Internship Object-Oriented Programming in C++ (WS 2023/2024)

A2 Part 1: Homework task for preparation for the presence group/Part 1: Homework Task for Preparation of the Presence Group

Learning objectives : input/output manipulators, C++ enumerations, new C++ free memory management via **`new`** and **`delete`** , repetition of programming with pointers using the example of a simply linked list./
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.

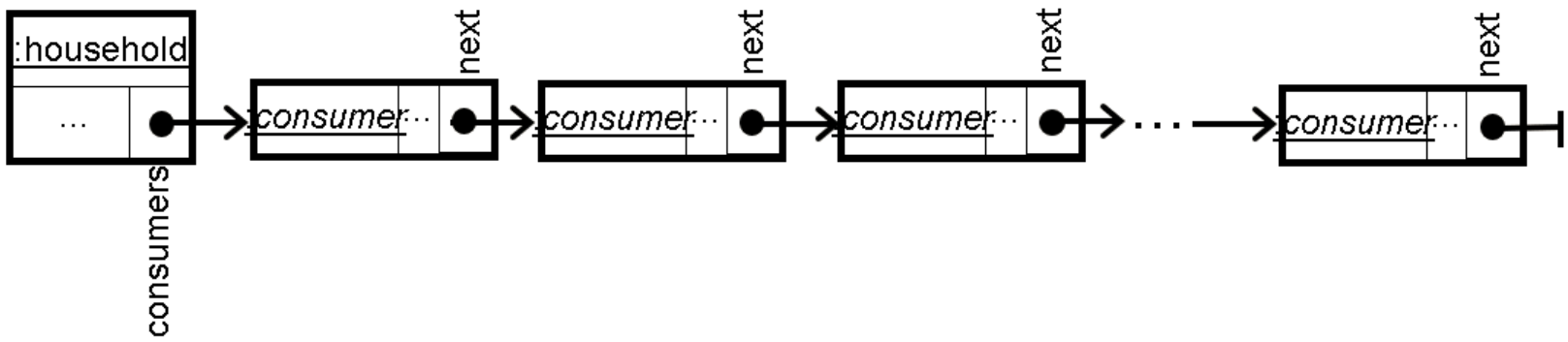
In this task, the lump sum calculation of power consumption for electrical consumers from the previous task A1 is to be further detailed .

Program in detail:/ Program in detail:

1. Define a C++ enumeration named **`Use`** with the enum values **`once`** , **`daily`** , **`mo_fr`** (Monday to Friday), **`sa_su`** (Saturdays and Sundays), and **`weekly`**./ 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. Program a function called **`input_use`** that has a C++ string and a reference of type **`Use`** above as parameters and no return. In the body, a frequency of use should be entered via a small selection menu as shown in the example below and the reference in the second parameter should be assigned the corresponding value from the **`Use`**
   enumeration type above./ 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 menu 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. Define a C++ structure (i.e. without **`typedef`**) called **`consumer`** with the components
   - **`description`** : C++ string for a description of the power consumer.
   - **`watt`** : consumption value of the electricity consumer as a floating point number in the unit watt.
   - **`watt_standby`** : Consumption value of the electricity consumer in standby as a 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 the above **`Use enumeration type`** . - **`next`** : Pointer to a next power consumer in a list of such power consumers./ Define a C++ structure (ie 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. positions in list: 1 2 3 n



Extend the structure for a household **from** task A1 with a pointer called **consumers** of the structure type **consumer** as the head of a list of consumers in the household and delete the integer component for the number of (larger) electrical devices in the household./
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. 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 the body of the function, add the electricity consumer (second parameter) to the list of consumers in the household (first parameter)./
   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. Program a function called **annual_hours_of_use** that takes a pointer to a consumer as a parameter and a floating point number as a return.
   In the body of the function, calculate the number of hours per year that an electricity consumer is switched on. To do this, multiply the number of operating hours when switched on daily by 365 (days), when switched on weekly by 52 (weeks), and when switched on on Saturdays and Sundays by 104 = 2 * 52 (weeks). when switched on on Mondays to Fridays with 260 = 5 * 52 (weeks) and return this value, otherwise when switched on once only the number of operating hours itself (see examples below)./ 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. Program a function called **annual_hours_of_standby** that takes a pointer to a consumer as a parameter and a floating point number as a return.
   In the body of the function, calculate the number of standby hours the consumer has in the year and return the value. This can be easily calculated by subtracting the number of operating hours per year from the 8760 = 365 * 24 hours per year (see examples below)./
   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. Program a function called **annual_kWh** that takes a pointer to an electricity consumer as a parameter and a floating point number as a return.
   In the body of the function, calculate the total consumption of an electricity consumer in the year calculated from the number of operating hours in the year multiplied by the wattage of the 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)./
   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. 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 the body of the function, as shown in the example below, move the consumer at position k in the list one position ahead in the list, i.e. at 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, ie at position **k-1** .
10. / 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. 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 the body of the function, as shown in the example below, write the following data for this consumer to the standard character output

stream, right-aligned with the previously defined constant column width: - the integer passed in the second parameter and, left-aligned after a colon and a space, the
description of the electricity consumer.
- right-aligned the character string **`power consumption`** and after a colon and a space left-aligned the wattage of the power consumer followed by its unit **`W`** (call the function defined above).
- right-aligned the character string **`power consumption standby`** and after a colon and a space left-aligned the standby wattage of the power consumer followed by its unit **`W`** (call the function defined above).
Note: If you have ever used MatLab, you are probably familiar with this type of output of the components of structure variables./
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. Modify your function called **`print_household`** so 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 the body of the function, change the outputs as in the example below so that the respective character strings are written to the standard character output stream flush to the right with the constant column width defined above and the corresponding values are written to the standard character output stream flush to the left after a colon and a space.
To output the list of electricity consumers in the household, program a loop to iterate through the list of electricity consumers.
To output the individual consumers, call the function from the previous subtask and pass a consecutive number as the second parameter.
When calculating annual electricity consumption and costs, delete the flat-rate calculation for the (larger) electrical appliances in the household and instead add up the consumption and costs for each individual consumer in the list in the body of the loop.
Also output the individual values as in the example below to check./
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. Modify the **`main`** function 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 the values of a part of the components for this household as in the example below and
- program a menu with the following functionalities:
    - **`q`** : End of program.
    - **`i : Create a new consumer on the heap, enter the data for it and insert it into the list of consumers of the household via a call to the add_consumer_to_household`** function defined above.
    - **`u`** : Moving a consumer up one position in the list of all consumers via a call to the **`move_up`** function defined above . To do this, read the position number of the consumer in the list from the standard character input stream and pass this to the function as a second parameter.
    - **`p`** : Output 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./
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. .

- **`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.

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 meters does the household have? 100
how many people 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
```

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◄ A1 Upload Teil 1/Part 1

Direkt zu:

A2 Upload Part 1/Part 1 ►