



The Result of Experiment on Neural Network Learning of Human Art Drawing

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Abstract

In the article, the authors consider one of the most pressing problems of our time. In the first part of the article authors describes the most modern and effective heuristic and multi-heuristic algorithms that can be used in NP-hard problems solving. The most effective algorithms considered in order to produce answers that are as close as possible to the correct solutions in a satisfactory time. In the second part, the authors develop the idea of us in intelligent algorithms and methods, giving examples of machine learning of neural networks. In particular, it raises the question about assessing the quality of the neural networks in both on classic templates and in the most difficult situations concerning the creative process. A large number of experiments were conducted as a part of the work, and the data was collected in the process of the neural network training such as its reaction to individual objects. The results are briefly sorted and presented in the form of tables intended for the further analyze, in order to develop mathematical models and algorithms for assessing the quality of the learning process for modern neural networks.

Keywords: Artificial intelligence, Neural networks, Machine learning, Deep learning, Heuristic algorithms, Cuckoo algorithm, Agent approach, Multi-heuristic approach, Learning optimization, Particle swarm optimization

1 Introduction

1.1 Artificial Intelligence and Creativity

The history of Artificial intelligence showed several stages of its development. First stage: Early enthusiasm and high expectations. The second stage: Machine learning is a period of development of artificial intelligence with the advent of large amounts of data. The third stage: Deep training of artificial intelligence is the next stage of development, new opportunities. England mathematician and philosopher Alan Turing is the founder of artificial intelligence. He developed a theoretical model of a computer. Modern programming languages, such as C, Pascal, Java, are equivalent to a Turing machine. Modern technologies are considered intelligent if they allow to solve creative problems. Definition from Wikipedia: "Creativity is a process of activity that creates qualitatively new materials and

spiritual values or the result of creating objectively new. The main criterion that distinguishes creativity from manufacturing (production) is the uniqueness of its result. The result of creativity can't be directly derived from the initial conditions. No one, except perhaps the author, can get exactly the same result if you create the same initial situation for him. Thus, in the process of creativity, the author invests in the material, in addition to labor, some irreducible to labor operations or the logical conclusion of the possibility, expresses in the end some aspects of his personality. It is this fact that gives the products of creativity additional value in comparison with the products of production. In creativity, not only the result, but the process itself is valuable.

There are different kinds of creativity: technical, scientific, social, philosophical, cultural, pedagogical, artistic, musical, sports, game, etc. All kinds of creativity correspond to the types of spiritual human activity. All kinds of human creativity give a NEW output (discovery, invention, innovation). Creativity and personality are inextricably linked. N.A. Berdyaev (2003) (4) writes: "Personality is not a substance, in the creative aspect".

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Neurobiological bases of creativity are connected with the work of neural networks of the nervous system (9). Creativity and personality are inextricably linked. Reflecting on the nature of unconscious creativity described in (1). Roem Wallace in 1926 identified four stages of creative thinking: preparation - incubation - insight - test (6, 20). Insight - a poly-semantic term from the field of zoopsychology, psychology and psychiatry, describing the complex mental, the essence of which is unexpected, partly intuitive to understand the problem and "sudden" finding its solution. Insight is not an Epiphany of logic. Research in this area belongs to scientists: Karl Dunker, Max Wertheimer, Professor of the University of Gottingen - Wolfgang Koehler.

Artificial intelligence is a property of intelligent systems to perform creative functions, which are traditionally considered the prerogative of man; science and technology of creating intelligent machines, especially intelligent computer programs (2).

NATO experts give the following definition of Artificial intelligence: "the Capacity provided by the optimal or suboptimal choice from a wide space of opportunities to achieve goals by implementing strategies, based on training or adaptation to the environment" (19).

Modern artificial intelligence - is the use of various algorithms, software analysis of big data (input) and the final solution (output),

The most productive algorithms for planning are:

1. Genetic algorithm (3, 10, 16).
2. Two-phase neural networks (14).
3. Differential evolution (11, 12, 24).
4. Particle swarm optimization (5, 8, 13, 15, 23, 25).
5. The sampling similarity algorithm (21).
6. Hybrid differential evolution and sequential quadratic programming algorithm.
7. Artificial bee colony algorithm (22)
8. Optimization learning algorithms (7)
9. Cuckoo algorithm for solving problems in the energy sector (18, 26).

Cuckoo algorithm is one of the most modern meta-heuristic algorithms, which has become popular due to optimization processes in the field of energy. The cuckoo algorithm is widely and successfully applied to various technical optimization problems, such as economic load optimization, hydrothermal planning, and distributed network reconfiguration.

With the use of artificial intelligence, mathematical calculations are carried out according to the algorithms incorporated in the program and performed by various software. Artificial intelligence, equipped with mathematical tools, is able to solve complex science-intensive problems. The authors in their study put forward a hypothesis about how much we train artificial intelligence in the field of artistic creativity (on the example of the analysis of human drawings).

