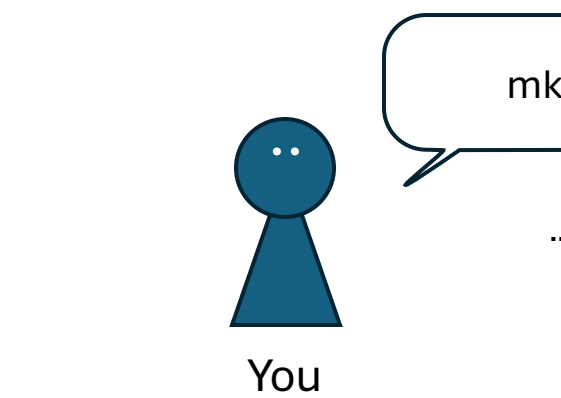


A diagram illustrating a user interaction. On the left, a blue circular icon with two white dots for eyes is positioned above a blue triangular base. Below this icon, the word "You" is written in black text. To the right of the icon, a white speech bubble with a black outline contains the text "mkdir".

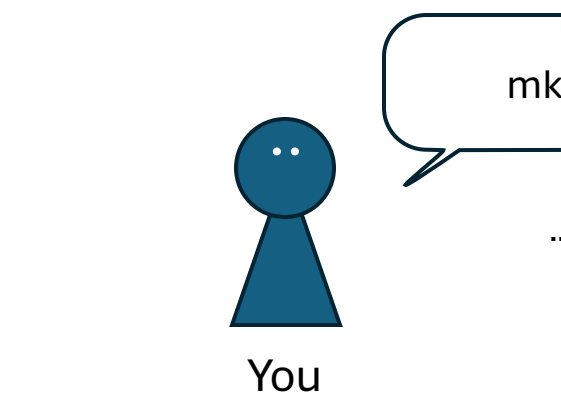
```
shumpei_yamakawa@cloudshell:~$ mkdir
```

aa-enabled	emc2ss	leagrog	p1entry-cursee	as
aa-exec	enquess	libnetcfg	ping	sa
aa-features-abi	eov	libtoolize	pinrg	sah-add
aclocal	envsubst	link	pinrg6	tsah-agent
aclocal-1.16	epn	linux32	pinky	sah-argv0
acrylic	erb	linux4t	pip	sah-copy-id
add-apt-repository	erfb.2	linux-check-removal	p1p3	sah-keygen
adepart	erno	linux-update-symbols	p1p.12	sah-keyscan
adder2line	etags	linux-version	phactition	stat
alloydb-auth-proxy	etags.emacs	in	pkcheck	stdbuf
antosci		lnato	pkgconf	strace
apropos	expand	lnstat	pkgconfig	strace-log-merge
apt	gromms	locale	ptill	streamapp
apt-add-repository	exmp	locale-check	pkttyagent	strings
apt-cache	factor	localescl	p1pm	strip
apt-cdrom	faiilog	localedef	p1pd	sty
apt-config	falllocate	local-extract	psap	SU
apt-get	false	logger	pod2html	Rudd
apt-key	fc-cache	login	pod2man	ruggedit
apt-mark	fc-cat	logintcl	pod2text	audoreplay
ar	fc-confilist	lgname	pod2usage	sum
arch	fc-list	look	podchecker	supervisordctl
as	fc-match	ls	pr	supervisorod
autoconf	lattrr	lsblk	preconv	sync
autobender	fc-query	lsb-release	printmv	sysnec_suggest3.2
automake	fc-scan	lsb_release	printf	systemctl
automake	fc-validate	lsagroup	prlimit	systemd
automake-1.16	fdp	lsapu	protoc	systemd-as-power
autoreconf	fgrep	lsanintrams	prove	systemd-analyze
autoscan	find	lsape	ptstat	systemd-ask-passw
autoupdate	file	lslocks	prune	systemd-cat
avx	findmnt	lslogins	ps	systemd-ctrl
b2num	flock	lsmem	pslog	systemd-otop
base32	fst	lsmod	psql	systemd-confest
base64	fold	lsnc	psrcase	systemd-creds
basename	free	lsppopt	ptrees.k11	systemd-cryptanno
basenc	funzip	lsubytes	ptar	systemd-cryptstatu
bash	fwac	lsu-de	ptardiff	systemd-did
bashbug		lt0-dump-13	ptargrap	systemd-detact-vi
base1	g++	lxc-attach	pts	systemd-escape
bcnaps	gr-g13	lxc-autostart	pwd	systemd-firstboot
bison	gc	lxc-cgroup	pwck	systemd-hacko
bison_yacc		lxc-checkconfig	pwsh	systemd-id128

**Executable files
(binary)**




A diagram illustrating a user interaction. On the left, a blue icon of a person's head and shoulders is labeled "You" below it. To the right of the icon is a speech bubble containing the text "mkdir". A dotted line extends from the right side of the speech bubble towards the right edge of the diagram.




A diagram illustrating a user interaction. On the left, a blue icon of a person's head and shoulders is labeled "You" below it. To the right of the icon is a speech bubble containing the text "mkdir". A dotted line extends from the right side of the speech bubble towards the right edge of the diagram.

mkdir



Ok, I will look for it in /usr/bin



Ok, I will look for it in /usr/bin

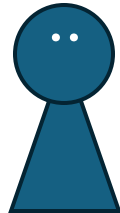
as-enabled	cmc2as	lsagroup	pinentry-curses	as
as-exec	cmcquess	libnatcfg	ping	sah
as-features-abi	env	libtoolize	ping4	sah-add
aslocal	envsubst	link	pinkeygen	sah-agent
aslocal-1.16	egn	linux32	pinkey	sah-argvd
asyclic	esb	linux44	pip	sah-cspp-ld
add-apt-repository	esb3.2	linux-check-removal	pip3	sah-keygen
addapt	erno	linux-update-symlinks	pip3.12	sah-keyscan
add2line	etags	linux-version	pkaction	stat
alloydb-auth-proxy	etags.emacs	ln	pkcheck	stdufb
anthescli	ex	lnaeto	pkgconf	strace
apropos	expand	lnatst	pkg-config	strace-log-merge
apt	expdiff	locale	pill	streaming
apt-add-repository	expr	locale-check	pktyagent	strings
apt-cache	factor	localaclt	pmap	strip
apt-cdrom	fallglo	localdef	pldd	stty
apt-config	falllocate	local-extract	plp	su
apt-get	false	logger	pod2html	sudo
apt-key	fc-cache	login	podman	sudoedit
apt-mark	fc-cat	logintctl	pod2text	sudoreplay
ar	fc-conflist	logname	podusage	sum
arch	fc-list	look	podchecker	supervisord
archo	fc-match	ls	ps	sync
autoconf	fc-pattern	lsattr	preconv	systemd-suggests.2
autoheader	fc-query	lsblk	printenv	systemd
automake	fc-scan	lsb-release	printer	systemd-ask-power
automake-1.16	fc-validate	lsbgroup	priamt	systemd-ask-passw
autoreconf	fdp	lsbpa	protoc	systemd-cat
autoscan	fdpgrp	lsinitramfs	prove	systemd-cgls
autoupdate	file	lsipe	prstat	systemd-cgtop
awk	find	lslocks	prune	systemd-confact
b2sum	findmnt	lslogins	ps	systemd-cored
base32	flock	lsmam	pslog	systemd-cryptantr
base64	fmt	lsmmd	psql	systemd-cryptstat
basenam	fold	lsn	ptar	systemd-delta
basenc	fres	lspgtop	ptree.x11	systemd-detact-vi
bash	funzip	lsusbays	ptar	systemd-escape
bashbug	fuser	lto-dump	ptardiff	systemd-firstboot
basel	fsck	lto-dump-13	ptd	systemd-hwdb
bccomp	g++	lxc-attach	ptx	systemd-id128
bison_yacc	g++-13	lxc-autostart	pwd	
	gcc	lxc-cgroup	pwdc	
	gccgo	lxc-checkconfig	pwdh	

/usr/bin/

Executable files
(binary)

```
aa-enabled      enc2as          leasgroy        pinentry-curses  ss
aa-esc          encguess        libnetcfg        ping             ssh
aa-features-abi env             libtoolize       ping4            ssh-add
aclocal          envsubst        link             ping6            ssh-agent
aclocal-1.16    eqn             linux32           pinky            ssh-argv0
acutils         arb             linux64           pip              ssh-copy-id
add-apt-repository arno            linux-check-removal pip3.12          ssh-keyscan
addpart         arno            linux-update-symlinks pkaction         stat
add2line        atlogb-auth-proxy pkcheck          strace
anthoscli       atlogb          pkgconf          strace-log-merge steamrip
apropos         atlogb          pkgconf          strings
apt             atlogb          pktyagent        strip
apt-add-repository factor          pldd            stty
apt-cache       faillog         pod2html         sudo
apt-cdrom       faillog         pod2man          sudoedit
apt-config      faillog         pod2text         sudoreplay
apt-get         false          pod2usage        sum
apt-key         fc-cache        podchecker       supervisorctl
apt-mark        fc-cat          ps               supervisorord
ar              fc-conflist     preconv          sync
arch            fc-list         printenv         syntax_suggest3.2
as              fc-match        printf           systemd
autoconf        fc-pattern      printf           systemd-ac-power
autoheader       fc-quary        printf           systemd-analyze
automite         fc-scan         printf           systemd-ask-passw
automake         fc-validate     printf           systemd-cat
automake-1.16   fdp            printf           systemd-cgls
autoreconf       file            printf           systemd-cgtop
autoscan         find            printf           systemd-confcat
autoupdate      findmnt         printf           systemd-creds
awk             flock           printf           systemd-cryptenro
b2sum           fmt             printf           systemd-cryptsetup
base32          free           printf           systemd-daemon
base64          fsum           printf           systemd-daemon-vi
basenr          fuser          printf           systemd-escape
bash            g++-13         printf           systemd-firstboot
bashbug         gapplication   printf           systemd-hwdb
base1           gc              printf           systemd-ld128
base1           gc              printf           systemd-ld128
bison           gc              printf           systemd-ld128
bison.yacc      gc              printf           systemd-ld128
```

mkdir



You




PC


Yes, found it.
Let's execute it

/usr/bin/home/


**Executable files
(binary)**



You



The diagram illustrates a basic interaction. On the left, a blue stick figure labeled "You" stands inside a large white rectangle. In the center, a smaller white rectangle is positioned, with a thick black vertical bar on its left side. On the right, a black stick figure labeled "PC" stands outside the rectangles. A speech bubble from the PC contains the text "Here you go". Three orange lines radiate from the top-right corner of the central rectangle towards the PC.



Here you go

aa-enabled	emc2ss	leagrow	pinentry-curses	ss
aa-exec	enoughss	libnetcfg	ping	ssh
aa-features-abi	evv	libnetc	pinseq	ssh-add
aclocal	envsubst	link	pinseq	ssh-agent
aclocal-1.16	epn	linux32	pinky	ssh-argv0
acrylic	erb	linux44	pip	ssh-copy-id
add-apt-repository	erfb.2	linux-check-removal	pip3	ssh-keygen
addapt	erno	linux-update-symlinks	pip3.12	ssh-keyscan
add2line	etags	linux-version	phabricator	stat
alloydb-auth-proxy	etags.emacs	in	pkcheck	stdbuf
antosci	in	inneto	pkconf	strace
apropos	expand	innetat	pkconf	strace-log-merge
apt	gromacs	locale	ptill	streammap
apt-add-repository	empr	locale-check	pktyagent	strings
apt-cache	factor	localeacl	p12pm	strip
apt-cdrom	faillog	localedef	plid	stty
apt-config	faillocate	local-extract	psmp	su
apt-get	false	logger	pod2html	sudo
apt-key	fc-cache	login	pod2man	sudoedit
apt-mark	fc-cat	logintcl	pod2text	sudoreplay
ar	fc-confilist	logname	pod2usage	sum
arch	fc-list	look	podchecker	supervisordctl
as	fc-match	ls	pr	supervisord
autoconf	lattr	lsblk	preconv	sync
autoheader	fc-query	lsb-release	printenv	sysctl suggest3.2
automake	fc-scan	lsb-release	printit	sysctlctl
automake	fc-validate	lsbgroup	prlimit	systemd
automake-1.16	fdp	lscpu	protoc	systemd-ask-power
autoreconf	fgrep	lsinitramfs	prove	systemd-analyze
autoscan	find	lsipc	prstat	systemd-ask-passw
autoupdate	file	lslocks	prune	systemd-cat
avx	findmnt	lslogins	ps	systemd-cgls
b2num	flock	lsmem	pslog	systemd-ctop
base32	fmt	lsmem	psql	systemd-confext
base64	fold	lscn	psutils	systemd-creds
basename	free	lspopnet	ptrees.kill	systemd-cryptenro
basenc	funzip	lsubytes	ptar	systemd-cryptstatu
bash	fwac	lsu-dm	ptardiff	systemd-dm
bashbug	fwadump	lto-dump-13	ptargrap	systemd-detect-vi
base1	g++	lxc-attach	ptx	systemd-escape
bcnaps	gr-rs	lxc-autosetab	pwd	systemd-firstboot
bison	lxc-cgroup	lxc-cgroup	pwdx	systemd-hack
bison_yacc	gc	lxc-checkconfig	pwsh	systemd-id128

**Executable files
(binary)**

A diagram showing a user icon (a blue circle with two dots for eyes on a blue trapezoid base) labeled "You". A speech bubble from the user contains the text "makeblastdb".

