Exercises

Lab 12

Introduction Q22 (1)

- **Question:**
  Can the
  count = write(fd, buffer, bytes);
  call return any value in *count* other than *nbytes*?
  If so, why?

- **Wrong answer (from Moodle Wiki):**
  Yes. If the end-of-file is encountered before *nbytes* are read, then a smaller value than *nbytes* is returned to count. A larger number, however, cannot be returned.

Introduction Q22 (2)

- Right answer:

  Open the shell and run

  man 2 write

```
RETURN VALUES
     Upon successful completion the number of bytes which were written is
     returned.  Otherwise, a -1 is returned and the global variable errno is
     set to indicate the error.
```

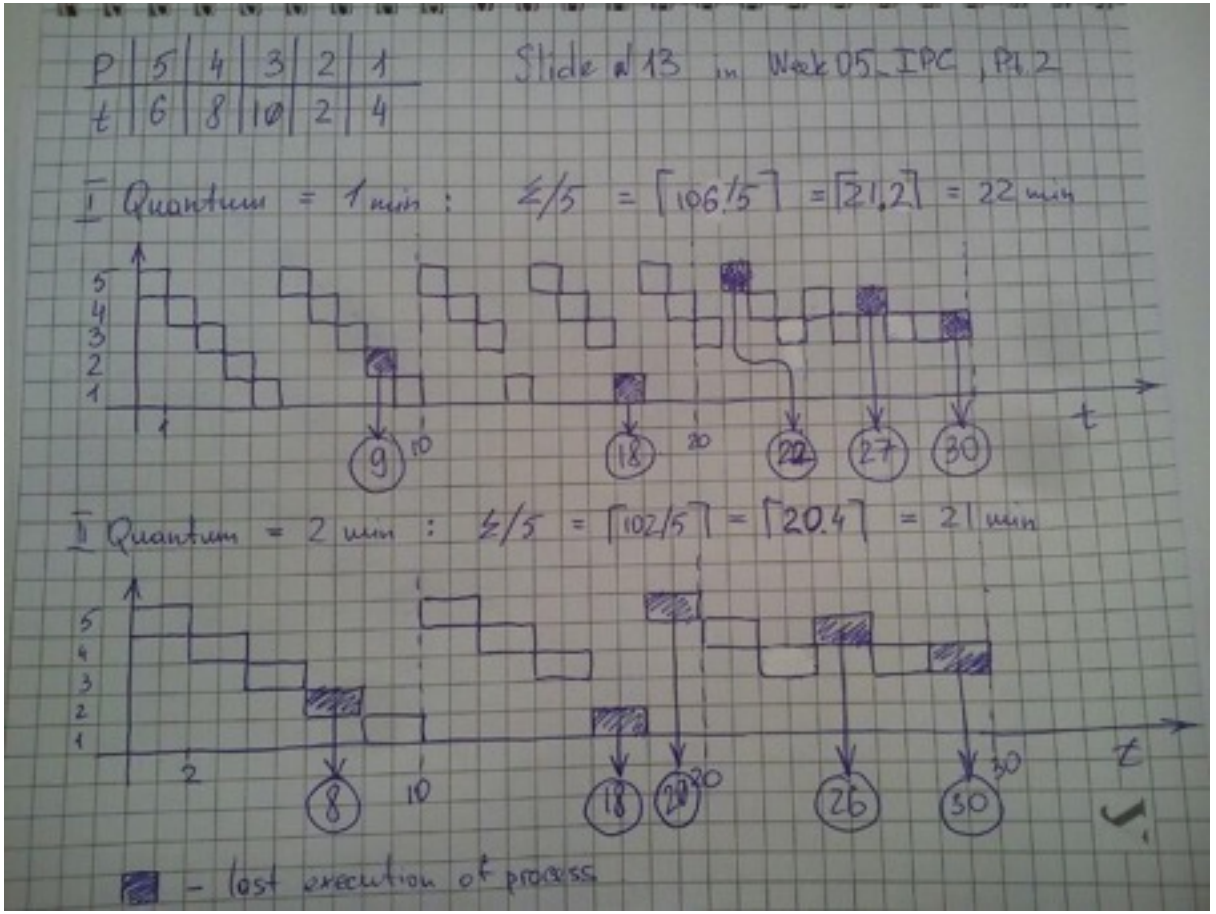
Processes and Threads Q45 (1)

- **Question:**
  Five batch jobs A through E, arrive at a computer center at almost the same time. They have estimated running times of 10, 6, 2, 4, and 8 minutes. Their (externally determined) priorities are 3, 5, 2, 1, and 4, respectively, with 5 being the highest priority. For each of the following scheduling algorithms, determine the mean process turnaround time. Ignore process switching overhead.

