

Multi-Agent Intelligent Decision Support System

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The development of the Multi-Agent Intelligent Decision Support System (MAIDSS) consisting of software modules that independently solve their private problems and combine their local capabilities to solve a common problem, extends the scope of automation of information processes to poorly formalized areas in which to make informed decisions it is necessary to perform logical inference, analyze large amounts of data and adapt to the conditions of uncertainty and non-stationarity of the environment.

According to the agent-based approach in the MAIDSS a complex problem is reduced into sub-tasks, which are solved by intelligent (applied) software agents. The cognitive data structures, logical inference methods, and artificial neural networks included in the applied software agents allow agents to act rationally and adapt to the environment. The Knowledge Representation and Processing Subsystem (KRPS) and Multi-Agent Reinforcement Learning (MARL) allow applied software agents to accumulate experience through interaction with each other and with the environment [1–8].

To create a highly efficient MAIDSS, it is necessary to develop a subsystem for managing a Distributed Knowledge Base (DKB), which should synthesize the optimal logical structure of the DKB or adapt the existing structure to the changing conditions of non-stationary environment, as well as timely and adequately respond to situations arising from the deficit of computational or time resources.

In order to increase manageability and accessibility of the DKB, the division of stored knowledge base objects into batches – partitions with different physical storage parameters is used. Some fragments of the DKB are of uncertain nature. Automating the processing of such fragments allows modeling complex causal relationships between concepts of some problem domain and increasing the range of sampling by query.

References

1. Zaytsev E.I., Khalabiya R.F., Stepanova I.V., Bunina L.V. Multi-Agent System of Knowledge Representation and Processing // Proceedings of the Fourth International Scientific Conference “Intelligent Information Technologies for Industry” (IITI'19). Vol. 1156. Springer, 2020. P. 131–141. DOI: 10.1007/978-3-030-50097-9_14.
2. Zaytsev E.I., Nurmatova E.V. Approach to knowledge management and the development of a multi-agent knowledge representation and processing system // Russian Technological Journal. 2023. Vol. 11, no. 4. P. 16–25. DOI: 10.32362/2500-316X-2023-11-4-16-25.
3. Nurmatova E.V., Zaitsev E.I. Modeling of objects state estimation on the basis of queries with fuzzy conditions // Engineering Bulletin of Don. 2024. No. 1 (109). (in Russian)
4. Sutton R.S., Barto A.G. Reinforcement Learning: An Introduction. Second Edition. MIT Press, Cambridge, MA, 2018. 552 p.
5. Barreto A., Dabney W., Munos R. et al. Successor features for transfer in reinforcement learning // Proceedings of the 31st International Conference on Neural Information Processing Systems. Curran Associates Inc., 2017. P. 4058–4068. DOI: 10.5555/3294996.3295161.
6. Jurgenson T., Avner O., Groshev E., Tamar A. Sub-goal trees: a framework for goal-based reinforcement learning // Proceedings of the 37th International Conference on Machine Learning. JMLR.org, 2020. Article 466. P. 5020–5030. DOI: 10.5555/3524938.3525404.
7. Zhao R., Sun X., Tresp V. Maximum entropy-regularized multi-goal reinforcement learning // Proceedings of the 36th International Conference on Machine Learning. Vol. 97. PMLR, 2019. P. 7553–7562.
8. Pong V., Gu S., Dalal M., Levine S. Temporal difference models: Model-free deep RL for model-based control // International Conference on Learning Representations, 2018.