CS 503 Lab 2 Answers

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Files modified/added

lab2q3.c ; lab2q4.c ; lab2q5.c; iobound.c ; cpubound.c ; resched.c; ready.c; prototypes.h; initialize.c; process.h

Testing Methodology

The following script in the main.c is an example for carrying out the tests. No additional parameters are needed for the lab test functions. Please take a look at excisting main.c for example execution of tests for each lab section.

```
/* main.c - main */
#include <xinu.h>
#include <stdio.h>
int lab2flag = 4; // set this!!!
process main(void)
{
    resume(create(lab2q4t1, 1024, 51, "lab2q4t1", 0, NULL));
    sleepms(6000);
    resume(create(lab2q4t2,1024,52, "lab2q4t2",0, NULL));
    sleepms(6000);
    resume(create(lab2q4t3,1024,52, "lab2q4t3",0, NULL));
    sleepms(3000);
    resume(create(shell, 8192, 50, "shell", 1, CONSOLE));
    /* Wait for shell to exit and recreate it */
    return OK;
}
```

The global variable lab2flag needs to be set prior to testing so as to enable the scheduling policy required to test the corresponding section of the lab, i.e set to 3/4/5. The sleeps in between resumes above are enabled for easy viewing(printing) to the console. To simulate these results I have 4 worker processes of priority of 54 and 1 monitor process of priority 57. Worker processes classify as either workerproceesTypeA or workerprocessTypeB. Type A processes

execute an infinite loop, and Type B is similar to Type A execept that it will sleep on having counted upto a certain number (say 200), it will invoke a sleep instruction for 20ms and relinquish the processor.

Next up, we explain the monitor process. The monitor process is responsible for spawning the worker processes and then calling sleepms for a designated time. Since, monitor process has the highest priority it will take up the CPU exclusively. On relinquishing the processor with sleep for the designated time, the 4 worker processes get a chance to execute and we get a chance to test. But when the monitor process wakes up, it executes the process status shell xsh-ps code to print the status of the processes and then kills the other 4 worker processes. Hence, this is the general methodology used to simulate the below results and by this we can visibly reason/ make inferences about the process execution.

Question 3: Monitoring CPU usage of processes

1 Test for fairness

In the image above, the upper half that describes lab2q3t2, I have set four workerprocessTypeA processes to have equal priority and they all share the CPU time, so as printed by the column CPU ms, they share the CPU time equitably. With worker process 1 being the last to execute right before the monitor process wakes up and takes over the cpu(after workerProc 1 time quantum completes of course).

2 Test for relinquishing CPU

In the middle part of the image above, I have set 4 processes to have equal priority. However, worker proce 1-3 are workerprocessTypeA and worker proc 4 is of type workerprocessTypeB. As mentioned earler, workerprocessTypeB is set to have a sleepms() invocation after a certain duration(after it counts up to 2000000). Hence, we can assume this process sleeps a lot. Until then, however it whirs in its infinite loop. So, as we can tell, process 4 has received significantly lesser time as compared to the other 3 processes.

3 Test for highest priority process hogging CPU

In this test I have set the 3 workerprocessTypeA processes to have same priority 54 however worker proc 4 has a higher priority 55 (yet its priority is lower than that of monitor process whose priority is 57). As we can see for the duration that the monitor process sleeps, the worker proc 4 hogs the CPU without allowing the other 3 worker processes to execute and takes up all of the 375 ms allotted for worker processes to execute. In other words, monitor process was let to sleep only for 375 ms, and then after it wakes up it takes over the cpu and prints the above information for us to visually validate.

```
In lab2q3t1 test | Note: sleeping for 5 seconds .. zzzzz ..
Clock time in seconds since boot is 5
Clock time in milliseconds since boot is 5053
In lab2q3t2 test | Note: 4 (workerProcessTypeA) equal CPU usage seen by monitorProcess
(Monitor process will have higher priority than workerProcessTypeA)
                                 State Prio Ppid Stack Base Stack Ptr Stack Size CPU time
id Name
                                                                                                                                                  ReadyQ Posn
                                             0 0 0x0EFDEFFC 0x0EFDEF1C
200 0 0x0EFDEFFC 0x0EFDCAAC
20 0 0x0EFD8FFC 0x0EFD8F44
52 3 0x0FDEFFFC 0x0FDEFB3C
54 5 0x0FDEFBFC 0x0FDEFB3C
54 5 0x0FDEFFBC 0x0FDEFB3C
                                  ready
    rdsproc
Main process
                                  wait
    cputimetest1
Worker Proc1
                                  ready
                                                                                                            1024
    Worker Proc2
                                  ready
                                                                                                             1024
                                                           5 0x0FDEF3FC 0x0FDEF36C
5 0x0EFC8FFC 0x0EFC8F6C
5 0x0EFC8BFC 0x0EFC8B5C
                                  ready
ready
                                                                                                            1024
     Worker Proc4
In lab2q3t3 test | Note: 3 (workerProcessTypeA) and 1 sleeper workerProcessTypeB
(Monitor process will have higher priority than workerProcessTypeA/B)
                                  State Prio Ppid Stack Base Stack Ptr Stack Size CPU time
                                                                                                                                                  ReadyQ Posn
                                                          0 0x0EFDCFFC 0x0EFDCAAC
0 0x0EFD8FFC 0x0EFD8F44
3 0x0FDEFFFC 0x0FDEFF40
     rdsproc
                                  wait
                                               200 0 0x0EFDCFFC 0x0EFDCAAC
20 0 0x0EFDEFFC 0x0EFDEF844
52 3 0x0FDEFFFC 0x0FDEFF840
54 11 0x0FDEFFFC 0x0FDEFF3C
54 11 0x0FDEFFFC 0x0FDEF73C
54 11 0x0FDEF8C 0x0FDEF33C
54 11 0x0EFC8FFC 0x0EFC8F80
57 11 0x0EFC8FFC 0x0EFC8F80
    Main process
cputimetest2
                                                                                                            65536
1024
                                  ready
   Worker Proc1
Worker Proc2
                                  ready
ready
                                                                                                            1024
1024
14 Worker Proc3
                                  ready
                                                                                                             1024
                                                                                                                               106
                                                       11 0x0EFC8BFC 0x0EFC8B5C
16 Monitor Proc
In lab2q3t4 test | Note: 3 (workerProcessTypeA) and 1 higher priority workerProcessTypeA (Monitor process will have higher priority than workerProcessTypeA)
                                  State Prio Ppid Stack Base Stack Ptr Stack Size CPU time
                                            0 0 0x0EFDEFFC 0x0EFDEF1C
200 0 0x0EFDCFC 0x0EFDCAAC
    rdsproc
                                                                                                            16384
                                                      0 0x0 EFDCFFC 0x0 EFDCAAC
0 0x0 EFD8 FFC 0x0 EFD8 F44
3 0x0 FDEFFFC 0x0 FDEFFBCC
17 0x0 FDEFFFC 0x0 FDEFFCC
17 0x0 FDEF7FC 0x0 FDEF7CC
17 0x0 FDEF3FC 0x0 FDEF3CC
    Main process
cputimetest3
                                  ready
ready
                                                                                                           65536
1024
.
18 Worker Proc1
19 Worker Proc2
                                  ready
                                                                                                             1024
    Worker Proc3
                                  ready
                                                                                                             1024
                                                        17 0x0EFC8FFC 0x0EFC8F3C
17 0x0EFC8BFC 0x0EFC8B5C
```

Figure 1: Experiment results using lab2q3.c tests

Question 4.2: Dynamic priority scheduling to achieve "fairness"

I used the same tests as for part 3 and these were the results. Right off the bat, we notice that the CPU time used by the CPU hogging processes and IO hogging processes is nearly indistinguishable in all three cases and all the values are 30ms within the range of each other. This shows that our dynamic priority scheduling strategy shares the CPU equitably among IO hogging and CPU hogging applications.