Processes and Threads Q45 (2)

- **Question (cont.):**
  - **(a) Round robin.**
  - (b) Priority scheduling.
  - (c) First-come, first-served (run in order 10, 6, 2, 4, 8).
  - (d) Shortest job first.
- For (a), assume that the system is multiprogrammed, and that each job gets its fair share of the CPU. For (b) through (d), assume that only one job at a time runs, until it finishes. All jobs are completely CPU bound.

Processes and Threads Q45 (3)

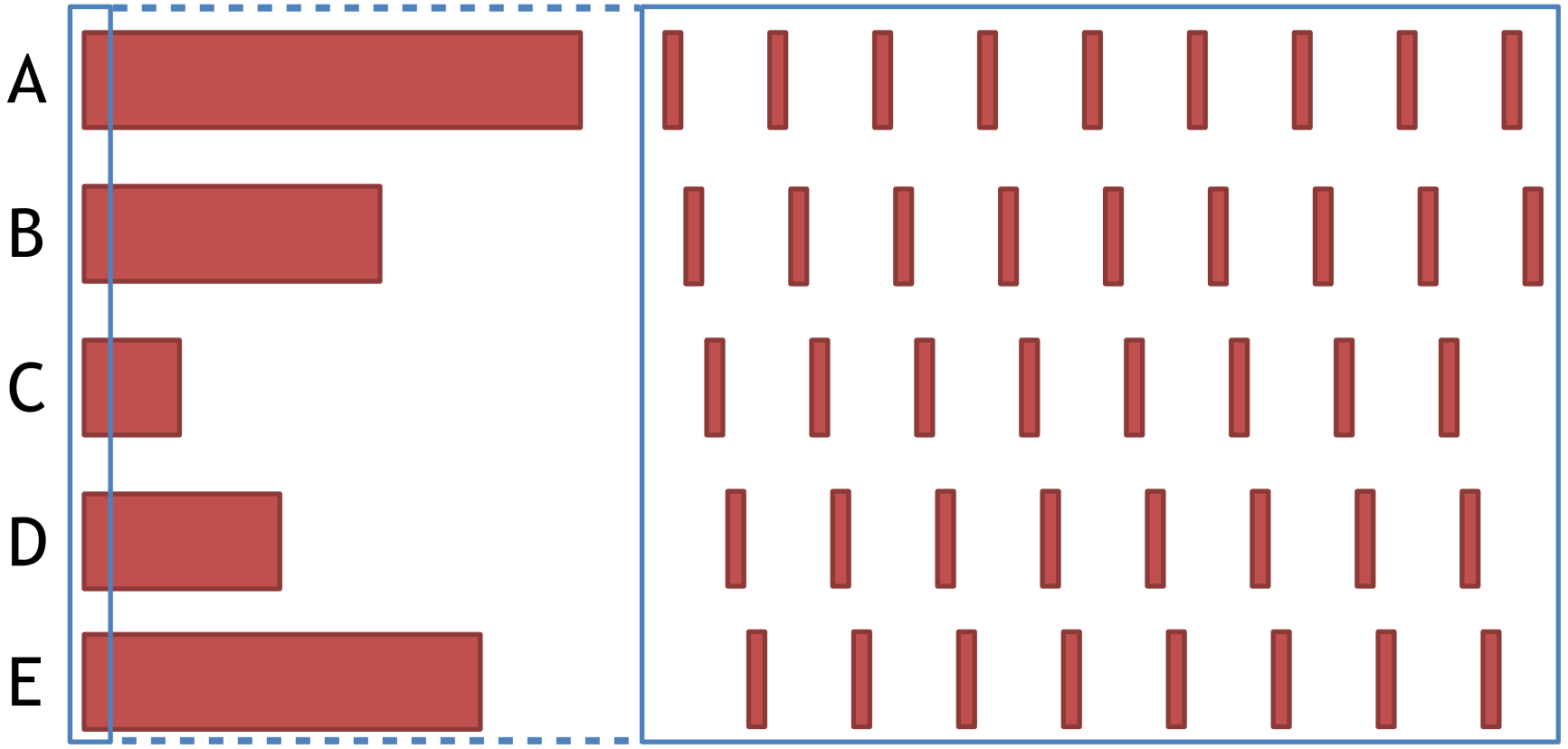


Wrong answer: (8 + 18 + 20 + 26 + 30) / 5

Processes and Threads Q45 (4)

