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When the demand paging handler is invoked during the fork system call,the kernel increments the region reference field of shared regions for the childprocess. For each of private regions of the child process, the kernel allocates anew region table entry and page table. The kernel then examines each entryin page table of the parent process. If a page is valid, the kernel incrementsthe reference process number in its frame table entry, indicating the numberof processes that share the page via different regions rather than through theshared region in order to let the parent and child processes go in differentways after the execve system call. Similarly, if the page exists on the swapspace, it increments the reference field of the swap table entry for this page.Now the page can be referenced through both regions, which share the pageuntil one of the parent or child processes writes to it.Then the kernel copies the page so that each region has a private version.To do this, the kernel turns on the copy-on-write bit for each page table entryin private regions of the parent and child processes during the fork systemcall. If either process writes the page, it causes a protection page fault thatinvokes the protection handler. Now we can see that the copy-on-write bitin a page table entry is designed to separate a child process creation fromits physical memory allocation. In this way, via protection page fault, thememory allocation can postpone until it is needed.The protection page fault can be caused in two situations. One is whena process references a valid page but its permission bits do not allow theprocess access, and the other is when a process tries to write a page whosecopy-on-write bit is set by the fork system call. The kernel has to check firstwhether or not permission is denied in order to make a decision about whatto do next, to signal an error message or to invoke the protection handler. Ifthe latter, the protection handler is invoked.When the protection handler is invoked, the kernel searches for the ap-propriate region and page table entry, and locks the region so that the pagecannot be swapped out while the protection handler operates on it. If thepage is shared with other processes, the kernel allocates a new frame andcopies the contents of the old page to it; the other processes still referencethe old page. After copying the page and updating the page table entry withthe new frame number, the kernel decrements the process reference numberof the old frame table entry.

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