2 Methodological Framework

Artistic creativity is a special human activity that generates a qualitatively new work and is distinguished by uniqueness, originality and socio-historical uniqueness.

Artistic creativity is made on the basis of the laws of artistic and figurative reflection of reality.

Can artificial intelligence draw anything NEW? To begin with, we will discern whether artificial intelligence is able to recognize a human figure. The research was conducted at the Russian state social University. Students performed laboratory work on the training of artificial intelligence on the site <https://quickdraw.withgoogle.com>. "Can a neural network learn to recognize patterns?". The main task of the study is to create the largest set of data in the form of drawings and help in the development of machine learning technologies. The neural network offered a person to draw an object in 20 seconds. For example: mailbox, glass of wine, kitchen stove, palm, line, square, face, belt, ocean, mobile phone, etc. - an infinite number of items. The study involved 44 people, students of higher education (compiled a list of participants of the experiment). Each student completed 10 tasks. One task included 6 drawings. The students were making drawings. The neural network recognized some of the drawings, but did not recognize some of the drawings. During the experiment, the reasons why the neural network could not recognize the pattern were revealed. 375 unique objects were analyzed. The most common drawings are square, bear, butterfly, camel. More than 10 times students used 73 objects. Unique objects (participated in the experiment 1-2 times) – 35 pieces. As a result, it was necessary to determine the level of thinking of the neural network. According to the results of the experiment, a report was formed on the recognized figures (excellent figure).

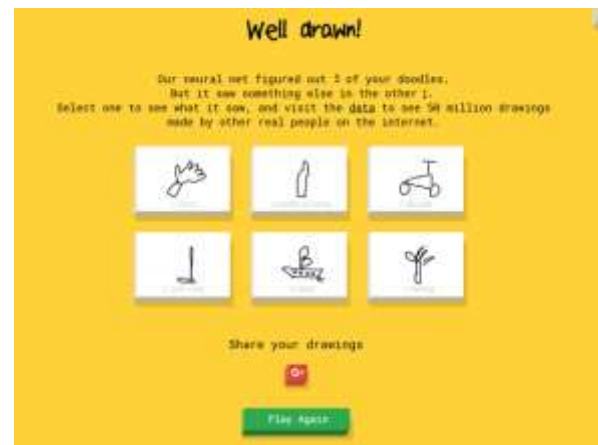


Figure 1: Neural network result of recognizing the man drawings.

So, the subjects performed 10 iterations (approaches) of 6 figures. As a result of the research, conclusions are drawn. The analysis of unrecognized drawings is carried out. According to the results of 25 experiments, the data are summarized. Each subject drew conclusions on the basis of mental (speculative) conclusions and equated the level of training of the neural network to the initial drawing skills of the child, thereby determining the level of thinking of the neural network, equating it to the age of the child.

Experiment 1. In the experiment, 60 pictures, among the unidentified (not witnesses) of figures – 13 pieces. Unrecognized description of the drawings:

1. Squirrel – poorly drawn
2. Baseball bat– the system is not yet trained
3. Matches - the system is not yet trained
4. Nail - system not yet trained
5. The aircraft system is not yet trained
6. Crocodile - the system is still not trained
7. The tube with the mask is poorly drawn
8. Foot – badly drawn
9. The key system is still not trained
10. Watermelon - system is still not trained
11. The aircraft system is not yet trained
12. Avocado - system is still not trained
13. Bandage - badly drawn

Result: as a result of the experiment, 60 drawings were made, among the unidentified (not understood drawings) – 13 pieces. The reason for the system error is that the system is not yet trained or the person did not draw well.

System thinking is appropriate to a 2-4 y.o. child.

Experiment 2. In the experiment, 60 pictures, recognized - 39, unrecognized - 21. Basically, the problem of not recognizing the picture was in poor-quality drawings of a person. Intelligence corresponds to a child of about seven (7) years.

Result: System thinking is appropriate to a 7y.o.child.

Experiment 3. As a result of the experiment, 16 iterations of 6 figures and 1 iteration with 4 figures (the total number of 100 figures) were made. Among unidentified (not understandable drawings) – 41 units. Description of unrecognized drawings - the system is not yet trained or poorly drawn. Thinking corresponds to a child of 6 years. The system didn't recognize 41 out of 100.

Result: System thinking is appropriate to a 6 y.o.child.

Experiment 4. As a result of the experiment, 10 iterations were carried out. Among the 60 drawings, 14 were not recognized, among which the first problem is the problem of the information system, and 13 poorly drawn images. Artificial intelligence corresponds to a 3-year-old child

Result: System thinking is appropriate to a 3 y.o.child.

Experiment 5. As a result of the experiment, 10 iterations were carried out, where 6 figures were drawn in each. Among 60 drawings, 38 images were recognized, 22 images were not recognized. Some images were not recognized due to the fault of the person, namely: 3 images could not be performed by the person from 22 unrecognized. Artificial intelligence corresponds to a child – 5 years.

