Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

Dashboard / Meine Kurse / Wintersemester 2023/2024 / Ingenieurwissenschaften / Informatik und Angewandte Kognitionswissenschaften / Praktikum OOP in C++ WS 2023/2024 / Aufgabe 1/Task 1 / A1 Teil 1: Hausaufgabe zur Vorbereitung auf die Präsenz-Gruppe/Part 1: Homework Task for Preparation of the Presence Group

A1 Teil 1: Hausaufgabe zur Vorbereitung auf die Präsenz-Gruppe/Part 1: Homework Task for Preparation of the Presence Group

Lernziele: C++-Eingaben von der Tastatur, C++-Ausgaben in die/das Konsolen-Ausgabe(fenster), Wiederholungen Konstante und Variable, Struktur, Schleife./
Learning objectives: C++ inputs from the keyboard, C++ outputs to the console output (window), repetitions constant and variable, structure, loop.

Im Rahmen der Klimakrise und steigender Energiekosten ist es sinnvoll sich über den eigenen privaten Strombedarf und die Stromkosten dafür klar zu werden. Ein erster Schritt den durchschnittlichen Gesamtstromverbrauch pro Jahr zu berechnen bietet eine vom Bund der Energieverbraucher entwickelte einfache Formel, die in dieser Praktikumsaufgabe im Mittelpunkt stehen soll:/
In the context of the climate crisis and rising energy costs, it makes sense to be clear about one's own private electricity needs and the electricity costs for them. A first step to calculate the average annual total power consumption is offered by a simple formula developed by the Association of Energy Consumers, which will be the focus of this practical assignment:

Formel 1/Formula 1

Stromverbrauch in kWh =
    (Personenzahl * jährlicher durchschnittlicher Verbrauch pro Person)
  + (Wohnfläche in Quadratmetern * jährlicher durchschnittlicher Verbrauch pro Quadratmeter)
  + (Anzahl der (größeren) Geräte im Haushalt * jährlicher durchschnittlicher Verbrauch pro (größeres) elektrisches Gerät)
wobei
jährlicher durchschnittlicher Verbrauch pro Person: 200 kWh.
jährlicher durchschnittlicher Verbrauch pro Quadratmeter: 9 kWh.
jährlicher durchschnittlicher Verbrauch pro (größeres) elektrisches Gerät: 200 kWh.

Power consumption in kWh =
    (number of persons * annual average consumption per person)
  + (living space in square metres * annual average consumption per square metre)
  + (number of (major) devices in the household * annual average consumption per (major) electrical appliance)
whereby
annual average consumption per person: 200 kWh.
annual average consumption per square metre: 9 kWh.
annual average consumption per (major) electrical device: 200 kWh.

Formel 2/Formula 2

Stromkosten in EUR = Verbrauch * Strompreis
Power costs in EUR = consumption * electricity price

1. Definieren Sie drei globale ganzzahlige konstante Variable für die drei obigen jährlichen durchschnittlichen Verbrauchswerte./
   Define three global integer constant variables for the three annual average consumption values above.
2. Definieren Sie eine Struktur mit Namen **`household`** (Haushalt) mit folgenden Komponenten:
   - C++-Zeichenkette für den Namen der Stadt, in der der Haushalt liegt.
   - ganzzahlige Anzahl von Personen im Haushalt.
   - ganzzahlige Anzahl von Quadratmetern des Haushalts.
   - ganzzahlige Anzahl (größerer) elektrischer Geräte im Haushalt./

   Define a structure called **`household`** with the following components:
   - C++ string for the name of the city in which the household is located.
   - integer number of persons in the household.
   - integer number of square metres of the household.
   - integer number of (larger) electrical devices in the household.
3. Schreiben Sie eine Funktion zur Berechnung des jährlichen Stromverbrauchs für einen Haushalt mit einer Struktur vom obigen Typ **`household`** als Parameter und einer Gleitpunktzahl als Rückgabe. Implementieren Sie im Rumpf die entsprechende obige Formel./

Write a function to calculate the annual power consumption for a household with a structure of the above type **household** as parameter and a floating point number as return. Implement the corresponding formula above in its body.

4. Schreiben Sie eine Funktion zur Berechnung der jährlichen Stromkosten für einen Haushalt mit einer Struktur vom obigen Typ **household** als ersten, dem Preis für eine Kilowattstunde als zweiten Parameter und einer Gleitpunktzahl als Rückgabe. Implementieren Sie im Rumpf die entsprechende obige Formel und rufen darin die Funktion aus der vorherigen Teilaufgabe 3 auf./
   Write a function for calculating the annual power costs for a household with a structure of the above type **household** as the first parameter, the price for a kilowatt-hour as the second parameter and a floating point number as the return. Implement the corresponding formula from above in its body and inside call the function from the previous subtask 3.
5. Schreiben Sie eine Funktion namens **print_household** mit einer Struktur vom obigen Typ **household** als ersten, dem Preis für eine Kilowattstunde als zweiten Parameter und ohne Rückgabe. Im Rumpf sollen genau wie in den Beispielen unten die mit Gleichheitszeichen unterstrichene Zeichenkette **AVERAGE POWER COSTS**, danach Zeile für Zeile die Werte aller Komponenten, der Preis für eine Kilowattstunde, der jährliche Stromverbrauch und die jährlichen Stromkosten auf den Standard-Zeichen-Ausgabestrom (also in das Bildschirmfenster) geschrieben werden. /
   Write a function called **print_household** with a structure of the type **household** above as the first parameter, the price for one kilowatt-hour as the second parameter and without return. In its body, just as in the examples below, the string **AVERAGE POWER COSTS** underlined with equal signs, then line by line the values of all components, the price for one kilowatt-hour, the annual power consumption and the annual power costs shall be written to the standard character output stream (i.e. to the screen window).
6. Schreiben Sie eine C++-**main**-Funktion.
   - Definieren Sie eine Variable vom obigen Struktur-Typ **household** sowie alle weiteren von Ihnen benötigten Variable.
   - Lesen Sie nach Ausgabe der Zeichenkette **CALCULATION OF AVERAGE POWER COSTS FOR A HOUSEHOLD** die Stadt, die Anzahl Quadratmeter und die Anzahl elektrischer Geräte als Werte der Strukturvariable ein sowie den Preis für eine Kilowattstunde in dieser Stadt - Ihre Aus- und Eingaben sollen genau wie im Beispiel unten aussehen.
   - Definieren Sie Schleife mit Werten n = 1, 2, .., 5 Personen, setzen im Rumpf der Schleife die Anzahl der Personen auf den Wert von n und rufen Ihre Funktion **print_household** aus Teilaufgabe 5 geeignet auf./

   Write a C++ **main** function.
   - Define a variable of the above structure type **household** as well as all other variables you need.
   - After outputting the string **CALCULATION OF AVERAGE POWER COSTS FOR A HOUSEHOLD**, read in the city, the number of square metres and the number of electrical devices as values of the structure variable as well as the price for a kilowatt-hour in this city - your outputs and inputs should look exactly like in the example below.
   - Define a loop with values n = 1, 2, ..., 5 persons, set the number of persons in the body of the loop to the value of n and call your function **print_household** from subtask 5 appropriately.
7. Testen Sie Ihr Programm für verschiedene Beispieldaten./
   Test your programme for different example data.

Verwenden Sie ausschließlich den C++-Eingabe-Operator **>>** und den Ausgabe-Operator **<<**, also weder die Funktionen **scanf** noch **printf** oder andere aus C!**/**
Only use the C++ input operator **>>** and the output operator **<<**, neither the functions **scanf** nor **printf** or others from C!

Beispiel Programmlauf/Example Program Run

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSEHOLD
in which city is the household located? Duisburg
how many square metres does the household have? 120
how many (major) electrical devices does the household have? 8
how many EUR does one kWh in Duisburg cost? 0.3
AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        1
(major) electrical devices:     8
price for one kWh:              0.3 EUR
annual power consumption:       2880 kWh
annual power costs:             864 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        2
(major) electrical devices:     8
price for one kWh:              0.3 EUR
annual power consumption:       3080 kWh
annual power costs:             924 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        3
(major) electrical devices:     8
price for one kWh:              0.3 EUR
annual power consumption:       3280 kWh
annual power costs:             984 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        4
(major) electrical devices:     8
price for one kWh:              0.3 EUR
annual power consumption:       3480 kWh
annual power costs:             1044 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        5
(major) electrical devices:     8
price for one kWh:              0.3 EUR
annual power consumption:       3680 kWh
annual power costs:             1104 EUR
```

Zuletzt geändert: Freitag, 6. Oktober 2023, 17:58

◄ Bitte registrieren Sie hier Ihre Praktikumsgruppe/ Direkt zu: A1 Upload Teil 1/Part 1 ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

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A1 Teil 2: Präsenzaufgabe/Part 2: Presence Task

Lernziel: Referenzen./
Learning objective: references.

Die sehr einfache Betrachtung und Berechnung des Energieverbrauchs soll in dieser zweiten Teilaufgabe noch etwas erweitert werden. Wird Warmwasser durch Strom, also in einem Boiler oder über einen Durchlauferhitzer, erwärmt, so gilt zusätzlich:
jährlicher durchschnittlicher Verbrauch pro Person bei elektrischer Warmwasserbereitung: 550 kWh
Erweitern Sie Ihren C++-Kode aus Teil 1 bis zum Ende dieser Gruppenstunde folgendermassen:/
The very simple consideration and calculation of energy consumption is to be extended somewhat in this second part task. If hot water is heated by electricity, i.e. in a boiler or via an instantaneous water heater, the following also applies:
annual average consumption per person with electric water heating: 550 kWh
Extend your C++ code from part 1 as follows until the end of this group hour:

1. Fügen Sie zu den drei globalen Konstanten am Anfang Ihres Programms eine vierte mit dem obigen Wert hinzu./
   Add a fourth with the above value to the three global constants at the beginning of your program.
2. Erweitern Sie Ihre Struktur mit Namen `household` (Haushalt) um eine Boolesche Variable die speichert, ob Warmwasser im Haushalt elektrisch erwärmt wird oder nicht./
   Extend your structure named `household` with a Boolean variable that stores whether hot water is heated electrically in the household or not.
3. Erweitern Sie Ihre Funktion zur Berechnung des jährlichen Stromverbrauchs für einen Haushalt um die unterschiedliche Berechnung des Verbrauchs bezüglich der Warmwassererwärmung gespeichert in der zusätzlichen Booleschen Variable für einen Haushalt./
   Extend your function for calculating the annual electricity consumption for a household by the different calculation of the consumption regarding the hot water heating stored in the additional Boolean variable for a household.
4. Erweitern Sie Ihre Funktion zur Ausgabe der Daten eines Haushalts wie im Beispiel unten, also geben zusätzlich eine Zeichenkette `water heated using electricity:` und dahinter `yes` oder `no` aus./
   Extend your function to output the data of a household as in the example below, so additionally output a string `water heated using electricity:` and `yes` or `no` behind it.
5. Schreiben Sie eine Funktion namens `input_city` mit einer Referenz auf eine C++-Zeichenkette als Parameter ohne Rückgabe.
   Lesen Sie im Rumpf nach einer Eingabeaufforderung `in which city is the household located?` einen Namen für eine Stadt vom Standard-Zeichen-Eingabestrom in die übergebene Referenzvariable ein./
   Write a function called `input_city` with a reference to a C++ string as a parameter without return.
   In the body, after a prompt `in which city is the household located?`, read a name for a city from the standard character input stream into the passed reference variable.
6. Schreiben Sie eine Funktion namens `input_integer` mit einer C++-Zeichenkette als erstem Parameter und einer Referenz auf eine ganze Zahl als zweitem Parameter ohne Rückgabe.
   Im Rumpf soll zuerst die Zeichenkette aus dem ersten Parameter als Eingabeaufforderung auf den Standard-Zeichen-Ausgabestrom geschrieben und danach eine ganze Zahl vom Standard-Zeichen-Eingabestrom in die übergebene Referenzvariable eingelesen werden (siehe Beispiele unten)./
   Write a function called `input_integer` with a C++ string as the first parameter and a reference to an integer as the second parameter without return.
   In the body, first write the string from the first parameter as a prompt to the standard character output stream and then read an integer from the standard character input stream into the passed reference variable (see examples below).
7. Schreiben Sie eine dritte Funktion namens `input_electric_water_heating` mit einer Referenz auf eine Boolesche Variable als Parameter ohne Rückgabe.
   Schreiben Sie im Rumpf eine Eingabeaufforderung `is hot water heated using electricity? (y(es) or n(o))` auf den Standard-Zeichen-Ausgabestrom. Programmieren Sie danach eine geeignete Eingabe vom Standard-Zeichen-Eingabestrom und abhängig davon dem Referenzparameter einen Booleschen Wert zu (siehe Beispiel unten)./
   Write a third function called `input_electric_water_heating` with a reference to a Boolean variable as a parameter with no return.
   In the body, write a prompt `is hot water heated using electricity? (y(es) or n(o))` to the standard character output stream. Then program a suitable input from the standard character input stream and depending on it, assign a Boolean value to the reference parameter (see example below).
8. Ändern Sie Ihre Funktion `main` so ab, dass die vier Werte für die Stadt, die Anzahl Quadratmeter der Wohnfläche, die Anzahl elektrischer Geräte und der Boolesche Wert zur elektrischen Warmwasserbereitung für einen Haushalt über Aufrufe der vorherigen drei Funktionen eingegeben werden.

Löschen Sie die Eingabe für den Preis für eine Kilowattstunde und definieren stattdessen im Rumpf der Schleife über die Anzahl Personen eine weitere innere **`for`**-Schleife, die die Werte `0.3` EUR/kWh, `0.35` EUR/kWh und `0.4` EUR/kWh durchläuft (siehe Beispiel)./
Modify your function **`main`** so that the four values for the city, the number of square metres of living space, the number of electrical devices and the Boolean value for electrical water heating for a household are inputted via calls to the previous three functions.
Delete the input for the price for a kilowatt hour and instead define a further inner **`for`** loop inside the body of the loop for the number of persons, which runs through the values `0.3` EUR/kWh, `0.35` EUR/kWh and `0.4` EUR/kWh (see example).

Beispiel Programmlauf/Example Program Run

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSEHOLD
in which city is the household located? Duisburg
how many square metres does the household have? 120
how many (major) electrical devices does the household have? 8
is hot water heated using electricity? (y(es) or n(o)) y
AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        1
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.3 EUR
annual power consumption:       3230 kWh
annual power costs:             969 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        1
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.35 EUR
annual power consumption:       3230 kWh
annual power costs:             1130.5 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        1
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.4 EUR
annual power consumption:       3230 kWh
annual power costs:             1292 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        2
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.3 EUR
annual power consumption:       3780 kWh
annual power costs:             1134 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        2
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.35 EUR
annual power consumption:       3780 kWh
annual power costs:             1323 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        2
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.4 EUR
annual power consumption:       3780 kWh
annual power costs:             1512 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        3
electrical devices:             8
```

```
water heated using electricity: yes
price for one kWh:              0.3 EUR
annual power consumption:       4330 kWh
annual power costs:             1299 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        3
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.35 EUR
annual power consumption:       4330 kWh
annual power costs:             1515.5 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        3
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.4 EUR
annual power consumption:       4330 kWh
annual power costs:             1732 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        4
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.3 EUR
annual power consumption:       4880 kWh
annual power costs:             1464 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        4
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.35 EUR
annual power consumption:       4880 kWh
annual power costs:             1708 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        4
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.4 EUR
annual power consumption:       4880 kWh
annual power costs:             1952 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        5
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.3 EUR
annual power consumption:       5430 kWh
annual power costs:             1629 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        5
electrical devices:             8
water heated using electricity: yes
```

```
price for one kWh:              0.35 EUR
annual power consumption:       5430 kWh
annual power costs:             1900.5 EUR

AVERAGE POWER COSTS
===================
household in:                   Duisburg
square metres:                  120
persons:                        5
electrical devices:             8
water heated using electricity: yes
price for one kWh:              0.4 EUR
annual power consumption:       5430 kWh
annual power costs:             2172 EUR
```

Zuletzt geändert: Mittwoch, 25. Oktober 2023, 13:47

◄ A1 Upload Teil 1/Part 1

Direkt zu:

A1 Upload Teil 1+2/Upload Part 1+2 ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

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A2 Teil 1: Hausaufgabe zur Vorbereitung auf die Präsenz-Gruppe/Part 1: Homework Task for Preparation of the Presence Group

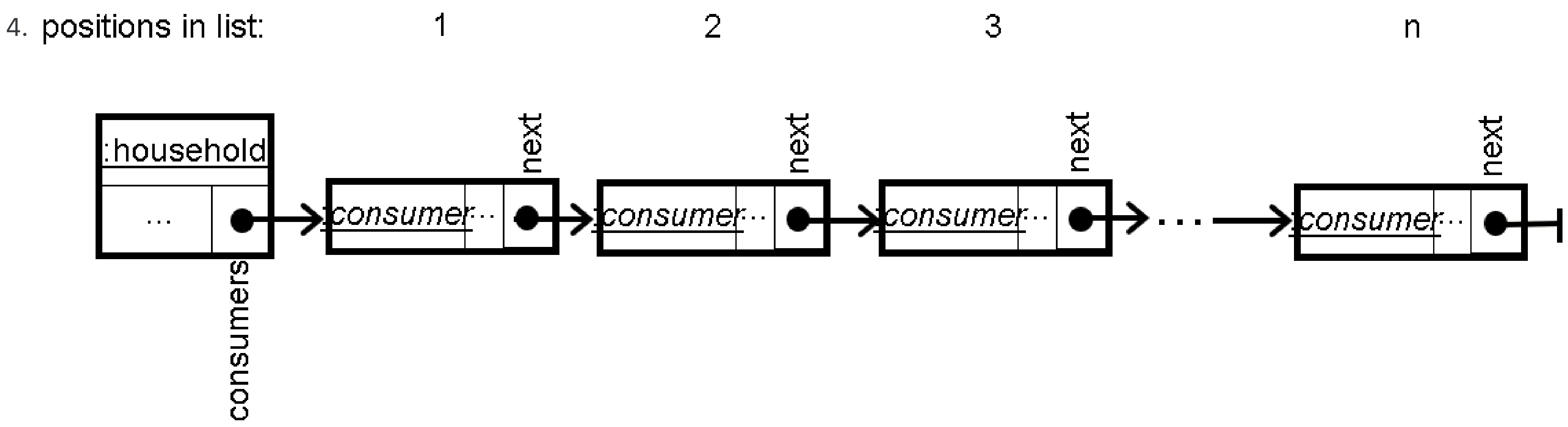
Lernziele: Ein-/Ausgabe-Manipulatoren, C++-Aufzählungen, neue C++ Freispeicherverwaltung via `new` und `delete`, Wiederholung Programmierung mit Zeigern am Beispiel einer einfach verketteten Liste./
Learning objectives: input/output manipulators, C++ enumerations, new free memory management via `new` and `delete`, repetition of programming with pointers using the example of a singly linked list.

In dieser Aufgabe soll die pauschale Berechnung des Stromverbrauchs für elektrische Verbraucher aus der vorherigen Aufgabe A1 weiter detailliert werden./
In this task, the lump sum calculation of power consumption for electrical consumer from the previous task A1 is to be further detailed.

Programmieren Sie im einzelnen:/Program in detail:

1. Definieren Sie eine C++-Aufzählung namens `Use` (Häufigkeit der Benutzung) mit den Aufzählungswerten `once` (einmal), `daily` (täglich), `mo_fr` (montags bis freitags), `sa_su` (samstags und sonntags) und `weekly` (wöchentlich)./
   Define a C++ enumeration called (frequency of) `Use` with the enumeration values `once`, `daily`, `mo_fr` (Monday to Friday), `sa_su` (Saturday and Sunday) and `weekly`.
2. Programmieren Sie eine Funktion namens `input_use`, die eine C++-Zeichenkette und eine Referenz vom obigen Typ `Use` als Parameter hat und keine Rückgabe.
   Im Rumpf soll über ein kleines Auswahlmenü wie im Beispiel unten gezeigt eine Häufigkeit der Benutzung eingegeben werden können und der Referenz im zweiten Parameter der entsprechende Wert aus dem obigen Aufzählungstyp `Use` zugewiesen werden./
   Program a function called `input_use` that has a C++ string and a reference of the above type `Use` as parameters and no return.
   In its body, it should be possible to enter a frequency of use via a short selection menue as shown in the example below and the reference in the second parameter should be assigned the corresponding value from the enumeration type `Use` above.
3. Definieren Sie eine C++-Struktur (also ohne `typedef`) mit Namen `consumer` (Strom-Verbraucher) mit den Komponenten
   - `description`: C++-Zeichenkette für eine Beschreibung des Stromverbrauchers.
   - `watt`: Verbrauchswert des Stromverbrauchers als Gleitpunktzahl in der Einheit Watt.
   - `watt_standby`: Verbrauchswert des Stromverbrauchers im Standyby als Gleitpunktzahl in der Einheit Watt.
   - `hours`: Anzahl der Betriebsstunden des Stromverbrauchers als Gleitpunktzahl.
   - `use`: Häufigkeit der Benutzung des Stromverbrauchers vom obigen Aufzählungstyp `Use`.
   - `next`: Zeiger auf einen nächsten Stromverbraucher in einer Liste von solchen Stromverbrauchern./

   Define a C++ structure (i.e. without `typedef`) called `consumer` with
   - `description`: C++ string for a description of the power consumer.
   - `watt`: consumption value of the power consumer as a floating point number in the unit Watt.
   - `watt_standby`: consumption value of the power consumer in standby mode as floating point number in the unit Watt.
   - `hours`: number of operating hours of the power consumer as a floating point number.
   - `use`: frequency of use of the power consumer of enumeration type `Use` above.
   - `next`: pointer to the next consumer in a list of such power consumers.

4. 

Erweitern Sie die Struktur für einen Haushalt `household` aus Aufgabe A1 um einen Zeiger namens `consumers` vom Strukturtyp `consumer` als Kopf einer Liste von Verbrauchern im Haushalt und löschen dafür die ganzzahlige Komponente für die Anzahl (größerer) elektrischer Geräte im Haushalt./
Extend the structure for a `household` from task A1 by a pointer named `consumers` of structure type `consumer` as head of a list of power consumers of the household and delete the integer component for the number of (larger) power consumers in the household.