A diagram showing a user icon (a blue circle with two dots for eyes on a blue trapezoid base) labeled "You". A speech bubble from the user contains the text "makeblastdb".


```
makeblastdb
```

Ok, I will look for it in /usr/bin


Ok, I will look for it in /usr/bin

aa-enabled	emc2ms	leagroup	pinentry-curses	ss
aa-exec	emcquess	libnetcfg	pingd	ss
aa-features-abi	env	libtoolize	pinkeyd	ssh-add
aclocal	envsubst	link	pinng6	ssh-agent
aclocal-1.16	epn	linux32	pinky	ssh-argv0
acrylic	esb	linux64	pip	ssh-copy-id
add-apt-repository	erbs.2	linux-check-removal	pip3	ssh-keygen
addpart	arino	linux-update-symlinks	pip3.12	ssh-keyscan
add2line	etags	linux-version	phabricator	stat
alloydb-auth-proxy	etags.emacs	in	pkchack	stdbuf
anthoscli	expand	lneato	pkgconf	strace
apropos	expm	lnatst	pkg-config	strace-log-merge
apt	expm	locale	ptail	streamrip
apt-add-repository	factor	locale-check	pktyagent	strings
apt-cache	factor	localaclt	plpmp	strip
apt-cdrom	faillog	localdefn	pldd	stty
apt-config	faillocate	local-extract	pmap	su
apt-get	false	logger	pod2html	sudo
apt-key	fc-cache	login	pod2man	sudedit
apt-mark	fc-cat	logintctl	pod2text	sudoersplay
ar	fc-confliat	logname	pod2usage	sum
arch	fc-list	look	podchecker	supervisorctl
as	fc-match	ls	preconv	supervisor
autoconf	fc-pattern	lsattr	printenv	sync
autoheader	fc-query	lsblk	printf	syntax_suggest3.2
automake	fc-scan	lsb_release	prlimit	systemd
automake	fc-validate	lsgroup	protoc	systemd-ac-power
automake-1.16	fdp	lscpa	prove	systemd-analyze
autoreconf	fdpgrp	lsinitramfs	prstat	systemd-ac-power
autoscan	find	lsnipe	prune	systemd-cat
autoupdate	findmnt	lslocks	ps	systemd-cgls
awk	fio	lslogins	pslog	systemd-cgtop
b2sum	flock	lsmem	psql	systemd-confext
base32	fmt	lsmem	psx	systemd-crypten
base64	fold	lsnipe	ptar	systemd-cryptsetup
basenano	free	lspgtop	ptardiff	systemd-delta
basenc	funsip	lsusbays	ptdirdiff	systemd-detect-vi
bash	fuser	lto-dump	ptx	systemd-escape
bashbug	fusermount3	lto-dump-13	pwd	systemd-firstboot
base1	g++	lxc-attach	pwdx	systemd-hwdb
bccomp	g++13	lxc-autostart	pwsh	systemd-id128
bc	gccgo	lxc-cgroup		
bison_yacc	gccgo	lxc-checkconfig		

**Executable files
(binary)**




A diagram showing a blue stick figure representing a user. Below the figure is the text "You". To the right of the figure is a speech bubble containing the text "makeblastdb".



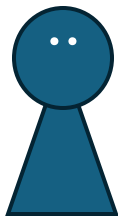
A diagram showing a blue stick figure representing a user. Below the figure is the text "You". To the right of the figure is a speech bubble containing the text "makeblastdb".

```
graph TD
    A[makeblastdb] --> B[blastn]
    B --> C[blastp]
```




No, I cannot find it...

**Executable files
(binary)**



You



blast

**Executable file of
blast**

Place the file into different directory

/usr/bin/

Executable files
(binary)

```
aa-enabled          enc2as              leasgroy            pinentry-curses    ss
aa-essc             encguess            libnetcfg            ping                ssh
aa-features-abi     env                 libtoolize           ping4               ssh-add
aclocal             envsubst            link                  ping6               ssh-agent
aclocal-1.16        eqn                 linux32               pinky               ssh-argv0
acpkg               esb                 linux64               pip                 ssh-copy-id
add-apt-repository  exrno               linux-check-removal  pip3.12            ssh-keygen
add2line            etags               linux-update-symlinks pkaction            ssh-keyscan
alllogB-auth-proxy etags.emans         ln                    pkcheck             stat
anthoscli           ex                  ineto                 pkgconf             stduf
apropos             expand               inatstat              pkg-config           strace
apt                 apt-get             locale                 pktyagent            strace-log-merge
apt-add-repository  apt-cache           localedef             pldd                 steamrip
apt-cdrom            apt-config          local-extract         pl2pm                strip
apt-get             apt-key             loggerr               pm2pm                stty
apt-mark            ar                  look                   pod2html             sudo
ar                  arch                logname                pod2man              sudoedit
as                   autoconf            look                   pod2text              autoreplay
as                   as                  ls                      pod2usage             sum
as                   autoheader          lsattr                 podchecker            supervisorctl
as                   automake             lsbk                   ps                     supervisorord
as                   automake             lsb_release            preconv              sync
as                   automake             lscgroup               printenv              syntax_suggest3.2
as                   automake-1.16        lscpu                  printf                systemctl
as                   autoreconf           lsdump                 printf                systemd
as                   autoscan             lsof                    printit               systemd-ac-power
as                   autoupdate           lsipc                  prove                  systemd-analyze
as                   awk                  lslocks                 ptstat                systemd-ask-passwd
as                   base32               lsmq                    prune                  systemd-cat
as                   base64               lsmq                    ps                      systemd-cgls
as                   basenr              lsmq                    pslog                  systemd-cgtop
as                   basenc              lsmq                    psq1                    systemd-confcat
as                   bash                 lsmq                    pstree                 systemd-creds
as                   bashlog             lsmq                    pstree.x11             systemd-cryptenro
as                   base1                lsmq                    pter                   systemd-cryptsetup
as                   base2                lsmq                    ptardiff               systemd-daemon
as                   base3                lsmq                    ptargrep               systemd-detect-vi
as                   base4                lsmq                    ptx                     systemd-escape
as                   base5                lsmq                    pwd                      systemd-firstboot
as                   base6                lsmq                    pwck                    systemd-hwdb
as                   base7                lsmq                    pwsh                    systemd-ld128
as                   base8                lsmq                    
```

makeblastdb

blast

Executable file of
blast

Ok, I will look for
it in /usr/bin

You

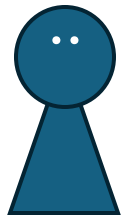
/usr/bin/home/

Directory A

/usr/bin/

Executable files
(binary)

```
aa-enabled          enc2as              leasgroy            pinentry-curses    ss
aa-essc             encguess            libnetcfg            ping                ssh
aa-features-abi     env                 libtoolize           ping4               ssh-add
aclocal             envsubst            link                  ping6               ssh-agent
aclocal-1.16        eqn                 linux32               pinky               ssh-argv0
acpolicy            esb                 linux64               pip                 ssh-copy-id
add-apt-repository  ezrno               linux-check-removal  pip3.12            ssh-keygen
addpart             etags               linux-update-symlinks pkaction            ssh-keyscan
add2line            etags.emacs         log                    pkcheck            stat
alloydb-auth-proxy anthoscli            ln                     pkgconf             statbuf
apropos             expand               in                      pkgconf             strace
apt                 apt-get             ineto                 pkgttyagent         strace-log-merge
apt-add-repository  apt-cache            locale                 pldd                strings
apt                 apt-cdrom            localecheck            pi2pm               strip
apt-config           apt-config            localedef              pldd                stty
apt-get             apt-key              local-extract          pmcap               sudo
apt-mark            ar                   logname                pod2html            sudoedit
ar                  arch                 look                    pod2man             sudoreplay
as                   autoconf             ls                       pod2usage            sum
as                   autoheader           lscat                  podchecker           supervisorctl
as                   automake              lsattr                 preconv             supervisorord
as                   automake              lsbk                    printenv             sync
as                   automake              lsb_release            printf               syntax_suggest3.2
as                   automake              lscgroup               printf               systemd
as                   automake-1.16         lscpu                  printit              systemd-ac-power
as                   autoreconf            ldd                     prove                systemd-analyze
as                   autoscan              ld                       ptstat              systemd-ask-passw
as                   autoupdate            ld64                    prune                systemd-cat
as                   awk                   ldflags                 ps                   systemd-cgls
as                   base32                ldso                     pslog                systemd-cgtop
as                   base64                ldo                      psq                  systemd-confext
as                   basenr               ldo2                     ptrace               systemd-creds
as                   basenc                ldo3                     ptrace.x11           systemd-cryptenro
as                   bash                  ldo4                     pter                 systemd-cryptsetup
as                   bashbug               ldo5                     ptardiff             systemd-delta
as                   basel                 ldo6                     ptargrep             systemd-detect-vi
as                   bc                     ldo7                     ptx                  systemd-escape
as                   bcc                     ldo8                     pwd                   systemd-firstboot
as                   bison                 ldo9                     pwck                  systemd-hwdb
as                   bison.yacc            ldo10                    pwh                  systemd-ld128
```



You

makeblastdb

blast

Executable file of
blast


/usr/bin/home/

Directory A

Ok, I will look for
it in /usr/bin

Check in
directory A, too

**Executable files
(binary)**

[illegible]

You

```
/usr/bin/home/
```

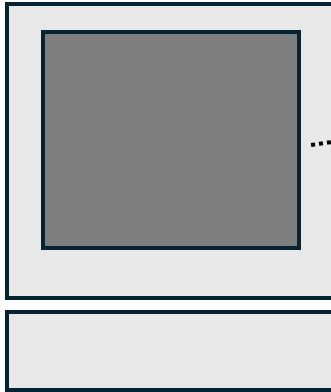
➔ but, the directory is for the basic command lines and may cause conflict with them...

“not recommended”

