Tasks and Training the Youngest Beginners for Informatics Competitions

Emil Kelevedjiev
Zornitsa Dzhenkova
BULGARIA

Competitions in informatics have been continually expanding and involving more and more young students.

- Balkan Youth Olympiad in Informatics for the students up to 15.5 years old.
- Belgrade (Serbia)
- Shumen (Bulgaria)

- In Bulgaria, 2001, we had an age group of 5-7th school grades (11-13 years old children), which we denoted at that time as a “youth age group”.

- Starting at 2002, groups were introduced with letter names: A, B, C, and D, which comprised 11-12, 9-10, 7-8, and 4-6th school grades, respectively (In Bulgarian schools the mentioned grades correspond to 18-19, 16-17, 14-15, 11-13 years old students, respectively).

- Starting at 2004, an additional group for the youngest students was introduced, group E, comprising the 4-5th grades.
- This modified the age division among groups A, B, C, and D, as 12, 11-10, 9-8 and 6-7th grades. Later, our observations showed that it would be better to change slightly this division principles and starting in the autumn of 2007, we have groups A, B, C, D, and E, that cover 11-12, 9-10, 7-8, 6, and 4-5th school grades,respectively.

- A permanently open question, often asked by teachers and trainers, who are involved in the preparation of students from the youngest age group, is the question:

- how to choose suitable tasks?

- The goal is to cover such material that might be expected in real competitions.

- Of course, the style of the olympiads does not always allow good prediction about the task types even for the youngest students.
- Nevertheless, it is possible to outline some set of themes and task types, which can serve as preparation tools.
- One important starting point to do this selection is examining the tasks, given at the previous real competitions.
- Classifying them, it becomes possible to make up manuals and handbooks.

- After having accumulated enough tasks (Bulgarian web portals site competitions in Informatics: http://infoman.musala.com; http://www.math.bas.bg/infos) previously given in competitions, it becomes possible to start an attempt for classification using keywords.
- The chosen keywords indicate some basic features from 3 different points of view:

a) basic concepts of the programming language (mainly concerning C/C++ language)

- simple data types: *numbers*, *symbols*, *strings*, *text* (as a set of strings and delimiters),
- one- and two-dimensional *arrays*, *arrays of strings,*
- some special attention is emphasized on the *sequence of input data* elements;

b) basic control constructions that form a program:

- simple computation by a chosen *formula*,
- *conditional operator* (“if” operator),
- *loop with a counter* (“for” cycle),
- *loop with a condition* (“while” cycle), combination of a loop and an “if” operator,
- *embedded loops*,
- *recursion*,
- reasonable use of *procedures* in programming (functions in C/C++ language);

c) algorithms (with respect to the involved subject):

- whole numbers and *divisibility*,
- digits of a number, *long numbers*,
- combinatory analysis,
- *sorting*,
- *recursion*,
- *geometry* (rectangular shapes with sides which are parallel to the coordinate axis)
- *date* and time intervals

- The choice and the amount of the keywords are not strictly determined.
- We rather assume keywords as abbreviations to point out what is the main essence of the task.

Study of the keywords

- We have studied all tasks given at the Bulgarian competitions during the years 2001–2007:
- Autumn, Winter and Spring Competition, and the three rounds of the National Olympiads in Informatics

Table 1

Data types

Keyword	Number of Tasks
Numbers	62
String	27
One-dimensional array	22
Sequence	13
Characters	10
Text	9
Two-dimensional array	8
Array of strings	3
Stack	2

Table 2

Control constructions

Keyword	Number of Tasks
Loop	73
Embedded loops	35
Loop and conditional operator	18
Conditional operator	17
Function	12
Input and output files	3
Computation by formula	1

Table 3

Algorithms

Keyword	Number of Tasks	Keyword	Number of Tasks
Sequential processing	17	Combinatorial analysis	2
Digits from a number	16	Dynamic programming	2
Print out a figure of characters	12	Games and strategies	2
Counting	11	Geometry	2
Divisibility	10	Number systems	2
Text processing	10	Palindrome	2
Optimal elements	9	Rectangular figures	2
Logical	7	Recursion	2
Dates	6	Decomposing numbers	1
Long numbers	6	Exhaustive search	1
Sorting	4	Fractional numbers	1
Modeling	3	Parity	1
String of digits	3	Raising to a power	1