5. Programmieren Sie eine Funktion namens `add_consumer_to_household`, die einen Zeiger auf einen Haushalt und einen Zeiger auf einen Verbraucher als Parameter hat und keine Rückgabe.
Fügen Sie im Rumpf der Funktion den Stromverbraucher (zweiter Parameter) der Liste der Verbraucher im Haushalt (erster Parameter) hinzu./
Program a function called `add_consumer_to_household` that has a pointer to a household and a pointer to a consumer as parameters and no return.
In its body, add the power consumer (second parameter) to the list of power consumers in the household (first parameter).
6. Programmieren Sie eine Funktion namens `annual_hours_of_use`, die einen Zeiger auf einen Verbraucher als Parameter hat und eine Gleitpunktzahl als Rückgabe.
Berechnen Sie im Rumpf der Funktion die Anzahl der Stunden im Jahr, die ein Stromverbraucher eingeschaltet ist. Multiplizieren Sie hierfür die Anzahl der Betriebsstunden bei täglichem Einschalten mit 365 (Tagen), bei wöchentlichem Einschalten mit 52 (Wochen), bei Einschalten an Samstagen und Sonntagen mit 104 = 2 * 52 (Wochen). bei Einschalten an Montagen bis Freitagen mit 260 = 5 * 52 (Wochen) und geben jeweils diesen Wert zurück, ansonsten bei einmaligem Einschalten nur die Anzahl der Betriebsstunden selbst (siehe Beispiele unten)./
Program a function called `annual_hours_of_use` that has a pointer to a consumer as a parameter and a floating point number as a return.
In its body, calculate the number of hours in a year a power consumer is switched on. To do this, multiply the number of operating hours by 365 (days) if it is switched on daily, by 52 (weeks) if it is switched on weekly, by 104 = 2 * 52 (weeks) if it is switched on Saturdays and Sundays. by 260 = 5 * 52 (weeks) if it is switched on Mondays to Fridays and return this value in each case, otherwise return only the number of operating hours itself if it is switched on once (see examples below).
7. Programmieren Sie eine Funktion namens `annual_hours_of_standby`, die einen Zeiger auf einen Verbraucher als Parameter hat und eine Gleitpunktzahl als Rückgabe.
Berechnen Sie im Rumpf der Funktion die Anzahl der Standby-Stunden des Verbrauchers im Jahr und geben den Wert zurück. Dieser kann einfach berechnet werden aus der Subtraktion der Anzahl Betriebsstunden im Jahr von den 8760 = 365 * 24 Stunden im Jahr (siehe Beispiele unten)./
Program a function called `annual_hours_of_standby` that has a pointer to a consumer as a parameter and a floating point number as a return.
In its body, calculate the number of standby hours of the consumer in a year and return the value. This can be easily calculated by subtracting the number of operating hours in a year from the 8760 = 365 * 24 hours in a year (see examples below).
8. Programmieren Sie eine Funktion namens `annual_kWh`, die einen Zeiger auf einen Stromverbraucher als Parameter hat und eine Gleitpunktzahl als Rückgabe.
Berechnen Sie im Rumpf der Funktion den Gesamtverbrauch eines Stromverbrauchers im Jahr berechnet aus der Anzahl der Betriebsstunden im Jahr multipliziert mit der Wattzahl des Verbrauchers plus die Anzahl der Standby-Stunden des Verbrauchers im Jahr multipliziert mit der Standby-Wattzahl.
Beachten Sie vor der Rückgabe des Verbrauchswerts die Umrechnung der Wattstunden in Kilowattstunden (siehe Beispiele unten)./
Program a function called `annual_kWh` that has a pointer to a power consumer as a parameter and a floating point number as a return.
In its body, calculate the total consumption of a power consumer in a year calculated from the number of operating hours in the year multiplied by the wattage of the power consumer plus the number of standby hours of the consumer in the year multiplied by the standby wattage.
Before returning the consumption value, note the conversion of watt hours to kilowatt hours (see examples below).
9. Programmieren Sie eine Funktion namens `move_up`, die einen Zeiger auf einen Verbraucher als ersten Parameter, eine ganze Zahl `k` als zweiten Parameter und einen Zeiger auf einen Verbraucher als Rückgabe hat.
Verschieben Sie im Rumpf der Funktion wie im Beispiel unten zu sehen den Verbraucher an Position k in der Liste um eine Position davor in der Liste, also an Position k-1./
Program a function called `move_up` that has a pointer to a consumer as its first parameter, an integer `k` as its second parameter and a pointer to a consumer as its return.
In its body, as shown in the example below, move the consumer at position `k` in the list by one position before it in the list, i.e. at position `k-1`.
10. Definieren Sie am Anfang Ihres Programms eine weitere globale ganzzahlige Konstante zur Angabe einer globalen Spaltenbreite in einer formatierten Ausgabe mit dem Wert 35./
Define another global integer constant at the beginning of your program to specify a global column width in a formatted output with the value 35.
11. Programmieren Sie eine Funktion namens `print_consumer`, die einen Zeiger auf einen Verbraucher als ersten Parameter und eine ganze Zahl als zweiten Parameter hat und keine Rückgabe.
Schreiben Sie im Rumpf der Funktion wie im Beispiel unten zu sehen rechtsbündig mit der zuvor definierten konstanten Spaltenbreite folgende Daten zu diesem Verbraucher auf den Standard-Zeichen-Ausgabestrom:
- die im zweiten Parameter übergebene ganze Zahl und nach einem Doppelpunkt und einem Leerzeichen linksbündig die Beschreibung des Stromverbrauchers.

- rechtsbündig die Zeichenkette `power consumption` und nach einem Doppelpunkt und einem Leerzeichen linksbündig die Wattzahl des Stromverbrauchers gefolgt von dessen Einheit `W` (rufen Sie dei oben definierte Funktion auf).
- rechtsbündig die Zeichenkette `power consumption standby` und nach einem Doppelpunkt und einem Leerzeichen linksbündig die Standby-Wattzahl des Stromverbrauchers gefolgt von dessen Einheit `W` (rufen Sie dei oben definierte Funktion auf).
Hinweis: wer von Ihnen schon einmal MatLab genutzt hat, kennt vermutlich diese Art der Ausgabe der Komponenten von Strukturvariablen./
Program a function called `print_consumer` that has a pointer to a consumer as the first parameter and an integer as the second parameter and no return.
In its body, as shown in the example below, write the following data about this consumer right-justified with the previously defined constant column width on the standard character output stream:
- the integer passed in the second parameter and, after a colon and a space, left-justified the description of the power consumption.
- right-justified the string `power consumption` and after a colon and a space left-justified the wattage of the power consumer followed by its unit `W` (call above defined function for the value).
- right-justified the character string `power consumption standby` and after a colon and a space left-justified the standby wattage of the power consumer followed by its unit `W` (call above defined function for the value).
Note: those of you who have ever used MatLab probably know this way of outputting the components of structure variables.

12. Ändern Sie Ihre Funktion namens `print_household` derart ab, dass Sie statt einer Struktur einen Zeiger auf einen Haushalt als ersten Parameter haben sowie unverändert den Preis für eine Kilowattstunde in EUR als zweiten Parameter und keine Rückgabe.
Ändern Sie im Rumpf der Funktion die Ausgaben wie im Beispiel unten ab, so dass jeweils rechtsbündig mit der oben definierten konstanten Spaltenbreite die jeweiligen Zeichenketten und nach einem Doppelpunkt und einem Leerzeichen linksbündig die entsprechenden Werte auf den Standard-Zeichen-Ausgabestrom geschrieben werden.
Programmieren Sie für die Ausgabe der Liste der Stromverbraucher in dem Haushalt eine Schleife zum Durchlauf der Liste der Stromverbraucher. Rufen Sie für die Ausgabe der einzelnen Verbraucher die Funktion aus der vorherigen Teilaufgabe auf und übergeben eine fortlaufende Nummer jeweils als zweiten Parameter.
Löschen Sie bei der Berechnung des jährlichen Stromverbrauchs und der Kosten die pauschale Berechnung für die (größeren) Elektrogeräte im Haushalt und summieren Sie stattdessen im Rumpf der Schleife mit die Verbräuche und Kosten für jeden einzelnen Verbraucher in der Liste.
Geben Sie die einzelnen Werte auch wie im Beispiel unten zur Kontrolle jeweils mit aus./
Change your function named `print_household` in such a way that instead of a structure you have a pointer to a `household` as the first parameter and unchanged the price for a kilowatt hour in EUR as the second parameter and no return.
In its body, change the outputs as in the example below so that the respective character strings are written right-justified with the constant column width defined above and the corresponding value is written left-justified after a colon and a space onto the standard character output stream.
For the output of the list of power consumers in the household, program a loop to run through the list of power consumers. For the output of the individual consumers, call the function from the previous subtask and pass a consecutive number as the second parameter in each case.
When calculating the annual electricity consumption and costs, note to delete the lump sum calculation for the (larger) power consumers in the household and instead additionally sum up the consumption and costs for each individual consumer in the list in the body of the loop.
Also output the individual values for checking purposes, as in the example below.
13. Ändern Sie die Funktion `main` folgendermassen ab:
- löschen Sie die Strukturvariable für einen haushalt und definieren stattdessen einen Zeiger auf einen Haushalt, der auf eine neue Strukturvariable für einen Haushalt auf dem Heap zeigt,
- lesen dann die Werte eines Teils der Komponenten für diesen Haushalt wie im Beispiel unten ein und
- programmieren Sie ein Menü mit folgenden Funktionalitäten:
   - `q`: Ende des Programms.
   - `i`: Erzeugen eines neuen Verbrauchers auf dem Heap, Eingabe der Daten zu diesem und Einfügen in die Liste der Verbraucher des Haushalts über einen Aufruf der oben definierten Funktion `add_consumer_to_household`.
   Für die Eingabe von `double`-Werten dürfen Sie gern zusätzlich Funktionen wie `input_double` analog zu `input_integer` definieren oder auch `input_power_consumer` o.ä.
   - `u`: Verschieben eines Verbrauchers in der Liste aller Verbraucher um eine Position nach oben über einen Aufruf der oben definierten Funktion `move_up`. Lesen Sie hierzu die Positionsnummer des Verbrauchers in der Liste vom Standard-Zeichen-Eingabestrom ein und übergeben diese als zweiten Parameter an die Funktion.
   - `p`: Ausgabe der Daten für den auf dem Heap gespeicherten Haushalt über einen Aufruf der oben definierten Funktion `print_household`.

Das Beispiel unten zeigt Aufrufe dieser Menü-Funktionalitäten./
Modify your function `main` as follows.
- delete the structure variable for a household and instead define a pointer to a household that points to a new structure variable for a household on the heap.
- then read in the values of some of the components for that household as in the example below and
- program a menu with the following functionalities:
   - `q`: quit program.
   - `i`: create a new consumer on the heap, enter the data for it and add it to the list of consumers of the household via a call to the function `add_consumer_to_household` defined above. For the input of `double` values you may define additional functions like `input_double` analogous to `input_integer` or `input_power_consumer` or similar.
   - `u`: move a consumer up one position in the list of all consumers by calling the function `move_up` defined above. To do this, input the position number of the consumer shown in the list from standard character input stream and pass it as the second parameter to the function.
   - `p`: print the data for the household stored on the heap via a call to the `print_household` function defined above.

The example below shows calls to these menu functionalities.

Beispiel Programmlauf/Example Program Run

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSEHOLD
in which city is the household located? Duisburg
what is the price for one kWh in EUR? 0.3
how many square metres does the household have? 100
how many persons live in this household? 3
is hot water heated using electricity? (y(es) or n(o)) y
q quit
i input power consumer
u move up power consumer
p print household
>> p
H O U S E H O L D   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2550.0 kWh
           total annual power costs: 765.0 EUR

q quit
i input power consumer
u move up power consumer
p print household
>> x
sorry wrong choice
q quit
i input power consumer
u move up power consumer
p print household
>> i
what is the description of the power consumer? Washing-Machine
how many watt it will have? 2000
how many watt standby it will have? 0
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? w
how many hours it will be operating then? 2
q quit
i input power consumer
u move up power consumer
p print household
>> p
H O U S E H O L D   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Washing-Machine
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2758.0 kWh
           total annual power costs: 827.4 EUR

q quit
i input power consumer
u move up power consumer
```

```
p print household
>> i
what is the description of the power consumer? Router
how many watt it will have? 10
how many watt standby it will have? 0
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? d
how many hours it will be operating then? 24
q quit
i input power consumer
u move up power consumer
p print household
>> p
H O U S E H O L D   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Router
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  2: Washing-Machine
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2845.6 kWh
           total annual power costs: 853.7 EUR

q quit
i input power consumer
u move up power consumer
p print household
>> i
what is the description of the power consumer? Office-PC
how many watt it will have? 200
how many watt standby it will have? 0.5
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? m
how many hours it will be operating then? 8.5
q quit
i input power consumer
u move up power consumer
p print household
>> p
H O U S E H O L D   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Office-PC
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
```

```
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  2: Router
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  3: Washing-Machine
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 3290.9 kWh
           total annual power costs: 987.3 EUR

q quit
i input power consumer
u move up power consumer
p print household
>> u
which one? 3
q quit
i input power consumer
u move up power consumer
p print household
>> p
H O U S E H O L D  P O W E R  C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Office-PC
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  2: Washing-Machine
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
                                  3: Router
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 3290.9 kWh
           total annual power costs: 987.3 EUR

q quit
i input power consumer
u move up power consumer
p print household
>> u
which one? 2
```

```
q quit
i input power consumer
u move up power consumer
p print household
>> p
H O U S E H O L D   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Washing-Machine
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
                                  2: Office-PC
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Router
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 3290.9 kWh
           total annual power costs: 987.3 EUR

q quit
i input power consumer
u move up power consumer
p print household
>> q
```

Zuletzt geändert: Dienstag, 31. Oktober 2023, 22:57

◄ A1 Upload Teil 1+2/Upload Part 1+2

Direkt zu:

A2 Upload Teil 1/Part 1 ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

A2 Teil 2: Präsenzaufgabe/Part 2: Presence Task

In Teil 2 der Aufgabe soll eine Erweiterung von einem auf mehrere Haushalte in einem Haus programmiert werden, für die die Stromkosten berechnet werden. Erweitern Sie Ihren C++-Kode aus Teil 1 bis zum Ende dieser Gruppenstunde folgendermassen:/
In part 2 of the task, an extension is to be made from one to several households in a house for which the power costs are calculated. Extend your C++ code from part 1 until the end of this group hour as follows:

1. Fügen Sie in der Funktion `print_consumer` in runden Klammern die Ausgabe der Adresse der ersten Komponente der Struktur `consumer` hinter einer Zeichenkette `at address:` hinzu (siehe Beispiel unten)./
   In function `print_consumer`, add the output of the address of the first component of the structure `consumer` in round brackets after a character string `at address:` (see example below).
2. Erweitern Sie die Funktion `print_household` um einen ganzzahligen Parameter mit der Nummer eines Haushalts und geben diese wie im Beispiel unten in der Ausgabeüberschrift für einen Haushalt mit aus.
   Geben Sie ebenfalls mit in runden Klammern die Adresse der ersten Komponente der Struktur `household` hinter einer Zeichenkette `at address:` aus (siehe Beispiel unten)./
   Extend function `print_household` with an integer parameter with the number of a household and output this as in the example below in the output header line for a household.
   Also within round brackets output the address of the first component of the structure household after a character string `at address:` (see example below).
3. Programmieren Sie eine Funktion namens `input_household` mit einem Zeiger auf einen Haushalt als Parameter und ohne Rückgabe.
   Statt in der Funktion `main` lesen Sie jetzt hier im Rumpf die Anzahl der Quadratmeter des Haushalts und die Anzahl der Personen in diesem ein sowie, ob Warmwasser elektrisch bereitet wird oder nicht. Setzen Sie den Kopf der Liste der Verbraucher auf einen Nullzeiger./
   Program a function called `input_household` with a pointer to a household as a parameter and without a return.
   Instead of in function `main`, in its body read the number of square metres of the household and the number of people as well as whether hot water is produced electrically or not. Set the header of the list of consumers to a null pointer.
4. Programmieren Sie eine Funktion namens `copy_consumers` mit zwei Zeiger-Parametern auf jeweils einen Haushalt und einen Zeiger auf einen Haushalt als Rückgabe.
   Fügen Sie im Rumpf der Funktion Kopien aller Stromverbraucher aus der Liste des Haushalts, aus dem kopiert wird, am Anfang der Liste der Stromverbraucher des Haushalts ein, in den kopiert wird (siehe Beispiele unten; bei der Ausgabe der beiden Haushalte müssen Sie danach jeweils andere Adressen sehen, und via move up kann jede Liste unterschiedliche Reihenfolgen der Stromverbraucher bekommen).
   Hinweis: es ist hilfreich, jeweils zwei Zeiger auf die beiden Listenköpfe und zwei weitere Zeiger zum parallelen Durchlauf der zu kopierenden und der neu zu erstellenden Liste zu haben./
   Program a function called `copy_consumers` with two pointer parameters to a household each and a pointer to a household as return.
   In the body of the function, insert copies of all power consumers from the list of the household from which you are copying at the head of the list of power consumers of the household to which you are copying (see examples below; when outputting the two households, you must see different addresses in each case, and via move up each list of power consumers can have different sequences).
   Note: it is helpful to have two pointers to each of the two list headers and two additional pointers for parallel iteration through the to copy and the newly to build up list.
5. Funktion `main`:/Function `main`:
   - Geben Sie nach einer geänderten ersten Ausgabezeile wie unten im Beispiel zu sehen eine Anzahl `n` von Haushalten in einem Haus ein, die Stadt, in der das Haus liegt, und den Preis für eine kWh wie zuvor. Definieren Sie zuvor zusätzliche lokale Variable in `main` für obige Werte sowie ein Feld von Zeigern der Länge `n` vom Typ `household` initialisiert mit Nullzeigern./
     After a modified first output line like shown in the example below, enter the number `n` of households in a house, the city in which the house is located, and the price for one kWh as before. Before, define additional local variables in `main` for the above values as well as an array of pointers of type `household` having length `n` initialised with null pointers.
   - Erweitern Sie die Funktionalität in den existierenden Menüpunkten jeweils um eine Abfrage, für welchen der Haushalte im Feld diese ausgeführt werden soll (siehe Beispiel unten)./
     Extend the functionality in the existing menu items to include a query for which of the households in the array this shall be executed (see example below).
   - Erweitern Sie Ihr Menü um folgende drei Menüpunkte:/
     Extend your menu by following three menu entries:

1. `a` Ausgabe aller Haushalte im Feld/print all households

   Rufen Sie, sofern diese keine Nullzeiger sind, innerhalb einer geeignet definierten Schleife jeweils die Funktion `print_household` auf./

   If these are not null pointers, call function `print_household` inside a suitably defined loop.
2. `n` neuer Haushalt/new household

   Geben Sie eine Fehlermeldung aus, wenn der Haushalt bereits existiert, erzeugen Sie ansonsten eine neue Strukturvariable auf dem Heap, weisen diesem neuen Haushalt die anfangs eingelesene Stadt zu und rufen obige Funktion `input_household` geeignet auf (siehe Beispiel unten)./

   Write an error message if the household already exists, otherwise create a new structure variable on the heap, assign the initially read city to this new household and call above function `input_household` appropriately (see example below).
3. `c` Kopie aller Verbraucher/copy all consumers

   Lesen Sie ein, von welchem Haushalt die Liste von Stromverbrauchern in welchen anderen kopiert werden soll; überprüfen Sie zuvor, dass beide Haushalte existieren, und rufen dann obige Funktion `copy_consumers` geeignet auf (siehe Beispiel unten)./

   Input from which household the list of power consumers to which other shall be copied, check that both households exist, and then call above function `copy_consumers` appropriately (see example below).

Laden Sie Ihren abgenommenen Programmkode in Moodle hoch./
Upload your accepted program code in Moodle

Beispiel Programmlauf/Example Program Run

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE
how many households does the house have? 6
in which city the house is located? Duisburg
what is the price for one kWh in EUR? 0.3
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> a
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> n
number of household? 2
how many square metres does the household have? 100
how many persons live in this household? 3
is hot water heated using electricity? (y(es) or n(o)) y
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> a
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd817b0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2550.0 kWh
           total annual power costs: 765.0 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> i
number of household? 2
what is the description of the power consumer? Washing-Machine
how many watt it will have? 2000
how many watt standby it will have? 0
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? w
how many hours it will be operating then? 2
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> p
number of household? 2
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
```

```
                               city: Duisburg (at address: 0xd817b0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Washing-Machine (at address: 0xd81a10)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2758.0 kWh
           total annual power costs: 827.4 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> n
number of household? 5
how many square metres does the household have? 50
how many persons live in this household? 2
is hot water heated using electricity? (y(es) or n(o)) n
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> a
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd817b0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Washing-Machine (at address: 0xd81a10)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2758.0 kWh
           total annual power costs: 827.4 EUR

H O U S E H O L D   N O   5   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd863f0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 50 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 850.0 kWh
           total annual power costs: 255.0 EUR

q quit
```

```
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> i
number of household? 5
what is the description of the power consumer? Router
how many watt it will have? 10
how many watt standby it will have? 0
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? d
how many hours it will be operating then? 24
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> a
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd817b0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Washing-Machine (at address: 0xd81a10)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2758.0 kWh
           total annual power costs: 827.4 EUR

H O U S E H O L D   N O   5   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd863f0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 50 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Router (at address: 0xd81a60)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 937.6 kWh
           total annual power costs: 281.3 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
```

```
>> i
number of household? 5
what is the description of the power consumer? Office-PC
how many watt it will have? 200
how many watt standby it will have? 0.5
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? m
how many hours it will be operating then? 8.5
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> a
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd817b0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Washing-Machine (at address: 0xd81a10)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2758.0 kWh
           total annual power costs: 827.4 EUR

H O U S E H O L D   N O   5   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd863f0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 50 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Office-PC (at address: 0xd85cb0)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  2: Router (at address: 0xd81a60)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1382.9 kWh
           total annual power costs: 414.9 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
```

```
>> c
number of household from which to copy consumers? 5
number of household to copy to? 2
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> a
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd817b0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Office-PC (at address: 0xd85d00)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  2: Router (at address: 0xd85d50)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  3: Washing-Machine (at address: 0xd81a10)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 3290.9 kWh
           total annual power costs: 987.3 EUR

H O U S E H O L D   N O   5   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd863f0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 50 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Office-PC (at address: 0xd85cb0)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  2: Router (at address: 0xd81a60)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1382.9 kWh
           total annual power costs: 414.9 EUR

q quit
```

```
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> u
number of household? 2
which one? 3
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>> a
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd817b0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Office-PC (at address: 0xd85d00)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  2: Washing-Machine (at address: 0xd81a10)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
                                  3: Router (at address: 0xd85d50)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 3290.9 kWh
           total annual power costs: 987.3 EUR

H O U S E H O L D   N O   5   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Duisburg (at address: 0xd863f0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 50 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Office-PC (at address: 0xd85cb0)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  2: Router (at address: 0xd81a60)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
```

```
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1382.9 kWh
           total annual power costs: 414.9 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
>>
```

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◄ A2 Upload Teil 1/Part 1

Direkt zu:

A2 Upload Teil 1+2/Upload Part 1+2 ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

Dashboard / Meine Kurse / Wintersemester 2023/2024 / Ingenieurwissenschaften / Informatik und Angewandte Kognitionswissenschaften / Praktikum OOP in C++ WS 2023/2024 / Aufgabe 3/Task 3 / A3 Teil 1: Hausaufgabe zur Vorbereitung auf die Präsenz-Gruppe/Part 1: Homework Task for Preparation of the Presence Group

A3 Teil 1: Hausaufgabe zur Vorbereitung auf die Präsenz-Gruppe/Part 1: Homework Task for Preparation of the Presence Group

Lernziele: inline-Funktionen, überladene Funktionen, überladene Operatoren./
Learning objectives: inline functions, overloaded functions, overloaded operators.

In dieser Aufgabe soll eine individuelle Berechnung des Stromverbrauchs für elektrische Verbraucher vorbereitet werden, die pauschale Berechnungen ersetzen kann. Die kleinste Zeiteinheit, in welcher der Verbrauch von Strom von Kunden und die Lieferung durch den Versorger überwacht und gehandelt werden, ist die Viertelstunde. Wie im Strommarkt in Deutschland soll deshalb in dieser Aufgabe der Verbrauch über das gesamte Jahr in Viertelstunden-Intervallen bearbeitet werden können./
In this task, an individual calculation of power consumption for power consumers is to be prepared, which can replace flat-rate calculations. The smallest unit of time in which the consumption of power by customers and the supply by the supplier are monitored and traded is the quarter of an hour. As in the electricity market in Germany, it should therefore be possible in this task to process consumption over the entire year in quarter-hour intervals.

