Research on Task Analysis Framework for Unconventional Sudden Decision-making Problems

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Abstract: In view of the structural uncertainty, suddenness and unpredictability of the current unconventional sudden decision-making problems, the analysis of the unconventional sudden emergency decision-making task analysis proposes a task analysis from task description to scenario construction and task analysis plan optimization process. In the task analysis, the joint extraction model is used to extract the task entities and the relationship between the task entities in the decision-making problem; the scenario construction is used to supplement the task description and constraint conditions; the cyclic neural network is used to simulate the thinking of the decision maker to complete the task analysis plan optimization. This analysis method adds hidden information such as the environment and constraints in the analysis to the analysis process, which is conducive to improving the suitability of the task analysis plan, and has application and promotion value in the research of task analysis framework for unconventional sudden decision problems.

1. Introduction
Unconventional emergencies have strong unpredictability and complexity, and their evolution presents the complexity and uncertainty of network dynamic systems. Analyzing unconventional and unexpected decision-making problems provides technical support for decision makers to quickly and accurately make an executable task chain.

In the early days, most models such as PCTBTA and GOMS that did not have universal applicability were used to analyze unconventional and unexpected decision-making problems. The GOMS model [1] was realized through the selection of rules; the PCTBTA method [2] analyzes the user’s task world and obtains relevant information about the user, environment and decision-making problem description, and provides data support for guiding decision-making problem modeling. The methods formulated under the traditional model cannot achieve an objective description of the evolution of unconventional sudden decision problems. With the development of network communication and computer technology, scenario construction has applications in the analysis of power safety emergencies [3], the interpretation of group emergencies [4], and the dispatch of emergency supplies [5].

This paper uses the joint extraction model in the knowledge graph to extract the decision-making problem entities and relationships and describe the problem in RDF. The logic description and coupling relationships in the analysis process are described through OWL DL language to perfect the situation. Before inputting the recurrent neural network, it will be based on the situation. The constructed decision-making problem description uses the TRANS E model to vectorize, and finally uses the cyclic neural network to complete the task analysis plan optimization.
2 Task Analysis of Unconventional Sudden Decision Problems

2.1 Basic concepts and principles of task analysis
The definition of mission in "Military Language" is: the goals and responsibilities of the armed forces in combat [6]. In this article, tasks are considered to be a specific set of goals in a certain environment. Before carrying out task analysis, it is necessary to clarify the task objectives, applicable behaviors in task execution, and indicators for judging whether the task is completed. After understanding, the task objectives in the decision-making problem are refined, a series of sub-tasks are generated by analysis. Therefore, task analysis is a process of gradually refining a fuzzy and abstract decision-making problem, and forming a task chain based on certain principles of executable and specific subtasks.

2.1.1. The principle of task granularity
Select the appropriate task granularity when task segmentation. Too large task granularity leads to too general subtasks and no value for task analysis; too small task granularity leads to an increase in the number of subtasks, resulting in data redundancy and affecting execution speed.

2.1.2. The principle of relative independence of subtasks
The sub-tasks should be independent of each other, that is, the coupling between the sub-tasks should be as low as possible, so that the association between the sub-tasks will not generate redundant service costs and time when performing the sub-tasks.

2.1.3. The levels between subtasks should be clear
A task can be subdivided into several subtasks, and subtasks can be subdivided into several lower subtasks. The hierarchy between subtasks should be clear enough.

2.2 Task Analysis of Unconventional Sudden Decision Problems
The results produced during the evolution of unconventional sudden decision-making problems have an impact on subsequent evolution. Therefore, it is necessary to consider the current state of unconventional sudden decision-making problems in a timely and dynamically reflect the current state of evolution. Except that it is no different from conventional decision-making problem task analysis. Unconventional sudden decision problems have the characteristics of structural uncertainty, suddenness and unpredictability, and their development also has obvious complexity. Therefore, the following two need to be considered when analyzing unconventional sudden decision problems Features:

2.2.1. Relatively high coupling
Due to the structural uncertainty of unconventional and sudden decision-making problems, the development process of unconventional and sudden decision-making problems will produce one-cause and multiple-effect or one-effect and multiple-cause situations, so unconventional and sudden decision-making problems are being analyzed The coupling degree between time and subtasks is relatively large.

2.2.2. Bad information collection environment
Due to the suddenness and unpredictability of unconventional and sudden decision-making problems, there may be large missing or large uncertainties in the process of collecting information.

After the above analysis, after the task analysis, we should get a series of task chains composed of subtasks with moderate task granularity, high independence and clear levels.

