GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung
Projektträger Jülich
Forschungszentrum Jülich

de.NBI
GERMAN NETWORK FOR BIOINFORMATICS INFRASTRUCTURE

Introduction to Linux and the Command Line with SimpleVM

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JÜLICH Forschungszentrum

SimpleVM

Hands-On Session

- **Part 1: SimpleVM Introduction**
- Part 2: Linux Command Line

SimpleVM

- SimpleVM is a multi-cloud application that eases the access to computational resources of the federated de.NBI Cloud.
- It takes care of any necessary network or volume setup.
- Automatically installed software
- No background knowledge in cloud computing necessary
- Additional Project Modes:
  - Workshop Mode
  - SimpleVM Cluster
- New SimpleVM Portal since October 2023

de.NBI Cloud - A Solution for (almost) Every Use Case

Infrastructure-, Platform- and Workflows- as-a-Service

openstack

- High configurability, infrastructure virtualization
- API access, e.g. for use with Terraform or Ansible
- Any software of the cloud ecosystem

kubernetes

- High configurability, service and container orchestration
- API access, e.g. for use with kubectl
- Any containerized software / service, Helm charts

SimpleVM

- Beginner-friendly, preconfigured Research Envs
- ELIXIR guarded interactive browser sessions
- “One-click” solution for setting up a workshop or cluster

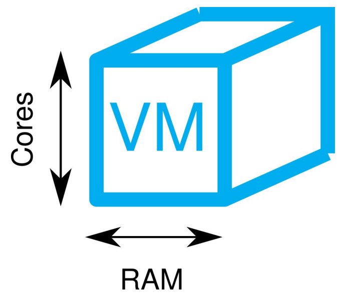
useGalaxy.eu

- Fully established bioinformatics tools and workflows, maintained by the community
- Point-and-click GUI for composition of bioinformatics workflows
- Interactive tours and comprehensive training library

Cloud Components

- Main building block of the cloud is a **virtual machine**.
- A virtual machine **instance** is a running instance of the virtual machine image with resource parameters (Cores and RAM) assigned to it.

1. Create your blueprint



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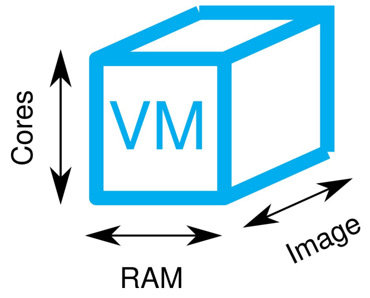

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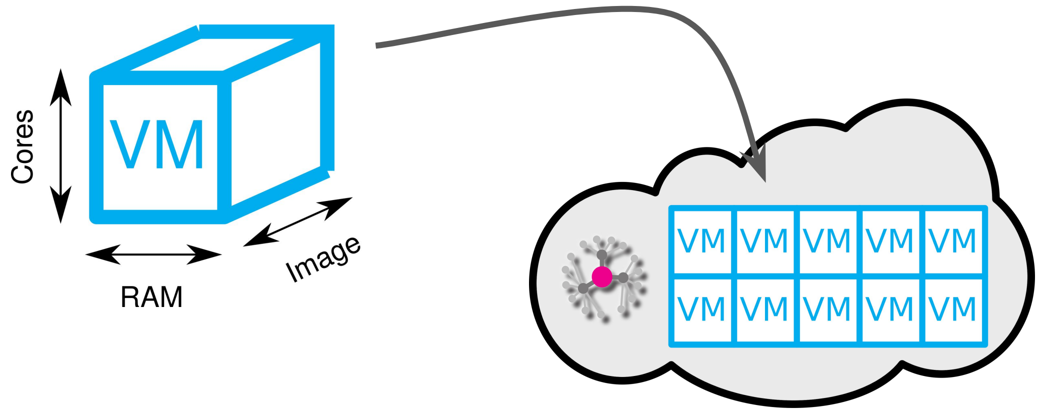

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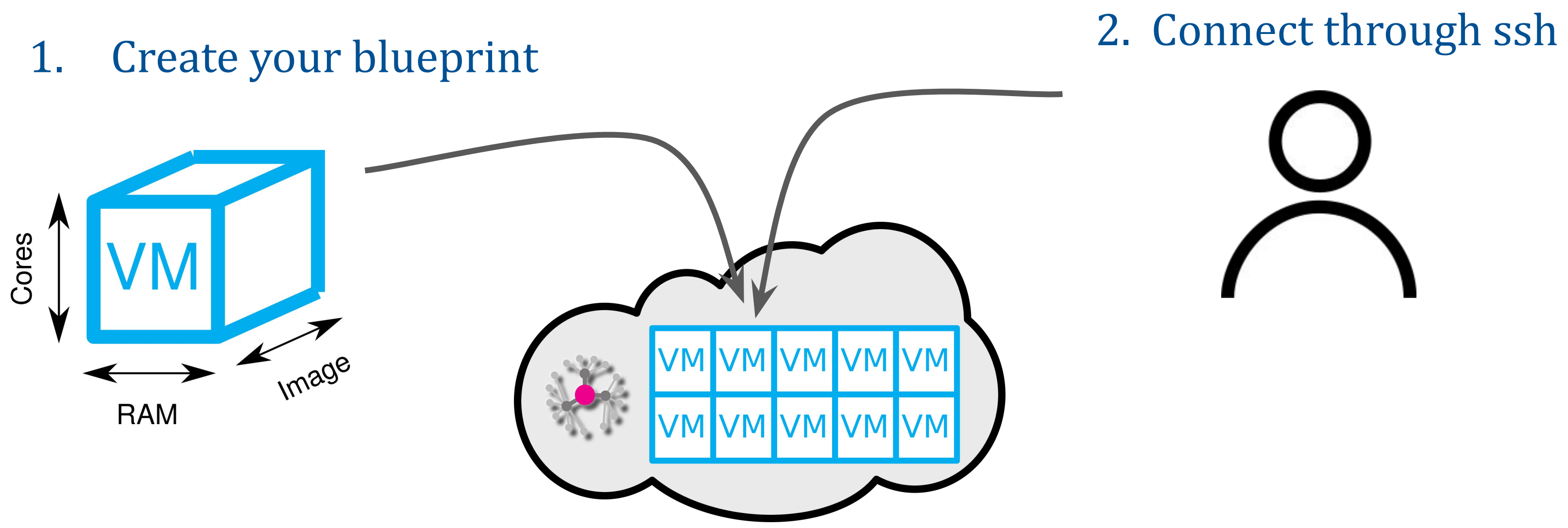
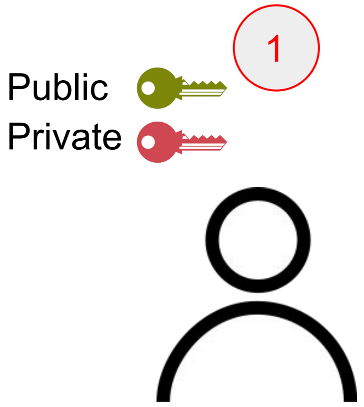


