

AI and IQ- the Comparison and the Measuring Methods

K. LUBIENIECKA - KOCOŃ

EMAIL:

ABSTRACT

The hereby article is to present the notions of two concepts: human and artificial intelligence. The paper first offer the short presentation of their most common definitions. Both terms are widely known, however, not often are they viewed from the same perspective. Thus, the most intriguing part is to treat both issues in the similar, if not the same, way, using close assessment tools. Furthermore, the ways, methods and the approaches towards the assessment tools are provided. Finally, the comparison between those two concepts is shown, together with the idea of ITS as an example of AI.

KEYWORDS: AI, intelligence, IQ

1. Introduction

Since the times when humans stopped assessing and estimating their status and position from comparing the strength of their muscles only, various methods and names upon which the success in the life of an individual were evoked. As there is no one path and one position within a society, there appeared a need to create, first within the spoken, casual environment, a method, as objective as possible, to describe the reasons some people progressed faster and further than others in different goals, paths and careers. What was rooted within informal ways of assessing one social predator by another, transformed into a scientific label and acquired a name: the intelligence.

The intelligence was an answer why some, starting from the bottom, reached the peak of what a society offered. Lack of it served as a useful insult and as an explanation why some, despite monstrous efforts, are unable to learn from their own mistakes.

However, once created, the label was to develop as well; thus various scientific discussions, followed by reasoned arguments, concerning the definitions, what the intelligence actually is, and how we may measure it. There are numerous answers to those two aspects of the issue

of intelligence; however, the scientific approach seemed to have become even more complex, when humanity development reached the era of technology. There appeared one more perspective: as there exist various machines, employed to perform the same work and actions as intelligent humans, can we assume the machines are as intelligent as their creators? The issue of an artificial intelligence itself seems disturbing for some; others tend to react overenthusiastically, aiming to prove whether a machine can outsmart a human. There again appeared a need to define what an artificial intelligence is and how we can measure it. Therefore, there were created not only the test to measure IQ, but also those which were to deal with AI.

2. IQ

IQ, a commonly used abbreviation of the words “intelligence quotient” seems to substitute the full word “intelligence” at least due to two reasons. First of all, vast majority of languages, English included, follow the rule of language economization, meaning that if something may be written or spoken in shorten than already existing version, it will, even if the meaning shifts a bit. Moreover, the abbreviation “IQ”, because, it seems, of the second part of the

name, refers also to the already tested and checked level of the intelligence, thus sounding more reliably than the intelligence itself. Having referred to the definitions of the issue of intelligence itself, within the rest of the article such abbreviation will be used as a kind of a synonym of the full name of that feature of character.

As mentioned before, there have been created many definitions to describe what the intelligence is. Together with the definition itself, there goes the approach towards the intelligence. According to Nečka, “for the majority of psychologists, the intelligence is and perhaps will long be an individual value, which distinguishes a person from other people (...). The intelligence is also understood as a generalized feature, which means a feature that is revealed in various situations and intellectual tasks. We shall not call the swiftness in performing “in one’s mind” arithmetic equations the intelligence, if such actions are not accompanied with other, cognitive abilities.”[2].

According to the definition described above, one may decide that the intelligence is the ability to learn from one’s mistakes fast enough to profit from the constantly changing conditions of the environment, community or group one is within; it would also mean the ability to perform different tasks properly, despite the changing conditions of such performance.

Nevertheless, it is important to mention that the intelligence may have more than one meaning. Gardnem [5] presented seven different types of intelligence, which are follows:

- Linguistic,
- Logical- mathematic,
- Special,
- Musical,
- Bodily- kinesthetic,
- Interpersonal,
- Intrapersonal.

The profound division of various occurrences of the intelligence is widely known. However, for the sake of the discussion, within the rest of the article the notion of intelligence will be treated as one feature, without further divisions.