Trends

- We present diagrams to illustrate observed tendencies for
- monotonic or periodic trends in time appearance of task types (by means of several chosen keywords)
- during the period 2001–2007 in the scene of the Bulgarian national competitions in informatics
- for the age groups of 4–7th grades

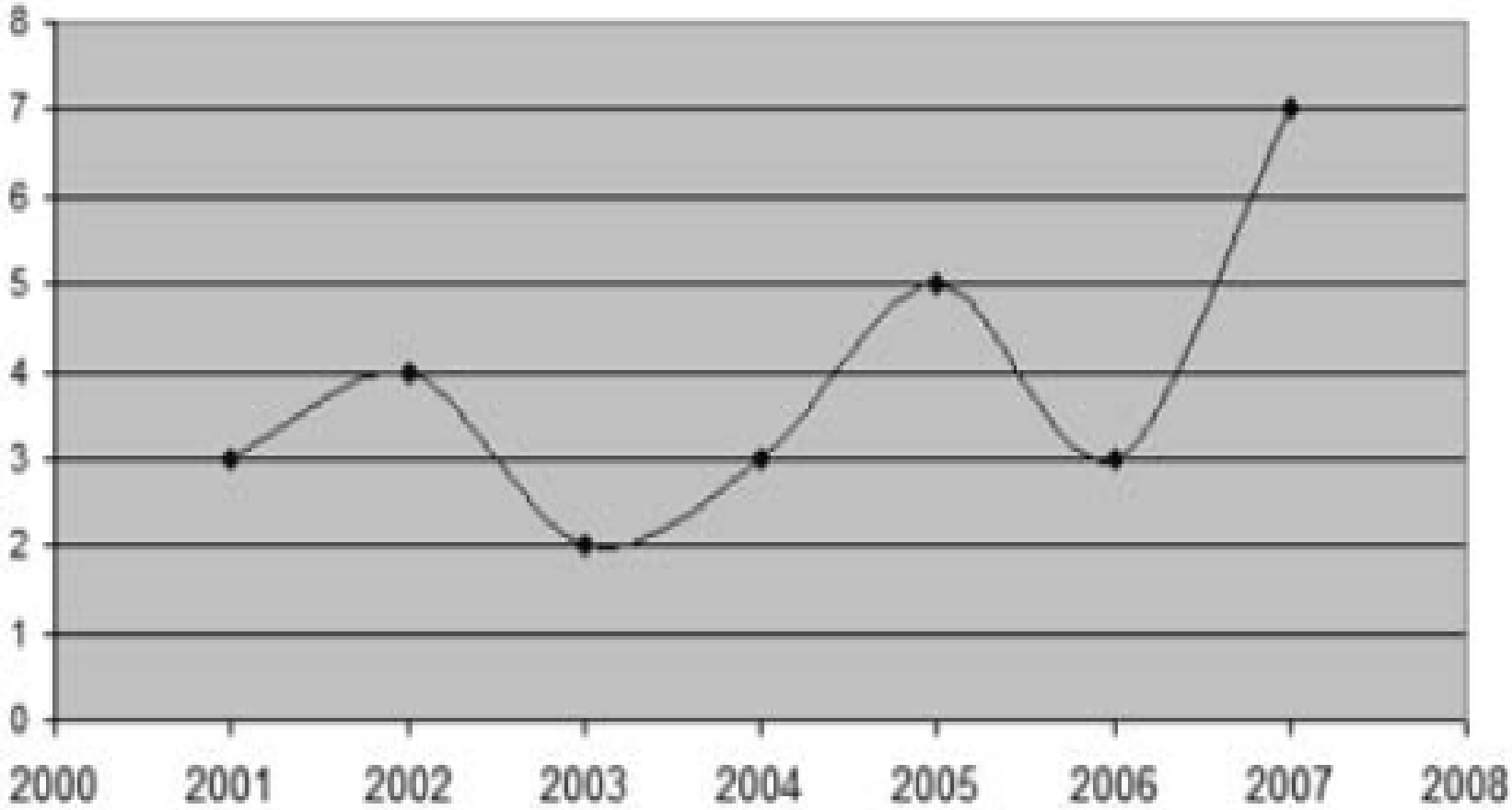

Fig. 1. Keyword: *String*.