Result: System thinking is appropriate to a 5 y.o. child.

Experiment 6. The experiment was carried out 10 iterations of 60 drawings unrecognized 6 figures (10%), the cause of the problem person and 1 picture in error AI (1.6%). AI corresponds to a child under 10 years of age.

Result: System thinking is appropriate to a 10 y.o. child.

Experiment 7. As a result of the experiment, 10 iterations were carried out, among 60 drawings. Not recognized - 16 drawings – because of the low skill of drawing a person. Of the 100 drawings, the system did not recognize 42. The system is not perfect and needs to be improved. Of the 60 drawings made, the system could not recognize 13 drawings, namely:

- 1)the toe is not able to portray
- 2)bird – the system didn't recognize

- 3)stitches – could not portray
- 4)snorkel with the mask depicted, the system didn't recognize
- 5) bat – the system did not recognize
- 6)ladder – the system does not recognize
- 7)the dog – the system didn't recognize
- 8)fireplace – the system does not recognize
- 9)bed – the system didn't recognize
- 10) rabbit - the system didn't recognize
- 11)basketball was not able to portray
- 12)pie – system not recognized
- 13)the steak was not able to portray

Result: at the moment the system corresponds to a 5-year-old child. In my opinion, AI corresponds to the development of a child aged 5 years. Most of the drawings are not recognized due to the fact that I am very bad with a computer mouse, the consequence of this is the inability to determine the figure of AI. System thinking is appropriate to a 5 y.o. child.

Experiment 8. As a result of the experiment, 60 drawings were made that were not recognized by the system - 17. Unidentified drawings: Sink, Candlestick, Train, Green beans, Trombone, Telephone, Crab, Fish, air conditioning, Foot, Cat, Stairs, Letter, Fan, Raccoon, Cruise liner, Balloon. Describe the problem: Some pictures were not recognized. Several figures the system could not recognize due to the small number of samples in the database.

Result: artificial intelligence corresponds to the development of the child at the level of 14-18 years. The system is not yet trained, maybe the person painted badly. System thinking is appropriate to a 14 y.o. child.

Experiment 9. As a result of the experiment, 10 iterations were carried out. Among the 60 drawings, the system did not recognize 19 drawings. The main reason is the lack of skill of the artist or not enough time to portray the object.

Result: the neural Network is not sufficiently trained, as many simple, accurately drawn objects, the neural network did not recognize. In my opinion, artificial intelligence corresponds to the development of a child at the age of 6 years. System thinking is appropriate to a 6 y.o. child.

Experiment 10. As a result of the experiment, 10 iterations were carried out, the total number of drawings – 60. Not recognized by the system – 9 (dishwasher, trombone, angel, lantern, Scorpion, bracelet, leaf, foot).

Result: the Problem of non-recognition, in most cases, was the “human problem”, that is, the wrong interpretation of the picture, although we should not exclude the fact that the system is not fully trained in the recognition of individual elements. System thinking is appropriate to a 5 y.o. child.

Experiment 11. As a result of the experiment, 10 iterations were carried out. Of the total number of drawings 44 are recognized, not recognized by the system 16. Unrecognized pictures: BlackBerry (the problem of man), the hand (the problem ISS), a calculator(problem ISS), air conditioning (man's problem), Wallet (the problem of man), toe (problem ISS), bandage (the problem ISS), the bulb (the problem ISS), the balloon (the problem ISS), the bed (the problem ISS), sleeping bag(man's problem), nail (problem

ISS), goatee (the problem of man), avocado (the problem of man).

Result: Most of the drawings are not recognized because of the limitations of artificial intelligence. In my opinion, IIS corresponds to the development of a 4y.o. child.

Experiment 12. When training the neural network, as a result of the experiment, 10 iterations were performed. Of the total number of drawings (60); not recognized by the system 14. List of unrecognized pictures: whale (the problem of man), wax crayon (the problem of the neural network), fire hydrant (the problem of man), tractor (the problem of the neural network), green beans (man's problem), ceiling fan (problem people), a postcard (the problem of man), watermelon (the problem of the neural network), camera (the problem of man), stitch (the problem of the neural network), pencil (the problem of man), Zebra (problem people), the bulb (the problem of the neural network), the hand (man's problem). In 9 out of 14 cases, the human factor, which means the wrong picture, was the fault of the incorrect definition of the figure.

Result: in my opinion, the neural network corresponds to the development of a 13 y.o. child.

Experiment 13. When training the neural network, as a result of the experiment, 10 iterations were carried out. Of the total number of drawings - 60, not recognized by the system - 12. Unrecognized drawings - Crab (the neural network is not trained), rabbit (it is not clear drawn), sleeping bag (it is not clear drawn), violin, key and Dolphin (the neural network is not trained), Inbox (dropped twice, was drawn in two different ways, the neural network is not trained), it is unclear drawn - eraser, peanuts, mermaid and protein. Description of the problem - in 6 cases, the neural network is not trained - could not recognize the pictures, in the other 6 cases there was not enough time or an error was made.

