

# Programmierkurs 2

Aufgaben für die Vorbereitung auf die Klausur im Wintersemester 2016/17

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# Versionshistorie

- 0.1.11
  - Added Disclaimer
- 0.1.10
  - Added „Types & Sizes“
- 0.1.9
  - Added „Funktionszeiger“
  - Added „Funktionszeiger 2“
- 0.1.8
  - Polished some code designs
- 0.1.7
  - Added „Malloc & free“
- 0.1.6
  - Added „Libraries“
- 0.1.5
  - Added „Zeigerarithmetik & Arrays“
  - Added „Zeigerarithmetik & Arrays 2“
  - Added „Zeigerarithmetik & Arrays 3“
- 0.1.4
  - Added TODOs
- 0.1.3
  - Design overhaul
- 0.1.2
  - Added „Struts and Unions“
  - Added „Struts and Unions 2“
- 0.1.1
  - Added „Startpunkt“
  - Added „Makefile“
- 0.1.0
  - Added „GNU Free Documentation License“
- 0.0.1
  - First document design

# C

## Startpunkt

Was hiervon sind valide Deklarationen der Main Methode? (ankreuzen)

<code>int main(int argc, char *argv[]) { return 0; }</code>	<input type="checkbox"/>
<code>int main(){ return 0; }</code>	<input type="checkbox"/>
<code>float main(){ return 0; }</code>	<input type="checkbox"/>
<code>void main() { return 0; }</code>	<input type="checkbox"/>
<code>int main(int argc, char **argv) { return 0; }</code>	<input type="checkbox"/>
<code>int main(void) { return 0; }</code>	<input type="checkbox"/>
<code>char* main() { return 0; }</code>	<input type="checkbox"/>

## Makefile

Situation: Zwei Quelldateien main.c und summe.c sowie die Headerdatei summe.h, die main.c ruft die Methode `int make_sum(int a, int b)`.

Schreiben Sie ein makefile, welches die Dateien kompiliert und eine ausführbare Datei „main“ erstellt. Beachten Sie dabei, dass die Anweisungen die Abhängigkeiten der Quelldateien beachten (Bonus wenn beim Kompilieren der richtige C-Standard angegeben wird)

main.c

```
#include <stdio.h>
#include "summe.h"

int main(void)
{
    printf("Summe von 9 und 21 ist %d\n", make_sum(9,21));
}
```

summe.c

```
int make_sum(int a, int b)
{
    return a+b;
}
```

summe.h

```
int make_sum(int a, int b);
```

makefile

## Structs und Unions

Sie sehen das Programm auf der rechten Seite, es ist laut C11 Standard valide und kompiliert ohne Fehler.  
Wie sieht die Ausgabe des Programms aus?

```
s.a =  
s.b =  
u.a =  
u.b =
```

## Structs und Unions 2

Welche der drei unteren Aussagen trifft zu?

Die Struktur s ist...

kleiner als das Union u	<input type="checkbox"/>
gleich groß wie das Union u	<input type="checkbox"/>
größer als das Union u	<input type="checkbox"/>

```
#include <stdio.h>  
  
struct teststruct {  
    int a;  
    char b;  
};  
  
union testunion {  
    int a;  
    char b;  
};  
  
int main()  
{  
    /*    Auszug aus der ASCII Tabelle  
        65 = A  
        66 = B*/  
    struct teststruct s;  
    s.a = 65;  
    s.b = 66;  
  
    printf("s.a = %d\n", s.a);  
    printf("s.b = %c\n", s.b);  
  
    union testunion u;  
    u.a = 65;  
    u.b = 66;  
  
    printf("u.a = %d\n", u.a);  
    printf("u.b = %c\n", u.b);  
  
    return 0;  
}
```

```
#include <stdio.h>  
  
struct point_s {  
    int x;  
    char y;  
};  
  
//hier kommt die Typdefinition hin:  
  
int main()  
{  
    struct point_s p1 = { 5, 7 };  
    point p2 = { 3, 2 };  
  
    printf("p1.x = %d, p1.y = %d\n", p1.x, p1.y);  
    printf("p2.x = %d, p2.y = %d\n", p2.x, p2.y);  
  
    return 0;  
}
```

## Typedef

Ergänzen Sie den nebenstehenden Programmcode so, dass ein neuer Typ definiert wird mit Namen `point`, der auf die Struktur `point_s` zeigt, sodass der untere Code nach C11 Standard valide ist und kompiliert.

