

OS project 1

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Implementation Details

Environment: Oracle VM VirtualBox, version: 5.1.16

I followed similar steps described in the PPT when I build the kernel.

Implementation steps:

1. Add system call to the system call table.
2. Add macro `#define __NR_functionName xxx(my definition)`, update `NR_SYSCALLS` accordingly.
3. Add prototype of the system call with a prefix `sys_` at `syscalls.h`.
4. Modify Makefile, add `functionName.o` to `obj-y`.
5. Rebuild and Reboot into the kernel that I just compiled, then run my test program using `syscall(__NR_functionName, Parameters)`.

Faced Difficulties

Implementing `show`, `min`, and `multiply` is pretty simple. But the true difficulty comes when we try to implement `CPU_Utilization`.

1. Many simple operations that we are familiar with cannot be directly used in Kernel Space environment. For example, the use of `FILE *` or the arithmetic of floating point numbers, so we'll have to look up special functions or procedures to deal with it.
2. A big difficulty when implementing the system calls is that everytime we made a typo or silly mistake, it takes us a long time to figure it out since compiling the kernel is time-consuming. So I learned to code more carefully and double check for syntax errors before I recompile my kernel.

3. I found out that the result of my CPU_Utilization is 100%. At first, I thought this is unreasonable. But at last, I found out that it's not my problem. The CPU Utilization is indeed 100% on the virtual machine(the CPU is always utilized by user and system). I double checked it with top command and cat /proc/stat(the idle time, which is the fourth parameter, is not changing).

```
OS [Running] - Oracle VM VirtualBox
willy@willy-VirtualBox: ~
top - 00:36:47 up 1:24, 2 users, load average: 1.66, 1.69, 1
Tasks: 135 total, 1 running, 134 sleeping, 0 stopped, 0 z
Cpu(s): 69.3%us, 30.3%sy, 0.0%ni, 0.0%id, 0.0%wa, 0.3%hi, 0.3%st
Mem: 1031576k total, 560180k used, 471396k free, 31520k buffers
Swap: 1046520k total, 0k used, 1046520k free, 315368k buffers
```

Results

```
// test min and multiply
printf("8*7 = %d\n", syscall(339, 8, 7));
printf("min(100, 1) = %d\n", syscall(340, 100, 1));
// test hello, check from dmesg
syscall(337);
//test show, check from dmesg
syscall(338);
//test CPU_Utilization(show percentage), check from dmesg
syscall(341);
```

```
8*7 = 56
min(100, 1) = 1
```

```
[ 3611.521783] eth0: no IPv6 routers present
[ 5253.385573] HELLO SYSTEM CALL
[ 5253.385575] kchang r05922092
[ 5253.385576] sunfanyun b04902045
[ 5253.399255] 100
willy@willy-VirtualBox:~$
```