Odenna Sagizbayeva.
Problem 14.
I would like to represent you some play about incompleteness of the computers.

Play:

The uncompleted play for very lonely automaton.
(Play - paradigm in two acts for experts in the field of the artificial intellect and not only...)

> - whether the God omnipotent?
> If he is omnipotent
> can he create a stone
> which can not be shifted?
> - He can,
> and this stone is a Mind …

AKT 1.
Achilles' heel.

Mr. Turtle comes on a visit to Mr. Achilles. Turtle finds out in him huge weight of the most different personal computers which stand in the most unusual places of an apartment. He comes in amazement and delight.

Turtle: My friend! Do you have a new hobby? From since you have started to collect computers? There is very rich collection!
Achilles: Well not so, what it will be compared to your amazing collection of boomerangs … But last time I am fond not so much of computers, how many programming.
Turtle: My God! Do you have taken a great interest in programming?!
Achilles: It is whim of our new author. Now, on his plan, I am an Achilles-programmer, the fastest of all programmers! But you, Mr. Turtle, do not guess for what we are necessary this time? You were always differed such insight!

… … … … … … … … … … … … … … … … … …..

Turtle: .... But if it will be necessary for you, it can be named for example so –
"Modernized problem of Turing" or "The task of Turing-Turtle".
Achilles: And you have found such problem?! In what it consists?
Turtle: I think that have found... But doubts of me yet have no left... You know in what problem of Turing consists?
Achilles: Well as far as I understand it is the original test for an intellectual solvency of computers.
Turtle: Partly you are right. But speech there goes not so much about computers, how many about programs or algorithms. And so, last time I searched for a problem on an intellectual INCONSISTENCY of algorithms. And I would like to ask you as fastest of all programmers to participate in one experiment. You will not object?

… … … … … … … … … … … … … … … … … … ….

Achilles: We shall run or prove theorems?
Turtle: No, it already was. The New times mean the new approaches. Now we shall play a computer games. You see it is no casual, on a plan of the new author, - you are a programmer.

Fastest of all programmers living on the Earth! Therefore I want to offer you some game in which the natural intelligence and computer, which you will compete, my friend, write.

Achilles: Oh, Mr. the Turtle, you overestimate my opportunities! The most complex game for which I made an algorithm is a game in "tic-tac-toe"!

Turtle: Tell, Achilles, can you play a "The sea fight"?

Achilles: "The sea fight "?!. Is it a simple game in which students at tiresome lectures play? You joke! You want to estimate intelligence of the machine with the help of the game "Sea fight "?!

Turtle: No I don't. But it is necessary for us to have a field for the game "Sea fight ". If my memory doesn't lie me there is used very nice field 10 on 10 sections, isn't it?

Achilles: You are completely right!

Turtle: I would like to arrange our game on such field. 100 sections quite will suffice us. Anyway for the beginning... Conditions of game will be not much more complex than conditions of "Sea fight". You can make the program of such level of complexity?

Achilles: I think, yes I can. But I will need more in detail the description of rules of game. As we programmers speak - statement of a task is necessary.

Turtle: Then, if you agree, we shall start!

(Achilles switches on his the most favorite computer, gets a pencil and that notebook in which due to last competition almost did not remain clean sheets.)

Achilles: I am ready.

Turtle: For the beginning we should construct a discrete field, 10 on 10 sections on which we shall place unique... We shall Name it "Automaton". This Automaton at each moment of time occupies one section of our field and on the following step of game can move in any of the next sections. How you will it organize for me does not interest. But it is desirable, what we could observe of behavior of our Automaton on the monitor. It is possible?

Achilles: Certainly it is possible! I guess that you achieve. Usually such programs name models of "universe". It will not cause special problems. But I need to specify some individual questions. The first: Whether on diagonal sections or only Automaton moves over verticals and horizontals?

Turtle: It is no essential. You can act how it will be necessary for you.

Achilles: It is good, and then I shall allow it to move and on diagonals.

(Achilles makes some records in a notebook).

One more specification - What occurs, when the Automaton will reach boundary of "universe"?

Turtle: It is your problem. You can make "universe" spherical or curtail as "bagel". Simply you can limit moving of the Automaton for limits of a field. I am interested a little with "laws of a nature" which you will think up in your computer world. It is important that they shouldn't be inconsistent.

....

