

Technical characteristics of MLIS and MNIS HIO 1.2

The names of the proposed software products are: **Multilingual local instrumental system of housing investment optimization**, version 1.2 (MLIS HIO 1.2) and **Multilingual network instrumental system of housing investment optimization**, version 1.2/upc (MNIS HIO 1.2/upc).

1. General characteristics of the products

1.1. Business benefits

Allowing possibility to any interested users promptly solve their tasks of optimizing the investment in a housing object (apartment or cottage), bought for their own residence in it, as well as tasks of optimizing the choice of a such object for lease.

1.2. Products positioning

Markets of software and network computing services to solve tasks of optimizing purchases and rentals of housing.

1.3. Information about users

Potential users of MLIS HIO 1.2 и MNIS HIO 1.2/upc are all those persons and organizations that deal with the trade of real estate

2. Products overview

Programs **MLIS/MNIS HIO 1.2** are designed to find optimal strategies of selecting a housing object of the required category with two possible purposes:

- 1) for the acquisition of this object for personal use, its possible repair or finishing, as well as purchase for it of a necessary furnishing at the given investment amount (mode of housing *purchase*);
- 2) for its lease at an allowable amount of rental fee (mode of housing *rental*).

MLIS/MNIS HIO 1.2 are multilingual programs. Alternative languages of their interfaces are stored in separate files, called *language shells*. These programs include two such shells: Russian and English, as well as a special program of version 1.0 called "**Генератор языковых оболочек (ГЯО 1.0)** (Generator of language shells (GLS 1.0))", that allows users themselves to create such shells for any languages in which they usually communicate.

MLIS HIO 1.2 is an offline program, designed for a particular user (the lite version of this program is free).

MNIS HIO 1.2/upc is intended to provide network services to many users. This system consists of two parts: one remote module of optimization (MO), which is a part of the Universal processing center (UPC) 9 MNIS 1.0 (that is why the suffix "/upc" is indicated in the name of this MNIS), and numerous automated work places (AWPs) targeted at specific MNIS users. Each such AWP is designed to prepare by a separate user the input data of the tasks to be solved and to output the calculation results, and the synthesis of optimal strategies of investing in a housing object (or of its choice) takes place in the MO. Information link between AWP and MO can be carried out via the Internet, over the local network or even on the computer bus of a single user of AWP. In the first and second cases MO is located on the network server, and in the third - on the computer of the indicated user. At that, there is ensured the operativeness and full automation of the AWP interaction with this module.

MLIS/MNIS HIO 1.2 are created on the basis of a new science-intensive information technology of automation of control of discrete technological and information processes (IT AC DTIP), having many uses, the founder of which is the author of these multilingual programs. A set of lite version of MLIS HIO 1.2 can be downloaded from any of two websites of the author: "Promotion center of IT AC DTIP" (<http://dtip-burlakov.com/en>) and "Implementation center of IT AC DTIP" (<http://dtip-optim.com/en/main>). There also the user can solve remotely up to 10 test tasks in MNIS HIO 1.2/upc.

Area of possible using MLIS/MNIS HIO 1.2 are **real estate companies/agencies, as well as potential buyers and tenants of real estate for later residence in it.**

Year of release these programs – 2017 (year of MNIS update to version 1.2/upc - 2018). Place of development - Kiev (Ukraine).

3. Products functions

MLIS/MNIS HIO 1.2 allow to solve the task of optimizing the investment in a housing object to be bought or of optimizing the choice of a such object to be leased, the formalized statement of which is given below. At the heart of its solution places the method of numerical optimization of discrete processes of service, as well as a unique optimization scheme for such processes, developed by the creator of these programs.

Definition. *A part of the housing object* means its separate premise (a room, a kitchen, a bathroom, etc.) with its possible contents. The last is called *furnishing*, which can include furniture and household appliances. One set of furniture or one household appliance is called here *an element of furnishing*.

Note 1. *Relative factor of influence* of some object (element, property) on anything is calculated as the quotient of dividing the specified value of influence degree of this object to the sum of specified values of influence degrees for all objects of the same class (group).

Note 2. *Utility factor* of some object (element, property) is a subjective quantitative estimate of a user (investor) concerning this object when using it as intended.

Notations in the program description:

- HO - a housing object;
- PHO - a part of housing object;
- RFF - repair or fine finish;
- EF - an element of furnishing.

