MOODLE INTELLECTUALIZATION

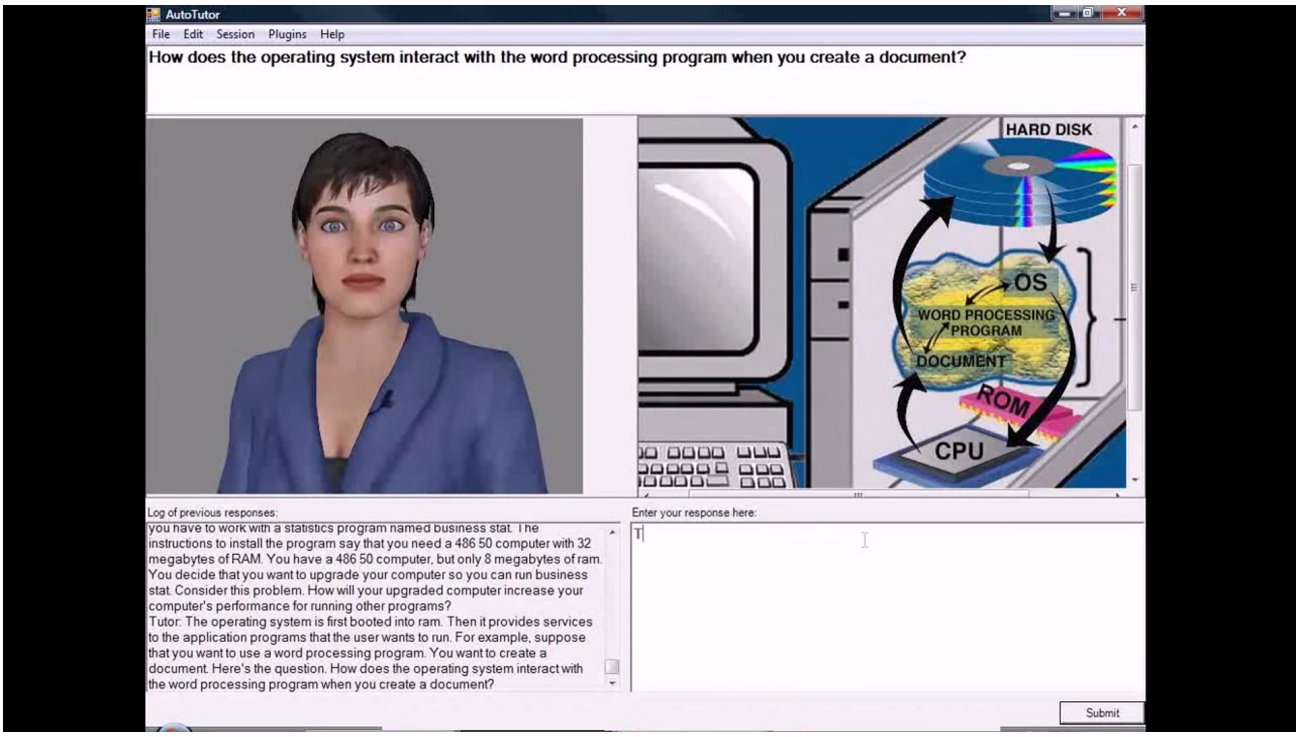
Moodle is one of the most popular today e-learning systems. It has components for multimedia, forums, discussions, e-libraries, and other internet-based features and is available for free.