Result: in my opinion, the neural network corresponds to the development of a 14 y.o. child.

Experiment 14. When training the neural network, as a result of the experiment, 10 iterations were carried out. Of the total number of drawings are not recognized by the system 19.

Result: in my opinion, the neural network corresponds to the development of a 8y.o. child.

Experiment 15. When training the neural network, as a result of the experiment, 10 iterations were carried out. Of the total number of drawings in 60, not recognized by the system - 17. Unidentified: headphones, bandage, pie, bulldozer, anvil, sword, purse, Cup, BlackBerry, sea turtle, anvil, green beans, cruise ship, guitar, calculator, wax chalk, asparagus.

Result: the Problem: 1) "did Not know how to draw an object"; 2) Incorrectly drew the object; 3) Not enough time for the execution of the figure. In my opinion, the IIA corresponds to the development of a 7-8y.o. child.

Experiment 16. When training the neural network, as a result of the experiment, 10 iterations were carried out. Of the total number of drawings - 60, unrecognized by the system - 12. Unrecognized drawings: Zebra, knee, lighthouse, goatee, foot, purse, BlackBerry, watermelon, ice cream, basketball, map, scissors.

Result: the Reasons for the failures: 1) could not complete the picture in 20 seconds; 2) ignorance of some

subjects; 3) incorrect drawings. In my opinion, the neural network corresponds to the development of a 10y.o. child.

Experiment 17. When training the neural network, as a result of the experiment, 10 iterations were carried out the total number of drawings - 60, not recognized by the system - 11. Unrecognized drawings and description of the problem:

Car - inability of the system to recognize the pattern

Bird - the inability to portray a figure for 20 seconds

Car pickup - inability to draw a picture

Truck - inability of the system to recognize the symbol

Sock - the inability of the system to recognize a slightly inaccurate character

Bottle cap - inability to draw a picture in 20 seconds

Teapot - inability of the system to recognize the symbol

Underwear - inability of the system to recognize the symbol

Bird - the inability to portray a figure for 20 seconds

Envelope - inability of the system to recognize the pattern

Bracelet - incorrect question and the inability of the system to isolate the desired element.

Result: the neural network corresponds to the development of a child -10 years. Since some complex characters are recognized, true, and some are not. System thinking is appropriate to a child of 10 years.

Experiment 18. When training the neural network, as a result of the experiment, 10 iterations were carried out. Among unidentified (not understandable drawings) - 29. The system is not trained or the person drew badly.

Conclusion: the Thinking of the neural network corresponds to a child 2-4 years old, because the neural network did not recognize 29 of the 60 drawings. System thinking is appropriate to a 2-4 y.o. child.

Experiment 19. When training the neural network, as a result of the experiment, 10 iterations were carried out. The system did not recognize 13 of the 60 drawings. The system did not recognize:

bird - system determined that it is a diamond

purse - 2 times - the system determined that it is a socket and toaster

baseball - the system has determined that it is a tennis racket

snail - the system determined that the drawn spoon

postcard - the system has determined that it is an envelope

hurricane - the system determined that the tornado is drawn

ocean - the system determined that the pool is drawn

violin - the system determined that the cello is drawn

toilet - the system determined that the dishwasher is drawn

blueberries - the system has determined that the painted peas

the laptop system has determined that the painted oven

raccoon system determined that the dog is drawn

Result: the Intelligence of this system is at the level of 5-6 year old child. Some of the drawings, the system failed to recognize their fault, as was the figure the user is drawing bad. System thinking is appropriate to a 5-6 y.o. child.

Experiment 20. The neural network did not recognize from 60 figures 19. From observations, it can be concluded that the trained neural network corresponds to a child of 8 years.

Result: system thinking is appropriate to a child of 8 years.

Experiment 21. Thinking of IIS is running at 58%. The system did not recognize 25 of the 60 drawings.

Result: it is not possible to determine the level of thinking of the neural network.

Experiment 22. When training the neural network, as a result of the experiment, 10 iterations were carried out. Among unidentified (incomprehensible) drawings – 3. Description of unrecognized drawings: 1. Cloud. (the neural network is not trained.) 2. Giraffe. (Man poorly painted.) 3. Water slide. (Man poorly painted. The level of neural network development corresponds to the level of a 12-year-old child.

Result: System thinking is appropriate to a 12y.o. child.

Experiment 23. When training the neural network, as a result of the experiment, 10 iterations were carried out. Among the unidentified (not clear) of figures – 13 pieces. The system is not yet trained or the person has drawn badly. Thinking of ICI corresponds to a child of 2 years. The neural network did not recognize 13 of the 60 drawings.

