Semantic network based component organization model for program mining

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Abstract: Based on the definition of component ontology, an effective component classification mechanism and a facet named component relationship are proposed. Then an application domain oriented, hierarchical component organization model is established. At last a hierarchical component semantic network (HCSN) described by ontology interchange language (OIL) is presented and then its function is described. Using HCSN and cooperating with other components retrieving algorithms based on component description, other components information and their assembly or composite modes related to the key component can be found. Based on HCSN, component directory library is catalogued and a prototype system is constructed. The prototype system proves that component library organization based on this model gives guarantee to the reliability of component assembly during program mining.

Key words: component semantic network; agent; program mining; ontology

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1 INTRODUCTION

The reusable component library is an important infrastructure for the software reuse, and component description methods and retrieving techniques are the key points in this research domain. ZHANG et al [1] reported that in large scale component library, in order to ensure the effective precision ratio, recall ratio and use rate, the component expressive scheme should be designed as an expandable and reducible description framework, then proposed an integrated software component description framework and an expandable mechanism through extensible markup language (XML). However the framework can not give other related components information to users or agents. During the process of program mining, users want to get their needed components and more useful information for the components assembly.

ZHANG et al [3,4] took component application domain, component model, component function description and component executing condition etc as facets of component directory organization. For component directory library organization for program mining, an effective component classification mechanism and a facet named component relationship are proposed. By using the ontology interchange language (OIL) [5,6], a function-kernelled model of component organization is presented, and finally a hierarchical component semantic network (HCSN) is formed. HCSN is the basis of effective organization of component library and retrieval of component assembly semantic.

2 FUNCTION-KERNELLED COMPONENT ORGANIZATION MODEL

Regarding component with complex function as coarse granularity component, and component with simple function as fine granularity component, the following hypothesis can be obtained.

Hypothesis The function of the coarse granularity component, which is organized according to different composite modes, is achieved by components with fine granularity. The composite mode of components is executive sequences of components, including sequence, branch, combination and recursion.

Based on the above hypothesis, the relationships among the stored components and their composite modes have to be described in the component library, so that users or agents can well understand the
A complex component is made up of simple components. Only when users or agents fully understand simple component function and their composite modes, it is possible for them to understand the function of complex component better. The component only accomplishes simple function named as meta-component.

Different application domain components are composed of meta-components according to some rules (business rules, business workflow etc.). During the process of program mining, users can have knowledge about how the component works and which algorithms are used by this component, then the search condition of the component includes core algorithms and some composite modes. Because core algorithms and general components are saved as meta-components in the component library, and become one part of other component description, users or agents can find needed components according to meta-components.

Fig. 1 shows the model diagram of function-kernelled component organization. The meta-component layer consists of acceptable standard algorithm and general components description, which are the basis of constructing other components. In the intra-domain component layer, intra-components are formed based on components of meta-component layer according to the business rules of application domain. The inter-domain component layer is formed by the components across different domains, and generally their executive process is distributed, such as Web Service technology.

According to the organization model of component in Fig. 1, description of coarse granularity is based on the meta-component description. Its advantage lies in that this is a kind of coarse granularity component description and not limited by internal execution details of the components, therefore the disadvantage of trivial details of formal description for component function in Ref. [1] can be avoided. Application or complex component can be simply described by using a general logic language based on some meta-components, which is convenient for high efficient execution of the retrieving algorithm based on the component description.

### 3 HIERARCHICAL COMPONENT SEMANTIC NETWORK

Firstly, component classification description based on OIL is proposed. Then relationship among components is defined. Function-kernelled component organization model is described by using OIL, and hierarchical component semantic network is put forward. The description of component with OIL is as follows:

```plaintext
class-def component
  slot-constraint provided-by
    has-value provider
  slot-constraint described-by
    has-value functionDescription
  slot-constraint require
    has-value execCondition
  slot-constraint has
    has-value serviceModel
  slot-constraint belong-to
    has-value application
  slot-constraint exist
    has-value relationship.
```

Provider of components includes information about author names (persons or companies), contact methods and component resource locations etc. Function description of component includes the natural language description of component function, interface regulation of achieving these functions, and the formal description that can concretely achieve every interface based on meta-components. The executive conditions of the component