Internet Programming Exam

Monday, January 5th, 2015

This is a closed book exam: no documentation is allowed

WRITE CLEARLY!!!

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1 Program Output (1 point)

What will be the output of the following program? If there are multiple possible outputs, show them *all*.

```
#include <stdio.h>
#include <sys/types.h>
#include <unistd.h>
int main() {
  if (fork()==0)
  {
    fork();
    if (execl("/bin/echo", "/bin/echo", "foo", 0) == -1)
    {
      fork();
    }
    printf("bar\n");
  }
  else
  {
    fork();
    if (execl("/bin/does_not_exist", "/bin/does_not_exist", "baz", 0) == -1)
    {
      fork();
    }
    printf("bat\n");
  }
}
```

Assumptions:

- Assume that the call to `/bin/echo` succeeds, and (as expected) outputs all parameters passed to it, plus a new line at the end.
- Assume that all prints (i.e., `printf()` and `/bin/echo`) are *atomic*, that is, the process executing them cannot be preemptied any time between printing the first and the last character. Note that this is not true in reality, but it makes the answer simpler.

2 Questions for Brief Answers (5 points)

SAMPLE QUESTION: What does the `listen()` system call do?
SAMPLE ANSWER: It is relevant only in the context of TCP. It promotes a client socket to a server socket, and sets the *backlog*, that is, the size of the queue holding incoming clients that have not yet been `accept()`ed.

1. What are the main differences between a CGI and a servlet?
2. Explain the role of the `rmiregistry` in Java RMI.
3. In RPC, when would you prefer UDP as the transport protocol and when TCP?
4. What is a DOM tree? Show a simple example. What is a DOM tree useful for?
5. What does the `signal()` system call do?
6. What is network byte order, and why is it needed?
7. Explain briefly the use of the SO_REUSEADDR socket option.
8. Can you use pipes[1] for communication between processes running on:
   (a) A single machine? If yes, under what conditions?
   (b) Different machines? If yes, under what conditions?
9. Explain the role of the portmapper in Sun RPC.
10. Are RMI calls blocking, non-blocking, or both?
    - If you answered "blocking", how can you emulate *non-blocking* calls?
    - If you answered "non-blocking", how can you emulate *blocking* calls?
    - If you answered "both", you don't need to write anything more.

[1]The question refers to *unnamed* pipes (the ones taught in class). Do **not** consider *named* pipes (also known as *FIFO*s).

3 Google Maps (4 points)

You are living in the era of MapQuest, MapBlast, and Yahoo! Maps, while Google hires *you* to design and build the killer maps application: Google Maps.

3.1 Drawing the map

Explain the design you would propose for the basic functionality. That is, draw the map, scroll around, zoom in/out, search for a place, and search for directions. Take GUI functionality for granted, and concentrate only on the networking part. What technology do you use? What types of messages? Who sends messages to whom? Try to give a detailed description.

Note: As you probably know, maps consist of a grid of tiles for each zoom level.

3.2 Real-time traffic information

Years later, Google asks you to include *real-time* traffic information on the maps. More specifically, they want certain highways to be colored based on the level of current traffic on them. When traffic changes, the highway's color should also change accordingly, without the user having to make a page refresh.

Describe in detail the design you would propose for such a system.

Note that it is assumed that traffic on any road does not change more frequently than once per two minutes.

3.3 Personalization

Finally, assume you want to personalize the maps per user. E.g., you want each user to be able to "save" his/her preferred standard initial location (e.g., Amsterdam, zoom level 12), a list of favorite points (e.g. "Pete's home", "VU Sportcentrum"), etc.

What technology should Google use to achieve this personalization?

3.4 PHP

Can you explain what functionality PHP provides in substantially facilitating the implementation of systems using your proposed solution for the previous question?

— Good luck!! —