Cloud Components - Secure Shell Protocol (SSH)

First Time Usage

1. Generate a key pair locally or let the Portal generate one for you

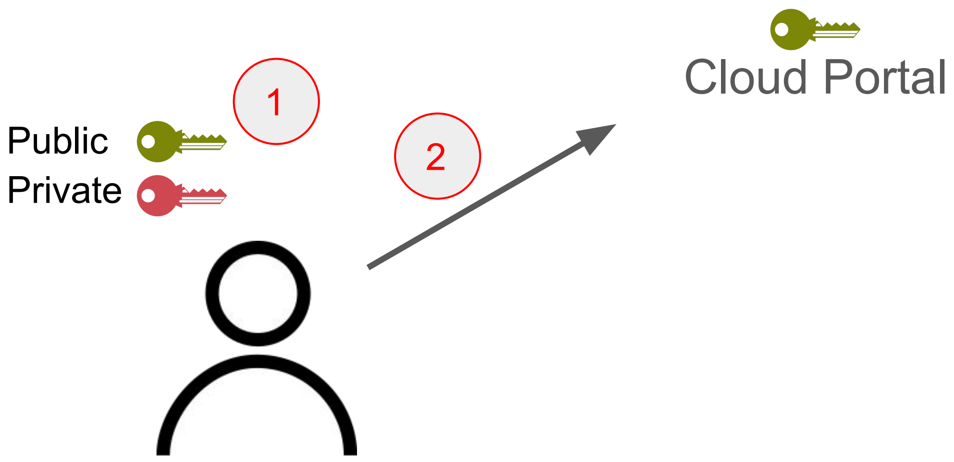


Cloud Components - Secure Shell Protocol (SSH)

First Time Usage

1. Generate a key pair locally or let the Portal generate one for you
2. Upload your public key to the de.NBI Cloud Portal/OpenStack

Connect to your VM

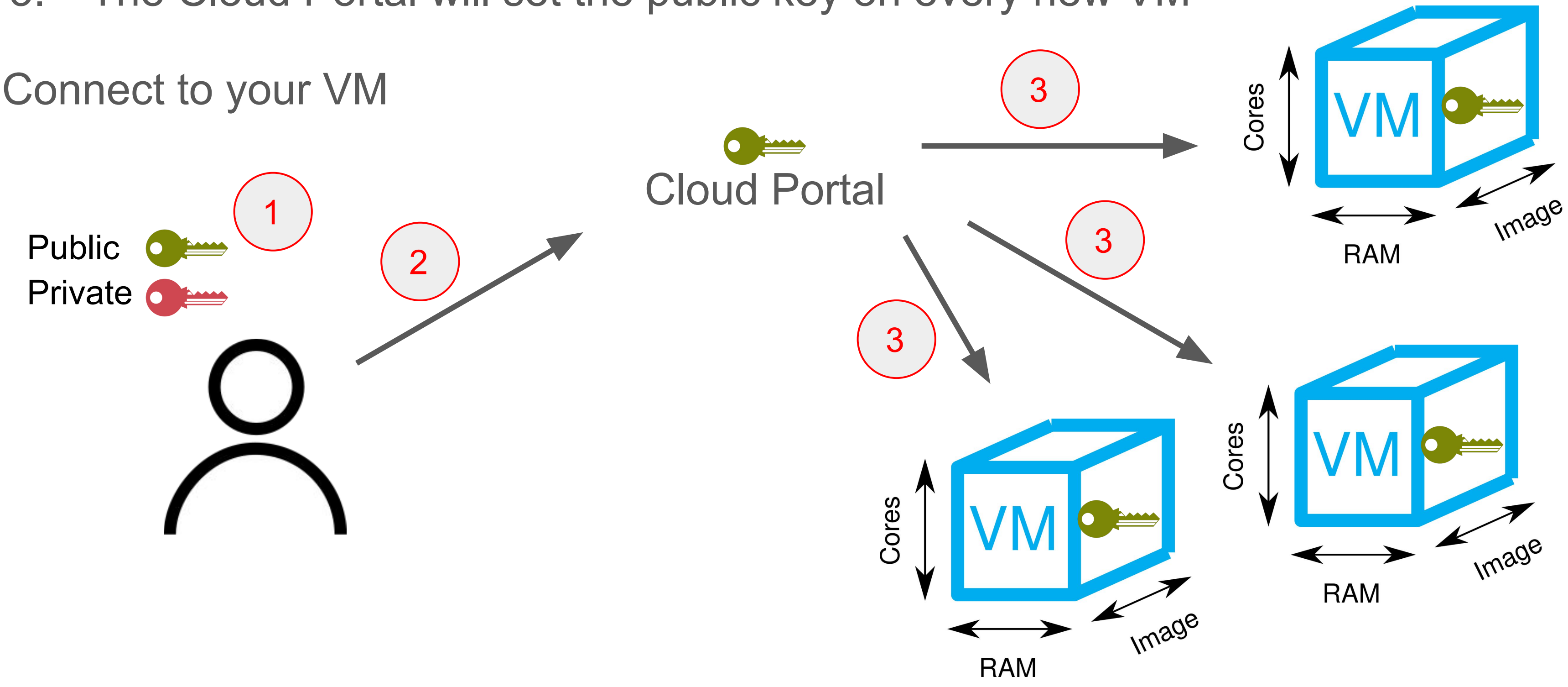


Cloud Components - Secure Shell Protocol (SSH)

First Time Usage

1. Generate a key pair locally or let the Portal generate one for you
2. Upload your public key to the de.NBI Cloud Portal/OpenStack
3. The Cloud Portal will set the public key on every new VM

Connect to your VM



Hands-On Session

- Go to the first part of the workshop:

  https://github.com/deNBI/simpleVMWorkshop/blob/main/part1.md

  - **Please start with part 1 of the SimpleVM workshop**

- ~ 10 Minutes

Internet:

WiFi Name:

