Beaver competition 2007 in Estonia

Report for the international Beaver community

April 27, 2008

1 General information

In Estonia, the Beaver competition was held from the 5th to the 11th of November 2007. The competition was held on 3 levels: Benjamins (up to grade 8), Juniors (grades 9 and 10), and Seniors (grades 11 and 12). Examination in all three levels consisted of 15 questions. The examination system was provided by Miksike LearningFolders `http://www.miksike.ee`. The system of online tests developed by Miksike is a web-based environment with accounts for teachers and their students. Every student had to have a supervising teacher who opened the questions for the student to answer in 45 minutes.

The questions were selected mainly from those that had been created in Pasvalys workshop 2007. The distribution of the topics was carefully followed: every level had

- 1 question on computer history,
- 1 or 2 questions concerning computer ethics,
- 3 questions concerning computer software,
- 1 question on computer hardware,
- 1 computer-related problem on geometry,
- 1 or 2 questions on algorithms,
- 2 questions concerning information comprehension,
- 1 question concerning logics,
- 3 questions on other fields of discrete mathematics (combinatorics, graphs, binary system, etc.).

The tests in Estonian as well as the results are available in
`http://www.math.olympiaadid.ut.ee/kobras/`.

The publicity made for the competition consisted of a short note in the all-Estonian teachers' newspaper, e-mails to relevant mailing-lists, direct e-mails to high schools and a note in the Miksike environment (seen by every visitor of the environment).

2   Competitors and results

There were 1240 Benjamin, 1044 Junior and 691 Senior students competing. In all levels the number of participants approximately doubled compared to the previous year. The maximum score for all levels was 30 points (2 points for each question).

The maximum score was achieved only in Benjamins' group, the best in Juniors achieved 28 (93.3%) and the best in Seniors only 23 points (76.7%). The average results were 12.4 points (41.2%) in the Benjamins', 12.1 points (40.4%) in the Juniors' and 10.9 points (36.1%) points in the Seniors' group. Compared to the results of the previous year, all averages have decreased by 5–9 percentage points, depending on the level. The histogram of the results is the following.