Result: System thinking is appropriate to a 2 y.o. child.

Experiment 24. When training the neural network, as a result of the experiment, 10 iterations were carried out. Among the unidentified (not clear) of figures -7. The system is not yet trained or the person has drawn badly.

Cause of error:

– Human factor. The input data sent by the user does not correspond to the actual image of the object;

– Neural network memory. The images of objects recorded in the neural network memory have different ways of representation (a three-dimensional object, a two-dimensional object, a minimalist style of representation, etc.), which prevents the comparison of the input data with the data in memory.

Result: it is impossible to determine the level of thinking of the neural network.

Experiment 25. The results Produced by 10 iterations of communication with the artificial intelligence of the neural network. Unrecognized drawings – 15. The system didn't recognize: the Boat – the system does not recognize the Tree – the system does not recognize the Grapes – badly drawn, the Rake – the system does not recognize the Torch – the system does not recognize Omar – poorly drawn, Swing-Board – incorrectly drawn, the Crocodile is poorly drawn, the Great wall of China – incorrectly drawn, the BlackBerry system does not recognize the Owl is poorly drawn, the Ladder system didn't recognize, Green beans – the system does not recognize Jacuzzi – the system does not recognize the Nail system is not recognized.

Result: the Level of development of artificial intelligence of the neural network is at the level of a 5-year-old child. In most cases, the drawings were not recognized due to the lack of training of the neural network. Thinking corresponds to a 5y.o. child.

Summarizing the results of the experiments, the information processing automated.

Table 1: Presents statistical data of 25 experiments.

Picture description	The number of correct answers	The number of wrong answers											Result
	+	(empty)	(empty)	+	-	-	0	1	+	-	+	-	
Avocado	5	1		1	1						4		12
Bus	8												8
Car	7			1	2								10
Pickup car	4	1			1		1						7
Shark	8	2		1	2		1						14
Barn	3	1			1								5
Rollercoaster	4				2		1						7
Pineapple	5	2					1						8
Angel	4			2	2								8
Peanut	2				1								3
Watermelon	3				3						1		7
Harp	6	1											7
Butterfly	9	5											14
Banana	6	1		1	1		1						10
Paintcan	4	2											6
Drum				1									1
Drums	6	1									1		8
Basketball	5			3	3			1					12
Swimming pool	5	2		2			1						10
Baseball				2	5			1			2		10
Baseballbat	6						1				2		9
Squirrel	5			3	2						1		11
Binoculars	1	1				1							3
Bat				1									1
Wineglass	4												4
Hospital	3	1		1									5

Beard	3	1		2	3					1		10
Boot	6	1					1					8
Bracelet	3	2		1	4		1					11
Diamond	7											7
Broccoli	4						1					5
Alarm	9											9
Bulldozer	4	1			1							6
Boomerang	3	1			3		1					8
Bottleofwine	5	3										8
Vase	8	1										9
Tub	6											6
Bucket	2	1										3
GreatChinesewall	6	1						1				8
Bike	7						1					8
Fan	2	1		2	1		1			1		8
Camel	6	4		1	1		1					13
Helicopter	6						1					7
Fork	3			3	1							7
Grape	2	1			1	1		1				6
Cello	3			1	1		2					7
Waterslide	9	1		1	2							13
Waterslides	1											1
Balloon				2	2							4
Waxchalk	2				2							4
Octagon	6											6
Bow tie	8	1										9
Hamburger	4						2					6
Dumbbell	3			2	1		1					7
Guitar	6	1			1							8
Eye	7	1										8
Mountain	3											3
Pea	3	1	1									5
Rake	1			2				1				4
Mushroom	10			1								11
Truck	6				1		1					8
Pear	6	1					1					8
Door	6	1										7
Dolphin	2				1		1					4
Tree	5							1				6
Jacuzzi	1			1	1			1	1			5
Sofa	2	1										3
Rain	9	1										10
House	7						1					8
Dragon	1	2			1							4
Drill	1	3										4
Oven	6											6
Hedgehog	4				1							5
BlackBerry	4	1		2	3			1				11
Raccoon	4			1	1			1		1		8
Giraffe	5				1							6
Fence	10											10
Brewingteapot	3				2							5
Curl	8				3		1					12
Lock	4											4
Castle	4											4
Star	2											2
Zebra	4	1		1	2							8
Greenbeans				1								1
Beans	3			2	4			1		1		11
Zigzag	6	2			2		1					11
Snake	3	1					1					5
“Stop” sign	3			1	1							5
Umbrella	4				1							5
Tooth	2				1							3