Notations in the formula for quality criterion:

- subscripts:
 - i - current HO property number; j - current PHO number; k - current PHO EF number;
- superscripts:
 - x - variant of HO (is specified); y - variant of RFF of PHO premise (is found); z - a choice option of PHO EF (is found);
- relative factors:
 - of influence (≤ 1): v_1 - for HO property; v_2 - for PHO; v_{21} - for PHO premise; v_{22} - for PHO furnishing; v_{221} - for one PHO EF;
 - of PHO capacity - kv ;
 - of PHO attractiveness - kp ;
- utility factors (≤ 1): p_1 - for HO property; p_{21} - for PHO premise; p_{211} - for RFF of PHO premise; p_{221} - for one PHO EF;
- for the mode of housing purchase:
 - C - allocated amount of investment; s_0 - cost of services of realtor and notary; s_1 - HO cost; s_2 - стоимость RFF cost for PHO premise; s_3 - cost of one purchasable EF.

The specified investment amount will be spent: 1) on the purchase of HO and payment for the services of realtor and notary; 2) on its possible RFF (optional); 3) on a possible purchase of its furnishing (optional).

Given:

- for the mode of housing purchase:
 - allocated investment amount;
 - cost of services of a realtor and a notary;
- for the mode of housing rental:
 - permissible amount of rental fee per month for HO;
- number of HO variants, for each of which is specified:
 - for the mode of housing purchase - cost of HO;
 - for the mode of housing rental - amount of its rental fee per month;
- nine properties of HO (the first of them refers to the HO itself, and the other eight - to its interconnection with the external environment), for each of which are specified:
 - a fixed parameter - purpose of a property;
 - influence degree of a property on HO (in conventional units);
 - for each variant of HO - utility factor of a property;
- number of PHOs, for each of which are specified:
 - name of PHO;
 - degree of its influence on HO (in conv.un.);

- for each HO variant:
 - relative factor of PHO capacity;
 - relative factor of PHO attractiveness;
 - utility factor of PHO premise;

provided the possible buying of HO furnishing:
(only for the mode of housing purchase)

- for each PHO are specified:
 - influence degree of furnishing on PHO (in conv.un);
 - number of the required PHO EFs, for each of which are specified:
 - name of EF;
 - in the presence of several EFs in PHO - minimum cost of a perfect EF, fully satisfying a tenant;
 - a possible sign of obligatory presence of EF (*);
 - number of choices of EFs, for each of which are specified:
 - cost of EF;
 - factor of EF;

provided the possible HO RFF:
(only for the mode of housing purchase)

- for each HO variant:
 - a possible sign of obligatory RFF of PHO premise;
 - number of RFF variants, for each of which are specified:
 - description of RFF variant;
 - RFF cost;
 - utility factor of RFF.

Maximized quality criteria - integral factor of attractiveness (IFA) of x-th HO variant (we denote it by G^x), depending on indexes y и z, which is calculated by the following formula:

$$G^x = \sum_{i=2}^8 v1_i \cdot p1_i^x + v1_1 \cdot \left\{ \sum_j v2_j \cdot kv_j^x \cdot kp_j^x \cdot [v21_j \cdot (p21_j^x + (1 - p21_j^x) \cdot p211_j^{xy}) + v22_j \cdot \sum_k v221_{jk} \cdot p221_{jk}^{xz}] \right\}$$

provided imposing the following restrictions:

$$s0 + s1^x + \sum_j (s2_j^{xy} + \sum_k s3_{jk}^{xz}) \leq C \quad \forall x.$$

Note 3. For a *perfect* sample of HO of the category in question, which fully satisfies the program user, the value of IFA is always equal to 1. The worse would be the HO, the less will be the value of this integral parameter provided that the user objectively sets different weighting factors in the being solved task. The found therein strategies of investment into various HO variants are sorted in order of decreasing G^x value.

4. Restrictions

maximum number of HO variants - **10** (for lite version of the program MLIS HIO 1.2 - **3**);
 maximum number of PHOs - **20** (for lite version of MLIS - **5**);
 maximum number of EFs for every PHO - **5**;
 maximum number of RFF variants for a PHO premise or of choice variants when buying EF - **3**;
 allowable number of phase states of an optimizable process - **1000000** (for lite version of MLIS - **2000**).

5. Practical application

MLIS/MNIS HIO 1.2 were put into operation in July 2017 (MNIS was updated to version 1.2/upc in July 2018). Now comes the stage of the search for potential dealers and users of these systems.

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