	LAB 2.4.2								
	HAB 2.4.2								
In	lab2q4t1 test	Note: 4	(woı	kerP	rocessTypeA)	equal CPU	usage see	n by monito	rProcess
	onitor process								
Pid	Name	State	Prio	Ppid	Stack Base	Stack Ptr	Stack Siz	e CPU time	ReadyQ Posn
0	prnull	ready			0x0EFDEFFC	0x0EFDEF50	8192	2147483647	4
1	rdsproc	wait	200		0x0EFDCFFC	0x0EFDCAAC	16384		
3	Main process	sleep	20		0x0EFD8FFC	0x0EFD8F74	65536		
5	Worker Proc1	ready	54	4	0x0FDEFBFC	0x0FDEFB3C	1024	96	3
6	Worker Proc2	ready	54	4	0x0FDEF7FC	0x0FDEF76C	1024	91	0
7	Worker Proc3	ready	54	4	0x0FDEF3FC	0x0FDEF36C	1024	91	1
8	Worker Proc4	ready	54	4	0x0EFC8FFC	0x0EFC8F6C	1024	91	2
9	Monitor Proc	curr	57	4	0x0EFC8BFC	0x0EFC8B5C	1024	61	
In	lab2q4t2 test	Note: 3	(woı	kerPı	rocessTypeA)	and 1 slee	eper worke	rProcessType	В
(M	onitor process	will have	high	ner pi	riority than	n workerProd	cessTypeA/	B)	
Pid	Name	State	Prio	Ppid	Stack Base	Stack Ptr	Stack Siz	e CPU time	ReadyQ Posn
0	prnull	ready			0x0EFDEFFC	0x0EFDEF1C	8192	2147483647	4
1	rdsproc	wait	200		0x0EFDCFFC	0x0EFDCAAC	16384		
3	Main process	sleep	20		0x0EFD8FFC	0x0EFD8F74	65536		
11	Worker Proc1	ready	54	10	0x0FDEFBFC	0x0FDEFB6C	1024	120	1
12	Worker Proc2	ready	54	10	0x0FDEF7FC	0x0FDEF73C	1024	130	3
13	Worker Proc3	ready				0x0FDEF33C		118	0
14	Worker Proc4	ready	54	10	0x0EFC8FFC	0x0EFC8F80	1024	121	2
15	Monitor Proc	curr	57	10	0x0EFC8BFC	0x0EFC8B5C	1024	61	
In	lab2q4t3 test	Note: 3	(woı	kerP	rocessTypeA)	and 1 higl	her priori	ty workerPro	cessTypeA
(M	onitor process	will have	high	ner p	riority than	n workerProd	cessTypeA)		
Pid	Name	State	Prio	Ppid	Stack Base	Stack Ptr	Stack Siz	e CPU time	ReadyQ Posn
	prnull	ready			0x0EFDEFFC	0x0EFDEF1C	8192	2147483647	4
	rdsproc	wait				0x0EFDCAAC			
	Main process					0x0EFD8F74			
	Worker Proc1	ready				0x0FDEFB3C			3
	Worker Proc2	ready				0x0FDEF76C			0
	Worker Proc3	ready				0x0FDEF36C			1
	Worker Proc4	ready				0x0EFC8F6C			2
21	Monitor Proc	curr	57	16	0x0EFC8BFC	0x0EFC8B5C	1024	61	
	LAB 2.4.3								

Figure 2: Dynamic priority scheduling

Question 4.3: Performance evaluation

1 All processes are CPU-bound

1.1 Nulluser runs only if no other process is ready

My design solution to this problem is to set the nulluser's propumsec to be MAXINT32 when it's instantiated, as can be viewed in the image above the value for prnull's CPU time usage is MAXINT32 = 2147483647. In addition, its propumsec field should not be updated when it is the oldprocess to be context switched out as we can't increment beyond the max value of the int32. This ensures that within the TS scheduling strategy the nulluser is always at the end of the readylist, and hence only executes if no other process is ready. The only caveat is that we can't deem this to be true for long running processes that

may be running for more than 24 days. Since, 24 days is roughly MAXINT32 milliseconds. In this lab since we are not dealing with long running instances, as specified in the document specifications, we can ignore this warning for now. As can be seen from the figure below, if we call ps as we execute the code the amount of time spent by each process is within 30ms of each other. So they work in lock-step where no process is left behind.

2 All processes are iobound

As can been from the figure below, if we call ps as we execute the code, all the processes work in lock-step. They are 30ms within the bound of each other. So this is the expected result. This is assuming the values for loop1 and loop2 are the same for all 6 processes. If they were different for different processes then time alloted to each process could be unpredicatable since it could be possible that a process that has a high propumsed time could execute while processes with the lower propumsed time are sleeping, and since the higher process is the only ready process(apart from null) it will execute and further the gap between itself and the lower processes. If this is the case then it could be very difficult for these lower propumsed time processes to catch up to the higher one. This can be the case only for different values of loop1 loop2 for the 6 iobound processes. Intuitively it makes sense.

3 Half-half

As show in image we go back to the last answer where we experimented with different values of loop1 and loop2 for the all processes are iobound case and notice that the same happens for cpubound processes. Every time all iobound processes are sleeping, the cpubound process takes over and gets more clock cycles and then it always stays in the lead an eventually the cpubound processes finish faster than the iobound processes. This is normal. Actually, it is the preferred way an OS must execute. What is the alternative to this? A cPU bound process not executing while all such IO bound processes are sleeping. Why waste the clock cycles. However, as soon as an iobound process wakes up it is given priority since it was given lower cpu clock cycles over the cpubound processes.