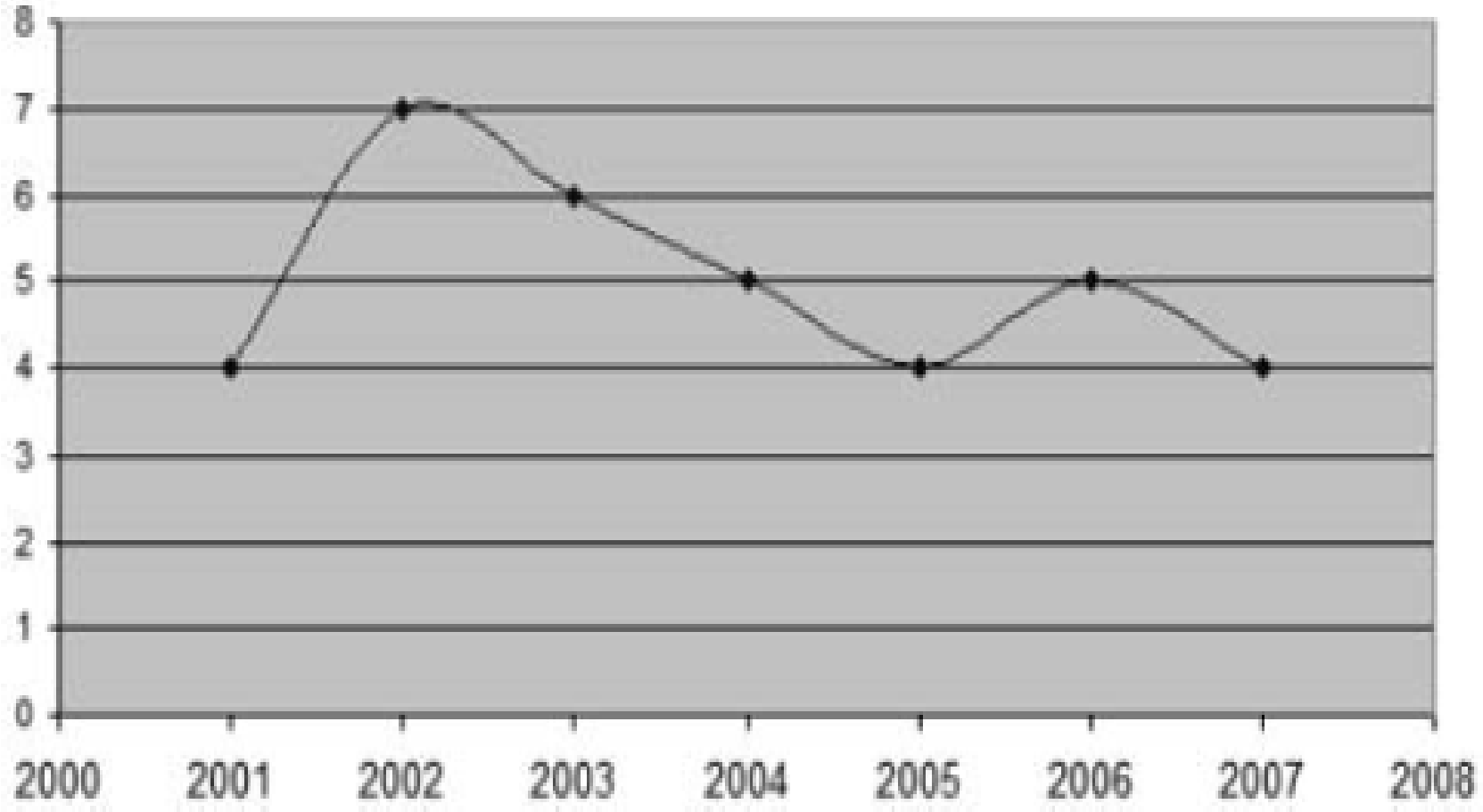

Fig. 2. Keyword: *Embedded loops*.