## Zeigerarithmetik & Arrays

Was sind laut C11 Standard valide Deklaration für ein Array aus Integer Werten? Wie groß ist das Array(nichts angeben, falls es sich um eine nicht valide Deklaration handelt)

Deklaration	valide?	Maximale Anzahl der enthaltenen Elemente?
int arr1[] = { 2 };	<input type="checkbox"/>	
int arr2[];	<input type="checkbox"/>	
int arr3[1];	<input type="checkbox"/>	
int arr4[2] = { 6 };	<input type="checkbox"/>	

## Zeigerarithmetik & Arrays 2

Ergänzen Sie den unteren Programmcode so, dass die Methode void uppercase(?) einen Zeiger erwartet, dessen Wert überprüft wie im Programmcode angegeben und ihn ggf. auf einen neuen Wert setzt. Beim Aufruf der Methode void uppercase(?) soll ein Zeiger auf den char c1 übergeben werden, nicht c1 selber.

```
#include <stdio.h>

void uppercase(          )
{
    char tmp =           ;//Wert von Übergabeparameter der Variable tmp zuweisen

    //Prüfe ob der Wert im lowercase Bereich liegt
    if(tmp >= 'a' && tmp <= 'z')
    {
        tmp = tmp - 'a' + 'A';

        = tmp; //Weise dem Speicher, auf den der Zeiger zeigt, den Wert von tmp zu
    }
}

int main()
{
    char c1 = 'a';

    printf("c1 = '%c'\n", c1);

    printf("making c1 uppercase..\n");
    uppercase(          );

    printf("c1 = '%c'\n", c1);

    return 0;
}
```

Die Ausgabe des korrekt vervollständigten Programms würde dann so aussehen

```
c1 = 'a'
making c1 uppercase..
c1 = 'A'
```

## Zeigerarithmetik & Arrays 3

Vervollständigen Sie die Methode `void uppercase_string(char * str)` so, dass alle Elemente eines übergebenen nullterminierten Chararrays uppercase sind

```
#include <stdio.h>

int work(char* str);
void uppercase_string(char* str);

int main()
{
    char str1[] = { 'h', 'e', 'l', 'l', 'o', '\0' };
    char str2[] = "world";

    work(str1);
    work(str2);

    return 0;
}

int work(char* str)
{
    printf("str = '%s'\n", str);

    printf("making str uppercase..\n");
    uppercase_string(str);

    printf("str = '%s'\n", str);
}

void uppercase_string(char* str)
{
    int i;
    for(i=0; i<strlen(str); i++)
    {
        if(str[i] >= 'a' && str[i] <= 'z')
        {
            str[i] = str[i] - 'a' + 'A';
        }
    }
}
```

In C gibt es von Haus aus nicht den Datentyp *String*, stattdessen wird dieser Datentyp über ein Chararray simuliert, dessen letztes Element ein `'\0'` ist, sodass man nicht die Länge des Arrays angeben muss. Dieser simulierte String lässt sich einmal über die ganz normale Arraydeklaration definieren, wobei das letzte Element ein `'\0'` ist (in der Aufgabe Variable `str1`). Der Nullterminator muss nicht am Ende des eigentlichen Arrays stehen, aber dies hat zur Folge, dass Methoden wie z.B. `printf()` alle Elemente nach dem Nullterminator ignorieren – gleichbedeutend ist das Verhalten undefiniert wenn ein so simulierter String keinen Nullterminator enthält. Weiterhin kann man ein nullterminiertes Chararray auch durch die Deklaration mit doppelten Anführungszeichen erzeugen (in der Aufgabe Variable `str2`), was deutlich einfacher und natürlicher ist, aber komplett gleichbedeutend mit der Arraynotation ist.

Die Ausgabe des korrekt vervollständigten Programms würde dann so aussehen

```
str = 'hello'
making str uppercase..
str = 'HELLO'
str = 'world'
making str uppercase..
str = 'WORLD'
```

## Funktionszeiger

Vervollständigen Sie das untere Programm so, dass die Funktion `int work(int a, ?)` einen `int` und einen Funktionszeiger, welcher als Parameter sowie als Rückgabe einen `int` hat, erwartet. Die Funktion `int work(int a, ?)` ruft den Funktionszeiger auf und gibt den Wert zurück.