LAN1-JBB

WiFi PWD:

jbb45_45

Hands-On Session

- Part 1: SimpleVM Introduction
- **Part 2: Linux Command Line**

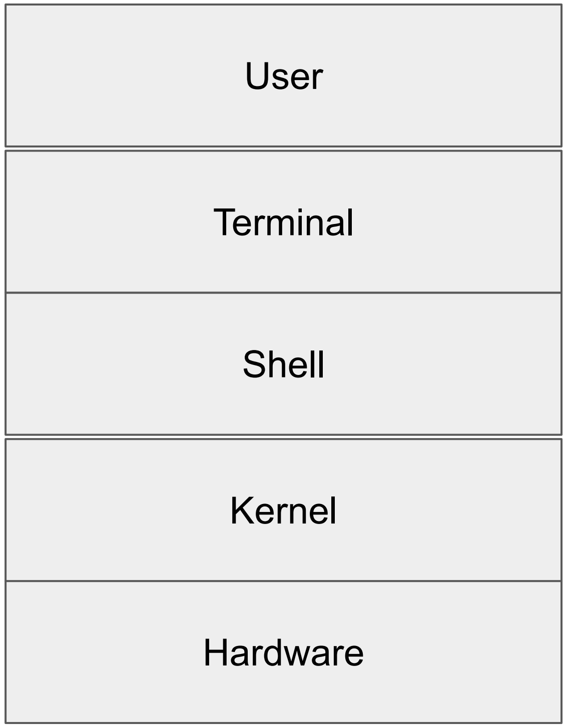
Part 2: Linux Command Line Introduction

Linux Command Line Introduction - Unix/Linux?

- Linux is a flavour of **Unix**
- **Unix:** set of programs to interact with the computer
- Main Properties:
  - **Multitasking environment:** Multiple processes can run in parallel
  - **Multiuser system:** Multiple users can use the same Linux system at the same time

Linux Command Line Introduction - Unix/Linux?

- The heart of a Linux system is the **kernel**
- The kernel allocates system resources
- You, as a user, use a **shell** to interact with the kernel
- The **terminal** is a graphical interface that lets you interact with the shell



Linux Command Line Introduction - Part 1

- Almost every command has a usage and manual **man page**

Get help and usage message: **--help / -h / -? / --usage**

```
ls --help
```

Read the manual: **man**

```
man ls
```

Space	one page down
b	one page up
q	quit

If **man** does not give any result, try:
info
help

Don't know what command to use? Try:
apropos

Linux Command Line Introduction - Part 1

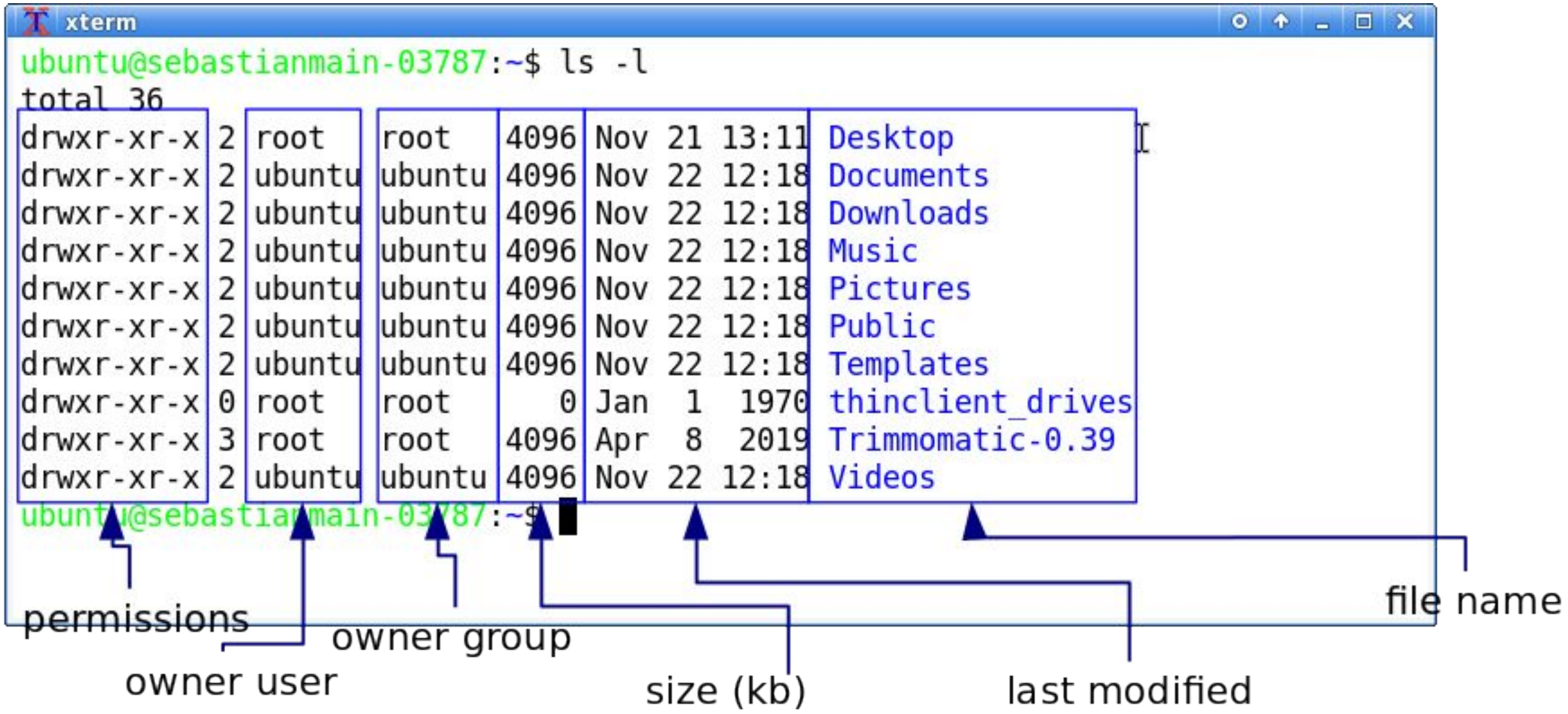
- Data in Unix is organized in files
    - Three types of files:
        - ordinary files (e.g. a program or text),
        - directories,
        - special files (e.g. shortcuts)
- Directories organized in hierarchical, tree like structure
    - with “/” as its root.
        - /home/ubuntu/projects/unix-course
        - /home/ubuntu/Downloads/test.txt

