

Computational Thinking in the Curriculum of Russia

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School system of Russia

- 3 levels of management: federal/regional/local
- **Federal** level: national educational standards, national final examinations (after upper secondary school), indicative curriculums, acceptance of textbooks
- **Regional** level: administration, quality control, human resources development
- **Local** (school) level: curriculum development, choice of textbooks

Informatics as school subject: history in brief

- Existing since 1985
- First motto: “Programming is the second literacy”
- Teachers from industry without pedagogical education
- 1990-es: liberalization of educational system of Russia
- Specialty “Math and Informatics teacher” for higher education
- 2004: First National Standard of secondary education
- 2005: National Final examination on Informatics
- 2010-2012 Second generation of educational standards
- 2016-2019 New indicative curriculums, new sets of textbooks

Educational standards

- 3 levels of primary/secondary school (11 years: 4/5/2)
- Informatics: from upper to lower secondary level
- Examinations – the same way
- 2004 – content (themes, concepts, ideas, terminology)
- 2010/2012 – competency (abilities, skills, educational outputs)
- National curriculum is indicative (adopted 2015)
- National examinations are the main factor determining the content of education

National final examinations

- Started in 2005 as subject of Unified State Examination as both final and entrance examinations
- Non-compulsory subject, still 7% of the whole set of graduates
- Standard for all subjects “paper” testing technology
- Used as a model for 9th grade examination
- After 11th grade – 2 compulsory subjects: Math and Russian
- After 9th grade – mandatory set of 4, 2 compulsory, 2 elective
- Part of 9th grade exam is made on computer (spreadsheet calculation and programming)

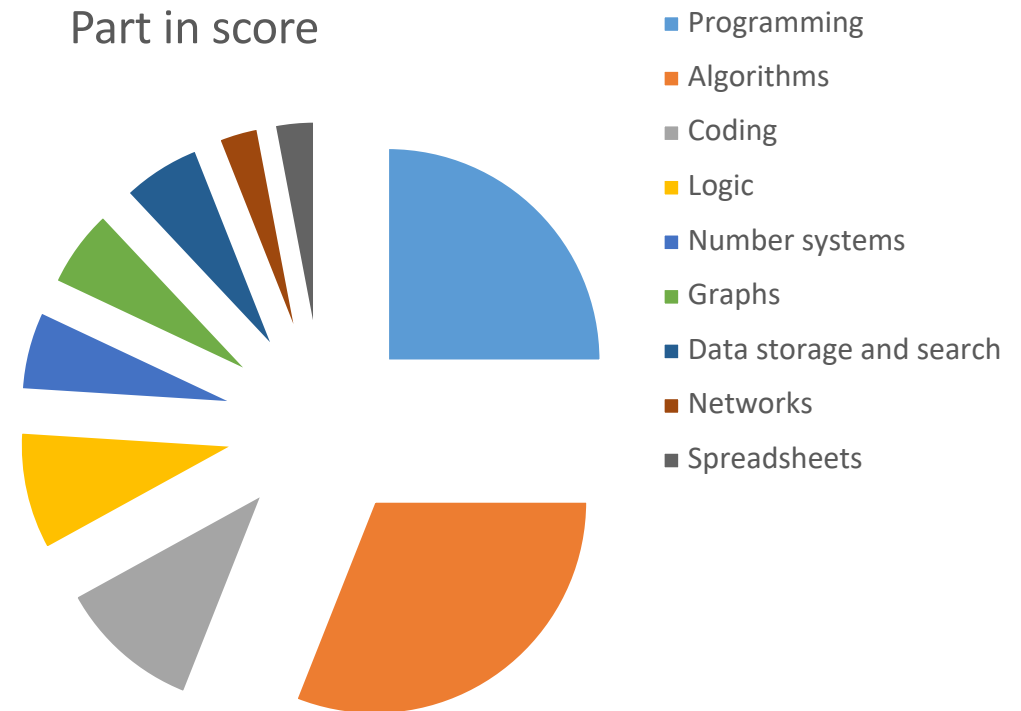
Structure of final examination

- Set of 27 assignments, makes 35 points at least
- Part is automated (23 points), 4 tasks are evaluated by experts (12 p)
- 9 themes (divisions) of the subject are covered
- 3 levels of complexity (basic/medium/high, ratio 34%/37%/29%)

Next slide – structure of subject content covered

Structure of subject themes in examination

Subject theme	Tasks	Part in score
Programming	4	25%
Algorithms	8	31%
Coding	4	11%
Logic	3	9%
Number systems	2	6%
Graphs	2	6%
Data storage and search	2	6%
Networks	1	3%
Spreadsheets	1	3%



Algorithms

- Natural language algorithms
- Recursive algorithms
- Executors of algorithms
- Data array processing
- Algorithm analysis
- Counting the number of algorithms
- The construction of the algorithm
- Winning strategy in the game

The list of algorithms to be studied

- Writing a natural number in the positional system with the base, less than or equal to 10. Processing and converting such a record.
- Finding sums, products of elements of a given finite numerical sequence (or array).
- Using the cycle to solve simple search problems (search the smallest Prime divisor of a given natural number, check numbers for simplicity, etc.).
- Filling of elements of one-dimensional and two-dimensional arrays by given rule.
- Operations with array elements. A linear search of the item. Insertion and deletion elements in the array. A permutation of the elements of this array in reverse order. Summation of array elements. Verification of compliance of elements of the array a certain condition.
- Finding the second largest (second maximum or second minimum) values in this array for a single view array's.
- Finding the minimum (maximum) value in given array and the number of elements equal to it, for a single array view.
- Operations with array elements selected by some condition (for example, finding the minimum even element in an array, finding the number and sum of all even elements in the array).
- Sort the array.
- Merge two ordered arrays into one without using sorts.
- Processing of individual characters of the string. The frequency count the appearance of a character in a string.
- Working with substrings of the given string with the word breaking on whitespace character. Find a substring within a given string, replacement of the found substring with another string.

Mathematical modeling in the curriculum

- The concept of number, positional notation of a number
- Tree, binary tree, family tree, game tree
- Graph, adjacency matrix, representation of graphs in computer programs
- Data structures: variable, string, array, list, tuple
- Boolean expressions and conditional statements, equations
- Finite-state machine (executor of algorithms)
- Dynamic programming method
- Combinations

What is not in the curricula (yet)

- Data structures: stack, queue, chain, set, record
- Machine learning
- Object-oriented programming
- Data analysis

Thank you!

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