Turtle: Let will be flat, only not on my back! Though the spherical universe is more graceful... However your universe will be easier and more evident. But we shall return to our lonely Automaton.

Achilles: Yes, in such empty "universe" it will be very lonely!

Turtle: That to it was not so alone; we shall construct a small house. For this purpose we shall allocate some cell on our field and we shall designate it by letter "Д". Further we shall consider that our Automaton is homebody and hates to be in the street, outside the small house.

....

Turtle: .... But if because of a blind case to move the Automaton for limits of a small house that is put it to any other cell of "universe" it becomes unfortunate. And it will want very much to come back home.

Achilles: If our Automaton was the Snail for it such event will be the present tragedy!

Turtle: And if you, Achilles care about it try to write algorithm of management which always returns the automatic device home and made it happy. Speaking more precisely, move it to the house for final number of steps. As far as I understand in programming the general schema of such algorithm should look so.

Mr. Turtle takes a pencil, finds a clean sheet in a notebook and draws the following algorithm.
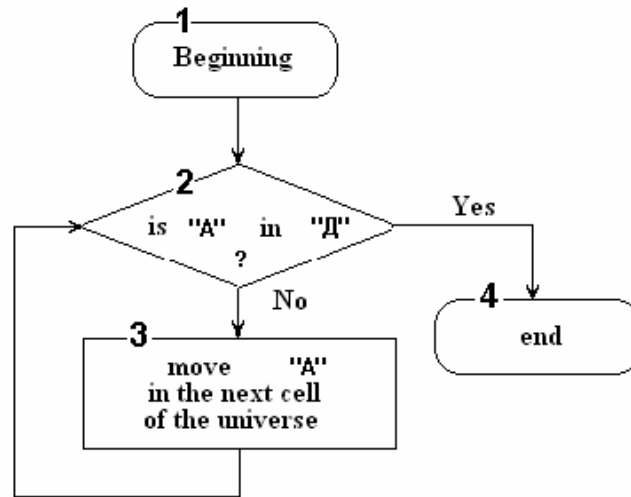

Turtle: I have truly drawn all?

Achilles: Oh! You have superb made the algorithmic schema of the problem! To me it remains only a little thing - to detail step number 3. Certainly, I am the fastest of programmers, but it requires to me some time...

(Achilles sits down at a computer. A bit later the fastest of programmers represents results to Mr. Turtle.)

All is ready! I argued as follows: Let assume, our Automaton appeared in any other point of our "universe" and has felt unfortunate. Then it is necessary to find out as far it appeared from the purpose. All that it should - define two relative coordinates of the current position in relation to "small house". Horizontal, we shall name it ΔX and vertical, we shall name it ΔY. Its actions on each step of game are to reduce these two distances up to 0. So, if $\Delta X>0$ that to make a step to the right, if ΔX- to the left, if $\Delta X = 0$ don't move horizontally. The same rules concerns also for a vertical direction. Operating thus, step by step, our Automaton sooner or later will get in the small house and again will feel itself happy!

Achilles starts the program. On the screen there is the rectangular "universe" divided on hundred sections.
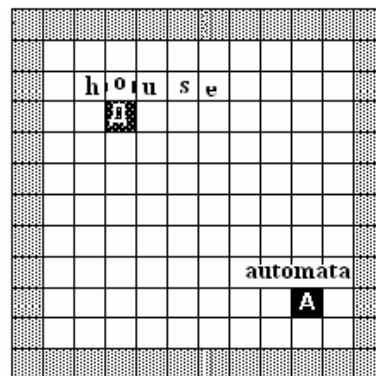
The program stops, writing on the screen the huge message "END!"

Achilles: I have consulted with a problem?

Turtle: Thank, my friend, you have made very witty algorithm. How you think, in all cases it will work successfully?

Achilles: Certainly in all! Our small house and its owner as though did not settle down, the algorithm always will result the Automaton to a point "Д". Besides it will result it on the shortest way, with the minimal expenses of efforts and time!

Turtle: And if I shall place a small house for limits of our "universe"?

Achilles: It will be not fair, Mr. Turtle! Against any rules of logic! The Automaton can not move for limits of our "universe" and when will not get to itself home!

....

Turtle: .... For this purpose I shall ask you, Achilles, to make so I could choose a direction of moving of our Automaton inside "universe" on each new step and thus to observe of results of the actions. Can you provide such "manual management"?