Beaver in Estonia 2007

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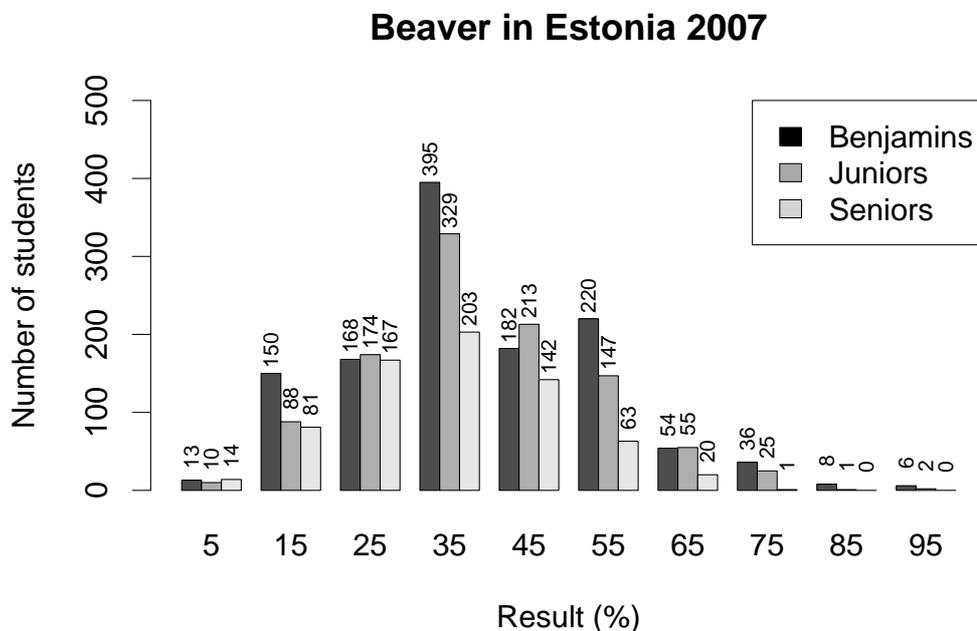
One obvious reason for the decrease of the result averages is the doubled number of participants. Indeed, if we compare only 300 top students of this and of previous year from each level, then one cannot surely tell that the results have changed neither in Benjamins' and perhaps nor in Juniors' group. What is more, the results of the 300 top students seem to have improved in the Seniors' group. (Student t-test gives respective confidence levels of 78%, 97% and 100% for stating significant change in averages of the top 300 students. The average results of the top 300 students in 2006 were 61.4%, 59.5% and 43.0%, respectively, and in 2007 62.4%, 58.0% and 48.1%, respectively.) This fact can also be visualized in the histograms of 300 top students.
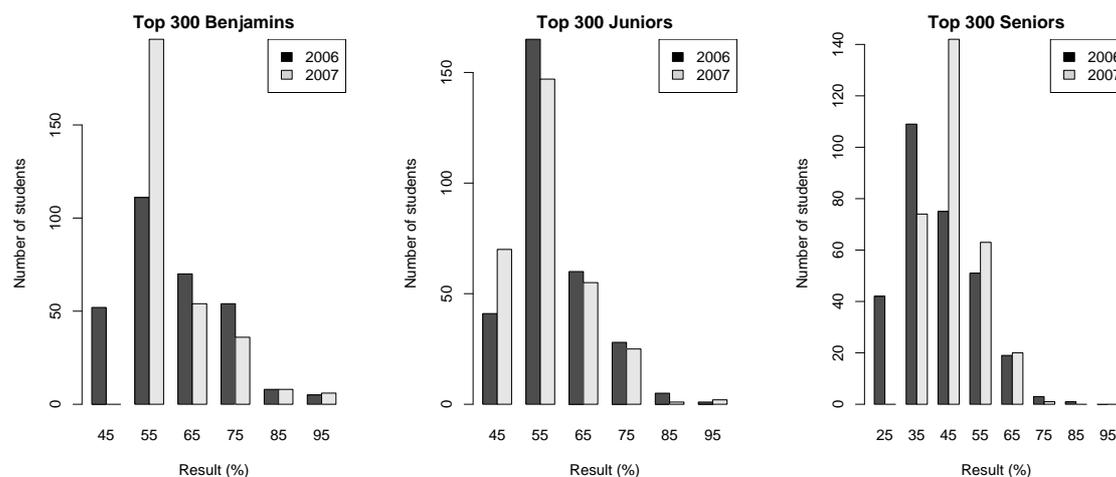
The schools that gave more than 150 competitors in total were Võru Kreutzwald Gymnasium (344), Ahtme Gymnasium (208), Pärnu Ülejõe Gymnasium (188), Võru Town Centre Gymnasium (183), Kärdla Common High School (179) and Kohtla-Järve Järve Russian Gymnasium (157).

After the results were opened, an incident of cheating was suspected: seven students of the 6th grade (!) from one and the same school appeared to have maximum score in the Benjamins' group. We contacted the teacher who supervised the contest there and she admitted that indeed those students did extensive teamwork. Hence, the results of these students were annulled in the meaning of individual ranking and they were not awarded. This incident urges the need to think over how to ensure honest competition in the contest, perhaps also more precise written rules should be compiled.

The awarding of the best 12 Benjamin, 12 Junior and 7 Senior students took place together with the final ceremony of the Estonian Olympiad in Informatics (February 17). Due to increasing interest in Beaver competition, there are plans for 2008/09 schoolyear to organize the second round of Beaver with invited students only.

3   Comments about competition questions

Correct answers are printed in bold, comments that are not part of the question text are in italics. Where not stated otherwise, in every question four radio buttons were given with the obligation to select exactly one.

3.1   Benjamins

The easiest questions (more than 60% correct answers) were the following.

Question 1. Microsoft Corporation was founded
    a) in 1975 by Bill Gates and Paul Allen;
    b) in 1981 by Niklaus Wirth *[creation of Pascal computer language]*;
    c) in 1971 by Gordon Moore *[first microprocessor produced by Intel]*;
    d) in 1984 by Philippe Kahn.
76.9% correct answers, 22.0% wrong answers, 1.0% unanswered.

Question 13. The following document was opened in a text processing program.

