

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

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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++-Code 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 Programmcode 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
```

HOUSEHOLD NO 2 POWER CONSUMPTION

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

HOUSEHOLD NO 2 POWER CONSUMPTION

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

HOUSEHOLD NO 5 POWER CONSUMPTION

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](#)

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