- **Right answer:**
  The right answer is highly dependent on order of the jobs and the time quanta given to each of the jobs
- It will be safe to suppose that in a multiprogrammed system each job runs for milliseconds, not minutes (as shown on the next slide)

Processes and Threads Q45 (5)



Round Robin job scheduling

Processes and Threads Q45 (6)

- **Right answer (cont.):**
  In this case all the five jobs will run simultaneously for ~10 minutes until job C finishes
- Then remaining four jobs will run for 8 minutes until job D finishes which makes turnaround time for D equal 18 minutes
- Using the same technique we obtain turnaround times for B, E and A which are 24, 28 and 30 minutes respectively

Processes and Threads Q45 (7)

- **Right answer (cont.):**
  - $T_C \approx 5 * 2 \text{ min} \approx 10 \text{ min}$
  - $T_D \approx T_C + 4 * 2 \text{ min} \approx 18 \text{ min}$
  - $T_B \approx T_C + T_D + 3 * 2 \text{ min} \approx 24 \text{ min}$
  - $T_D \approx T_C + T_D + T_B + 2 * 2 \text{ min} \approx 28 \text{ min}$
  - $T_A \approx T_C + T_D + T_B + T_E + 2 \text{ min} \approx 30 \text{ min}$
- Average turnaround time is ~22 minutes ((10 + 18 + 24 + 28 + 30) / 5)

Memory Management Q11 (1)

- **Question:**
  Consider the following C program:

```
int X[N];
int step = M;                    /* M is some predefined constant */
for (int i = 0; i < N; i += step)
  X[i] = X[i] + 1;
```

- (a) If this program is run on a machine with a 4-KB page size and 64-entry TLB, what values of M and N will cause a TLB miss for every execution of the inner loop?
- (b) Would your answer in part (a) be different if the loop was repeated many times? Explain.

Memory Management Q11 (2)

- **Wrong answer (from Moodle Wiki):**

a) M has to be at least 4,096 to ensure a TLB miss for every access to an element of X. Since N only affects how many times X is accessed, any value of N will do.

b) M should still be at least 4,096 to ensure a TLB miss for every access to an element of X. But now N should be greater than 64K to thrash the TLB, that is, X should exceed 256 KB.

Memory Management Q11 (3)

- **Right answer:**
- a) While 4096 is a safe guess, there is more precise answer
- Let's have a closer look on the memory structure:

X[0]	X[…]	X[1023]	X[1024]	X[…]	X[2047]	X[1024 * k + 0]	…
Page 0			Page 1			Page k	

Memory Management Q11 (4)

- Minimum int size is 4 bytes which gives us 1024 integers per memory page
- It means that after X[0] is accessed, accessing any of the succeeding elements up to X[1023] would not generate TLB fault
- However, if we try to access X[0], X[1024], X[2048] and so on, each time a TLB miss will occur which means that M should be at least 1024, not 4096

Memory Management Q11 (5)

- b) M should still be at least 1024 to cause a TLB miss for every execution of the inner loop
- Assuming that such page replacement algorithm as LRU or FIFO is used, we need to fill the whole TLB and make one more reference to an absent page to make sure that the page 0 is not in the TLB at the beginning of each outer cycle
- It means that we need to have at least 65 pages. In this case N should be at least 64 * 1024 + 1

File Systems Q40 (1)

- **Question:**
  A UNIX file system has 4-KB blocks and 4-byte disk addresses. What is the maximum file size if i-nodes contain 10 direct entries, and one single, double, and triple indirect entry each?
- **Wrong answer (from outside sources):**
  ~16.06 GB

File Systems Q40 (2)

- **Right answer:**
  - With 10 direct entries we can address 10 blocks (40 KB)
  - With one single indirect entry there is a whole 4 KB block of addresses (4096 bytes / 4 bytes = 1024 addresses).
  - Therefore, we can address 1024 blocks (4096 KB or 4 MB)

File Systems Q40 (3)

- **Right answer (cont.):**
  - With one double indirect entry there is a block containing 1024 addresses of blocks containing 1024 addresses which means that we can address 1024^2 (4 GB)
  - With one triple indirect entry we can address 1024^3 blocks (4 TB)
  - The right answer is ~4.004 TB

Deadlocks Q38 (1)

- **Question:**
  Cinderella and the Prince are getting divorced. To divide their property, they have agreed on the following algorithm. Every morning, each one may send a letter to the other's lawyer requesting one item of property. Since it takes a day for letters to be delivered, they have agreed that if both discover that they have requested the same item on the same day, the next day they will send a letter canceling the request