1. Erweitern Sie die C++-Aufzählung namens `Use` (Häufigkeit der Benutzung) um die Werte `monday`, `tuesday`, `wednesday`, `thursday`, `friday`, `saturday` und `sunday`, belassen Sie diesen folgend die Aufzählungswerte `once` (einmal), `daily` (täglich), `mo_fr` (montags bis freitags) und `sa_su` (samstags und sonntags) und löschen Sie `weekly` (wöchentlich)./
   Add the values `monday`, `tuesday`, `wednesday`, `thursday`, `friday`, `saturday` and `sunday` to the C++ enumeration called `Use`, leave the enumeration values `once`, `daily`, `mo_fr` (Monday to Friday) and `sa_su` (Saturday and Sunday) and delete `weekly`.
2. Programmieren Sie einen überladenen binären Ausgabe-Operator `<<` für die Aufzählungswerte von `Use`, der obiger Reihenfolge entsprechend `Monday`, `Tuesday`, `Wednesday`, `Thursday`, `Friday`, `Saturday`, `Sunday`, `once`, `daily`, `Monday to Friday` beziehungsweise `Saturday and Sunday` auf den im ersten Parameter übergebenen Ausgabestrom schreibt./
   Program an overloaded binary output operator `<<` for the enumeration values of `Use`, which writes `Monday`, `Tuesday`, `Wednesday`, `Thursday`, `Friday`, `Saturday`, `Sunday`, `once`, `daily`, `Monday to Friday` or `Saturday and Sunday` to the output stream passed in the first parameter according to the above sequence of enumeration values.
3. Programmieren Sie einen überladenen unären Operator `++` für die Aufzählungswerte von `Use`, der den Wochentag inkrementiert, also `tuesday` für den Parameterwert `monday` zurück liefert, `wednesday` für den Parameterwert `tuesday`, ..., `sunday` für den Parameterwert `saturday`, `monday` für den Parameterwert `sunday`, und für `once`, `daily`, `mo_fr`, `once` und `sa_su` den gleichen Wert./
   Program an overloaded unary operator `++` for the enumeration values of `Use`, which increments the day of the week, i.e. returns `tuesday` for the parameter value `monday`, `wednesday` for the parameter value `tuesday`, ..., `sunday` for the parameter value `saturday`, `monday` for the parameter value `sunday`, and the same value for `once`, `daily`, `mo_fr`, `once` and `sa_su`.
4. Ändern Sie Ihre Funktion `input_use` passend auf alle obigen Aufzählungswerte ab (siehe auch Beispiele unten)./
   Modify your function `input_use` fitting to all above enumeration values (see also examples below).
5. Definieren Sie zwei weitere globale ganzzahlige konstante Variable mit den Werten `365` für die Anzahl Tage in einem Jahr (10 bei ersten Tests, siehe Hinweise und Programmlauf 1 unten) und `96` = 24 * 4 für die Anzahl Viertelstunden-Intervalle an einem Tag./
   Define two further global integer constant variables with the values `365` for the number of days in a year (10 for the first tests, see notes and program run 1 below) and `96` = 24 * 4 for the number of quarter-hour intervals in a day.

6.

	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00		22:45	23:00	23:15	23:30	23:45
quarter	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	…	[91]	[92]	[93]	[94]	[95]
[0]	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	…	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
[1]	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	…	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
[2]	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	…	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
[3]	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	…	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		⋮	⋮	⋮	⋮	⋮
[362]	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	…	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
[363]	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	…	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
[364]	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	…	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**

Definieren Sie eine Struktur mit Namen `year` (Jahr) mit folgenden Komponenten:

- ganzzahliger Wert für die Jahreszahl.
- Aufzählungswert vom obigen Typ `Use` für den ersten Wochentag im Jahr.
- C++-Zeichenkette für die Einheit der Werte gespeichert im Feld dieser Struktur.
- zweidimensionales Feld von Gleitpunktzahlen mit der Anzahl Zeilen für die Tage im Jahr gegeben über die erste in der vorherigen Teilaufgabe definierten Konstante und der Anzahl Spalten für die Viertelstunden-Intervalle gegeben über die zweite obige Konstante./

Define a structure called `year` with the following components:

- integer value for the year itself.
- enumeration value of the above type `Use` for the first day of the week in the year..
- C++ string for the unit of the values stored in the array of this structure.
- two-dimensional array of floating point numbers with the number of rows for the days given by the first constant defined in the previous subtask and the number of columns for the quarter-hour intervals given by the second constant above.

7. Programmieren Sie eine `inline` Funktion namens `zeros` (Nullen), die eine Referenzvariable vom Strukturtyp `year` als Operanden hat und eine Referenz vom Strukturtyp `year` zurück gibt.

   Setzen Sie im Rumpf alle Viertelstunden-Intervallwerte auf `0.0` und geben danach die Referenzvariable als Funktionswert zurück./

   Program an `inline` function called `zeros`, which has a reference variable of structure type `year` as operand and returns a reference of structure type `year`.

   In the body, set all quarter-hour interval values to `0.0` and then return the reference variable as function value.

8. Programmieren Sie eine `inline` Funktion namens `time` (Uhrzeit), die zwei ganzzahlige Werte für die Stunde `h` als ersten und für die Minute `m` als zweiten Parameter hat und eine ganzzahlige Rückgabe.

   Berechnen Sie im Rumpf die Minute des Tages (`h * 60 + m`) und geben diese als Funktionswert zurück, also bspw. 795 = 13 * 60 + 15 für 13:15 Uhr./

   Program an `inline` function called `time`, which has two integer values for the hour `h` as first parameter and for the minute `m` as second parameter and an integer return.

   Calculate the minute of the day (h * 60 + m) in the body and return this as a function value, e.g. 795 = 13 * 60 + 15 for 13:15 o'clock.

9. Programmieren Sie einen überladenen binären Ausgabe-Operator **<<** für eine Referenzvariable vom Strukturtyp `year`.

   Schreiben Sie im Rumpf zuerst `year:` und die Jahreszahl aus der Struktur auf den im ersten Parameter übergebenen Ausgabestrom. Schreiben Sie danach zeilenweise für jeden Tag im Jahr die Nummer des Tags und den Wochentag auf den Ausgabstrom, die Uhrzeiten aller vollen Stunden und die jeweils vier gespeicherten Viertelstundenwerte (siehe Beispiele unten).

   Verwenden Sie für die Ausgabe des jeweiligen Wochentags und die Berechnung des nächsten Wochentags den oben definierten Ausgabe-Operator **<<** und den Inkrement-Operator **++**./

   Program an overloaded binary output operator **<<** for a reference variable of structure type `year`.

   In the body, first write `year:` and the strucure's year onto the output stream passed in the first parameter. Then line by line write the number of the day and the day of the week for each day of the year onto teh output stream, the full hours clock time with following four stored quarter-hour values (see examples below).

   Use the output operator **<<** defined above and the increment operator **++** to output the respective day of the week and to calculate the next day of the week.

10. Programmieren Sie einen überladenen binären Additions-Operator **+** für zwei Referenzvariable vom Strukturtyp `year` als Operanden, der eine Variable vom Strukturtyp `year` zurück gibt.

    Überprüfen Sie zuerst im Rumpf, dass die Jahreszahlen, der erste Wochentag im Jahr und die Einheiten der Operanden übereinstimmen. Initialisieren Sie danach eine neue Variable vom Strukturtyp `year`, addieren für diese elementweise alle Viertelstundenwerte und geben diese Variable zurück./

    Program an overloaded binary addition operator **+** for two reference variables of structure type `year` as operands, which returns a variable of structure type `year`.

    In the body, first check that the number of the year, the first day of the week in the year and the units of the operands match.

    Then initialise a new variable of structure type `year`, add for this all quarter-hour values element by element and return this variable.

11. Programmieren Sie eine überladene Funktion namens `add_consumption`, die eine Referenz vom Strukturtyp `year` als ersten Parameter hat, drei ganzzahlige Werte für einen bestimmten Tag im Jahr (also `once` (einmalig)), zwei Minutenwerte für diesen Tag von wann bis wann der

Stromverbraucher an diesem Tag bei welcher Wattzahl (übergeben in einem fünften Parameter als Gleitpunktzahl) zum Verbrauch in dem Feld hinzu addiert werden soll. Die Funktion soll keine Rückgabe haben und im Rumpf für jede Verbrauchsminute den entsprechend berechneten Viertelstundenwert erhöhen.
Hinweis: das jeweilige Viertelstunden-Intervall können Sie als Ganzzahlanteil der Division der Tagesminute durch 15 Minuten berechnen und die minütliche Wattzahl durch Division des Verbrauchswerts durch 60 Minuten./
Program an overloaded function called `add_consumption`, which has a reference of the structure type `year` as the first parameter, three integer values for a certain day in the year (i.e. `once`), two minute values for this day from when to when the power consumer on this day is to be added to the consumption in the array at which wattage (passed in the fifth parameter as a floating point number). The function should have no return and increase the corresponding calculated quarter-hour value in the body for each minute of consumption.
Note: the respective quarter-hour interval can be obtained as the integer part of the division of the minute value of the day by 15 minutes and the wattage per minute by dividing the consumption value by 60 minutes.

12. Programmieren Sie eine weitere überladene Funktion namens `add_consumption`, die als einzigen Unterschied zur vorherigen Funktion eine Variable vom Aufzählungstyp `Use` als zweiten Parameter hat und keine Rückgabe.
    Im Rumpf soll dann statt nur an einem bestimmten Tag wie in der Teilaufgabe zuvor täglich, montags bis freitags, samstags und sonntags oder an allen Wochentagen im kompletten Jahr der jeweilige Verbrauch in den angegebenen Zeiten von-bis bei den Viertelstundenwerten addiert werden (siehe Beispiele unten)./
    Program another overloaded function called `add_consumption`, which as the only difference to the previous function has a variable of the enumeration type `Use` as its second parameter and no return.
    In the body, the respective consumption in the specified time interval from-to should then be added to the quarter-hour values instead of just on one certain day as in the subtask before regarding daily, Mondays to Fridays, Saturdays and Sundays or all weekdays in the entire year (see examples below).
13. Programmieren Sie eine `inline` Funktion namens `sum` (Summe), die eine Referenzvariable vom Strukturtyp `year` als Operanden hat und eine Gleitpunktzahl zurück gibt.
    Summieren Sie im Rumpf alle Viertelstunde-Intervallwerte des gesamten Jahres auf und geben den Summenwert zurück./
    Program an `inline` function called `sum`, which has a reference variable of structure type `year` as operand and returns a floating point number.
    Sum up all quarter-hour interval values of the whole year in the body and return the sum value.
14. Schreiben Sie eine `main`-Funktion, in der die oben definierten Funktionalitäten getestet werden können.
    Definieren Sie hierzu neben allen weiteren von Ihnen benötigten Variablen zwei Strukturvariable namens `actual` und `total` vom Typ `year` und initialisieren diese mit der Jahreszahl `2024`, `Montag` als erstem Tag im Jahr, der Einheit `Watt` und Nullen für alle Viertelstunden-Intervallwerte.
    Initialisieren Sie als Preis für eine kWh Strom `30` ct/kWh wie in den Aufgaben A1 und A2 zuvor.
    Implementieren Sie dann ein kleines Menü wie in den Beispielen unten und rufen in den Menüpunkten jeweils die oben definierten Operatoren und Funktionen auf:
    - `a` hier ist nur `total = total + actual;` auszuführen.
    - `c` rufen Sie jeweils mit `actual` und auch mit `total` als Parameter Ihre Funktion `sum` auf und geben die Summenwerte für den Jahres-Stromverbrauch sowie die mit dem kWh-Preis multiplizierten Kosten aus (Hinweis: rechnen Sie hierzu Watt in Kilowatt um).
    - `o` hier ist nur `cout << actual;` aufzurufen.
    - `t` hier ist nur `cout << total;` aufzurufen.
    - `u` rufen Sie je nach Eingabe passend zur Nutzungsfrequenz und der weiteren Werte eine der beiden überladenen Funktionen `add_consumption` auf.
    - `z` rufen Sie Ihre Funktion `zeros` für `actual` auf./

    Write a function `main` in which the functionalities defined above can be tested.
    In addition to all the other variables you need, define two structure variables named `actual` and `total` of type year and initialise them with the year `2024`, `Monday` as the first day of the year, the unit `Watt` and zeros for all quarter-hour interval values.
    Initialise a price of 30 ct/kWh for one kWh of power as in tasks A1 and A2 above.
    Then implement a small menu as in the examples below and call the operators and functions defined above in the menu items:
    - `a` here only `total = total + actual;` is to be executed.
    - `c` call your function `sum` with `actual` and also with `total` as parameter and output the total values for the annual power consumption and the costs multiplied by the kWh price (note: convert watts to kilowatts for this)..
    - `o` here only `cout << actual;` is to be called.
    - `t` here only `cout << total;` is to be called.
    - `u` call one of the two overloaded functions `add_consumption` fitting to the inputted frequency of use and the other inputted values.
    - `z` call your function `zeros` for `actual`.

Wichtige Hinweise
Gehen Sie bei der Entwicklung am besten schrittweise vor - schreiben Ihr Programm und Menü erst einmal mit nur einer einfachen Funktionalität, und erweitern dieses dann schrittweise.
Da die Anzahl der Viertelstundenwerte in einem Jahr recht groß ist und die Ausgabe dafür sowohl lang und unübersichtlich wird als auch zeitlich länger dauert, entwickeln und testen Sie Ihr Programm zunächst mit einem kleineren Wert für die Tage in einem Jahr (bspw. 10 bei ersten Tests) und auch einem kleineren Wert für die Viertelstundenwerte eines Tages (bspw. 12 bei ersten Tests; Uhrzeit nur bis 03:00 Uhr) - siehe Programmlauf 1.
Vergleichen Sie erst nach ausreichendem Testen Ihrer Funktionalität danach bei 365 Tagen im Jahr mit jeweils 96 Viertelstundenwerten die berechneten Summenwerte für den Jahresverbrauch und die Jahres-Stromkosten mit den pauschal berechneten Werten für eine Waschmaschine, einen Router und einen Office-PC aus Aufgabe A2 - siehe Programmlauf 2 (während Waschmaschine und Router gleiche Jahres-Verbrauchswerte und Stromkosten ergeben, zeigen sich kleine Rundungsfehler beim Office-PC mit Betriebs- und Standbyzeiten)./
Important notes

It is best to proceed step by step during development - write your program and menu with only one simple functionality at first, and then extend it step by step.
As the number of quarter-hour values in a year is quite large and the output is both long and confusing and takes longer, first develop and test your program with a smaller value for the days in a year (e.g. 10 for initial tests) and also a smaller value for the quarter-hour values of a day (e.g. 12 for initial tests; only time until 03:00 o'clock) - see program run 1.
Only after sufficiently testing your functionality, compare the calculated total values for the annual consumption and the annual power costs for 365 days a year, each with 96 quarter-hour values, with the flat-rate calculated values for a washing machine, a router and an office PC from task A2 - see program run 2 (while the washing machine and router result in the same annual consumption values and power costs, small rounding errors occur for the office PC with operating and standby times).

Beispiel Programmlauf 1 für 10 Tage und 12 Viertelstundenwerte/Example Program Run 1 for 10 days and 12 quarter hours

```
YEARLY CONSUMPTION QUARTER HOUR
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> o
year: 2024
day 0: Monday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 1: Tuesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 2: Wednesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 3: Thursday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 4: Friday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 5: Saturday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 6: Sunday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 7: Monday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 8: Tuesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 9: Wednesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> t
year: 2024
day 0: Monday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 1: Tuesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 2: Wednesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 3: Thursday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 4: Friday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 5: Saturday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 6: Sunday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 7: Monday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 8: Tuesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 9: Wednesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
d
from hour:minute? 00:20
to hour:minute? 01:37
how many watt it will have? 60
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> o
year: 2024
day 0: Monday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 1: Tuesday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 2: Wednesday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 3: Thursday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 4: Friday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 5: Saturday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 6: Sunday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 7: Monday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 8: Tuesday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 9: Wednesday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 770.00 Watt (costs: 0.23 EUR)
sum total = 0.00 Watt (costs: 0.00 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> a
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 770.00 Watt (costs: 0.23 EUR)
sum total = 770.00 Watt (costs: 0.23 EUR)
q quit
a add actual to total (using operator +)
```

```
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> z
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 0.00 Watt (costs: 0.00 EUR)
sum total = 770.00 Watt (costs: 0.23 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
1
from hour:minute? 01:50
to hour:minute? 02:33
how many watt it will have? 100
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> o
year: 2024
day 0: Monday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 1: Tuesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 2: Wednesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 3: Thursday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 4: Friday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 5: Saturday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00
```

```
day 6: Sunday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 7: Monday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 8: Tuesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 9: Wednesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 143.33 Watt (costs: 0.04 EUR)
sum total = 770.00 Watt (costs: 0.23 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
3
from hour:minute? 00:00
to hour:minute? 00:16
how many watt it will have? 240
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> o
year: 2024
day 0: Monday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 1: Tuesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 2: Wednesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 3: Thursday
 0:00      60.00       4.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 4: Friday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 5: Saturday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 6: Sunday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 7: Monday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 8: Tuesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 9: Wednesday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
m
from hour:minute? 00:30
to hour:minute? 01:15
how many watt it will have? 60
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> o
year: 2024
day 0: Monday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 1: Tuesday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 2: Wednesday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 3: Thursday
 0:00      60.00       4.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 4: Friday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 5: Saturday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 6: Sunday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 7: Monday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 8: Tuesday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 9: Wednesday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 567.33 Watt (costs: 0.17 EUR)
sum total = 770.00 Watt (costs: 0.23 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> a
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 567.33 Watt (costs: 0.17 EUR)
sum total = 1337.33 Watt (costs: 0.40 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
```

```
>> t
year: 2024
day 0: Monday
 0:00       0.00      10.00      30.00      30.00
 1:00      30.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 1: Tuesday
 0:00       0.00      10.00      30.00      30.00
 1:00      30.00      15.00       7.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 2: Wednesday
 0:00       0.00      10.00      30.00      30.00
 1:00      30.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 3: Thursday
 0:00      60.00      14.00      30.00      30.00
 1:00      30.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 4: Friday
 0:00       0.00      10.00      30.00      30.00
 1:00      30.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 5: Saturday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 6: Sunday
 0:00       0.00      10.00      15.00      15.00
 1:00      15.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 7: Monday
 0:00       0.00      10.00      30.00      30.00
 1:00      30.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 8: Tuesday
 0:00       0.00      10.00      30.00      30.00
 1:00      30.00      15.00       7.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 9: Wednesday
 0:00       0.00      10.00      30.00      30.00
 1:00      30.00      15.00       7.00       0.00
 2:00       0.00       0.00       0.00       0.00

q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
o
on which day? 6
from hour:minute? 01:05
to hour:minute? 01:31
how many watt it will have? 12000
q quit
```

```
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> o
year: 2024
day 0: Monday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 1: Tuesday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 2: Wednesday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 3: Thursday
 0:00      60.00       4.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 4: Friday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 5: Saturday
 0:00       0.00       0.00       0.00       0.00
 1:00       0.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 6: Sunday
 0:00       0.00       0.00       0.00       0.00
 1:00    2000.00    3000.00     200.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 7: Monday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

day 8: Tuesday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00      16.67
 2:00      25.00      25.00       5.00       0.00

day 9: Wednesday
 0:00       0.00       0.00      15.00      15.00
 1:00      15.00       0.00       0.00       0.00
 2:00       0.00       0.00       0.00       0.00

q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 5767.33 Watt (costs: 1.73 EUR)
sum total = 1337.33 Watt (costs: 0.40 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>>
```

Beispiel Programmlauf 2 für 365 Tage und 96 Viertelstundenwerte/Example Program Run 2 for 365 days and 96 quarter hours

```
YEARLY CONSUMPTION QUARTER HOUR
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 0.00 Watt (costs: 0.00 EUR)
sum total = 0.00 Watt (costs: 0.00 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
d
from hour:minute? 00:00
to hour:minute? 24:00
how many watt it will have? 10
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 87600.00 Watt (costs: 26.28 EUR)
sum total = 0.00 Watt (costs: 0.00 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> a
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 87600.00 Watt (costs: 26.28 EUR)
sum total = 87600.00 Watt (costs: 26.28 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> z
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
```

```
z set actual to zeros (call function zeros)
>> c
sum actual = 0.00 Watt (costs: 0.00 EUR)
sum total = 87600.00 Watt (costs: 26.28 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
5
from hour:minute? 09:00
to hour:minute? 11:00
how many watt it will have? 2000
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 208000.00 Watt (costs: 62.40 EUR)
sum total = 87600.00 Watt (costs: 26.28 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> a
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 208000.00 Watt (costs: 62.40 EUR)
sum total = 295600.00 Watt (costs: 88.68 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> z
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 0.00 Watt (costs: 0.00 EUR)
sum total = 295600.00 Watt (costs: 88.68 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
```

```
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
m
from hour:minute? 08:30
to hour:minute? 17:00
how many watt it will have? 200
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 443700.00 Watt (costs: 133.11 EUR)
sum total = 295600.00 Watt (costs: 88.68 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
m
from hour:minute? 00:00
to hour:minute? 08:30
how many watt it will have? 0.5
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 444809.25 Watt (costs: 133.44 EUR)
sum total = 295600.00 Watt (costs: 88.68 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> u
how often it will be used?
Monday    (0)
Tuesday   (1)
Wednesday (2)
Thursday  (3)
```

```
Friday    (4)
Saturday  (5)
Sunday    (6)
daily     (d)
mo_fr     (m)
once      (o)
sa_su     (s)?
m
from hour:minute? 17:00
to hour:minute? 24:00
how many watt it will have? 0.5
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 445722.75 Watt (costs: 133.72 EUR)
sum total = 295600.00 Watt (costs: 88.68 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> a
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>> c
sum actual = 445722.75 Watt (costs: 133.72 EUR)
sum total = 741322.75 Watt (costs: 222.40 EUR)
q quit
a add actual to total (using operator +)
c annual consumption and cost (price for one kWh: 30.00 ct/kWh; calling function sum)
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
z set actual to zeros (call function zeros)
>>
```

Zuletzt geändert: Freitag, 3. November 2023, 21:21

◄ A2 Upload Teil 1+2/Upload Part 1+2

Direkt zu:

A3 Upload Teil 1/Part 1 ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

Dashboard / Meine Kurse / Wintersemester 2023/2024 / Ingenieurwissenschaften / Informatik und Angewandte Kognitionswissenschaften / Praktikum OOP in C++ WS 2023/2024 / Aufgabe 3/Task 3 / A3 Teil 2: Präsenzaufgabe/Part 2: Presence Task

A3 Teil 2: Präsenzaufgabe/Part 2: Presence Task

Erweitern Sie Ihren C++-Kode aus Teil 1 bis zum Ende dieser Gruppenstunde folgendermassen:/
Extend your C++ code from part 1 until the end of this group hour as follows:

1. Erweitern Sie den Ausgabeoperator für Daten vom Strukturtyp `year` um die Ausgabe der Zeichenkette `unit:` und der Einheit dahinter zusammen in runden Klammern./
   Extend the output operator for data of the structure type `year` to include the output of string `unit:` and the unit behind it together in round brackets.
2. Programmieren Sie eine `inline` Funktion namens `ones` (Einsen), die eine Referenzvariable vom Strukturtyp `year` als Operanden hat und eine Referenz vom Strukturtyp `year` zurück gibt.
   Setzen Sie im Rumpf alle Viertelstunden-Intervallwerte auf `1.0` und geben danach die Referenzvariable als Funktionswert zurück./
   Program an `inline` function called `ones`, which has a reference variable of structure type `year` as operand and returns a reference of structure type `year`.
   In the body, set all quarter-hour interval values to `1.0` and return the reference variable as function value.
3. Programmieren Sie einen überladenen binären Subtraktions-Operator `-` für zwei Referenzvariable vom Strukturtyp `year` als Operanden, der eine Variable vom Strukturtyp `year` zurück gibt.
   Überprüfen Sie zuerst im Rumpf, dass die Jahreszahlen, der erste Wochentag im Jahr und die Einheiten der Operanden übereinstimmen.
   Initialisieren Sie danach eine neue Variable vom Strukturtyp `year`, subtrahieren für diese vom ersten Operanden elementweise alle Viertelstundenwerte gegeben im zweiten Operanden und geben die Ergebnis-Variable zurück./
   Program an overloaded binary subtraction operator `-` for two reference variables of structure type `year` as operands, which returns a variable of structure type `year`.
   In the body, first check that the number of the year, the first day of the week in the year and the units of the operands match.
   Then initialise a new variable of structure type `year`, subtract all quarter-hour values given in the second operand from the first operand element by element and return the result variable.
4. Programmieren Sie einen überladenen binären Multiplikations-Operator `*` für eine Gleitpunktzahl und eine Referenzvariable vom Strukturtyp `year` als Operanden, der eine Variable vom Strukturtyp `year` zurück gibt.
   Initialisieren Sie im Rumpf eine neue Variable vom Strukturtyp `year,` multiplizieren Sie elementweise alle Viertelstundenwerte gegeben im zweiten Operanden mit der Gleitpunktzahl im ersten Operanden und geben diese Variable zurück./
   Program an overloaded binary multiplication operator `*` for a floating point number and a reference variable of structure type `year` as operands, which returns a variable of structure type `year`.
   Initialise a new variable of structure type `year` in the body, multiply all quarter-hour values given in the second operand element by element with the floating point number in the first operand and return this variable.
5. Definieren Sie eine Funktion namens `set_unit` mit einer Referenz vom Strukturtyp `year` als ersten und einer C++-Zeichenkette als zweitem Parameter ohne Rückgabe.
   Setzen Sie im Rumpf die Komponente mit der Einheit der Werte (`unit`) in der Strukturvariable auf den Wert der Zeichenkette im zweiten Parameter./
   Define a function called `set_unit` with a reference of the structure type `year` as the first parameter and a C++ character string as the second parameter without return.
   In the body, set the component `unit` of the structure variable with the unit of the values to the value of the character string in the second parameter.
6. Erweitern Sie in Ihrer Funktion `main` bei den Menüpunkten und deren Funktionalität (Beispiele siehe unten):/
   Extend in your function `main` in the menu items and their functionality (see examples below):
   - `m subtract actual from total (using operator -)`
     hier ist nur `total = total - actual;` auszuführen./
     here only `total = total - actual;` is to be executed.
   - `s scalar multiplication`
     lesen Sie einen Skalar ein und multiplizieren je nach Auswahl `actual` oder `total` mit diesem Wert über Ihren oben definierten überladenen Multiplikationsoperator./
     read in a scalar and, depending on a selection, multiply `actual` or `total` by this value using your overloaded multiplication operator defined above.

