# Einführung in C - Introduction to C

## 2. Data types, variables, operators

Prof. Dr. Eckhard Kruse

DHBW Mannheim

# Data types, variables ... example (1)

```
int main( ) {
   int a, b, c, res;
   a=5;  b=7;  c=10;
   res=a/2+b/4+c;
   printf("result is %d - wow!\n", res);
}
```

*Explicit, static typing: Variable definition*

*Initialization (no default values)*

*placeholder int*

Datatype

Variables (identified by names store values of a given type)

Arithmetic operators

```
>calc.exe

result is 13 - wow!

>
```

# Data types, variables (2)

Example

```
int main( ) {
   float a, b, c, res;
   a=5.0;  b=7.0;  c=10.0;
   res=a/2+b/4+c;
   printf("result is %f - wow!\n", res);
}
```

*placeholder float*

Datatype
Variables (identified by names store values of a given type)
Arithmetic operators

```
>calc.exe

result is 14.250000 - wow!

>
```

# Variables: Concepts

Definition

```
int main( ) {
   float a, b, c, res;
   a=5.0;  b=7.0;  c=10.0;
   res=a/2+b/4+c;
   printf("result is %f \n", res);
}
```

*Explicit, static typing: Variable definition*

*Initialization (no default values)*

Scope

**Variables:**

- Have a name
- are of some type
- represent memory storing a value of that type
- need to be defined before being used (this reserves the memory)
- need to be assigned a value before being used (initialization)
- have a **scope**, i.e. they are visible in certain portions of the program.

# Data types

## Integer (Ganzzahl)

`int` standard integer: maximum range depends on CPU

-32768 to +32767 (16 Bit)
-2147483648 to +2147483647 (32Bit)

`short, long, long long` *(C99)*

`unsigned int, unsigned short, unsigned long`

0 to 65535

0 to +4294967295

## Floating point number (Gleitkommazahl)

`float`
`double`
`long double` *(C99)*

Float/double Notation with e or E, e.g.:
2.308E3 = $2.308*10^{3}$ = 2308
5.12E-1 = $5.12*10^{-1}$ = 0.512

## Character (Byte)

`char` -128 to 127
`unsigned char` 0 to 255

Typically used for characters, e.g. 'A' = 65, 'B'=66

## Boolean Values: true/false are represented as integers (1 / 0)

(C99: _Bool, <stdbool.h> → bool)

# Control flow – some basics...

Example

```
#include <stdio.h>

int main()
{
    char c, old_c;
    c=0;
    while(1) {  // comments... (see file)
        old_c=c;
        c=c+1;
        if(old_c>c) {
            printf("overflow %d -> %d \n", old_c, c);
        }
    }
}
```

# Integer overflow

Exercise

`int_overflow.c`

**Code snippet 201**

# Floating point numbers

Exercise

`floating_point.c`

**Code snippet 202**

# for-loop – some basics...

Example

```
#include <stdio.h>

int main()
{
    int i, j;
    char c;
    for(i=0; i<256; i=i+16)
    {
        printf("%3d ",i);
        for(j=0; j<16; j=j+1) {
            c=i+j;
            printf("%c",c);
        }
        printf("\n");
    }
}
```

# ASCII table

Exercise

**ASCII_table.c**

**Code snippet 203**