Question 5: Dynamic workloads

My solution to this problem involves a very intuitive yet effective method to manage dynamic workloads. To revisit the problem we have long standing process who gets very heavily demoted by a newly entered process. So the process would be allowed to execute until its cputime alloted rises up to the long standing process. But this is clearly leading to starvation. So the solution is to demote priority of process for cputime used and promote priority for the amount of time it has spent on the readylist. Hence, every time resched is

invoked all the processes on the ready list are given 6ms of promotion. Here we are using the same ready list as provided originally but the key of a process when inserted is the negation of its cputime used. Hence, the lower the cputime used by processes the better the chance of it to be executed next. By adding 6ms on each resched call to ready list processes that haven't won the ongoing time quantum, they slowly move up the process queue to get a chance to execute next, a chance they could've never got without this strategy. Hence, a priority of process is defined by = wait-time - cpu-time used, where wait time is 6ms * (number of times resched was invoked while it was on ready list). The results are shown in the image below.

As we can see that process with pid 4 has CPU time 690 while processes with pid 8 and 9 are supposed to demote the other processes by a lot and hog the cpu until they get a similar amount of time as them 690ms. But after a while process 4's ReadyQ key is decremented because it has been rewarded for waiting. And even though pid 9 has cpu time of 481 and pid 4 process has 690 cpu time the position of process with pid 4 on readylist is higher than process with pid 9. Hence, we have shown that dynamic workloads can be scheduled fairly, to prevent starvation.