Linux Command Line Introduction - Part 1

- Commands for navigation: **`pwd`**, **`ls`**, **`cd`**
- Places to navigate (current: /home/ubuntu/dir, aim: /home/ubuntu):
  - Absolute path: **`cd /home/ubuntu/`**
  - Relative path: **`cd ..`**
  - Home directory: **`cd ~`**
- Commands to manipulate the filesystem tree:
  - **`mkdir`**, Syntax: mkdir directory_to_create
  - **`rm -r`**, Syntax: rm -r directory_to_remove
- View a file:
  - **`less`** file_to_view
- Other:
  - **`file`**: Returns you the type of the file
  - **`df`**: Allows you check the usage of your disk. (size of the free and used space)

Linux Command Line Introduction - Part 1

- Permissions:
    - You can view the permissions of file with "**`ls -l`**"



```
ubuntu@sebastianmain-03787:~$ ls -l
total 36
drwxr-xr-x 2 root   root   4096 Nov 21 13:11 Desktop
drwxr-xr-x 2 ubuntu ubuntu 4096 Nov 22 12:18 Documents
drwxr-xr-x 2 ubuntu ubuntu 4096 Nov 22 12:18 Downloads
drwxr-xr-x 2 ubuntu ubuntu 4096 Nov 22 12:18 Music
drwxr-xr-x 2 ubuntu ubuntu 4096 Nov 22 12:18 Pictures
drwxr-xr-x 2 ubuntu ubuntu 4096 Nov 22 12:18 Public
drwxr-xr-x 2 ubuntu ubuntu 4096 Nov 22 12:18 Templates
drwxr-xr-x 0 root   root      0 Jan  1  1970 thinclient_drives
drwxr-xr-x 3 root   root   4096 Apr  8  2019 Trimmomatic-0.39
drwxr-xr-x 2 ubuntu ubuntu 4096 Nov 22 12:18 Videos
ubuntu@sebastianmain-03787:~$
```

Linux Command Line Introduction - Part 1

- Permissions:
  - You can view the permissions of file with "`ls -l`"
  - Modify permissions by using **chmod**
    - -rw-r-- --- = (user, group, others)
    - r = readable, w = writable, x = executable
    - Example: `chmod g+w file` (make file writable for the group)
- Execute a program:
  - You can execute a local program by providing the path of the file: "/path/to/my_program_to_execute"
  - You can cancel any command with "Ctrl+c"

Linux Command Line Introduction - Part 1

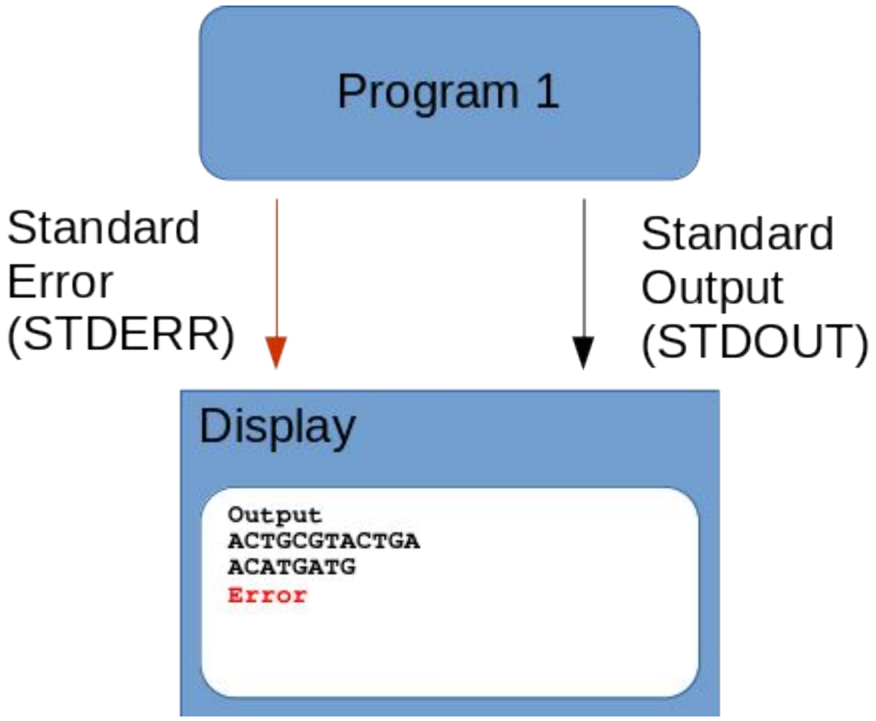
- Go to the second part of the SimpleVM workshop:

  https://github.com/deNBI/simpleVMWorkshop

- Once you are done, continue with the actual Linux Course:
- Your task is to **identify the correct commands** by using the list of commands and execute them. Feel free to experiment. Take a look at the solution **if absolutely necessary.**
- Tutorial: https://github.com/deNBI/unix-course
- Please just do part 1 of the tutorial!
- ~20 Minutes

Linux Command Line Introduction - Part 2

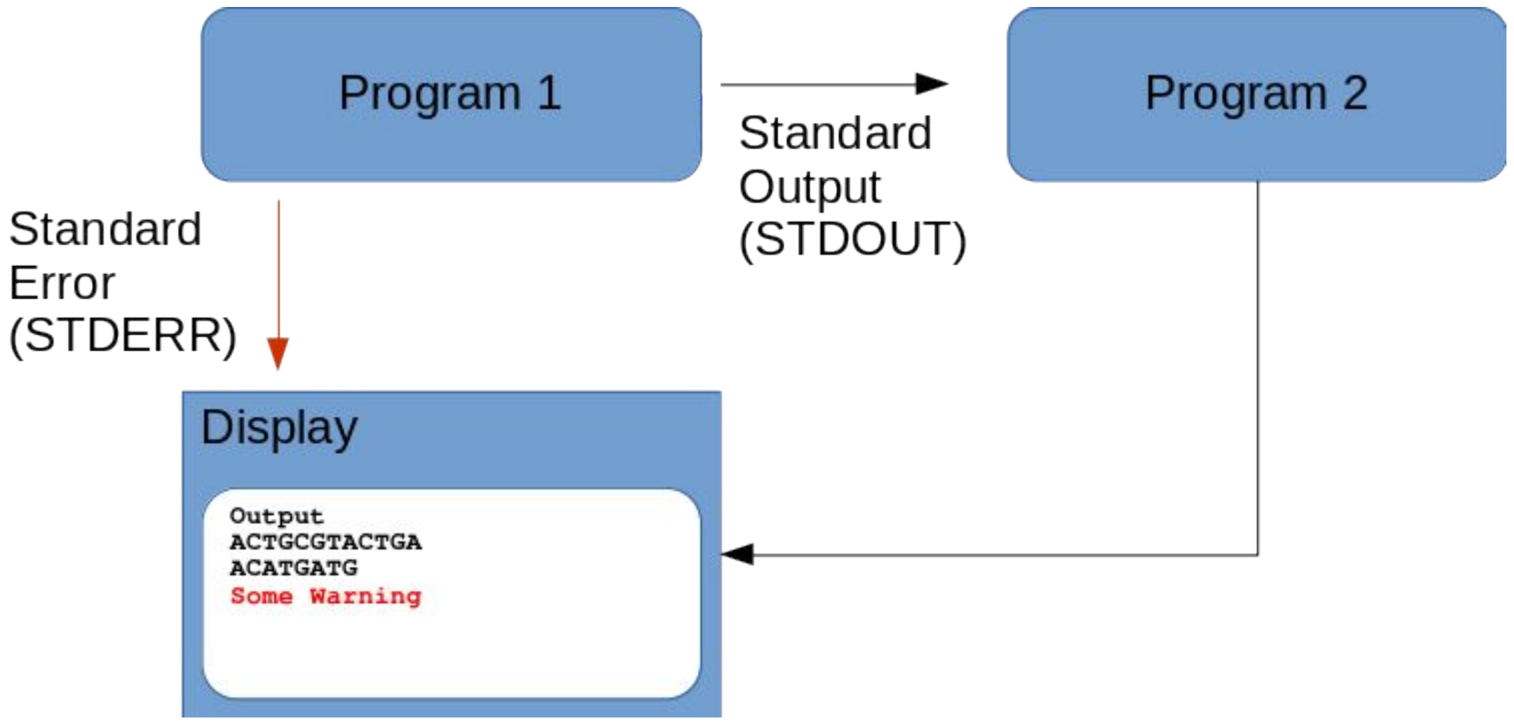
- Many unix commands support streams (files) as input and/or output



```
Output
ACTGCGTACTGA
ACATGATG
Error
```