- **`c change unit`**

  lesen Sie eine Einheit als C++-Zeichenkette ein und ändern je nach Auswahl für **`actual`** oder **`total`** den Wert für Einheit über die oben definierte Funktion./

  read in a unit as a C++ character string and, depending on the selection for **`actual`** or **`total`**, change the value for unit using the function defined above.
- **`y set actual to ones (call function ones)`**

  rufen Sie Ihre Funktion **`ones`** für **`actual`** auf./

  call your function **`ones`** for **`actual`**.

Laden Sie Ihren abgenommenen Programmkode in Moodle hoch./
Upload your accepted program code in Moodle

Beispiel Programmlauf/Example Program Run

```
YEARLY CONSUMPTION QUARTER HOUR
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> y
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> o
year: 2024 (unit: Watt)
day 0: Monday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 1: Tuesday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 2: Wednesday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 3: Thursday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 4: Friday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 5: Saturday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 6: Sunday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 7: Monday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 8: Tuesday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 9: Wednesday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

q quit
```

```
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> s
a for actual
t for total
a
value of scalar? 600
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> o
year: 2024 (unit: Watt)
day 0: Monday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00

day 1: Tuesday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00

day 2: Wednesday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00

day 3: Thursday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00

day 4: Friday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00

day 5: Saturday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00

day 6: Sunday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00

day 7: Monday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00

day 8: Tuesday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00

day 9: Wednesday
 0:00     600.00     600.00     600.00     600.00
 1:00     600.00     600.00     600.00     600.00
 2:00     600.00     600.00     600.00     600.00
```

```
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> s
a for actual
t for total
a
value of scalar? 0.001
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> c
a for actual
t for total
a
what is the new unit? kW
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> o
year: 2024 (unit: kW)
day 0: Monday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

day 1: Tuesday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

day 2: Wednesday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

day 3: Thursday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

day 4: Friday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

day 5: Saturday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

day 6: Sunday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

day 7: Monday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

day 8: Tuesday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

day 9: Wednesday
 0:00       0.60       0.60       0.60       0.60
 1:00       0.60       0.60       0.60       0.60
 2:00       0.60       0.60       0.60       0.60

q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> s
a for actual
t for total
a
value of scalar? 0.3
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> c
a for actual
t for total
a
what is the new unit? EUR
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> o
year: 2024 (unit: EUR)
day 0: Monday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 1: Tuesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 2: Wednesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18
```

```
day 3: Thursday
 0:00      0.18      0.18      0.18      0.18
 1:00      0.18      0.18      0.18      0.18
 2:00      0.18      0.18      0.18      0.18

day 4: Friday
 0:00      0.18      0.18      0.18      0.18
 1:00      0.18      0.18      0.18      0.18
 2:00      0.18      0.18      0.18      0.18

day 5: Saturday
 0:00      0.18      0.18      0.18      0.18
 1:00      0.18      0.18      0.18      0.18
 2:00      0.18      0.18      0.18      0.18

day 6: Sunday
 0:00      0.18      0.18      0.18      0.18
 1:00      0.18      0.18      0.18      0.18
 2:00      0.18      0.18      0.18      0.18

day 7: Monday
 0:00      0.18      0.18      0.18      0.18
 1:00      0.18      0.18      0.18      0.18
 2:00      0.18      0.18      0.18      0.18

day 8: Tuesday
 0:00      0.18      0.18      0.18      0.18
 1:00      0.18      0.18      0.18      0.18
 2:00      0.18      0.18      0.18      0.18

day 9: Wednesday
 0:00      0.18      0.18      0.18      0.18
 1:00      0.18      0.18      0.18      0.18
 2:00      0.18      0.18      0.18      0.18

q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> v
sum actual = 21.60 EUR
sum total = 0.00 Watt
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> c
a for actual
t for total
t
what is the new unit? EUR
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> a
```

```
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> o
year: 2024 (unit: EUR)
day 0: Monday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 1: Tuesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 2: Wednesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 3: Thursday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 4: Friday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 5: Saturday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 6: Sunday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 7: Monday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 8: Tuesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 9: Wednesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> t
year: 2024 (unit: EUR)
day 0: Monday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 1: Tuesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 2: Wednesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 3: Thursday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 4: Friday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 5: Saturday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 6: Sunday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 7: Monday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 8: Tuesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

day 9: Wednesday
 0:00       0.18       0.18       0.18       0.18
 1:00       0.18       0.18       0.18       0.18
 2:00       0.18       0.18       0.18       0.18

q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> v
sum actual = 21.60 EUR
sum total = 21.60 EUR
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> y
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
```

```
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> o
year: 2024 (unit: EUR)
day 0: Monday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 1: Tuesday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 2: Wednesday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 3: Thursday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 4: Friday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 5: Saturday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 6: Sunday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 7: Monday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 8: Tuesday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

day 9: Wednesday
 0:00       1.00       1.00       1.00       1.00
 1:00       1.00       1.00       1.00       1.00
 2:00       1.00       1.00       1.00       1.00

q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> s
a for actual
t for total
a
value of scalar? 0.03
q quit
a add actual to total (using operator +)
```

```
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> o
year: 2024 (unit: EUR)
day 0: Monday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

day 1: Tuesday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

day 2: Wednesday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

day 3: Thursday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

day 4: Friday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

day 5: Saturday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

day 6: Sunday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

day 7: Monday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

day 8: Tuesday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

day 9: Wednesday
 0:00       0.03       0.03       0.03       0.03
 1:00       0.03       0.03       0.03       0.03
 2:00       0.03       0.03       0.03       0.03

q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> m
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
```

```
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> t
year: 2024 (unit: EUR)
day 0: Monday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

day 1: Tuesday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

day 2: Wednesday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

day 3: Thursday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

day 4: Friday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

day 5: Saturday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

day 6: Sunday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

day 7: Monday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

day 8: Tuesday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

day 9: Wednesday
 0:00       0.15       0.15       0.15       0.15
 1:00       0.15       0.15       0.15       0.15
 2:00       0.15       0.15       0.15       0.15

q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>> v
sum actual = 3.60 EUR
sum total = 18.00 EUR
q quit
a add actual to total (using operator +)
m subtract actual from total (using operator -)
s scalar multiplication
c change unit
```

```
v sum up values
o output actual (using operator <<)
t output total (using operator <<)
u add consumption according to frequency of use (call functions add_consumption)
y set actual to ones (call function ones)
z set actual to zeros (call function zeros)
>>
```

Zuletzt geändert: Montag, 20. November 2023, 00:03

◄ A3 Upload Teil 1/Part 1

Direkt zu:

A3 Upload Teil 1+2/Upload Part 1+2 ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

Dashboard / Meine Kurse / Wintersemester 2023/2024 / Ingenieurwissenschaften / Informatik und Angewandte Kognitionswissenschaften / Praktikum OOP in C++ WS 2023/2024 / Aufgabe 4/Task 4 / A4 Teil 1: Hausaufgabe zur Vorbereitung auf die Präsenz-Gruppe/Part 1: Homework Task for Preparation of the Presence Group

A4 Teil 1: Hausaufgabe zur Vorbereitung auf die Präsenz-Gruppe/Part 1: Homework Task for Preparation of the Presence Group

Lernziele: Persistenz von Daten, Lesen und Schreiben von Dateien./
Learning objectives: Persistence of data, reading and writing files.

In A2 Teil 1+2 wurde die Berechnung des Stromverbrauchs für n Haushalte in einem Haus verwaltet, wobei ein Feld von Zeigern auf die einzelnen Haushalte definiert war. In jedem dieser Haushalte konnte eine Liste von Stromverbrauchern gespeichert werden.
In dieser Aufgabe soll Ihr Programm aus A2 Teil 1+2 erweitert werden, so dass die Daten aller Haushalte eines Hauses in einer Datei gespeichert werden können sowie aus einer solchen Datei auch wieder eingelesen werden können.
Das folgende Beispiel `house4.csv` zeigt eine solche Datei, in der als Separatorzeichen das Semikolon (`;`) verwendet wird:/
In A2 part 1+2, the calculation of power consumption was managed for n households in a house, with an array of pointers defined to the individual households. A list of power consumers could be stored in each of these households.
In this task, your program from A2 part 1+2 is to be extended so that the data of all households in a house can be saved in a file and can also be read in again from such a file.
The following example `house4.csv` shows such a file, in which the semicolon (`;`) is used as a separator character:

```
A4;5;Bergisch Gladbach;0.3
household;2;Bergisch Gladbach;true;5;200
consumer;Washing Machine;2;weekly;2000;0
consumer;Office PC;8.5;Monday to Friday;200;0.5
consumer;Router;24;daily;10;0
household;3;Bergisch Gladbach;false;2;100
consumer;Dish Washer;3.5;daily;250;0
consumer;LED TV;2;Saturday and Sunday;70;0.5
```

In der ersten Zeile der Datei ist `A4` als Kennung der Aufgabe gespeichert, danach die (maximale) Anzahl der Haushalte im Haus (Größe Feld), hier `5`, danach die Stadt, in der das Haus sich befindet, hier `Bergisch Gladbach`, und der zu berücksichtigende Strompreis für eine Kilowattstunde in EUR, hier `0.3`.
In den weiteren Zeilen folgt jeweils ein Haushalt, sofern dieser existiert, und direkt nachfolgend die Liste aller seiner Stromverbraucher.
Für einen Haushalts folgen nach `household` die Nummer im Haus (also der Index im Feld), die Stadt, ob Warmwasser elektrisch bereitet wird (`true`) oder nicht (`false`), die Anzahl Personen im Haushalt und die Anzahl der Quadratmeter.
Für die Daten eines Stromverbrauchers folgen jeweils auf `consumer` dessen Beschreibung, die Anzahl der Betriebsstunden, die Häufigkeit der Benutzung als Zeichenkette `once`, `daily`, `Monday to Friday`, `Saturday and Sunday` oder `weekly`, der Verbrauch in Watt und der Standby-Verbrauch in Watt.
Ergänzen Sie wie in den Beispielen unten zu sehen Ihre Menüauswahl in `main` um die zwei Menüpunkte
`r read data from file`
`w write data into file`
über die nach Eingabe eines Dateinamens und des zu verwendenden Separatorzeichens alle Daten aus der Datei - formatiert wie oben beschrieben - gelesen oder in eine Datei geschrieben werden können./
The first line of the file contains `A4` as the task identifier, followed by the (maximum) number of households in the house (length of array), here `5`, then the city in which the house is located, here `Bergisch Gladbach`, and the power price to be taken into account for one kilowatt hour in EUR, here `0.3`.
The next lines contain a household, if it exists, followed directly by a list of all its power consumers.
For a `household`, its number in the house (i.e. index in the array), the city, whether hot water is produced electrically (`true`) or not (`false`), the number of people in the household and the number of square metres follow in a line.
For the data of a power consumer in a line, following `consumer` is its description, the number of operating hours, the frequency of use as string `once`, `daily`, `Monday to Friday`, `Saturday and Sunday` or `weekly`, the consumption in watts and the standby consumption in watts.
As shown in the examples below, add the following two menu items to your menu selection in function `main`
`r read data from file`
`w write data into file`
which, after entering a file name and the separator character to be used, can be used to read all data from the file - formatted as described above - or to write into the file.

Hinweise zur Lösung/Notes on the Solution

- Programmieren Sie je eine Funktion für das Lesen und eine für das Schreiben einer solchen Datei, die als (Referenz-)Parameter den Dateinamen, das Separatorzeichen, das Feld von Zeigern auf Haushalte, dessen Länge, die Stadt, den Strompreis für eine Kilowattstunde und mögliche weitere benötigte Parameter haben.
  Die Reihenfolge der Verbraucher in jedem Haushalt soll dabei für jeden Haushalt genau gleich wie in der Datei sein./
  Program one function for reading and one for writing such a file, which have the file name, the separator character, the array of pointers to the households, its length, the city, the power price for one kilowatt hour and any further required parameters as (reference) parameters.
  The sequence of consumers in each household should be exactly the same as given in the file.
- Sie dürfen beliebig weitere Funktionen und Operatoren definieren, die Sie benötigen, bspw. einen Ausgabeoperator wie in A3 für die Elemente der Aufzählung `Use`./
  You may define any other functions and operators that you need, e.g. an output operator as in A3 for the elements of the enumeration `Use`.
- Es ist sinnvoll, zuerst nur das Schreiben in eine Datei zu programmieren und an einfachen kleinen Beispielen zu testen (siehe erste Programmläufe unten)./
  It makes sense to first program only the writing to a file and to test it on simple small examples (see first program runs below).
- Beim Einlesen aus der Datei können Sie jeweils über die Funktion `get` Zeichen für Zeichen bis zum Separatorzeichen oder Zeilenende einlesen und jeweils an eine C++-Zeichenkette anhängen, die den Wert für eine Komponente beinhaltet.
  Oder Sie können via `getline` eine gesamte Zeile als C++-Zeichenkette einlesen und über Schleifen aus dieser Teil-Zeichenketten jeweils Zeichen für Zeichen bis zum Separatorzeichen in Variablen für die Werte der Komponenten kopieren.
  Sie benötigen keine zusätzlichen Funktionen zur Verarbeitung von (Sub-)Strings, regulären Ausdrücken, zum Tokenising von Strings oder was Sie sonst noch bei der Suche im Internet hierzu finden würden und nicht in der Lehrveranstaltung erklärt wurde - einfache Kopier-Schleifen auf den Strings reichen hier vollkommen aus./
  When reading from the file, you can use function `get` to read in character by character up to the separator character or the end of line and append each character to a C++ string that contains the value for a component.
  Or you can use `getline` to read in an entire line as a C++ string and use loops to copy parts of strings character by character up to the separator character into variables for the values of the components.
  You do not need any additional functions for processing (sub)strings, regular expressions, for tokenising strings or anything else you would find when searching the Internet that was not explained in the course - simple copy loops on the strings are completely sufficient here.
- Binden Sie die Standard-Bibliothek `<string>` in Ihr Programm ein und rufen
  `double stod(const string)` (string to double) oder
  `int stoi(const string)` (string to integer)
  auf für die Umwandlung einer Zeichenkette mit dem Wert einer Komponente in eine Zahl./
  Include the standard library `<string>` in your program and call
  `double stod(const string) (string to double) or`
  `int stoi(const string) (string to integer)`
  for the conversion of a string with the value of a component to a number.
  ```
  string number1 = "3.14"; double pi = stod(number1);
  string number2 = "11"; int n = stoi(number2);
  ```
- Für das Einlesen der Häufigkeit der Benutzung eines Stromverbrauchers bietet sich an eine weitere Funktion zu programmieren mit einer C++-Zeichenkette als Parameter und einer Rückgabe vom Typ `Use`./
  To read in the frequency of use of a power consumer, it makes sense to program another function with a C++ string as parameter and a return of type `Use`.
- Hilfreich bei der Programmentwicklung kann sein, zusätzliche Test-Ausgaben einzelner gelesener Werte für Komponenten/Teil-Strings während des Einlesens der Daten aus einer Datei zu machen./
  It can be helpful during program development to make additional test outputs of individual read values for components/sub-strings during reading data out of the file.
- Vergessen Sie nicht, die Separatorzeichen selbst in den Zeilen jeweils zu überlesen./
  Do not forget to read over the separator characters themselves in the lines.
- Testen Sie auch mit, Daten in geschriebenen `.csv`-Dateien in einem Texteditor zu ändern, erweitern und löschen und danach wieder einzulesen./
  You can also test changing, extending and deleting data in written `.csv` files in a text editor and then reading it in again.

Beispiel Programmlauf 1/Example Program Run 1

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE
how many households does the house have? 5
in which city the house is located? Duisburg
what is the price for one kWh in EUR? 0.3
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: house0.csv
input separator character: ;
output file "house0.csv" opened...
output file "house0.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> q
```

house0.csv

```
A4;5;Duisburg;0.3
```

Beispiel Programmlauf 2/Example Program Run 2

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE
how many households does the house have? 2
in which city the house is located? Essen
what is the price for one kWh in EUR? 0.3
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> r
input file name: house0.csv
input separator character: ;
input file "house0.csv" opened...
file contains up to 5 households, but here only 2 are supported
input file "house0.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> q
```

Beispiel Programmlauf 3/Example Program Run 3

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE
how many households does the house have? 8
in which city the house is located? Essen
what is the price for one kWh in EUR? 0.5
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> r
input file name: house1.csv
input separator character: ;
input file "house1.csv" opened...
input file "house1.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 1
how many square metres does the household have? 100
how many persons live in this household? 3
is hot water heated using electricity? (y(es) or n(o)) y
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
H O U S E H O L D   N O   1   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0x10a1a30)
                  price for one kWh: 40.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2550.0 kWh
           total annual power costs: 1020.0 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: house2.csv
input separator character: ;
output file "house2.csv" opened...
output file "house2.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> q
```

`house1.csv`

```
A4;5;Bergisch Gladbach;0.4
```

`house2.csv`

```
A4;8;Bergisch Gladbach;0.4
household;1;Bergisch Gladbach;true;3;100
```

Beispiel Programmlauf 4/Example Program Run 4

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE
how many households does the house have? 8
in which city the house is located? Mülheim an der Ruhr
what is the price for one kWh in EUR? 0.5
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> r
input file name: house2.csv
input separator character: ;
input file "house2.csv" opened...
input file "house2.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
H O U S E H O L D   N O   1   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0x26bef50)
                  price for one kWh: 40.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2550.0 kWh
           total annual power costs: 1020.0 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 2
how many square metres does the household have? 50
how many persons live in this household? 2
is hot water heated using electricity? (y(es) or n(o)) n
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
H O U S E H O L D   N O   1   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0x26bef50)
                  price for one kWh: 40.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
```

```
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2550.0 kWh
           total annual power costs: 1020.0 EUR

H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0x26bf100)
                  price for one kWh: 40.00 ct/kWh
                      square metres: 50 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 850.0 kWh
           total annual power costs: 340.0 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> i
number of household? 1
what is the description of the power consumer? LTE Router
how many watt it will have? 24
how many watt standby it will have? 0
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? d
how many hours it will be operating then? 24
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
H O U S E H O L D   N O   1   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0x26bef50)
                  price for one kWh: 40.00 ct/kWh
                      square metres: 100 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: LTE Router (at address: 0x26bf140)
                  power consumption: 24.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 210.2 kWh
                       annual costs: 84.10 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2760.2 kWh
           total annual power costs: 1104.1 EUR

H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0x26bf100)
                  price for one kWh: 40.00 ct/kWh
                      square metres: 50 qm
```

```
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 850.0 kWh
           total annual power costs: 340.0 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: house3.csv
input separator character: #
output file "house3.csv" opened...
output file "house3.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> q
```

house3.csv

```
A4#8#Bergisch Gladbach#0.4
household#1#Bergisch Gladbach#true#3#100
consumer#LTE Router#24#daily#24#0
household#2#Bergisch Gladbach#false#2#50
```

Beispiel Programmlauf 5/Example Program Run 5

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE
how many households does the house have? 5
in which city the house is located? Bochum
what is the price for one kWh in EUR? 0.25
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> r
input file name: house4.csv
input separator character: ;
input file "house4.csv" opened...
input file "house4.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 1
how many square metres does the household have? 50
how many persons live in this household? 2
is hot water heated using electricity? (y(es) or n(o)) y
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy consumers? 2
number of household to copy to? 1
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy consumers? 3
number of household to copy to? 1
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
H O U S E H O L D   N O   1   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0x6ef1f0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 50 qm
                            persons: 2
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer (at address: 0x6ef320)
                  power consumption: 250.00 W
```

```
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 95.81 EUR
                                  2: LED TV (at address: 0x6ef370)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 5.65 EUR
                                  3: Washing Machine (at address: 0x6ef230)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
                                  4: Office PC (at address: 0x6ef280)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  5: Router (at address: 0x6ef2d0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 1100.0 kWh
     total annual power consumption: 2629.1 kWh
           total annual power costs: 788.7 EUR

H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0x6eef50)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 200 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Washing Machine (at address: 0x6eefc0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
                                  2: Office PC (at address: 0x6ef010)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Router (at address: 0x6ef090)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.3 EUR