3. Installing the software

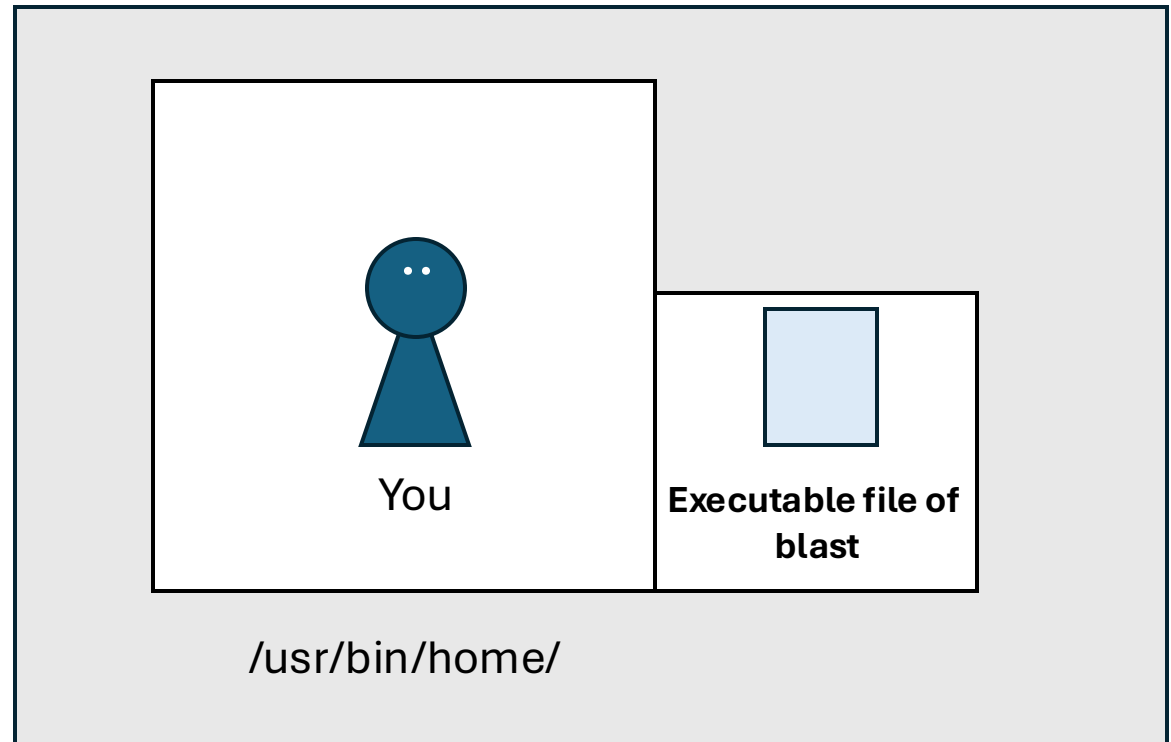
Installing the software

Web online

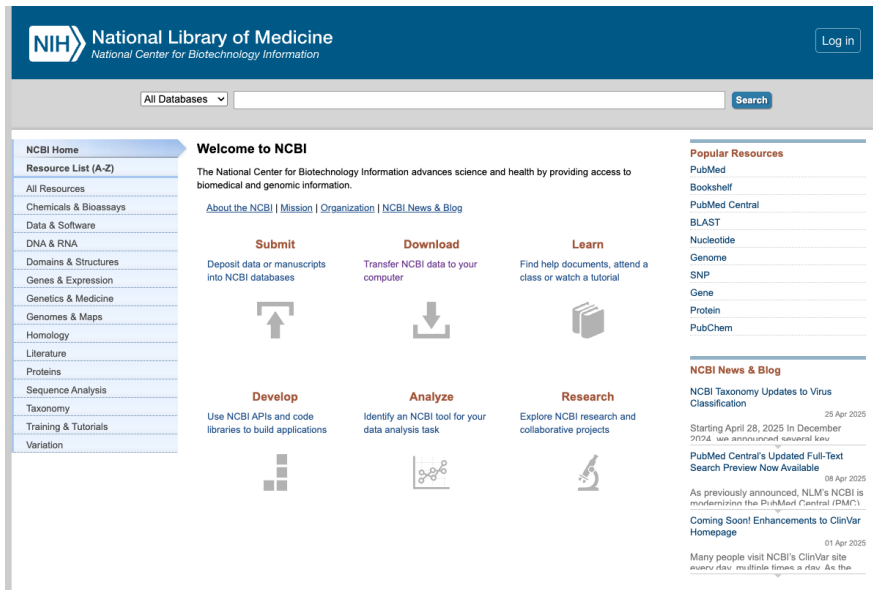


1. **Download the software**
2. **Add a directory to PATH**

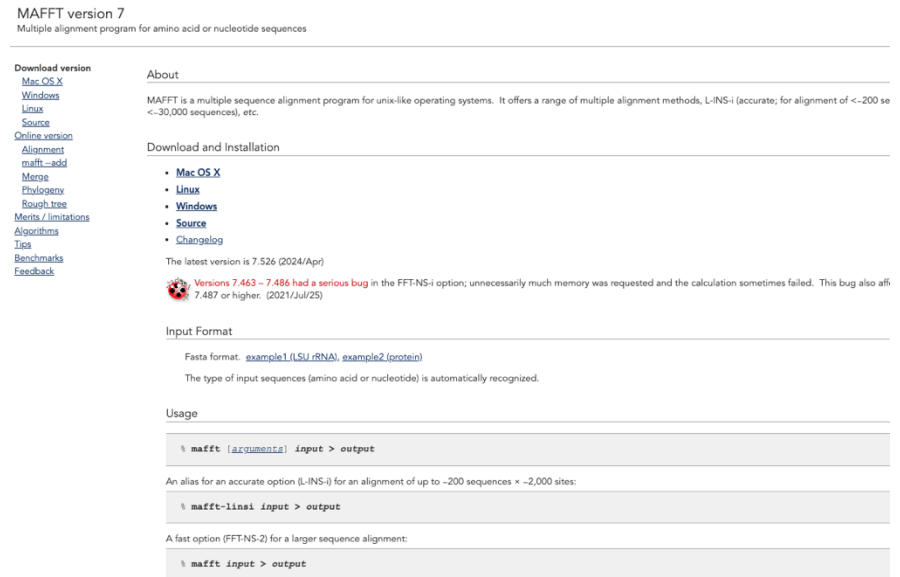
Your local PC (=Cloud Shell)



1. Download the software



Ex) NCBI provides a lot of the tools such as blast, sra-tools, and so on...



Ex) The webpage of MAFFT, an alignment tool

Go to the webpage of the software

All Databases

Search

NCBI Home

Resource List (A-Z)

All Resources
Chemicals & Bioassays
Data & Software
DNA & RNA
Domains & Structures
Genes & Expression
Genetics & Medicine
Genomes & Maps
Homology
Literature
Proteins
Sequence Analysis
Taxonomy
Training & Tutorials
Variation

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Explore NCBI research and collaborative projects



Popular Resources

PubMed
Bookshelf
PubMed Central
BLAST
Nucleotide
Genome
SNP
Gene
Protein
PubChem

NCBI News & Blog

NCBI Taxonomy Update Classification

Starting April 28, 2025 | 2024 was announced so PubMed Central's Update Search Preview Now At

As previously announced, we are announcing the PubMed Central's Update Search Preview Now At

Many people visit NCBI every day, multiple times

Follow the web page...

Basic Local Alignment Search Tool

BLAST finds regions of similarity between biological sequences. The program compares nucleotide or protein sequences to sequence databases and calculates the statistical significance.

[Learn more](#)

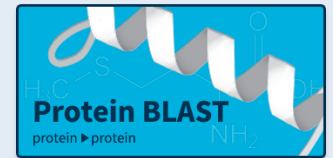
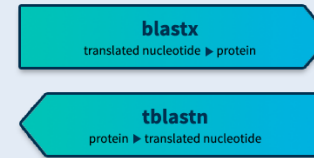
Mon, 17 Mar 2025

Improvements include upgrading to GCP Artifact Registry and better handling of job completion status in kubernetes version 1.30+.

ElasticBLAST 1.4.0 is now available!

[More BLAST news...](#)

Web BLAST



BLAST > [blast-help](#) > Download BLAST Software and Databases

Was this cor

BLAST+ executables

What are the next steps?

Magic-BLAST

IgBLAST

SRPRISM

Databases

BLAST+ executables

Do you have difficulties running high volume BLAST searches? Do you have sequence data to search and cannot use the NCBI BLAST web site? Do you have your own server? Do you have your own research pipeline? Have security or sending searches outside of your organization? If you answered yes to any of these questions, read on!

The NCBI provides a suite of command-line tools to run BLAST called BLAST+. This allows users to perform BLAST searches on their own server without size, volume and database restrictions. BLAST+ can be used with a command line so it can be integrated directly into your workflow.

What are the next steps?

Download and install BLAST+. Installers and source code are available from <https://ftp.ncbi.nlm.nih.gov/blast/executables/blast+/LATEST/>. Download the databases you need, (see database section below), or create your own. Start searching.

For more details, please see the [BLAST+ user manual](#), the [BLAST Help manual](#), the [BLAST releases notes](#), and the article in BMC Bioinformatics ([PubMed link](#)). See our [versioning policy](#).

The BLAST+ suite is the currently supported package. The older C toolkit executables are no longer supported. See our [versioning policy](#).

We are always listening and welcome your feedback at [BLAST Support Center](#).

Standalone and API BLAST



Download BLAST

Get BLAST databases and executables



Use BLAST API

Call BLAST from your application



Use BLAST in the cloud

Start an instance at a cloud provider

Index of /blast/executables/blast+/LATEST

Name	Last modified	Size
Parent Directory		-
ChangeLog	2024-06-25 14:34	85
ncbi-blast-2.16.0+-1.src.rpm	2024-06-25 14:31	21M
ncbi-blast-2.16.0+-1.src.rpm.md5	2024-06-25 14:35	63
ncbi-blast-2.16.0+-1.x86_64.rpm	2024-06-25 14:31	202M
ncbi-blast-2.16.0+-1.x86_64.rpm.md5	2024-06-25 14:35	66
ncbi-blast-2.16.0+-aarch64-linux.tar.gz	2024-07-30 11:04	225M
ncbi-blast-2.16.0+-aarch64-linux.tar.gz.md5	2024-07-30 11:04	74
ncbi-blast-2.16.0+-aarch64-macosx.tar.gz	2024-06-25 14:33	191M
ncbi-blast-2.16.0+-aarch64-macosx.tar.gz.md5	2024-06-25 14:35	75
ncbi-blast-2.16.0+-aarch64.dmg	2024-06-25 14:33	193M
ncbi-blast-2.16.0+-aarch64.dmg.md5	2024-06-25 14:35	65
ncbi-blast-2.16.0+-src.tar.gz	2024-06-25 14:35	27M
ncbi-blast-2.16.0+-src.tar.gz.md5	2024-06-25 14:35	64
ncbi-blast-2.16.0+-src.zip	2024-06-25 14:35	31M
ncbi-blast-2.16.0+-src.zip.md5	2024-06-25 14:35	61
ncbi-blast-2.16.0+-universal-macosx.tar.gz	2024-06-25 14:44	398M
ncbi-blast-2.16.0+-universal-macosx.tar.gz.md5	2024-06-25 14:44	76
ncbi-blast-2.16.0+-universal.dmg	2024-06-25 14:43	400M
ncbi-blast-2.16.0+-universal.dmg.md5	2024-06-25 14:44	66
ncbi-blast-2.16.0+-win64.exe	2024-06-25 14:30	129M
ncbi-blast-2.16.0+-win64.exe.md5	2024-06-25 14:35	63
ncbi-blast-2.16.0+-x64-linux.tar.gz	2024-06-25 14:33	246M
ncbi-blast-2.16.0+-x64-linux.tar.gz.md5	2024-06-25 14:35	70
ncbi-blast-2.16.0+-x64-macosx.tar.gz	2024-06-25 14:35	206M
ncbi-blast-2.16.0+-x64-macosx.tar.gz.md5	2024-06-25 14:35	71
ncbi-blast-2.16.0+-x64-win64.tar.gz	2024-06-25 14:31	133M
ncbi-blast-2.16.0+-x64-win64.tar.gz.md5	2024-06-25 14:35	70
ncbi-blast-2.16.0+-x86_64.dmg	2024-06-25 14:34	208M
ncbi-blast-2.16.0+-x86_64.dmg.md5	2024-06-25 14:35	64

FTP
(File Transfer Protocol)

Index of /blast/executables/blast+/LATEST

Name	Last modified	Size
Parent Directory		-
ChangeLog	2024-06-25 14:34	85
ncbi-blast-2.16.0+-1.src.rpm	2024-06-25 14:31	21M
ncbi-blast-2.16.0+-1.src.rpm.md5	2024-06-25 14:35	63
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ncbi-blast-2.16.0+-src.tar.gz.md5	2024-06-25 14:35	64
ncbi-blast-2.16.0+-src.zip	2024-06-25 14:35	31M
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ncbi-blast-2.16.0+-x64-macosx.tar.gz	2024-06-25 14:35	206M
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ncbi-blast-2.16.0+-x64-win64.tar.gz	2024-06-25 14:31	133M
ncbi-blast-2.16.0+-x64-win64.tar.gz.md5	2024-06-25 14:35	70
ncbi-blast-2.16.0+-x86_64.dmg	2024-06-25 14:34	208M
ncbi-blast-2.16.0+-x86_64.dmg.md5	2024-06-25 14:35	64

FTP
(File Transfer Protocol)

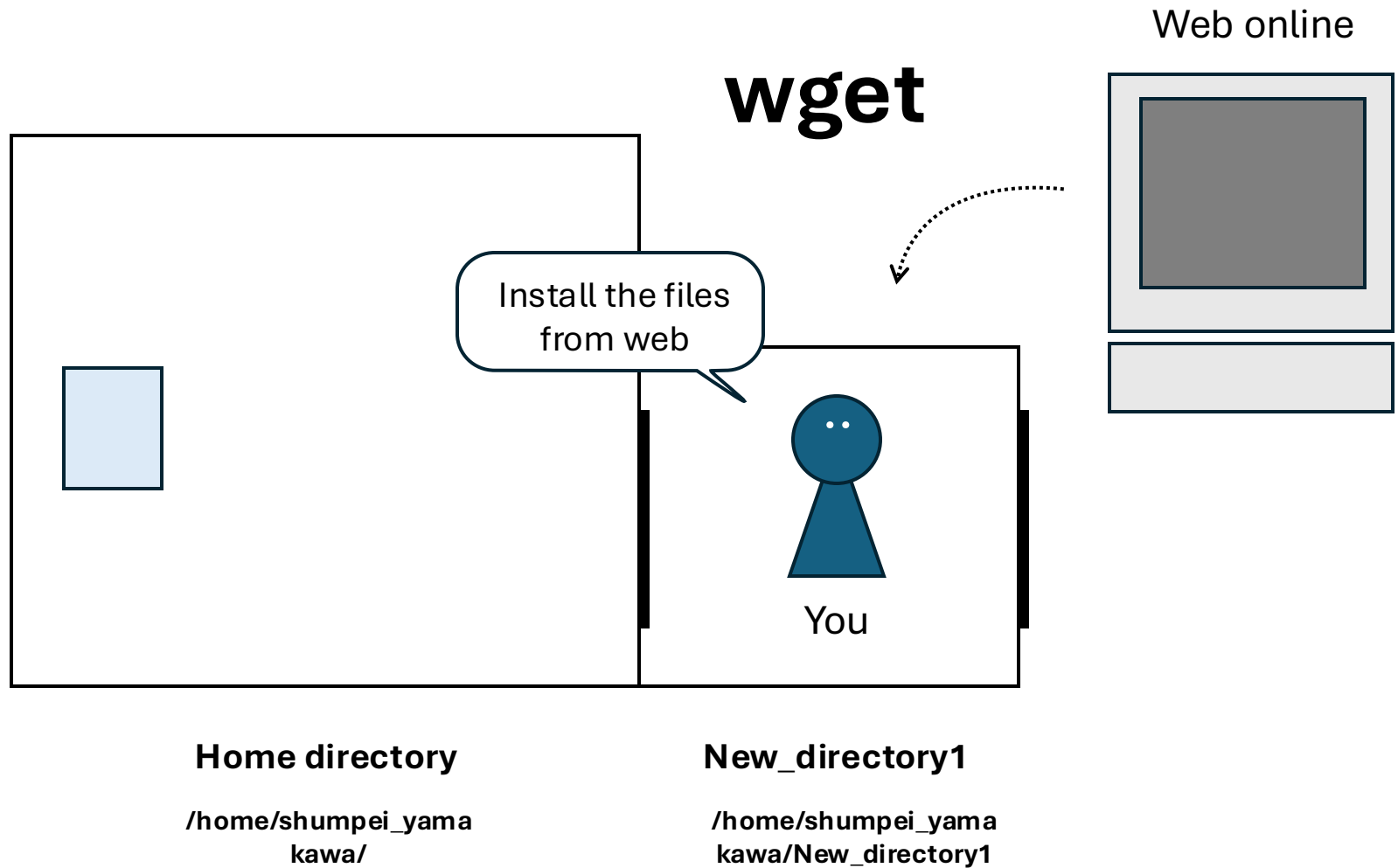
Index of /blast/executables/blast+/LATEST

