Technische Hochschule Rosenheim
Technical University of Applied Sciences

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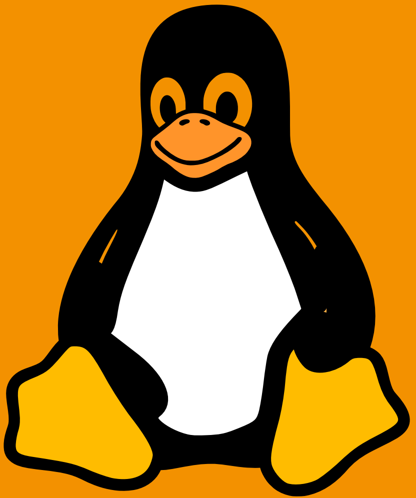
OS 9 – Communication 2



source: iconspng.com

The lecture is based on the work and the documents of Prof. Dr. Ludwig Frank

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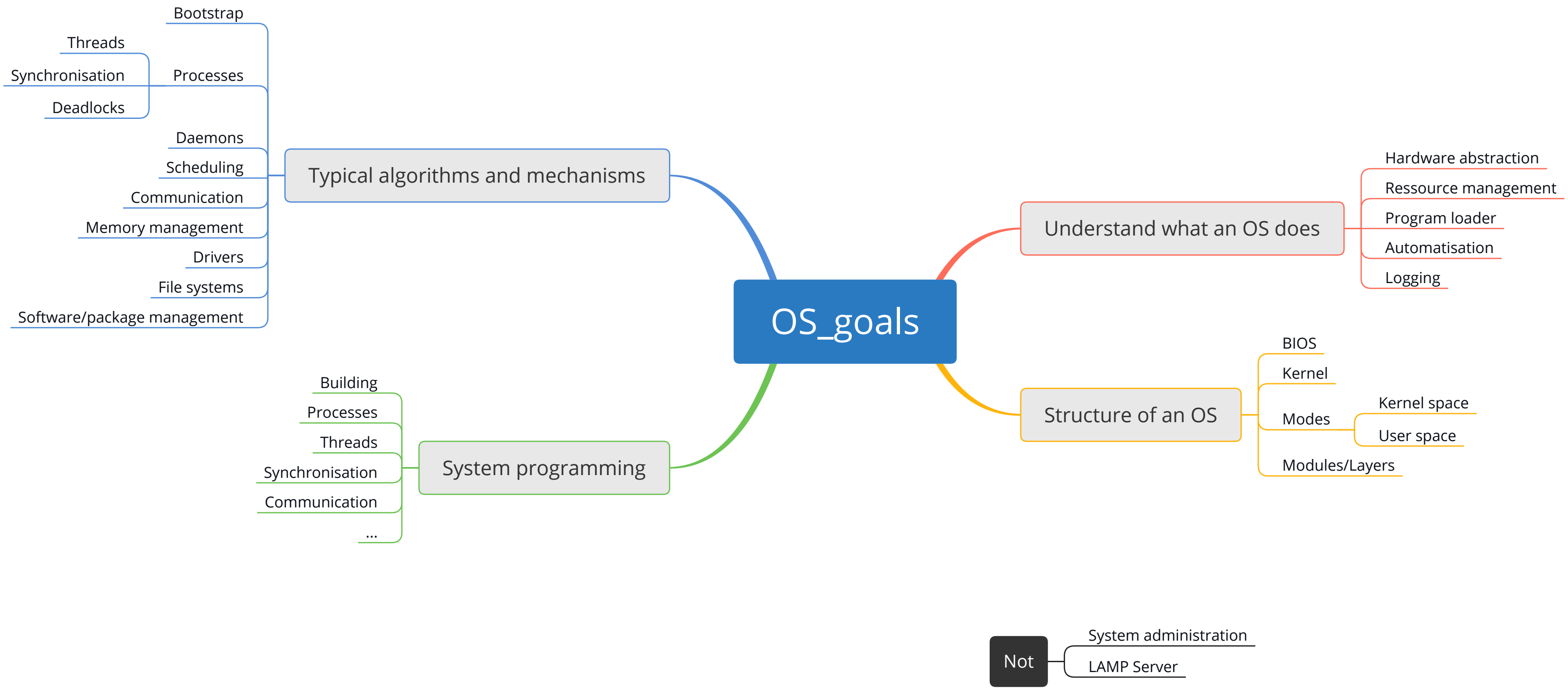
Goal



