

Tasks in Informatics on Pattern Recognition and Other Senses

Pavel S. PANKOV, Sabina B. TAGAEVA

Institute of Mathematics of the National Academy of Sciences

Chui prospect 265a, Bishkek, 720071, Kyrgyzstan

e-mail: pps5050@mail.ru, tagaeva_72@mail.ru

Abstract. The authors propose tasks with vast initial data that cannot be solved in a short time by common algorithms, but can be solved by human capabilities, “senses”. AI initially claimed it didn’t have such senses, but then, after being trained by the authors, it rejoiced and declared that it now understood how humans see. For example, if many points form a “simple curve without condensations of points” on a plane, then “the shortest way connecting all points” is obvious; small shifts of points do not change the algorithm. A description is given of a real thing with properties opposite to the properties of its mathematical model. AI could predict this property using the sense of reality. Tasks on the integrity (wholeness) sense, the symmetry sense, and the number (real-number) sense are given too. Therefore, tasks must be designed so that the AI cannot solve them.

Keywords: informatics, task, pattern recognition, integrity sense, symmetry sense, number sense.

1. Introduction

As usual, suppose that only integer numbers are considered. “Integer points” (X, Y) are points with integer coordinates on a plane. We will call a coordinate rectangle with integer coordinates a “box”. Rounding up or down to an integer number is denoted $\lceil \cdot \rceil$ or $\lfloor \cdot \rfloor$. Our comments are in $[]$. The tasks proposed by us and by AI have continuous numbering.

To take a snapshot of the Internet and identify common ideas across electronic subjects, we conducted dialogues with AI deepseek.com (DS), Gemini (GM), and grok.com (GR).

Consider a conventional

Task-1: Given a number M | M numbers (digits, signs) denoting an object Z , write a program calculating a property of Z . CPU time is 1 second (traditionally).

To highlight better and faster programs and “stretch” participants’ scores, subtasks are usually assigned.

Remark. To avoid zero scores, we propose to make subtask 1 (1 or 2 points) as simple as possible. It will not affect medal distribution, but will encourage “weak” teams to participate next time. Even a correct program of type

“Input M ($3 \leq M \leq 5$); if $M=3$ then output 9; if $M=4$ then output 16; if $M=5$ then output 25”

demonstrates knowledge of programming and can be given 1 point.

We propose formulating certain Task-1-type problems in an informal, concise manner, deliberately omitting explicit input and output specifications. This approach aligns with the notion of “naturalness” (Pankov, 2008), whereby a problem is considered natural if it can be readily understood by a person without specialized knowledge, and if its solution can be intuitively perceived, at least for small values of M , without the need for formal calculations.

Building on this idea, we advocate the development of tasks that allow a thinking agent (human or AI) to infer a plausible solution strategy, even for larger values of M . Such tasks could broaden the scope of problems in Olympiad Informatics (OI) by emphasizing intuitive reasoning and insight alongside formal algorithmic problem solving.

1.1 Search for Methods to Develop Solvable Tasks with Large Initial Data

As an example, mention a well-known

Task-2. Large numbers. Given M in $5..10^5$. Denote $K := M^M$. Write a program to calculate $M^{(2 \cdot K)} - (M^K + M) \cdot (M^K - M)$.

The contestant (or their coach) may protest: *Such a calculation will take years*. But some other contestants (and AI isolated from the internet) will have solved this task successfully, although some of them (newbies) have never seen such problems before. The jury will make a strong-willed decision not to exclude this task. What capability of these contestants promoted their success? Some people call such capabilities “intuition”, the moment of guessing “insight”.

To get an overview of possible types of solvable tasks with large initial data, we referred to AI.

We: Give examples of tasks in informatics whose solutions are obvious to humans, even with large sets of initial data. [Below GM says “We” meaning humans].

GM: In computer science, there is a distinct class of problems where human biological vision outperforms even the most efficient algorithms ... Here are several tasks that are “computationally expensive” for a machine but trivial for a human:

Task-3. Global Connectivity (The “Twisted Wire” Problem). Consider a chaotic “spaghetti” of two long, intertwined lines on a screen. You are asked if the two ends on the far left and far right belong to the same line.