Name	Last modified	Size
Parent Directory		-
ChangeLog	2024-06-25 14:34	85
ncbi-blast-2.16.0+-1.src.rpm	2024-06-25 14:31	21M
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ncbi-blast-2.16.0+-aarch64-linux.tar.gz.md5	2024-07-30 11:04	74
ncbi-blast-2.16.0+-aarch64-macosx.tar.gz	2024-06-25 14:33	191M
ncbi-blast-2.16.0+-aarch64-macosx.tar.gz.md5	2024-06-25 14:35	75
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ncbi-blast-2.16.0+-x86_64.dmg.md5	2024-06-25 14:35	64

Copy link address

<https://ftp.ncbi.nlm.nih.gov/blast/executables/blast+/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz>

```
~$ wget https://ftp.ncbi.nlm.nih.gov/blast/executables/blast+/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
```

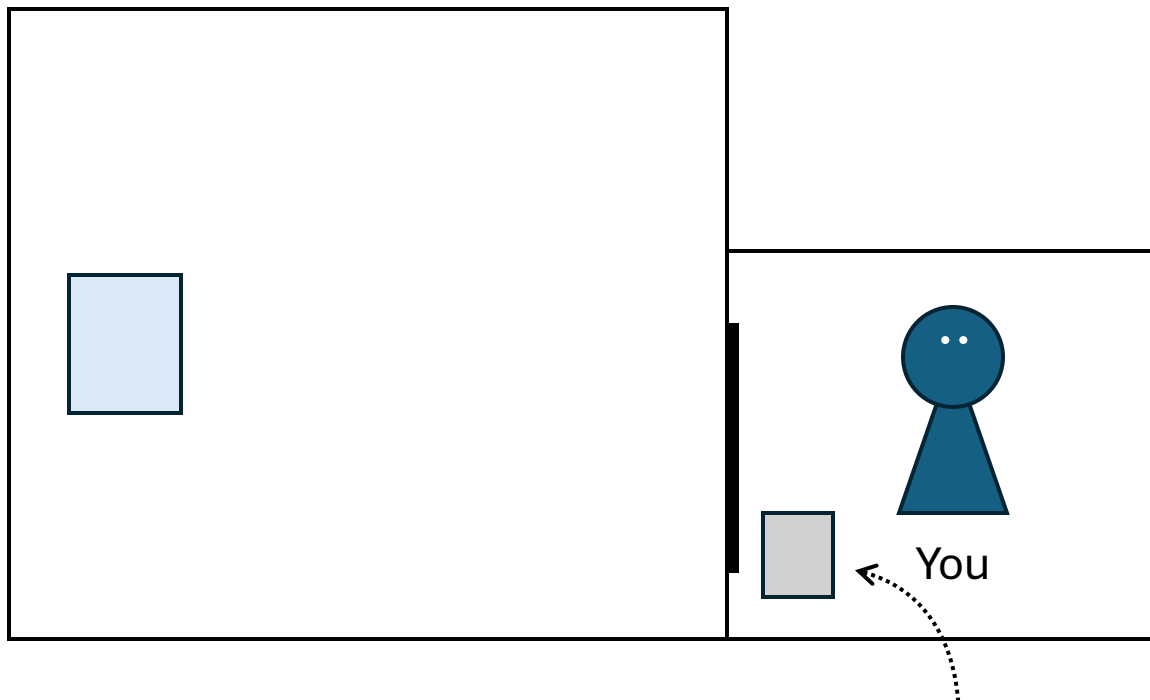


```
shumpei_yamakawa@cloudshell:~$ wget https://ftp.ncbi.nlm.nih.gov/blast/executables/blast+/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
--2025-05-14 13:21:21-- https://ftp.ncbi.nlm.nih.gov/blast/executables/blast+/LATEST/ncbi-blast-2.16.0+-x64-linux.tar.gz
Resolving ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)... 130.14.250.13, 130.14.250.31, 130.14.250.7, ...
Connecting to ftp.ncbi.nlm.nih.gov (ftp.ncbi.nlm.nih.gov)|130.14.250.13|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 257516053 (246M) [application/x-gzip]
Saving to: 'ncbi-blast-2.16.0+-x64-linux.tar.gz'

ncbi-blast-2.16.0+-x64-linux.tar.gz      100%[=====>] 245.59M  14.4MB/s   in 13s

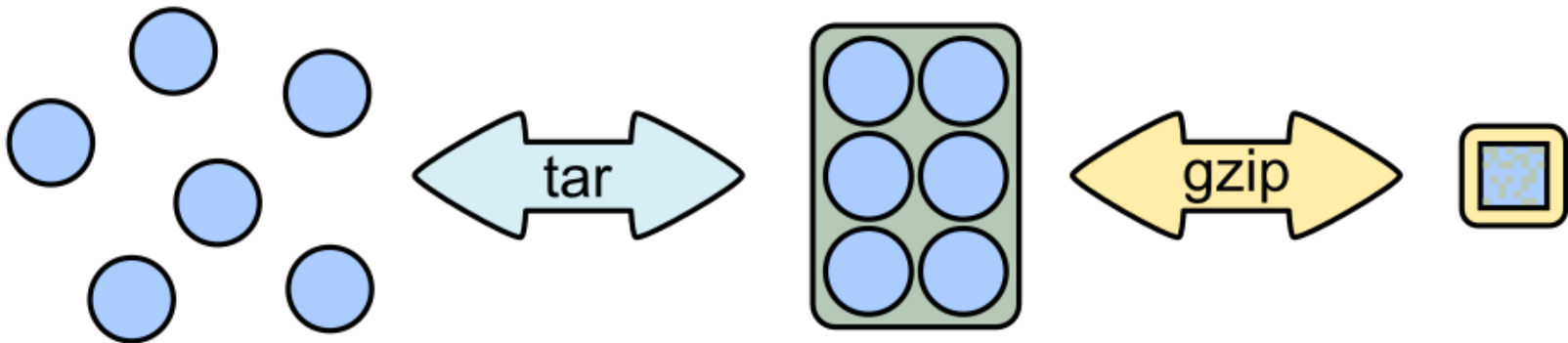
2025-05-14 13:21:35 (18.4 MB/s) - 'ncbi-blast-2.16.0+-x64-linux.tar.gz' saved [257516053/257516053]

shumpei_yamakawa@cloudshell:~$ ls
ncbi-blast-2.16.0+-x64-linux.tar.gz  New directory!  README-cloudshell.txt  test
```