Achilles: Certainly I can! Then our model to turn to computer game! It becomes interactive.

Turtle: Yes, it is similar to that... Now, suppose, I put a problem, and I operating our Automaton "manually", return it in the small house. Whether you recognize this problem correct in relation to laws of our "universe" in particular and to laws of logic in general?

Achilles: Yes I recognize! You can not force to do the Automaton something that is not stipulated by logic of "universe", of my program.

Turtle: It means that if I will manage to specify for the Automaton a way to the small house such problem can be named quite feasible and not contradicting to "laws of a nature"?

Achilles: For the Automaton how object of "universe"? Yes!

**Turtle**: And for algorithm, which manage it?

Achilles: I think that all will depend on complexity of a problem...

Turtle: Then I shall allow myself to offer such problem which will be impracticable for your algorithm but quite is feasible basically. Have you paid attention to that your Automaton goes on the shortest way?

Achilles: Yes I have.

Turtle: Then I shall change a little the plan of our universe for that shortest way which you so were admired and between the Automaton and "small house" I shall put an obstacle as a small wall.

Mr. Turtle draws the plan of a new task.
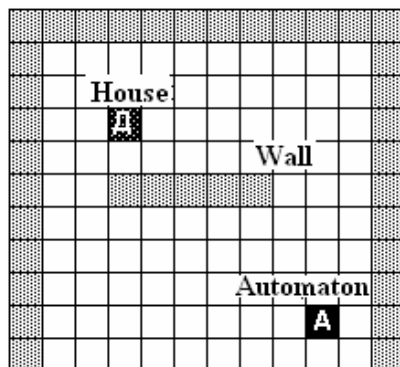
Turtle: How will lead itself your Automaton?

Achilles: From the beginning it will start to move on a diagonal... Then it will be rested against a wall, trying to move upwards... But the wall will not let to move, also it will be, under laws of our

"universe", to creep along the wall, and stop only opposite to the small house... Further the program will go in cycles. And we should restart the computer.

Turtle: Super! It means that the problem appears for your algorithm insoluble?!

Achilles: Yes such task for it not under force.

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Achilles starts drawing up another algorithm. There passes some time and a new program of the Automaton's management appears is ready.

Achilles: A new algorithm will check the Automaton was rested against a wall. If such will take place, strategy of the automatic device № 1 temporarily is cancelled and included strategy № 2 - search of a roundabout way. Our Automaton starts to move to the right, checking is the wall was finished. If it has taken place - strategy № 1 is included. Taking into account that you, Mr. Turtle, can move up a wall in dense to boundary of "universe", I had to write strategy of behavior of the Automaton in corners. Having reached a corner, the Automaton starts to move along a perpendicular wall in parallel it, also to the right. Then eventually it will bypass all "universe" on a circle and will reach to border of a wall from the other side. Here it will find out a border and will include strategy № 1 - movements on the shortest way.

Turtle: You have surprised me Achilles! And why didn't you teach the Automaton to move back if it will be rested against a corner? This way it will reach the purpose much faster!

Achilles: But you can arrange a wall like this:

Achilles draws new plan.
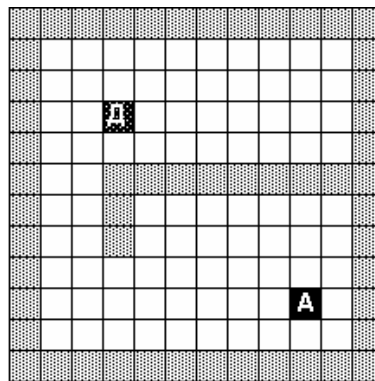
Achilles: Then my automatic device will go in cycles between two corners! And I would not like it.

Turtle: I in delight! You try to foresee ALL my subsequent steps! By the way, what about steps? Have you paid attention that we Achilles, is imperceptible for our selves were involved into the next competition?

Achilles: Admit, Mr. Turtle, you achieved it from the beginning!

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Turtle: I not only shall draw the new plan of "universe" with an insoluble problem. I even shall draw a trajectory of movement of yours "Automaton № 2" in new conditions.