In last years with the progress in artificial intelligence field developers are starting to implement new generation of intelligent e-learning systems with dialogue natural language interface:

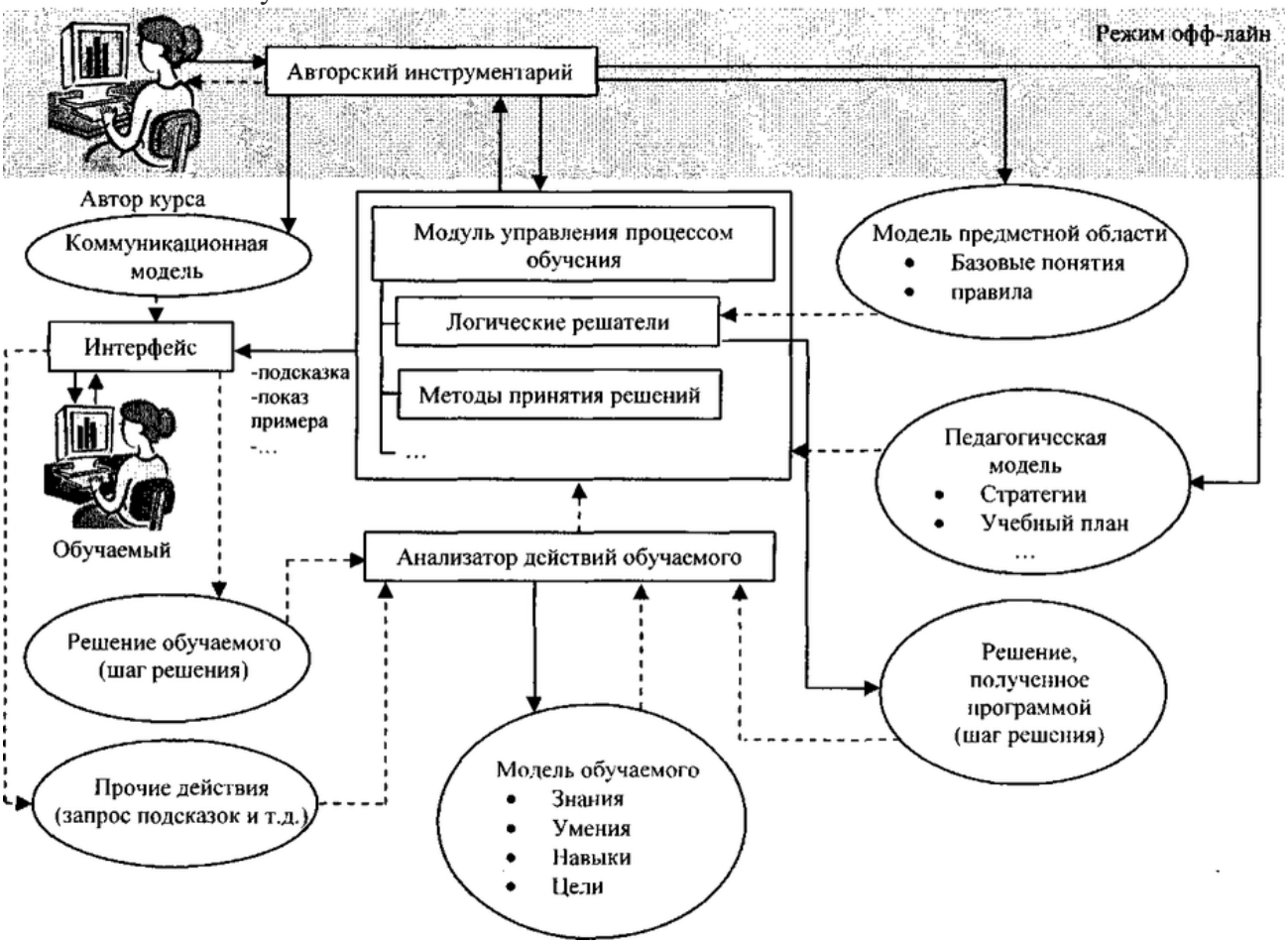
1. Systems are being actively developed (AutoTutor, iSTART, Rimac, Robo-Sensei) that can show an animated character talking with student in natural language. Both keyboard and microphone can be used for input. Some systems can also use camera to react to student's facial expressions.
2. Intelligent learning systems emulate real teacher behavior by forming a sequence of questions based on student's previous answers.
3. Automatic adaptation of learning strategy based on student individual characteristics, entrance test results and current knowledge estimation.
4. Systems can tell students, what exactly is wrong or missing in their answer.
5. Systems provide hints and optionally assist students in their tasks.

