System-Level Programming

5 Language Overview

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Structure of a C Program – General

```
1  // include files
2  #include ...
3
4  // global variables
5  ... variable1 = ...
6
7  // subfunction 1
8  ... subfunction_1(...) {
9    // local variables
10   ... variable1 = ...
11   // statements
12   ...
13 }
14 // subfunction n
15 ... subfunction_n(...) {
16
17   ...
18
19 }
20
21 // main function
22 ... main(...) {
23
24   ...
25
26 }
```

- 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

```
1  // include files
2  #include <led.h>
3
4  // global variables
5  LED nextLED = RED0;
6
7  // subfunction 1
8  LED lightLED(void) {
9    if (nextLED <= BLUE1) {
10     sb_led_on(nextLED++);
11   }
12   return nextLED;
13 }
```

```
14 // subfunction 2
15 void wait(void) {
16   volatile unsigned int i;
17   for (i = 0; i < 0xffff; i++)
18     ;
19 }
20
21 // main function
22 void main(void) {
23   while (lightLED() < 8) {
24     wait();
25   }
26 }
```

- A C-program (usually) consists of
  - a set of global variables — `nextLED`, line 5
  - a set of (sub-)functions — `wait()`, line 15
    - 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

Identifier [= Java]

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- 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 [≈Java]

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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 [= Java]

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- (Expression of) constants in the code
  - 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

Instructions [= Java]

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```

- Outline the actual procedure of the program
- They are hierarchically made up from three basic forms
  - single instruction – expression followed by ;
    - single semicolon ↦ empty instruction
  - block – sequence of instructions, wrapped in {...}
  - control structures, followed by instructions

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Expressions [= Java]

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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