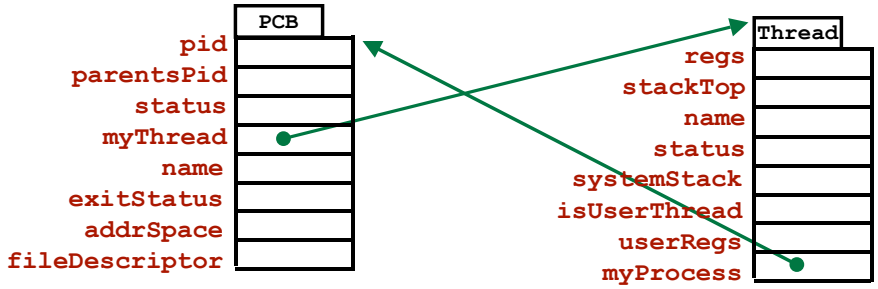
Project 5 Discussion

Threads and Processes - Design Options



class ProcessControlBlock

...

myThread: ptr to Thread

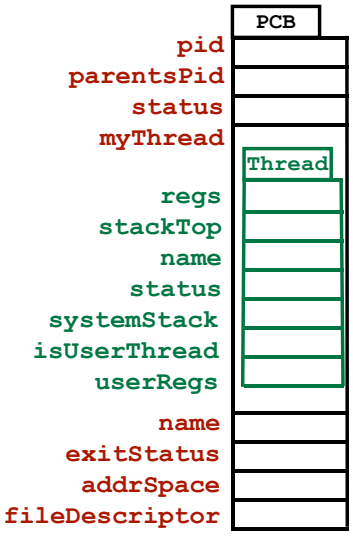
class Thread

...

myProcess: ptr to ProcessControlBlock

Threads and Processes - Design Options

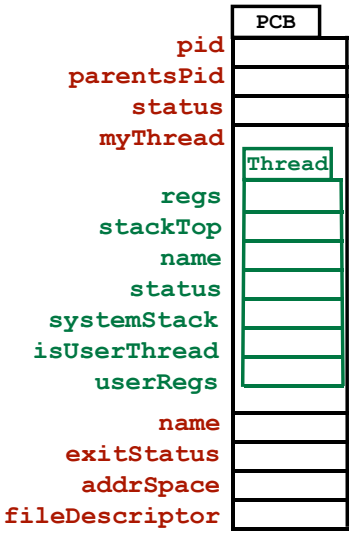
class ProcessControlBlock
    ...
    myThread: Thread



Threads and Processes - Design Options

class ProcessControlBlock
    ...
    myThread: Thread

pcb = ...
... = pcb.myThread.stackTop

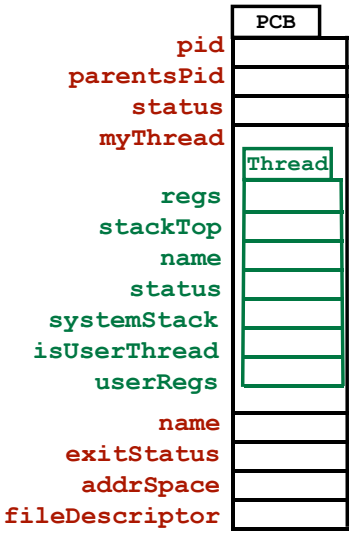


Threads and Processes - Design Options

```
class ProcessControlBlock
    ...
    myThread: Thread

pcb = ...
... = pcb.myThread.stackTop

var th: Thread
    th = pcb.myThread
    ... = th.stackTop
```



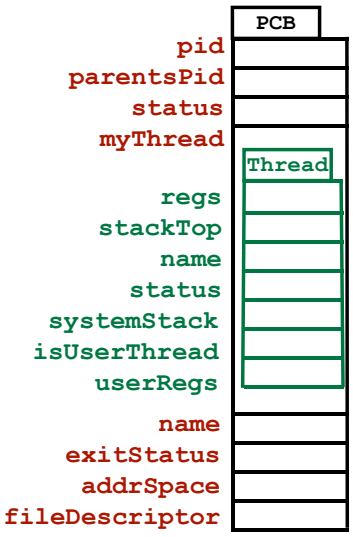
Threads and Processes - Design Options

```
class ProcessControlBlock
    ...
    myThread: Thread

pcb = ...
... = pcb.myThread.stackTop

var th: Thread
    th = pcb.myThread
    ... = th.stackTop

var th: ptr to Thread
    th = & pcb.myThread
    ... = th.stackTop
```