**ncbi-blast-2.16.0+-
x64-linux.tar.gz**

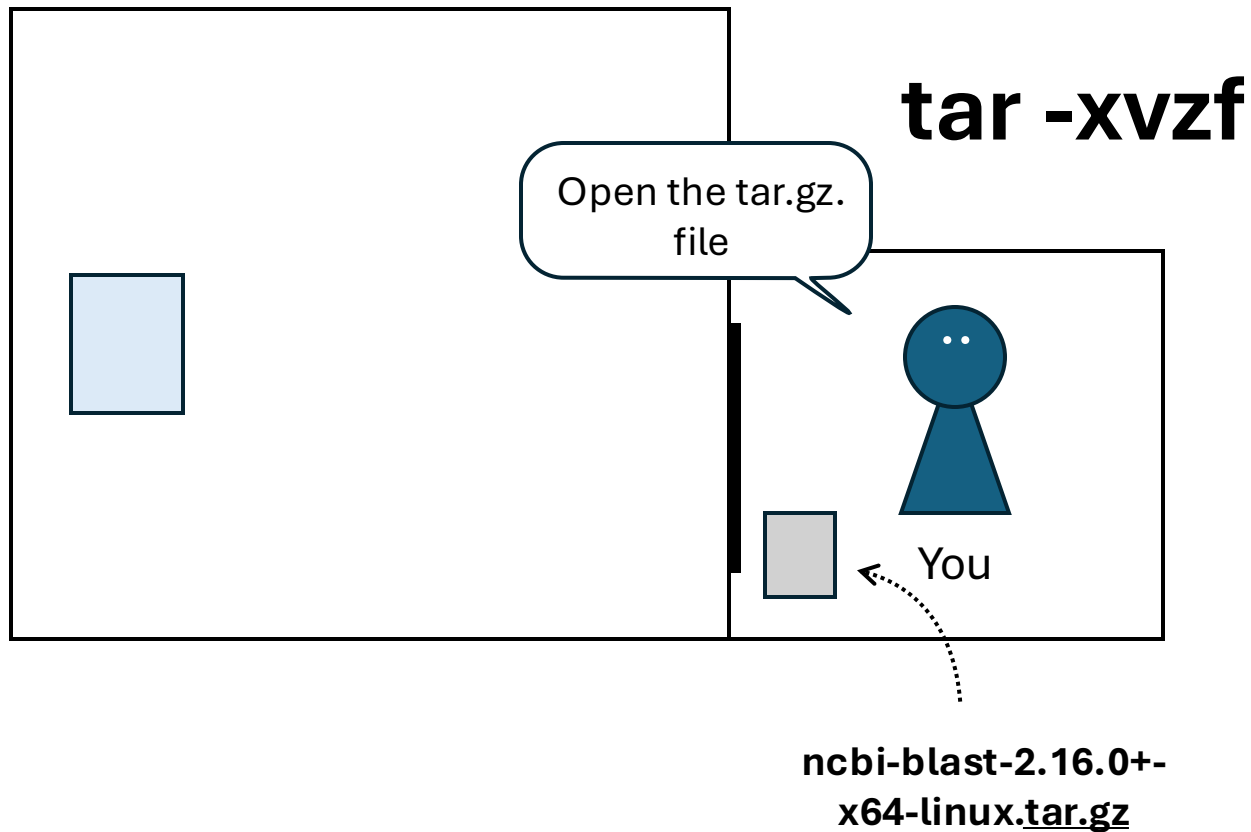
Archive and compress



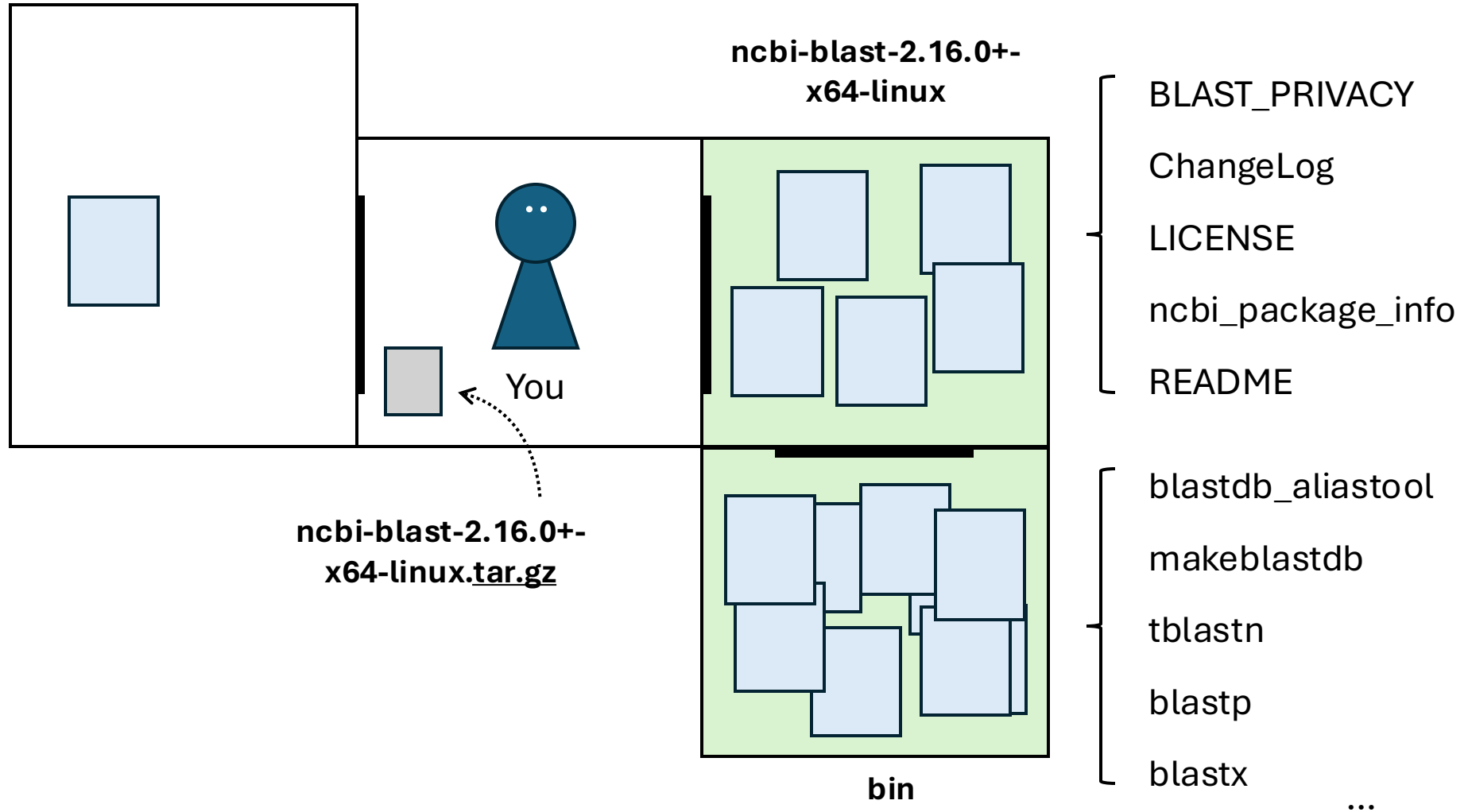
archive

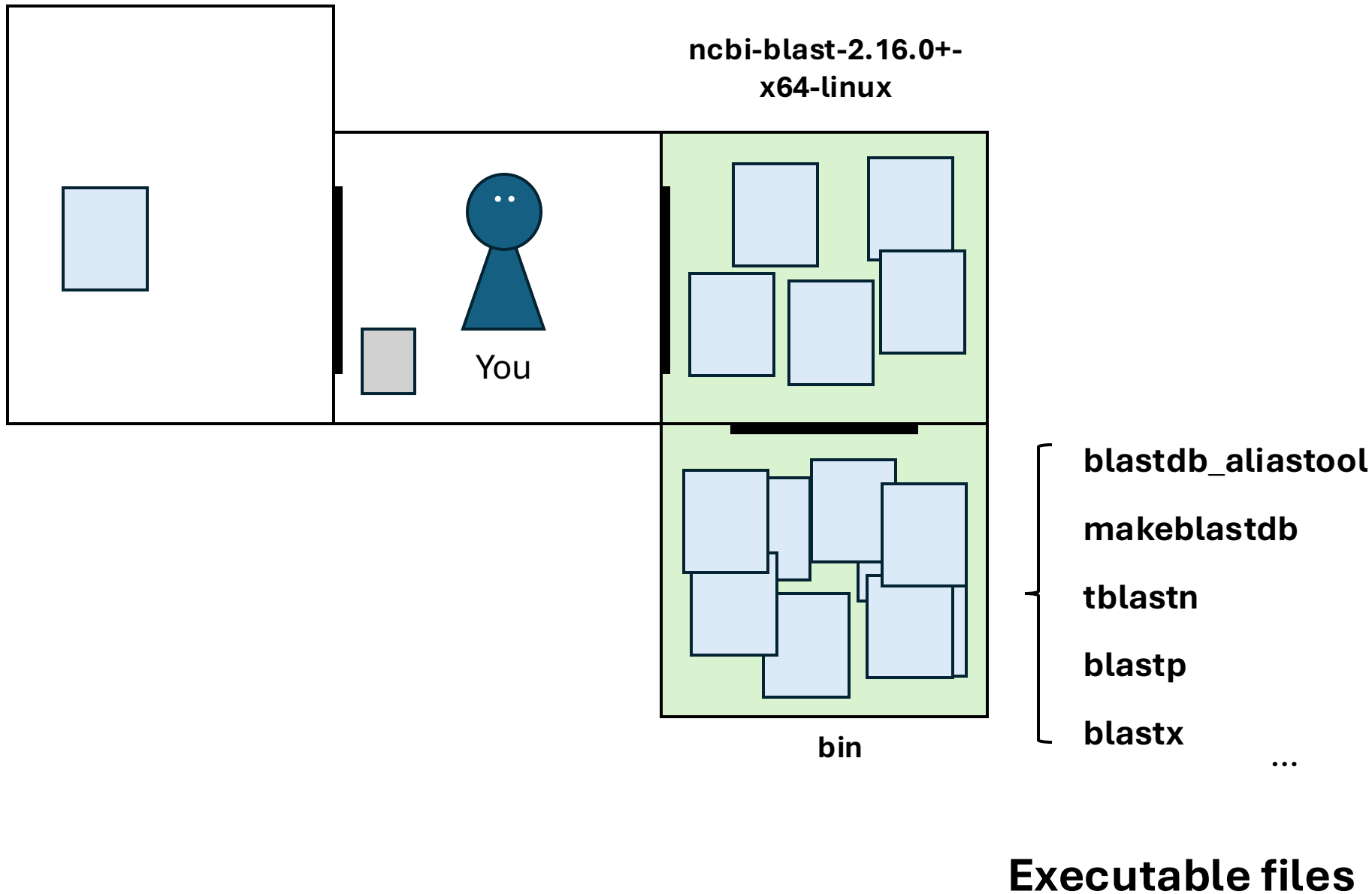
compress


```
~$ tar -xvzf ncbi-blast-2.16.0+-x64-linux.tar.gz
```



```
shumpei_yamakawa@cloudshell:~$ tar -xvzf ncbi-blast-2.16.0+-x64-linux.tar.gz
ncbi-blast-2.16.0+/
ncbi-blast-2.16.0+/ChangeLog
ncbi-blast-2.16.0+/bin/
ncbi-blast-2.16.0+/bin/rpsblast
tar: ncbi-blast-2.16.0+/bin/rpsblast: Wrote only 6656 of 10240 bytes
```





Not always so easy....

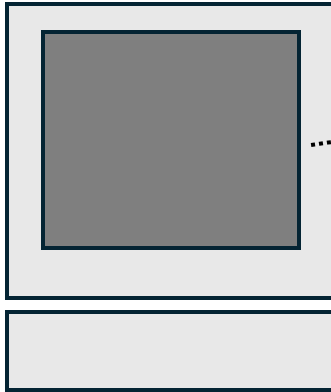
RAXML

```
wget https://github.com/stamatak/standard-RAXML.git
unzip master.zip
cd standard-RAXML-master/
make -f Makefile.gcc
rm *.o
make -f Makefile.SSE3.gcc
rm *.o
make -f Makefile.PTHREADS.gcc
rm *.o
make -f Makefile.SSE3.PTHREADS.gcc
echo 'export PATH="/home/shumpei_yamakawa/test/standard-RAXML-master:$PATH"' >> ~/.bashrc; source ~/.bashrc
```



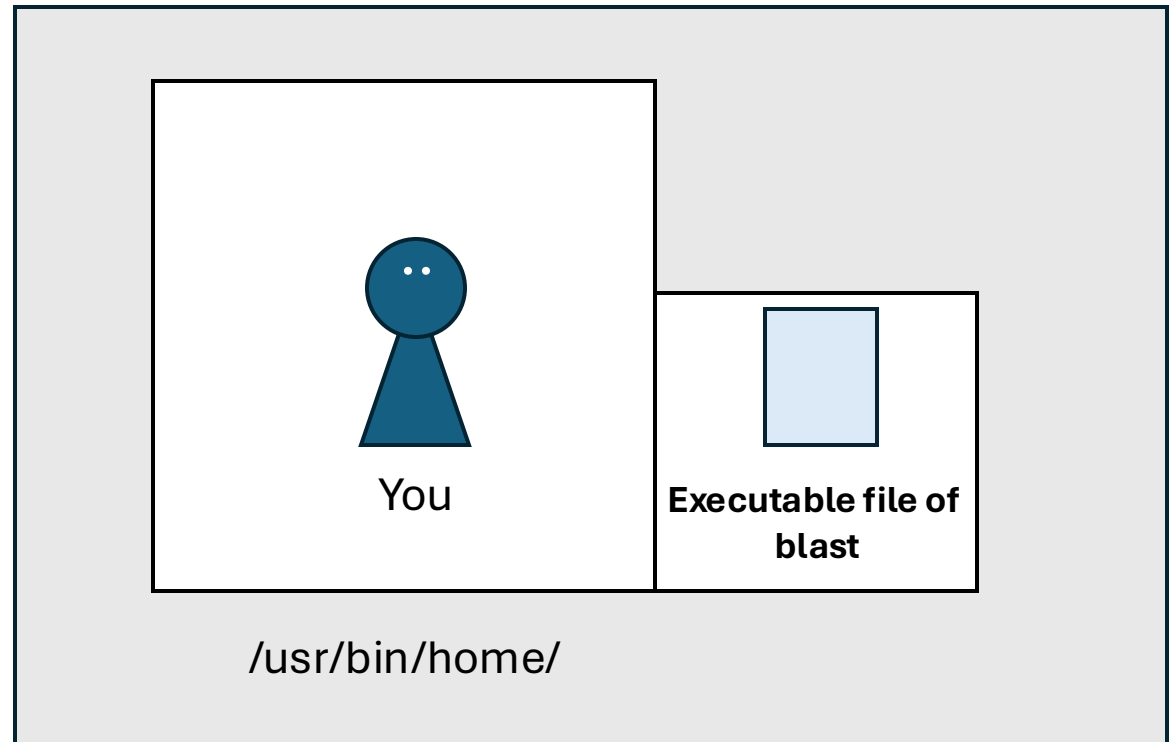
Installing the software

Web online



1. **Download the software**
2. **Add a directory to PATH**

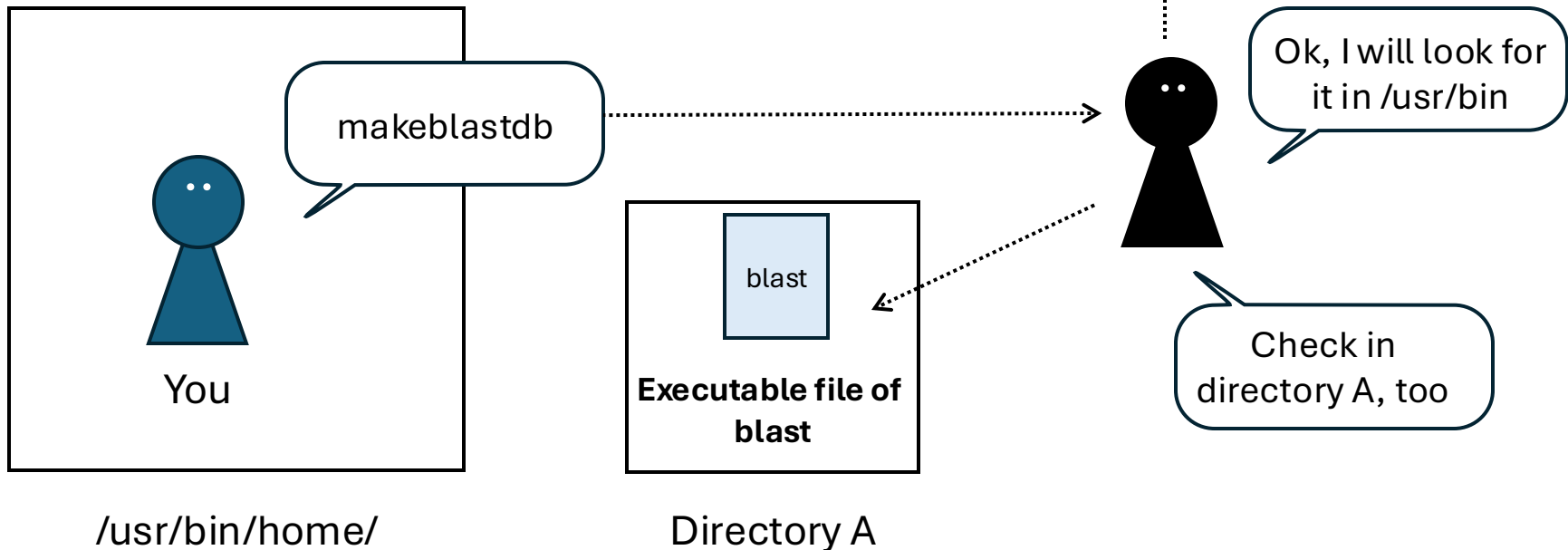
Your local PC (=Cloud Shell)

