Programmierkurs 2

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

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# Versionshistorie

* 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)

|  |  |
| --- | --- |
| int main(int argc, char \*argv[]) { return 0; } | □ |
| int main(){ return 0; } | □ |
| float main(){ return 0; } | □ |
| void main() { return 0; } | □ |
| int main(int argc, char \*\*argv) { return 0; } | □ |
| int main(void) { return 0; } | □ |
| char\* main() { return 0; } | □ |

## 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

#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**;**

**}**

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 | □ |
| gleich groß wie das Union u | □ |
| größer als das Union u | □ |

#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 }; | □ |  |
| int arr2[]; | □ |  |
| int arr3[1]; | □ |  |
| int arr4[2] = { 6 }; | □ |  |

## 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

*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 str1), was deutlich einfacher und natürlicher ist, aber komplett gleichbedeutend mit der Arraynotation ist.*

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**;** **!=** '\0'**;** i**++)**

**{**

**if((** **>=** 'a'**)** **&& (** **<=** 'z'**))**

**{**

**=** **-** 'a' **+** 'A'**;**

**}**

**}**

**}**

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

## 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 **= ;**

int i**;**

**for(**i**=**0**;** **;** 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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