Operating System

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**OS 2021 Problem Sheet #1**

**Problem 1.1:** library and system calls

$ ltrace /bin/date

strrchr("/bin/date", '/') = "/date"

setlocale(LC\_ALL, "") = "en\_US.UTF-8"

bindtextdomain("coreutils", "/usr/share/locale") = "/usr/share/locale"

textdomain("coreutils") = "coreutils"

\_\_cxa\_atexit(0x556ecb5c79b0, 0, 0x556ecb5df248, 0x736c6974756572) = 0

getopt\_long(1, 0x7ffff55e0a68, "d:f:I::r:Rs:u", 0x556ecb5de260, nil) = -1

nl\_langinfo(0x2006c, 0, 0, 0) = 0x7f0eb9f17135

getenv("TZ") = nil

malloc(128) = 0x556ecb9e9440

clock\_gettime(0, 0x7ffff55e0890, 1, 0x556ecb9e94c0) = 0

getenv("TZ") = nil

localtime\_r(0x7ffff55e07c0, 0x7ffff55e07d0, 0x556ecb5d7128, 8) = 0x7ffff55e07d0

strcmp("", "EST") = -69

strlen("EST") = 3

memcpy(0x556ecb9e9449, "EST\0", 4) = 0x556ecb9e9449

strftime(" Sun", 1024, " %a", 0x7ffff55e07d0) = 4

fwrite("Sun", 3, 1, 0x7f0eba0d76a0) = 1

fputc(' ', 0x7f0eba0d76a0) = 32

fputc('0', 0x7f0eba0d76a0) = 48

fwrite("9", 1, 1, 0x7f0eba0d76a0) = 1

fputc(' ', 0x7f0eba0d76a0) = 32

strftime(" Jan", 1024, " %b", 0x7ffff55e07d0) = 4

fwrite("Jan", 3, 1, 0x7f0eba0d76a0) = 1

fputc(' ', 0x7f0eba0d76a0) = 32

fwrite("2022", 4, 1, 0x7f0eba0d76a0) = 1

fputc(' ', 0x7f0eba0d76a0) = 32

strftime(" 04:32:15 AM", 1024, " %r", 0x7ffff55e07d0) = 12

fwrite("04:32:15 AM", 11, 1, 0x7f0eba0d76a0) = 1

fputc(' ', 0x7f0eba0d76a0) = 32

strlen("EST") = 3

fwrite("EST", 3, 1, 0x7f0eba0d76a0) = 1

\_\_overflow(0x7f0eba0d76a0, 10, 3, 0x5453Sun 09 Jan 2022 04:32:15 AM EST

) = 10

\_\_fpending(0x7f0eba0d76a0, 0, 0x556ecb5c79b0, 1) = 0

fileno(0x7f0eba0d76a0) = 1

\_\_freading(0x7f0eba0d76a0, 0, 0x556ecb5c79b0, 1) = 0

\_\_freading(0x7f0eba0d76a0, 0, 0x556ecb5c79b0, 1) = 0

fflush(0x7f0eba0d76a0) = 0

fclose(0x7f0eba0d76a0) = 0

\_\_fpending(0x7f0eba0d75c0, 0, 0x7f0eba0d7801, 3072) = 0

fileno(0x7f0eba0d75c0) = 2

\_\_freading(0x7f0eba0d75c0, 0, 0x7f0eba0d7801, 3072) = 0

\_\_freading(0x7f0eba0d75c0, 0, 0x7f0eba0d7801, 3072) = 0

fflush(0x7f0eba0d75c0) = 0

fclose(0x7f0eba0d75c0) = 0

+++ exited (status 0) +++

$ strace /bin/date

execve("/bin/date", ["/bin/date"], 0x7ffd8476f110 /\* 39 vars \*/) = 0

brk(NULL) = 0x55dc21b8d000

access("/etc/ld.so.preload", R\_OK) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/etc/ld.so.cache", O\_RDONLY|O\_CLOEXEC) = 3

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=89954, ...}) = 0

mmap(NULL, 89954, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7fa11b798000

close(3) = 0

openat(AT\_FDCWD, "/lib/x86\_64-linux-gnu/libc.so.6", O\_RDONLY|O\_CLOEXEC) = 3

read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0@n\2\0\0\0\0\0"..., 832) = 832

fstat(3, {st\_mode=S\_IFREG|0755, st\_size=1839792, ...}) = 0

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa11b796000

mmap(NULL, 1852680, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7fa11b5d1000

mprotect(0x7fa11b5f6000, 1662976, PROT\_NONE) = 0

mmap(0x7fa11b5f6000, 1355776, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x25000) = 0x7fa11b5f6000

mmap(0x7fa11b741000, 303104, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x170000) = 0x7fa11b741000

mmap(0x7fa11b78c000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1ba000) = 0x7fa11b78c000

mmap(0x7fa11b792000, 13576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7fa11b792000

close(3) = 0

arch\_prctl(ARCH\_SET\_FS, 0x7fa11b797580) = 0

mprotect(0x7fa11b78c000, 12288, PROT\_READ) = 0

mprotect(0x55dc2081a000, 4096, PROT\_READ) = 0

mprotect(0x7fa11b7d8000, 4096, PROT\_READ) = 0

munmap(0x7fa11b798000, 89954) = 0

brk(NULL) = 0x55dc21b8d000

brk(0x55dc21bae000) = 0x55dc21bae000

openat(AT\_FDCWD, "/usr/lib/locale/locale-archive", O\_RDONLY|O\_CLOEXEC) = 3

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=3041456, ...}) = 0

mmap(NULL, 3041456, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7fa11b2ea000

close(3) = 0

openat(AT\_FDCWD, "/etc/localtime", O\_RDONLY|O\_CLOEXEC) = 3

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=3536, ...}) = 0

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=3536, ...}) = 0

read(3, "TZif2\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\5\0\0\0\5\0\0\0\0"..., 4096) = 3536

lseek(3, -2252, SEEK\_CUR) = 1284

read(3, "TZif2\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\5\0\0\0\5\0\0\0\0"..., 4096) = 2252

close(3) = 0

fstat(1, {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}) = 0

write(1, "Sun 09 Jan 2022 04:35:32 AM EST\n", 32Sun 09 Jan 2022 04:35:32 AM EST

) = 32

close(1) = 0

close(2) = 0

exit\_group(0) = ?

+++ exited with 0 +++

Executing /bin/date produces:

System calls: 49

Library calls: 45

Frequent system and library calls are:

1. pread64(): Reads up to count byte from file descriptor from given offset.
2. mmap(): Maps between files/devices and process address space
3. fstat(): Status of file

**Problem 1.2:** system call errors

* 1. int open(const char \*path, int oflag, ...)
* invalid assignment of arguments for oflag
* path provided doesn’t exist or contains a file
  1. int close(int fildes)
* if fildes is not a valid file descriptor

1. Errno reports the last system call error that has occurred. So errno will be the error of the last failed system call.

**Problem 1.3:** execute a command in a modified environment or print the environment

Inside the folder you will find the code.