Linux Command Line Introduction - Part 2

- Many unix commands support streams (files) as input and/or output
- Streams can be **redirected**

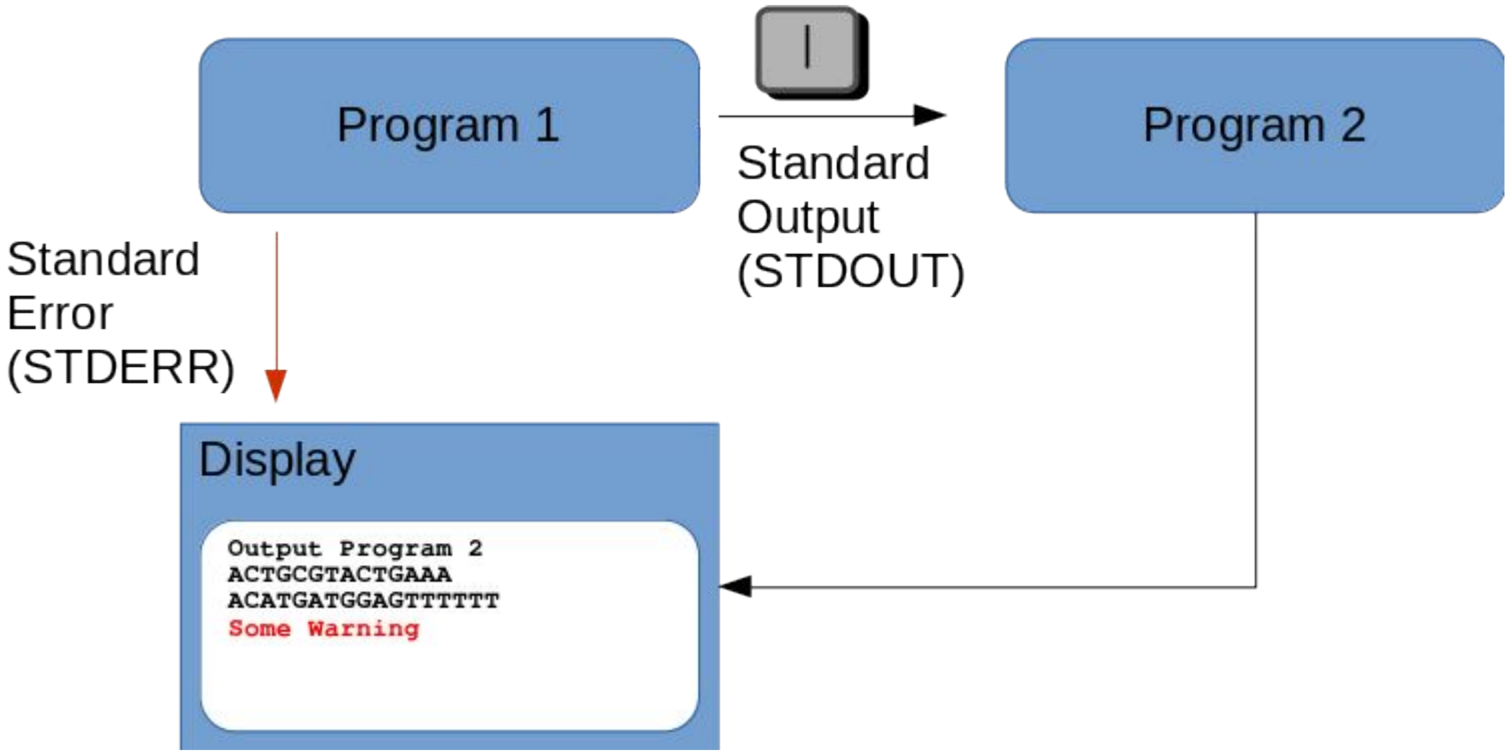


```
Output
ACTGCGTACTGA
ACATGATG
Some Warning
```

How?