> IKT võistlused on värav   uute teadmisteni ning
> meeliköitev viis ühendamaks tehnoloogiat ja haridust.

After pressing some button the text looked as follows.

> IKT·võistlused·on·värav· →   →   uute·teadmisteni·ning
> meeliköitev·viis·ühendamaks·tehnoloogiat·ja·haridust.¶

Which button was it?
    a) 🖼️ *[inserts a MS Excel table]*
    b) ¶
    c) ↕≡ *[alters line spacing]*
    d) A̲ *[alters font colour]*
69.8% correct answers, 27.6% wrong answers, 2.5% unanswered.

The hardest questions (less than 30% correct answers) were the following.

Question 15. One wishes to find a background picture where the heroes from the cartoon "Tom and Jerry" would be depicted. Which text should be written into the text box of Google search engine in order to achieve the best result?
    a) "Wallpaper cartoon Tom and Jerry";

b) Wallpaper AND cartoon AND "Tom and Jerry";
c) "Wallpaper OR image" AND cartoon AND "Tom and Jerry";
d) Wallpaper OR image AND cartoon AND Tom and Jerry.
13.7% correct answers, 83.2% wrong answers, 3.1% unanswered. Mostly given answer was a) (63.3%).
It might have not been clear for the competitors that the quotation marks in a) were also to be written into Google textbox (though it is evident if one reads through all the variants), since for the quickest result one would indeed write 'Wallpaper cartoon Tom and Jerry' (without any closuring marks).

Question 3. Pille's computer has been connected to the Internet. Pille uses her computer under administrator account with empty password, the computer has no firewall and no software against viruses and other malware has been installed. Which computers are in direct threat due to such behaviour?
a) only Pille's computer;
b) all the computers in the same local area network;
c) all the computers in the world that have been connected to the Internet *[since every such computer may be used as a platform for attack against other computers]*;
d) all the computers in the world.
14.0% correct answers, 85.4% wrong answers, 0.6% unanswered. Mostly given answers were b) (45.6%) and a) (36.1%).

Question 12. There is a program where one can push buttons "Rotate counterclockwise", "Rotate clockwise", "Copy" and "Paste", where "Paste" pastes the clipboard information into the position of the mouse cursor leaving the information in the clipboard as well. One has an image file where a strawberry and a raspberry are depicted (left). In addition to that one has an empty image file where one must create the picture shown in the right. At least how many times one needs to push buttons? Selecting a part of the image does not count as pushing any button.

a) 7;
b) 8;
c) 9 *[indeed, one needs to "Copy" the strawberry, then to "Paste" it and*

again "Paste" and "Rotate CCW"; after that one needs to "Copy" the raspberry, "Paste" it three times but one pasting also requires "Rotate CW"];
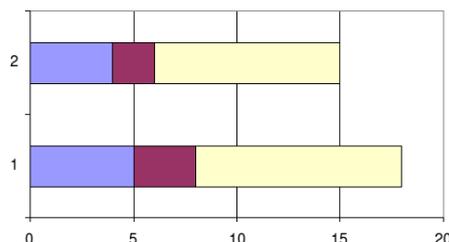
    d) 10.

21.6% correct answers, 75.3% wrong answers, 3.1% unanswered. Mostly given answers were a) (33.8%) and b) (32.7%).

Such questions need very precise wording: every seemingly abundant sentence is to eliminate some possible misunderstanding of the question.

Question 10. Which of the data ranges below enables to form the diagram?

	A	B	C
1	5	3	10
2	4	2	9
3	3	0	4

    a) A1:C1;
    b) A2:C2;
    c) A2:C3;
    d) A1:C2.

26.5% correct answers, 69.5% wrong answers, 4.1% unanswered. Mostly given answer was c) (29.4%).

3.2 Juniors

The easiest question (more than 60% correct answers) was the following.