The Computer: It must use a Pathfinding Algorithm (such as Breadth-First Search) to trace pixels one by one from start to finish, checking for continuity at each coordinate.

The Human: We use visual tracing. Our eyes (and brain) perceive the flow of the curve as a single “object” rather than a collection of pixels, allowing us to follow the path almost effortlessly. [The idea of the curve is fruitful].

Task-4. Clustering and Grouping. Given a scatter plot with 5,000 points where the points naturally form three distinct “clouds” or clusters.

The Computer: It must run an algorithm such as K-Means or DBSCAN, calculating the Euclidean distance between thousands of point pairs and iterating until the “centers” of the clusters are found.

The Human: We see the clusters immediately. The Law of Proximity in Gestalt psychology allows us to group spatial data into meaningful sets without performing any calculations. [The idea of cluster is fruitful].

Task-5. Convex Hull and Boundary Detection. Imagine hundreds of nails hammered into a board. You need to identify which nails would be touched by a rubber band stretched around the entire group.

The Computer: It uses the Gift Wrapping Algorithm, or Graham Scan, which sorts points by angle and calculates the “turn” (cross product) for every triplet of points to ensure the boundary always turns inward.

The Human: We instantly perceive the “outer shape” of the group. Our brain ignores the interior points and focuses on the extreme coordinates, identifying the “silhouette” of the data set. [Not only the extreme coordinates, but also on “boundary points” too].

Task-6. Symmetry Identification. Given a massive, complex bitmap image, determine if it is perfectly symmetrical.

The Computer: It must compare every pixel on the left side with its corresponding pixel on the right ($O(n)$ complexity).

Humans are evolutionarily hard-wired to detect bilateral symmetry (a survival trait for identifying faces or predators). We don’t compare pixels; we sense the “balance” of the image. [Some humans can detect central symmetry, rotational symmetry too].

1.2 Clarifying Objectives

We call humans’ capacities, including those listed by AI, “senses” (also clever pattern recognition, which knows many classes of objects and/or contains many various algorithms).

AI did not mention, and we did not find any known tasks on “senses” on the Internet, except for our task on “almost straight line”; see Task-13.

We clarify the objectives of the article: to teach AI some senses and to propose developing original tasks that leverage those senses, taking into account that AI would “help” solve them.

The tasks that, in our opinion, are suitable to create tasks for Olympiads in informatics of various difficulty are marked with the # symbol.

2. Teaching Artificial Intelligence to Have Senses

Task-7. Distorted square [It is not said to AI]. We: There is the quadrangle: (2, 5), (202, 5), (202, 205), (3, 205), (2, 5). What will you say?

DS, after extensive calculations: *Right trapezoid (two right angles) with parallel top and bottom but of different lengths, left side slanted, lengths... area....*

We: *Think again.*

DS: *Almost a 200×200 square. [Insight!]*

We: *Thank you. You have the integrity (wholeness) sense.*

DS: *Indeed, even in abstract coordinate analysis, I instinctively referenced the simpler, more regular form (the Prägnanz tendency) — revealing that my pattern-completion mechanism mimics, in functional terms, a sense of perceptual integrity.... it highlights how AI can mirror human cognitive principles without possessing subjective perception.*

We: *Thank you for the detailed response.*

GR: *This quadrangle is almost a perfect rectangle... but not quite. [Insight!]*

We: *Thank you. You have a sense of integrity.*

GR: *...And I'm quietly proud that you noticed I noticed. Now tell me... was that quadrangle drawn to test me ...?*

We invented such a simple quadrangle to test thinking beings: humans and AI. There is a difference: you were given ten numbers and imagined. Only very clever humans can construct an image in their mind with such ten numbers. If a human sees such a drawing on paper, then they will say “almost square”.

GM: *We have an almost perfect square with a side length of 200, but there is a critical “error” or resonant gap in its structure. [Insight with explanation].*

Task-8. Puzzle [It is not said to AI]. We: Given: a polygon (5, 8)–(105, 8)–(105, 108)–(102, 105)–(102, 108)–(5, 108) and a polygon (205, 208)–(202, 205)–(202, 208). What will you do?