Pid Name		ps \$ ps	curr	20	28	0x0EFD8FFC	0x0EFD8DF8	8192	2
0 prnull			State	Prio	Ppid	Stack Base	Stack Ptr	Stack Size	CPU Time
Teleproc									
22 cpubound 1	0	prnul1	ready	0	0	0x0EFDEFFC	0x0EFDEF1C	8192 2	147483647
23 cpubound 2	1	rdsproc	wait	200	0	0x0EFDCFFC	0x0EFDCAAC	16384	2
24 cpubound 3	22	cpubound 1	ready	1	3	0x0FDEFFFC	0x0FDEFCF0	1024	7062
25 cpubound 4	23	cpubound 2	ready	1	3	0x0FDEFBFC	0x0FDEF980	1024	7084
26 cpubound 5	24	cpubound 3	ready	1	3	0x0FDEF7FC	$0\times 0 \texttt{FDEF} 58 4$	1024	7085
27 cpubound 6	25	cpubound 4	ready	1	3	0x0FDEF3FC	0x0FDEF0EC	1024	7069
Shell	26	cpubound 5	ready	1	3	0x0EFC8FFC	$0\times 0 \text{EFC8CF0}$	1024	7071
Year State Prio Ppid Stack Base Stack Pti Stack Stack Pti Stac	27	cpubound 6	ready	1	3	0x0EFC8BFC	0x0EFC88F0	1024	7072
State Prio Ppid Stack Base Stack Prio Ppid Stack Prio Ppid Stack Base Stack Prio Ppid Prio Ppid Prio P	28	shell	recv	50				8192	
Pid Name	70	ps	curr	20	28	0x0EFD8FFC	0x0EFD8DF8	8192	2
0 prnull ready 0 0 0 0x0EFDEFFC 0x0EFDEF1C 16384 2 22 cpubound 1 ready 1 3 0x0FDEFFC 0x0FDEF1C 1024 7176 23 cpubound 2 ready 1 3 0x0FDEFFEC 0x0FDEFEC 1024 7176 24 cpubound 3 ready 1 3 0x0FDEFFEC 0x0FDEFEC 1024 7176 25 cpubound 4 ready 1 3 0x0FDEFFEC 0x0FDEFAC 1024 7177 25 cpubound 5 ready 1 3 0x0FDEFFEC 0x0FDEFAC 1024 7180 26 cpubound 5 ready 1 3 0x0EFC8FEC 0x0EFC8FEC 1024 7180 27 cpubound 6 ready 1 3 0x0EFC8FEC 0x0EFC8FEC 1024 7180 28 shell recv 50 3 0x0EFC8FEC 0x0EFC8FEC 1024 7180 28 shell recv 50 3 0x0EFC8FEC 0x0EFC8FEC 1024 7180 28 shell recv 50 3 0x0EFC8FEC 0x0EFC8FEC 1024 7180 29 prnull ready 1 0 0x0EFD8FFC 0x0EFC8FEC 1024 7180 20 prnull ready 1 0 0x0EFD8FFC 0x0EFC8FEC 1024 7180 20 prnull ready 1 0 0x0EFD8FFC 0x0EFD8F8 8192 3 21 probused 1 ready 1 0 0x0EFD8FFC 0x0EFD8F8 8192 3 22 cpubound 2 ready 1 3 0x0FDEFFC 0x0EFD8F8 8192 3 23 cpubound 2 ready 1 3 0x0FDEFFFC 0x0EFD8F8 8192 3 24 cpubound 3 ready 1 3 0x0FDEFFFC 0x0EFD8F8 8192 1247483647 25 cpubound 4 ready 1 3 0x0FDEFFFC 0x0EFD8F8 8192 1247483647 26 cpubound 5 ready 1 3 0x0FDEFFFC 0x0EFD8F8 8192 1247483647 27 cpubound 6 ready 1 3 0x0FDEFFFC 0x0EFD8F8 8192 124748 28 shell recv 50 3 0x0EFC8FFC 0x0EFD8F8 8192 2 2 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFD8F8 8192 2 2 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFE8F8 8192 2 2 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFE8F8 8192 2 2 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8F8 8192 2 2 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8F8 8192 2 2 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8F8 8192 2 2 cpubound 7 ready 1 3 0x0EFC8FFC 0x0EFC8F8 8192 3 2xsh \$ ps Pid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 0 0 0x0EFD8FFC 0x0EFC8FFC 0x0EFC8F8 8192 2 2 cpubound 1 ready 1 3 0x0EFC8FFC 0x0EFC8FFC 0x0EFC8F8 1024 7389 24 cpubound 2 ready 1 3 0x0EFC8FFC 0x0EFC8FFC 1024 7389 25 cpubound 4 ready 1 3 0x0EFC8FFC 0x0EFC8FFC 1024 7389 26 cpubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8FFC 1024 7389 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8FFC 1024 7389 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8FFC 1024 7389 28 shell recv 50 3 0x0EFC8FFC									
0 prnull ready 0 0 0 0x0 eFDEFFC 0x0 eFDEF1C 16384 2 2 cpubound 1 ready 1 3 0x0 FDEFFC 0x0 FDCARC 16384 7176 23 cpubound 2 ready 1 3 0x0 FDEFFC 0x0 FDEFCFC 1024 7176 24 cpubound 3 ready 1 3 0x0 FDEFFC 0x0 FDEFAFC 1024 7176 25 cpubound 4 ready 1 3 0x0 FDEFFC 0x0 FDEFAFC 1024 7177 25 cpubound 5 ready 1 3 0x0 FDEFFC 0x0 FDEFAFG 1024 7180 26 cpubound 5 ready 1 3 0x0 EFC8FFC 0x0 EFC8FG 1024 7180 27 cpubound 6 ready 1 3 0x0 EFC8FFC 0x0 EFC8GF0 1024 7180 28 shell recv 50 3 0x0 EFC8FFC 0x0 EFC8BEC 1024 7180 28 shell recv 50 3 0x0 EFC8FFC 0x0 EFC8BEC 1024 7180 28 shell recv 50 3 0x0 EFC8FFC 0x0 EFC8BEC 1024 7180 29 prnull ready 0 0 0x0 EFD8FF 0x0 EFD8FF 8 8192 2 20 pubound 1 ready 1 3 0x0 EFC8FFC 0x0 EFC8BF 8 8192 3 xsh \$ps Pid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 1 3 0x0 EFDEFFC 0x0 EFDEFA 16384 2 2 cpubound 1 ready 1 3 0x0 EFDEFFC 0x0 EFDEFA 16384 2 2 cpubound 2 ready 1 3 0x0 FDEFFFC 0x0 EFDEFC 1024 7252 23 cpubound 2 ready 1 3 0x0 FDEFFFC 0x0 EFDEFG 1024 7256 24 cpubound 3 ready 1 3 0x0 FDEFFFC 0x0 EFDEFG 1024 7256 25 cpubound 4 ready 1 3 0x0 FDEFFFC 0x0 EFDEFG 1024 7256 25 cpubound 5 ready 1 3 0x0 FDEFFFC 0x0 EFDEFA 1024 7274 26 cpubound 5 ready 1 3 0x0 EFC8FFC 0x0 EFC8FF 1024 7274 27 cpubound 6 ready 1 3 0x0 EFC8FFC 0x0 EFC8F 1024 7274 28 shell recv 50 3 0x0 EFC8FFC 0x0 EFC8F 8 1024 7274 28 shell recv 50 3 0x0 EFC8FFC 0x0 EFC8F 8 1024 7274 29 ps curr 20 28 0x0 EFC8FFC 0x0 EFC8F 8 1024 7274 20 probound 6 ready 1 3 0x0 EFC8FFC 0x0 EFC8F 8 1024 7274 21 rdsproc wait 200 0 0x0 EFDEFFC 0x0 EFC8F 8 1024 7274 22 cpubound 1 ready 1 3 0x0 EFC8FFC 0x0 EFC8F 8 1024 7274 24 cpubound 2 ready 1 3 0x0 EFC8FFC 0x0 EFC8F 8 1024 7389 25 cpubound 1 ready 1 3 0x0 EFC8FFC 0x0 EFC8F 8 1024 7389 25 cpubound 2 ready 1 3 0x0 EFC8FFC 0x0 EFC8F 8 1024 7389 26 cpubound 3 ready 1 3 0x0 EFC8FFC 0x0 EFDEFA 1024 7389 27 cpubound 4 ready 1 3 0x0 EFC8FFC 0x0 EFDEFA 1024 7389 28 cpubound 5 ready 1 3 0x0 EFC8FFC 0x0 EFDEFA 1024 7389 29 cpubound 6 ready 1 3 0x0 EFC8FFC 0x0 EFDEFS 1024 7389 20 cpubound 6 ready 1	Pid	Name		Prio	Ppid	Stack Base	Stack Ptr		CPU Time
1 rdsproc									
Provided Part Provided Part Provided Part Pa			_						
Tready 1 3 0x0FDEFBFC 0x0FDEF8FC 1024 7176 1777 1776 1777		-							
Teady 1 3 0x0FDEF7FC 0x0FDEF4F0 1024 7177 7180		-	-	_	_				
25 opubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF160 1024 7180 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7180 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7180 27 opubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7180 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8BKC 8192 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		-	_						
Teady 1 3 0x0			ready	1	_			1024	7177
27 cpubound 6	25	cpubound 4	ready	1				1024	7180
Tecv So			ready	1				1024	7180
State			ready	1				1024	
State Prio Ppid Stack Base Stack Ptro Stack Size CPU Time	28	shell	recv	50	3	0x0EFC87FC	0x0EFC848C	8192	2
Prid Name	71	ps	curr	20	28	0x0EFD8FFC	$0\times 0 \texttt{EFD8DF8}$	8192	3
0 prnull ready 0 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 1 rdsproc wait 200 0 0x0EFDEFFC 0x0FDEFAC 16384 2 22 cpubound 1 ready 1 3 0x0FDEFFFC 0x0FDEF6C 1024 7252 23 cpubound 2 ready 1 3 0x0FDEFFFC 0x0FDEF6C 1024 7256 24 cpubound 3 ready 1 3 0x0FDEFFFC 0x0FDEF960 1024 7256 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF8E 1024 7256 25 cpubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF84 1024 7274 26 cpubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF84 1024 7261 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC88F0 1024 7274 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8880 1024 7274 28 shell recv 50 3 0x0EFC8FFC 0x0EFC88B0 1024 7274 29 s curr 20 28 0x0EF08FFC 0x0EFD8F8 8192 2 72 ps curr 20 28 0x0EF08FFC 0x0EFD8F8 8192 3 xsh \$ ps Pid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 0 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 1 rdsproc wait 200 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 1 rdsproc wait 200 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 2 cpubound 1 ready 1 3 0x0FDEFFFC 0x0FDEF84 1024 7389 23 cpubound 2 ready 1 3 0x0FDEFFFC 0x0FDEF84 1024 7389 24 cpubound 3 ready 1 3 0x0FDEFFFC 0x0FDEF86 1024 7390 25 cpubound 4 ready 1 3 0x0FDEFFFC 0x0FDEF86 1024 7390 25 cpubound 5 ready 1 3 0x0FDEFFFC 0x0FDEF86 1024 7397 27 cpubound 6 ready 1 3 0x0FDEF3FC 0x0EFDEF86 1024 7391 27 cpubound 6 ready 1 3 0x0FDEF3FC 0x0EFC88EC 1024 7391 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8EEC 1024 7391 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8EEC 1024 7391	xsh	\$ ps							
0 prnull ready vait 0 0 000 EFDEFFC 0x0 EFDEAC 8192 2147483647 1 rdsproc wait 200 0 0x0 EFDEFFC 0x0 EFDEAC 16384 2 2 22 cpubound 1 ready 1 3 0x0 FDEFFFC 0x0 FDEFFCC 1024 7252 7252 23 cpubound 2 ready 1 3 0x0 FDEFFFC 0x0 FDEFF6C 1024 7256 7256 24 cpubound 3 ready 1 3 0x0 FDEFFFC 0x0 FDEF86C 1024 7256 7256 25 cpubound 4 ready 1 3 0x0 EFC8FFC 0x0 EFC8FC 1024 7274 7261 27 cpubound 5 ready 1 3 0x0 EFC8FFC 0x0 EFC8FF0 1024 7261 7274 726 28 shel1 recv 50 3 0x0 EFC8FFC 0x0 EFC848C 8192 2 2 29 curr 20 28 0x0 EFD8FFC 0x0 EFD8F8 8192 3 3 xsh \$ ps prid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time CPU Time 0 prnull ready 1 read	Pid	Name		Prio	Ppid	Stack Base	Stack Ptr		CPU Time
1 rdsproc									
22 cpubound 1 ready 1 3 0x0FDEFFFC 0x0FDEFCEC 1024 7252 23 cpubound 2 ready 1 3 0x0FDEFBFC 0x0FDEF960 1024 7268 24 cpubound 3 ready 1 3 0x0FDEFBFC 0x0FDEF960 1024 7256 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF184 1024 7274 26 cpubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF184 1024 7274 26 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC86F0 1024 7261 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC88F0 1024 7274 28 shell recv 50 3 0x0EFC8FFC 0x0EFC88F0 1024 7274 28 shell recv 50 3 0x0EFC8FFC 0x0EFC88F0 8192 2 72 ps curr 20 28 0x0EFD8FFC 0x0EFD8F8 8192 3 xsh \$ ps Pid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 0 0 0x0EFDEFFC 0x0EFD8F1 61834 2 22 cpubound 1 ready 1 3 0x0FDEFFFC 0x0EFD8F8 1024 7389 23 cpubound 2 ready 1 3 0x0FDEFFFC 0x0FDEF88 1024 7389 24 cpubound 3 ready 1 3 0x0FDEFFFC 0x0FDEF88 1024 7389 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF88 1024 7389 26 cpubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF88 1024 7390 27 cpubound 6 ready 1 3 0x0FDEF3FC 0x0EFC8EC 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8EC 1024 7391 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8EC 8192 2 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8EC 8192 2 28 shell recv 50 3 0x0EFC8FFC 0x0EFD8F8 8192 3		-	_						
