System Programming

C programming manual: lab 2

Bachelor Electronics/ICT

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C programming

Lab targets: pointers in C, parameter passing (call-by-value/reference), understanding the function stack in C

Exercise: *parameter passing and the function stack*

The following code is incorrect. **Draw the function stack** before, during, and after the function call to date_struct() to indicate where the problem appears.

```
typedef struct {
    short day, month;
    unsigned year;
} date_t;

void date_struct( int day, int month, int year, date_t *date) {
    date_t dummy;
    dummy.day = (short)day;
    dummy.month = (short)month;
    dummy.year = (unsigned)year;
    date = &dummy;
}

int main( void ) {
    int day, month, year;
    date_t d;
    printf("\nGive day, month, year:");
    scanf("%d %d %d", &day, &month, &year);
    date_struct( day, month, year, &d);
    printf("\ndate struct values: %d-%d-%d", d.day, d.month, d.year);
    return 0;
}
```

And what if we rewrite the code such that the function date_struct() returns a pointer to date? Draw the function stack before, during, and after the function call to date_struct() to find out what really happens. Explain why the code might work if the function f is not called.

```
typedef struct {
    short day, month;
    unsigned year;
} date_t;
void f( void ) {
    int x, y, z;
    printf("%d %d %d\n", x, y, z );
}

date_t * date_struct( int day, int month, int year ) {
    date_t dummy;
    dummy.day = (short)day;
    dummy.month = (short)month;
    dummy.year = (unsigned)year;
    return &dummy;
}

int main( void ) {
    int day, month, year;
    date_t *d;
    printf("\nGive day, month, year:");
```

```
    scanf("%d %d %d", &day, &month, &year);
    d = date_struct( day, month, year );
    //f();
    printf("\ndate struct values: %d-%d-%d", d->day, d->month, d->year);
    return 0;
}
```

Exercise: *parameter passing*

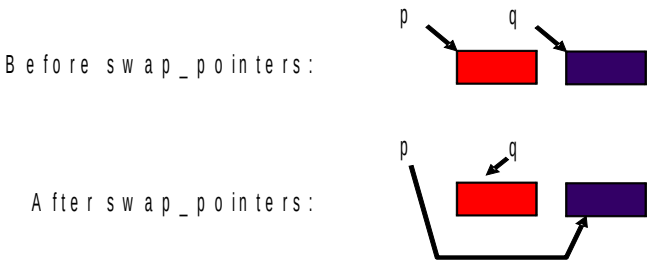
Implement the function 'swap_pointers'. This functions takes two arguments of type void pointer and has no return value. The functions 'swaps' the two pointers as illustrated below. **Draw the function stack** before, during, and after the function call to swap_pointers().

```
int a = 1;
int b = 2;
// for testing we use pointers to integers
int *p = &a;
int *q = &b;

printf("address of p = %p and q = %p\n", p, q);
// prints p = &a and q = &b

swap_pointers( ?p , ?q );
```

// find the correct parameter passing of pointer p and q




```
printf("address of p = %p and q = %p\n", p, q);
// prints p = &b and q = &a
```

Exercise: *random numbers, the time() and sleep() functions*

*THE SOLUTION OF THIS EXERCISE NEEDS TO BE UPLOADED AS A **ZIP FILE** CONTAINING **ONLY A main.c FILE** ON labtools.groept.be BEFORE THE NEXT LAB.*

YOUR SOLUTION IS ONLY ACCEPTED IF THE CRITERIA FOR THIS EXERCISE AS DESCRIBED ON labtools.groept.be ARE SATISFIED!

Implement a program that simulates a sensor node measuring the outdoor temperature. Use the pseudo-random number generator to simulate temperature readings and use the sleep function (read man pages!) to generate temperature readings at a pre-defined frequency. The temperature values should be realistic outdoor values (not too cold, too hot – e.g. between -10 and +35°C). Use #define's to set the frequency, min. and max. temperature values.
Print every reading as a new line on screen as follows:

Temperature = <temperature> @<date/time>

where <temperature> should be printed with 1 digit before (= width) and 2 digits after (= precision) the decimal point, and <date/time> is the date and time as returned by the Linux 'date' command.

If you are not very experienced in programming, then solve this exercise step-by-step, i.e.:

- *First, write code to generate a random temperature value (see hint 1).*
- *Next, add code to print the temperature and date/time in the desired format (see hint 2 , 3 and 4).*
- *Finally, add a loop to keep the sensor node running forever and print data at the required frequency.*

Hint 1: use the library function srand() to initialize the pseudo-random generator with the result of 'time(NULL)'. srand() should be called only once.

Hint 2: Printing the temperature in the correct format can be easily done with the format specifier *%1.2f* i.s.o. *%f*.

Hint 3: printf() followed by sleep() will delay the output to screen (buffered output!). To avoid this use the statement 'fflush(stdout);' just after printf().

Hint 4: An easy way to get the Linux date/time is 'system(“date”);'