Toothpaste	6	1			1		1				1		10
Toothbrush	5	1											6
Yoga	2				1								3
Cactus	3			1			1						5
Calendar	2			1									3
Calculator	8				2								10
Camera	6				2		2				1		11
Stone	2	4		1	2		1	1					11
Camouflage	4				3								7
Canoe	4	1			1								6
Pencil	5	1			2		1						9
Map	6	1		1	1								9
Potato	1												1
Frenchfries	3	1											4
Boat	4	1		1	2			1			1		10
Swing	4			1	1								6
SwingBoard	1	1		2			1	1			1		7
Square	14	2											16
kangaroo	1			1	2						2		6
Brush				1									1
paintbrush	3			1	2								6
Brush				1									1
Whale	5				3								8
WhaleWall	1												1
Keyboard	3	1			2								6
Clarinet	8	1		3									12
Strawberry	5	1		2			1						9
Key	5	1		1	1		1				1		10
GolfClub	4	2					1						7
Book	10	1					1						12
Knee	7	1			1		1						10
Wheel	4	1		1									6
Mosquito	3	1		1							1		6
Houseplant	7	1									2		10
Dresser	3						1						4
Computer				1									1
Compass	5				1		1						7
Computer	3			1	1								5
Envelope	4				1								5
Conditioner				3	4		1			1	2		11
Basket	2				1								3
Cow		1		1							1		3
Crown	4												4
Fire	6	1		4									11
CoffeeCup	2	1			1								4
Purse				2	4			2			1		9
Cat	8			1			1						10
Crab	2	1		2	1					1	3		10
Bed	4	2			1		1	1					9
Bed	1										4		5
Crocodile	1	2						1			1		5
Rabbit	8	1			1			1					11
Circle	3												3
Mug	6	1					1						8
CruiseShip	10				2								12
CruiseLiner				1									1
Cover				1									1
BottleCap	1	1			4								6
Bush		1		1	1								3
Palm	2			1			1						4
Bulb	4	1		1	3								9
Eraser	1	1			1					1			4
Swan	5						1						6
Lion	1			3	1								5

Candy	5					1						6
Stairs	3			3	4		1					11
Years. Mouse				1								1
FlyingSaucer	6	1		2		1						10
Bat	4			1								5
Line	3	2										5
Sheet	3			3	4	1				1		12
Persons	1											1
Person	8				1	1			1			11
Spoon	5				1							6
Elbow	3	1										4
Shovel	4					1						5
Horse	9			2	3							14
Bulb	2	1		1	2					1		7
Moon	7			1	1							9
Frog	1	1		3						2		7
Ambulance	4			1	1	1						7
Lighthouse				1	1							2
Bear	2	8		3	1					1		15
Mill	4					1						5
Broom	4	1			1							6
Sword	3	1			2	2						8
AnimalMigration	2			1	3							6
Microwave	4											4
MicrowaveOven				1								1
Microphone	4	3										7
MobilePhone	7				1							8
Brain	6	1		2	1	1						11
Lightning	6					1						7
Hammer	4				2	1						7
Mona	3	1		2	1							7
Carrot	4	2										6
IceCream	3	3			1	1						8
SeaTurtle	2				1							3
Most	2	3		1	1							7
Motorcycle	5	1				1						7
Ant	3			1		1			1			6
Mouse	5	2			1							8
Anvil	2	1			2	1						6
WristWatch	2											2
Headphones	4	1			1					1	1	8
Skyscraper	2	1										3
Skyscraper	2											2
Underwear	2	2		1	2							7
Foot	4	1			1							6
Nail	1	1		2	1		1			1		7
Scissors	2	1		1	2							6
Nose				2		1						3
Socks				1								1
Sock	4				3							7
Rhinoceros	4	1								2		7
Laptop	7			2	1	1	1					12
Monkey	2			2								4
Marmoset				1								1
Cloud	7	Cloud		1	2							10
Sheep	6				1							7
Necklace	3											3
Ocean	5			2	2	1	1			1		12
Lobster	1			2	3		1			1		8
Octopus	5									1		6
Screwdriver	1	1		1								3
Glasses	4	1				1						6
Tent	6			1						1		8
Finger	6	1			1	1						9