H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0x6ef0e0)
                  price for one kWh: 30.00 ct/kWh
                      square metres: 100 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                 1: Dish Washer (at address: 0x6ef150)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 95.81 EUR
                                 2: LED TV (at address: 0x6ef1a0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 5.65 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 491.5 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: house5.csv
input separator character: ,
output file "house5.csv" opened...
output file "house5.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> q
```

house4.csv

```
A4;5;Bergisch Gladbach;0.3;;
household;2;Bergisch Gladbach;true;5;200
consumer;Washing Machine;2;weekly;2000;0
consumer;Office PC;8.5;Monday to Friday;200;0.5
consumer;Router;24;daily;10;0
household;3;Bergisch Gladbach;false;2;100
consumer;Dish Washer;3.5;daily;250;0
consumer;LED TV;2;Saturday and Sunday;70;0.5
```

house5.csv

```
A4,5,Bergisch Gladbach,0.3
household,1,Bergisch Gladbach,true,2,50
consumer,Dish Washer,3.5,daily,250,0
consumer,LED TV,2,Saturday and Sunday,70,0.5
consumer,Washing Machine,2,weekly,2000,0
consumer,Office PC,8.5,Monday to Friday,200,0.5
consumer,Router,24,daily,10,0
household,2,Bergisch Gladbach,true,5,200
consumer,Washing Machine,2,weekly,2000,0
consumer,Office PC,8.5,Monday to Friday,200,0.5
consumer,Router,24,daily,10,0
household,3,Bergisch Gladbach,false,2,100
consumer,Dish Washer,3.5,daily,250,0
consumer,LED TV,2,Saturday and Sunday,70,0.5
```

Zuletzt geändert: Montag, 27. November 2023, 09:42

◄ A3 Upload Teil 1+2/Upload Part 1+2

Direkt zu:

CSV (Dateiformat) (Wikipedia) ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

Dashboard / Meine Kurse / Wintersemester 2023/2024 / Ingenieurwissenschaften / Informatik und Angewandte Kognitionswissenschaften / Praktikum OOP in C++ WS 2023/2024 / Aufgabe 4/Task 4 / A4 Teil 2: Präsenzaufgabe/Part 2: Presence Task

A4 Teil 2: Präsenzaufgabe/Part 2: Presence Task

Im bisherigen Programm wird jeweils zu Beginn des Programms der Strompreis für eine Kilowattstunde für alle Haushalte in einem Haus gleich angegeben. In der Praxis schließt allerdings jeder Haushalt einen eigenen Strom-Liefervertrag mit einem der Stromlieferanten ab. Ändern und erweitern Sie Ihren C++-Kode aus A4 Teil 1 folgendermassen:/
In the current program, the power price for one kilowatt hour is given same for all households in a house at the start of the program. In practice, however, each household has its own power supply contract with one of the power suppliers. Change and extend your C++ code from A4 part 1 as follows:

1. Fügen Sie der Struktur `household` als weitere Komponenten eine Gleitpunktzahl für einen Strompreis hinzu sowie eine C++-Zeichenkette für den Stromlieferanten./
   Add a floating point number for a power price and a C++ string for the power supplier as further components to structure `household`.
2. Löschen Sie in der Funktion `main` die Variable zur Speicherung des Strompreises und die Eingabe eines Wertes für diesen. Fügen Sie stattdessen bei der Eingabe eines Haushalts eine Strompreiseingabe und eine Eingabe des Stromlieferanten hinzu./
   In function `main`, delete the variable for storing the power price and the input of a value for it. Instead add a power price input and an input for a power supplier when inputting a household.
3. Löschen Sie in allen Funktionen und Funktionsaufrufen den Parameter mit dem Strompreis, ändern und ergänzen die Ausgabe eines Haushalts auf die Ausgabe des Strompreises und des Stromlieferanten aus den beiden neuen Komponentendaten der Struktur, und ändern Sie auch alle Preisberechnungen auf den Strompreis aus der Komponente des Haushalts./
   Delete the parameter with the power price in all functions and function calls, change/add the output of a household to output the power price and the power supplier from the two new component data of the structure, and also change all price calculations using the power price from the household component.
4. Löschen Sie in der Funktion zum Schreiben aller Daten in eine Datei den Strompreis-Parameter und die Ausgabe des Strompreises in der ersten Zeile der Datei. Fügen Sie dafür beim Schreiben der Haushalte je zwei weitere Werte für den Strompreis und den Stromlieferanten am Ende der jeweiligen Zeile in der Datei ein./
   In the function for writing all data to a file, delete the power price parameter and the output of the power price into the first line of the file. Add two more values for the power price and the power supplier at the end of the respective lines in the file for writing the households.
5. Löschen Sie in der Funktion zum Lesen aller Daten aus einer Datei den Strompreis-Parameter und das Einlesen des Strompreises aus der ersten Zeile der Datei. Fügen Sie stattdessen beim Einlesen der Daten der einzelnen Haushalte das Einlesen des Strompreises und des Stromlieferanten mit ein./
   In the function for reading all data from a file, delete the power price parameter and the reading of the power price out of the first line of the file. Instead, when reading in the data of the individual households, include the reading in of the power price and the power supplier.

Beispiel Datei `house42.csv` (zusätzliche Werte in roter Farbe)/Example File `house42.csv` (additional values in red colour)

```
A4#5#Bergisch Gladbach
household#2#Bergisch Gladbach#true#5#200#0.3#Yello Strom
consumer#Washing Machine#2#weekly#2000#0
consumer#Office PC#8.5#Monday to Friday#200#0.5
consumer#Router#24#daily#10#0
household#3#Bergisch Gladbach#false#2#100#0.4#Stadtwerke
consumer#Dish Washer#3.5#daily#250#0
consumer#LED TV#2#Saturday and Sunday#70#0.5
```

Datei Programmlauf/Example Program Run

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE
how many households does the house have? 6
in which city the house is located? Duisburg
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> r
input file name: house42.csv
input separator character: #
input file "house42.csv" opened...
input file "house42.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0xf35ec0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Washing Machine (at address: 0xf35f60)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
                                  2: Office PC (at address: 0xf35fb0)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Router (at address: 0xf36030)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.3 EUR

H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0xf36080)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer (at address: 0xf36120)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  2: LED TV (at address: 0xf36170)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 655.3 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 4
how many square metres does the household have? 50
how many persons live in this household? 2
is hot water heated using electricity? (y(es) or n(o)) y
what is the price for one kWh in EUR? 0.5
who is the power supplier? RWE
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> p
number of household? 4
H O U S E H O L D   N O   4   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0xf35cb0)
                  price for one kWh: 50.00 ct/kWh
                     power supplier: RWE
                      square metres: 50 qm
                            persons: 2
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 1100.0 kWh
     total annual power consumption: 1550.0 kWh
           total annual power costs: 775.0 EUR

q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy consumers? 2
number of household to copy to? 4
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
```

```
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy consumers? 3
number of household to copy to? 4
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
H O U S E H O L D  N O  2  P O W E R  C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0xf35ec0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Washing Machine (at address: 0xf35f60)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
                                  2: Office PC (at address: 0xf35fb0)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Router (at address: 0xf36030)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.3 EUR

H O U S E H O L D  N O  3  P O W E R  C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0xf36080)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer (at address: 0xf36120)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  2: LED TV (at address: 0xf36170)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
```

```
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 655.3 EUR

H O U S E H O L D   N O   4   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                               city: Bergisch Gladbach (at address: 0xf35cb0)
                  price for one kWh: 50.00 ct/kWh
                     power supplier: RWE
                      square metres: 50 qm
                            persons: 2
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer (at address: 0xf35e10)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 159.69 EUR
                                  2: LED TV (at address: 0xf35e60)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 9.42 EUR
                                  3: Washing Machine (at address: 0xf35d20)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 104.00 EUR
                                  4: Office PC (at address: 0xf35d70)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 222.64 EUR
                                  5: Router (at address: 0xf35dc0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 43.80 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 1100.0 kWh
     total annual power consumption: 2629.1 kWh
           total annual power costs: 1314.5 EUR


q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: house43.csv
input separator character: |
output file "house43.csv" opened...
output file "house43.csv" closed
q quit
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
```

```
r read data from file
w write data into file
>>
```

Beispiel Datei `house43.csv` (zusätzliche Werte in roter Farbe)/Example File `house43.csv` (additional values in red colour)

```
A4|6|Bergisch Gladbach
household|2|Bergisch Gladbach|true|5|200|0.3|Yello Strom
consumer|Washing Machine|2|weekly|2000|0
consumer|Office PC|8.5|Monday to Friday|200|0.5
consumer|Router|24|daily|10|0
household|3|Bergisch Gladbach|false|2|100|0.4|Stadtwerke
consumer|Dish Washer|3.5|daily|250|0
consumer|LED TV|2|Saturday and Sunday|70|0.5
household|4|Bergisch Gladbach|true|2|50|0.5|RWE
consumer|Dish Washer|3.5|daily|250|0
consumer|LED TV|2|Saturday and Sunday|70|0.5
consumer|Washing Machine|2|weekly|2000|0
consumer|Office PC|8.5|Monday to Friday|200|0.5
consumer|Router|24|daily|10|0
```

Zuletzt geändert: Donnerstag, 30. November 2023, 11:24

◄ A4 Upload Teil 1/Part 1

Direkt zu:

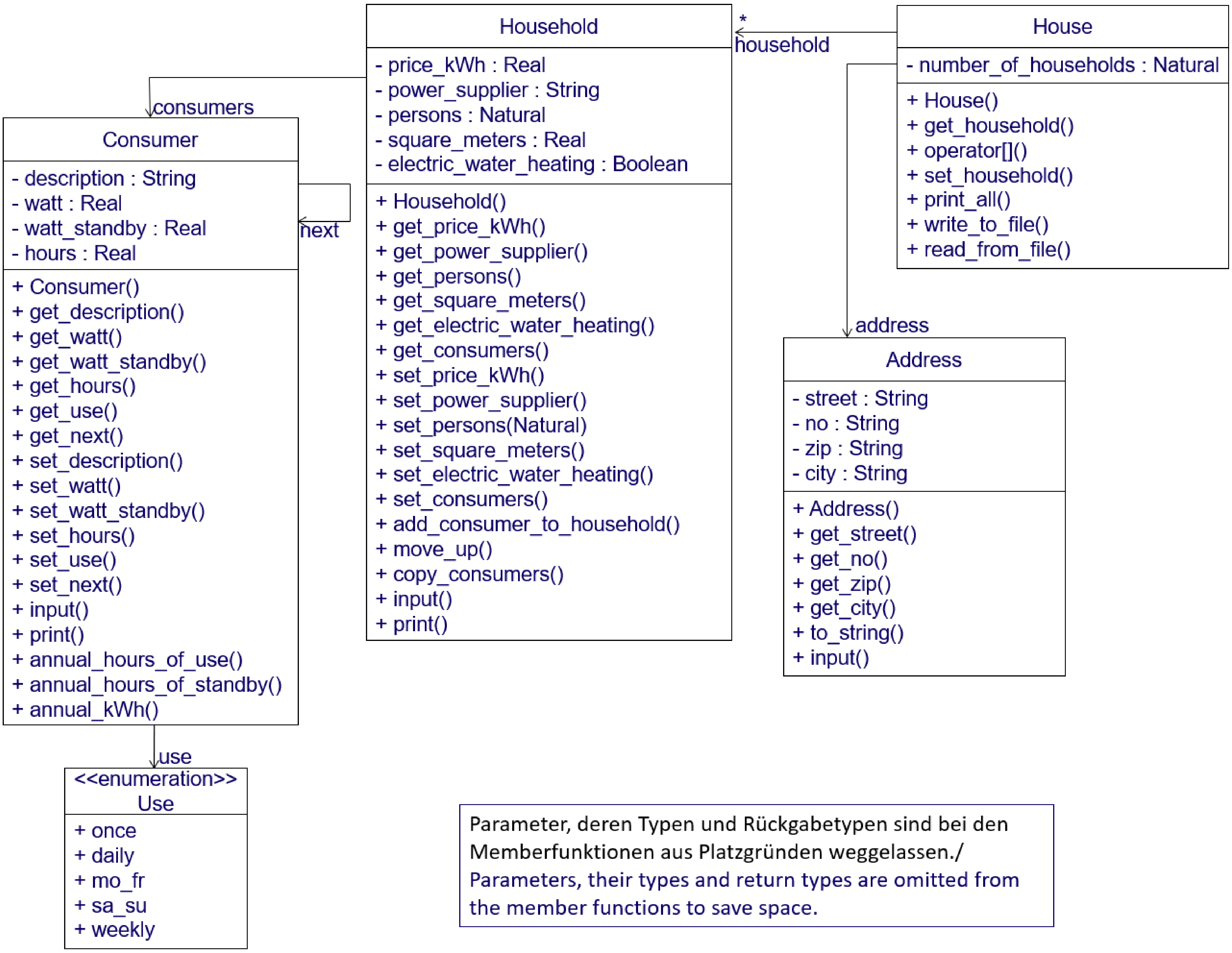
A4 Upload Teil 1+2/Upload Part 1+2 ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

Dashboard / Meine Kurse / Wintersemester 2023/2024 / Ingenieurwissenschaften / Informatik und Angewandte Kognitionswissenschaften / Praktikum OOP in C++ WS 2023/2024 / Aufgabe 5/Task 5 / A5 Teil 1/Part 1

A5 Teil 1/Part 1

Nachdem in der Vorlesung Klassen eingeführt sind, soll der C++-Kode aus Aufgabe A4 Teil 1+2 nun mit Objekten und Nachrichten an Objekte statt prozeduraler Funktionsaufrufe umgeändert werden. Damit werden dann Daten und Funktionen in den Klassen zusammengefasst, und es gibt kleinere Änderungen und Ergänzungen wie unten dann beschrieben.
Das nachfolgende UML-Diagramm zeigt die zu implementierenden Klassen mit einer Klasse Haus (**House**), die eine bestimmte Anzahl an Haushalten (**Household**) über ein Feld von Zeigern auf diese speichert, und einer Liste von Verbrauchern (**Consumer**) in jedem Haushalt./
Now that classes have been introduced in the lecture, the C++ code from task A4 part 1+2 is to be modified with objects and messages to objects instead of procedural function calls. Therefore data and functions are combined in the classes, and there are smaller changes and additions as described below.
The following UML diagram shows the classes to be implemented with a class **House** storing a certain number of **Households** using an array of pointers to them and a list of **Consumers** in each household.



Parameter, deren Typen und Rückgabetypen sind bei den Memberfunktionen aus Platzgründen weggelassen./
Parameters, their types and return types are omitted from the member functions to save space.

Aufzählung/Enumeration `Use`

Die Aufzählung **Use** und zugehörige Funktionen und Operatoren bleiben unverändert./
The enumeration **Use** and associated functions and operators remain unchanged.

Klasse/Class `Consumer`

Die Struktur **`consumer`** wird neu als Klasse **`Consumer`** für Strom-Verbraucher modelliert.

Die bisherigen Komponenten der Struktur werden zu als privat definierten Attributen.

Neben einem Standard-Konstruktor, der nur das Zeiger-Attribut **`next`** auf einen Nullzeiger initialisieren soll, sollen für alle Attribute jeweils eine öffentliche getter- und eine setter-Methode definiert werden.

Die bisherigen Funktionen zur Berechnung der jährlichen Stunden der Nutzung, der jährlichen Stunden Standby-Betrieb, der jährlich insgesamt verbrauchten Kilowattstunden, der Eingabe der Verbraucher-Daten vom Standard-Zeichen-Eingabestrom und deren Ausgabe auf den Standard-Zeichen-Ausgabestrom einschließlich Ausgabe des Wertes von **`this`** sollen zu öffentlichen Member-Funktionen **`annual_hours_of_use`**, **`annual_hours_of_standby`**, **`annual_kWh`**, **`input`** und **`print`** werden.

Definieren Sie keine befreundeten Funktionen oder Klassen!/

The structure **`consumer`** is now modeled as a class **`Consumer`** for power consumers.

The previous components of the structure become attributes defined as private.

In addition to a standard constructor, which should only initialise the pointer attribute **`next`** to a null pointer, a public getter and a setter method should be defined for all attributes.

The previous functions for calculating the annual hours of use, the annual hours of standby, the total annual kilowatt hours consumed, the input of consumer data from the standard character input stream and their output to the standard character output stream including output of the value of **`this`** should become public member functions **`annual_hours_of_use`**, **`annual_hours_of_standby`**, **`annual_kWh`**, **`input`** and **`print`**.

Do not define any **`friend`** functions or classes!

Klasse/Class `Household`

Die Struktur **`household`** wird neu als Klasse **`Household`** für einen Haushalt modelliert.

Die bisherigen Komponenten der Struktur werden zu als privat definierten Attributen; die Komponente/das Attribut **`city`** soll gleichzeitig gelöscht werden, da diese für alle Haushalte gleich ist und redundand.

Neben einem Standard-Konstruktor, der nur das Zeiger-Attribut **`consumers`** auf einen Nullzeiger initialisieren soll, sollen für alle Attribute jeweils eine öffentliche getter- und eine setter-Methode definiert werden.

Die bisherigen Funktionen einen Verbraucher zu einem Haushalt hinzuzufügen, Verbraucher von einem Haushalt in einen anderen hinzu zu kopieren, einen Verbraucher in der Liste der Verbraucher eine Position nach oben zu verschieben, die Eingabe der Daten eines Haushalts vom Standard-Zeichen-Eingabestrom und die Ausgabe aller Daten einschließlich der Ausgabe des Wertes von **`this`** auf den Standard-Zeichen-Ausgabestrom sollen zu öffentlichen Member-Funktionen **`add_consumer_to_household`**, **`copy_consumers`**, **`move_up`**, **`input`** und **`print`** werden.

Definieren Sie keine befreundeten Funktionen oder Klassen!/

The structure **`household`** is now modelled as class **`Household`** for a household.

The previous components of the structure become attributes defined as private; the component/attribute **`city`** is to be deleted at the same time, as it is the same for all households and redundant.

In addition to a standard constructor, which should only initialise the pointer attribute **`consumers`** to a null pointer, and a public getter and a setter method should be defined for all attributes.

The previous functions to add a consumer to a household, to copy consumers from one household to another, to move a consumer up one position in the list of consumers, to input the data of a household from the standard character input stream and to output all data including the output of the value of **`this`** to the standard character output stream should become public member functions **`add_consumer_to_household`**, **`copy_consumers`**, **`move_up`**, **`input`** and **`print`**.

Do not define any **`friend`** functions or classes!

Klasse/Class `Address`

Statt einer Komponente/eines Attributs **`city`** in jedem Haushalt und für ein Haus mit diesen Haushalten soll nur einmal die komplette Adresse eines Hauses gespeichert werden. Hierzu soll die Klasse **`Address`** mit vier privaten Attributen namens **`street`**, **`no`**, **`zip`** und **`city`**, alle vom Typ C++-Zeichenkette, definiert werden.

Definieren Sie einen öffentlichen überladenen Konstruktor mit vier Parametern zur Initialisierung der vier Attribute, die alle vier als Defaultwert die leere Zeichenkette **`""`** haben sollen.

Weiterhin sollen öffentliche getter-Methoden für die vier Attribute definiert werden, eine Methode **`input`** zur Eingabe der vier Attribute vom Standard-Zeichen-Eingabestrom sowie eine Methode namens **`to_string`**, die die Adresse als eine einzige Zeichenkette in der Form Straße Hausnummer, Postleitzahl Ort zurück gibt (siehe Beispiele unten).

Definieren Sie keine befreundeten Funktionen oder Klassen!/

Instead of a component/attribute **`city`** in each household and for the house with these households, the complete address of a house should be stored once. The class **`Address`** with four private attributes named **`street`**, **`no`**, **`zip`** and **`city`**, all of type C++ **`string`**, shall be defined.

Define a public overloaded constructor with four parameters to initialise the four attributes, all four should have the empty character string **`""`** as their default value.

Furthermore, define public getter methods for the four attributes, an input method to input the four attributes from the standard character input stream, and a method named **`to_string`** that returns the address as a single string in the form street house number, postcode city (see examples below).

Do not define any **`friend`** functions or classes!

Klasse/Class `House`

Die Klasse House hat ein ganzzahliges Attribut **`number_of_households`** für die Anzahl der Haushalte, ein Zeiger-auf-Zeiger-Attribut **`household`** auf die Haushalte in diesem Haus (definiert als **`Household **household;`**) und die Adresse als Attribut **`address`** vom obigen Typ **`Address`**.

Definieren Sie einen öffentlichen Konstruktor mit einer ganzen Zahl als ersten und einem Objekt vom Typ **`Address`** als zweiten Parameter. Allokieren Sie im Rumpf der Funktion ein Feld von **`number_of_households`** Zeigern (via **`household = new Household*[number_of_households];`**) und

initialisieren alle Zeiger als Nullzeiger.
Definieren Sie eine öffentliche Methode **get_household** mit einer ganzen Zahl **n** als Parameter, die im Rumpf einen Zeiger auf den **n**-ten Haushalt zurück liefert. Definieren Sie einen öffentlichen überladenen unären Operator **[]** mit genau gleicher Funktionalität als Alternative dazu.
Definieren Sie eine öffentliche Methode **set_household** mit einem Zeiger auf einen Haushalt und einer ganzen Zahl **n** als Parameter, die im Rumpf den Haushalt als **n**-ten Haushalt speichert.
Definieren Sie weiterhin die Funktionen zur Ausgabe aller Haushalte in einem Haus einschließlich Ausgabe des Wertes von **this** auf den Standard-Zeichen-Ausgabestrom, das Schreiben aller Daten für ein Haus in eine Datei und das Lesen einer solchen Datei als öffentliche Member-Funktionen **print_all**, **write_to_file** und **read_from_file**.
Ändern Sie beim Schreiben und Lesen der Dateien in der ersten Zeile einer Datei die Kennung von **A4** auf **A5** sowie statt nur der Stadt die komplette Adresse des Hauses.
Erzeugen Sie beim Lesen einer Datei ein neues Objekt vom Typ **House** auf dem Heap (unabhängig vom bestehenden Haus kann das so neu erzeugte Haus eine andere Anzahl an Haushalten haben) und geben einen Zeiger auf dieses am Ende des Einlesens als Funktionswert zurück, im Fehlerfall einen Zeiger auf das vorhandene Objekt.
Löschen Sie bei allen einzelnen Haushalten in den weiteren Zeilen der Datei das Schreiben bzw. das Einlesen der Stadt (siehe separate Datei-Beispiele im Moodle-Kurs dazu).
Definieren Sie keine befreundeten Funktionen oder Klassen!/
The class **House** has an integer attribute **number_of_households** for the number of households, a pointer-to-pointer attribute **household** for the households in this house (defined as **Household **household;**) and the attribute **address** of type **Address** above.
Define a public constructor with an integer as first parameter and an object of type **Address** as second parameter. Allocate an array of **number_of_households** pointers in the body of the function (via **household = new Household*[number_of_households];**) and initialise all pointers as null pointers.
Define a public method **get_household** with an integer **n** as a parameter, which returns a pointer to the **n**-th household in the body.
Define a public overloaded unary **operator[]** with exactly the same functionality as an alternative.
Define a public method **set_household** with a pointer to a household and an integer **n** as a parameter, which saves the household as the **n**-th household in the body.
Further define the functions for outputting all households in a house including outputting the value of **this** to the standard character output stream, writing all data for a house to a file and reading such a file as public member functions **print_all**, **write_to_file** and **read_from_file**.
When writing and reading the files, change the identifier in the first line of a file from **A4** to **A5** and the complete address of the house instead of just the city.
When reading a file, create a new object of type **House** on the heap (regardless of the existing house, the newly created house can have a different number of households) and return a pointer to it at the end of reading, or a pointer to the existing object in the event of an error.
Delete the writing or reading of the city for all individual households in the other lines of the file (see separate file examples in the Moodle course).
Do not define any **friend** functions or classes!

