System-Level Programming

5 Language Overview

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Summer Term 2024

http://sys.cs.fau.de/lehre/ss24
A C-program (usually) consists of

- a set of **global variables**
- a set of (sub-)functions
  - a set of **local variables**
  - a set of **instructions**
- the function **main()**, which is the entry point for any execution
Structure of a C Program – an Example

// include files
#include <led.h>

// global variables
LED nextLED = RED0;

// subfunction 1
LED lightLED(void) {
    if (nextLED <= BLUE1) {
        sb_led_on(nextLED);
        nextLED++;
    }
    return nextLED;
}

// subfunction 2
void wait(void) {
    volatile unsigned int i;
    for (i = 0; i < 0xffffffff; i++)
        ;
}

// main function
void main(void) {
    while (lightLED() < 8) {
        wait();
    }
}

A C-program (usually) consists of

- a set of global variables
  - nextLED, line 5
- a set of (sub-)functions
  - a set of local variables
    - i, line 16
  - a set of instructions
    - for-loop, line 17
- the function main(), which is the entry point for any execution
```
// include files
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// subfunction 1
LED lightLED(void) {
    if (nextLED <= BLUE1) {
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    return nextLED;
}

// subfunction 2
void wait(void) {
    volatile unsigned int i;
    for (i = 0; i < 0xffff; i++)
    {
    }
}

// main function
void main() {
    while (lightLED() < 8) {
        wait();
    }
}
```

Names given by the developer for certain elements of the program:
- element: type, variable, constant, function, jump mark
- structure: [ A-Z, a-z, _ ] [ A-Z, a-z, 0-9, _ ]*
  - one letter, followed by a combination of letters, numbers and underscores
  - underscore can be used as a first symbol, however, this is usually reserved for compiler manufacturers
- every identifier has to be declared prior to being used
Keywords

```
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```

Reserved words of the language

(shall never be used as an identifier)

- embedded (primitive) types: `unsigned int`, `void`
- type modifiers: `volatile`
- control structures: `for`, `while`
- elementary instructions: `return`
## Literals

For every primitive data type, there is at least one literal form.

- For integers: decimal (base 10: 65535), hexadecimal (base 16, leading 0x: 0xffff), octal (base 8, leading 0: 0177777)

The programmer can then choose the best suited form.

- 0xffff is more handy than 65535 to represent the maximal value of a 16-bit integer
Outline the actual **procedure** of the program

They are hierarchically made up from three basic forms

- single instruction – **expression** followed by `;`
  - single semicolon $\mapsto$ empty instruction
- **block** – sequence of instructions, wrapped in `{...}`
- control structures, followed by instructions

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Expressions

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```

Valid combination of operators, literals, and identifiers

- “valid” in the sense of syntax and types
- priority rules for operators determine the order, in which the expressions get handled
  - order of execution can be explicitly forced with the help of brackets `( )`
  - the compiler is allowed to evaluate partial expressions in the most efficient order