Threads and Processes - Design Options

```
class ProcessControlBlock
    ...
    myThread: Thread

pcb = ...
... = pcb.myThread.stackTop

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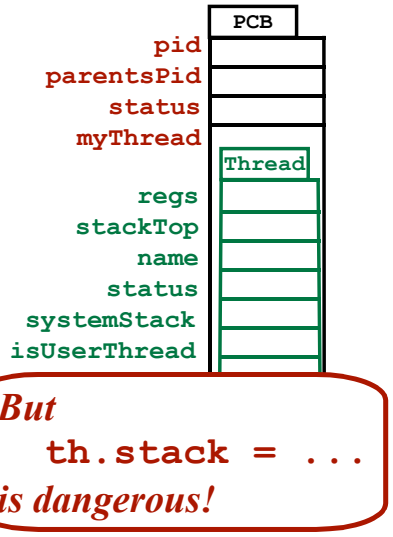
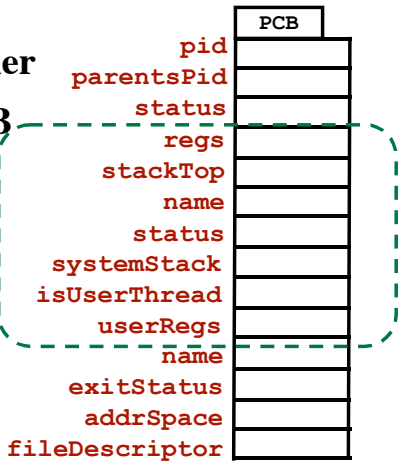


Threads and Processes - Design Options

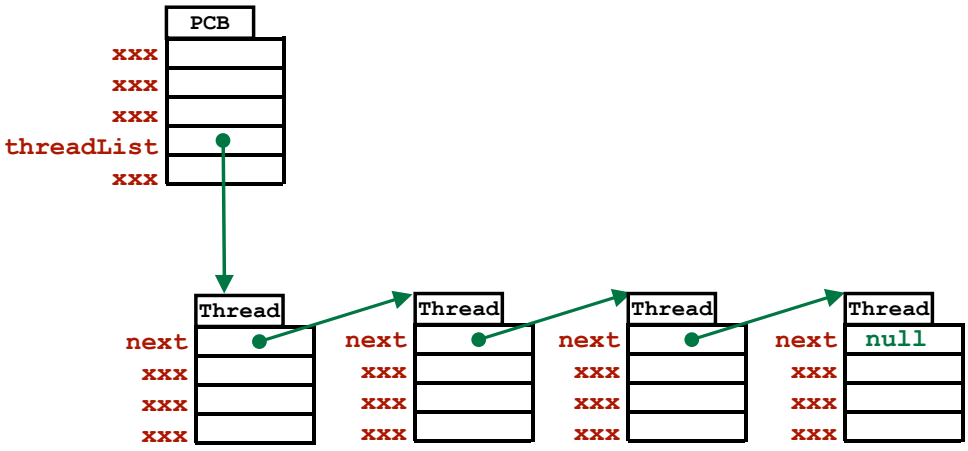
Another Option:

- Get rid of class Thread altogether
- Include all Thread fields in PCB



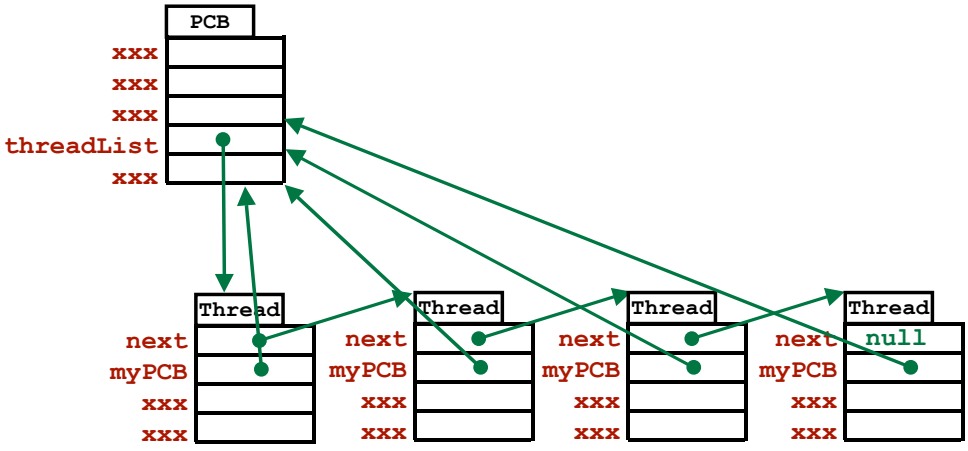
Threads and Processes - Design Options

Multiple Threads per Process



Threads and Processes - Design Options

Multiple Threads per Process



Class Thread

fields

- **regs: array [13] of int** -- **Space for r2..r14**
- **stackTop: ptr to void** -- **Current system stack top ptr**
- **name: ptr to array of char**
- **status: int** -- **JUST_CREATED, READY,**
  -- **RUNNING, BLOCKED, UNUSED**
- **systemStack: array [SYSTEM_STACK_SIZE] of int**
- **isUserThread: bool**
- **userRegs: array [15] of int** -- **Space for r1..r15**
- **myProcess: ptr to ProcessControlBlock**

Class Thread

methods

- **Init (n: ptr to array of char)**
- **Fork (fun: ptr to function (int), arg: int)**
- **Yield ()**
- **Sleep ()**
- **CheckOverflow ()**
- **Print ()**

Class ProcessControlBlock

fields

- **pid: int** -- The process ID
- **parentsPid: int** -- The pid of the parent of this process
- **status: int** -- ACTIVE, ZOMBIE, or FREE
- **myThread: ptr to Thread** -- Each process has one thread
- **exitStatus: int** -- The value passed to Sys_Exit
- **addrSpace: AddrSpace** -- The logical address space
- **fileDescriptor: array [MAX_FILES_PER_PROCESS] of ptr to OpenFile**

Class ProcessControlBlock

methods

- **Init** ()
- **Print** ()

Class ThreadManager

fields
threadTable: array [MAX_NUMBER_OF_PROCESSES] of Thread
freeList: List [Thread]
threadManagerLock: Mutex
-- These synchronization objects
aThreadBecameFree: Condition
-- apply to the "freeList"

Class ThreadManager

methods
Init ()
Print ()
GetANewThread () returns ptr to Thread
FreeThread (th: ptr to Thread)

Class ProcessManager

