The Architecture of Intelligent Agent-based Educational System for Training Students in a Technical University

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Research problem statement: development of reasonable design solutions to support education of students in technical fields at Vologda State University.

Basic requirements for the information and educational environment of a technical university:

- Flexibility, openness and scalability
- Interactivity and visualization
- Integration
- Adaptability, etc.

So, electronic learning environment should be complex distributed system with some intellectual capabilities.

One of the effective ways to overcome the complexity of an information system with intellectual behavior is a multi-agent approach.
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Architecture of the intelligent agent-based educational system, agent levels:

- Agent of human-computer interaction
- User agents level:
  - Agent of trainee
  - Agent of teacher-tutor
  - Agent of teacher-expert
  - Agent of main teacher-expert
- Base agents level:
  - Educational process agents
  - Knowledge management agents
  - Administrative agents
  - Test generation and testing agents
  - Semantic Search Agents

To the levels of services (next slide)
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Services level,
Presentation level,
Back-end:
Next, consider in more detail some interesting elements of the educational system:

- Using formal grammars to generate test questions
- Semi-automatic generation of questions from texts in natural language
- Remote workshop on programming and databases
- Plagiarism detection subsystem for the remote workshop
- Elements of adaptive learning
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Generating different variants of questions in tests using formal grammars

More details:
https://elibrary.ru/item.asp?id=36979394
(full text available, in Russian)
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Moscow, Russia
14-17 April, 2020

Generation questions by analyzing texts in a natural language (work in progress)

Textbooks, lecture notes → Text analysis → Test Preparation Environment

Questions generation → Selection, correction, editing → Export of tests → E-learning system

More details:
https://elibrary.ru/item.asp?id=17911140
(full text available, in Russian)
Remote workshop on programming and databases
atpp.vstu.edu.ru/acm
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Subsystem for detection plagiarism in source code

Comparison of compiled object codes instead of source codes is used.

Benefit: effective counteraction to many intentional code modifications, such as:
- replacement of the for loop with while loop, or vice versa:
  \[\text{while}(x < 5) \rightarrow \text{for}();x < 5;\]
- insertion of redundant or never executing code:
  \[x++; x--;\]
  \[\text{if } (\text{false}) \{ \ldots \}\]
- etc.

More details: https://elibrary.ru/item.asp?id=26392154 (full text available, in Russian)

<table>
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<tr>
<th>Date</th>
<th>Author</th>
<th>Problem</th>
<th>Compiler</th>
<th>Result</th>
<th>Test</th>
<th>Points</th>
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Analysis of plagiarism

The similar solution was sent by Ivan Petrov. Similarity is 58.80%.

After visual analysis of sources, teacher should manually define uniqueness of solution.

Result: It is unique. It is NOT unique.

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```cpp
#include <iostream>
#include <vector>
#include <algorithm>
using namespace std;
vector<int> vec;
vector<int> ::iterator it;
int main()
{
  int n=0, k=0,v=0,p=0;
  cin>>n;
  for(int i=0;i<n;i++)
```

```
#include <iostream>
#include <vector>
#include <algorithm>
int main()
{
  int r, q, d;
  std::cin>>r;
  std::vector<int> data(r);
  for(int v=0; v<r; v++)
    std::cin>>data.at(v);
  std::cin>>q>>d;
```
Student should be given assignments according to their skills and abilities.

In order to determine the complexity of a particular problem for a particular student, the recommendation system takes into account:

- solutions of other problems by this student,
- solutions of this problem by another students,
- expert assessment of this problem,
- other data about this student (year of study, etc.)

For classification, a decision tree is constructed.
Thank you for attention!

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