Research of Possibility to Apply Hopfield Neural Net for Solving Schedule Construction Problem

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In a lot of cases schedule construction problem are NP-complete. In this paper we won't stop on cases for which optimal polynomial algorithms exist. Let's note that all such problems are almost degenerated, because they dictate hard limitations to the type of initial partially order relation on the set of processes, computing complexity of processes, number of processors, and a possibility of interrupting execution of process: type of initial relation is forest, equal computing complexity of processes, number of processors is less than three, possibility of interrupting the execution of any process, and resuming the execution on any processor of computing system (CS). Most of real CS and programs do not satisfy such limitation. Deterministic heuristic algorithms don't have an ability of localization of the optimal solution. Algorithms that use the trail and error method don't also have such ability or need a big number of iterations to localize an optimal solution. Application of Hopfield neural net for solving the schedule construction problem is based on its ability of quick localization of the nearest optimum. Different variants of Hopfield neural net for solving the schedule construction problem are researched in this paper.

If Hopfield neural net is used for solving the whole problem (binding and ordering processes on processors are determined by Hopfield neural net) then a problem appears of adding new members to goal function (energy of net) that respond to fines in the case of breaking the claim of acyclic of the schedule or initial partially order on the set of processes. For example, the value of member responding to acyclic of the schedule depends on the length of the contour if it exists. This fact makes the possibility of preliminary tuning of neural net's weights by universal way to be problematic.

Second approach of using Hopfield neural net is based on decomposition of the schedule construction problem into two problems: 1) determination of binding of the processes on processors, 2) determination of order of the processes on every processor. First problem is solved by Hopfield neural net and second one is solved by a quick heuristic algorithm. This approach helps us to avoid the problems existing in the first method of application of Hopfield neural net, but still to have an ability of quick localization of optimum. Possibility of adding a feedback to the chain "Hopfield neural net – heuristic algorithm" is considered for improving work quality and ability of autonomous application of the algorithm. Two variants of adding feedback are considered: directed correction of initial approximation and artificial variation of computing complexity of the processes. The results of numerical research of all considered algorithms will be presented in the report.

Intercoalition Multiple Objective Decision Making for Linear Problems

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In large-scale technical and economical multilevel systems, it is necessary to coordinate the local problems of decision making for departments regarding the interests for whole company. In each subsystem Decision Maker (DM) has his coalition of local objectives. The main DM makes the global choice on the base of all these criteria. Therefore it is required to work out the intercoalition multiple objective methods of agreed decision making. New algorithm for solution of intercoalition multiple objective linear problem of decision making is proposed.

Let us denote by (X, f) an intercoalitional multicriterial linear problem of decision making,

$$X = \{x : \sum_{j=1}^{n} a_{lj} x_j \leq b_l,\ l = \overline{1,m},\ x_j \geq 0,\ j = \overline{1,n}\},$$

$$f = \{f_i(x) = \sum_{j=1}^{n} c_{ij} x_j,\ \ i \in I = \{1, ..., M\}\},$$

where X is the feasible domain and f is the set of criteria.

Let us denote by (X, f^q) the q-local multicriterial linear problem of decision making, where

$$\bigcup_{q \in Q} f^q = f,\ f^q = \{f_{i_q},\ i_q \in I_q = \{1, ..., M_q\}\},$$

$$\bigcup_{q \in Q} I_q = I,\ I_q \cap I_p = \emptyset\ \ \forall p, q \in Q.$$

The problem (X, f) is transformed to solution of problems (X, f^q), $q \in Q$. Then the new multicriterial problem arises to deside whether the number of the criterial functions equals to the number of coalitions.

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A Space Model of War Attrition

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In this paper, the attrition process of two fighting sides is considered. The process is studied on simplex subdivision of a two-dimensional sphere. The following map determines the dynamics of this process:

$$\varphi : Z^{2N} \to Z^{2N}, \quad \varphi = \psi \circ \sigma.$$

Here the map ψ is defined as follows:

$$(\psi_{m,\bar{c}} \circ x)_i = [x_i(1+e^{-\left(c_0 x_i + c_1 x_{i+N} + c_2 \sum_{j\in B_i} x_j + c_3 + c_3 \sum_{j\in B_i} x_{j+N}\right)} - m^{\alpha})],$$

$i < N$, and $(\psi_{m,\bar{c}} \circ x)_i =$

$$= [x_i(1 + e^{-\left(c_0 x_i + c_1 x_{i-N} + c_2 \sum\limits_{j\in B_{i-N}} x_{j+N} + c_3 + c_3 \sum\limits_{j\in B_{i-N}} x_j\right)} - m^{\beta})],$$

$i \geq N$. The map belongs to the family

$$\Psi = \{\psi_{(m,\bar{c})} : m \in (0,1)^2, \bar{c} = (c_0, c_1, c_2, c_3) \in \mathbf{R}^4_+, c_2 < c_0 < c_3 < c_1\},$$

x is the vector of the process state (distribution of units of both sides on the simplices); Z^{2N} presents the set of the process states; $m = (m^{\alpha}, m^{\beta})$, m^{α} and m^{β} are reducing rates of the sides for one step of the process; c_i is reciprocal influence coefficient of the ith unit; $[\cdot]$ is the operator of the rounding for real number to the nearest greater integer; B_i is the set of indexes of the simplices adjacent to the ith simplex.