Toe	4				1			1			1		7
Palm	7												7
Panda	5	1		3									9
Parachute	6				1								7
SailingShip	6	1					2						9
Pliers	1												1
Passport	7			1	1								9
Pliers	2	1		2	1		1						7
Spider	7			1									8
Pen	5	1		1									7
Plumage	1												1
Hourglass	8							1					9
Cookie	1									2			3
Jacket	5	2					2						9
Pickup	2												2
Saw	3	1		1	2		2						9
Penguin	3			1	1		1						6
Pie					2			2					4
Letter				1									1
Pizza	4						1						5
TeddyBear	5	3		2	1								11
Beach	2	1					1						4
Bandage				1	5					1			7
Submarine	1				1								2
Candlestick				2	5		1						8
Pillow	7												7
Pillow	1												1
Train	1			1	1								3
FireEngine	3			1			1						5
FireHydrant	6	5	1		1								13
FireHydrant	1												1
PoliceCar	7			1	2								10
Pomade	5	1			2								8
Doughnut	5			1									6
Parrot	3			2	1		1						7
Dishwasher	5			1	1								7
CeilingFan	5	1		1	2		2						11
PostCard	4	1		1	1			1					8
Mailbox	7	1		1	2		1			1			13
Belt	1	2		2	2								7
AccessLadder	3							1					4
Pond	5	1			2								8
Bird	2			1	3			2			1		9
Console	4	2					1			1			8
Gun	2	1			1								4
Bee	4	1											5
Radio	2	1					2						5
Rainbow	9	2											11
Sink				5	2						1		8
PictureFrame	2						1						3
PictureFrame	1												1
River	5			1									6
Socket	2				1								3
RollerSkates	9	1											10
Roth	7	2			3								12
Hand	1			1	2								4
Mouthpiece	4	1			1		2						8
Mermaid	4				1						1		6
Fish	4			2			1						7
Backpack	3	3		1			1						8
Garden	4			1	2						1		8
GardenHose	7												7
Saxophone	4			2			1						7
Aircraft	3										2		5

TrafficLights	2											2
Candle	5	1		1								7
Pig	2	1			2					1		6
Sweater	10	3		1								14
Heart	5			1	2		2					10
Bench	8									1		9
Skateboard	9	1					1					11
Pan	4			1	3							8
Griddle	1											1
Ambulance	1											1
Scorpion	3	1			3							7
Clip	7											7
Violin	8	2			1			1				12
Remand	2											2
Elephant	4				1							5
Snowman	8						3					11
Snowflake	4						1					5
Dog	3			1	5			1		1		11
Owl	1	1		2	2			1				7
Sun	7											7
SleepingBag	3			2	2		1					8
Asparagus	2				4		2					8
Match	1											1
Matches	1			2	1					2		6
Quiltings	1	1		1				1		1		5
Stitch					1							1
Steak	6			1	1		1	1				10
Stereo	5			1	1					1		8
Stethoscope	7				2		1					10
WashingMachine	3											3
Table	4	2			1					1		8
Chair	5	2					1					8
Foot	6			1	2		1			1		11
Ties	1											1
Sandwich							1					1
Table	3	2		1			1					7
Tv	4											4
Phone	3	1		2	1	1						8
TennisRacket	3											3
Tigris	4			1			2					7
Axe	5			1								6
Tornado	5											5
Cake	2											2
BirthdayCake	5	1					1					7
Torchere	9			1								10
Toaster	3						1					4
Grass	5	1		1			1					8
Tractor	2	2		3	1							8
Trombone					1							1
Springboard for jumping the water	5											5
Triangle	9		1									10
Trombone	1			1	1		1					4
Pipe	1			1								2
Trumpet (MusicalInstrument)	1				1							2
Pipe(Muses. Tool)	1											1
Trumpet(MusicalInstrument)		1										1
TubeAndMask	1											1
TubeWithMask	2						1	1		1		5
Toilet	2	1			2			1				6
Snail	8			1				1				10
StreetLamp	6											6
SmilingFace	7		1				1					9
Smile	1											1
Hurricane	5	2		1				1		1		10

Moustache	2			2	1								5
Duck	5			1	1					2			9
Ear	7	1					1						9
Flag	2												2
Flamingo	5												5
FeltPen	6						1						7
Lantern	3							1					4
Piano	4	2			2		2						10
FruitIce	6						1						7
Van	6	2			1				1				10
Jersey	6			1									7
Football	4						2						6
Bread	8	2											10
HockeyStick	6			1	1		1						9
HockeyPuck	5			2									7
Hot Dog	4	1					1						6
Flower	5	1											6
Church	7				1								8
Kettle	1												1
Clock	3				1		1						5
Cup	2	1			1	1	1				2		8
Suitcase	7												7
Skull	5			1									6
Turtle	2										1		3
Blueberry	4				1			1		1			7
Hexagon	4	1		1									6
SchoolBus	4			2	1		1						8
Helmet	4			1							1		6
FlipFlops	3												3
Hat	3	1		1	1								6
Shorts	3												3
Pants	3	2					1						6
Brush	1												1
EiffelTower	4	1					2						7
Goatee	1			1	2								4
Apple	4						1						5
The overall result	1491	220	4	225	305	4	133	41	3	9	76	1	2512

As a result of data processing the following dependencies are obtained. Figure 2. - The ratio of unrecognized neural network drawings and recognized objects (pictures). From figure 2 it can be seen that the recognized neural network drawings - 59%, which is 18% more than unrecognized. From figure 3 it is seen that is not recognized iteration -27%. Figure 4 shows that the human factor is the cause of errors in pattern recognition by the neural network, which is explained by the following reasons:

- not every person (subject) is an artist, so most people do not have the ability to draw, do not have the skills to image objects and objects;

- not enough time to complete the picture, the more that are in need of training the neural network includes training complex pictures such as: Green beans, Mona Lisa, migration, anvil, nose, jail, detention facility, stress time, trombone (musical instrument) and clarinet (musical instrument), a goatee.