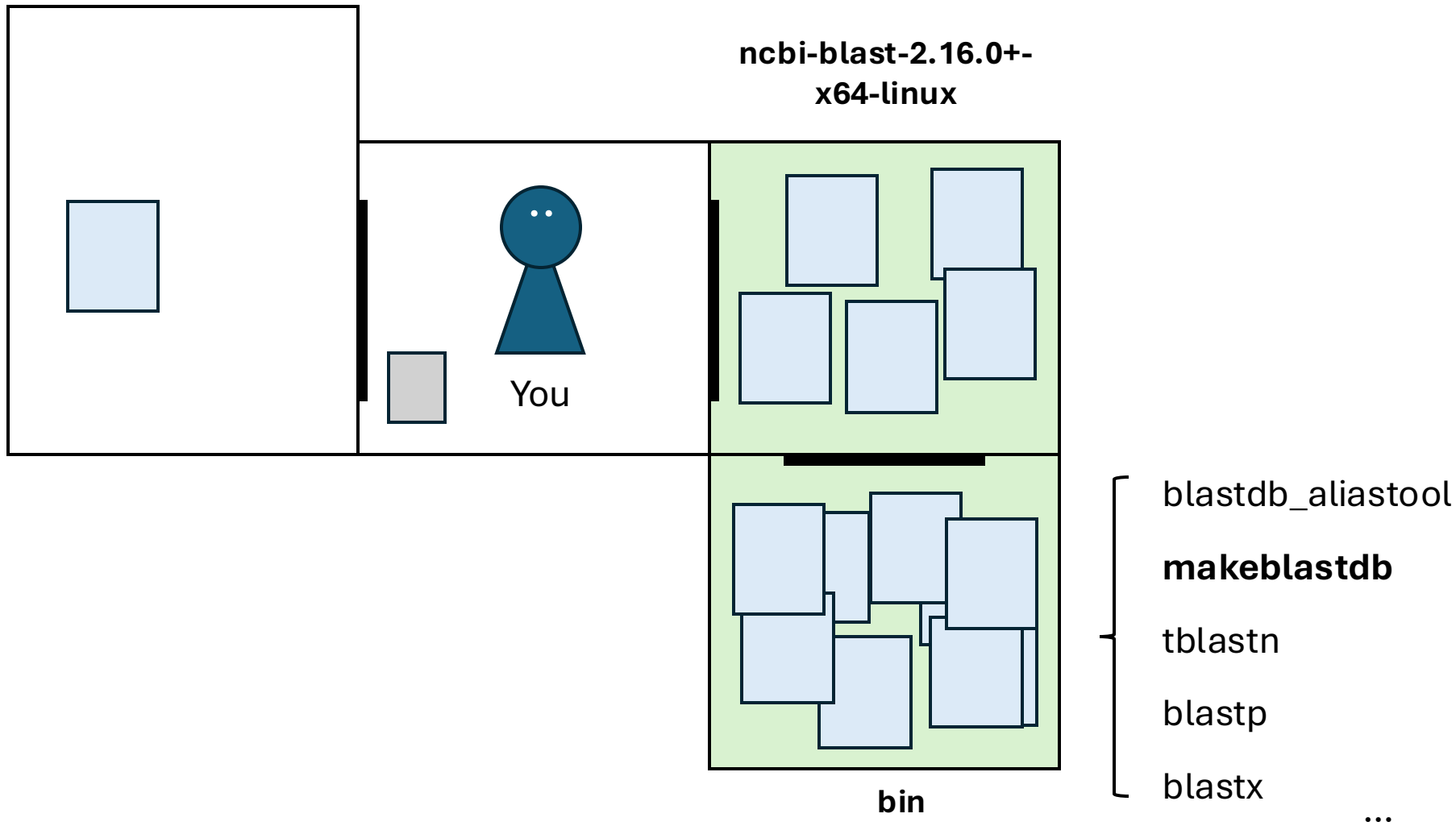


/usr/bin/

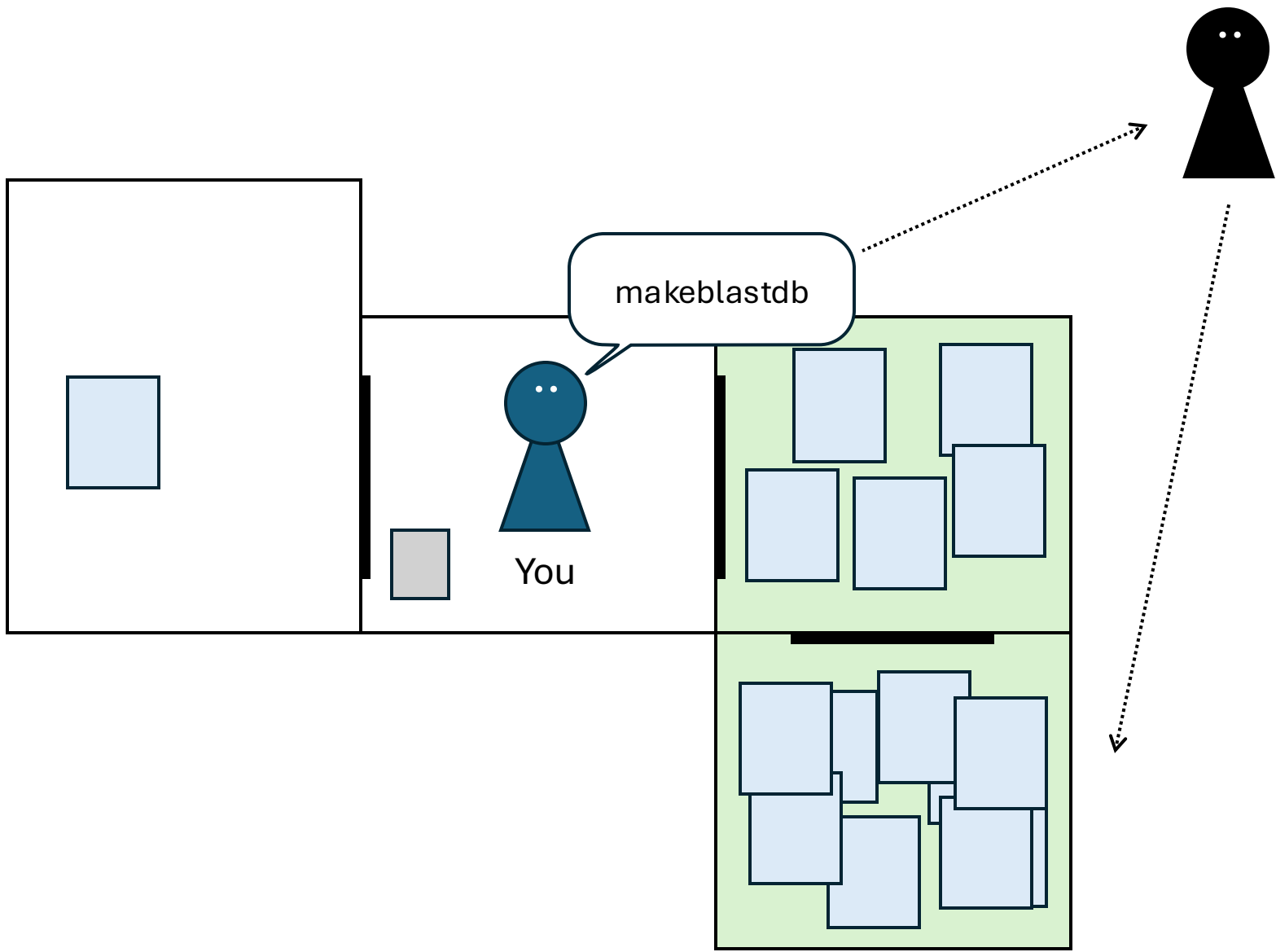
Executable files
(binary)

```
aa-enabled      enc2as          leasgroy        pinentry-curses  ss
aa-essc         encguess        libnetcfg       ping             ssh
aa-features-abi env             libtoolize      ping4            ssh-add
aclocal         envsubst        link             ping6            ssh-agent
aclocal-1.16    eqn             linux32          pinky            ssh-argv0
acpolicy        esb             linux64          pip              ssh-copy-id
add-apt-repository  ezrno           linux-check-removal  pip3.12          ssh-keygen
addpart         etags           linux-update-symlinks  pkaction         ssh-keyscan
add2line        etags.emacs     ln               pkgconf          stat
alllogd-auth-proxy  ex              lnato            pkg-config       strace
anthoscli       expand           local            pkll             strace-log-merge
apropos         apt             locale           pkttysagent      steamship
apt             apt-add-repository  factor          pldd             strings
apt-cache       apt-cdrom       faillog          pl2pm            strip
apt-cdrom       apt-config       faillog          pldd             stty
apt-get          apt-get         false            pmap             su
apt-key         apt-key         fc-cache         pod2html         sudo
apt-mark        ar              fc-cat           pod2man          sudoedit
ar              arch            fc-conflist      pod2text         sudoreplay
arch            autoconf        fc-list          pod2usage        sum
as              as              fc-match         podchecker       supervisorctl
autoconf        autoheader      fc-pattern       ps               supervisorord
autoheader      automake        fc-query        preconv          sync
automake        automake        fc-scan          printenv         syntax_suggest3.2
automake-1.16   automake        fc-scan          printf           systemctl
autoreconf      automake        fc-validate      print           systemd
autoscan        autoupdate      fdop            lscpu            systemd-ac-power
autoupdate      awk             file            lscpu            systemd-ac-power
awk             base32          findmt           lsdump           systemd-analyze
base32          base64          flock            lsdump-13        systemd-analyze
base64          basenc          fold             lsdump-13        systemd-ask-passw
basenc          bash            free             lsdump-13        systemd-cat
bash            bash            fsumip          lsdump-13        systemd-cgls
bashbug         basel           fuser           lsdump-13        systemd-cgroup
basel           bcrops          gcc              lsdump-13        systemd-confat
bison           bison           gcc++13          lsdump-13        systemd-creds
bison.yacc      bison.yacc      gcc              lsdump-13        systemd-cryptenro
enc2as          encguess        leasgroy         lsdump-13        systemd-cryptenro
encguess        libnetcfg       libnetcfg        lsdump-13        systemd-cryptenro
env             libtoolize      link             lsdump-13        systemd-cryptenro
envsubst        link             linux32          lsdump-13        systemd-cryptenro
eqn             linux32          linux64          lsdump-13        systemd-cryptenro
esb             linux64          linux-check-removal  lsdump-13        systemd-cryptenro
ezrno           linux-update-symlinks  ln               lsdump-13        systemd-cryptenro
etags           linux-version   lnato            lsdump-13        systemd-cryptenro
etags.emacs     ln               lnato            lsdump-13        systemd-cryptenro
ex              ln               lnato            lsdump-13        systemd-cryptenro
expand          local            locale           lsdump-13        systemd-cryptenro
apt             apt-add-repository  factor          lsdump-13        systemd-cryptenro
apt-cache       apt-cdrom       faillog          lsdump-13        systemd-cryptenro
apt-cdrom       apt-config       faillog          lsdump-13        systemd-cryptenro
apt-get          apt-get         false            lsdump-13        systemd-cryptenro
apt-key         apt-key         fc-cache         lsdump-13        systemd-cryptenro
apt-mark        ar              fc-cat           lsdump-13        systemd-cryptenro
ar              arch            fc-conflist      lsdump-13        systemd-cryptenro
arch            autoconf        fc-match         lsdump-13        systemd-cryptenro
as              as              fc-pattern       lsdump-13        systemd-cryptenro
autoconf        autoheader      fc-query        lsdump-13        systemd-cryptenro
autoheader      automake        fc-scan          lsdump-13        systemd-cryptenro
automake        automake        fc-scan          lsdump-13        systemd-cryptenro
automake-1.16   automake        fc-validate      lsdump-13        systemd-cryptenro
autoreconf      automake        fdop            lsdump-13        systemd-cryptenro
autoscan        autoupdate      file            lsdump-13        systemd-cryptenro
autoupdate      awk             file            lsdump-13        systemd-cryptenro
awk             base32          findmt           lsdump-13        systemd-cryptenro
base32          base64          flock            lsdump-13        systemd-cryptenro
base64          basenc          fold             lsdump-13        systemd-cryptenro
basenc          bash            free             lsdump-13        systemd-cryptenro
bash            bash            fsumip          lsdump-13        systemd-cryptenro
bashbug         basel           fuser           lsdump-13        systemd-cryptenro
basel           bcrops          gcc              lsdump-13        systemd-cryptenro
bison           bison           gcc++13          lsdump-13        systemd-cryptenro
bison.yacc      bison.yacc      gcc              lsdump-13        systemd-cryptenro
enc2as          encguess        leasgroy         lsdump-13        systemd-cryptenro
encguess        libnetcfg       libnetcfg        lsdump-13        systemd-cryptenro
env             libtoolize      link             lsdump-13        systemd-cryptenro
envsubst        link             linux32          lsdump-13        systemd-cryptenro
eqn             linux32          linux64          lsdump-13        systemd-cryptenro
esb             linux64          linux-check-removal  lsdump-13        systemd-cryptenro
ezrno           linux-update-symlinks  ln               lsdump-13        systemd-cryptenro
etags           linux-version   lnato            lsdump-13        systemd-cryptenro
etags.emacs     ln               lnato            lsdump-13        systemd-cryptenro
ex              ln               lnato            lsdump-13        systemd-cryptenro
expand          local            locale           lsdump-13        systemd-cryptenro
apt             apt-add-repository  factor          lsdump-13        systemd-cryptenro
apt-cache       apt-cdrom       faillog          lsdump-13        systemd-cryptenro
apt-cdrom       apt-config       faillog          lsdump-13        systemd-cryptenro
apt-get          apt-get         false            lsdump-13        systemd-cryptenro
apt-key         apt-key         fc-cache         lsdump-13        systemd-cryptenro
apt-mark        ar              fc-cat           lsdump-13        systemd-cryptenro
ar              arch            fc-conflist      lsdump-13        systemd-cryptenro
arch            autoconf        fc-match         lsdump-13        systemd-cryptenro
as              as              fc-pattern       lsdump-13        systemd-cryptenro
autoconf        autoheader      fc-query        lsdump-13        systemd-cryptenro
autoheader      automake        fc-scan          lsdump-13        systemd-cryptenro
automake        automake        fc-scan          lsdump-13        systemd-cryptenro
automake-1.16   automake        fc-validate      lsdump-13        systemd-cryptenro
autoreconf      automake        fdop            lsdump-13        systemd-cryptenro
autoscan        autoupdate      file            lsdump-13        systemd-cryptenro
autoupdate      awk             file            lsdump-13        systemd-cryptenro
awk             base32          findmt           lsdump-13        systemd-cryptenro
base32          base64          flock            lsdump-13        systemd-cryptenro
base64          basenc          fold             lsdump-13        systemd-cryptenro
basenc          bash            free             lsdump-13        systemd-cryptenro
bash            bash            fsumip          lsdump-13        systemd-cryptenro
bashbug         basel           fuser           lsdump-13        systemd-cryptenro
basel           bcrops          gcc              lsdump-13        systemd-cryptenro
bison           bison           gcc++13          lsdump-13        systemd-cryptenro
bison.yacc      bison.yacc      gcc              lsdump-13        systemd-cryptenro
```





Executable files



**/home/shumpei_yamakawa/n
cbi-blast-2.16.0+/bin**

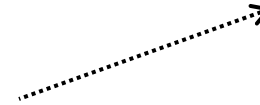
PATH: Search path for executable commands



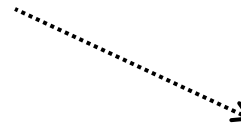
PATH

```
/home/usr/directoryA:  
/home/usr/direcotryB:  
/home/usr/direcotryC:
```