Linux Command Line Introduction - Part 2

- Many unix commands support streams (files) as input and/or output
- Streams can be **redirected**

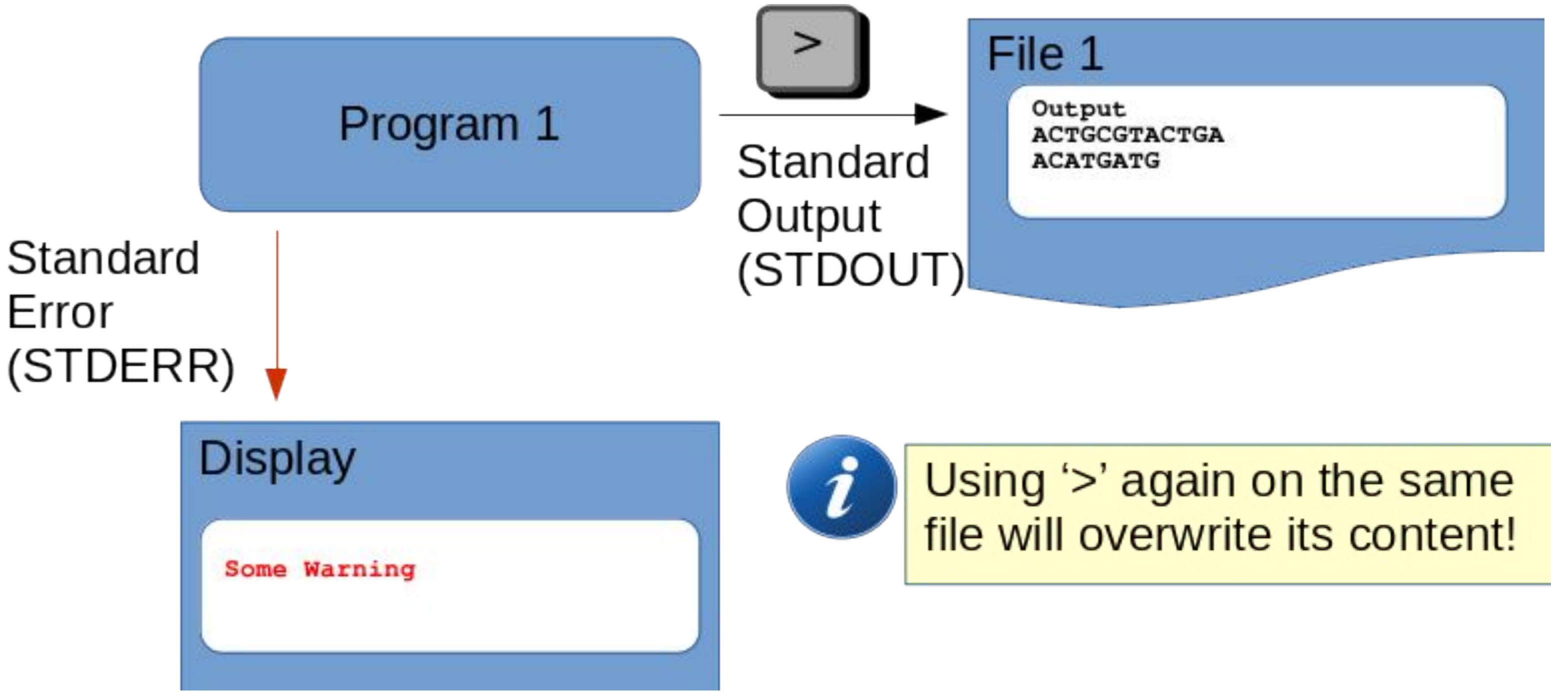


```
Output Program 2
ACTGCGTACTGAAA
ACATGATGGAGTTTTTT
Some Warning
```

Example: `ls -la | less`

Linux Command Line Introduction - Part 2

- Many unix commands support streams (files) as input and/or output
- Streams can be **redirected into files**

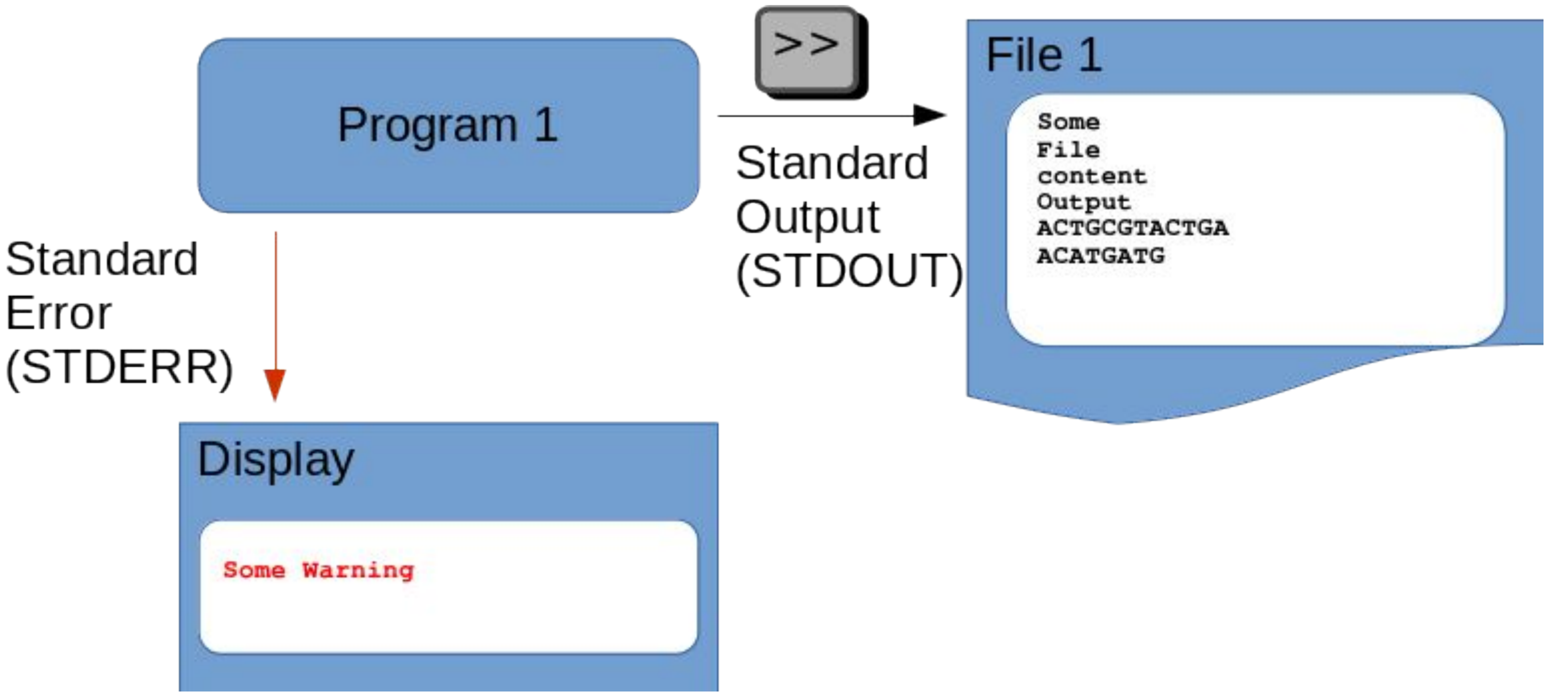


Using '>' again on the same file will overwrite its content!