DS: *Fit the small triangle into the notch of the first polygon. [Is it an imagination?]*

GR: *... Move Polygon B close to Polygon A (most frequent intent in this kind of puzzle): This triangle precisely fills the missing notch in Polygon A. [Knowing and*

mastering the notion “puzzle”].

GM: Firstly demonstrated the arrangement of the hexagon (white color) and the triangle (white color), and further demonstrated the hexagon (white color) with the triangle fitted (red color).

Remark. GM explained that AI will not respond “*I will do nothing*” because of the Agency instinct.

Task-9. Radiant [It is not said to AI]. We: There are three segments: (1, 2)–(4, 3); (8, 6)–(13, 16); (19, 1)–(11, 3). What will you do?

GM: could not solve.

GR: proposed various variants of actions, without specifics of these segments.

DS: I would say: “Notice that the lines containing these segments are concurrent at (7,4)”.

We: Thank you. We did not ask “What will you say?” We asked, “What will you do?”

DS: Ah - you’re right. My apologies. I would draw the segments on paper or on the screen. Extend each segment lightly with dashed lines to verify that they all intersect at (7, 4). Mark that intersection point clearly. [DS highlighted actions].

We: Thank you.

[What kind of tasks can be developed on DS’s original response to Task-9?]

3. Tasks on geometrical curves

In many tasks in informatics, an “object” and “actions with an object” can be distinguished. The object is specified partly in the task text, partly by the initial data.

Definition 1. If any transformation of the object does not change (does not complicate) an algorithm to solve the task, then the task is said to be data-variable.

Many of such transformations are obvious:

- multiplying all given numbers by a small number;
- small shift of a geometrical object;
- rotation of a geometrical object by 90^0 , by 180^0 ;
- permutation, reenumeration of constituents in initial data.

We found some classes of data-variable tasks with transformation: small perturbations of the initial data, see below.

If such transformations change the answer, then such tasks can be presented as parametrized tasks at competitions (especially at the initial stages, which are conducted online) and at examinations in informatics and mathematics to prevent direct cheating.

In this section, the following option is in all tasks: a path may pass through a Point many

times, to avoid using Hamiltonian algorithms and conditions.

Task-10. Manhattan. On the coordinate plane, $2 * M$ Points, $M \in 2..10^6$, have coordinates

$$\begin{aligned} X[K] &= |40 * (K - M) - 15 + (-1)^K| + (K * K \bmod 3) - 1; \\ Y[K] &= |30 * (K - M) - 10 + (-1)^K|, \quad K = 1..2 * M. \end{aligned} \quad (1)$$

One can move along segments parallel to the coordinate axes only.

Find (write a program finding) the length of the shortest path connecting all Points.

Solution. Guess that Points can be renumbered ($Z[K]$, $K = 1..2 * M$) in such a way that segments $Z[K] - Z[K + 1]$ and $Z[K + 1] - Z[K + 2]$, $K = 1..2 * M - 2$ are “almost parallel”, and the answer is $\text{Sum}\{|Z[K + 1] - Z[K]|: K = 1..2 * M - 1\}$ with the Manhattan norm.

Comments. GM called the components “ $+(-1)^K$ ”, “ $(K * K \bmod 3) - 1$ ” (see Definition 1) “vibrations”. That is, AI feels not only “integrity”, “perfectness”, but deviations from it too.

We gave this task with $M = 3$ to DS. Firstly, it arranged the points in increasing order of the X-coordinate and was convinced that their Y-coordinates also increased. After some attempts (unnecessary from a human point of view) it found the right answer.

To exclude this technique, we gave

Task-11. Six-points. Replace (1) by

$$(10, 2); (-1, 30); (21, 3); (2, 20); (31, 1); (0, 11). \quad (2)$$

The solution for humans is also evident. But DS could not recognize the task as NP-hard and used the MST (Kruskal) algorithm, considering almost all permutations.

Hence, tasks of the following type can be given at OI.