Deadlocks Q38 (2)

- Among their property is:
  - their dog, Woofer,
  - Woofer's doghouse,
  - their canary, Tweeter and
  - Tweeter's cage
- The animals love their houses, so it has been agreed that any division of property separating an animal from its house is invalid, requiring the whole division to start over from scratch

Deadlocks Q38 (3)

- Both Cinderella and the Prince desperately want Woofer. So that they can go on (separate) vacations, each spouse has programmed a personal computer to handle the negotiation. When they come back from vacation, the computers are still negotiating.
  - Why?
  - Is deadlock possible?
  - Is starvation possible?
- Discuss your answer

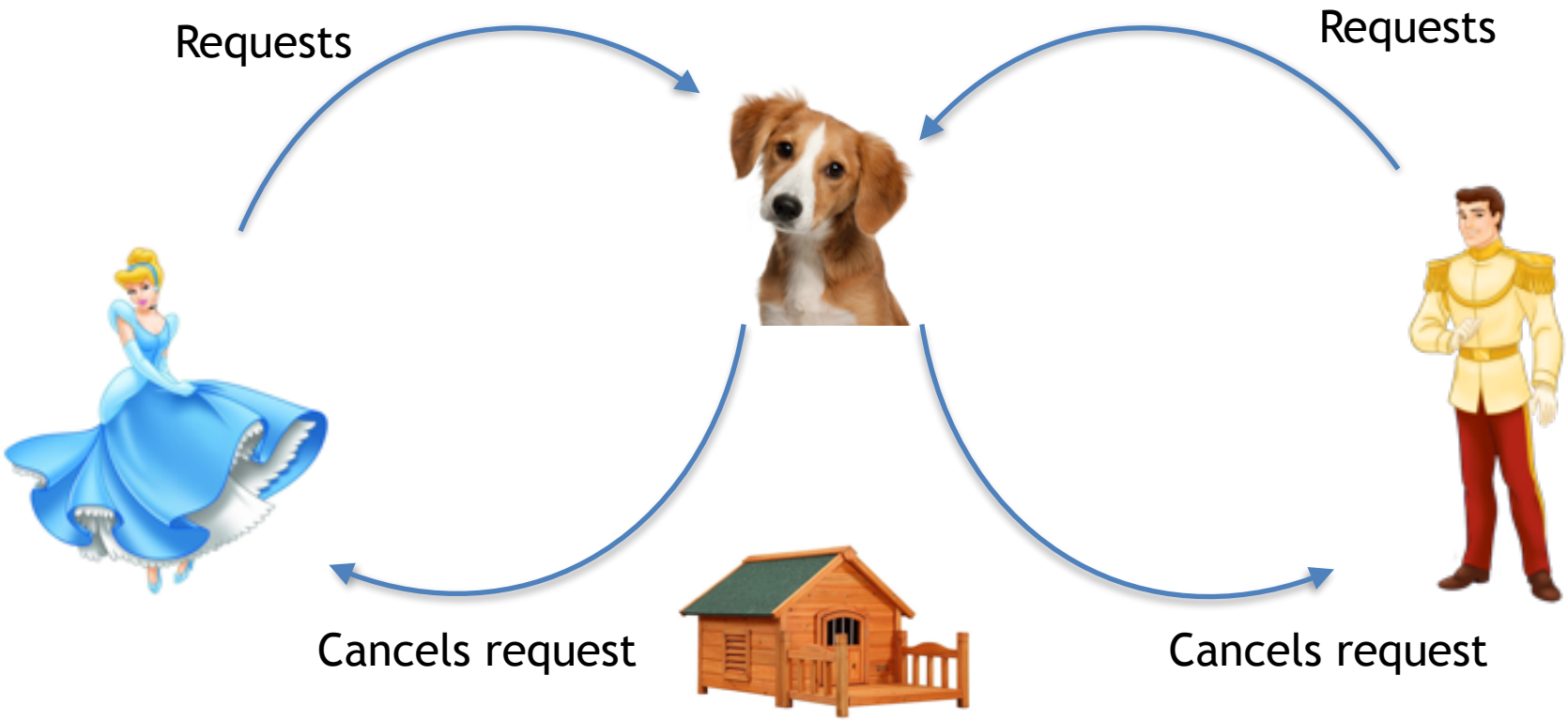
Deadlocks Q38 (4)