Experts estimate efficiency of intelligent systems at least twice as high as of their traditional counterparts.

Example of dialogue from AutoTutor systems:



There are no such systems for Russian language and their direct translation is not possible due to significant differences in languages. In Russia IPU RAN in collaboration with KGTU and other universities are currently developing intellectual e-learning system called “Volga” aimed at math for school and university students.



Volga system chart

In the center of the Volga system there is the “Education process control” (модуль управления процессом обучения) module which uses information coming from “Logical solver” (логические решатели) and “Decision maker” (методы принятия решений) modules.

For new educational material generation modules uses data from modules “Subject area knowledge” (модель предметной области) and “Pedagogical model” (педагогическая модель) which contains Education strategies (стратегии обучения) and Education plan (учебный план). It also uses data about student, coming from modules “Actions analyzer” (анализатор действий обучаемого) and “Student model” (модель обучаемого).

System can solve following school or university exercises:

1) Calculation-based
2) Theorem proving
3) Determining whether something is solvable or not

Subject area knowledge currently used by system solver includes some parts of geometry and mathematical statistics areas. Solver uses this data for answer checking and providing hints.

In the first case “Actions analyzer” would match student answer with closest possible variant and determine whether it is complete and correct.

In the second case the same search in performed and the first incomplete step from solution that was found is shown to student. If it does not help, system will show a sequence of hints until they lead student to completion of his or her task.

Developers of "Volga" stated that they are not ready yet to include natural language processing in their system.

It can be said that not much in happening in russian language e-learning development with natural language processing in the last ten years. Intellectualization focus is mostly placed on adaptive education planning based on student's individual characteristics.

Dialogue-based natural language e-learning systems are expected to differ from dialogue-based systems in other areas such as information retrieval systems.

While answering test questions, students will often try to answer as close as possibly to what teacher is expecting from them, which means that they will usually use same words or even whole phrases as the ones given by teacher. This allows to create a model of answer that will contain most of the elements that students can possibly use in their answer.

This will allow students to enter their answers in natural language and allow system to use parameters such as semantic completeness and correctness while grading answers.

If principles stated earlier are correct, in case of successful material acquisition student answer will not significantly differ from the reference answer.

Natural language processing system development experience have shown that some means for text processing are required that will allow to represent its content in formal language. This requires following:

1. Homonyms resolution.
2. Synonyms resolution.
3. Transforming of complex language constructs into a set of simpler ones. This will allow to unify different variants of these constructs.
4. Transforming sentences into sentences with fixed word order.
5. Coreference resolution.
6. Creation of verb valence dictionary for semantic analysis.

It was decided to use Moodle as a shell for course development and implement intellectialization modules as its plugins.

Final goal of course material and student answer text processing is assessment of student answer correctness. Correctness and depth of answer are calculated based on semantic similarity between student answer and correct answer. If answer is not complete, system should be able to automatically generate additional questions. Final grade is calculated based on main and additional answer grades and their weight coefficients.

First step of text analysis is the extraction of entities such as words, punctuation, numbers, dates, phone numbers, names, formulas and so on.

Then morphological analysis is used to determine word lemmas, part of speech, case, number etc. Homonyms can be found at this step.

After individual words have been analysed, sentences are being analysed to form syntax trees. This will later allow to transform texts to unify possible phrase variations which is required for semantic analysis. "Sentence transformer" module is responsible for this operation.

Last step before semantic analysis is coreference resolution, which means that pronouns have to be replaced with nouns and collocations thet refer to. At the same time this allows to connect sentences into a text.