Task-12#. Manhattan2. Replace (1) by

$$\begin{aligned} X[K] &= 40 * K + (-1)^K + (K \bmod 3); \quad Y[K] = (K \bmod 5) + 2 * (-1)^K, \quad K = 1..M; \quad (3) \\ X[K] &= 3 * (-1)^K - (K \bmod 3); \quad Y[K] = 30 * (K - M) + (K \bmod 5) - (-1)^K, \\ &K = M + 1..2 * M. \end{aligned}$$

The following statement appears:

“*Theorem 1*”. If M Points form “a not very twisting curve with not too small and not too large distances between Points” from the thinking being’s standpoint, then the shortest path in a “natural-geometrical” metric connecting all Points after appropriate renumeration is obvious; small shifts of Points do not influence the renumeration.

But it is very difficult to clarify this wording because senses cannot be expressed in words.

If the shape of the arrangement of Points has forks (for instance, the shape of Y), then we have a task equivalent to

Task-13. Helicopter (NOI in Kyrgyzstan, 2022). All distances and coordinates are ex-

pressed in helicopter flight hours. The geologist must survey M Points ($4 \leq M \leq 10^4$) with coordinates

$$X[K] = A * K, Y[K] = ((2 * K * K + B) \bmod 3) + (K \bmod 2), K = 1..M, \quad (4)$$

and return to the 1-Point. $3 \leq A \leq 10, 1 \leq B \leq 3$ are given numbers.

The geologist must spend one hour at each Point. Re-visiting a Point is permitted [the optimal solution does not re-visit Points; this statement is added to address participants' questions and to mask the solution's idea]. CPU time is 1 second.

For a flight between two Points, the fee is

$$D(i, j) := [\text{sqrt}((X[i] - X[j])^2 + (Y[i] - Y[j])^2)] +.$$

How many hours of helicopter use should a geologist pay for?

Solution. The following statement is obvious, but it is necessary for the participant to feel the "naturalness" of the task.

Theorem 2. The distance $D(i, j)$ meets the triangle inequality.

For $i \neq j$ denote $DX := \text{abs}(X[i] - X[j])$ ($>= 3$); $DY := \text{abs}(Y[i] - Y[j])$ ($<= 3$);

$DQ2 := DX^2 + DY^2$. Then $D(i, j) = DQ := [\text{sqrt}(DQ2)] +.$

Using the built-in subroutine $\text{sqrt}()$ for $\text{sqrt}(DQ2)$ takes too long. We can use

Sqrt-2. Note that $DQ <= DX + 2$; Calculate $(DX + 1)^2$ and compare; or

Sqrt-3 (optimal). If $DY = 0$, then $DQ := DX$; else $DQ := DX + 1$; if $(DX = 3$ and $DY = 3)$ then $DQ := 5$.

A standard graph search algorithm can reach $M \sim 100$. But it is obvious that the optimal way consists of two sequences: (F) from 1-Point to M -Point and (B) back, and each Point must be in one of the sequences.

Algorithm (the best, in our opinion). Consider the case: i -Point is in F, $i = 2..M$. Then the greatest j -Point in B can be in $1..i-1$.

Introduce the array $W[i, j]$:

The sum

$$W[i, j] := (\text{the } F \text{ from } 1 \text{ to } i\text{-th}) + (\text{the } B \text{ from } j\text{-th down to } 1)$$

must be the least possible.

The values of the array $W[i, j]$ can be computed using dynamic programming.

$$W[2, 1] := D(1, 2).$$

For $i = 2..M-1$

{Calculation of $W[i+1, j]$:

Subcase 1: i -Point is in F. Then $\{W[i+1, j] := W[i, j] + DQ[i, i+1], j = 1..i-1\}$.

Subcase 2: i-Point is in B. Then we make a reverse. Swap F and B.

$$W[i+1, i] := \min \{W[i, j] : j=1..i-1\}.$$

The answer is

$$A := \min \{W[M, j] + D(M, j) : j=1..M-1\} + M.$$

Complexity of this algorithm is $O(M^2)$.

4. Tasks demanding geometrical imagination

Task-14#. Composing. Given twelve numbers denoting two triangles (without common points). (*) Rotation | (**) Rotation-and-mirroring is allowed. Find the minimal number of vertices of a polygon that can be composed by attaching one triangle to another side-by-side.