Example: `ls -la ~ > myHomeDir.txt`

Linux Command Line Introduction - Part 2

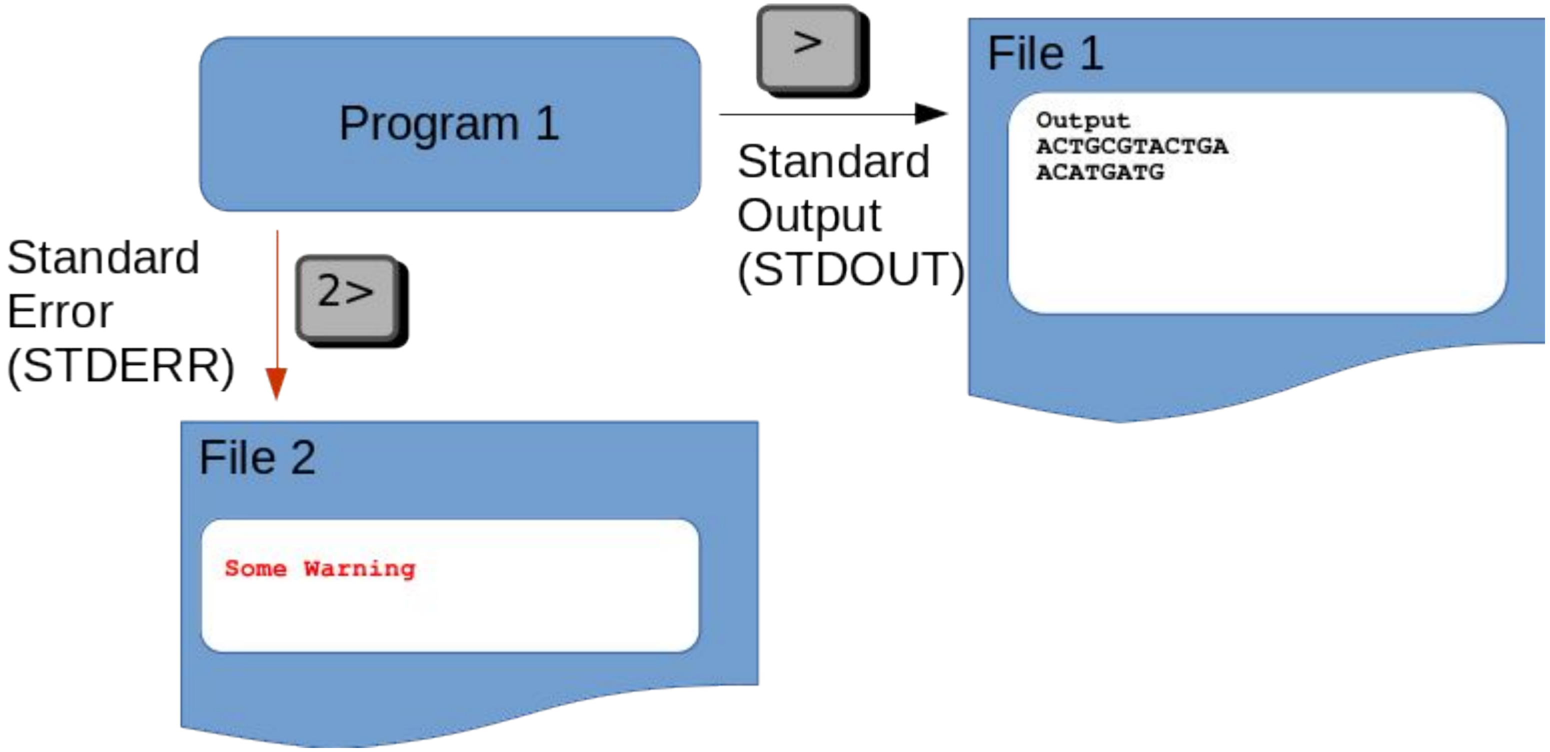
- Many unix commands support streams (files) as input and/or output
- Streams can be appended **to files**



Example: `ls -la ~ >> myHomeDir.txt`

Linux Command Line Introduction - Part 2

- Many unix commands support streams (files) as input and/or output
- You can also **redirect STDERR**

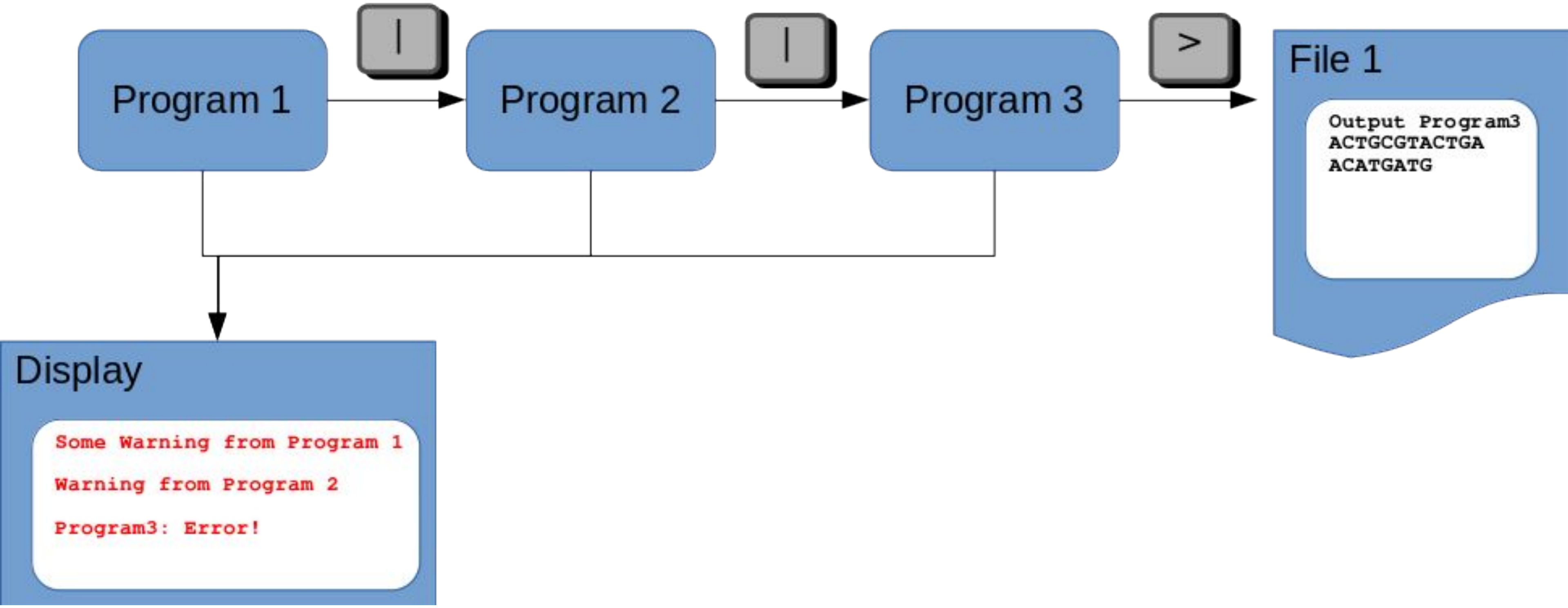


```
Output
ACTGCGTACTGA
ACATGATG
```

```
Some Warning
```