Funktion/Function `main`

Ändern Sie die Funktion so ab, dass Sie einen Zeiger namens **house** vom Typ **House** definieren initialisiert als Nullzeiger und löschen das bisherige Feld von Zeigern auf Haushalte als lokale Variable.
Fügen Sie einen weiteren Menüpunkt **h house initialisation** hinzu, bei dem nach Eingabe der Anzahl der Haushalte in einem Haus und dessen Adresse ein neues Objekt vom Typ **House** auf dem Heap erzeugt wird über einen Konstruktoraufruf.
Die Funktionalitäten für alle Menüpunkte müssen auf Nachrichten an das Objekt vom Typ **House** geändert werden./
Modify the function so that you define a pointer named **house** of type **House** initialised as a null pointer and delete the previous array of pointers to households as local variable.
Add a further menu item **h house initialisation**, where after entering the number of households in a house and its address, a new object of type **House** is created on the heap calling the constructor.
The functionalities of all menu items need to be changed to messages to the object of type **House**.

Hinweise/Notices

Bei den Änderungen im Kode von **main** müssen Sie bei den einzelnen Menüpunkten jeweils entsprechende Nachrichten an das Objekt schicken, auf das der Zeiger **house** zeigt.
Da alle Attribute mit Sichtbarkeit privat definiert sind, müssen Sie mit getter- und setter-Nachrichten statt direkten Zugriffen auf die Attribute arbeiten, bspw. beim Lesen und Schreiben von Daten aus bzw. in Dateien - es sollen wie oben geschrieben keine **friend**-Funktionen oder **friend**-Klassen verwendet werden.
Beachten Sie bei den Parametern der Member-Funktionen, dass ein Parameter entfällt, falls dieser das Objekt ist, an das dieNachricht gesendet wird./
When making changes to the code of **main**, you must send corresponding messages to the object to which pointer **house** points for the individual menu items.
As all attributes are defined with visibility privately, you must work with getter and setter messages instead of direct access to the attributes, e.g. when reading and writing data from or to files - as described above, no **friend** functions or **friend** classes should be used.
Note for the parameters of the member functions that one parameter gets omitted, if it is the object the message is sent to.

Beispiel Programmlauf 1/Example Program Run 1

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE - CLASS VERSION
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
house is a nullptr, please first choose h to initialise a new house
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> h
how many households does the house have? 6
what is the street name? Lotharstraße
what is house number? 65d
what is zip code? 47057
what is the city name? Duisburg Neudorf
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x1d1a00)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 2
how many square metres does the household have? 200
how many persons live in this household? 5
is hot water heated using electricity? (y(es) or n(o)) y
what is the price for one kWh in EUR? 0.3
who is the power supplier? Yello Strom
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x1d1a00)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x1d17a0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 4550.0 kWh
           total annual power costs: 1365.00 EUR
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> i
number of household? 2
what is the description of the power consumer? Washing Machine
how many watt it will have? 2000
how many watt standby it will have? 0
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? w
how many hours it will be operating then? 2
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> i
number of household? 2
what is the description of the power consumer? Office PC
how many watt it will have? 200
how many watt standby it will have? 0.5
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? m
how many hours it will be operating then? 8.5
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x1d1a00)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x1d17a0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Office PC
                              (this: 0x1d5d40)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  2: Washing Machine
                              (this: 0x1d5cf0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5203.3 kWh
           total annual power costs: 1560.98 EUR
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> i
number of household? 2
what is the description of the power consumer? Router
how many watt it will have? 10
how many watt standby it will have? 0
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? d
how many hours it will be operating then? 24
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x1d1a00)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x1d17a0)
                  price for one kWh: 30.00 ct/kWh
```

```
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Router
                              (this: 0x1d6070)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  2: Office PC
                              (this: 0x1d5d40)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Washing Machine
                              (this: 0x1d5cf0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.26 EUR
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 3
how many square metres does the household have? 100
how many persons live in this household? 2
is hot water heated using electricity? (y(es) or n(o)) n
what is the price for one kWh in EUR? 0.4
who is the power supplier? Stadtwerke
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy consumers? 3
number of household to copy to? 4
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
```

```
======================================================================
                                H O U S E
======================================================================
                              (this: 0x1d1a00)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x1d17a0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Router
                              (this: 0x1d6070)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  2: Office PC
                              (this: 0x1d5d40)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Washing Machine
                              (this: 0x1d5cf0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.26 EUR
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x1d6bc0)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1300.0 kWh
           total annual power costs: 520.00 EUR
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> i
number of household? 3
what is the description of the power consumer? LED TV
how many watt it will have? 70
how many watt standby it will have? 0.5
how often it will be used?
daily  (d)
```

```
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? s
how many hours it will be operating then? 2
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> i
number of household? 3
what is the description of the power consumer? Dish Washer
how many watt it will have? 250
how many watt standby it will have? 0
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? d
how many hours it will be operating then? 3.5
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x1d1a00)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x1d17a0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Router
                              (this: 0x1d6070)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  2: Office PC
                              (this: 0x1d5d40)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Washing Machine
                              (this: 0x1d5cf0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
```

```
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.26 EUR
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x1d6bc0)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer
                              (this: 0x1d5f50)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  2: LED TV
                              (this: 0x1d5f00)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 655.28 EUR
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: h1.csv
input separator character: ;
output file "h1.csv" opened...
output file "h1.csv" closed
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> q
```

Beispiel Programmlauf 2/Example Program Run 2

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE - CLASS VERSION
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> h
how many households does the house have? 1
what is the street name? Test Street
what is house number? 2a
what is zip code? 54321
what is the city name? Test City
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x6e1a00)
                            address: Test Street 2a, 54321 Test City
               number of households: 1
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> r
input file name: h1.csv
input separator character: ;
input file "h1.csv" opened...
input file "h1.csv" closed
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x6e5fa0)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e60a0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
```

```
                                  1: Router
                              (this: 0x6e60f0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  2: Office PC
                              (this: 0x6e6140)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Washing Machine
                              (this: 0x6e61c0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.26 EUR
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e6210)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer
                              (this: 0x6e6260)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  2: LED TV
                              (this: 0x6e62b0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 655.28 EUR
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 4
how many square metres does the household have? 50
how many persons live in this household? 3
is hot water heated using electricity? (y(es) or n(o)) y
what is the price for one kWh in EUR? 0.5
who is the power supplier? RWE
```

```
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x6e5fa0)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e60a0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Router
                              (this: 0x6e60f0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  2: Office PC
                              (this: 0x6e6140)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Washing Machine
                              (this: 0x6e61c0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.26 EUR
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e6210)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer
                              (this: 0x6e6260)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  2: LED TV
                              (this: 0x6e62b0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 655.28 EUR
H O U S E H O L D   N O   4   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e5ce0)
                  price for one kWh: 50.00 ct/kWh
                     power supplier: RWE
                      square metres: 50.00 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 2100.0 kWh
           total annual power costs: 1050.00 EUR
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy consumers? 2
number of household to copy to? 4
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy consumers? 3
number of household to copy to? 4
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x6e5fa0)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e60a0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
```

```
----------------------------------------------------------------------
                                  1: Router
                              (this: 0x6e60f0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  2: Office PC
                              (this: 0x6e6140)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Washing Machine
                              (this: 0x6e61c0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.26 EUR
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e6210)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer
                              (this: 0x6e6260)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  2: LED TV
                              (this: 0x6e62b0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 655.28 EUR
H O U S E H O L D   N O   4   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e5ce0)
                  price for one kWh: 50.00 ct/kWh
                     power supplier: RWE
                      square metres: 50.00 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer
                              (this: 0x6e5e20)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
```

```
                 annual consumption: 319.4 kWh
                       annual costs: 159.69 EUR
                                  2: LED TV
                              (this: 0x6e5e70)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 9.42 EUR
                                  3: Router
                              (this: 0x6e5d30)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 43.80 EUR
                                  4: Office PC
                              (this: 0x6e5d80)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 222.64 EUR
                                  5: Washing Machine
                              (this: 0x6e5dd0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 104.00 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 3179.1 kWh
           total annual power costs: 1589.54 EUR
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> u
number of household? 4
which one? 5
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> u
number of household? 4
which one? 4
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x6e5fa0)
                            address: Lotharstraße 65d, 47057 Duisburg Neudorf
               number of households: 6
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e60a0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                 1: Router
                              (this: 0x6e60f0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                 2: Office PC
                              (this: 0x6e6140)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                 3: Washing Machine
                              (this: 0x6e61c0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.26 EUR
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6e6210)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                 1: Dish Washer
                              (this: 0x6e6260)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                 2: LED TV
                              (this: 0x6e62b0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 655.28 EUR
H O U S E H O L D   N O   4   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
```

```
                              (this: 0x6e5ce0)
                  price for one kWh: 50.00 ct/kWh
                     power supplier: RWE
                      square metres: 50.00 qm
                            persons: 3
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer
                              (this: 0x6e5e20)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 159.69 EUR
                                  2: LED TV
                              (this: 0x6e5e70)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 9.42 EUR
                                  3: Washing Machine
                              (this: 0x6e5dd0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 104.00 EUR
                                  4: Router
                              (this: 0x6e5d30)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 43.80 EUR
                                  5: Office PC
                              (this: 0x6e5d80)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 222.64 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 1650.0 kWh
     total annual power consumption: 3179.1 kWh
           total annual power costs: 1589.54 EUR
======================================================================
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: h2.csv
input separator character: #
output file "h2.csv" opened...
output file "h2.csv" closed
q quit
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
```

```
w write data into file
>> q
```

Zuletzt geändert: Samstag, 9. Dezember 2023, 01:13

◄ A4 Upload Teil 1+2/Upload Part 1+2

Direkt zu:

h1.csv ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

A5 Teil 2/Part 2

Klassenvariable/Class Variable

- Fügen Sie der Klasse **`Consumer`** eine statische private Klassenvariable hinzu. In dieser soll die Anzahl aller erzeugten Objekte, also aller Stromverbraucher insgesamt, gezählt werden. Inkrementieren Sie dazu im Rumpf des Konstruktors der Klasse diese Klassenvariable.
- Definieren Sie weiterhin eine statische öffentliche getter-Funktion dieser Klasse, die den Wert dieser Klassenvariable zurück liefert.
- Ergänzen Sie weiterhin in der Methode **`print_all`** der Klasse **`House`** eine Ausgabe, wieviele Stromverbraucher insgesamt in allen Haushalten im Haus zusammen existieren (siehe Beispiele unten)./

- Add a static private class variable to the class **`Consumer`**. The number of all created objects, i.e. all power consumers in total, should be counted in this variable. To do this, increment this class variable in the body of the constructor of the class.
- Also define a static public getter function in this class that returns the value of this class variable.
- In the **`print_all`** method of the class **`House`**, add an output of the total number of power consumers in all households in the house (see examples below).

Destruktoren/Destructors

Erweitern Sie die Klassen **`Address`**, **`Consumer`**, **`Household`** und **`House`** jeweils um einen Destruktor:

- Der Destruktor von **`Address`** soll im Rumpf die Adressdaten ausgeben, den Wert von **`this`**, und dass dieses Objekt gelöscht wird.
- Der Destruktor von **`Consumer`** soll im Rumpf die Beschreibung ausgeben, den Wert von **`this`**, und dass dieses Objekt gelöscht wird. Weiterhin soll die Anzahl der Objekte der Klasse, also die Klassenvariable, dekrementiert werden.
- Der Destruktor von **`Household`** soll im Rumpf alle Stromverbrauches des Haushalts löschen, den Wert von **`this`** ausgeben, und dass dieses Objekt gelöscht wird.
- Der Destruktor von **`House`** soll im Rumpf alle Haushalte löschen, den Wert von **`this`** ausgeben, und dass dieses Objekt gelöscht wird (siehe Beispiele unten)./

Extend the classes **`Address`**, **`Consumer`**, **`Household`** and **`House`** each with a destructor:

- The destructor of **`Address`** shall output the address data in the body, the value of **`this`**, and that this object is deleted.
- The destructor of **`Consumer`** shall output the description in the body, the value of **`this`**, and that this object is deleted. Furthermore, the number of objects in the class, i.e. the class variable, should be decremented.
  The destructor of **`Household`** shall delete all power consumers of the household in its body, output the value of **`this`**, and that this object is deleted.
- The destructor of **`House`** shall delete all households in its body, output the value of `this`, and that this object is deleted (see examples below).

Beispiel Programmlauf 1/Example Program Run 1

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE - CLASS VERSION
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> h
how many households does the house have? 1
what is the street name? Lotharstrasse
what is house number? 123
what is zip code? 47057
what is the city name? Duisburg
Address Lotharstrasse 123, 47057 Duisburg at address 0x62fd30 deleted
Address Lotharstrasse 123, 47057 Duisburg at address 0x62fb80 deleted
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0xdf1a10)
                            address: Lotharstrasse 123, 47057 Duisburg
               number of households: 1
      total number of all consumers: 0
======================================================================
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 0
how many square metres does the household have? 100
how many persons live in this household? 4
is hot water heated using electricity? (y(es) or n(o)) y
what is the price for one kWh in EUR? 0.39
who is the power supplier? Stadtwerke Duisburg
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0xdf1a10)
                            address: Lotharstrasse 123, 47057 Duisburg
               number of households: 1
      total number of all consumers: 0
H O U S E H O L D   N O   0   P O W E R   C O N S U M P T I O N
```

```
----------------------------------------------------------------------
                              (this: 0xdf17b0)
                  price for one kWh: 39.00 ct/kWh
                     power supplier: Stadtwerke Duisburg
                      square metres: 100.00 qm
                            persons: 4
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 2200.0 kWh
     total annual power consumption: 3100.0 kWh
           total annual power costs: 1209.00 EUR
======================================================================
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> i
number of household? 0
what is the description of the power consumer? Notebook
how many watt it will have? 90
how many watt standby it will have? 0
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? d
how many hours it will be operating then? 1
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0xdf1a10)
                            address: Lotharstrasse 123, 47057 Duisburg
               number of households: 1
      total number of all consumers: 1
H O U S E H O L D   N O   0   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xdf17b0)
                  price for one kWh: 39.00 ct/kWh
                     power supplier: Stadtwerke Duisburg
                      square metres: 100.00 qm
                            persons: 4
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Notebook
                              (this: 0xdf5d40)
                  power consumption: 90.00 W
          power consumption standby: 0.00 W
                annual hours of use: 365.00 h
            annual hours of standby: 8395.00 h
                 annual consumption: 32.9 kWh
                       annual costs: 12.81 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
```

```
      power consumption all persons: 2200.0 kWh
     total annual power consumption: 3132.8 kWh
           total annual power costs: 1221.81 EUR
======================================================================
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: h0.csv
input separator character: |
output file "h0.csv" opened...
output file "h0.csv" closed
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> d
Consumer Notebook at address 0xdf5d40 deleted
Household at address 0xdf17b0 deleted
House at address 0xdf1a10 deleted
Address Lotharstrasse 123, 47057 Duisburg at address 0xdf1a10 deleted
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> q
```

Beispiel Programmlauf 2/Example Program Run 2

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE – CLASS VERSION
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> h
how many households does the house have? 1
what is the street name? Lotharstrasse
what is house number? 123
what is zip code? 47057
what is the city name? Duisburg
Address Lotharstrasse 123, 47057 Duisburg at address 0x62fd30 deleted
Address Lotharstrasse 123, 47057 Duisburg at address 0x62fb80 deleted
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> r
input file name: h1.csv
input separator character: ;
input file "h1.csv" opened...
Address Lotharstrasse 65d, 47057 Duisburg Neudorf at address 0x62f730 deleted
Address Lotharstrasse 65d, 47057 Duisburg Neudorf at address 0x62f830 deleted
input file "h1.csv" closed
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0xd95fc0)
                            address: Lotharstrasse 65d, 47057 Duisburg Neudorf
               number of households: 6
      total number of all consumers: 5
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xd960c0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Router
                              (this: 0xd96110)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  2: Office PC
                              (this: 0xd96160)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Washing Machine
                              (this: 0xd961e0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.26 EUR
H O U S E H O L D  N O  3  P O W E R  C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xd96230)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer
                              (this: 0xd96280)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  2: LED TV
                              (this: 0xd962d0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 655.28 EUR
======================================================================
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 4
how many square metres does the household have? 50
how many persons live in this household? 3
is hot water heated using electricity? (y(es) or n(o)) n
what is the price for one kWh in EUR? 0.5
who is the power supplier? RWE
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
```

```
r read data from file
w write data into file
>> c
number of household from which to copy consumers? 2
number of household to copy to? 4
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy consumers? 3
number of household to copy to? 4
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0xd95fc0)
                            address: Lotharstrasse 65d, 47057 Duisburg Neudorf
               number of households: 6
      total number of all consumers: 10
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xd960c0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                  list of consumers
----------------------------------------------------------------------
                                  1: Router
                              (this: 0xd96110)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  2: Office PC
                              (this: 0xd96160)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  3: Washing Machine
                              (this: 0xd961e0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 5290.9 kWh
           total annual power costs: 1587.26 EUR
```

```
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xd96230)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer
                              (this: 0xd96280)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  2: LED TV
                              (this: 0xd962d0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 1638.2 kWh
           total annual power costs: 655.28 EUR
H O U S E H O L D   N O   4   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xd95d10)
                  price for one kWh: 50.00 ct/kWh
                     power supplier: RWE
                      square metres: 50.00 qm
                            persons: 3
     water heated using electricity: no
                  list of consumers
----------------------------------------------------------------------
                                  1: Dish Washer
                              (this: 0xd95e50)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 159.69 EUR
                                  2: LED TV
                              (this: 0xd95ea0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 9.42 EUR
                                  3: Router
                              (this: 0xd95d60)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 43.80 EUR
                                  4: Office PC
                              (this: 0xd95db0)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 222.64 EUR
                                  5: Washing Machine
                              (this: 0xd95e00)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 104.00 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 600.0 kWh
     total annual power consumption: 2129.1 kWh
           total annual power costs: 1064.54 EUR
======================================================================
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> d
Consumer Router at address 0xd96110 deleted
Consumer Office PC at address 0xd96160 deleted
Consumer Washing Machine at address 0xd961e0 deleted
Household at address 0xd960c0 deleted
Consumer Dish Washer at address 0xd96280 deleted
Consumer LED TV at address 0xd962d0 deleted
Household at address 0xd96230 deleted
Consumer Dish Washer at address 0xd95e50 deleted
Consumer LED TV at address 0xd95ea0 deleted
Consumer Router at address 0xd95d60 deleted
Consumer Office PC at address 0xd95db0 deleted
Consumer Washing Machine at address 0xd95e00 deleted
Household at address 0xd95d10 deleted
House at address 0xd95fc0 deleted
Address Lotharstrasse 65d, 47057 Duisburg Neudorf at address 0xd95fc0 deleted
q quit
d delete house
h house initialisation
i input power consumer
u move up power consumer
p print household
a print all households
n new household
c copy all consumers (added to already existing ones)
r read data from file
w write data into file
>> q
```

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◄ A5 Upload Teil 1/Part 1

Direkt zu:

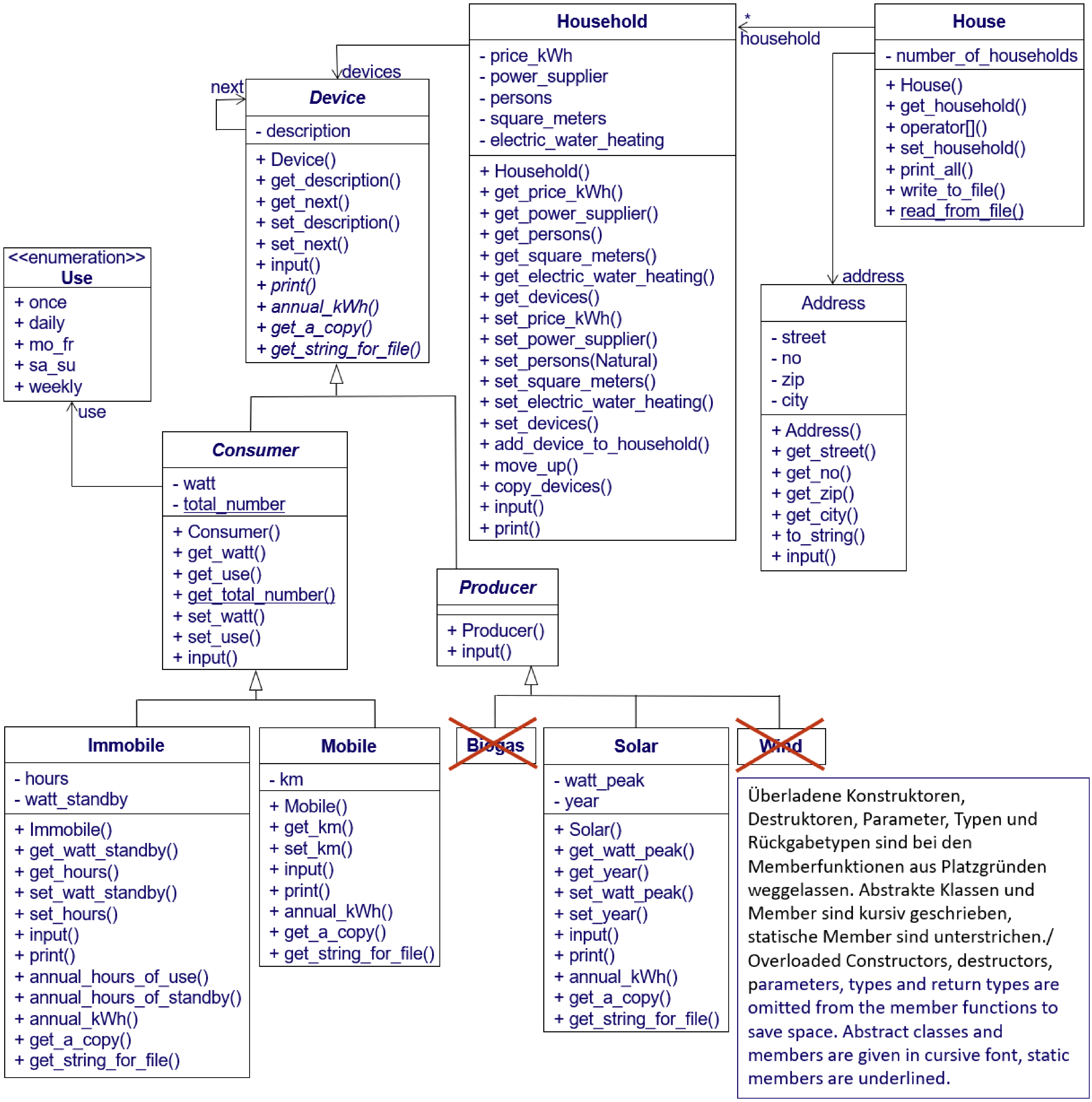
A5 Upload Teil 1+2/Part 1+2 ►

Praktikum Objektorientierte Programmierung in C++ (WS 2023/2024)

A6: Aufgabe zur Abnahme in den Präsenz-Gruppen/Homework for Acceptance in the Presence Groups

In Aufgabe A5 wurden Klassen eingeführt für Stromverbraucher (**`Consumer`**), Haushalte (**`Household`**), Häuser (**`House`**) und deren Adressen (**`Address`**). In Aufgabe A6 soll die Klassenstruktur umgebaut/erweitert werden auf eine Vererbungshierarchie für Geräte (**`Device`**) allgemein, zu denen Stromverbraucher (**`Consumer`**) und Stromerzeuger (**`Producer`**) gehören sollen. Bei den Stromverbrauchern werden mobile (**`Mobile`**) und nicht mobile (**`Immobile`**) unterschieden, als Beispiel für Stromerzeuger sollen Solaranlagen (**`Solar`**) hinzukommen. Das folgende UML-Klassenmodell zeigt die zu programmierenden Klassen mit ihren Membern./

In task A5, classes were introduced for power consumers (**`Consumer`**), households (**`Household`**), houses (**`House`**) and their addresses (**`Address`**). In task A6, the class structure is to be reorganised/extended to a single inheritance hierarchy for devices (**`Device`**) in general, which should include power consumers (**`Consumer`**) and power producers (**`Producer`**). A distinction is made between mobile (**`Mobile`**) and non-mobile (**`Immobile`**) power consumers, and solar systems (**`Solar`**) are to be added as an example of power producers. The following UML class model shows the classes to be programmed with their members.