Question 10. While on vacation, Anne always sends a postcard to Jüri. In order to keep her message secret, she replaces symbols with some other symbols. Which of the keys decodes Anne's message AOEGJD BFGLCBJE BFCK?

a)

Kood	A	D	E	C	B	G	F	J	K	N	P	O	L
Sümbol	I	K	L	V	P	R	O	G	M	E	A	T	U

b)

Kood	A	D	E	C	B	G	F	J	K	N	P	O	L
Sümbol	T	K	U	O	L	R	E	A	N	V	G	S	P

c)

Kood	A	D	E	C	B	G	F	J	K	N	P	O	L
Sümbol	K	S	B	I	T	R	E	A	D	M	N	O	V

d)

Kood	A	D	E	C	B	G	F	J	K	N	P	O	L
Sümbol	L	B	R	K	O	E	A	D	N	M	V	F	G

71.9% correct answers, 20.6% wrong answers, 7.6% unanswered.

The correct answer reads the message as KOBRAS TERVITAB TEID, mean-

ing BEAVER SENDS GREETINGS TO YOU. Indeed, if the correct variant reads as KOBRAS. . . and other variants as ITLRGK. . . , TSUOAK. . . , and LFREDB. . . , all three meaning nothing, this question cannot be too hard.

The hardest questions (less than 30% correct answers) were the following.

Question 3. A memory module consists of eight chips, each of capacity 256 megabits. What is the total capacity of the module in megabytes?
*[Written answer in a text box was required. Correct is **256**.]*
20.4% correct answers, 65.2% wrong answers, 14.4% unanswered. Mostly given answer was 2048 (30.1%).

Question 7. Peeter is required to write down all the letters he finds on his path. Which of the following words can not be Peeter's writing, if he moves only along the arrows from beginning *[=algus]* to end *[=lõpp]*?

    a) `abaabba`
    b) `ba`
    c) `abaaab`
    d) `aab`

20.5% correct answers, 73.2% wrong answers, 6.3% unanswered. Mostly given answer was b) (38.0%).
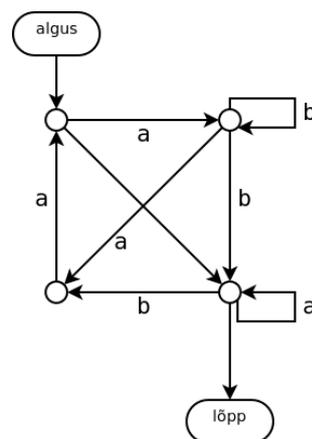
Question 6. Speakers of Esromic language use only five letters: E, S, R, O, and M. In average, in Esromic texts 14% of letters are E, 18% of letters are S, 25% of letters are R, 18% of letters are O and 25% of letters are M. Which of the following codes ensures shortest messages as sequences of • and – in average?

    a) E = • • •, S = • –, R = •, O = – •, M = –
    b) E = – •, S = – –, R = • •, O = •, M = –
    c) E = •, S = –, R = – –, O = • –, M = • •
    d) E = – –, S = • –, R = –, O = – •, M = •

21.0% correct answers, 68.4% wrong answers, 10.6% unanswered. Mostly given answer was c) (30.1%).
The composer of the question needs to choose the proper variants carefully in order not to require students to solve a linear optimization problem. Here d) is better than a) due to the encoding of E; d) is better than b) due to the encodings of O and R; d) is better than c) due to the encodings of E, S, R and M.

Question 13. Which of the following formulae written in B5 yields the value TRUE? *[Checkboxes were given; the competitors were allowed to select*

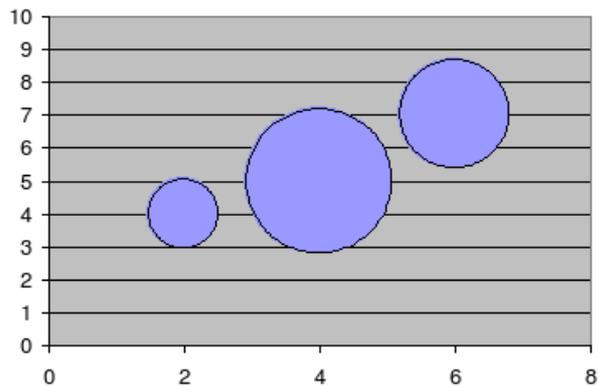*any combination of choices (including empty choice).]*

	A	B
1	1	0
2	2	3
3	4	
4	-1	1
5		TRUE

    a) AVERAGE(A1:B2)=AVERAGE(A1:B4)
    b) COUNT(A1:B2)=COUNT(A2:B3)
    c) SUM(A1:B4)=SUM(A1:B3)
    d) SUM(A1:B2)=SUM(A1:A4)

4.9% fully correct answers, 33.2% partially correct answers, 61.9% wrong answers.

