

Homework 4

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Practice Exercise: 4.1, 4.4, 4.10, 4.17, 4.19

4.1 Provide three programming examples in which multithreading provides better performance than a single-threaded solution.

- web服务器响应客户机的请求（使用多线程的方式来实现并发响应）
- 使用多线程进行数组排序加速
- 使用多线程进行矩阵运算加速

4.4 What are two differences between user-level threads and kernel-level threads? Under what circumstances is one type better than the other?

- 用户线程位于内核之上，管理无需内核提供支持；内核线程由内核直接支持并管理；用户线程由线程库进行调度；内核线程由内核进行调度
- 内核线程可以被操作系统感知；用户线程不可被操作系统感知
- 用户线程执行开销比内核线程小，执行效率比内核线程高

4.10 Which of the following components of program state are shared across threads in a multithreaded process?

- a. Register values
- b. Heap memory
- c. Global variables
- d. Stack memory

堆内存(Heap memory)和全局变量(Global variables)是被线程共享的。

4.17 Consider the following code segment:

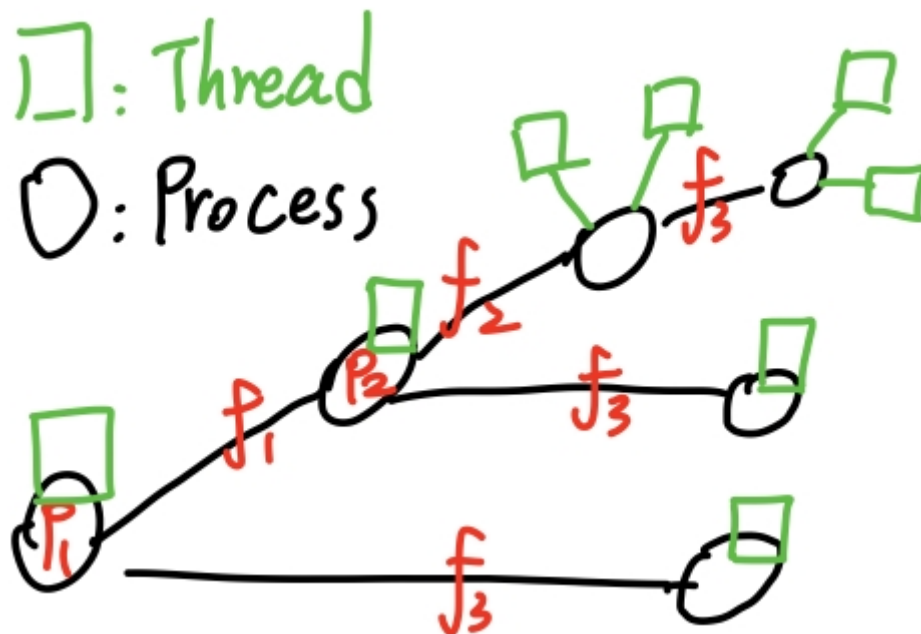
a. How many unique processes are created?

b. How many unique threads are created?

```
pid_t pid;

pid = fork();
if (pid == 0) { /* child process */
    fork();
    thread_create( . . . );
}
fork();
```

- 一共有6个进程（5个是新创建的）
- 一共有8个线程（7个是新创建的）



4.19 The program shown in Figure 4.23 uses the Pthreads API. What would be the output from the program at LINE C and LINE P?

```
#include <pthread.h>
#include <stdio.h>

int value = 0;
void *runner(void *param); /* the thread */

int main(int argc, char *argv[])
{
    pid_t pid;
    pthread_t tid;
    pthread_attr_t attr;

    pid = fork();

    if (pid == 0) { /* child process */
        pthread_attr_init(&attr);
        pthread_create(&tid, &attr, runner, NULL);
        pthread_join(tid, NULL);
        printf("CHILD: value = %d", value); /* LINE C */
    }
    else if (pid > 0) { /* parent process */
        wait(NULL);
        printf("PARENT: value = %d", value); /* LINE P */
    }
}

void *runner(void *param) {
    value = 5;
    pthread_exit(0);
}
```

Figure 4.22 C program for Exercise 4.19.

- LINE C: CHILD: value = 5
- LINE P: PARENT: value = 0
- 因为fork后生成的子进程里创建了线程，子进程等待线程运行后再执行，value被修改为5。因为fork产生的子进程与父进程数据独立，所以父进程内的value还是0。