In order to facilitate research and description, set the total task as T, and the corresponding goals, methods and indicators are represented by G, M, and R respectively. Use formula 1 to express the task set of unconventional emergency task analysis:

\[ S = \{s_1, s_2, \ldots, s_n\} \]  \hspace{1cm} (formula 1)

Among them: \( s_i \), \( i=1,2,\ldots,n \), representing a specific task. \( s_i \) is represented by a matrix:

\[ s_i = \{g_i, m_i, n_i\} \]  \hspace{1cm} (formula 2)
Among them, \( g_i \) represents the target set of task \( i \); \( m_i \) represents the set of all operations of task \( i \); \( n_i \) represents the mutual influence and effect between task \( i \) and other tasks. The task analysis is characterized as a mapping, and the mapping is represented by a function as shown in formula 3:

\[
S = f(G, M, R) \quad (\text{formula 3})
\]

3 Construction of Task Analysis Framework for Unconventional Sudden Decision-making Problems

3.1 Task analysis process of unconventional sudden decision problems

The process of task analysis for unconventional emergent decision-making problems can be divided into three steps in general: ① Description of the task ② Construction of the task scenario ③ Analysis and generation of the task.

3.1.1. Description of the task

At this stage, the entities in the task sentence and the relationships between the entities are extracted, and then the extracted entities and relationships are stored in the RDF storage mode to construct a small semantic network related only to unconventional and sudden decision-making problems. This is the next step — Prepare the scenario.

3.1.2. Scenario construction

In the description stage of the task, constraints such as environment, resources and coupling relations are not expressed. This paper uses OWL DL to describe the constraints in the task analysis of unconventional and sudden decision-making problems. The scenario construction steps are as follows: ① Convert RDF to OWL language. Constraints can be accurately logically described in OWL language; ② The description of constraints in OWL language. According to the experts’ experience and other factors, supplement the background, environment, coupling relationship and other constraints of the OWL file constructed by the initial task sentence, and define the relationship between each entity; ③ Convert OWL to RDF. According to the converted RDF, the changes and defects before and after the scenario construction are observed, and the decision makers are intuitively represented.

3.1.3. Task analysis and generation

After training a large number of samples, When analyzing unconventional sudden decision-making problems, compare the extracted task features with those obtained from training, and perform task analysis and generation. The main tasks are: ① Vectorization. In order to facilitate the understanding of the machine, the RDF is vectorized, and the vector matrix of the task sentence after the scene construction is used as the input of the cyclic neural network; ② The training of the cyclic neural network. The memory function of the cyclic neural network makes the collected information more comprehensive. The RNN is trained in the offline training stage, and the situational data is input in the online monitoring stage to get the results.

The task analysis process of unconventional sudden decision problems is shown in Figure 1.
3.2 Task analysis method for unconventional sudden decision problems

3.2.1 Task description based on information extraction
Task information extraction is divided into entity extraction and relationship extraction. Miwa etc.\cite{8} first applied neural networks to the joint extraction of entities and relationships in 2016. This model captures the associations between tasks by sharing the underlying coding information. Convert the pipeline form into a joint extraction mode. The joint extraction model is shown in Figure 2:

![Figure 2 Joint extraction model](image)

3.2.2 Task scenario construction based on the mutual conversion between RDF and OWL
RDF has limited expressive capabilities and cannot distinguish between categories and objects, define and describe the relationship/attributes of classes; while OWL language can provide flexible data modeling capabilities and efficient automatic reasoning, so OWL can be regarded as an extension of RDF \cite{9}. Steps of constructing ontology: ① Inspect the existing relevant ontology, judge whether the ontology meets the current requirements, and inherit if it meets the requirements; otherwise, define the relevant ontology yourself. ② Construct related ontology classes, attributes, and constraint relationships with the help of experts. ③ Use owl language to formally describe the ontology. ④ Evaluation and inspection of the ontology. The scenario construction flowchart is as follows:
3.2.3. Task recommendation generation based on recurrent neural network

The TRANS E model is used to vectorize RDF, and the vector corresponding to the triple is represented as \((h, r, t)\), where \(h\) represents the vector corresponding to the head entity; \(r\) represents the vector corresponding to the relationship; \(t\) represents the tail entity. The corresponding vector, each entity is a low-dimensional, dense vector. In the ideal situation of the TRANS E model, there will be a \(h+r=t\) relationship between the embeddings of a correct triplet, but there is no such relationship between the wrong triplet. The optimization goal is shown in Figure 4:

![Figure 4 TRANS E target optimization](image)

The vector group is used as the input of the recurrent neural network to judge the similarity between the unconventional sudden task and the training sample, and then generate the recommendation of the task. The task analysis method for unconventional sudden decision problems is shown in Figure 5:
4. Conclusion
This article summarizes the related concepts and analysis methods of unconventional sudden decision-making problems, and proposes task analysis methods to solve unconventional sudden decision-making problems on this basis. This method decomposes the task analysis process of the decision-making problem. In addition to the original task sentence information, hidden information is added as a supplementary description of the task sentence in the scenario construction process, making the final task analysis plan more applicable and the effect of task analysis is effective. The improvement of the company has laid a good foundation for further task planning in the later period. However, there is currently no quantification and specific description of constraints and environmental information, which will have a certain impact on the final result.

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