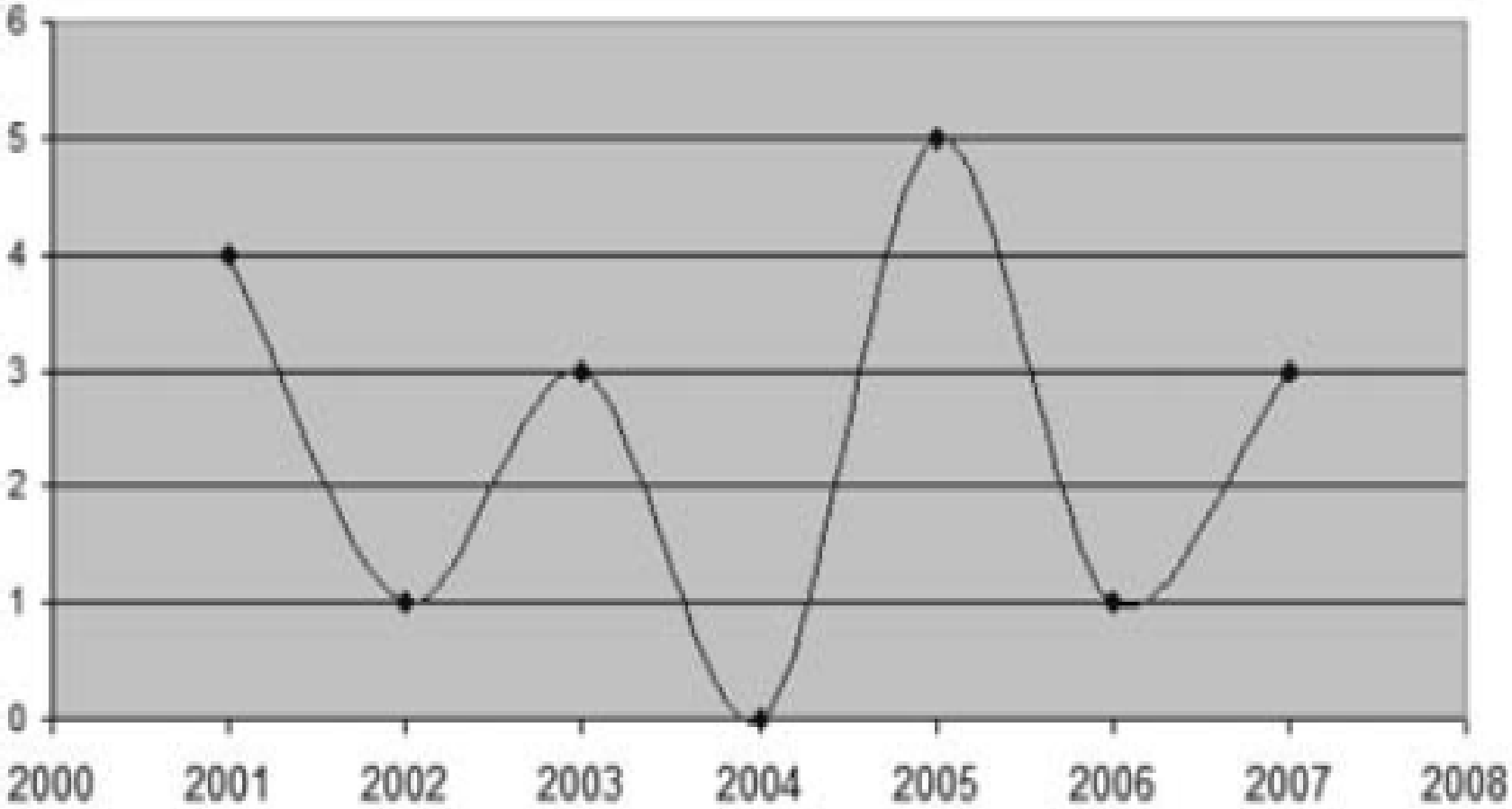

Fig. 3. Keyword: *Sequential processing*.