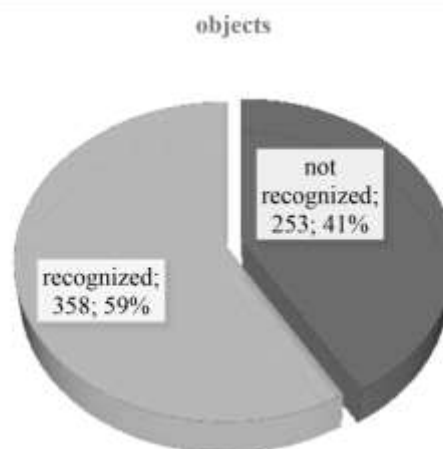


Figure 2: Not recognized and recognized objects (in %).



Figure 3: Not recognized and recognized iterations (in %).

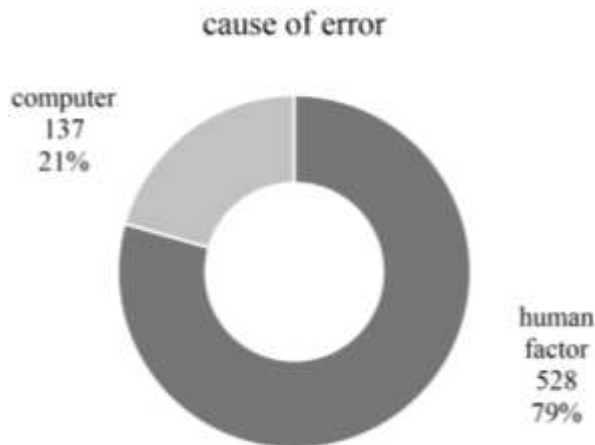


Figure 4: Cause of error (in iterations in %).

3 Results

It should be noted that students in the course of the experiment noted do not know the true meaning of some words. It is determined that the neural network learning algorithm requests an image of similar words, for example:

1. Teddy Bear and Teddy bear.
2. Cruise ship and Cruise liner
3. Potatoes and French fries
4. French fries and Chips
5. Television

Training of the neural network was carried out simultaneously by 45 students, performing many iterations. The first experiments on visual observation showed that neural network training corresponds to the thinking of a child aged 2 to 4 years. As the neural network was being trained, the neural network learning ability assessment came to the age of 7-8 years, then 12-14 years, sometimes up to 18 years and fell again to the development of a 5-year-old child. This suggests that the neural network is trainable. Participants of the experiment in 79% of cases considered guilty of a bad result of the Information system human factor – the inability of a person to draw an object correctly. Indeed, not everyone has artistic abilities.

4 Discussion

October 11, 2019. Russian President Vladimir Putin approved a national strategy for the development of artificial intelligence until 2030. “In order to accelerate the development of artificial intelligence in the Russian Federation, conduct scientific research in the field of artificial intelligence, increase the availability of information and computing resources for users, improve the training system in this area, it is necessary to apply a national strategy for the development of artificial intelligence until 2030,” - the document says (17).

«Artificial intelligence in a strategy refers to technological solutions that allow you to simulate the cognitive functions of a person and get results when performing certain tasks that are comparable, at least, with the results of intellectual human activity. Artificial intelligence includes IT infrastructure, software (including that using machine learning methods), as well as processes and services for processing data and finding solutions, the strategy says. Countries with the development of artificial intelligence will receive advantages not comparable to nuclear weapons, Russia has every chance of succeeding in this, said Russian President Vladimir Putin earlier» Putin V.V. approved the development strategy of artificial intelligence until 2030 (17).

5 Conclusion

The article presents the most modern and actual heuristic and multi-heuristic algorithms that can give solutions as close as possible to the correct ones by the satisfying time (solution of NP-difficult problems). It also touches upon the issue of assessing the quality of neural networks both on standard templates and for the most difficult situations related to the creative process. Within the framework of the work, twenty-five experiments were conducted and data on more than a hundred proposed images were collected and neural network reaction was noted to each of the described object. The obtained results are carefully sorted and presented in the form of tables intended for further analyze in order to develop mathematical models and algorithms for assessing the quality of the learning process of modern neural networks. The authors put forward the thesis about the need to develop mathematical models to assess the quality of machine learning algorithms. The authors classify the results obtained on the different stages of the machine learning. In the article discusses both typical examples of the modern neural network and the most complex ones related to the creative process. The authors conducted a huge number of experiments on different objects recognition and in general at different stages of machine learning. The authors also tried to assess the possibility of simulating the creative process through the deep machine learning. The main purpose of the publication is the publishing the results for the aim of the further analyze and developing methods and algorithms for assessing the quality of machine learning.

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