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swtch.txt

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1 CS 202, Spring 2024
2 Handout 11 (Class 17)
3
4 1. User-level threads and swtch()
5
6 We'll study this in the context of user-level threads.
7
8 Per-thread state in thread control block:
9
10     typedef struct tcb {
11         unsigned long saved_rsp;    /* Stack pointer of thread */
12         char *t_stack;             /* Bottom of thread's stack */
13         /* ... */
14     };
15
16 Machine-dependent thread initialization function:
17
18     void thread_init(tcb **t, void (*fn) (void *), void *arg);
19
20 Machine-dependent thread-switch function:
21
22     void swtch(tcb *current, tcb *next);
23
24 Implementation of swtch(current, next):
25
26     # gcc x86-64 calling convention:
27     # on entering swtch():
28     # register %rdi holds first argument to the function ("current")
29     # register %rsi holds second argument to the function ("next")
30
31     # Save call-preserved (aka "callee-saved") regs of 'current'
32     pushq %rbp
33     pushq %rbx
34     pushq %r12
35     pushq %r13
36     pushq %r14
37     pushq %r15
38
39     # store old stack pointer, for when we swtch() back to "current" later
40     movq %rsp, (%rdi)           # %rdi->saved_rsp = %rsp
41     movq (%rsi), %rsp          # %rsp = %rsi->saved_rsp
42
43     # Restore call-preserved (aka "callee-saved") regs of 'next'
44     popq %r15
45     popq %r14
46     popq %r13
47     popq %r12
48     popq %rbx
49     popq %rbp
50
51     # Resume execution, from where "next" was when it last entered swtch()
52     ret
53
54

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55
56 2. Example use of swtch(): the yield() call.
57
58 A thread is going about its business and decides that it's executed for
59 long enough. So it calls yield(). Conceptually, the overall system needs
60 to now choose another thread, and run it:
61
62     void yield() {
63
64         tcb* next = pick_next_thread(); /* get a runnable thread */
65         tcb* current = get_current_thread();
66
67         swtch(current, next);
68
69         /* when 'current' is later rescheduled, it starts from here */
70     }
71
72 3. How do context switches interact with I/O calls?
73
74 This assumes a user-level threading package.
75
76 The thread calls something like "fake_blocking_read()". This looks
77 to the _thread_ as though the call blocks, but in reality, the call
78 is not blocking:
79
80     int fake_blocking_read(int fd, char* buf, int num) {
81
82         int nread = -1;
83
84         while (nread == -1) {
85
86             /* this is a non-blocking read() syscall */
87             nread = read(fd, buf, num);
88
89             if (nread == -1 && errno == EAGAIN) {
90                 /*
91                  * read would block. so let another thread run
92                  * and try again later (next time through the
93                  * loop).
94                  */
95                 yield();
96             }
97         }
98
99         return nread;
100     }
101
102
103
104
105

```