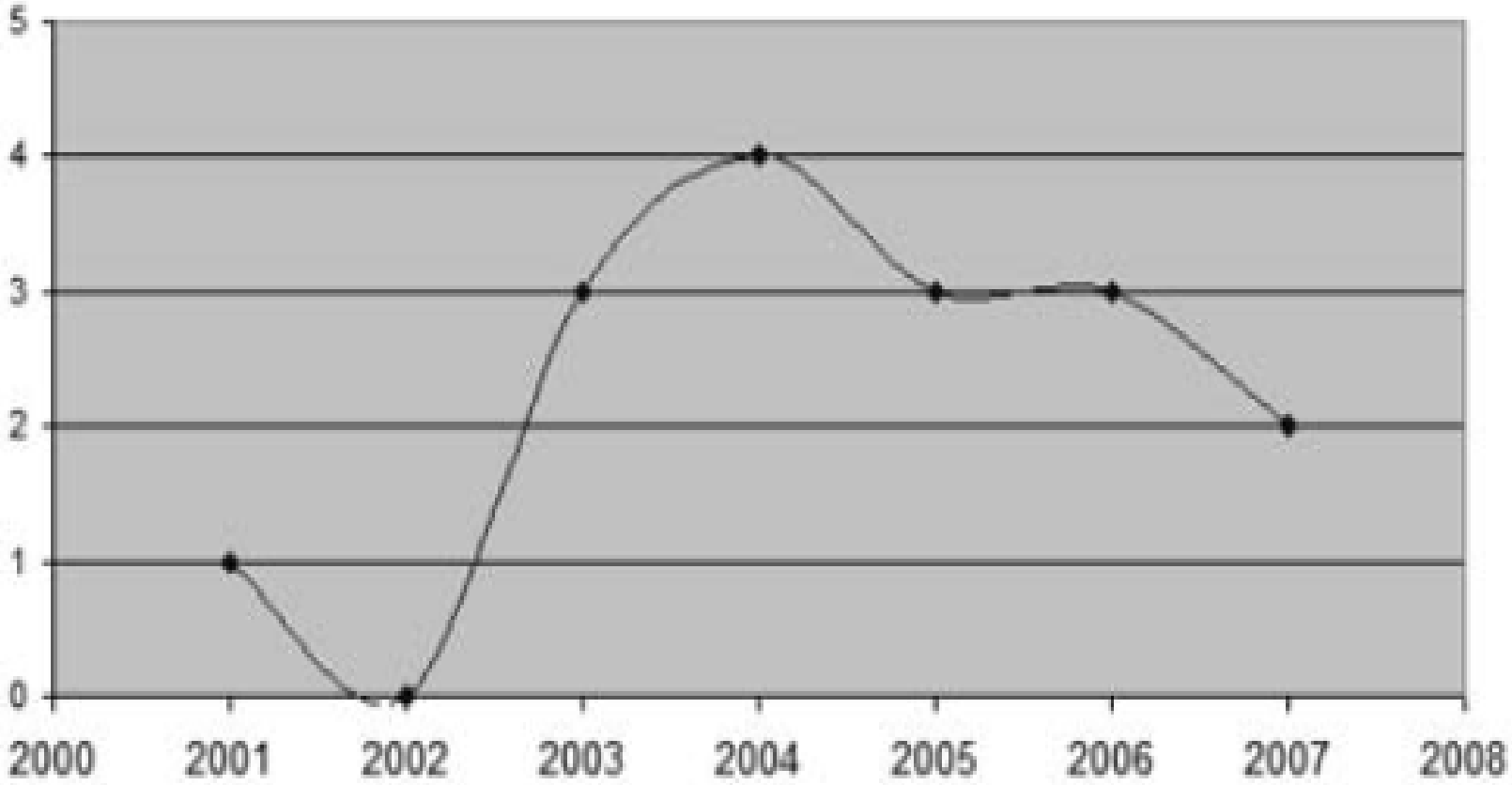

Fig. 4. Keyword: *Digits from a number*.