The map σ determines a redistribution of the units of both sides on the simplices. It is shown that the following lemma and theorem are true.

Lemma. For any trajectory of the process all its points starting from a_n don't leave the cube $[0; R]^{2\times N}$.

Theorem. Any boundary trajectory of the process is either stationary point or periodical orbit.

Let us consider the map $\varphi : R^{2N} \to R^{2N}$. Its restriction to Z^{2N} coincides with ψ. Therefore we omit $[\cdot]$-operator. Further we restrict the set of the maps σ to the set of redistribution of the units on adjacent simplices. The following results are obtained.

For the given map one and only one assertion is valid.

The case A. The map φ has three stationary points:

the 1st point 0 is an unstable knot,

the 2nd point

$$(x_i = -\ln(m_\alpha)/(\alpha_0 + 3\alpha_2),\ i \in \{0, \bar{N}-1\};\quad x_i = 0,\ i \notin \{0, \bar{N}-1\})$$

is a stable knot,

and the 3rd point

$$(x_i = -\ln(m_\beta)/(\alpha_0 + 3\alpha_2),\ i \notin \{0, \bar{N}-1\};\quad x_i = 0,\ i \in \{0, \bar{N}-1\})$$

is a hyperbolic point, its unstable manifold is a curve between 2nd and 3rd points, its stable manifolds are $(N-1)$-dimensional surfaces determined by the basis $\{(1,0,...0)^*, (0,1,0,...0)^*, (0,...0,1,0)^*\}$ and the curve being the normal complement of the aforesaid two manifolds.

The case B. The map has four stationary points:

the 1st point 0 is an unstable knot,

$(x_i = -\ln(m_\alpha)/(\alpha_0 + 3\alpha_2),\ i \in \{0, \bar{N}-1\};\ x_i = 0,\ i \notin \{0, \bar{N}-1\})$ is a stable knot,

$(x_i = -\ln(m_\beta)/(\alpha_0 + 3\alpha_2),\ i \notin \{0, \bar{N}-1\};\ x_i = 0,\ i \in \{0, \bar{N}-1\})$ is a stable knot,

$(x_i > 0\ \forall i)$ is a hyperbolic point, its unstable manifold is a curve between 2nd and 3rd points, its stable manifold is the normal complement of the unstable manifold.

The case C: the quality structure is similar to the case A, the properties of 2nd and 3rd stationary points are changed symmetrically.

Two-person game connected with the process will be considered in the paper.

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Web Implementation of the Multi-Attribute Graphic Search for Preferable Decision Alternatives Given in Large Lists

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The Web application server is considered that supports selecting a small number of decision alternatives from a large list of them. The alternatives are given as rows of a table, which columns are attributes that describe important features of the alternatives. The server applies the technique of the Reasonable Goals Method (RGM) introduced by Gusev and Lotov [1] for the case of a finite number of decision alternatives given in tables. In the RGM, user has first to specify several (from three to seven) attributes as selection criteria. Any alternative is related by this to a point in the criterion space. Then, the convex hull of the Edgeworth-Pareto Hull (CEPH) of the variety of the criterion points, i.e., the convex hull broadened by all dominated criterion points, is approximated and displayed to user in a dialogue. By this user is informed about the choice opportunities and criterion tradeoffs for the whole list of alternatives. User has to identify a preferable point that belongs to the CEPH (a reasonable goal). Then, the decision alternatives that are in line with the identified goal are provided to user.

The Web application server is based on the client-server architecture and uses Java applets and servelets. User has first to prepare a table in a simple form and to paste it into HTML form. This starts the server, which is coded in C and can work in UNIX or WINDOWS NT environment. It computes the polyhedral approximation of the CEPH that is transmitted to user along with the Java applet that provides its interactive visualization. So, visualization is executed at users computer. User explores the CEPH in the form of decision maps that inform user on efficient tradeoff among three selection criteria. Influence of the rest of criteria is studied by manual movement of sliders of scroll-bars or by animation of decision maps, i.e., by automatic movement of sliders. The reasonable goal is identified by a click of computer mouse. The applet transmits the goal to the server, and the server returns selected rows to user. The demo version of the application server has been established now at http://www.ccas.ru/mmes/mmeda/rgdb/index.htm

Customized versions of the application server may be used, say, by clients of e-commerce sites for supporting a graphic search for beneficial goods or services from large lists, like lists of real estate, tourist tours, securities on exchange, etc. Selection of partners for business-to-business relations in electronic marketplaces is possible, too.

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Knowledge Base Update in the Decision Making Process

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Principles of verification of decision tables in the stage of knowledge base revision in the process of generating new rules from experiments under uncertainty are considered. In the process of knowledge acquisition either existing decision tables should be updated or new subtables should be created. The method is suggested to coordinate all the information in the knowledge base.