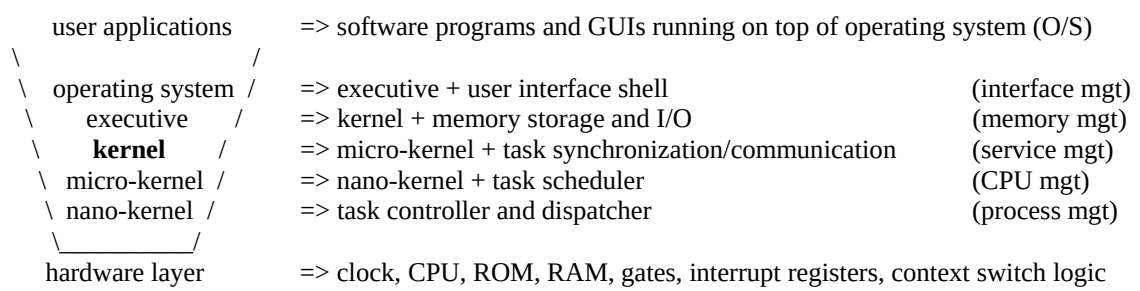
Lecture 16: Kernels

kernel – smallest portion of operating system that provides for task scheduling, dispatching, intertask communication, synchronization, and concurrency



nano-kernel: does task bookkeeping, execution, storage, division of activities, and dispatching

micro-kernel: schedules nano-kernel tasks involving real-time issues (hard or soft), priority management, interrupt handling, and time management

kernel: provides message queues, mailboxes, semaphores, pipes, and sockets to micro-kernel

executive: provides memory and I/O services to the kernel
cyclic executive: executive run as a periodic process by the kernel
Note: Most commercial RTOSes these days are run as cyclic executives. They are efficient, simple, control other periodic processes, predictable, have fast context switching; but they create design contraints, subject to breaking if rescheduling (overhead) is needed. Alternatively can use foreground-background executive.

operating system (O/S): provides file security, file management, and user tool command interface to the executive; acts as an interface to the computer hardware below and the software/user applications above

real-time operation system (RTOS): O/S that allows user access to the low level system services and resources to ensure tasks are predictable, visible, schedulable, concurrent, and dependable:

- predictable -tasks will execute within bounded time constraints and meet their assigned deadlines
- visible -tasks can be managed by system services, memory management is available, interrupt and fault/exception handling are available, and I/O services are utilized
- schedulable -tasks have time-sharing and priority allocation and access to CPU using static or dynamic priority handling management
- concurrent -tools are provided for task communication and synchronization and resource sharing such as mailboxes, semaphores, message queues
- dependable -tasks will meet their deadlines even if system faults occur

Other features:

- -keeps list of task pointers for scheduling on the stack
- -manages stack memory, cache, on-board memory
- -compiler library support and optional debugging services
- -provides floating point support
- -is as small as possible (5 – 20 KB of ROM)
- -has network management (e.g. FTP, SNMP)
- -provides device driver support including I/O and other embedded hardware initialization
- -does task management and scheduling
- -provides task communication tools like mailboxes, message queues, global memory, semaphores
- -provides clock, timing services, counter functions, internal interrupt handling
- -allows external interrupt register access and polling
- -enables interrupt priority levels
- -allows creation and initialization of software system devices