Überladene Konstruktoren, Destruktoren, Parameter, Typen und Rückgabetypen sind bei den Memberfunktionen aus Platzgründen weggelassen. Abstrakte Klassen und Member sind kursiv geschrieben, statische Member sind unterstrichen./
Overloaded Constructors, destructors, parameters, types and return types are omitted from the member functions to save space. Abstract classes and members are given in cursive font, static members are underlined.

1. Definieren Sie eine abstrakte Klasse mit Namen ***Device*** (Gerät) mit folgenden Membern (verschieben Sie dabei geeignet aus der A5 Klasse **Consumer** die entsprechenden Member):/
   Define an abstract class with name **Device** with the following members (move appropriate members from A5 class **Consumer**):
   - privates Attribut namens **description** vom Typ C++-Zeichenkette./
     private attribute called **description** of type C++ string.
   - privates Zeiger-Attribut namens **next** vom Typ ***Device*** zum Aufbau einer Liste von Geräten (Stromverbraucher und Stromerzeuger in einem Haushalt)./
     private pointer attribute named **next** of type ***Device*** to create a list of devices (power consumers and producers in a household).
   - öffentlicher überladener Konstruktor mit einem Zeiger vom Typ ***Device*** als Parameter und mit Defaultwert Nullzeiger, der das Zeiger-Attribut auf den Parameterwert initialisiert./
     public overloaded constructor with a pointer of type ***Device*** as a parameter with default value null pointer, which initialises the pointer attribute to the parameter value.
   - öffentlicher virtueller Destruktor, der eine Ausgabe wie in den Beispielen unten macht./
     public virtual destructor that produces an output as in the examples below.
   - öffentliche Member-Funktion mit Namen **get_description** ohne Parameter, die den Wert des Zeichenketten-Attributs zurück liefert./
     public member function with name **get_description** without parameter that returns the value of the string attribute.
   - öffentliche Member-Funktion mit Namen **get_next** ohne Parameter, die den Wert des Zeiger-Attributs zurück liefert./
     public member function with name **get_next** without parameter that returns the value of the pointer attribute.

   - öffentliche Member-Funktion mit Namen **set_description** mit einer Zeichenkette als Parameter, die den Wert des Zeichenketten-Attributs auf den Parameterwert setzt./
     public member function with name **set_description** with a string as parameter, which sets the value of the string attribute to the parameter value.
   - öffentliche Member-Funktion mit Namen **set_next** mit einem Zeiger vom Typ ***Device*** als Parameter, die den Wert des Zeiger-Attributs auf den Parameterwert setzt./
     public member function with name **set_next** with a pointer of type ***Device*** as parameter, which sets the value of the pointer attribute to the parameter value.
   - virtuelle öffentliche Member-Funktion mit Namen **input** ohne Parameter und ohne Rückgabe, die eine Bechreibung für das Gerät einliest und im Attribut **description** speichert./
     public virtual member function with name **input** without parameter and without return, which reads in a description for the device and saves it in attribute **description**.
   - öffentliche rein virtuelle, also dynamisch gebundene Member-Funktion mit Namen ***print*** mit einer ganzen Zahl und einer Gleitpunktzahl als Parameter ohne Rückgabe, die in den abgeleiteten Klassen implementiert werden muss./
     public pure virtual, i.e. dynamically bound member function with name ***print*** with an integer and a floating point number as parameters without return, which must be implemented in the derived classes.
   - öffentliche rein virtuelle, also dynamisch gebundene Member-Funktion mit Namen ***annual_kWh*** ohne Parameter und mit einer Gleitpunktzahl als Rückgabe, die in den abgeleiteten Klassen implementiert werden muss./
     public pure virtual, i.e. dynamically bound member function with name ***annual_kWh*** without parameter and with a floating point number as return, which must be implemented in the derived classes.
   - öffentliche rein virtuelle, also dynamisch gebundene Member-Funktion mit Namen ***get_a_copy*** ohne Parameter und mit einem Zeiger vom Typ ***Device*** als Rückgabe, die in den abgeleiteten Klassen implementiert werden muss./
     public pure virtual, i.e. dynamically bound member function with name ***get_a_copy*** without parameter and with a pointer of type ***Device*** as return, which must be implemented in the derived classes.
   - öffentliche rein virtuelle, also dynamisch gebundene Member-Funktion mit Namen ***get_string_for_file*** mit einem Zeichen als Parameter und einer C++-Zeichenkette als Rückgabe, die in den abgeleiteten Klassen implementiert werden muss./
     public pure virtual, i.e. dynamically bound member function named ***get_string_for_file*** with one character as parameter and a C++ string as return, which must be implemented in the derived classes.
2. Ändern Sie die bisherige Klasse ***Consumer*** (Stromverbraucher) aus A5 um in eine abstrakte Klasse öffentlich abgeleitet von der Klasse ***Device*** mit:/
   Change the previous class ***Consumer*** from A5 into an abstract class publicly derived from class ***Device*** with:
   - behalten Sie die beiden privaten Attribute **watt** vom Typ Gleitpunktzahl und **use** vom Aufzählungstyp **Use**./
     keep the two private attributes **watt** of floating point number type and **use** of enumeration type **Use**.
   - fügen Sie eine private statische ganzzahlige Klassenvariable **total_number** hinzu, die mit dem Wert 0 initialisiert werden und die Anzahl der Objekte speichern soll./
     add a private static integer class variable **total_number**, which shall be initialised with value 0 and store the number of objects.
   - Definieren Sie einen öffentlichen überladenen Konstruktor mit einem Zeiger vom Typ ***Device*** als Parameter und mit Defaultwert Nullzeiger zur Initialisierung des Zeiger-Attributs der Oberklasse. Inkrementieren Sie im Rumpf die Klassenvariable, die das erzeugte Objekt mitzählen soll./
     Define a public overloaded constructor with a pointer of type ***Device*** as parameter with default value null pointer to initialise the pointer attribute of the superclass. In the body, increment the class variable counting the created objects.
   - Definieren Sie einen öffentlichen virtuellen Destruktor, der eine Ausgabe wie in den Beispielen unten macht und die Klassenvariable dekrementiert./
     Define a public virtual destructor that produces an output as in the examples below and decrements the class variable.
   - behalten Sie die öffentlichen Memberfunktionen **get_watt**, **get_use**, **set_watt**, **set_use** und fügen eine statische Klassenfunktion **get_total_number** ohne Parameter und mit einer ganzen Zahl als Rückgabe hinzu, die den Wert der Klassenvariable zurück liefert./
     keep the public member functions **get_watt**, **get_use**, **set_watt**, **set_use** and add a static class function **get_total_number** without parameter and with an integer as return, which returns the value of the class variable.
   - virtuelle öffentliche Member-Funktion mit Namen **input** ohne Parameter, die zuerst die gleichnamige Member-Funktion der direkten Oberklasse aufruft und danach eine Wattzahl und die Häufigkeit der Benutzung einliest und in den Attributen **watt** und **use** speichert./
     virtual public member function with the name **input** without parameter, which first calls the member function of the same name of the direct superclass and then reads in a wattage and the frequency of use and saves both in the attributes **watt** and **use**.
3. Definieren Sie eine Klasse **Immobile** (nicht mobiler Stromverbraucher) öffentlich abgeleitet von der abstrakten Klasse ***Consumer*** mit:/
   Define a class **Immobile** (non-mobile power consumer) publicly derived from the abstract class ***Consumer***:
   - verschieben Sie die beiden privaten Attribute **watt_standby** und **hours** vom Typ Gleitpunktzahl (aus der A5 Klasse ***Consumer***) in diese Unterklasse./
     move the two private attributes **watt_standby** and **hours** of type floating point number (from A5 class ***Consumer***) to this subclass.
   - definieren Sie einen öffentlichen überladenen Konstruktor mit einem Zeiger vom Typ ***Device*** als Parameter mit einem Defaultwert Nullzeiger zur Initialisierung des Zeiger-Attributs in der Oberklasse./
     define a public overloaded constructor with a pointer of type ***Device*** as parameter with a default value null pointer for initialising the pointer attribute in the superclass.
   - definieren Sie einen virtuellen öffentlichen Destruktor, der eine Ausgabe wie in den Beispielen unten macht./
     define a virtual public destructor that produces an output as in the examples below.

  - übernehmen Sie Member-Funktionen `get_watt_standby`, `get_hours`, `set_watt_standby`, `set_hours`, `annual_hours_of_use`, `annual_hours_of_standby`, `annual_kWh`, `input` und `print` (aus der Klasse `Consumer` in A5). Passen Sie wo notwendig geeignet an, fügen Sie `print` als zweiten Parameter den Preis für eine Kilowattstunde hinzu, rufen Sie in `input` die gleichnamige Funktion der Oberklasse auf und erfragen danach die Werte der beiden hinzu gekommenen Attribute./
    Take member functions `get_watt_standby`, `get_hours`, `set_watt_standby`, `set_hours`, `annual_hours_of_use`, `annual_hours_of_standby`, `annual_kWh`, `input` and `print` (from the `Consumer` class in A5). Make suitable adjustments where necessary, add the price for a kilowatt hour as a second parameter to `print`, call in function `input` the function of the same name from the superclass and then query the values of the two added attributes.
  - definieren Sie eine virtuelle öffentliche Member-Funktion namens `get_a_copy` ohne Parameter und mit einem Zeiger vom Typ `Device` als Rückgabe. Erzeugen Sie im Rumpf ein neues Objekt der Klasse `Immobile` auf dem Heap, kopieren alle Attributwerte (Hinweis: möglich über eine einzige Anweisung `*kopie = *this;`) und geben die Adresse des Objekts als Funktionswert zurück (die Funktion wird weiter unten benötigt beim Kopieren aller Geräte in einem Haushalt in einen anderen Haushalt)./
    define a virtual public member function called `get_a_copy` without parameter and with a pointer of type `Device` as return. In the body, create a new object of the class `Immobile` on the heap, copy all attribute values (note: possible via a single `*copy = *this;` statement) and return the address of the object as function value (the function is required below when copying all devices in a household to another household).
  - definieren Sie eine virtuelle öffentliche Member-Funktion namens `get_string_for_file` mit einem Zeichen als Parameter und mit einer C++-Zeichenkette als Rückgabe. Konkatenieren Sie im Rumpf eine C++-Zeichenkette beginnend mit `Immobile` und hängen jeweils getrennt über das Zeichen im Parameter als Separatorzeichen die Werte aller Attribute (ausser von `next`) an die Zeichenkette an, so dass Sie (genutzt in der weiter unten definierten Funktion `write_to_file`) die komplette Zeile für dieses Objekt als eine Zeichenkette erhalten und als Funktionswert zurück geben (siehe Beispiele unten und Beispieldateien)./
    define a virtual public member function called `get_string_for_file` with a character as parameter and a C++ string as return. In the body, concatenate a C++ string starting with `Immobile` and append the values of all attributes (except `next`) to the character string separated by the separator character in the parameter, so that you receive a complete line for this object as character string (used in `write_to_file` function defined below) and return it as function value (see examples below and example files).

4. Definieren Sie eine Klasse `Mobile` (mobiler Stromverbraucher wie E-Auto, E-Bike, E-Scooter, ...) öffentlich abgeleitet von der abstrakten Klasse `Consumer` mit:/
   Define a class `Mobile` (mobile power consumer such as e-car, e-bike, e-scooter, ...) publicly derived from the abstract class `Consumer`:
   - definieren Sie ein privates Attribut `km` vom Typ Gleitpunktzahl für die gefahrenen Kilometer./
     define a private attribute `km` of the floating point number type for the kilometres driven.
   - definieren Sie einen öffentlichen überladenen Konstruktor mit einem Zeiger vom Typ `Device` als Parameter mit Defaultwert Nullzeiger zur Initialisierung des Zeiger-Attributs in der Oberklasse./
     define a public overloaded constructor with a pointer of type `Device` as a parameter with default value null pointer to initialise the pointer attribute in the superclass.
   - definieren Sie einen virtuellen öffentlichen Destruktor, der eine Ausgabe wie in den Beispielen unten macht./
     define a virtual public destructor that produces an output as in the examples below.
   - definieren Sie zwei öffentliche Member-Funktionen `get_km` und `set_km`, die den Wert des Attributs zurück liefern bzw. setzen sollen auf den Parameterwert, den `set_km` übergeben bekommt./
     define two public member functions `get_km` and `set_km`, which return the value of the attribute resp. set it to the parameter value passed to `set_km`.
   - definieren Sie eine öffentliche Member-Funktion namens `input` ohne Parameter und ohne Rückgabe. Rufen Sie im Rumpf die gleichnamige Funktion der Oberklasse auf und fragen danach einen Wert für das Attribut `km` ab./
     define a public member function called `input` without parameter and without return. In the body, call the superclass function of the same name and then query for a value for the attribute `km`.
   - definieren Sie eine virtuelle öffentliche Member-Funktion namens `annual_kWh` ohne Parameter und mit einer Gleitpunktzahl als Rückgabe für die im Jahr verbrauchten Kilowattstunden des mobilen Verbrauchers. Berechnen Sie als Rückgabewert im Rumpf ähnlich zu den nicht mobilen Verbrauchern den Jahres-Stromverbrauch über das entsprechend umgerechnete Produkt aus der Häufigkeit der Nutzung multipliziert mit den dabei jeweils gefahrenen Kilometern und mit den auf 100 km verbrauchten Kilowattstunden (siehe Beispiele unten)./
     Define a virtual public member function called `annual_kWh` without parameters and with a floating point number as return for the kilowatt hours consumed by the mobile consumer during the year. Calculate the annual power consumption as return value in the body similar to the non-mobile consumers, using the correspondingly converted product of the frequency of use multiplied by the kilometres driven and the kilowatt hours consumed per 100 km (see examples below).
   - definieren Sie eine virtuelle öffentliche Member-Funktion namens `print` ohne Rückgabe mit einer ganzen Zahl als erstem Parameter (Nummer in der Liste der Geräte) und einer Gleitpunktzahl als zweitem Parameter für den Preis einer Kilowattstunde. Geben Sie im Rumpf analog zu den nicht mobilen Verbrauchern die Nummer aus dem Parameter und die Beschreibung des mobilen Verbrauchers (Attribut `description` der Oberklasse `Device`) aus, die Adresse im Speicher, den Verbrauch an Kilowattstunden auf 100 km (Attribut `watt` der Oberklasse `Consumer` umgerechnet in Kilowatt), die Häufigkeit der Benutzung, die gefahrenen Kilometer, den Jahresverbrauch an Kilowattstunden und die Kosten dafür./
     define a virtual public member function called `print` without return with an integer as the first parameter (number in the list of devices) and a floating point number as the second parameter for the price of a kilowatt hour. In the body in the same way as for non-mobile consumers, output the number from the parameter and the description of the mobile consumer (attribute `description` of the superclass `Device`), the address in the memory, the consumption of kilowatt hours per 100 km (attribute `watt` of the superclass `Consumer` converted to kilowatts), the frequency of use, the kilometres driven, the annual consumption of kilowatt hours and the costs for this.
   - definieren Sie eine virtuelle öffentliche Member-Funktion namens `get_a_copy` ohne Parameter und mit einem Zeiger vom Typ `Device` als Rückgabe. Erzeugen Sie im Rumpf ein neues Objekt der Klasse `Mobile` auf dem Heap, kopieren alle Attributwerte (Hinweis: möglich über eine

einzige Anweisung `*kopie = *this;`) und geben die Adresse des Objekts als Funktionswert zurück (die Funktion wird weiter unten benötigt beim Kopieren aller Geräte in einem Haushalt in einen anderen Haushalt)./
define a virtual public member function called `get_a_copy` without parameter and with a pointer of type ***`Device`*** as return. In the body, create a new object of class `Mobile` on the heap, copy all attribute values (note: possible via a single statement `*copy = *this;`) and return the address of the object as function value (the function is required below when copying all devices in a household to another household).
    - definieren Sie eine virtuelle öffentliche Member-Funktion namens `get_string_for_file` mit einem Zeichen als Parameter und mit einer C++-Zeichenkette als Rückgabe. Konkatenieren im Rumpf eine C++-Zeichenkette beginnend mit `Mobile` und hängen jeweils getrennt über das Zeichen im Parameter als Separatorzeichen die Werte aller Attribute (ausser von `next`) an die Zeichenkette an, so dass Sie (genutzt in der weiter unten definierten Funktion `write_to_file`) die komplette Zeile für dieses Objekt als eine Zeichenkette erhalten und als Funktionswert zurück geben (siehe Beispiele unten und Beispieldateien)./
define a virtual public member function called `get_string_for_file` with a character as parameter and a C++ string as return. In the body, concatenate a C++ character string starting with `Mobile` and append the values of all attributes (except `next`) to the character string separated by the separator character in the parameter, so that you receive a complete line for this object as character string (used in `write_to_file` function defined below) and return it as function value (see examples below and example files).

5. Definieren Sie eine abstrakte Klasse ***`Producer`*** (Stromerzeuger) öffentlich abgeleitet von der Klasse ***`Device`*** mit folgenden Membern:/
Define an abstract class ***`Producer`*** (power generation) publicly derived from the class ***`Device`*** with the following members:
    - öffentlicher überladenen Konstruktor mit einem Zeiger vom Typ ***`Device`*** als Parameter mit Defaultwert Nullzeiger zur Initialisierung des Zeiger-Attributs in der Oberklasse./
public overloaded constructor with a pointer of type ***`Device`*** as a parameter with default value null pointer to initialise the pointer attribute in the superclass.
    - virtueller öffentlicher Destruktor, der eine Ausgabe wie in den Beispielen unten macht./
virtual public destructor that produces an output as in the examples below.
    - öffentliche Member-Funktion namens `input` ohne Parameter und ohne Rückgabe. Rufen Sie im Rumpf nur die gleichnamige Funktion der Oberklasse auf./
public member function called `input` without parameter and without return. In the body, only call the superclass function of same name.
6. Definieren Sie eine Klasse `Solar` (Solaranlage) öffentlich abgeleitet von der abstrakten Klasse ***`Producer`*** mit folgenden Membern:/
Define a class `Solar` (solar plant) publicly derived from the abstract class ***`Producer`*** with the following members:
    - definieren Sie ein privates Attribut namens `watt_peak` vom Typ Gleitpunktzahl für die installierte Leistung der Solaranlage./
define a private attribute called `watt_peak` of type floating point number for the installed power of the solar plant.
    - definieren Sie ein privates ganzzahliges Attribut namens `year` für das Jahr der Installation der Solaranlage./
define a private integer attribute called `year` for the year in which the solar plant was installed.
    - definieren Sie einen öffentlichen überladenen Konstruktor mit einem Zeiger vom Typ ***`Device`*** als Parameter mit Defaultwert Nullzeiger zur Initialisierung des Zeiger-Attributs in der Oberklasse./
define a public overloaded constructor with a pointer of type ***`Device`*** as parameter with default value null pointer to initialise the pointer attribute in the superclass.
    - definieren Sie einen virtuellen öffentlichen Destruktor, der eine Ausgabe wie in den Beispielen unten macht./
define a virtual public destructor that produces an output as in the examples below.
    - definieren Sie vier öffentliche Member-Funktionen `get_watt_peak`, `get_year`, `set_watt_peak` und `set_year`, die die Werte der Attribute zurück liefern bzw. setzen sollen auf die Parameterwerte, die die Setter-Funktionen übergeben bekommen./
define four public member functions `get_watt_peak`, `get_year`, `set_watt_peak` and `set_year`, which return resp. set the values of the attributes to the parameter value that are passed to the setter functions.
    - definieren Sie eine öffentliche Member-Funktion namens `input` ohne Parameter und ohne Rückgabe. Rufen Sie im Rumpf die gleichnamige Funktion der Oberklasse auf und fragen danach Werte für die Attribute `watt_peak` und `year` ab (siehe Beispiele unten)./
define a public member function called `input` without parameter and without return. Call the function of the same name of the superclass in the body and then query values for the attributes `watt_peak` and `year` (see examples below).
    - definieren Sie eine virtuelle öffentliche Member-Funktion namens `annual_kWh` ohne Parameter und mit einer Gleitpunktzahl als Rückgabe für die im Jahr erzeugten Kilowattstunden der Solaranlage. Als Vereinfachung kann für 1 Watt-Peak installierte Leistung 1 Watt berechnet werden. Berücksichtigen Sie bei der Berechnung zusätzlich die durch die Alterung der Solarzellen jedes Jahr um 0.5 % verminderte Leistung, als Beispiel weist also in diesem Jahr 2024 eine im Jahr 2014 installierte Solaranlage einen Verlust von 5 % auf. Geben Sie den Wert für die erzeugten Kilowattstunden mit einem negativen Vorzeichen versehen zurück, so dass bei der Summierung der Kilowattstunden aller Geräte diese erzeugten Kilowattstunden subtrahiert und nicht addiert werden (siehe Beispiele unten)./
define a virtual public member function called `annual_kWh` without parameters and with a floating point number as return for the kilowatt hours generated by the solar plant in the year. As a simplification, 1 watt can be calculated for 1 watt peak of installed solar power. When making the calculation, also take into account a 0.5 % reduction in power output each year due to the ageing of the solar cells; for example, a solar system installed in 2014 will show a loss of 5 % in 2024. Return the value for the generated kilowatt hours with a negative sign so that when the kilowatt hours of all devices are summed up, these generated kilowatt hours are subtracted and not added (see examples below).
    - definieren Sie eine virtuelle öffentliche Member-Funktion namens `print` ohne Rückgabe mit einer ganzen Zahl als erstem Parameter (Nummer in der Liste der Geräte) und einer Gleitpunktzahl als zweitem Parameter für den Preis einer Kilowattstunde. Geben Sie im Rumpf analog zu den Verbrauchern die Nummer aus dem Parameter und die Beschreibung des mobilen Verbrauchers (Attribut `description` der Oberklasse ***`Device`***) aus, die Adresse im Speicher, die installierte Leistung, das Alter der Solaranlage, die jährliche Erzeugungsmenge und die gesparten Kosten (siehe Beispiele unten)./
define a virtual public member function called `print` without return with an integer as the first parameter (number in the list of devices) and a floating point number as second parameter for the price of a kilowatt hour. In the body, analogue to the consumers, print the number from the

  first parameter and the description of the mobile consumer (attribute `description` of the superclass *`Device`*), the address in the memory, the installed power, the age of the solar plant, the annual generation quantity and the costs saved (see examples below).

