Programmierkurs 2

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

Disclaimer:

Die Aufgaben in diesem Dokument sind so konzipiert, dass sie ohne Hilfsmittel zu lösen sind und beruhen auf Wissen, welches in der Vorlesung „Programmierkurs 2“ im Wintersemester 2016/17 vermittelt wurde.

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Dieses Dokument soll keine Klausur repräsentieren, da das Aufgabenspektrum viel zu groß ist, viel mehr soll dieses Dokument als Überprüfung dienen, ob man alle besprochenen Aspekte der drei Programmiersprachen C, C++ und C# kennt und erklären kann. Gegebenenfalls werde ich abgeschätzte Bearbeitungszeiten an die Aufgaben schreiben und den Schwierigkeitsgrad, damit ihr evaluieren könnt wie sicher ihr in den Themengebieten seid.

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  - Added „C++ > Klassen und Vererbung 3, Mehrfachvererbung“
  - Added Footer
- 0.1.12
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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

```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

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

summe.h

```c
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**	□
gleich groß wie das Union **u**	□
größer als das Union **u**	□

```c
#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;
}
```

```c
#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 und 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 und 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 und Arrays 3

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

*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.*

```
#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?

```c
#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 =
```

Datentypen und ihre Größen

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

8 bit	□
16 bit	□
32 bit	□
64 bit	□
Bitte ein Bit	□
128 bit	□
abhängig vom Betriebssystem	□

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

genau 8 bit	□
mindestens 8 bit	□
genau 16 bit	□
mindestens 16 bit	□

Datentypen und ihre Größen 2

Wir haben folgenden Programmcode

```c
#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
```

Abhängigkeitsbibliotheken

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

```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?

```c
#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++

Klassen und Vererbung

Erstellen Sie eine Klasse Auto mit den folgenden Eigenschaften:

- Sie hat zwei (private) Attribute
  - Einen **std::string** namens „name“
  - Einen **int** namens „baujahr“
- Einem öffentlichen Konstruktor der einen **std::string** und einen **int** übergeben bekommt und die oben genannten Attribute initialisiert. Diesen bitte in der Headerdatei **Auto.h** implementieren
- Einen öffentlichen Destruktor der vollständigkeit halber, der jedoch nichts macht, da die Klasse Auto nur Werteobjekte enthält dessen Destruktor implizit aufgerufen wird. Diesen bitte in der Headerdatei **Auto.h** implementieren
- Eine öffentliche Methode **std::string getBeschreibung()**. Diese bitte in der Headerdatei **Auto.h** angeben und in der **Auto.cpp** implementieren

Benutzen Sie die dabei vorgegebenen Textboxen in denen Teile bereits implementiert sind.

makefile

```
main: main.cpp Auto.h Auto.o
	g++ main.cpp -o main Auto.o -std=c++11

Auto.o: Auto.cpp Auto.h
	g++ Auto.cpp -c -std=c++11

clean:
	rm Auto.o main
```

main.cpp

```
#include <iostream>
#include "Auto.h"

int main()
{
	Auto* a1 = new Auto("Trabant 601", 1976);
	Auto* a2 = new Auto("Porsche 911", 1963);

	std::cout << a1->getBeschreibung() << std::endl;
	std::cout << a2->getBeschreibung() << std::endl;

	return 0;
}
```

Die Ausgabe des korrekt vervollständigten Programms würde dann so aussehen

Auto.h

```
#ifndef AUTO_H
#define AUTO_H

#include <string>









#endif
```

Auto.cpp

```
#include "Auto.h"

// hier "std::string getBeschreibung()" implementieren

{
	std::string out = "Auto: name='" + name + "', baujahr=" + std::to_string(baujahr);

	return out;
}
```

Klassen und Vererbung 2, Polymorphie und virtuelle Funktionen

In der folgenden Aufgabe haben wir die zwei Klassen Dreirad und Panzer, die von der abstrakten Klasse Fahrzeug ableiten.

Wie lautet die Ausgabe(ganz unten)?

makefile

```
main: main.cpp Fahrzeug.h Fahrzeug.o Dreirad.h Dreirad.o Panzer.h Panzer.o
	g++ main.cpp -o main Fahrzeug.o Dreirad.o Panzer.o -std=c++11

Dreirad.o: Dreirad.cpp Dreirad.h Fahrzeug.o
	g++ Dreirad.cpp -c Fahrzeug.o -std=c++11

Panzer.o: Panzer.cpp Panzer.h Fahrzeug.o
	g++ Panzer.cpp -c Fahrzeug.o -std=c++11

Fahrzeug.o: Fahrzeug.cpp Fahrzeug.h
	g++ Fahrzeug.cpp -c -std=c++11

clean:
	rm Fahrzeug.o Panzer.o Dreirad.o main
```

Fahrzeug.h

```
#ifndef FAHRZEUG_H
#define FAHRZEUG_H

#include <string>

class Fahrzeug
{
	private:
		int baujahr;

	public:
		Fahrzeug(int _baujahr) : baujahr(_baujahr) {};

		~Fahrzeug() {};

		int inline getBaujahr() { return baujahr; };

		std::string virtual getBeschreibung() = 0;

		std::string getTyp();
};

#endif
```

Fahrzeug.cpp

```
#include "Fahrzeug.h"

std::string Fahrzeug::getTyp()
{
	return "Fahrzeug";
}
```