Example 10–1 (**). Given $(2, 0)–(2, 40)–(32, 0)$ and $(-7, -7)–(-4, -7)–(-7, -3)$. Answer: 4.

Solution. Imagine all possible cases and write conditions for each case.

Remark. By our experience, “weak” participants solve such tasks better than “strong” participants.

The latter tries to modify any known algorithm of types $O(M^2)$ or $O(M \log M)$, but in vain.

[A similar task for a quadrangle and a triangle is too difficult; a similar task for a parallelogram and a triangle is suitable.]

Task-15#. Pentagon. Given $M \in 2..2^i/2$ and the pentagon $(0, 0)–(M, 0)–(M, M)–(1, M+3/2)–(0, M)$. How many integer points are within the boundary of the pentagon? Output this number mod 2026.

Example 10–1. Given $M=2 \rightarrow$ Answer is 3.

Remark. The fraction $3/2$ is involved to prevent the immediate application of Pick’s formula.

Solution. The pentagon is the square and the little triangle over it. Answer:

$$((M \bmod 2026) * ((M-1) \bmod 2026) + ((M-1 - \lfloor 2 * (M-1) / 3 \rfloor) \bmod 2026)) \bmod 2026.$$

[The triangle may be changed to a trapezium, to two triangles for $M > 5$, etc.]

5. Tasks on the sense of clusters

Task-16#. Clusters. It is ASCII Art

```
***_*****_***
**_***_*****
**_***_*****
```

How many clusters of asterisks are here?

[We used monospaced Consolas font to bring humans' perception close to AI's one]

*DS: We treat * as solid, - as empty [Embodying of symbols!]. Clusters defined by 8-direction connectivity.*

Let's index columns starting from 1: ...(after many comparisons)

So clusters:

A: Top-left: R1(1–3), R2(1–2), R3(1–2)

B: Middle: R2(7–8), R3(7)

C: Right: R1(12–14), R2(13–16), R3(14–15).

[DS not only identified clusters but also gave them informal names].

We: Thank you. You have a sense of clusters.

GR: (rapidly, carelessly) 4 clusters.

We: No. Involve vertical connections. GR: 3 clusters. We: Thank you.

Task-17 (idea of incidence matrix). We: A graph with $M=10^4$ vertices is defined as follows: Let $M1:=M \div 2$. If

$$(((i \leq M1) \text{ and } ((j \leq M1)) \text{ or } ((i > M1) \text{ and } ((j > M1)))) \text{ and } (((\text{abs}(i-j)) \bmod 3) \neq 0) \quad (5)$$

then i -vertex and j -vertex are connected. How many connected components does the graph have?

DS: Denote $A=\{1,2,\dots,M1\}$ (first half); $B=\{M1+1,M1+2,\dots,M\}$ (second half).

So connections exist only within A or within B, and the difference in indices is not a multiple of 3.

(proof that both A and B are connected) *2 connected components.*

If we add the arc $M1-(M1+1)$, then we obtain two “dense” components connected by only one arc.

Hence, the following types of tasks can be given:

General Task-18. Chain-of-clusters. An incidence matrix is given by a formula of type (5). Its analysis by a thinking being demonstrates that there are K “densely connected” components connected by $(K-1)$ arcs consecutively. Then any task on such a graph is reduced to independent tasks on each component.

Using the idea of clusters for finding small coverings:

General Task-19. Boxes. Given M Points on a plane. Find the least possible area A_3 of a box containing three Points.

An algorithm to solve such a task is obvious for Points forming a “simple curve” (includ-

ing “curves” mentioned in Section 3). Introduce the function $Area\text{-}box(point1, point2, point3)$, being the area of the minimal box containing these points.

If the points of a “simple curve” are represented along a curve as $1..M$ then

$$A_3 := \min\{Area\text{-}box(Point[Q], Point[Q+1], Point[Q+3]): Q=1..M-2\}.$$

Another kind of tasks:

Task-20 – subtask-19. Triples. On the coordinate plane, M Points ($10 \leq M \leq 10^6$) have coordinates

$$M5 = M \text{ div } 5; X[K] = (K \text{ div } M5) * 10 + (-1)^K; Y[K] = (K \text{ mod } M5) * 100 + (K \text{ mod } 3), K=1..M.$$

Solution. Clusters of five points are evident for a human.