23 cpubound 2 ready 1 3 0x0FDEFBFC 0x0FDEF960 1024 7256 24 cpubound 3 ready 1 3 0x0FDEF3FC 0x0FDEF4EC 1024 7256 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF3EC 1024 7256 26 cpubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7261 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8880 1024 7274 28 shell recv 50 3 0x0EFC8FC 0x0EFC8880 1024 7274 29 ps curr 20 28 0x0EFD8FFC 0x0EFD8FF 8192 2 3 xsh \$ ps Pid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 0 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 1 rdsproc wait 200 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 1 rdsproc wait 200 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 1 rdsproc ready 1 3 0x0FDEFFFC 0x0FDEF8 1024 7389 23 cpubound 1 ready 1 3 0x0FDEFFFC 0x0FDEF80 1024 7389 24 cpubound 2 ready 1 3 0x0FDEFFFC 0x0FDEF80 1024 7389 24 cpubound 3 ready 1 3 0x0FDEFFFC 0x0FDEF80 1024 7390 25 cpubound 4 ready 1 3 0x0FDEFFFC 0x0FDEF80 1024 7391 26 cpubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8EC 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8EC 1024 7391 28 shell recv 50 3 0x0EFC8FFC 0x0EFDBF8 8192 3		-							
24 cpubound 3 ready 1 3 0x0FDEF7FC 0x0FDEF4EC 0x0FDEF184 1024 7256 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF184 1024 7274 26 cpubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8FF0 1024 7261 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8FF0 1024 7274 28 shell recv 50 3 0x0EFC8FFC 0x0EFC848C 8192 2 72 ps curr 20 28 0x0EFD8FFC 0x0EFD8F8 8192 3 xsh \$ ps Pid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 0 0 0x0EFDEFFC 0x0EFD8AC 16384 2 CPU Time 1 rdsproc wait 200 0 0x0EFDEFFC 0x0EFD8AC 16384 2 2 cpubound 1 ready 1 3 0x0FDEFFFC 0x0EFD8AC 16384 2 22 cpubound 1 ready 1 3 0x0FDEFFFC 0x0EFD8AC 16384 2 7389 23 cpubound 2 ready 1 3 0x0FDEFFFC 0x0FDF580 1024 7389 24 cpubound 3 ready 1 3 0x0FDEF3FC 0x0FDEF580 1024 7387 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF8C 1024 7387 26 cpubound 5 ready 1 3 0x0FDEF3FC 0x0EFC8CFC 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8CFC 1024 7391 28 shell ready 1 ready 1 3 0x0EFC8FFC 0x0EFC8CFC 1024 7391 27 cpubound 6 ready 1 ready 1 0x0EFC8FFC 0x0EFC8CFC 1024 7391 28 shell ready 1 ready 1 0x0EFC8FFC 0x0EFC8FC 1024 7391 27 cpubou			-	_					
25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF184 1024 7274 26 cpubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8CFO 1024 7261 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8CFO 1024 7274 28 shell recv 50 3 0x0EFC8FFC 0x0EFC888C 8192 2 72 ps curr 20 28 0x0EFD8FFC 0x0EFD8FS 8192 3 xsh \$ ps Pid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 0 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 1 rdsproc wait 200 0 0x0EFDEFFC 0x0EFDEF1C 616384 2 22 cpubound 1 ready 1 3 0x0FDEFFFC 0x0FDEF84 1024 7389 23 cpubound 2 ready 1 3 0x0FDEFFFC 0x0FDEF84 1024 7389 24 cpubound 3 ready 1 3 0x0FDEFFFC 0x0FDEF80 1024 7389 25 cpubound 4 ready 1 3 0x0FDEFFFC 0x0FDEF80 1024 7387 26 cpubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF80 1024 7387 26 cpubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF80 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8EC 1024 7391 28 shell recv 50 3 0x0EFC8FFC 0x0EFD8F8 8192 3		-	_						
26 opubound 5 ready 1 3 0x0 EFC8FFC 0x0 EFC8CF0 1024 7261 7261 27 opubound 6 ready 1 3 0x0 EFC8BFC 0x0 EFC88B0 1024 7274 7274 28 shell recv 50 3 0x0 EFC8FFC 0x0 EFC8BER 8192 2 2 72 ps curr 20 28 0x0 EFD8FFC 0x0 EFD8F8 8192 3 3 xsh \$ ps Fid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 0 0 0x0 EFDEFFC 0x0 EFDEF1C Stack Size CPU Time 1 rdsproc wait 200 0 0x0 EFDEFFC 0x0 EFDEF1C Stack Size CPU Time 22 cpubound 1 ready 1 3 0x0 FDEFFFC 0x0 EFDEF1C Stack Size CPU Time 16384 2 2 147483647 23 cpubound 2 ready 1 3 0x0 FDEFFFC 0x0 EFDEF84 1024 7389 24 cpubound 3 ready 1 3 0x0 FDEFFFC 0x0 FDEF86 1024 7389 24 cpubound 4 ready 1 3 0x0 FDEF3FC 0x0 FDEF580 1024 7391 25 cpubound 5 ready 1 3 0x0 EFC8FFC 0x0 EFC8EC 1024 7391 26 cpubound 5 ready 1 3 0x0 EFC8FFC 0x0 EFC8EC 1024 7391 27 28 28 <td></td> <td>-</td> <td>_</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		-	_						
Provided			_						
28 shell recv 50 3 0x0EFC87FC 0x0EFC848C 8192 2 72 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3 xsh \$ ps Pid Name State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 0 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 1 rdsproc wait 200 0 0x0EFDEFFC 0x0EFDEAAC 16384 2 22 cpubound 1 ready 1 3 0x0FDEFFFC 0x0EFD84 1024 7389 23 cpubound 2 ready 1 3 0x0FDEFFFC 0x0FDEF98 1024 7389 24 cpubound 3 ready 1 3 0x0FDEFFFC 0x0FDEF98 1024 7390 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF8C 1024 7390 25 cpubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF8C 1024 7397 26 cpubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF8C 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8EC 1024 7391 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8EC 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3			_						
72 ps curr 20 28 Ox0 EFD8FFC 0x0 EFD8DF8 8192 3 xsh \$ ps State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time 0 prnull ready 0 0 x0 EFDEFFC 0x0 EFDEFTC 8192 2147483647 1 rdsproc wait 200 0x0 EFDCFFC 0x0 EFDEFGAAC 16384 2 22 cpubound ready 1 3 0x0 FDEFFFC 0x0 FDEF984 1024 7389 23 cpubound ready 1 3 0x0 FDEFFFC 0x0 FDEF980 1024 7389 24 cpubound ready 1 3 0x0 FDEF7FC 0x0 FDEF880 1024 7389 25 cpubound ready 1 3 0x0 FDEF3FC 0x0 FDEF880 1024 7387 26 cpubound ready 1 3 0x0 FDEF3FC 0x0 EFC88FC 1024 7391 27 cpubound ready 1 3 0x0 EFC88FC 0x0 EFC88EC 1024 7391 28 shell recv 50 <		•	-						
State Prio Ppid Stack Base Stack Ptro Stack									
Prid Name			curr	20	28	0x0EFD8FFC	0x0EFD8DF8	8192	3
0 prnull ready 0 0 0x0EFDEFFC 0x0EFDEF1C 8192 2147483647 1 rdsproc wait 200 0 0x0EFDEFFC 0x0EFDEF1C 16384 2 22 opubound 1 ready 1 3 0x0FDEFFFC 0x0FDEF984 1024 7389 23 opubound 2 ready 1 3 0x0FDEFFFC 0x0FDEF980 1024 7389 24 opubound 3 ready 1 3 0x0FDEFFFC 0x0FDEF980 1024 7389 25 opubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF580 1024 7390 25 opubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF0EC 1024 7397 26 opubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7391 27 opubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8EEC 1024 7391 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8EEC 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3									
0 prnull ready 0 0 000 EFDEFFC 0x0 EFDEF1C 8192 2147483647 1 rdsproc wait 200 0 0x0 EFDEFFC 0x0 EFDCAAC 16384 2 22 cpubound 1 ready 1 3 0x0 FDEFFFC 0x0 FDEFB84 1024 7389 23 cpubound 2 ready 1 3 0x0 FDEFFFC 0x0 FDEFB86 1024 7389 24 cpubound 3 ready 1 3 0x0 FDEFFFC 0x0 FDEF580 1024 7390 25 cpubound 4 ready 1 3 0x0 FDEF3FC 0x0 FDEF580 1024 7387 26 cpubound 5 ready 1 3 0x0 EFC8FFC 0x0 FDEF0EC 1024 7391 27 cpubound 6 ready 1 3 0x0 EFC8FFC 0x0 EFC8EFC 1024 7391 28 shell recv 50 3 0x0 EFC8FFC 0x0 EFC88EC 8192 2 73 ps curr 20 28 0x0 EFD8FFC 0x0 EFD8DF8 8192 3				Prio	Ppid	Stack Base	Stack Ptr	Stack Size	CPU Time
1 rdsproc wait 200 0 0x0EFDCFFC 0x0EFDCAAC 16384 2 22 cpubound 1 ready 1 3 0x0FDEFFFC 0x0FDEFB84 1024 7389 23 cpubound 2 ready 1 3 0x0FDEFFFC 0x0FDEFB80 1024 7389 24 cpubound 3 ready 1 3 0x0FDEF7FC 0x0FDEF580 1024 7390 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF0EC 1024 7387 26 cpubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8EEC 1024 7391 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8BEC 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFD8F8 8192 3						00 PPP PPP 0	00 PPP PP4 0	0.100	147403647
22 cpubound 1 ready 1 3 0x0FDEFFFC 0x0FDEFD84 1024 7389 23 cpubound 2 ready 1 3 0x0FDEFFFC 0x0FDEF980 1024 7389 24 cpubound 3 ready 1 3 0x0FDEF9FC 0x0FDEF980 1024 7390 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF0EC 1024 7387 26 cpubound 5 ready 1 3 0x0FDEF3FC 0x0FDEF0EC 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8ECD 1024 7391 28 shell recv 50 3 0x0EFC8FFC 0x0EFC8BEC 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3									
23 cpubound 2 ready 1 3 0x0FDEFBFC 0x0FDEF980 1024 7389 24 cpubound 3 ready 1 3 0x0FDEF7FC 0x0FDEF580 1024 7390 25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF0EC 1024 7387 26 cpubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7391 28 shell recv 50 3 0x0EFC8FC 0x0EFC848C 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFC8BFS 8192 3		-							
24 opubound 3 ready 1 3 0x0FDEF7FC 0x0FDEF580 1024 7390 25 opubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF0EC 1024 7387 26 opubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7391 27 opubound 6 ready 1 3 0x0EFC8FFC 0x0EFC8EC 1024 7391 28 shel1 recv 50 3 0x0EFC87FC 0x0EFC88EC 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3			_	_					
25 cpubound 4 ready 1 3 0x0FDEF3FC 0x0FDEF0EC 1024 7387 26 cpubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8FFC 0x0EFC88EC 1024 7391 28 shel1 recv 50 3 0x0EFC8FFC 0x0EFC88EC 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3			_						
26 cpubound 5 ready 1 3 0x0EFC8FFC 0x0EFC8CF0 1024 7391 27 cpubound 6 ready 1 3 0x0EFC8BFC 0x0EFC88EC 1024 7391 28 shel1 recv 50 3 0x0EFC8FC 0x0EFC88EC 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3		•	-						
27 cpubound 6 ready 1 3 0x0EFC8BFC 0x0EFC88EC 1024 7391 28 shell recv 50 3 0x0EFC87FC 0x0EFC848C 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3			-						
28 shell recv 50 3 0x0EFC87FC 0x0EFC848C 8192 2 73 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3		-	_						
73 ps curr 20 28 0x0EFD8FFC 0x0EFD8DF8 8192 3		-	_						
					_				_
xsn \$ ps		-	curr	20	28	UX0EFD8FFC	UX0EFD8DF8	8192	3
	xsn	a ps							

