Operating Systems

Lab. Class

Project #5

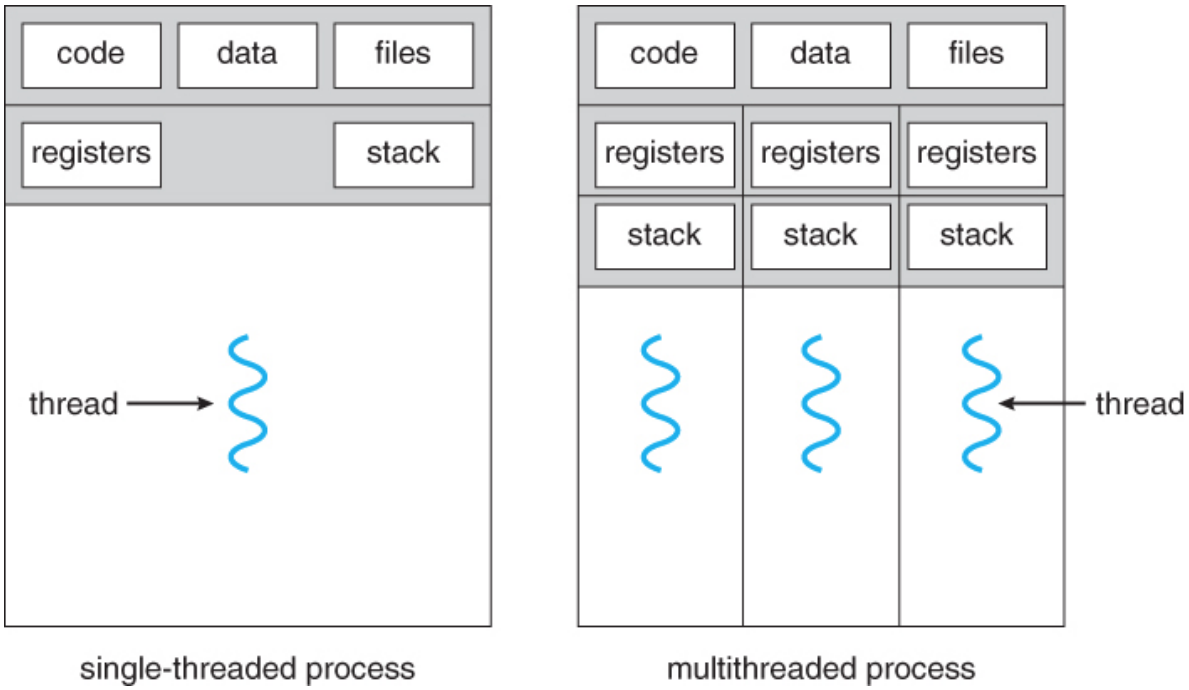
Project Plan

- 6 projects
  0. Install xv6
  1. System call
  2. Scheduling
  3. Memory
  4. Virtual memory
  5. Concurrency 1
  6. Concurrency 2