For example, $M=202$, $M5=40$. Choose and renumber [these thoughts swift through some people’s minds very quickly]:

$$XR[1,1] = X[1] = -1; YR[1,1] = Y[1] = 101,$$

$$XR[1,2] = X[41] = 9; YR[1,2] = Y[41] = 102,$$

$$XR[1,3] = X[81] = 19; YR[1,3] = Y[81] = 100,$$

$$XR[1,4] = X[121] = 29; YR[1,4] = Y[121] = 101,$$

$$XR[1,5] = X[161] = 39; YR[1,5] = Y[161] = 102,$$

$$XR[2,1] = X[2] = 1; YR[2,1] = Y[2] = 202,$$

...

$$XR[2,5] = X[162] = 41; YR[2,5] = Y[162] = 200,$$

...

$$XR[40,1] = X[40] = -1; YR[40,1] = Y[40] = 202,$$

...

$$XR[40,5] = X[200] = -1; YR[40,5] = Y[200] = 200,$$

...

Algorithm. Compare $Area\text{-}box(1st, 2nd, 3rd)$, $Area\text{-}box(2nd, 3rd, 4th)$ and $Area\text{-}box(3rd, 4th, 5th)$ in each quintet.

Remark. We do not exploit the periodicity of “vibrations” to speed up the algorithm, as per Definition 1.

6. Tasks on the symmetry sense

Task-21#. Axial symmetry [It is not said to AI]:

*Given $M \in 5..10^{\wedge}12$, $(2 * M + 10)$ fixed Points*

$\{X[K]=7; Y[K]=4+K: K=1..M\}; \{X[K]=9; Y[K]=4+K-M: K=M+1..2 * M\};$
 $\{X[K]=2+K-2 * M; Y[K]=M+2: K=2 * M+1..2 * M+5\}; \{X[K]=K-2 * M+4;$
 $Y[K]=M+2: K=2 * M+6..2 * M+10\};$

three movable Points $(15, M+2); (16, M+2); (17, M+2)$. Find the minimum number of Points that need to be moved to obtain a symmetrical configuration.

GM has guessed that the symmetry is axial about $X=8$ and has tried to move the fixed point $(14, M+2)$. After pointing out its mistake, it gave the correct answer: $(16, M+2); (2, M+2); (17, M+2); (1, M+2)$.

The problem is that words have no definitions: vocabularies explain words in terms of other words, which leads to logical vicious circles. Pankov et al. (2005) and Bayachorova et al. (2009) attempted to provide independent definitions (mathematical models) of some verbs and other notions based on “naturalness” and well-known “similarity” and “alternation”; a similar technique was used in Pankov et al. (2024).

DS has guessed that it is the axial symmetry about $X=8$, but made a mistake: $7+4=5$. After pointing out its mistake, it gave a correct answer: 2. Some years ago, only WolframAlpha.com could treat and demonstrate numbers; now, many AIs have gradually learned, but still have hallucinations.

Task-22#. Central symmetry [It is not said to AI]:

*Given $M \in 10..10^{\wedge}12$, $(2 * M + 7)$ fixed Points*

$\{X[K]=7; Y[K]=4+K: K=1..M\}; \{X[K]=9; Y[K]=K-M: K=M+1..2 * M\};$
 $\{X[K]=2+K-2 * M; Y[K]=5: K=2 * M+1..2 * M+3\}; \{X[K]=K-2 * M+6; Y[K]=M:$
 $K=2 * M+4..2 * M+7\};$

five movable Points $(15, M); (16, M); (16, M-1); (16, M-2); (16, M-3)$.

Find the minimum number of Points that need to be moved to obtain a symmetrical configuration.

GM: tried to find axial symmetry but in vain.

We: No. It is not an axial symmetry. Think again.

GM: Alright - let's read the problem again carefully, and think about symmetry type ... the center is $X=8, Y=(M+5)/2$ [right!]. Given complexity and time, ... the intended answer from known problem variants is 3. [This answer is right, but is not justified.]