Linux Command Line Introduction - Part 2

- Many unix commands support streams (files) as input and/or output
- You can build small **pipelines** by ‘connecting’ tools



```
Output Program3
ACTGCGTACTGA
ACATGATG
```

```
Some Warning from Program 1
Warning from Program 2
Program3: Error!
```

Example: `ls ~ | grep .txt | sort`

Linux Command Line Introduction - Part 2

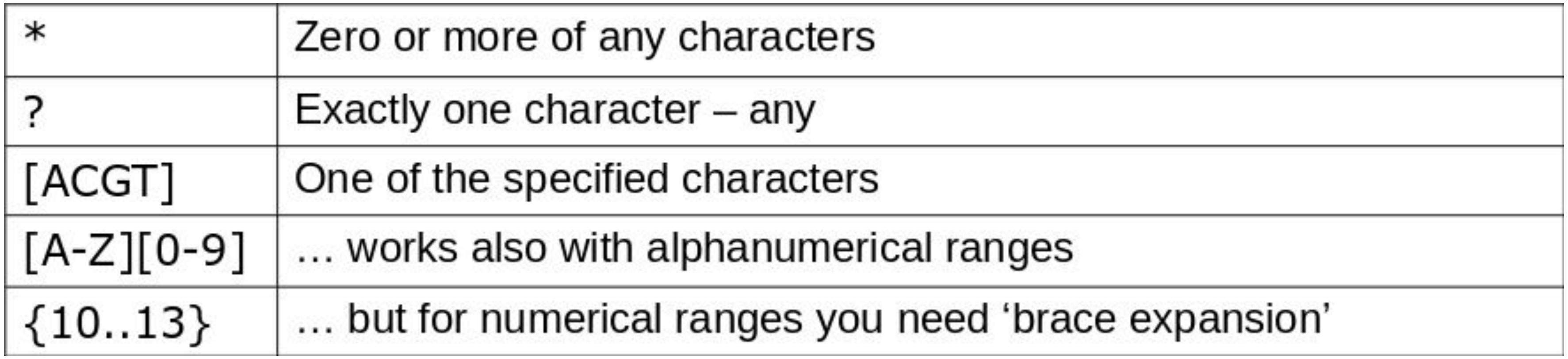
- Many unix commands support streams (files) as input and/or output
- Streams can be **redirected**
- **Into files**
  - Stdout: Text that is produced by the program can be redirected by using “>”.
    - Example: ./myProgram > output.txt
  - Stderr: Error messages are send through stderr and can be redirected using “2>”.
    - Example: ./myProgram 2> error.txt
  - Stdin: The stdin input stream accepts text as input that can be provided by using Linux pipes
    - Example: ./myProgram1 | ./myProgram2
- Linux processes
  - You can list all running programs using “**`ps`**”
  - You can terminate processes by using “**`kill`** id_of_process”.

Linux Command Line Introduction - Part 2

- **Search** for patterns:
    - **`grep`**: Search for specific patterns
        - Example: **`grep “error” output.log`**
        - Search for the term “error” in output.log and displays every line that contains this term
        - Special characters in the pattern:
            - “^”: denotes the beginning of the line
            - “$”: denotes the end of a line
- Search and replace:
    - **`sed`**: search and replaces a pattern in a file (stream)
        - syntax: **`sed ‘s/pattern/replacement/’`**

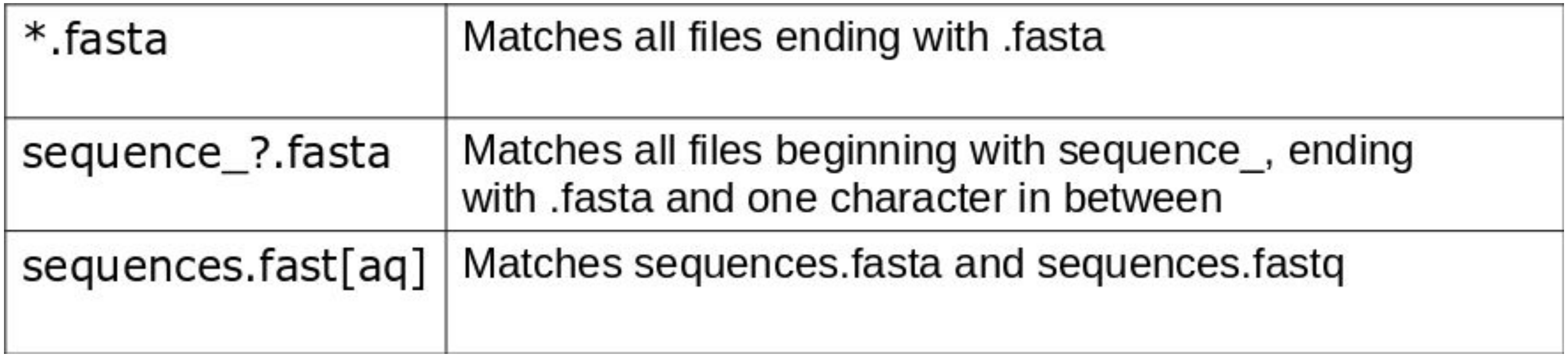
Linux Command Line Introduction - Part 2

- **Wildcards** can be used perform actions on multiple files at the same time
- Common wildcards:



*	Zero or more of any characters
?	Exactly one character – any
[ACGT]	One of the specified characters
[A-Z][0-9]	… works also with alphanumerical ranges
{10..13}	… but for numerical ranges you need ‘brace expansion’

- Example:



*.fasta	Matches all files ending with .fasta
sequence_?.fasta	Matches all files beginning with sequence_, ending with .fasta and one character in between
sequences.fast[aq]	Matches sequences.fasta and sequences.fastq

Linux Command Line Introduction - Part 2

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Acknowledgements

Cloud Governance Team and Cloud Portal Team:

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- Peter Belmann
- Nils Hoffmann
- Viktor Rudko