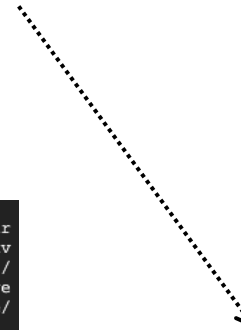
≡ a directory list



directory A



directory B

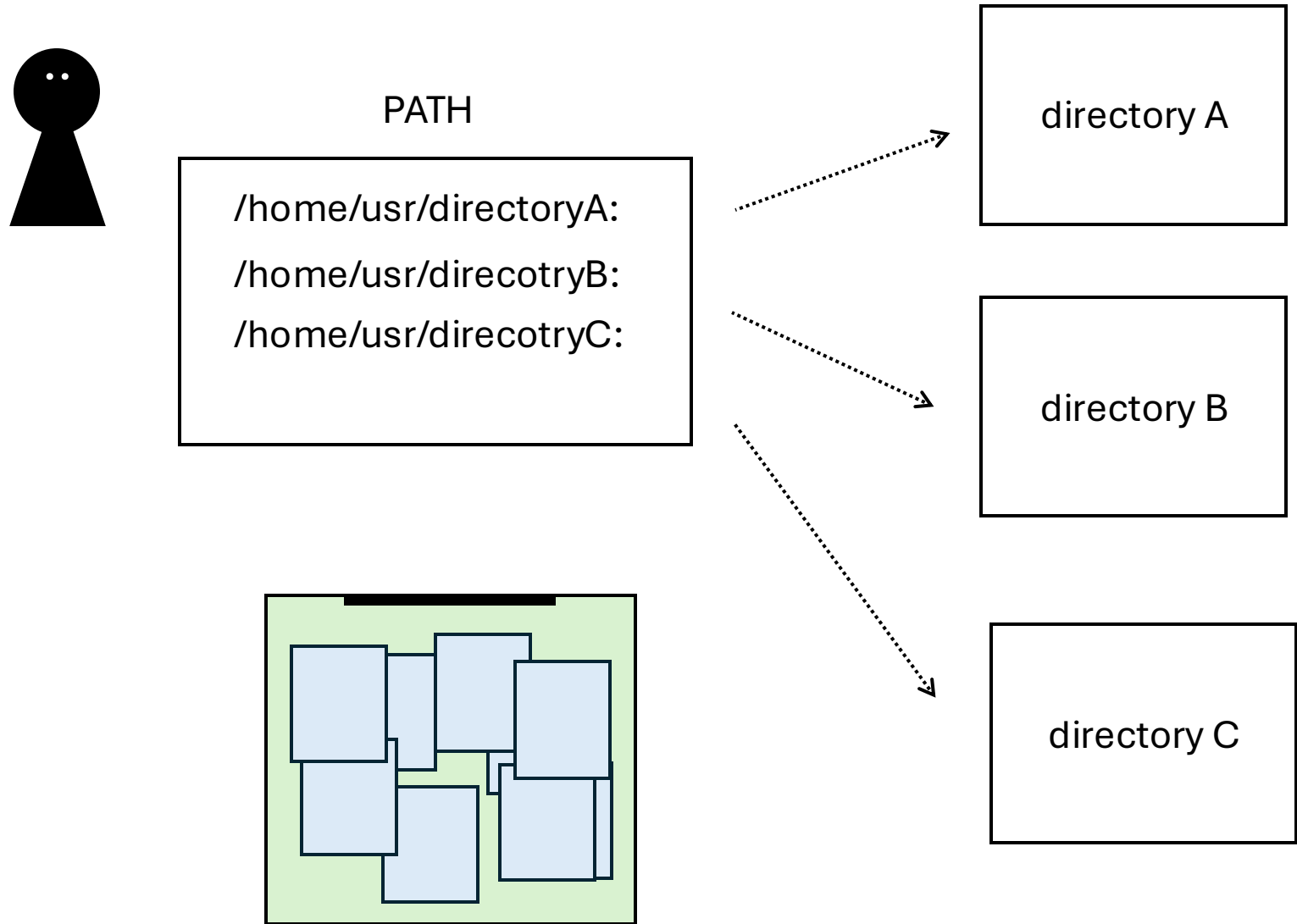


directory C

Ex)

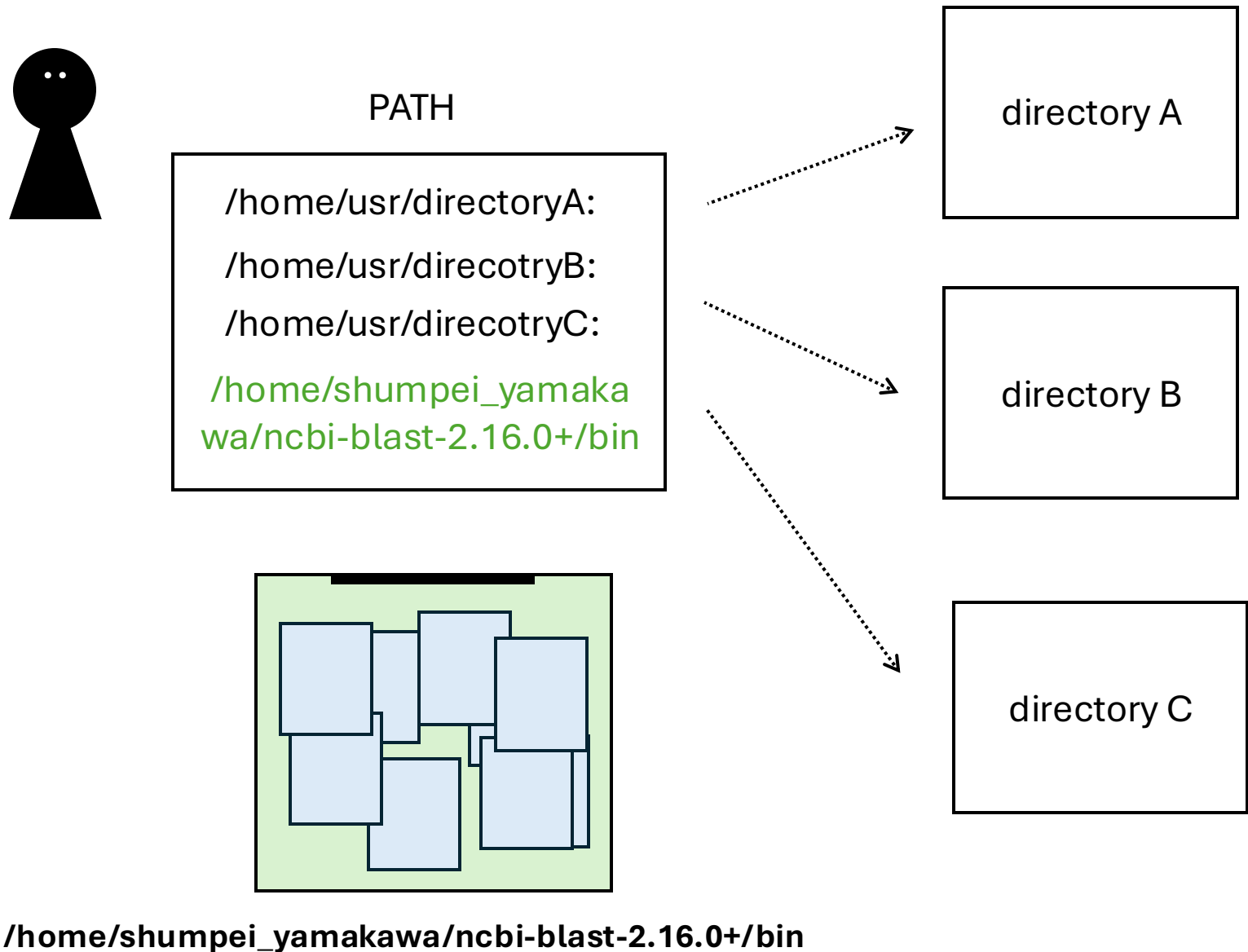
```
shumpei_yamakawa@cloudshell:~$ echo $PATH  
/home/shumpei_yamakawa/test/standard-RAXML-master:/home/shumpei_yamakawa/test/trimal-tr  
imal/source:/home/shumpei_yamakawa/test/ncbi-blast-2.16.0+/bin:/opt/gradle/bin:/opt/mav  
en/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/local/go/bin:/  
usr/local/node_packages/node_modules/.bin:/usr/local/rvm/bin:/home/shumpei_yamakawa/.ge  
ms/bin:/usr/local/rvm/bin:/home/shumpei_yamakawa/gopath/bin:/google/gopath/bin:/google/  
flutter/bin:/usr/local/nvm/versions/node/v22.15.0/bin
```

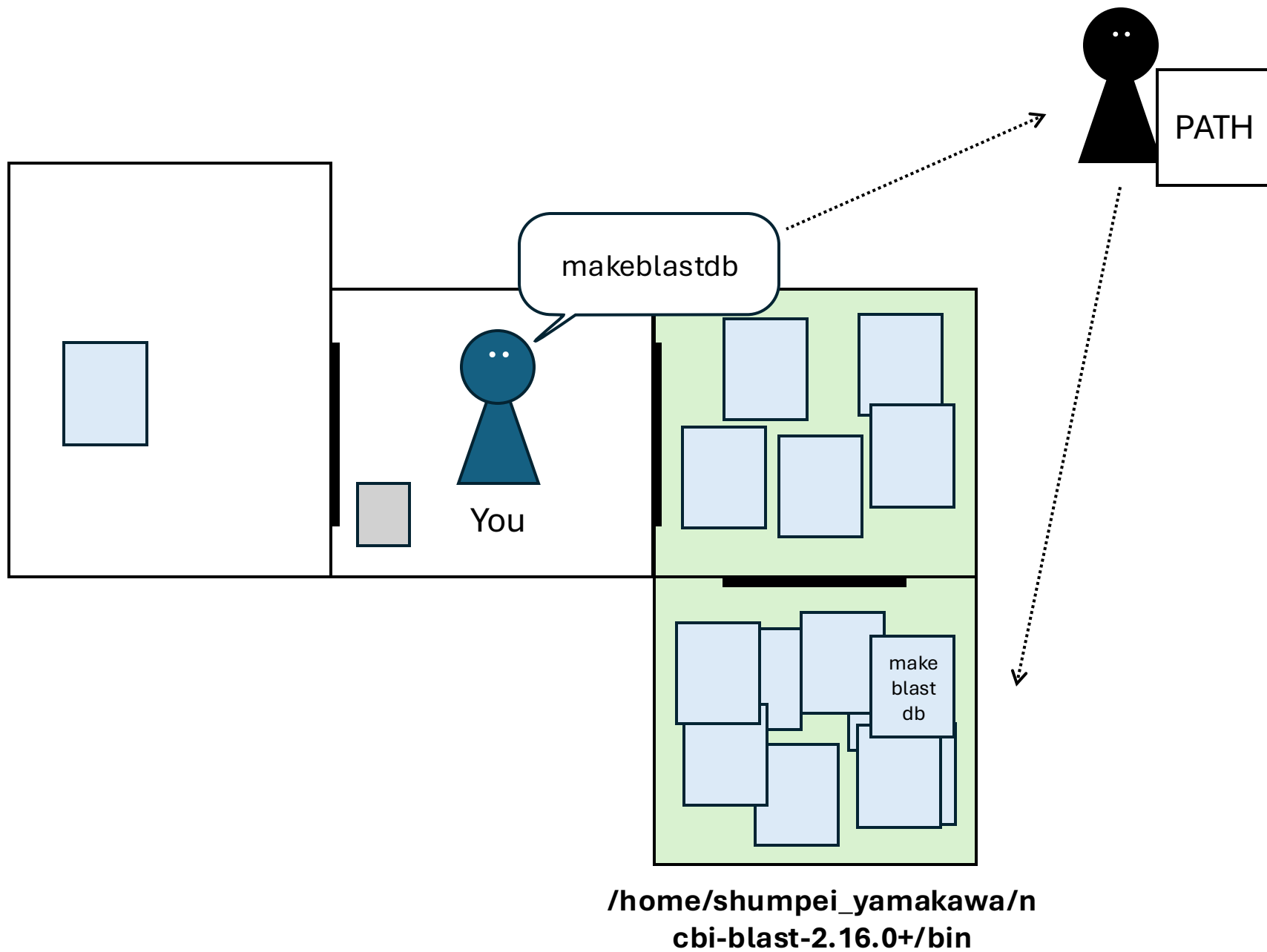
PATH: Search path for executable commands



/home/shumpei_yamakawa/ncbi-blast-2.16.0+/bin

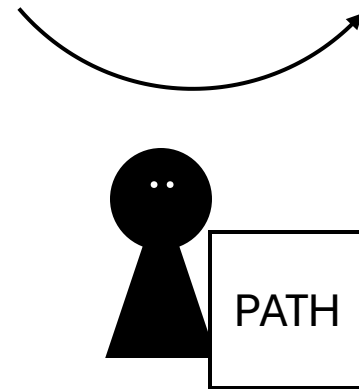
PATH: Search path for executable commands





```
export PATH="/home/shumpei_yamakawa/test/ncbi-blast-2.16.0+/bin:$PATH"
```

Add to PATH!