- OS_goals
  - Typical algorithms and mechanisms
    - Bootstrap
    - Processes
      - Threads
      - Synchronisation
      - Deadlocks
    - Daemons
    - Scheduling
    - Communication
    - Memory management
    - Drivers
    - File systems
    - Software/package management
  - System programming
    - Building
    - Processes
    - Threads
    - Synchronisation
    - Communication
    - ...
  - Understand what an OS does
    - Hardware abstraction
    - Ressource management
    - Program loader
    - Automatisation
    - Logging
  - Structure of an OS
    - BIOS
    - Kernel
    - Modes
      - Kernel space
      - User space
    - Modules/Layers
- Not
  - System administration
  - LAMP Server

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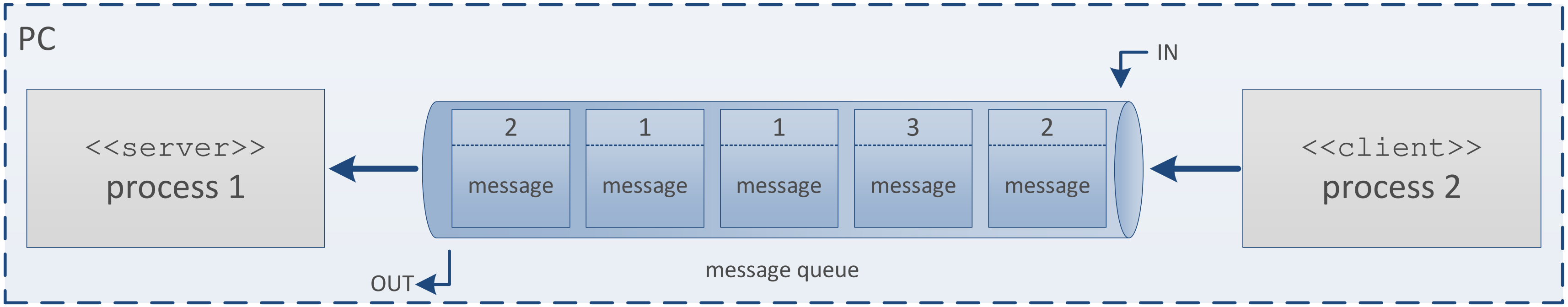
Goal

OS::Communication

- Message queue
- Shared memory
- Process communication summary

Message queue



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Message queue

Message queue concept

- Queue to **store messages**
- Inter-process communication (IPC) between processes on one PC.
- Messages have **priority/type**.
- Internal stored as a linked list.
- **Send** into queue **does not require** an **active receiver**
- **Read** from queue **does not require** an **active sender**
- Max queue size (default: 16 KiB on Linux).
- Max message size (default: 8 KiB on Linux).

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Message queue

Message structure

```
struct message {
    long priority;    //priority or type
    char message[64]; //buffer for message bytes
};
```

Message priority/type

- The lower the number, the higher the priority
- The priority can be interpreted as a type (each type has its own number)

Message queue usage scenarios (`PRIO_FETCH_FLAG`)

- Read message after message (FIFO principle) (`priority == 0`)
- Read only message with specific priority/type (`priority == N`)
- Read the messages with the highest priority/type first, up to a certain number (`priority == -N`)

Message queue: Pseudo C code

```
struct message { //structure for messages
  long priority;
  char message[64];
};

void receiver() {
  //create message queue
  msgget(...);



  //receive message
  //blocks if message queue is empty
  msgrcv(...);

  //... work with message

  //remove message queue
  msgctl(...);
}
```

```
void sender() {
  //open existing message queue
  msgget(...);

  //prepare message

  //send message
  //blocks if message queue is full
  msgsnd(...);

  //close not needed



}
```

Message queue: Linux commands

Command	Description
`ipcs`	Show information on IPC facilities
`ipcs -q`	Shows active message queues in the system
`ipcmk`	Make various IPC resources
`ipcmk -Q`	Create a message queue
`ipcrm`	Remove certain IPC resources
`ipcrm -q 1`	Remove message queue with id 1
`ipcrm -Q 2`	Remove message queue with key 2

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Message queue

C example

*Please find the source file(s) in the repository.