Figure 3: All processes are CPU bound

```
uter loop 36 | process priority is 1 | preempt is 30
iority is 1 | preempt is 30
Pid Name
                      State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time
 0 prnull
                                0
                                    0 0x0EFDEFFC 0x0EFDEEB8
                                                                   8192 2147483647
                      ready
  1 rdsproc
                      wait
                             200
                                     0 0x0EFDCFFC 0x0EFDCAAC
22 shell
                      recv
                              50
                                     3 0x0EFC8FFC 0x0EFC8C8C
3 0x0FDEFFFC 0x0FDEFF58
                                                                   8192
                                                                                4
 23 iobound 1
                                                                              307
                      sleep
                                                                    1024
                                     3 0x0FDEFBFC 0x0FDEFB58
 24 iobound 2
                      sleep
                                                                    1024
                                                                              302
 25 iobound 3
                      sleep
                                     3 0x0FDEF7FC 0x0FDEF758
                                                                    1024
                                                                              304
                                    3 0x0FDEF3FC 0x0FDEF358
3 0x0EFC6FFC 0x0EFC6F58
 26 iobound 4
                      sleep
                                                                    1024
                                                                              288
 27 iobound 5
                      sleep
                                                                    1024
                                                                              306
 28 iobound 6
                      sleep
                                     3 0x0EFC6BFC 0x0EFC6B58
                                                                    1024
                              20 22 0x0EFD8FFC 0x0EFD8DF8
 50 ps
                      curr
                                                                    8192
xsh $
 In iobound 4 | The PID is 26 | outer loop 37 | process priority is 1 | preempt is 30
 In iobound 6 |The PID is 28 | outer loop 37 | process priority is 1 | preempt is 30
In iobound 2 | The PID is 24 | outer loop 37 | process priority is 1 | preempt is 30
 In iobound 3 |The PID is 25 | out
 In iobound 5 | The PID is 27 | outer loop 37 | process priority is 1 | preempt is 30
In iobound 1 |The PID ier loop 37 | process priority is 1 | preempt is 30
s 23 | outer loop 37 | process priority is 1 | preempt is 30
Pid Name
                      State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time
  0 prnull
                      ready
                               0
                                    0 0x0EFDEFFC 0x0EFDEEB8
                                                                    8192 2147483647
                      wait 200
                                     0 0x0EFDCFFC 0x0EFDCAAC
3 0x0EFC8FFC 0x0EFC8C8C
  1 rdsproc
                                                                  16384
 22 shell
                              50
                                                                   8192
                      recv
 23 iobound 1
                      sleep
                                     3 0x0FDEFFFC 0x0FDEFF58
 24 iobound 2
                      sleep
                                    3 0x0FDEFBFC 0x0FDEFB58
3 0x0FDEF7FC 0x0FDEF758
                                                                    1024
                                                                              309
 25 iobound 3
                      sleep
                                                                    1024
                                                                              311
 26 iobound 4
                                     3 0x0FDEF3FC 0x0FDEF1D0
                                                                    1024
                      ready
                                                                              300
                              1 3 0x0EFC6FFC 0x0EFC6F58
1 3 0x0EFC6BFC 0x0EFC6B58
20 22 0x0EFD8FFC 0x0EFD8DF8
 27 iobound 5
                      sleep
                                                                    1024
                                                                              313
 28 iobound 6
                      sleep
                                                                    1024
                                                                              309
 51 ps
                                                                    8192
                      curr
xsh $ he PID is 26 | outer loop 38 | process priority is 1 | preempt is 30
```