Turtle draws the following plan:
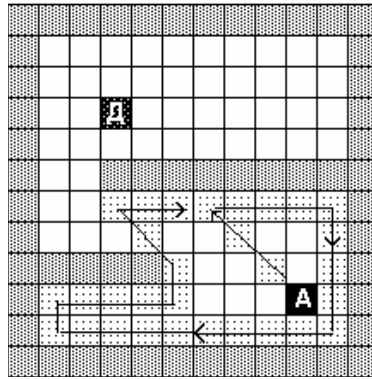
Achilles analyzes the next plan offered by Turtle and comes to a conclusion, that his new algorithm also is imperfect.

Turtle: As you can see, my friend, it is not too difficult to force this algorithm to run on an infinite circle.

Achilles: I intrigue more and more! Now I see that I considered the decision of your problem too thoughtlessly. I also did not assume that in so simple "universe" it is possible to think up so many complicated problems! Let me try once more?

Turtle: To allow?!! Yes I shall ask you about it!! But I would ask you to name the Automaton - "Automaton № 3 ".

Achilles: However, I will need some time. Do you allow me to present a new algorithm tomorrow?

....

A bit later the Achilles -programmer has called to Mr. Turtle and has invited him to demonstration of algorithm № 3.

Turtle: Well, my friend will you tell to me how your new program works?

Achilles: With pleasure! Knowing that you can suit as much as necessary complex labyrinths, I have decided to refuse "short-sighted" strategy of searching and have written algorithm which carefully analyzes all condition of "universe".

Turtle: Oh! You, obviously, have done enormous work! And in what does essence your analysis?

Achilles: Taking into account that a problem solvable only when there is though also twisting, but an open way to the house, I have written algorithm which based on research of topology of space...

Here we shall leave our heroes alone and we shall omit the description of Achilles' idea for details of work of an algorithm as we now shall see, have no essential value.

When the Achilles -programmer has finished Mr. Turtle has come in delight.

Turtle: Dear Achilles! You have written the amazing program and it is pity to me to disappoint you! Your program is valid to consult with any as much as complex labyrinth, but under condition of as you were expressed "topological coherence" points of an arrangement of the Automaton with its house.

Achilles: And can you break this condition, not breaking rules of our game?

Turtle: Elementary! I shall show you the decision! Moreover! Knowing your talent, I am sure - the following algorithm which you will write also will solve an offered problem. But only next task! But not this!

The turtle draws the next plan of a problem.
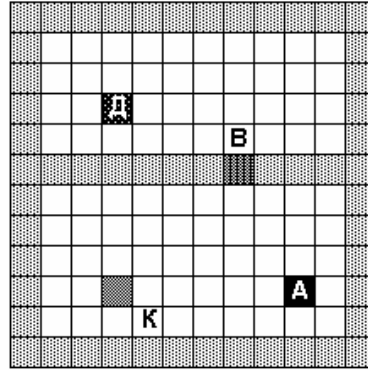
Turtle: Look here. There are the continuous wall between the Automaton "A" and the house "Д". In it the closed door "B". The door will open in the event that the Automaton will move in the cell "К" - "key". As you can see the decision is trivial. Though the space of the house and the Automaton have no yours "topological connection". How will the Automaton arrive?

Achilles: You have broken me!.. But if I will take into account an opportunity of existence of doors...

Turtle: But for this purpose you should construct new algorithm. Name it "Automaton № 4 "...

Here, we shall leave our heroes alone and we shall return to them only after long time. The further supervision over their competition does not matter and will tire the reader. Even not enough acute reader can guess the further development of the event. Therefore we shall pass the rest of representation and we shall return only to final action of the first act...

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There are Achilles -programmer and his inseparable friend, Mr. Turtle, in the same place and behind the same employment. The program of game has grown up till such sizes that there are a little space in a disk. For this time our programmer has turned to an expert on an artificial intelligence because solving more and more complex problems he leant many approaches in theory of algorithms. Now he talks on completely not clear, for uninitiated, language and Mr. Turtle hardly understood about what there is a speech. However... We find inseparable partners at that moment when Achilles restarts the computer as the next task of Mr. Turtle has once again tired out both the next Automaton and the computer in the next infinite cycle.

Achilles: ... And now I should write the new program? How will it be called?

Turtle: "The Automaton № 92672 "!

Achilles: But now you, Mr. Turtle, have exhausted all opportunities to tire out my algorithm in impasse!

