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Monitoring of dynamically changing graph

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Анапа.

36 слайдов

Monitoring of dynamically changed graph

слайд 2.

A task of graph exploration has a goal to uncover a structure of unknown graph by moving along its arcs. Such task can met in many domains.

Now we regard as possible applications exploration of networks and exploration of Web-application structure.

слайд 3.

We consider graphs can change in due course.

That is why it is necessary not to investigate graphs once, but permanently to trace its changes.

слайд 4.

In 1966 M. O. Rabin posed the problem of directed graph exploration with a finite automaton.

Automaton on a graph is an analogue of the Turing machine — tape cells correspond to graph vertices, where the automaton can store some data, and moves along the tape correspond to moves along graph arcs.

слайд 5.

This system can considered also as an aggregate of finite automata located in graph vertices and interacting by message sending.

Each automaton changes its state according to the data stored in the corresponding vertex, and moves along graph arcs are replaced with messages sent on graph arcs.

слайд 6.

Graph exploration starts from some specified vertex, called root vertex.

Directed graph exploration is not a trivial task.

We suppose that operation time of an automaton is negligibly small and some constant bounds the time of message transport through an arc.

In the worst case it takes time of an order $O(mn)$, where n is the number of graph vertices, m is the number of graph arcs.

This holds for various algorithms of graph exploration based on breadth-first or depth-first traversal.

Messages are both input and output symbols of vertex automata.

If message size and number of each automaton states are bounded globally, all automata are just finite state machines.

Usual graph exploration corresponds to possibility for a single message to have a size linear on the number of vertices.

If message size is bounded globally (finite state machines), the most efficient known algorithm of graph exploration with a single message has worst case working time $O(nm + n^2 \log \log n)$.

If the traversal is repeated by message interchange between automata located in vertices known after the first exploration worst case working time becomes $O(nm + n^2 l(n))$, where $l(n)$ is the number of times logarithm calculation is repeated until $1 \leq \log(\log \dots (n) \dots) < 2$ holds.

слайд 7.

We consider *parallel* graph exploration— many messages can walk through its arcs in parallel.

слайд 8.

Last year we proposed the algorithm for parallel graph exploration. The algorithm builds two spanning trees of the graph: the direct-spanning tree, which has the root vertex as its tree root and is directed from the root, and the back-spanning tree, directed to the root.

слайд 9.

слайд 10.

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слайд 18.

слайд 22.

слайд 32.

слайд 33.

слайд 34.