Reminders

- Project 1 due tomorrow at 5:00 pm
- Homework 2 out, due next Wednesday
- Start thinking about project groups (3 people) for the rest of the quarter
- Today: project 1 questions

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Project 1 – issues

- C strings
- Copy_to/from_user and counters
- Syscalls: macros ; arguments
- Execvp
- Other things

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C strings

- You only need to use:
  - **strncmp**(src,dest,256) – compare strings, 0 if equal, not 0 o.w.
  - **strtok**:
    - 1st use: tok = strtok(buf, "*delimiters*");
    - Subsequent uses: tok = strtok(NULL, "*delimiters*");
  - **fgets**(buf, 256, stdin) – read a line (up to 256 chars) from stdin (or getline)
  - *(maybe)* **strncpy**(dest, src, 256) – copy up to 256 chars from src to dest
  - *(maybe)* Allocate memory with **malloc**, free with **free**
- Fine to assume:
  - A maximum length for a shell command (say, 256)
  - Maximum number of arguments (say, 256 again)

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Passing counters

- Do not printk the statistics in execcounts!!!
- Execcounts should pass count values to the shell
  - The shell then prints out statistics
- Copying counters to userspace:
  - Shell passes in something to hold data
    - This could be a pointer to a struct, an array, or four pointers to ints.
  - execcounts fills the data in

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Copying data to/from kernel

- Unsafe to directly access user pointers!

```
long sys_gettimeofday(struct timeval *tv)
{
    if (tv) {
          struct timeval ktv;
          do_gettimeofday(&ktv);
          if (copy_to_user(tv, &ktv, sizeof(ktv)))
                return -EFAULT;
    }
    return 0;
}
```

- copy_to/from_user return amount of uncopied data

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Syscalls

- Two ways to use one:
  - Linux style:
    - in <asm/unistd.h>:

```
#define __NR_foo 292
static inline _syscall2(int, foo, int, arg1,
                        char *, arg2)
```

    - In userspace, just call `foo(4,"test");`
  - BSD style:
    - in shell.c:

```
#define __NR_foo 292
ret = syscall(__nr_foo, arg1, arg2);
```

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How syscalls work

In entry.S:

```
ENTRY(system_call)
        pushl %eax                      # save orig_eax
        SAVE_ALL
       cmpl $(NR_syscalls),%eax
        jae badsys
        call *SYMBOL_NAME(sys_call_table)(,%eax,4)
        movl %eax,EAX(%esp)             # save the return value
restore_all:
        RESTORE_ALL
```

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Execvp

- You must build an array of strings to pass to it
- Make sure the last thing in this array is NULL!
- Make sure the array includes the program name!

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Extern

- How do we access global variables defined in one file from another file?

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Code quality

- What's wrong with this:

```
char * buffer;
buffer = malloc(100);
strcpy(buffer, param);
```

- How do we fix this?

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Debugging

```
#define MYDEBUG

#ifdef MYDEBUG
  #define DEBUG(x) x
#else
  #define DEBUG(x)
#endif

…  DEBUG(printf("debug output"));
```

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Debugging 2

- Just for printing:

```
#ifdef MYDEBUG
#  ifdef __KERNEL__
      /* This one if debugging is on, and kernel space */
#     define PDEBUG(fmt, args...) printk("myprg: " fmt, ## args)
#  else
      /* This one for user space */
#     define PDEBUG(fmt, args...) fprintf(stderr, fmt, ## args)
#  endif
#else
#  define PDEBUG(fmt, args...) /* not debugging: nothing */
#endif
```

- works for both for kernel and userspace
- To use:

```
PDEBUG("Testing two numbers: %d and %d\n", num, num2);
```

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Things to check

- Check that every malloc has a matching free
- Check for errors
  - E.g. execvp returns -1, malloc returns NULL
  - Frequently, global constant errno will be set
  - Use *perror("error description");* to see what the error was.

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Fork

- How does it work?
- Any problems with it?

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UNIX startup

- Kernel only creates one process: *init* (pid 1)
  - Never creates any other processes
- *init* spawns other processes using **fork**, **exec**, etc.
- E.g. *init* creates a bunch of *getty* processes
  - One for each terminal
  - Each outputs "login: " prompt, gets input, **exec**s *login* process
    - *Login* prompts for a password, **exec**s shell if it's ok
- Off-topic: why is cd a built-in command in your shell?

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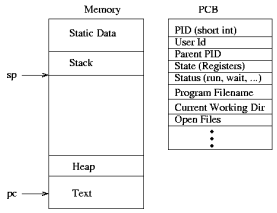
A UNIX Process



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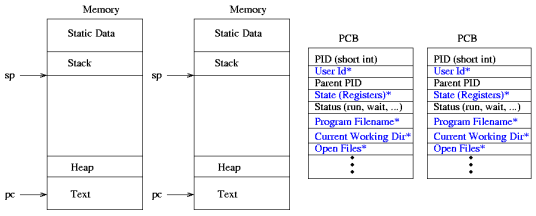
Same Process after fork



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