Mach: kind of portable OS for both uniprocessors and multiprocessors. Separate the memory management from hardware support.

## Mach design

abstractions in Mach:

* task(like a process)
* thread
* port
* message
* memory object

the core thought in Mach: the memory management can integrate with the message communication system.

protection is done in per-page, each page will have current-protection and maximum-protection.

the fork: inherit all the information of tits parents, applying the copy-on-write machinism.

## implementation

the four data structures:

* resident page table: machine independent pages.
* address map: mapping from one set of addresses to a memory object(in linked-list structure)
* memory object: a unit of backing storage or a user task
* pmap: machine dependent memory mapping data structure(v-p mappings?)

the physical page table entry components:

* a memory object list
* memory allocation queue
* object/offset hash bucket

address map: a doubly linked list of address map entries, each of which maps a contiguous range of virtual addresses onto a contiguous area of a memory object.

memory object: in most cases as files, together with a pager(managing task). Can get access to the pager by sending messages to the corresponding port.

shadow objects: holding modified pages which originally belonged to another object. The other parts which are not changes still point to the original objects.