Figure 4: All processes are IO bound

```
ps
Pid Name
                              State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time
  0 prnull
                              ready
                                                  0 0x0EFDEFFC 0x0EFDEF1C
                                                                                           8192 2147483647
   1 rdsproc
3 Main process
                              wait
                                       200
                                                  0 0x0EFDCFFC 0x0EFDCAAC
0 0x0EFD8FFC 0x0EFD8F74
                                                                                          16384
65536
                                         20
                              sleep
                                                  3 0x0FDEFFFC 0x0FDEFF58
3 0x0FDEFBFC 0x0FDEFB58
3 0x0FDEF7FC 0x0FDEF758
 22 iobound 4
23 iobound 5
                              sleep
sleep
                                                                                           1024
                                                                                                           15
 24 iobound 6
                              sleep
                                                                                            1024
                                                  3 0x0FDEF7FC 0x0FDEF758
3 0x0FDEF3FC 0x0FDEF0F0
3 0x0EFC8FFC 0x0EFC8D54
3 0x0EFC8BFC 0x0EFC88F0
 25 cpubound 4
26 cpubound 5
                              ready
ready
                                                                                           1024
1024
                                                                                                          478
 27 cpubound 6
28 shell
                              ready
                                                                                           1024
                                                                                                          478
                                                3 0x0EFC87FC 0x0EFC848C
28 0x0EFC67FC 0x0EFC65B8
                              recv
34 ps curr 20 28 0x0EFC67FC 0x0EFC65B8 8192 xsh $ e PID is 24 | outer loop 1 | process priority is 1 | preempt is 30
 In iobound 5 |The PID is 23 | outer loop 2 | process priority is 1 | preempt is 30
 In iobound 4 | The PID is 22 | outer loop 3 | process priority is 1 | preempt is 30
 In iobound 4 |The PID is 22 | outer loop 4 | process priority is 1 | preempt is 30
 In iobound 5 |The PID is 23 | outer loop 3 | process priority is 1 | preempt is 30
 In iobound 6 |The PID is 24 | outer loop 2 | process priority is 1 | preempt is 30
 In iobound 4 |The PID is 22 | outer loop 5 | process priority is 1 | preempt is 30
Pid Name
                              State Prio Ppid Stack Base Stack Ptr Stack Size CPU Time
  0 prnull
                              ready
                                                  0 0x0EFDEFFC 0x0EFDEF1C
                                                                                           8192 2147483647
                                                  0 0x0 EFDEFFC 0x0 EFDEF1C

0 0x0 EFDEFFC 0x0 EFDEAAC

0 0x0 EFD8 FFC 0x0 EFD8 F74

3 0x0 FDEFFFC 0x0 FDEFF58

3 0x0 FDEFFFC 0x0 FDEF758

3 0x0 FDEF7FC 0x0 FDEF758
                                      200
  1 rdsproc
3 Main process
                              wait
                                                                                          16384
                              sleep
 22 iobound 4
23 iobound 5
24 iobound 6
                              sleep
                                                                                           1024
                              sleep
                                                                                                           29
63
                                                                                            1024
                                                                                            1024
 25 cpubound 4
26 cpubound 5
27 cpubound 6
                              ready
ready
                                                   3 0x0FDEF3FC 0x0FDEF0F0
                                                                                           1024
                                                                                                          896
                                                3 0x0EPC8FFC 0x0EFC8CF0
3 0x0EFC8BFC 0x0EFC88EC
3 0x0EFC87FC 0x0EFC848C
28 0x0EFC67FC 0x0EFC848C
                                                                                            1024
                              readv
                                                                                            1024
                                                                                                          900
 28 shell
35 ps
                              recv
                                         50
20
```