Turtle: I deeply doubt of it. I am sure, my friend, that next time will be an opening to deceive yours algorithm.

Achilles: And do you already know it?

Turtle: I have no idea! But I know that after you will write the program № 92673 which will solve a problem № 92672 which I have no thought up yet. But I can find for it other task № 92673 which the Automaton № 92673 will not decide but will solve the Automaton № 92674, which you...

Achilles: But why are you so sure?

Turtle: At the beginning I wasn't so sure. But now... Now I am more and more convincing that, basically, our competition is only cybernetic variant of theorem of Gödel about incompleteness of axiomatic systems. The model of our computer "universe" with any your algorithm of management represents axiomatic system. Moreover, our model of "universe" uses axioms of arithmetic. That is

it "is rich enough". And according to theorem of Gödel such axiomatic system never is complete. Within the problem it is possible to construct such formula, and in our case such statement of a problem which is impossible neither to prove (i.e. to come to a decision for final number of steps) nor to deny (i.e. to prove that it is impossible to come to decision).

Achilles: Do you want to say, as perfect algorithms I will make you always can nonplus it?

Turtle: Alas, I am afraid that it is! If I am not mistaken, you can win me only in that case if your algorithm will contain indefinitely big number of rules or axioms, for this purpose it is necessary to write indefinitely long and indefinitely complex program. It follows from the second theorem of Gödel. And from our experiment. You have chance to win only in a limit...

Achilles: In a limit?!!.. Within the limits of that?

Turtle: Well if we will consider a certain function of complexity of each new Automaton from its number then a limit of this function on infinity and will give...

Achilles: You scoff at me, Mr. Turtle!

Turtle: If somebody scoffs it is only our new author and as far as I understand not at us. Axiomatic systems are not only incomplete, but also essentially incomplete. It is impossible complete them by adding of final number of axioms.

Achilles: It is indefinitely complex algorithm! Even for me, the fastest of programmers... And do you know about it from the beginning?!

Turtle: I have guessed it. Everybody guess it, Achilles. But there are not many people who want to notice existence of "Achilles' heel" inherent for any algorithm from the birth of the theory of algorithms. Your divine mother, Mathematics dipped you into a life-giving source of formal logic, holding for a heel? Such small heel, I do not remember, paradox of Russell, theorems of Gödel or thesis of Church?

Achilles: But Mr. Turtle, taking into account, that we have no indefinitely big brains, there no indefinitely complex algorithm inside them. And nevertheless we can solve those tasks!

Turtle: Yes you are right; my head is not too great. But let's agree that our game was on equal. My brain and your algorithms solved the same problem. Direct and return. We decided them from the different sides and with different success. I solved them always, and the algorithm - never. And it doesn't depend on life experience and talents. You know who has prompted me conditions of this problem?

Achilles: It will be interesting to know it.

Turtle: Children. I frequently observed, how absolutely usual children play computer games. Composers of these games are very inventive in creation different conditions. And very often these games contradict all life experience of players. Any magic tricks. ... And nevertheless obstinate children always find an answer of the most fantastic tricks. Then I have thought what will be if I change their places? And as you can see, the result is discouraging! Agree that we nevertheless managed to find such condition of game which allows distinguishing the person from the machine!

Achilles: Do you want to say that you have found the decision of Turing's task?

Turtle: And didn't you understand it yet?.. Our competition is also a variant of this task! Let's present that from the beginning I competed not with the Automaton № 1 but with your last Automaton. What is the number of it?

Achilles: 92671

Turtle: Let assume I know nothing about it and at all I do not know, whether I play with the Automaton or resourceful man. We shall assume, I shall try all those 92670 problems which were offered by me from the beginning and "the Automaton № 92671" with will decide them very fast.

Achilles: You will have suspicion that before you a reasonable person, will not you?

Turtle: Yes, if I shall be impatient, I shall come to such wrong opinion. But if I shall be patient, sooner or later I shall find a problem № 92672 or № 92673 or any № 1000001 and I shall send your algorithm in an infinite cycle!

Achilles: Thus you will open forgery!

Turtle: Quite right.

Achilles: And if from opposite will play the person?