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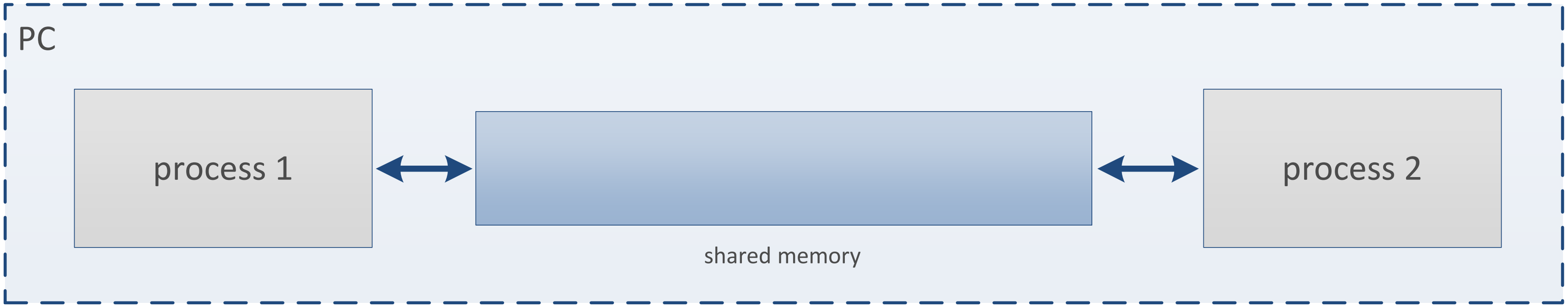
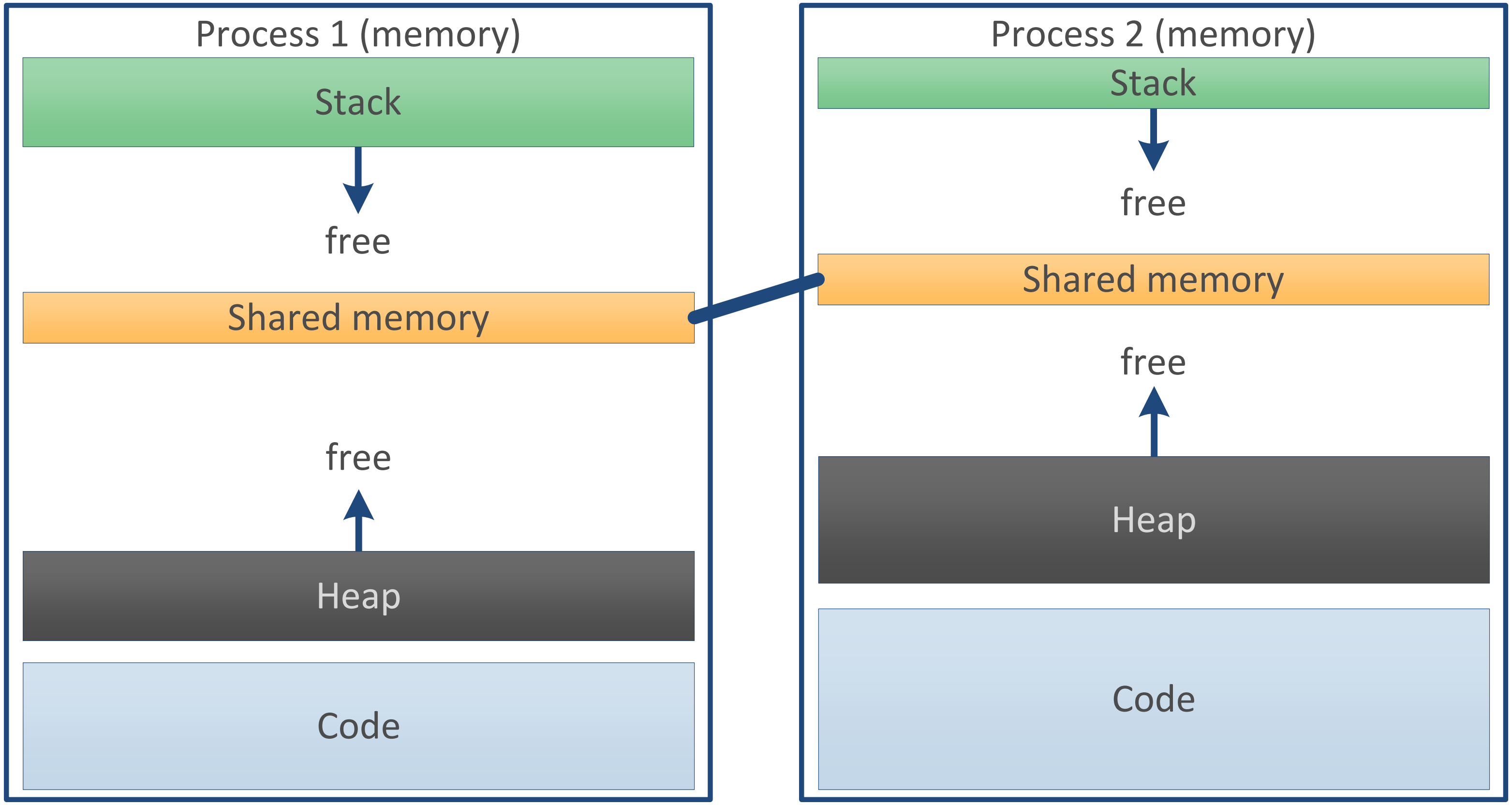
Shared memory