Question 9. What numbers should be written into B3 and C3 in order to form a bubble diagram from the range A1:C3?

    a) 6 into B3, 5 into C3
    b) 5 into B3, 6 into C3
    c) 9 into B3, 16 into C3
    d) 16 into B3, 9 into C3

27.2% correct answers, 63.6% wrong answers, 9.2% unanswered. Mostly given answer was b) (37.1%).
*Note that the leftmost bubble is characterized by $(2, 4, 4)$, the bubble in the middle by $(6, 7, B3)$ and the rightmost by $(4, 5, C3)$. Even if one is not aware that the third component indicates the surface of the bubble, it is clear that first two components determine the position of the bubble, hence the size of the bubble somehow depends on the third component. Therefore the other three variants are obviously wrong. This type of question would require too*

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software-specific knowledge if one included some seemingly correct answers, e.g. 8 into B3, 12 into C3.

3.3 Seniors

The easiest questions (more than 60% correct answers) were the following.

Question 4. There is an algorithm in the picture. There are commands in the triangles. The condition in the rhombus leads command running sequence. An arrow ← means that the expression in the right is computed and the variable in the left is then evaluated with the computed value.
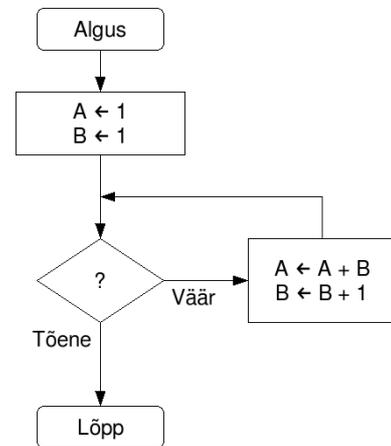
Which of the conditions written in the rhombus would cause the algorithm run infinitely?
[Algus=Beginning, Lõpp=End, Tõene=True, Väär=False]

a) A = 46,　　b) B = 100,　　**c) A $<$ B,**　　d) A $>$ B * 100.

68.0% correct answers, 27.7% wrong answers, 4.3% unanswered.

0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Question 10. The table in the left is the key for Beaver code. An example of decoding a Beavercoded message is shown below, left. What message has been Beavercoded in the table below, right?
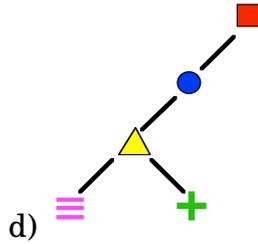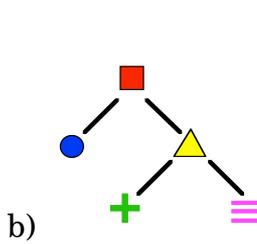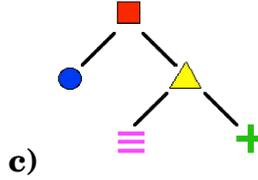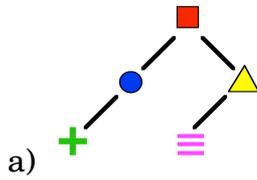
9			K	O	
13				B	
3		R	A		
14					S

6	K	P	E	R
11	T	Ü	Š	A
4	P	O	T	O
2	G	R	Q	A
15	H	N	S	P
10	Ä	M	J	M

[Written answer in a text box was required. Correct is **KRÜPTOGRAMM***.]*
66.1% correct answers, 19.2% wrong answers, 14.7% unanswered.

Question 9. Tree structure in the right can be denoted, for short, as (A(B(C))(D(E(F))(G))). Which of the following trees can be denoted, for short, as (■(●)(▲(≡)(✚)))?
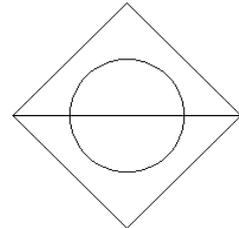

a)

b)

c)

d)
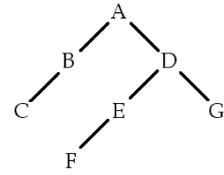
62.2% correct answers, 37.0% wrong answers, 0.7% unanswered.