The major value of the intelligence, it seems, apart from its use, lays within the ability to measure it; and although there do exist the claims concerning every of the known method of measuring the IQ, stating that none of the tests are reliable, as they test other features apart from the intelligence itself, nonetheless the ability to provide our environment with our worth not only with our deeds, but also with certain label, given from some authority that have assessed our abilities, presents us with certain advantage on the both private and professional ground. That is why, perhaps, despite some claims mentioned above, the IQ tests may enjoy ever- lasting popularity.

2.1. Wechsler Test

Strelau claims that “IQ tests and intelligence abilities tests may be described as standardized and normalized tools measuring intellectual ability basing on the effectiveness of performing mental tasks” [5]. Thus, there will be shortly described some most popular of them.

One of the most widely known tests are so called Wechsler tests [5]. The WAIS – R (PL) scale consists of eleven tests: six within the main scale, where the tested answers and five within nonverbal scale, where the respondent writes or fills the test in. the tasks, included into WAIS are as follows [5]:

- Information,
- Gaps in the pictures,
- Repeating the numbers,
- Putting pictures in order,
- Dictionary,
- Building blocks,
- Arithmetic,
- Jigsaws,
- Understanding,
- Digit symbols,
- Similarities.

It is claimed that the variant results from those eleven tests may be explained with three features: verbal understanding, perception organization and distractors resistance [5].

2.2. Raven Test

One of the most commonly used group tests is the Raven test. It is to assess liquid intelligence [5], meaning the level of general intelligence, understood as the value of the g factor. It standard version consists of five scales: A, B, C, D, E; in each of them there are twelve sentences (sixty together); the respondent is to find the relation between the formula and the lacking element. Together with the Raven test the lexicon is used to estimate the verbal abilities: there are nine subtests, five of which closed ones, which refer to so called passive speech, and four open ones which serve to create one’s own statements [5].

2.3. APIS Test and Omnibus Test

The APIS test, according to its authors, is : the intelligence test “intended for group assessment (...) the tasks are created to evaluate the abstract- logical abilities, as well as the verbal, optical- spatial and social abilities” [1]. The test itself was updated in 2005. The tests within it assess as follows:

- “behavior” test- the cognitive aspect of social abilities,
- “squares” test- visual- spatial abilities,
- “synonyms” test- verbal abilities, knowledge of words,

- “classification” test- abstract- logical abilities,
- “numbers transformation” test- abstract- logical abilities,
- “new words” test- verbal abilities; fluency,
- “building blocks” test- optical- spatial abilities,
- “stories” test- social abilities.

The last test to enumerate is the Omnibus test. It serves to assess the crystallized intelligence, understood as the declarative and procedural knowledge [1]. The test consists of five groups of tasks [1]:

- Filling in the verbal analogies,
- Filling in the series of numbers,
- Assessing if the conclusions are true or false,
- Finding antonyms,
- Finding synonyms for phraseological phrases.

The Omnibus test was normalized on students and applicants to Foreign Office and Civil Service Departments and therefore it is claimed to be prepared for people having above- average intellectual abilities [1].

3. AI

The notion of artificial intelligence, in most cases known from different science- fiction movies, is still a relatively new term. Philosophy Encyclopedia provides the reader with its detailed definition:

“The artificial intelligence is a relatively new branch of science, which deals with programming and examining the behavior of computers which are used both to solve some problems, intellectual, engineering and operational tasks, and as a psychological tool- to model the mental abilities. The author of the notion is Alan Turing, who in his paper Computing Machinery and Intelligence replaced the question if the machines can think with the question if we could call intelligent such device, which behaves, writing questions and answers, in the same way as humans, meaning it is in this context undistinguishable from a human. The aim of the majority of the works concerning AI is to build such devices or programs, which perform certain actions, so that they would pass the test, no matter if it would be chess or proving mathematic theorems. Some people use AI techniques to build such machines which perform certain actions better than humans, or to perform such tasks, which humans could not do, meaning some intellectual tasks, as storing huge amount of data, using the knowledge from the certain branch of science, or some physical tasks, performed by robots” [3]. As it would be mentioned below, such definition apply as well to ITS, which would serve as an example of a device to undergo IQ tests tasks.