Shared memory



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Shared memory

Shared memory concept

- Shared memory area between processes
- Inter-process communication (IPC) between processes on one PC.
- It is a **plain memory area** with a certain size
- Access **needs to be synchronised** (e.g. semaphore)
- Access is **very fast** (comparable with own memory access)

Shared memory: Pseudo C code

```
seminit(READY_TO_WRITE, 1); //declare and initialise semaphore
seminit(READY_TO_READ,  0); //declare and initialise semaphore

void receiver() {
  //create shared memory
  shmget(...);
  //attach the shared memory
  shared_mem_address = shmat(...);




  //copy data from shared memory
  P(READY_TO_READ);
  copy(data, shared_mem_address); //data = sm
  V(READY_TO_WRITE);

  //... work with data
  work_with(data);

  //detach shared memory
  shmdt(...);
  //remove shared memory
  shmctl(...);
}
```

```
void sender() {
  //get existing shared memory
  shmget(...);
  //attach the shared memory
  shared_mem_address = shmat(...);

  //... prepare data
  data = prepare_data();

  //copy data into shared memory
  P(READY_TO_WRITE);
  copy(shared_mem_address, data); //sm = data
  V(READY_TO_READ);




  //detach shared memory
  shmdt(...);



}
```

Shared memory: Linux commands

Command	Description
`ipcs`	Show information on IPC facilities
`ipcs -m`	Shows active shared memory in the system
`ipcmk`	Make various IPC resources
`ipcmk -M 8`	Create a shared memory with 8 bytes
`ipcrm`	Remove certain IPC resources
`ipcrm -m 1`	Remove shared memory with id 1
`ipcrm -M 2`	Remove shared memory with key 2

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Shared memory

C example

*Please find the source file(s) in the repository.

Process communication summary

Mechanism	data	store	access contr.	remote	bidirect.	fast	prio.	sync req.
signal						X		
unix socket	X		X		X	X		
network socket	X			X	X			
pipe	X	_x_	X			X		
message queue	X	X	X			X	X	
shared memory	XX	XX	X		X	XX		X

Comparison of different communication mechanism: `https://www.programering.com/a/MTO0AzMwATI.html`

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Summary and outlook

Summary

- Message queue
- Shared memory
- Process communication summary

Outlook

- Deadlocks
- Deadlock analysis
- Deadlock prevention