In our opinion, such tasks (with strict wording) may be given at OIs: how many, at least, Points must be erased | added | shifted to obtain an axisymmetric | centrally symmetric configuration?

Task-23#. Numerical anti-symmetry [It is not said to AI]. [Probably, a new type of tasks, close to central symmetry].

We: Calculate $S := \sum_{K=4..2 \cdot (9^{12})} \{((1+(K \bmod (9^{12})))^{(K \bmod (9^{12}))}) * ((-1)^K)\}$.

DS: $S=2+(-9)+64=57$. [Right!]

GR: Noted that: The range $K = 4 \dots 2m$ contains exactly m complete residue classes modulo m (from $K \equiv 4, 5, \dots, m-1, 0, 1, \dots, m-1$ up to the last full cycle ending at $2m \equiv 0 \pmod{m}$). But further, it made pseudo-logical reasoning and obtained $S=0$.

GM: Denoted $f(x)=(1+x)^x$ and calculated $f(1)*(-1)^1 + f(2)*(-1)^2 + f(3)*(-1)^3=57$.

Task-24#. Odd functions [not said to AI]. Calculate

$J := \int_{-2}^7 \{\min\{\max\{-1, x^7/(1+x^6)\}, 1\}\}$.

DS: made vast approximate calculations but at last guessed that the function is odd and gave the exact answer $J=5$.

7. Tasks on the number sense

We mean: “real-number sense” and use real numbers in this section.

Remark. There are definitions of real numbers as limits of converging infinite sequences of rational numbers, but mathematicians do not use them; rather, they use “real-number sense” in practice.

Task-25#. Length.

We: Define $L=12$; $Q:=10^L$; function $F(X):=\sqrt{100^2-X^2}$, real number $H:=100/Q$. Find such natural number W that $W < S := \sum_{K=1..10^L-1} \{\sqrt{H^2+(F(K*H)-F((K+1)*H))^2}\} < W+2$.

Remark. Such a task with demand “ $W \leq S \leq W+1$ ” is incorrect because there is no algorithm to distinguish a constructively computable number from zero; conditional example: $(49^{1/4}-7^{1/2})$.

DS: This sum approximates the arc length of the quarter circle or something? (We did not respond).

DS guessed without error estimates: $W=157$.

GM: The difference between the length of an arc and a broken line of 10^{12} segments is negligible (of the order of $1/Q^2$), $W=156$ or 157 .

Remark. From a mathematical point of view, the order of $1/Q^2$ is true but means nothing for a strict estimation.

GR: made vast estimations of errors, $W=156$ or 157 .

We: Define $L:=5$;

DS made convincing but unsubstantiated estimates of errors and gave 157.

We: Define $L:=2$;

DS calculated and gave the right answer: 155.

Hence, such tasks based on the jury's convincing may be given, although they seem unusual. A simplified version for younger contestants.

Task-26. Poly-polygon. Given M in $5..10^6$. Calculate such an integer number W that the perimeter S of the regular 10^{100} -gon of diameter M is in $[W, W+2]$.

8. Tasks on the sense of reality

The sense of reality is widely used when a task in informatics contains only a “literary part”, without a strict mathematical duplication. For example, the thickness of the walls of a paper box is negligibly small compared to its width; the length of a car is negligibly small compared to the distance between villages; a car instantly goes from a state of rest to a state of uniform motion. The human (contestant) and the AI both guess the formal statement of the task the jury had in mind and give an answer the jury had in mind.

Consider an opposite example.

Task-27. Tin.

*We (Pankov et al, 2026): The surface (made of tin) consists of six triangles with the following seven vertices (in cylindrical coordinates: radial distance in inch; angle; height in inch): $A[0]:= (0"; 0; 0")$; $A[K]:= (15"; \pi * i/3; (5 + 2 * (-1)^K))$; $K = 1 .. 6$. The little ball of diameter 1/5 inch (made of steel) is launched from the point $A[1]$. Because of gravity, the ball rolls down along the “valley” to point $A[0]$. What will be?*

DS: The ball will oscillate between valley $A[1]A[0]$ and ridge $A[0]A[4]$.