PC

PATH



```
/home/usr/directoryA:  
/home/usr/direcotryB:  
/home/usr/direcotryC:
```

Set the path



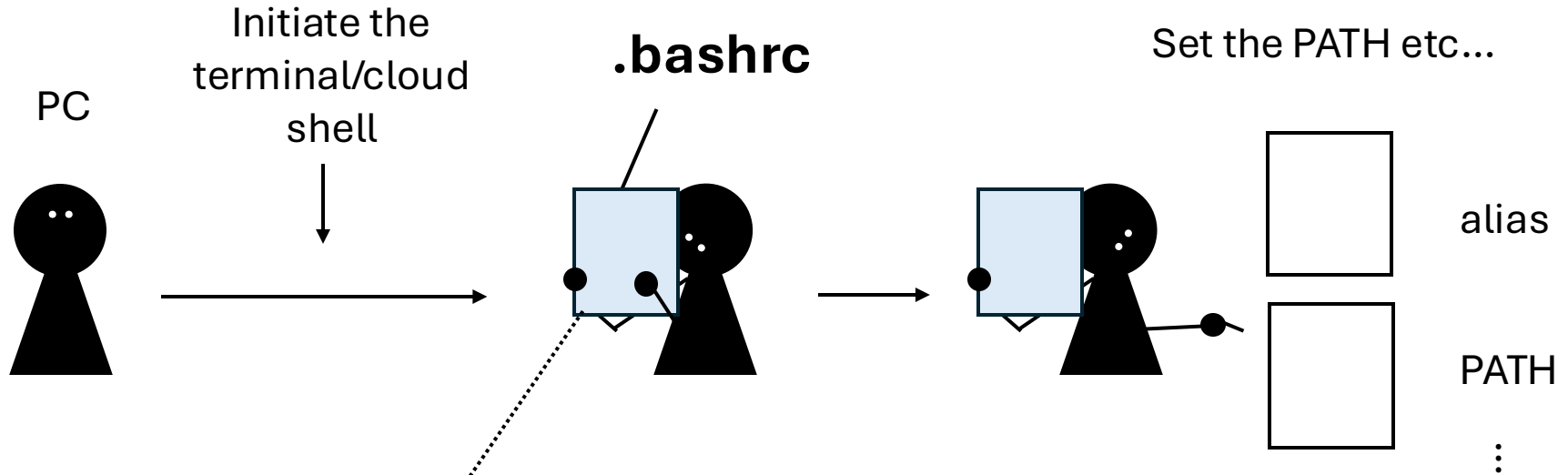
```
/home/usr/directoryA:  
/home/usr/direcotryB:  
/home/usr/direcotryC:  
  
/home/shumpei_yamaka  
wa/ncbi-blast-2.16.0+/bin
```

Terminate
the session



```
/home/usr/directoryA:  
/home/usr/direcotryB:  
/home/usr/direcotryC:
```

**PATH setting is
only temporal
in a session**



```
# ~/.bashrc: executed by bash(1) for non-login shells.
# see /usr/share/doc/bash/examples/startup-files (in the package bash-doc)
# for examples

# If not running interactively, don't do anything
case $- in
  *) ;;
  *) return;;
esac

# don't put duplicate lines or lines starting with space in the history.
# See bash(1) for more options
HISTCONTROL=ignoreboth

# append to the history file, don't overwrite it
shopt -s histappend

# for setting history length see HISTSIZE and HISTFILESIZE in bash(1)
HISTSIZE=1000
HISTFILESIZE=2000

# check the window size after each command and, if necessary,
# update the values of LINES and COLUMNS.
shopt -s checkwinsize

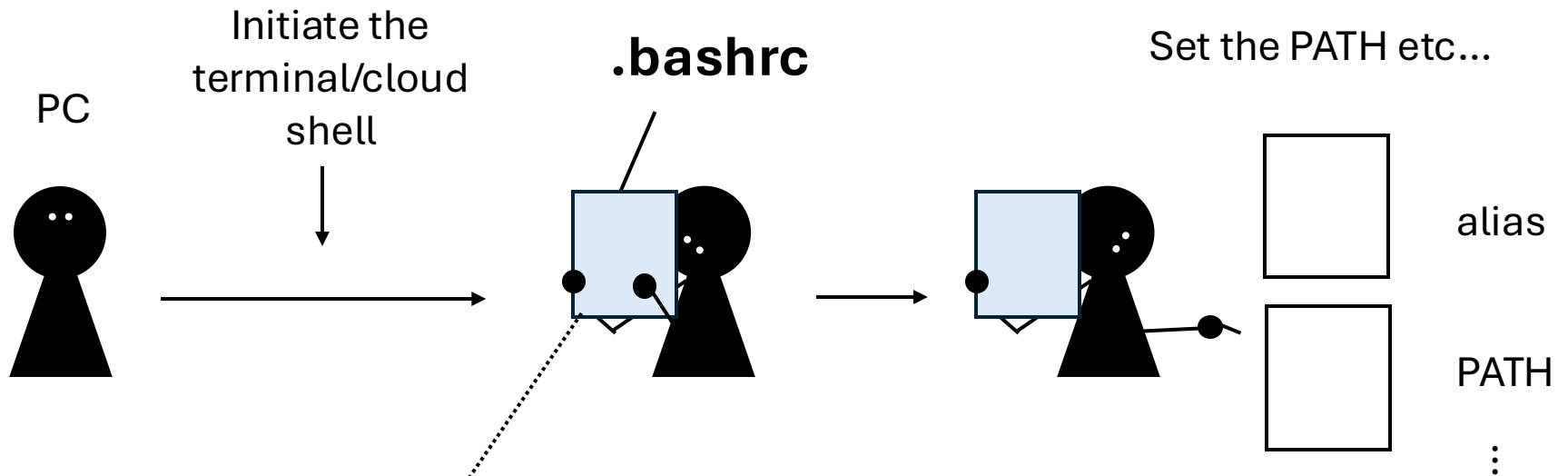
# If set, the pattern "*" used in a pathname expansion context will
# match all files and zero or more directories and subdirectories.
#shopt -s globstar

# make less more friendly for non-text input files, see lesspipe(1)
[ -x /usr/bin/lesspipe ] && eval "$(SHELL=/bin/sh lesspipe)"

# set variable identifying the chroot you work in (used in the prompt below)
if [ -z "${debian_chroot:-}" ] && [ -r /etc/debian_chroot ]; then
  debian_chroot=$(cat /etc/debian_chroot)
fi

# set a fancy prompt (non-color, unless we know we "want" color)
case "$TERM" in
  xterm-color|*-256color) color_prompt=yes;;
esac
```

.bashrc =
A file automatically executed whenever a
Bash shell session starts



```
# ~/.bashrc: executed by bash(1) for non-login shells.
# see /usr/share/doc/bash/examples/startup-files (in the package bash-doc)
# for examples

# If not running interactively, don't do anything
case $- in
  *i*) ;;
  *) return;;
esac

# don't put duplicate lines or lines starting with space in the history.
# See bash(1) for more options
HISTCONTROL=ignoreboth

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[ -x /usr/bin/lesspipe ] && eval "$(SHELL=/bin/sh lesspipe)"

# set variable identifying the chroot you work in (used in the prompt below)
if [ -z "${debian_chroot:-}" ] && [ -r /etc/debian_chroot ]; then
  debian_chroot=$(cat /etc/debian_chroot)
fi

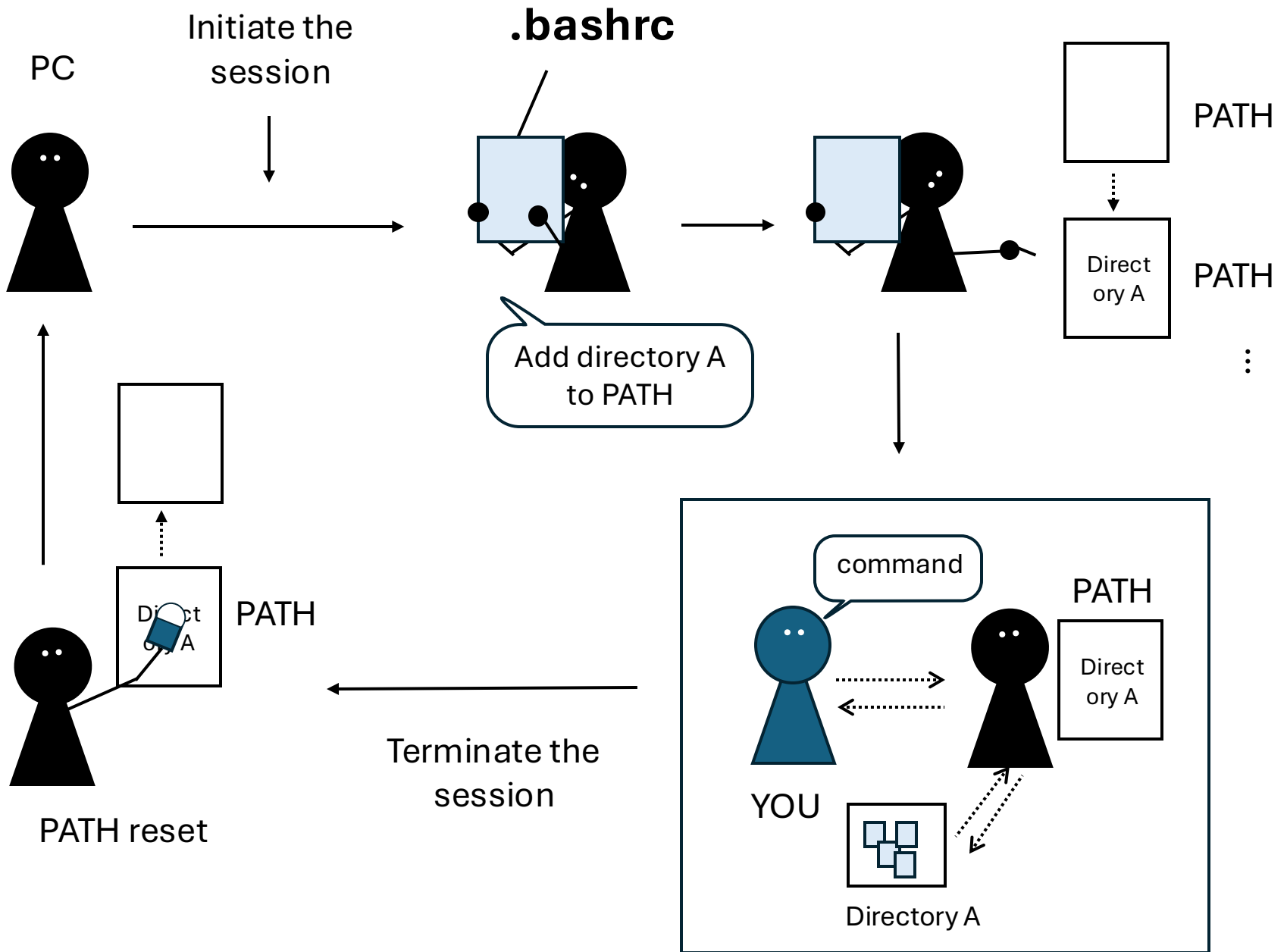
# set a fancy prompt (non-color, unless we know we "want" color)
case "$TERM" in
  xterm-color|*-256color) color_prompt=yes;;
esac
```

Add



export

PATH="/home/shumpei_yamakawa/test/
ncbi-blast-2.16.0+/bin:\$PATH"



```
# ~/.bashrc: executed by bash(1) for non-login shells.
# see /usr/share/doc/bash/examples/startup-files (in the package bash-doc)
# for examples

# If not running interactively, don't do anything
case $- in
  *i*) ;;
  *) return;;
esac

# don't put duplicate lines or lines starting with space in the history.
# See bash(1) for more options
HISTCONTROL=ignoreboth

# append to the history file, don't overwrite it
shopt -s histappend

# for setting history length see HISTSIZE and HISTFILESIZE in bash(1)
HISTSIZE=1000
HISTFILESIZE=2000

# check the window size after each command and, if necessary,
# update the values of LINES and COLUMNS.
shopt -s checkwinsize

# If set, the pattern "*" used in a pathname expansion context will
# match all files and zero or more directories and subdirectories.
#shopt -s globstar

# make less more friendly for non-text input files, see lesspipe(1)
[ -x /usr/bin/lesspipe ] && eval "$(SHELL=/bin/sh lesspipe)"

# set variable identifying the chroot you work in (used in the prompt below)
if [ -z "${debian_chroot:-}" ] && [ -r /etc/debian_chroot ]; then
    debian_chroot=$(cat /etc/debian_chroot)
fi

# set a fancy prompt (non-color, unless we know we "want" color)
case "$TERM" in
  xterm-color|*-256color) color_prompt=yes;;
esac
```

~/.bashrc

⋮

```
alias grep='grep --color=auto'
alias fgrep='fgrep --color=auto'
alias egrep='egrep --color=auto'
fi

# colored GCC warnings and errors
#export GCC_COLORS='error=01;31:warning=01;35:note=01;36:caret=01;32:locus=01'

# some more ls aliases
alias ll='ls -alF'
alias la='ls -A'
alias l='ls -CF'

# Add an "alert" alias for long running commands. Use like so:
#   sleep 10; alert
alias alert='notify-send --urgency=low -i "${[ $? = 0 ]} && echo terminal || echo error"'

# Alias definitions.
# You may want to put all your additions into a separate file like
# ~/.bash_aliases, instead of adding them here directly.
# See /usr/share/doc/bash-doc/examples in the bash-doc package.

if [ -f ~/.bash_aliases ]; then
    . ~/.bash_aliases
fi

# enable programmable completion features (you don't need to enable
# this, if it's already enabled in /etc/bash.bashrc and /etc/profile
# sources /etc/bash.bashrc).
if ! shopt -oq posix; then
    if [ -f /usr/share/bash-completion/bash_completion ]; then
        . /usr/share/bash-completion/bash_completion
    elif [ -f /etc/bash_completion ]; then
        . /etc/bash_completion
    fi
fi
source /google/devshell/bashrc.google
export PATH="/home/shumpei.yamakawa/test/ncbi-blast-2.16.0+/bin:$PATH"
```