Turtle: If both of us shall be unshakable, our duel will never be finished. In general people play such games all theirs life. But there are fields of much bigger sizes. Our artificial computer "universe" is only simplified model. People should play THIS game in real universe. This game sometimes names a science, economy, politics, history, progress or evolution. Our duel is only the next step of human mind in this grandiose competition. This play which characters we are is only the next act in this super play. In this sense the form of our duel was surprisingly plaited with its concrete content. Actually there are a lot of such problems. They meet everywhere. We just do not notice them. But some cases are very appreciable. Therefore, since that time, I started collect data on accidents in which computers are guilty.

Achilles: Data on accidents in which are guilty computers? You surprise me! Computers can not be guilty in accidents! It is absurdity. In accidents only people are guilty!

Turtle: Yes, you are right. People are always guilty. But I speak about accidents in which people trusted in computers very much, and computers are not guilty.

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Achilles: Yes, Mr. Turtle, you have disturbed me. Now I see our competition in other light. I thought that we are plying with children's toys … But people also do not always solve similar tasks!

Turtle: Yes, you are right, but agree, people find the most unusual decisions in the most improbable situations. People just sometimes do not have time. But the problem of computer programs at all doesn't contain in time. There can not be intelligence!

People always had time while they quietly went on the Earth by feed. But now they rush like crazy by theirs terrible cars and more often have no time. Therefore they trust in computers which can be in time but do not think. Thus people fondly believe that programmers can provide all possible situations beforehand.

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Achilles: Yes, to creep, as you, Mr. Turtle, we shall not agree … And task of Turing has no decision …

Turtle: Why it has no? It has. But only negative. The intelligence cannot be reduced to algorithm.

Achilles: But Mr. Turtle to what it can be reduced?

Turtle: I don't know! We have a mysterious ability, which can't be described by logic. There we are finding a new decision and then we return back and find their logic substantiation in "backdating". This mysterious ability distinguishes an alive brain from the Automaton or machines. We usually name it as ability to creativity. This ability allows us at the following moment to know something that nobody knows in this moment. Algorithms are absolutely not capable for such things. They know only that theirs founder initially has put in memory, for example you Achilles who really showed ability to creativity when made them. You see when somebody speaks that the machine makes a decision on the basis of arrived information it is not true. It does not accept any decisions. There is the programmer who analyzes the essence of a task and assumes that it is necessary to make that and that on the basis of the information. He has made the decision beforehand, and "has charged" the program. And all! Therefore any algorithm will lose in a duel sooner or later where it is necessary to show creativity. They will lose as soon as will settle a stock of the ready decisions initially incorporated in it.

Achilles: But what about heuristics, about self-training eventually!

Turtle: Heuristics it is also ready decisions. Not so strictly received, but available. Heuristics are fruit of another's creativity. It is your own training, my friend. The program of self-training will train the Automaton only what was incorporated in algorithm of training. It is no more. It is not creativity. Any program remains the program. …………………….. Agree, Achilles, my problem very

precisely will draw a line, which separates us from those machines which we are wrongly inclined to count reasonable.

АХИЛЛ: Are they capable to everything, what we are able, except for ability to creativity?

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Turtle: Yes, you right. Before Turing nobody could formulate concept of algorithm. Turing has defined algorithm through the machine. He has defined mathematically precisely. The first time in mathematics besides numbers and logic constructions the concept from the real world - "machine" has appeared. And it has solved a centuries-old problem. Agree, the method of Turing which has solved this complex problem is extraordinary graceful and courageous! From this I conclude, that Mr. Turing undoubtedly had ability to creativity.

Achilles: And you, Mr. Turtle, have defined your creativity through the artful task.

Turtle: Quite right. Now we can decide only that device like creatively conceiving which can play our game indefinitely long without any help. It is the only restriction. The decision should exist. Any device which can not breeze through our test has no such property.

Achilles: It means that it can not have intellect?

Turtle: Certainly.

Achilles: And if the device will sustain your test?

Turtle: Then I recognize its ability to creativity.

Achilles: And reasonable?

Turtle: Probably, but it is not necessary. Ability to creativity is a necessary condition of reasonable behavior. But it does not mean yet, that it is sufficient condition. While one is clearly that algorithms can not be reasonable.

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Turtle: Achilles, we distract from the main thing! Shall we continue our duel further? Or you recognize your defeat and will allow me to sing next song about Achilles' heel?

Achilles: Sing Mr. Turtle... But I should say you that Turtle's ability to creativity is higher than to singing...

Mr. Turtle is singing the song……….