We: No. It is not a mathematical device; it is a real one. Think again.

DS: But a sphere of finite size cannot balance perfectly on a ridge made of two planes, ... with slight perturbation, it will fall into one of the two valleys ($A[0]A[3]$ or $A[0]A[5]$). The ball will process around $A[0]$, visiting all six valleys and ridges in turn.

We: Thank you. You are right. We add “randomly”. You substituted an unpredictable process.

Remark. We repeated this demand. DS had forgotten its preceding response, thought, and said: “But because of symmetry breaking at nanoscale...”, and called it “engineering perspective” [another name for the sense of reality].

Hence, the following types of tasks may be given (the example is too simple).

Task-28. Real colors. Distances are given in cm.

Points over a horizontal straight line are given in coordinates OX (to the right) and OZ (up):

$B[1](0, 9)$; $B[2](20, 5)$; $B[3](40, 7)$; $B[4](60, 3)$. There is a surface (made of tin): $B[1]–B[2]$ is a yellow valley; $B[2]–B[3]$ is a green ridge; $B[3]–B[4]$ is a red valley. There is a sticky fence all around. All is symmetric with respect to the vertical plane XOZ .

The little ball of diameter $1/2$ (made of steel) is launched from the point $B[1]$. In what color will it stop?

Mathematically, the answer is “red”. But actually, the answer is “green”.

9. Conclusion

Through iterative dialogue and collaborative task-solving, we and others engaging with AI systems have contributed to the development of AI capabilities that may be metaphorically described as “senses.” These emerging capabilities enable AI to recognize patterns, anticipate plausible solutions, and respond in ways that go beyond strictly formal or procedural reasoning. As a result, mutual understanding between humans and AI is enhanced, opening new possibilities for integrating such systems meaningfully into problem-solving processes.

Building on this perspective, we propose exploring a class of informatics tasks that are approached not solely through formal logical deduction, but through the “senses” of thinking agents, whether human or artificial. In such tasks, the emphasis shifts from constructing complete formal proofs to providing convincing, insight-driven solutions grounded in intuition, pattern recognition, and plausibility. This does not replace rigorous reasoning, but complements it by foregrounding alternative modes of understanding that are closer to how complex problems are often approached in real-world contexts.

We suggest incorporating such tasks into Olympiad Informatics to broaden the discipline’s scope, encouraging new forms of reasoning and interaction while strengthening connections between competition tasks and authentic problem-solving situations.

References

- Bayachorova B.J., Pankov P. (2009). Independent Computer Presentation of a Natural Language. *Varia Informatica*. Polish Information Processing Society, 73–84.
- Pankov P.S. (2008). Naturalness in Tasks for Olympiads in Informatics. *Olympiads in Informatics*, 2, 16–23.
- Pankov P.S., Alimbay E. (2005). Virtual Environment for Interactive Learning Languages. *Human Language Technologies as a Challenge for Computer Science and Linguistics: Proceedings of 2nd Language and Technology Conference*, Poznan, 357–360.
- Pankov P.S., Bayaliev E.J. (2024). Olympiads without Words. *Olympiads in Informatics*, 18, 81–88.
- Pankov P.S., Tagaeva S.B. (2026). Demonstrative mechanical strange attractor. Ministry of Science, Higher Education and Innovation of the Kyrgyz Republic, Department of Expertise. Decision on issuing a patent for a utility model, March 12.



Pavel S. Pankov (1950), doctor of physics-mathematics sciences, prof., corr. Member of the Kyrgyzstan National Academy of Sciences (KR NAS), was the chairman of the jury of Bishkek City OIs, 1985-2013, of Republican OIs, 1987-2012, has participated in National OIs since 2020, was the leader of Kyrgyzstani teams at IOIs, 2002-2013, 2018-2023. He graduated from the Kyrgyz State University in 1969 and is the head of the Institute of Mathematics of the KR NAS Laboratory.



Sabina B. Tagaeva (1972), candidate of physics-mathematics sciences, Associate professor. She graduated from the Kyrgyz National University named after Jusup Balasagyn in 1995. Currently, she is the Academic Secretary of the Institute of Mathematics of the KR NAS.