  - definieren Sie eine virtuelle öffentliche Member-Funktion namens `get_a_copy` ohne Parameter und mit einem Zeiger vom Typ *`Device`* als Rückgabe. Erzeugen Sie im Rumpf ein neues Objekt der Klasse `Solar` auf dem Heap, kopieren alle Attributwerte (Hinweis: möglich über eine einzige Anweisung `*kopie = *this;`) und geben die Adresse des Objekts als Funktionswert zurück (die Funktion wird weiter unten benötigt beim Kopieren aller Geräte in einem Haushalt in einen anderen Haushalt)./
    define a virtual public member function called `get_a_copy` without parameter and with a pointer of type *`Device`* as return. In the body, create a new object of class `Solar` on the heap, copy all attribute values (note: possible via a single `*copy = *this;` statement) and return the address of the object as function value (the function is required below when copying all devices in a household to another household).
  - definieren Sie eine virtuelle öffentliche Member-Funktion namens `get_string_for_file` mit einem Zeichen als Parameter und mit einer C++-Zeichenkette als Rückgabe. Konkatenieren im Rumpf eine C++-Zeichenkette beginnend mit `Solar` und hängen jeweils getrennt über das Zeichen im Parameter als Separatorzeichen die Werte aller Attribute (ausser von `next`) an die Zeichenkette an, so dass Sie (genutzt in der weiter unten definierten Funktion `write_to_file`) die komplette Zeile für dieses Objekt als eine Zeichenkette erhalten und als Funktionswert zurück geben (siehe Beispiele unten und Beispieldateien)./
    define a virtual public member function called `get_string_for_file` with a character as parameter and a C++ string as return. In the body, concatenate a C++ string starting with `Solar` and append the values of all attributes (except `next`) to the character string separated by the separator character in the parameter, so that you receive a complete line for this object as string (used in `write_to_file` function defined below) and return it as function value (see examples below and example files).

7. Ändern Sie in der bisherigen Klasse `Household` (Haushalt) das Attribut `consumers` in ein Attribut namens `devices` vom Basis-Typ *`Device`* um und passen ebenfalls alle Member-Funktionen entsprechend an, also `get_devices`, `set_devices`, `add_device_to_household`, `copy_devices`, `move_up`. Beachten Sie, dass im Unterschied zu `copy_consumers` nun unterschiedliche Objekte in der Liste der Geräte vorkommen. Rufen Sie für eine Kopie der Liste von Geräten in der geänderten Funktion `copy_devices` jeweils die virtuelle Funktion `get_a_copy` für Zeiger auf kopierte Objekte des gleichen Subtyps auf./
   In the previous class `Household`, change the attribute `consumers` to an attribute called `devices` of the base type *`Device`* and also adapt all member functions accordingly, i.e. `get_devices`, `set_devices`, `add_device_to_household`, `copy_devices`, `move_up`. Note that, unlike `copy_consumers`, different objects now appear in the list of devices. Therefore, copying a list of objects in a modified function `copy_devices`, call the virtual function `get_a_copy` to receive pointers to copied objects of the same subtype.
8. In der Klasse `House` müssen die beiden Funktionen zum Schreiben und Lesen von Dateien geändert/erweitert werden./
   In the class `House`, the two functions for writing and reading files must be changed/extended.
   - Ändern Sie in der Member-Funktion `write_to_file` die Versionsnummer am Anfang der Datei auf `A6`. Beim Durchlauf der jeweiligen Listen der Geräte in einem Haushalt können Sie nun einfacher als zuvor jeweils die von einer Nachricht `get_string_for_file` an ein Gerät zurück gelieferte C++-Zeichenkette als Zeile in eine Datei schreiben./
     In the member function `write_to_file`, change the version number at the beginning of the file to `A6`. More easily than before, when running through the respective list of devices in a household, you can write the C++ string returned by a message `get_string_for_file` to a device as a line into the file.
   - Ändern Sie die Funktion `read_from_file` um auf eine statische öffentliche Klassenfunktion, so dass Sie keine Nachricht mehr an ein Objekt senden müssen. Ändern Sie im Rumpf den Fall einer gelesenen Zeile beginnend mit `consumer` auf neu `Immobile` und beginnend mit `household` auf `Household`. Fügen Sie als weitere Fälle gelesene Zeilen beginnend mit `Mobile` und `Solar` hinzu./
     Change function `read_from_file` to a static public class function so that you no longer need to send a message to an object. In the body, change the case for reading a line starting with `consumer` to new `Immobile` and starting with `household` to new `Household`. Add further cases for reading lines starting with `Mobile` and `Solar`.
9. Ändern Sie die Funktion `main` folgendermassen ab:/
   Modify function `main` as follows:
   - Ändern/Ergänzen Sie Menüpunkte für die Eingabe von Geräten:/
     Change/add menu items for inputting devices:
     `i input immobile consumer` (bisher `input consumer`/former `input consumer`)
     `m input mobile consumer`
     `s input solar producer`
   - Rufen Sie im Menüpunkt/Directly call in menue entry
     `r read data from file`
     direkt die entsprechende Klassen-Funktion auf und weisen den von dieser zurück gelieferten Zeiger der Variable für das Haus zu./
     the corresponding class function and assign the pointer returned by it to the variable for the house.

Hinweis

Überlegen Sie, wie Sie Ihr eigenes Programm am besten und geschicktesten schrittweise ändern und erweitern und testen können.
Beispielsweise könnten Sie zuerst `read_from_file` in eine Klassenfunktion umwandeln, in `main` entsprechend ändern und Ihr Programm austesten.
Danach könnten Sie überlegen, erstmal nur die Klassen *`Device`*, *`Consumer`* und `Immobile` auf Basis der vorherigen Version A5 zu programmieren und wieder Ihr Programm nach Änderungen in `main` auszutesten.
Auf dieser Grundlage können Sie dann analog die neuen Klassen *`Producer`*, `Mobile` und `Solar` nach und nach hinzufügen, danach jeweils die Funktionen `write_to_file` und `read_from_file` erweitern und so zum fertigen Programm kommen./

Note

Think about how you can best and most skilfully change and extend and test your own program step by step.
For example, you could first convert `read_from_file` into a class function, change in `main` accordingly and test your program.

Then you could consider programming only the classes ***Device***, ***Consumer*** and **Immobile** on the basis of the previous version A5 and testing your program after modifying **main** again.

On this basis, you can then add the new classes ***Producer***, **Mobile** and **Solar** one by one, afterwards extend functions **write_to_file** and **read_from_file** and thus arrive at the finished program.

Beispiel Programmlauf 1/Example Program Run 1

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE - CLASS VERSION WITH INHERITANCE
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> h
how many households does the house have? 1
what is the street name? Teststrasse
what is house number? 123
what is zip code? 45678
what is the city name? Testort
Address Teststrasse 123, 45678 Testort at address 0x62fd20 deleted
Address Teststrasse 123, 45678 Testort at address 0x62fb70 deleted
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x6c1a00)
                            address: Teststrasse 123, 45678 Testort
               number of households: 1
          total number of consumers: 0
======================================================================
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 0
how many square metres does the household have? 100
how many persons live in this household? 1
is hot water heated using electricity? (y(es) or n(o)) y
what is the price for one kWh in EUR? 0.4
who is the power supplier? RWE
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> a
```

```
======================================================================
                                H O U S E
======================================================================
                              (this: 0x6c1a00)
                            address: Teststrasse 123, 45678 Testort
               number of households: 1
          total number of consumers: 0
H O U S E H O L D   N O   0   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6c17a0)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: RWE
                      square metres: 100.00 qm
                            persons: 1
     water heated using electricity: yes
                    list of devices
----------------------------------------------------------------------
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 550.0 kWh
     total annual power consumption: 1450.0 kWh
           total annual power costs: 580.00 EUR
======================================================================
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> s
number of household? 0
what is the description of the power consumer? Balcony Power Plant
how many watt peak have been installed? 800
in which year the solar modules are installed? 2014
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x6c1a00)
                            address: Teststrasse 123, 45678 Testort
               number of households: 1
          total number of consumers: 0
H O U S E H O L D   N O   0   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6c17a0)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: RWE
                      square metres: 100.00 qm
                            persons: 1
     water heated using electricity: yes
                    list of devices
----------------------------------------------------------------------
                                  1: Balcony Power Plant
                              (this: 0x6c5ce0)
        solar cells installed power: 800.00 watt_peak
                 age of solar cells: 10 years
                  annual production: -760.0 kWh
```

```
                     annual savings: -304.00 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 550.0 kWh
     total annual power consumption: 690.0 kWh
           total annual power costs: 276.00 EUR
======================================================================
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: house1.csv
input separator character: ;
output file "house1.csv" opened...
output file "house1.csv" closed
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> m
number of household? 0
what is the description of the power consumer? E-SUV
how many watt it will have? 21500
how often it will be used?
daily  (d)
mo_fr  (m)
once   (o)
sa_su  (s)
weekly (w)? m
how many km will be driven? 100
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0x6c1a00)
                            address: Teststrasse 123, 45678 Testort
               number of households: 1
          total number of consumers: 1
H O U S E H O L D   N O   0   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0x6c17a0)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: RWE
                      square metres: 100.00 qm
                            persons: 1
     water heated using electricity: yes
```

```
                    list of devices
----------------------------------------------------------------------
                                  1: E-SUV
                              (this: 0x6c5f00)
           power consumption 100 km: 21.50 kW
                          km driven: 100.00 km Monday to Friday
                 annual consumption: 5590.0 kWh
                       annual costs: 2236.00 EUR
                                  2: Balcony Power Plant
                              (this: 0x6c5ce0)
        solar cells installed power: 800.00 watt_peak
                 age of solar cells: 10 years
                  annual production: -760.0 kWh
                     annual savings: -304.00 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 550.0 kWh
     total annual power consumption: 6280.0 kWh
           total annual power costs: 2512.00 EUR
======================================================================
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: house2.csv
input separator character: ;
output file "house2.csv" opened...
output file "house2.csv" closed
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> d
Mobile E-SUV at address 0x6c5f00 deleted
Consumer E-SUV at address 0x6c5f00 deleted
Device E-SUV at address 0x6c5f00 deleted
Solar Balcony Power Plant at address 0x6c5ce0 deleted
Producer Balcony Power Plant at address 0x6c5ce0 deleted
Device Balcony Power Plant at address 0x6c5ce0 deleted
Household at address 0x6c17a0 deleted
House at address 0x6c1a00 deleted
Address Teststrasse 123, 45678 Testort at address 0x6c1a00 deleted
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> a
house is a nullptr, please first choose h to initialise a new house or r to read from file
q quit
```

```
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>>
```

Beispiel Programmlauf 2/Example Program Run 2

```
CALCULATION OF AVERAGE POWER COSTS FOR A HOUSE - CLASS VERSION WITH INHERITANCE
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> a
house is a nullptr, please first choose h to initialise a new house or r to read from file
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> r
input file name: house3.csv
input separator character: ;
input file "house3.csv" opened...
Address Lotharstrasse 65d, 47057 Duisburg Neudorf at address 0x62f6c0 deleted
 is an unknown structure
input file "house3.csv" closed
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> a
=======================================================================
                                H O U S E
=======================================================================
                              (this: 0xf65ef0)
                            address: Lotharstrasse 65d, 47057 Duisburg Neudorf
               number of households: 6
          total number of consumers: 7
H O U S E H O L D  N O  1  P O W E R  C O N S U M P T I O N
-----------------------------------------------------------------------
                              (this: 0xf65fd0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: ENBW
                      square metres: 100.00 qm
                            persons: 1
     water heated using electricity: yes
                    list of devices
-----------------------------------------------------------------------
                                  1: E-Bike
                              (this: 0xf66020)
           power consumption 100 km: 0.50 kW
                          km driven: 100.00 km daily
                 annual consumption: 182.5 kWh
                       annual costs: 54.75 EUR
                                  2: balcony power plant
                              (this: 0xf660d0)
        solar cells installed power: 600.00 watt_peak
                 age of solar cells: 1 years
```

```
                  annual production: -597.0 kWh
                     annual savings: -179.10 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 550.0 kWh
     total annual power consumption: 1035.5 kWh
           total annual power costs: 310.65 EUR
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf66120)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                    list of devices
----------------------------------------------------------------------
                                  1: balcony power plant
                              (this: 0xf66170)
        solar cells installed power: 600.00 watt_peak
                 age of solar cells: 1 years
                  annual production: -597.0 kWh
                     annual savings: -179.10 EUR
                                  2: Router
                              (this: 0xf661f0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  3: Office PC
                              (this: 0xf66250)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  4: Washing Machine
                              (this: 0xf662e0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 4693.9 kWh
           total annual power costs: 1408.16 EUR
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf66340)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                    list of devices
----------------------------------------------------------------------
                                  1: balcony power plant
                              (this: 0xf66390)
        solar cells installed power: 0.80 watt_peak
                 age of solar cells: 2 years
                  annual production: -0.8 kWh
                     annual savings: -0.32 EUR
                                  2: E-SUV
                              (this: 0xf66410)
           power consumption 100 km: 18.00 kW
                          km driven: 100.00 km Monday to Friday
                 annual consumption: 4680.0 kWh
                       annual costs: 1872.00 EUR
                                  3: Dish Washer
                              (this: 0xf66490)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
```

```
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  4: LED TV
                              (this: 0xf664f0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 6317.4 kWh
           total annual power costs: 2526.97 EUR
======================================================================
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> n
number of household? 4
how many square metres does the household have? 50
how many persons live in this household? 2
is hot water heated using electricity? (y(es) or n(o)) y
what is the price for one kWh in EUR? 0.5
who is the power supplier? RWE
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy devices? 2
number of household to copy to? 4
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> c
number of household from which to copy devices? 3
number of household to copy to? 4
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
```

```
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0xf65ef0)
                            address: Lotharstrasse 65d, 47057 Duisburg Neudorf
               number of households: 6
          total number of consumers: 13
H O U S E H O L D   N O   1   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf65fd0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: ENBW
                      square metres: 100.00 qm
                            persons: 1
     water heated using electricity: yes
                    list of devices
----------------------------------------------------------------------
                                  1: E-Bike
                              (this: 0xf66020)
           power consumption 100 km: 0.50 kW
                          km driven: 100.00 km daily
                 annual consumption: 182.5 kWh
                       annual costs: 54.75 EUR
                                  2: balcony power plant
                              (this: 0xf660d0)
        solar cells installed power: 600.00 watt_peak
                 age of solar cells: 1 years
                  annual production: -597.0 kWh
                     annual savings: -179.10 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 550.0 kWh
     total annual power consumption: 1035.5 kWh
           total annual power costs: 310.65 EUR
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf66120)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                    list of devices
----------------------------------------------------------------------
                                  1: balcony power plant
                              (this: 0xf66170)
        solar cells installed power: 600.00 watt_peak
                 age of solar cells: 1 years
                  annual production: -597.0 kWh
                     annual savings: -179.10 EUR
                                  2: Router
                              (this: 0xf661f0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  3: Office PC
                              (this: 0xf66250)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  4: Washing Machine
                              (this: 0xf662e0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 4693.9 kWh
           total annual power costs: 1408.16 EUR
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf66340)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                    list of devices
----------------------------------------------------------------------
                                  1: balcony power plant
                              (this: 0xf66390)
        solar cells installed power: 0.80 watt_peak
                 age of solar cells: 2 years
                  annual production: -0.8 kWh
                     annual savings: -0.32 EUR
                                  2: E-SUV
                              (this: 0xf66410)
           power consumption 100 km: 18.00 kW
                          km driven: 100.00 km Monday to Friday
                 annual consumption: 4680.0 kWh
                       annual costs: 1872.00 EUR
                                  3: Dish Washer
                              (this: 0xf66490)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  4: LED TV
                              (this: 0xf664f0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 6317.4 kWh
           total annual power costs: 2526.97 EUR
H O U S E H O L D   N O   4   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf61a30)
                  price for one kWh: 50.00 ct/kWh
                     power supplier: RWE
                      square metres: 50.00 qm
                            persons: 2
     water heated using electricity: yes
                    list of devices
----------------------------------------------------------------------
                                  1: balcony power plant
                              (this: 0xf65ea0)
        solar cells installed power: 0.80 watt_peak
                 age of solar cells: 2 years
                  annual production: -0.8 kWh
                     annual savings: -0.40 EUR
                                  2: E-SUV
                              (this: 0xf66910)
           power consumption 100 km: 18.00 kW
                          km driven: 100.00 km Monday to Friday
                 annual consumption: 4680.0 kWh
                       annual costs: 2340.00 EUR
                                  3: Dish Washer
                              (this: 0xf66960)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
```

```
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 159.69 EUR
                                  4: LED TV
                              (this: 0xf669c0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 9.42 EUR
                                  5: balcony power plant
                              (this: 0xf65ce0)
        solar cells installed power: 600.00 watt_peak
                 age of solar cells: 1 years
                  annual production: -597.0 kWh
                     annual savings: -298.50 EUR
                                  6: Router
                              (this: 0xf667f0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 43.80 EUR
                                  7: Office PC
                              (this: 0xf66850)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 222.64 EUR
                                  8: Washing Machine
                              (this: 0xf668b0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 104.00 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 1100.0 kWh
     total annual power consumption: 6711.3 kWh
           total annual power costs: 3355.65 EUR
======================================================================
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> u
number of household? 4
which one? 8
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> u
```

```
number of household? 4
which one? 7
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> a
======================================================================
                                H O U S E
======================================================================
                              (this: 0xf65ef0)
                            address: Lotharstrasse 65d, 47057 Duisburg Neudorf
               number of households: 6
          total number of consumers: 13
H O U S E H O L D   N O   1   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf65fd0)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: ENBW
                      square metres: 100.00 qm
                            persons: 1
     water heated using electricity: yes
                    list of devices
----------------------------------------------------------------------
                                  1: E-Bike
                              (this: 0xf66020)
           power consumption 100 km: 0.50 kW
                          km driven: 100.00 km daily
                 annual consumption: 182.5 kWh
                       annual costs: 54.75 EUR
                                  2: balcony power plant
                              (this: 0xf660d0)
        solar cells installed power: 600.00 watt_peak
                 age of solar cells: 1 years
                  annual production: -597.0 kWh
                     annual savings: -179.10 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 550.0 kWh
     total annual power consumption: 1035.5 kWh
           total annual power costs: 310.65 EUR
H O U S E H O L D   N O   2   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf66120)
                  price for one kWh: 30.00 ct/kWh
                     power supplier: Yello Strom
                      square metres: 200.00 qm
                            persons: 5
     water heated using electricity: yes
                    list of devices
----------------------------------------------------------------------
                                  1: balcony power plant
                              (this: 0xf66170)
        solar cells installed power: 600.00 watt_peak
                 age of solar cells: 1 years
                  annual production: -597.0 kWh
                     annual savings: -179.10 EUR
                                  2: Router
                              (this: 0xf661f0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 26.28 EUR
                                  3: Office PC
                              (this: 0xf66250)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 133.58 EUR
                                  4: Washing Machine
                              (this: 0xf662e0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 62.40 EUR
----------------------------------------------------------------------
    power consumption square meters: 1800.0 kWh
      power consumption all persons: 2750.0 kWh
     total annual power consumption: 4693.9 kWh
           total annual power costs: 1408.16 EUR
H O U S E H O L D   N O   3   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf66340)
                  price for one kWh: 40.00 ct/kWh
                     power supplier: Stadtwerke
                      square metres: 100.00 qm
                            persons: 2
     water heated using electricity: no
                    list of devices
----------------------------------------------------------------------
                                  1: balcony power plant
                              (this: 0xf66390)
        solar cells installed power: 0.80 watt_peak
                 age of solar cells: 2 years
                  annual production: -0.8 kWh
                     annual savings: -0.32 EUR
                                  2: E-SUV
                              (this: 0xf66410)
           power consumption 100 km: 18.00 kW
                          km driven: 100.00 km Monday to Friday
                 annual consumption: 4680.0 kWh
                       annual costs: 1872.00 EUR
                                  3: Dish Washer
                              (this: 0xf66490)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 127.75 EUR
                                  4: LED TV
                              (this: 0xf664f0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 7.53 EUR
----------------------------------------------------------------------
    power consumption square meters: 900.0 kWh
      power consumption all persons: 400.0 kWh
     total annual power consumption: 6317.4 kWh
           total annual power costs: 2526.97 EUR
H O U S E H O L D   N O   4   P O W E R   C O N S U M P T I O N
----------------------------------------------------------------------
                              (this: 0xf61a30)
                  price for one kWh: 50.00 ct/kWh
                     power supplier: RWE
                      square metres: 50.00 qm
                            persons: 2
     water heated using electricity: yes
                    list of devices
----------------------------------------------------------------------
                                  1: balcony power plant
                              (this: 0xf65ea0)
        solar cells installed power: 0.80 watt_peak
                 age of solar cells: 2 years
                  annual production: -0.8 kWh
                     annual savings: -0.40 EUR
                                  2: E-SUV
                              (this: 0xf66910)
           power consumption 100 km: 18.00 kW
                          km driven: 100.00 km Monday to Friday
                 annual consumption: 4680.0 kWh
                       annual costs: 2340.00 EUR
                                  3: Dish Washer
                              (this: 0xf66960)
                  power consumption: 250.00 W
          power consumption standby: 0.00 W
                annual hours of use: 1277.50 h
            annual hours of standby: 7482.50 h
                 annual consumption: 319.4 kWh
                       annual costs: 159.69 EUR
                                  4: LED TV
                              (this: 0xf669c0)
                  power consumption: 70.00 W
          power consumption standby: 0.50 W
                annual hours of use: 208.00 h
            annual hours of standby: 8552.00 h
                 annual consumption: 18.8 kWh
                       annual costs: 9.42 EUR
                                  5: balcony power plant
                              (this: 0xf65ce0)
        solar cells installed power: 600.00 watt_peak
                 age of solar cells: 1 years
                  annual production: -597.0 kWh
                     annual savings: -298.50 EUR
                                  6: Washing Machine
                              (this: 0xf668b0)
                  power consumption: 2000.00 W
          power consumption standby: 0.00 W
                annual hours of use: 104.00 h
            annual hours of standby: 8656.00 h
                 annual consumption: 208.0 kWh
                       annual costs: 104.00 EUR
                                  7: Router
                              (this: 0xf667f0)
                  power consumption: 10.00 W
          power consumption standby: 0.00 W
                annual hours of use: 8760.00 h
            annual hours of standby: 0.00 h
                 annual consumption: 87.6 kWh
                       annual costs: 43.80 EUR
                                  8: Office PC
                              (this: 0xf66850)
                  power consumption: 200.00 W
          power consumption standby: 0.50 W
                annual hours of use: 2210.00 h
            annual hours of standby: 6550.00 h
                 annual consumption: 445.3 kWh
                       annual costs: 222.64 EUR
----------------------------------------------------------------------
    power consumption square meters: 450.0 kWh
      power consumption all persons: 1100.0 kWh
     total annual power consumption: 6711.3 kWh
           total annual power costs: 3355.65 EUR
======================================================================
q quit
d delete house
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>> w
input file name: house4.csv
input separator character: |
output file "house4.csv" opened...
output file "house4.csv" closed
q quit
d delete house
```

```
h house initialisation
i input immobile consumer
m input mobile consumer
s input solar producer
u move up device
p print household
a print all households
n new household
c copy all devices (added to already existing ones)
r read data from file
w write data into file
>>
```

Zuletzt geändert: Donnerstag, 18. Januar 2024, 00:47

◄ A5 Upload Teil 1+2/Part 1+2

Direkt zu:

house1.csv ►