- Individual projects

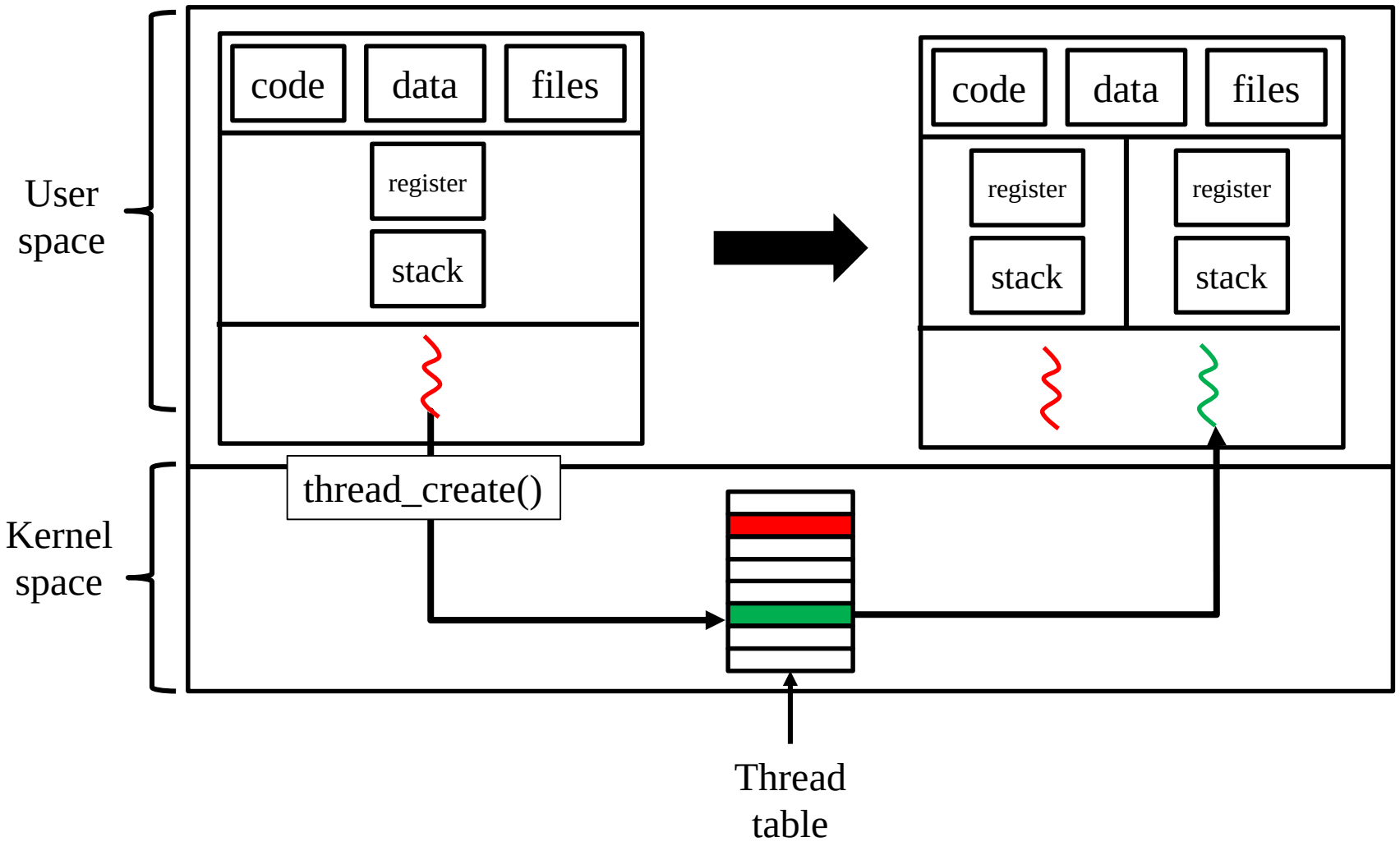
Supporting Threads on Xv6

- The original xv6 process is single-threaded.
- A multithreaded process consists of one or more threads.
  - Each thread has its own call stack.
  - Every thread shares code, data, and other resources such as open files



https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/4_Threads.html

Supporting Threads on Xv6 (Cont'd)



Supporting Threads on Xv6 – thread_create()

Name

thread_create – create a new thread

Synopsis

int thread_create(void *(*function)(void *), int priority, void *arg, void *stack);

Description

The thread_create() starts a new thread in the calling process. The new thread starts execution by invoking function(); arg is passed as the sole argument of function(). priority is the scheduling priority of the new thread (0~40). stack is the pointer to call stack of new thread.

Return value

Return the thread ID (tid) of the new thread. tid is guaranteed to be unique within a process. On error, return -1.

Supporting Threads on Xv6 – thread_exit()

Name

thread_exit – terminate calling thread

Synopsis

void thread_exit(void *retval);

Description

The thread_exit() function terminates the calling thread and returns a value via retval that is available to another thread in the same process that calls thread_join().

Return value

This function does not return to the caller.

Supporting Threads on Xv6 – thread_join()

Name

thread_join – join with a terminated thread

Synopsis

int thread_join(int tid, void **retval);

Description

The thread_join() function waits for the thread specified by tid to terminate. If that thread has already terminated, then thread_join() returns immediately.

thread_join() copies the exit status of the target thread into the location pointed to by *retval. The call stack of the terminated thread should be freed by the calling thread.

Return value

On success, return 0. If there's no thread with input tid, return -1.

Supporting Threads on Xv6 – gettid()

Name

gettid() – get thread identification

Synopsis

int gettid(void);

Description

The gettid() function returns caller's thread ID (TID). If the process is a single-threaded process, the thread ID is same as the process ID. In a multi-thread process, all threads have the same PID, but each one has a unique TID within a process.

Return value

Return the thread ID of calling thread.

Supporting Threads on Xv6 – getpid()

Name

getpid() – get process identification

Synopsis

int getpid(void);

Description

The getpid() function returns the caller’s process ID (PID). On multi-threaded pro cess, every thread of the same process returns same PID.

Return value

Return the process ID of calling process.

PA #5 – Thread support on Xv6

- Implement the following system calls on xv6
  - thread_create()
  - thread_exit()
  - thread_join()
  - gettid()
- Modify the following system call to support threads
  - getpid()
- Implement a priority scheduler which supports threads
  - Refer to PA #2

- Submission deadline
  - 2017-05-28 23:59

PA #5 – Things to Consider (1)

- We assume that each thread always terminates by calling thread_exit().

- If the main thread terminates or any thread calls exit(), the whole process is terminated. In this case, all the threads should be terminated as well. Also, address space should be freed and open files should be closed.

- Open files are shared among threads. If thread A opens a file, the file can be also accessed by another thread B (in the same process) using the same file descriptor. Files opened by thread A need not be closed automatically when thread A terminates.

PA #5 – Things to Consider (2)

- When a thread calls thread_exit(), the thread remains in the zombie state until another thread calls thread_join().
- There is no parent-child hierarchy among threads. Any thread can invoke thread_join() for another thread.
- All threads within a process should return the same PID. Thread IDs are guaranteed to be unique only within a process.
- The maximum number of threads per process is limited to 8 (including the main thread). Your implementation should support at least 32 processes.

PA #5 Template Code

- `git clone https://github.com/jinsoox/xv6-skku.git -b pa4`
- Modifications
  - Remove debug messages
    - Do not print any messages on screen
  - halt system call
    - Halt xv6 program
  - New system calls for supporting threads (in thread.c)
    - thread_create(), thread_exit(), thread_join(), gettid()
  - Existing system call for supporting threads (in proc.c)
    - getpid()
  - Multithreaded test program
    - threadtest.c

Project Submission Procedure

- http://sys.skku.edu
  - Submit a tarball file made from "**make tarball**"

- Submission deadline
  - 2017-05-28 23:59

- Since 6nd submission, -5% penalty of the project score
  - Up to 5 submissions are free to accept
- Every one day delay, -25% penalty of the project score
  - You can use up to 5 *slip* days

PA #5 Reference

- Our thread interface is a simplified version of POSIX Pthreads interface. Refer to manual pages on pthread_create(), pthread_join(), and pthread_exit().