Figure 5: Half-Half

LAB 2.5									
Pid Name	Ctata	Drio	nni d	Stack Base	grack Dry	atook aire	a anu tima	ReadyO Posn	Boadwo Vov
rid Name	state		- PIG	SCACE BASE					readyo key
0 prnull	ready	0	0	0x0EFDEFFC			2147483647		-2147483647
1 rdsproc				0x0EFDCFFC					224,40304,
2 Main process	G113 75 75	20	0	0.0000000000	0.40 EED9 3.D0	65526	2.2		
4 cpubound 1 5 cpubound 2 6 cpubound 3 7 cpubound 4 8 cpubound 5 9 cpubound 6	ready	1		0x0FDEFFFC	0x0FDEFD74	1024	690	3	-624
5 coubound 2	ready		3	0x0FDEFFEC	0x0FDEF970	1024	691	2	-619
6 cpubound 3	ready		3	0x0FDEF7FC	0x0FDEF544	1024	702	5	-648
7 cpubound 4	ready		3	0x0FDEF3FC	0x0FDEF174	1024	691	4	-631
8 cpubound 5	ready		3	0x0EFC8FFC	0x0EFC8D44	1024	131		-119
9 cpubound 6	ready		3	0x0EFC8BFC	0x0EFC8974	1024	91	0	- 31
Pid Name	State	Prio	Ppid	Stack Base	Stack Ptr	Stack Size	e CPU time	ReadyQ Posn	
0 prnull	ready			0x0EFDEFFC			2147483647		-2147483647
1 rdsproc	wait	200	0	0x0EFDCFFC	0x0EFDCA9C	16384	2		
2 Main manages		20		00	00	CEE2C	100		
4 cpubound 1	readv	1	3	0x0FDEFFFC 0x0FDEFFFC 0x0FDEF7FC 0x0FDEF3FC	0x0FDEFD74	1024	690	3	- 582
5 cpubound 2	ready	1	3	0x0FDEFBFC	0x0FDEF970	1024	691	2	- 577
6 cpubound 3	ready	1	3	0x0FDEF7FC	0x0FDEF544	1024	702	5	-606
7 cpubound 4	ready	1	3	0x0FDEF3FC	0x0FDEF174	1024	691	4	- 589
8 cpubound 5	ready	1	3	0x0EFC8FFC	0x0EFC8D74	1024	190	1	-160
9 cpubound 6	ready		3	0x0EFC8FFC 0x0EFC8BFC	0x0EFC8974	1024			-115
Pid Name								ReadyQ Posn	
0 prnull	ready			0x0EFDEFFC			2147483647		-2147483647
1 *********		200		0**0 PPD0PP0	0**0********	16201			
3 Main process	CHITT	20	ō	0x0EFDCFFC	0x0EFD8AD0	65536	212		
4 cpubound 1	ready	1	3	0x0FDEFFEC	0x0FDEFD74	1024	690	3	- 534
5 cpubound 2	ready	1	3	0x0FDEFFFC 0x0FDEFBFC	0x0FDEF970	1024	691	2	- 529
6 cpubound 3	ready			0x0FDEFFFC 0x0FDEF3FC 0x0EFC8FFC 0x0EFC8BFC	0x0FDEF544	1024		5	- 558
7 cpubound 4	ready	1	3	0 v0 EDEE3 EC	0 v0 FDEF174	1024		4	- 541
8 cpubound 5	ready	1	3	0x0EEC8EEC	0x0EEC8D74	1024	250	ī	-220
9 cpubound 6	ready		3	0x0EFC8PFC	0x0EFC8974	1024	301	ō	-205
Pid Name	State	Prio	Pnid	Stack Base	Stack Ptr	Stack Size		ReadyO Posn	
									ready key
0 prnull	ready			0x0EFDEFFC			2147483647		-2147483647
1 rdsproc	wait	200	ň	0x0EFDCFFC	0 x0 EFDCA9C	16384	2		214/40304/
3 Main process	CHITT	200	ň	0x0EFD8FFC	0 v0 FFD8 AD0	65536			
4 cpubound 1	ready	1		0 v0 EDEFEEC	0 v0 EDEED74	1024	690	3	- 486
5 cpubound 2	ready	1	3	0 v0 EDEFREC	0 v0 FDEF970	1024	691	2	- 481
6 cpubound 3	ready	1	3	0x0FDEF7FC	0x0FDEF544	1024	702	5	- 510
7 cpubound 4	ready	1	3	0x0EDEE3EC	0x0FDEF174	1024	691	4	- 493
8 cpubound 5	ready	1	3	0x0FDEFFFC 0x0FDEFBFC 0x0FDEF7FC 0x0FDEF3FC 0x0EFC8FFC	0x0FEC8D70	1024	340	0	- 274
9 cpubound 6	ready	1	3	0x0EFC8BFC	0x0EFC8974	1024	391		-301
Pid Name								ReadyQ Posn	
						DCGCK DIZC		rosn	
0 prnull				0x0EFDEFFC			2147483647		-2147483647
1 wdownoo	man di te	200		00 ========	0.0000000000	16204			2111100011
3 Main process	CULTE	200	0	0x0EFDCFFC	0 X 0 EFDCA9C	65536	392		
4 cpubound 1	ready	1	3	0x0FDEFEEC	0x0EFDGAD0	1024	690	2	- 41 4
5 cpubound 2	ready		3	0 x0 EFDEFFC 0 x0 EFDEFFC 0 x0 FDEFFFC 0 x0 FDEF7FC 0 x0 FDEF3FC 0 x0 EFC8FFC 0 x0 EFC8BFC	0 v0 FD FF 9.74	1024	721	1	- 409
6 cpubound 3	ready		3	0x0FDEFSFC	0x0FDEF5/4	1024	702	5	- 438
7 cpubound 4	ready			0x0FDEF7FC	0x0FDEF344	1024	721	3	- 430
8 cpubound 5	ready		3	OXOFDEFSEC	0x0FDEF1/4	1024	430	0	- 394
9 cpubound 6	ready		2	0x0EFC8FFC 0x0EFC8BFC Stack Base	0.0000000074	1024	430 481	4	- 421
Pid Name	State	Pric	Pnid	Stack Page	Stack Ptr	Stack Size	a CDII timo	ReadyQ Posn	
	state			beack base					neadyo key
	ready			0x0EFDEFFC			2147483647		-2147483647
0 prnull 1 rdsproc	wait	300		0x0EFDEFFC			214/40304/		224/40304/
	wait	200		0x0EFD8FFC					
3 Main process 4 cpubound 1								3	- 666
5 cpubound 2	ready		3	0x0FDEFFFC	0x0FDEFD/0	1024	721	2	-661
6 cpubound 3	ready		3	0x0FDEFBFC 0x0FDEF7FC	0x0FDEF9/4	1024		5	-701
7 cpubound 4	ready ready		3	0x0FDEF3FC	0x0FDEF5/4	1024		4	- 701 - 673
	ready			0x0FDEF5FC		1024		0	- 484
o cpubound 5	ready		- 3	OROLLCOLLC	O AO EF COD/4	1024	330		404

Figure 6: Dynamic Workloads