

# THE ABSTRACTIONS OF OPERATING SYSTEMS

No	Name	Objects	power of ten
9	Graphics service	windows, events	+3
8	Shell (GUI)	application programs	+3
7	Directories	directories	0
6	Streams	file, device, pipe	-2
5	Processes	processes	-2
4	Inter-process communication (IPC)	message, port	-3
3	Memory management	address, page, segment	-4
2	Threads	thread, ready list, semaphore	-4
1	Low-level I/O	device, driver	-4
0	Hardware levels	interrupts, procedures, call stacks, instruction set, logic gates	-12 to -9

NOTE: numbers in time scale column are powers of 10 orders of magnitude on the times between events at that level.

Levels 1-5 make up the **microkernel**, i.e., the smallest set of functions that must be executed in privileged (supervisor) mode.