The hardest questions (less than 25% correct answers) were the following.

Question 6. How many possible ways are there to draw the figure in the right in one line, without taking pencil off the paper?
*[Written answer in a text box was required. Correct is **72**.]*
0.0% correct answers, 98.7% wrong answers, 1.3% unanswered.
*We assume that the students totally misunderstood the question. Some "almost correct" answers, such as 36, 18, etc, were given only by less than 1% of the students. The most frequent answers were 2 (21.2%) and 4 (18.3%).*

Question 14. The following text was entered in a text processing program.
Kiri on paindlik materjal ja kergesti võib seda ka valesti kasutada. See ei tähenda, et ei oleks vaja kunagi riskida, kuid ometi peaks teadma, milles peituvad ohud.
After that "Asenda" *["Replace"]* was chosen in the menu "Redigeeri" *["Edit"]*, the following data were entered and "Asenda kõik" *["Replace all"]* was chosen. How many replacements were performed?
["Kasuta metamärke"="Use wildcards"]

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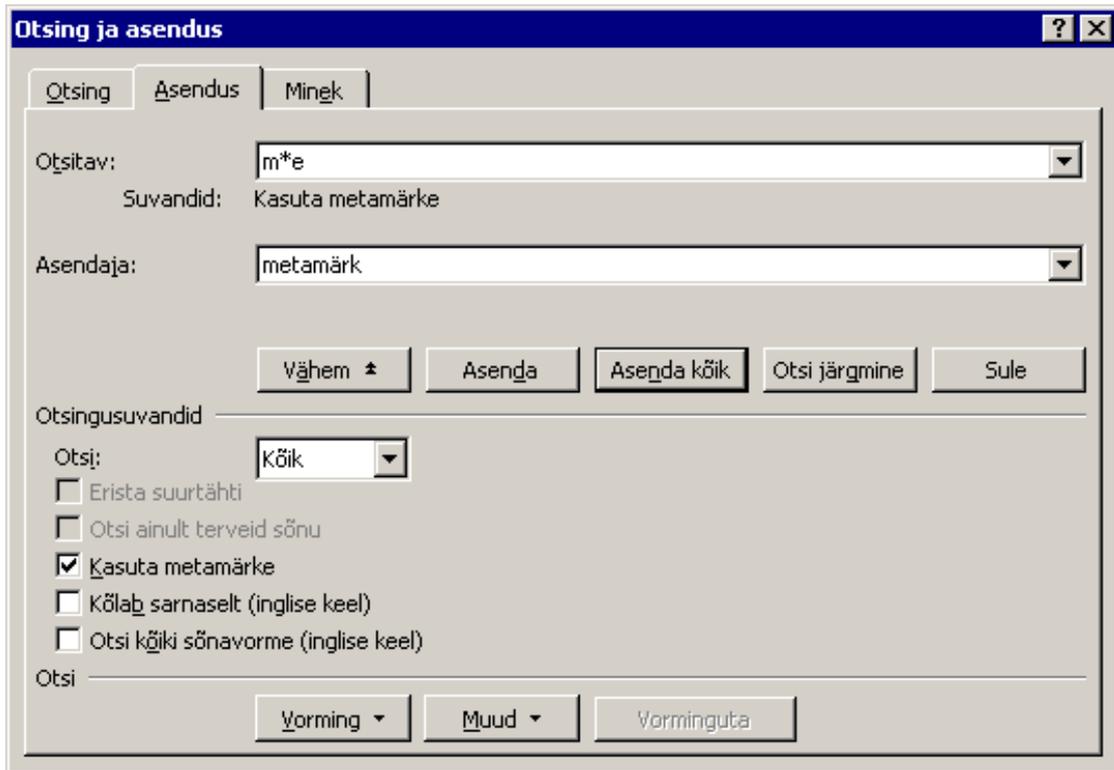
    a) 0
    b) 2
    c) 3
    d) 4

15.3% correct answers, 82.7% wrong answers, 2.0% unanswered. Mostly given answers were a) (42.1%) and b) (35.9%).