Weiterhin soll die `int main()` Funktion zwei Funktionszeiger erstellen, mit denen nachher die Funktion `int work(int a, ?)` aufgerufen wird. Der erste Funktionszeiger `fp1` soll auf die Funktion `int add_two(int a)` verweisen, der zweite `fp2` auf die Funktion `int add_multiply_by_three(int a)`.

```
#include <stdio.h>

int add_two(int a)
{
    return a+2;
}

int multiply_by_three(int a)
{
    return a*3;
}

int work(int a,          )
{
    return          ;
}

int main()
{

    int a = 7;
    printf("work(a, fp1) = %d\n", work(a, fp1));
    printf("work(a, fp2) = %d\n", work(a, fp2));

    return 0;
}
```

Die Ausgabe des korrekt vervollständigten Programms würde dann so aussehen

```
work(a, fp1) = 9
work(a, fp2) = 21
```



## Funktionszeiger 2

Was gibt das untere Programm bei Ausführung aus?

```
#include <stdio.h>

int add(int a, int b)
{
    return a+b;
}

int subtract(int a, int b)
{
    return a-b;
}

int multiply(int a, int b)
{
    return a*b;
}

int divide(int a, int b)
{
    return a/b;
}

int main()
{
    int (* fp1) (int, int) = add;
    int (* fp2) (int, int) = &subtract;
    int (* fp3) (int, int) = *multiply;
    int (* fp4) (int, int) = **divide;

    int a = 7;
    int b = 3;
    printf("fp1 = %d\n", (*fp1) (a, b));
    printf("fp2 = %d\n", fp2(a, b));
    printf("fp3 = %d\n", (*fp3) (a, b));
    printf("fp4 = %d\n", fp4(a, b));

    printf("etwas Action reinbringen..\n");
    fp2 = fp1;
    fp1 = fp3;
    printf("fp1 = %d\n", (*fp1) (a, b));
    printf("fp2 = %d\n", fp2(a, b));
    printf("fp3 = %d\n", (*fp3) (a, b));
    printf("fp4 = %d\n", fp4(a, b));

    return 0;
}
```

Ausgabe:

```
fp1 =
fp2 =
fp3 =
fp4 =
etwas Action reinbringen..
fp1 =
fp2 =
fp3 =
fp4 =
```

## Types & sizes

Wie groß ist ein int laut C11 Standard? (nur eine Lösung ist korrekt)

8 bit	<input type="checkbox"/>
16 bit	<input type="checkbox"/>
32 bit	<input type="checkbox"/>
64 bit	<input type="checkbox"/>
Bitte ein Bit	<input type="checkbox"/>
128 bit	<input type="checkbox"/>
abhängig vom Betriebssystem	<input type="checkbox"/>

Wie groß ist ein char laut C11 Standard? (nur eine Lösung ist korrekt)

genau 8 bit	<input type="checkbox"/>
mindestens 8 bit	<input type="checkbox"/>
genau 16 bit	<input type="checkbox"/>
mindestens 16 bit	<input type="checkbox"/>

Wir haben folgenden Programmcode

```
#include <stdio.h>
#include <stdlib.h>

int main()
{
    int arr1[5] = { 1, 2, 3 };
    int arr2[] = { 1, 2, 3 };
    int* arr3 = (int*) malloc(sizeof(int) * 5);

    printf("sizeof(int) = %d\n", sizeof(int));
    printf("sizeof(int*) = %d\n", sizeof(int*));
    printf("sizeof(arr1) = %d\n", sizeof(arr1));
    printf("sizeof(arr2) = %d\n", sizeof(arr2));
    printf("sizeof(arr3) = %d\n", sizeof(arr3));

    return 0;
}
```

Wie sieht die Ausgabe aus? (kreise die richtige Ausgabe ein)