```
fields
    processTable: array [MAX_NUMBER_OF_PROCESSES]
                                of ProcessControlBlock
    processManagerLock: Mutex
                                -- These synchronization objects
    aProcessBecameFree: Condition
                                --    apply to the "freeList"
    freeList: List [ProcessControlBlock]
    aProcessDied: Condition
                                -- Signalled for new ZOMBIEs
    nextPid: int
```


Class ProcessManager

```
methods
    Init ()
    Print ()
    GetANewProcess () returns ptr to ProcessControlBlock
    FreeProcess (p: ptr to ProcessControlBlock)
    -- TurnIntoZombie (p: ptr to ProcessControlBlock)
    -- WaitForZombie (proc: ptr to ProcessControlBlock)
                                                returns int
```

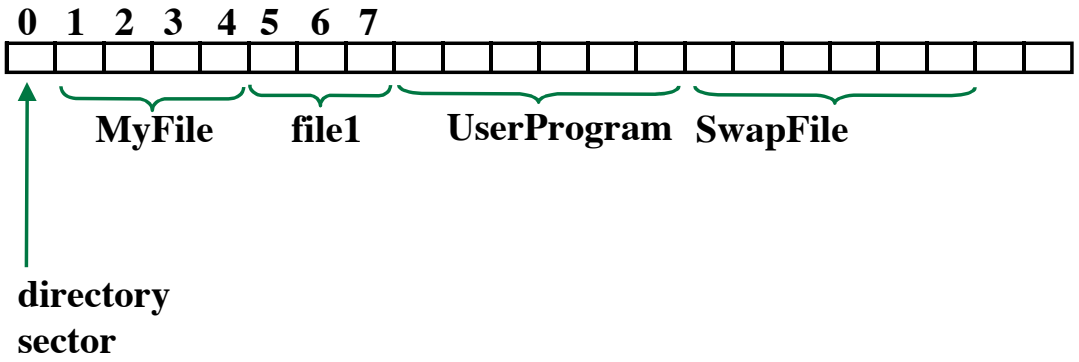
The “Stub” File System

Model of disk
- **Sequence of sectors**

The File System
- **Sector zero contains the directory**
- **Only one directory (a “flat” file system)**

Files:
- **Name**
- **Starting sector**
- **Size (number of bytes)**
- **All sectors for a file are contiguous**

The “Stub” File System



The “diskUtil” Utility

Another BLITZ tool

Initialize the file system, create empty directory...
diskUtil -i

List the directory of the BLITZ “DISK”...
diskUtil -l

Copy a file from Unix to the BLITZ “DISK”...
diskUtil -a *UnixFileName* *BlitzFileName*

Get help info...
diskUtil -h

File-Related Classes

Class “FileControlBlock” (FCB)
- **Contains info kernel needs to read/write to a file**
  - **Where on disk**
  - **A buffer area to use**
  - **Length of file**
- **Must have only one FCB per file**

Class “FileManager”
- **A monitor**
- **Where all the methods are**

Class FileControlBlock

fields
- **fcbID: int**
- **numberOfUsers: int**
  -- count of OpenFiles pointing here
- **startingSectorOfFile: int -- or -1 if FCB not in use**
- **sizeOfFileInBytes: int**
- **bufferPtr: ptr to void -- ptr to a page frame**
- **relativeSectorInBuffer: int -- or -1 if none**
- **bufferIsDirty: bool -- Set to true when buffer is modified**

Class FileControlBlock