Based on course plan and student model, system will generate individual education strategy for different students. Student model is a dynamic system which uses data from student psychopedagogical testing module. This data includes information such as studying style, dominating thinking type, levels of attention, memory, and intelligence, as well as needs, motives and possible fears and their reasons. Student model is also based on entrance testing results, which determines how much current student knowledges corresponds to course requirements.

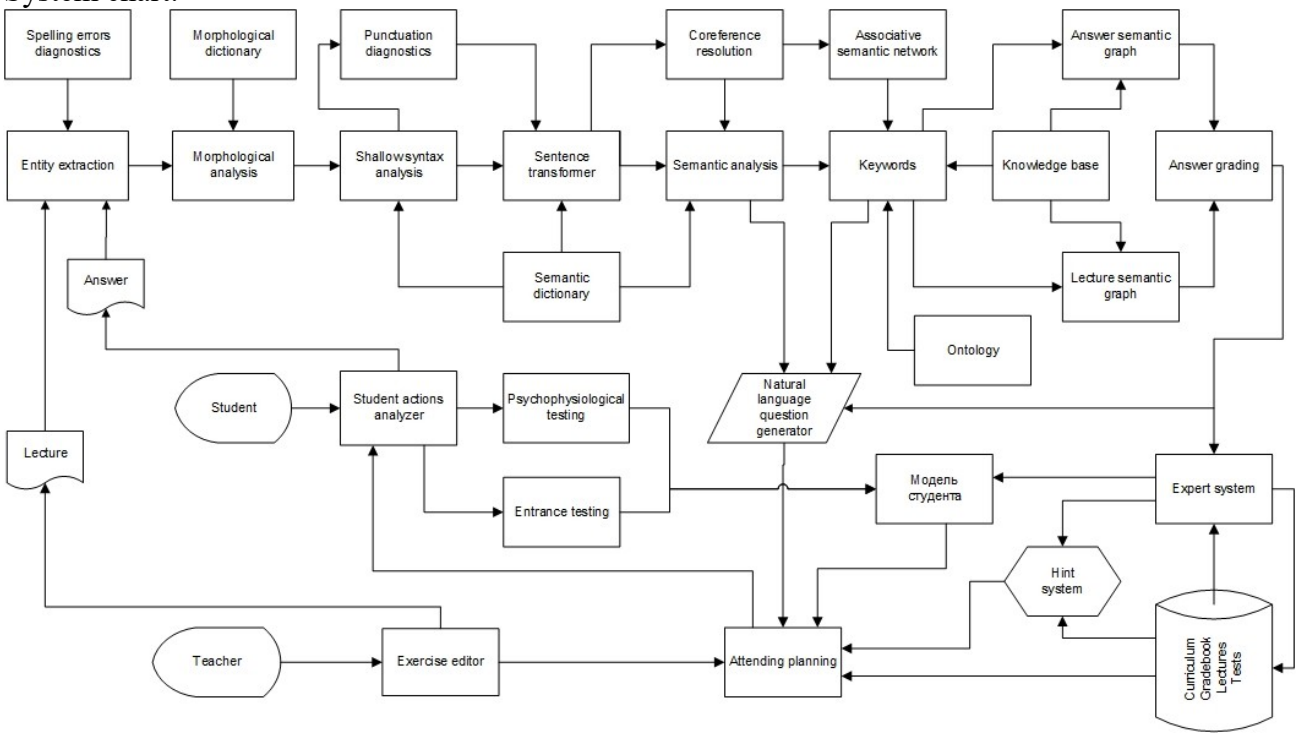
Psychopedagogical testing and entrance testing represent statistical characteristics in student model. To allow for continuing control over education process, system also has to include estimation of current student knowledge into model. This allows to correct education strategy if system detects low student efficiency level.

If student has difficulties completing his task, help system will optionally assist them with a sequence of hints:

1) Theoretical material display.
2) System can show an algorithm used to solve tasks of this type.
3) System can show the answer.

Expert system will send report on task completion status and form recommendations on next possible student actions.

System chart:



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