(INFO: die Rückgabe von `sizeof(int)` und `sizeof(int*)` wurde mit einer Variable realisiert, da der Rückgabewert abhängig vom System ist)

a)

```
sizeof(int) = x
sizeof(int*) = y
sizeof(arr1) = x*5
sizeof(arr2) = x*3
sizeof(arr3) = x*5
```

b)

```
sizeof(int) = x
sizeof(int*) = y
sizeof(arr1) = x*5
sizeof(arr2) = x*3
sizeof(arr3) = y
```

c)

```
sizeof(int) = x
sizeof(int*) = y
sizeof(arr1) = x*3
sizeof(arr2) = x*3
sizeof(arr3) = y
```

## Libraries

Sie haben die Quelldateien `auto.c`, `fahrrad.c` die zu einer Library `fahrzeug.a` hinzugefügt werden sollen via den Anweisungen im `makefile` und dem Konsolentool „ar“

`auto.c`

```
#include <stdio.h>
#include "fahrzeug.h"

Auto new_auto(char* bezeichnung, int ps, double preis)
{
    Auto a = { bezeichnung, ps, preis };
    return a;
}

void print_auto(Auto a)
{
    printf("bezeichnung = %s, ps = %d, preis = %.2f", a.bezeichnung, a.ps, a.preis);
}
```

`fahrrad.c`

```
#include <stdio.h>
#include "fahrzeug.h"

Fahrrad new_fahrrad(char* bezeichnung, double preis)
{
    Fahrrad f = { bezeichnung, preis };
    return f;
}

void print_fahrrad(Fahrrad f)
{
    printf("bezeichnung = %s, preis = %.2f", f.bezeichnung, f.preis);
}
```

`fahrzeug.h`

```
#ifndef FAHRZEUG_H_
#define FAHRZEUG_H_

typedef struct {
    char* bezeichnung;
    int ps;
    double preis;
} Auto;

Auto new_auto(char* bezeichnung, int ps, double preis);
void print_auto(Auto a);

typedef struct {
    char* bezeichnung;
    double preis;
} Fahrrad;

Fahrrad new_fahrrad(char* bezeichnung, double preis);
void print_fahrrad(Fahrrad f);

#endif
```

main.c

```
#include <stdio.h>
#include "fahrzeug.h"

int main()
{
    Auto a = new_auto("Ford Fiesta", 42, 1337.0);
    Fahrrad f = new_fahrrad("Hollandrad", 420.0);

    printf("Auto a: ");
    print_auto(a);
    printf("\n");

    printf("Fahrrad f: ");
    print_fahrrad(f);
    printf("\n");

    return 0;
}
```

makefile

Bonus:

Warum sind in der Headerdatei `fahrzeug.h` diese Compileranweisungen enthalten?

```
#ifndef FAHRZEUG_H_
#define FAHRZEUG_H_

[...]
```

```
#endif
```

## Malloc & free

Vervollständigen Sie das Programm so, dass die Funktion `char* create_string(int length, char init)` ein Chararray dynamisch mittels der Library `stdlib.h` erzeugt mit `length` Elementen, die den Wert von `init` haben. Zudem soll das Chararray nullterminiert sein.

Weiterhin soll die Methode `void delete_string(char* str)` ein dynamisch erzeugtes Chararray übergeben bekommen und dieses mittels der Library `stdlib.h` löschen

```
#include <stdio.h>
#include <stdlib.h>

char* create_string(int length, char init)
{
    char* str = malloc(length * sizeof(char));

    int i;
    for(i=0; i<length; i++)
    {
        str[i] = init;
    }

    return str;
}

void delete_string(char* str)
{
}

int main()
{
    char* str1 = create_string(5, 'a');
    char* str2 = create_string(9, 'B');

    printf("str1 = %s\n", str1);
    printf("str2 = %s\n", str2);

    delete_string(str1);
    delete_string(str2);

    return 0;
}
```

Die Ausgabe des korrekt vervollständigten Programms würde dann so aussehen

```
str1 = aaaaa
str2 =BBBBBBBBB
```

# C++

Classes & inheritance(TODO)

Namespaces(TODO)

Input & output / streams(TODO)

Operator overloading(TODO)

Exceptions(TODO)

Multiple inheritance(TODO), maybe?

Inline functions(TODO), maybe?

Virtual methods(TODO)

Templates(TODO)

# C#

Preamble(TODO)

Input & output(TODO)

Classes & inheritance(TODO)

Namespaces(TODO)

Exceptions(TODO)

Observer model(TODO)

Delegates(TODO)

Events(TODO)

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