Panzer.h

```
#ifndef PANZER_H
#define PANZER_H

#include <string>
#include "Fahrzeug.h"

class Panzer : Fahrzeug
{
	private:
		std::string name;

	public:
		Panzer(std::string _name, int _baujahr) : name(_name), Fahrzeug(_baujahr) {};

		~Panzer() {};

		std::string getBeschreibung();

		std::string getTyp();
};

#endif
```

Panzer.cpp

```
#include "Panzer.h"

std::string Panzer::getBeschreibung()
{
	std::string out = "Panzer: name='" + name + "', baujahr=" + std::to_string(getBaujahr());

	return out;
}

std::string Panzer::getTyp()
{
	return "Panzer";
}
```

Dreirad.h

```
#ifndef DREIRAD_H
#define DREIRAD_H

#include <string>
#include "Fahrzeug.h"

class Dreirad : Fahrzeug
{
	private:
		double preis;

	public:
		Dreirad(double _preis, int _baujahr) : preis(_preis), Fahrzeug(_baujahr) {};

		~Dreirad() {};

		std::string getBeschreibung();

		std::string getTyp();
};

#endif
```

Dreirad.cpp

```
#include "Dreirad.h"

std::string Dreirad::getBeschreibung()
{
	std::string out = "Dreirad: preis=" + std::to_string(preis) + "$, baujahr=" + std::to_string(getBaujahr());

	return out;
}

std::string Dreirad::getTyp()
{
	return "Dreirad";
}
```

main.cpp

```
#include <iostream>
#include "Fahrzeug.h"
#include "Dreirad.h"
#include "Panzer.h"

int main()
{
	Panzer* p = new Panzer("Leopard 2", 1979);
	Dreirad* d = new Dreirad(59.99, 2011);

	std::cout << "Beschreibung: " << p->getBeschreibung() << ", Typ: " << p->getTyp() << std::endl;
	std::cout << "Beschreibung: " << d->getBeschreibung() << ", Typ: " << d->getTyp() << std::endl;

	Fahrzeug* f1 = (Fahrzeug*) p;
	Fahrzeug* f2 = (Fahrzeug*) d;

	std::cout << "Beschreibung: " << f1->getBeschreibung() << ", Typ: " << f1->getTyp() << std::endl;
	std::cout << "Beschreibung: " << f2->getBeschreibung() << ", Typ: " << f2->getTyp() << std::endl;

	return 0;
}
```

Ausgabe:

```
Beschreibung:                                   , Typ:
Beschreibung:                                   , Typ:
Beschreibung:                                   , Typ:
Beschreibung:                                   , Typ:
```

Bonus:
Was bedeutet, dass die Klasse Fahrzeug abstrakt ist?

Bonus2:
Warum ist die Klasse Fahrzeug abstrakt?

Bonus3:
Was bedeutet das **inline** bei der Funktion **int inline getBaujahr()** in der Klasse Fahrzeug?
Vor- und Nachteile nennen sowie die Funktionsweise.

Klassen und Vererbung 3, Mehrfachvererbung

Wieso ist Mehrfachvererbung mit Vorsicht zu benutzen?

Wieso kann der g++ Compiler die folgende Ergänzung zur Klassenhierarchie von „Klassen und Vererbung 2“ nicht kompilieren?(Beim Compilieren von **Panzerdreirad.o** meckert er)

Panzerdreirad.h

```
#ifndef PANZERDREIRAD_H
#define PANZERDREIRAD_H

#include <string>
#include "Panzer.h"
#include "Dreirad.h"

class Panzerdreirad : Panzer, Dreirad
{
        private:

        public:
                Panzerdreirad(std::string _name,
double _preis, int _baujahr) : Panzer(_name,
_baujahr), Dreirad(_preis, _baujahr) {};

                ~Panzerdreirad() {};

                std::string getBeschreibung();

                std::string getTyp();
};

#endif
```

Panzerdreirad.cpp

```
#include "Panzerdreirad.h"

std::string Panzerdreirad::getBeschreibung()
{
        std::string out = "Panzerdreirad: name='" +
getName() + "', preis=" + std::to_string(getPreis()) + ",
baujahr=" + std::to_string(getBaujahr());

        return out;
}

std::string Panzerdreirad::getTyp()
{
        return "Panzerdreirad";
}
```

makefile

```
main: main.cpp Panzerdreirad.h Panzerdreirad.o
	g++ main.cpp -o main Fahrzeug.o Dreirad.o Panzer.o -std=c++11

Panzerdreirad.o: Panzerdreirad.cpp Panzerdreirad.h Dreirad.o Dreirad.h
Panzer.o Panzer.h
	g++ Panzerdreirad.cpp -c Dreirad.o Panzer.o -std=c++11

Dreirad.o: Dreirad.cpp Dreirad.h Fahrzeug.o
	g++ Dreirad.cpp -c Fahrzeug.o -std=c++11

Panzer.o: Panzer.cpp Panzer.h Fahrzeug.o
	g++ Panzer.cpp -c Fahrzeug.o -std=c++11

Fahrzeug.o: Fahrzeug.cpp Fahrzeug.h
	g++ Fahrzeug.cpp -c -std=c++11

clean:
	rm Fahrzeug.o Panzer.o Dreirad.o Panzerdreirad.o main
```

Namespaces(TODO)
Input & output / streams(TODO)
Operatorenüberladung(TODO)
Exceptions(TODO)
Templates(TODO)

C#

Präamble(TODO)

Input & output(TODO)

Klassen und Vererbung(TODO)

Namespaces(TODO)

Exceptions(TODO)

Observer Modell(TODO)

Delegates(TODO)

Events(TODO)

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