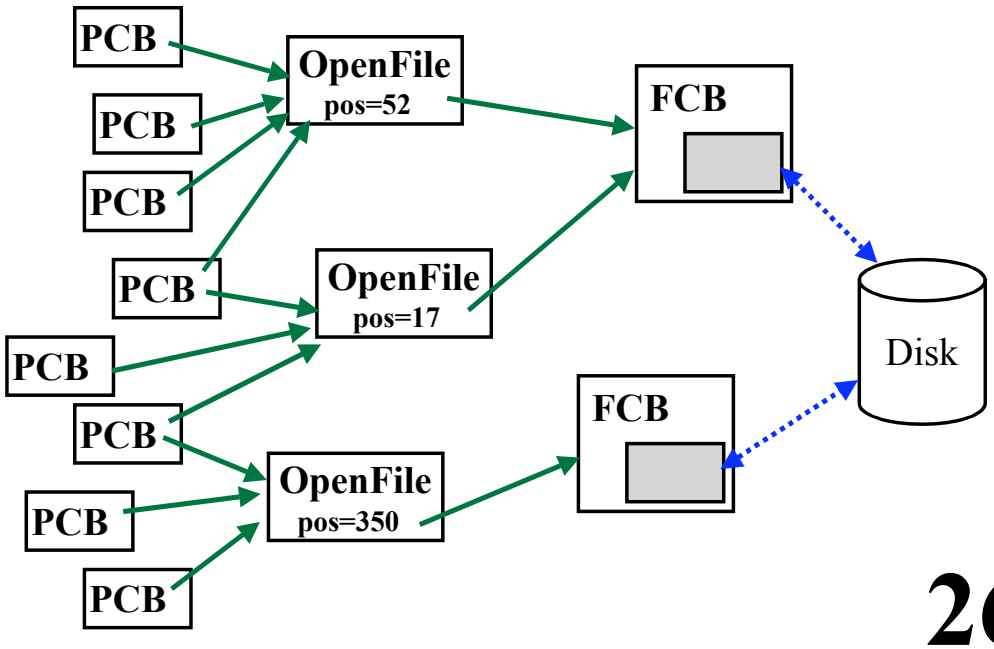
methods
- **Init ()**
- **Print ()**

Class OpenFile

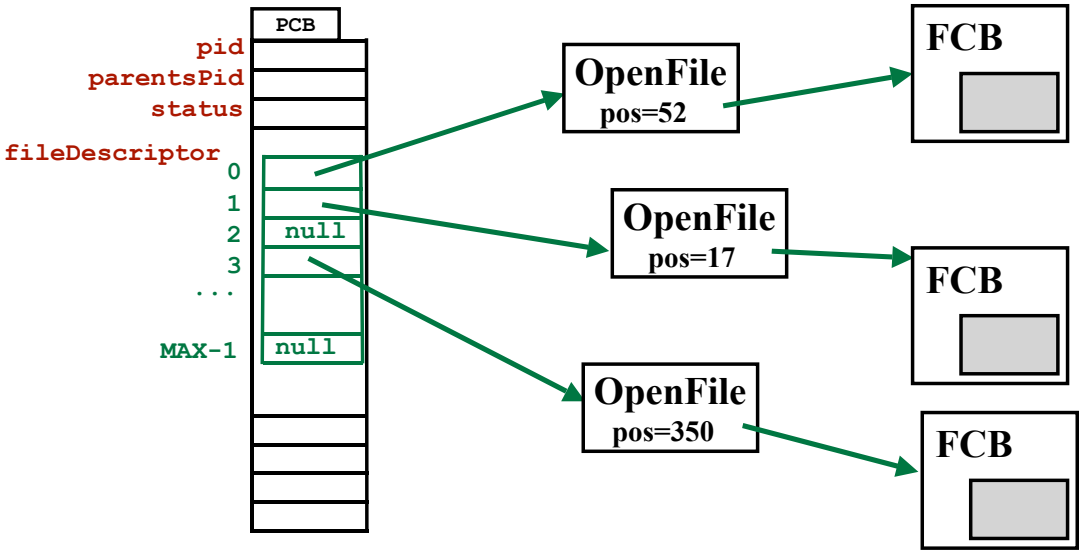
Contains:

- **Ptr to the FCB for this file**
- **The "current position"**
- **Processes point to "OpenFile"s, not "FCB"s**

The Unix Open-File Model



File Descriptors



Class OpenFile

fields

currentPos: int -- 0 = first byte of file

fcb: ptr to FileControlBlock -- null = not open

numberOfUsers: int -- count of Processes pointing here

Class OpenFile

methods
Print ()
SynchRead (targetAddr, numBytes: int) returns bool
-- returns true if all okay
ReadInt () returns int
LoadExecutable (addrSpace: ptr to AddrSpace) returns int
-- returns -1 if problems

Class FileManager

fields
fileManagerLock: Mutex

fcbTable: array [MAX_NUM_FILE_CONTROL_BLKS]
of FileControlBlock
anFCBBecameFree: Condition
fcbFreeList: List [FileControlBlock]

openFileTable: array [MAX_NUM_OPEN_FILES]
of OpenFile
anOpenFileBecameFree: Condition
openFileFreeList: List [OpenFile]

directoryFrame: ptr to void

Class FileManager

methods
Init ()
Print ()
FindFCB (filename: String) returns
ptr to FileControlBlock -- null if errors
Open (filename: String) returns ptr to OpenFile
-- null if errors
Close (open: ptr to OpenFile)
Flush (open: ptr to OpenFile)
SynchRead (open: ptr to OpenFile,
targetAddr, bytePos, numBytes: int) returns bool
SynchWrite (open: ptr to OpenFile,
targetAddr, bytePos, numBytes: int) returns bool

Class DiskDriver

fields
DISK_STATUS_WORD_ADDRESS: ptr to int
DISK_COMMAND_WORD_ADDRESS: ptr to int
DISK_MEMORY_ADDRESS_REGISTER: ptr to int
DISK_SECTOR_NUMBER_REGISTER: ptr to int
DISK_SECTOR_COUNT_REGISTER: ptr to int
semToSignalOnCompletion: ptr to Semaphore
semUsedInSynchMethods: Semaphore
diskBusy: Mutex

Class DiskDriver

methods

Init ()

SynchReadSector

(sectorAddr, numberOfSectors, memoryAddr: int)

StartReadSector

(sectorAddr, numberOfSectors, memoryAddr: int,
whoCares: ptr to Semaphore)

SynchWriteSector

(sectorAddr, numberOfSectors, memoryAddr: int)

StartWriteSector

(sectorAddr, numberOfSectors, memoryAddr: int,
whoCares: ptr to Semaphore)