Center for Research on Embedded Systems (CERES)

Embedded Systems Programming

Final Examination, November 1, 2013 (14:00-16:00)

Instructions. No reading material, computer or calculator is allowed into the examination; you may only use a paper-based dictionary. The exam comprises 5 questions in 2 pages and will take 2 hours. Before starting to answer the questions, please make sure that your copy is properly printed. Good luck!

Question 1 (10/100 points). a. Explain what shadowing and a shadow variable are. (**5 points**)
b. Give an example of a static- and a dynamic priority assignment algorithm. (**5 points**).

Question 2 (30/100 points). a. Explain what setjmp and longjmp mean in C programming. (**4 points**) **b.** Explain what spawn, dispatch and yield mean. (**6 points**) **c.** Explain how setjmp and longjmp are used in order to implement spawn and dispatch (no code is necessary, explaining the steps and data structures in words is sufficient, **10 points**). **d.** Give the output of the following program and explain how it is produced. (**10 points**)

```c
#include <stdio.h>
#include <setjmp.h>

jmp_buf jmp;

void f(char * s, int n)
{
    int y = n-1;
    printf("%s%d\n",s,y);
    if (y == 0) longjmp(jmp, 1);
    else f(s,y);
}


int main(){
    char o[3] = {'h','i','\0'};

    while(1){
        if (setjmp(jmp)) break;
        f(o, 4);
        printf("was there...\n");
    }
    printf("...Got here!\n");
    return 0;

}
```


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Question 3 (20/100 points). Consider the following specification of 3 periodic tasks.

Task	Execution Time	Period = Deadline
A	1	5
B	1	3
C	5	10

3.a. Is this set of tasks schedulable using Rate Monotonic and/or Earliest Deadline First scheduling? Motivate your answer using utilization-based schedulability analysis (for your information: $2^{(1/2)} = 1.4$, $2^{(1/3)} = 1.3$ and $2^{(1/4)} = 1.2$). (**10 points**)

3.b. Show the scheduling of the first 2 instance of A, the first 4 instances of B and the first instance of C, using both the Rate Monotonic and the Earliest Deadline First algorithm. Assume that the first instance of all three tasks arrive simultaneously. (**10 points**)

Question 4 (20/100 points). Implement a reactive object RoInpA for an 8-bit input port inpA, mapped into a constant memory location (defined by macro INPAADDR). The reactive object should provide an initialization method (to initialize the input port with their correct address) and a method returnEvenBits that when called busy waits until the 7^{th} bit of the input is set; when the 7^{th} bit is set, it returns an integer of which the 4 most significant bits are reset and the 4 least significant bits are the values of bits 0, 2, 4, and 6 of the input port.

Question 5 (20/100 points). a. Why should not a worker thread access UI elements from the activity How can a worker thread update UI elements? How should a worker thread then update a UI element (just explain in words, **10 points**) **b.** Write a small code snippet for an app which connects to a server on the IP address “192.168.12.3” and port “4444”, sends to it the string “Hello world!” and receives whatever the server sends it and stores it in the string “response”. (**10 points**)

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