

Problem Sheet #1

Problem 1.1: *library and system calls*

(1+1 = 2 points)

Answer the following questions by using `strace` and `ltrace` on a Linux system. Provide enough context information to make it clear how the results were obtained.

- How many system calls and how many library calls does executing `/bin/date` produce?
- What are the most frequent (top three) library and system calls and what do these calls do?

Problem 1.2: *system call errors*

(1+1 = 2 points)

System call errors are usually indicated by returning a special value (usually -1 for system calls that return an int) and by indicating the details in the global variable `int errno`, declared in `errno.h`.

- For each of the following system calls, describe a condition that causes it to fail (i.e., a condition that causes -1 to be returned and that sets `errno` to a distinct value).
 - `int open(const char *path, int oflag, ...)`
 - `int close(int fildes)`
- What is the value of `errno` after a system call completed without an error?

Problem 1.3: *execute a command in a modified environment or print the environment* (6 points)

On Unix systems, processes have access to environment variables that can influence the behavior of programs. The global variable `environ`, declared as

```
extern char **environ;
```

points to an array of pointers to strings. The last pointer has the value `NULL`. By convention, the strings have the form "name=value" and the names are often written using uppercase characters. Examples of environment variables are `USER` (the name of the current user), `HOME` (the current user's home directory), or `PATH` (the colon-separated list of directories where the system searches for executables).

Write a program `env` that implements some of the functionality of the standard `env` program. The syntax of the command line arguments is the following:

```
env [OPTION]... [NAME=VALUE]... [COMMAND [ARG]...]
```

- If called without any arguments, `env` prints the current environment to the standard output.
- If called with a sequence of "name=value" pairs and no further arguments, the program adds the "name=value" pairs to the environment and then prints the environment to the standard output.
- If called with a command and optional arguments, `env` executes the command with the given arguments.
- If called with a sequence of "name=value" pairs followed by a command and optional arguments, the program adds the "name=value" pairs to the environment and executes the command with the given arguments in the modified environment.