- High-priority resources

- Low-priority resources

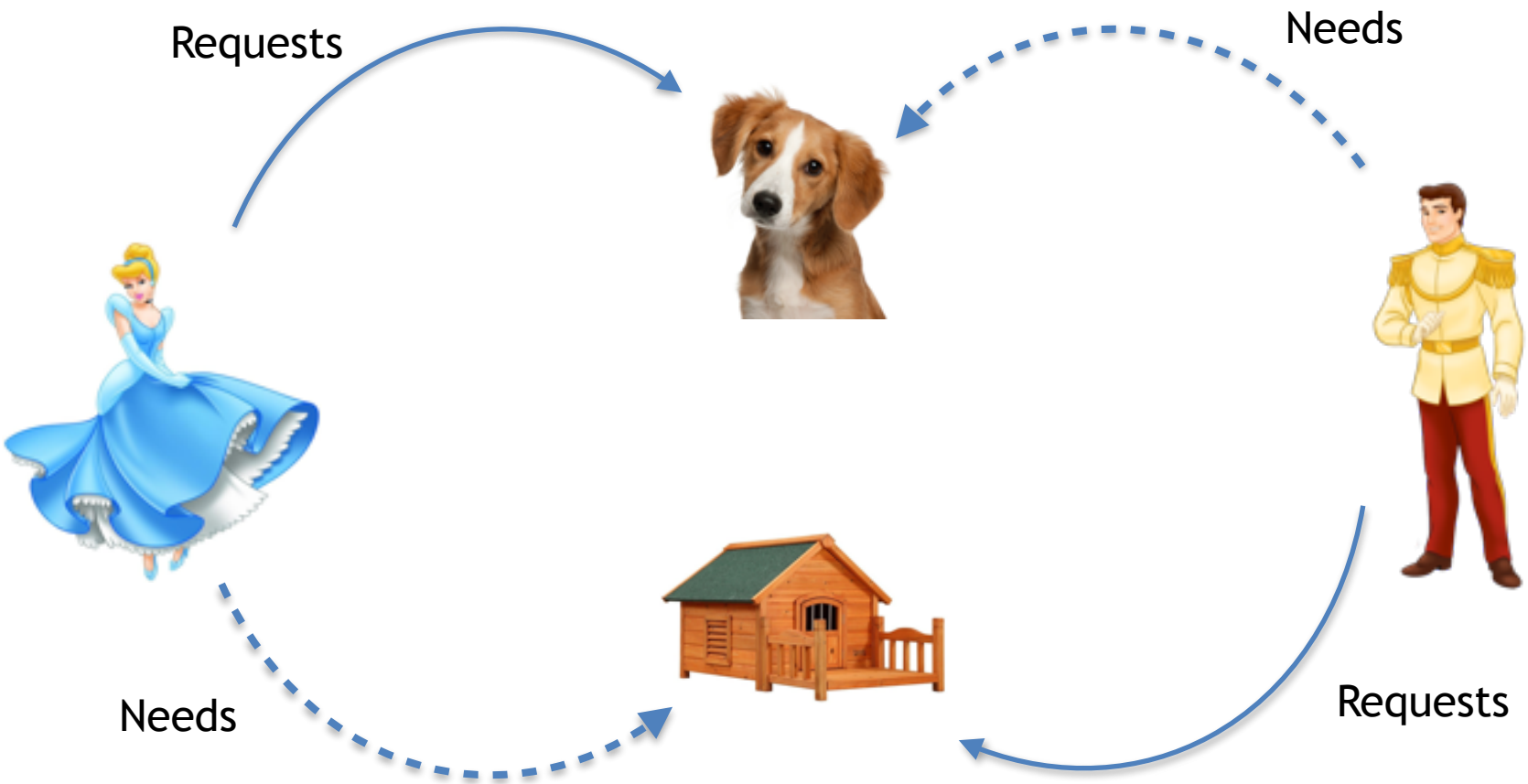
Deadlocks Q38 (5)

- Starvation (or not?)



Deadlocks Q38 (6)

- Deadlock



Special Thanks

- to everyone who contributes to the course wiki
- to Simon Zorin whose drawing was used during the discussion of the second problem

References

- http://animaliaz-life.com/dogs.html
- http://creativecan.com
- http://www.loveyourparrot.com
- http://alfa-img.com/show/vintage-canary-cage.html
- http://www.thefeministwire.com/wp-content/uploads/2014/03/Cinderella.jpg
- http://vignette1.wikia.nocookie.net/disney/images/a/ad/Charming.png/revision/latest?cb=20120718062233