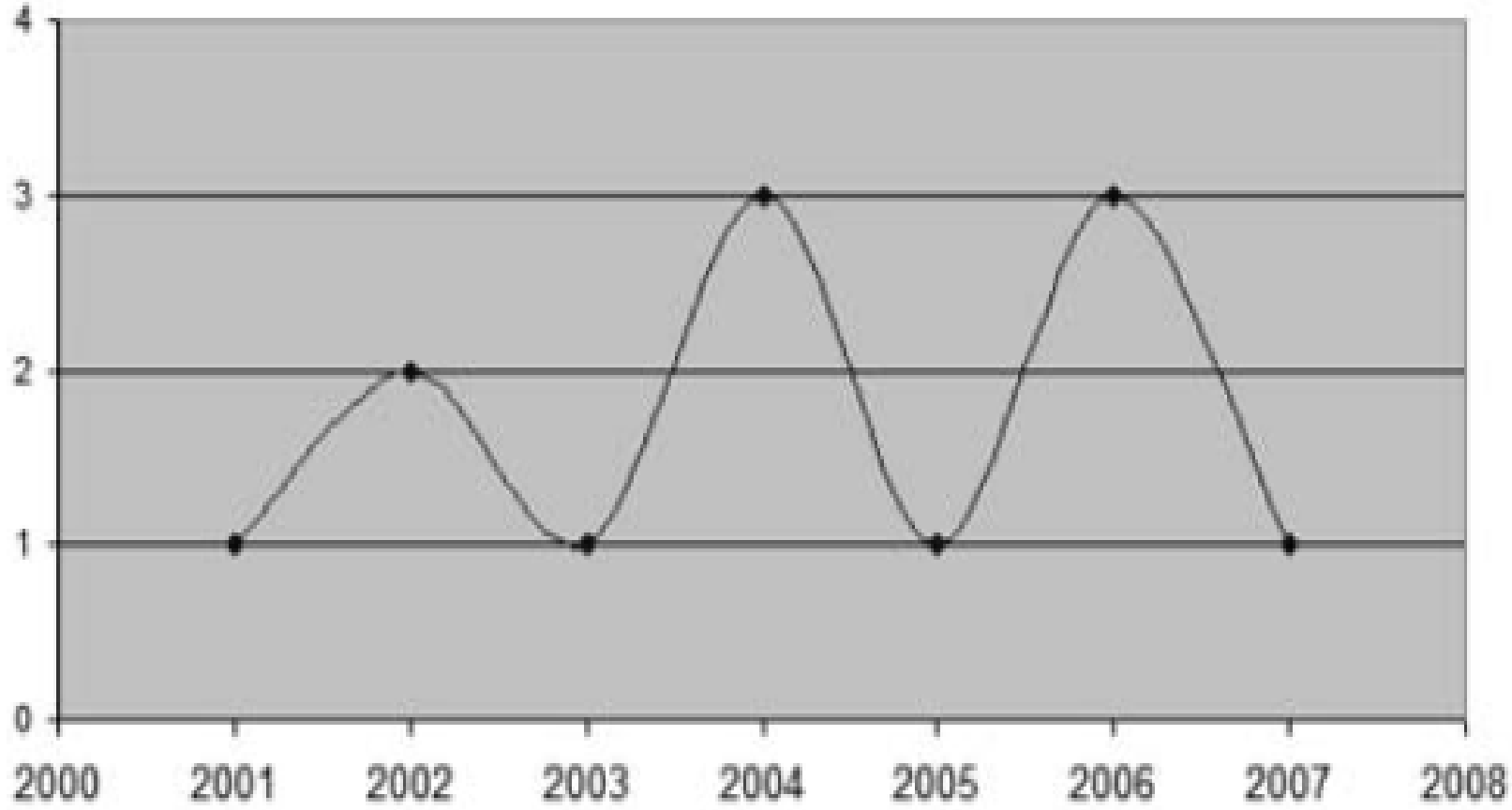

Fig. 5. Keyword: *Print out a figure of characters*.