*This question may seem a Microsoft question, but actually it is not. The question requires knowledge only about two general facts: the wildcard * means "zero or more arbitrary symbols"; replacements are done linearly (not recursively).*

Question 15. Jaana scanned a 3 cm × 4 cm passport photo in 600 dpi resolution using 8-bit grayscale mode. What is the approximate size of the uncompressed image file on disk?

    a) 30 kB
    b) 450 kB
    c) 700 kB *[indeed, since $\frac{3}{2.54} \cdot 600 \cdot \frac{4}{2.54} \cdot 600 : 1024 \approx 654$]*
    d) 4300 kB

17.9% correct answers, 80.0% wrong answers, 2.2% unanswered. Mostly given answers were a) (38.5%) and b) (35.4%).

One might assume that the reason for choosing a) or b) is extensive experience
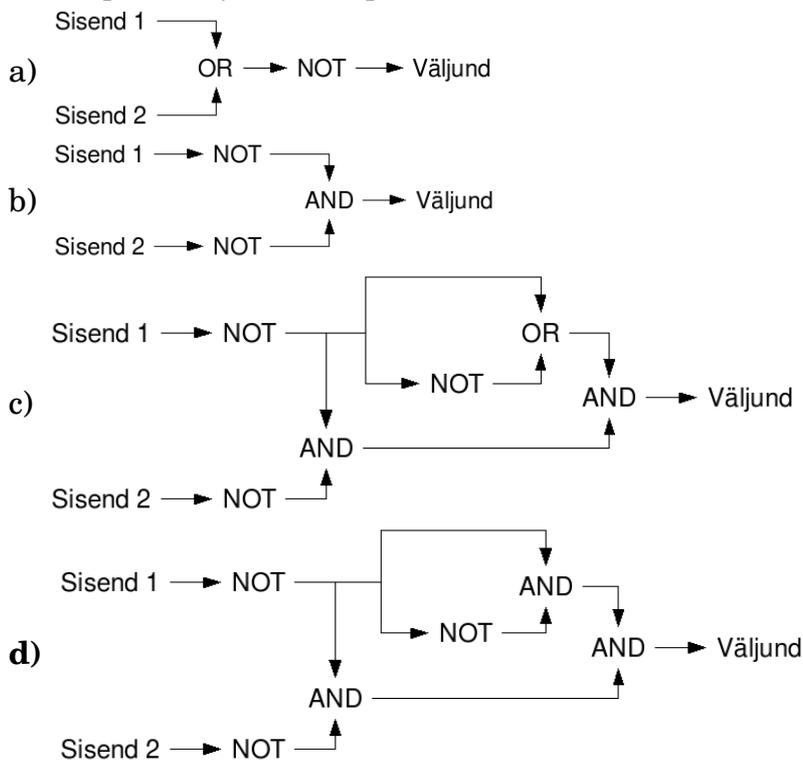
with lossy compression (JPG).

Question 11. Logic schemes are called equivalent if the outputs are equal for every inputs. High and low signal levels are used as input and output. The meaning of the operations in schemes is the following:

- NOT transforms high level to low and vice versa,
- AND outputs high level if all inputs are high, otherwise it outputs low level,
- OR outputs high level if at least one input is high, otherwise it outputs low level.

One of the logic schemes below is not equivalent with the other three. Which is the one?

[Sisend=Input, Väljund=Output]

a)
Sisend 1 ———→
OR → NOT → Väljund
Sisend 2 ———→

b)
Sisend 1 → NOT ———→
AND → Väljund
Sisend 2 → NOT ———→

c)
Sisend 1 → NOT ———→
OR →
→ NOT →
AND → Väljund
AND ———→
Sisend 2 → NOT ———→

d)
Sisend 1 → NOT ———→
AND →
→ NOT →
AND → Väljund
AND ———→
Sisend 2 → NOT ———→

20.9% correct answers, 75.5% wrong answers, 3.6% unanswered. Mostly given answers were c) (30.3%), a) (23.2%) and b) (22.0%).