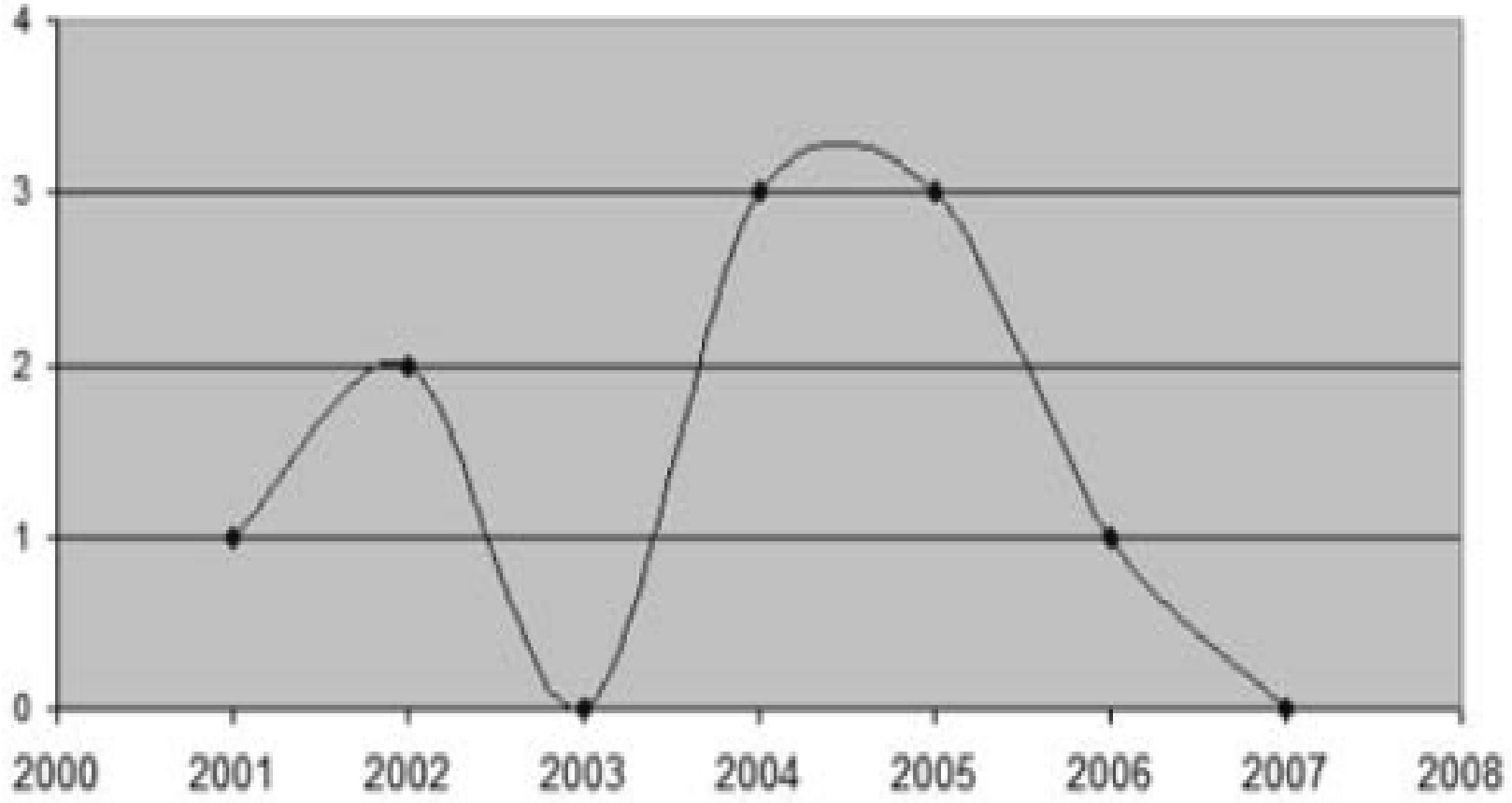

Fig. 6. Keyword: *Divisibility*.

Conclusions

- Although the presented data as above graph samples are not statistically significant, they give us some ideas about the variety of themes.

- Assigning keywords to each task is influenced by personal feelings, tastes, or opinions, but there are some more or less steady principles to choose these keywords.
- In many cases the keywords are self-descriptive and publishing information about tasks together with keywords is easily understandable and can help teachers in their training education process for competitive problem solving.

- The authors of tasks for the future competitions could find useful information about the history of tasks from the previous competitions in order not to duplicate or sometimes intentionally repeat some kinds of problems.
- In more broad sense, the study of the keywords might be applied for initializing appropriate changes and improvements in the national curriculum, which is used now as a recommendable list of themes in all the set of local out-of-class forms for young student preparation in Bulgaria.

Thank you for your attention