Alan Turing, to check his theory, build the device which is to check whether a machine may be undistinguishable

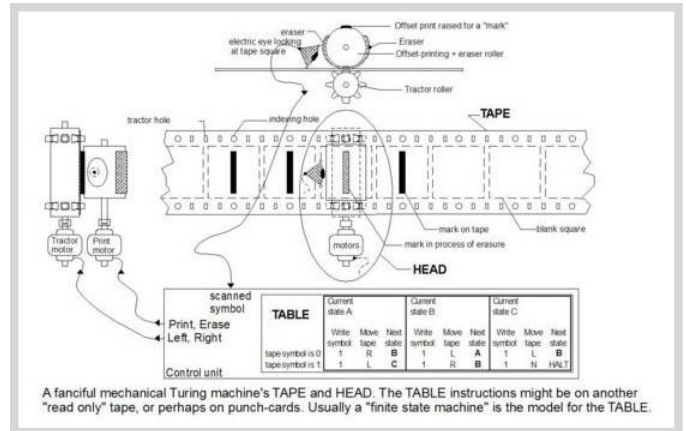


Fig. 1. Modeling and simulation process flow in TRANSIMS

Source: [own work]

from a human in a given aspect. The device is called “Turing machine”, as presented in Figure 1 [6].

The way how the machine works, is well described , among others, in Stanford University materials. According to it, a Turing machine is a type of state machine. “At any time the machine is in any one of a finite number of states. Instructions for a Turing machine consist of specified conditions under which the machine will transition between one state and another.

A Turing machine has an infinite one-dimensional tape divided into cells. Traditionally, it is thought of the tape as being horizontal with the cells arranged in a left-right orientation. According to the first version, the tape has one end, at the left say, and stretches infinitely far to the right. Each cell is able to contain one symbol, either ‘0’ or ‘1’.

Within the same description, the machine has a read-write head, which at any time scanning a single cell on the tape. This read-write head can move left and right along the tape to scan successive cells. The action of a Turing machine is determined completely by the current state of the machine, the symbol in the cell currently being scanned by the head and a table of transition rules, which serve as the “program” for the machine.

Each transition rule is a 4-tuple:

< State0, Symbol, Statenext, Action >

which can be read as saying “if the machine is in state State0 and the current cell contains Symbol then move into state Statenext taking Action”. The actions available to a Turing machine are either to write a symbol on the tape in the current cell (which we will denote with the symbol in question), or to move the head one cell to the left or right, which we will denote by the symbols « and » respectively.

If the machine reaches a situation in which there is not exactly one transition rule specified, i.e., none or more than one, then the machine halts” [4]

As this is an abstract version, we can shift some of it within current technological situation; the tape serves as the memory of the machine, while the read-write head is the memory bus through which data is accessed (and updated) by the machine. [4].

However, there are two crucial aspects to note about the definition. There are two important things to notice about the definition. The first is that the machine's tape is infinite in length, corresponding to an assumption that the memory of the machine is infinite, and the second may be described as assuming the availability of infinite time to complete the computation [4].

These two assumptions are intended to ensure that the definition of computation that results is not too narrow. This is, it ensures that no computable function will fail to be Turing-computable solely because there is insufficient time or memory to complete the computation. If a function is not Turing-computable it is because Turing machines lack the computational machinery to carry it out, not because of a lack of spatio-temporal resources[4].

Nevertheless, one need to note, that despite numerous tries, none of the currently made devices passed the test on Turing machine. Not yet, at least.

3. Is IQ equal to AI?

As described above, there is not a machine able to deceive the assessors and prove to behave as a human. Therefore, we may draw the conclusion than intuition and intuitive thinking, and thus the ability to learn from the changing circumstances in which the task is performed is the main difference between the concept of IQ and the AI. Nonetheless, is that mean people tend to overuse the term "intelligent" towards machines?

If we decide to examine the most popular test assessing human intelligence, we may notice that although there exist certain areas where it would be impossible for a device to prove its usefulness, there are still those in the test that may be equally well, if not better, performed by artificial "mind".

The areas tested in Wechsler test are within the reach of ITS in the similar extend as for a human. Both need to be filled with information to be able to use it, one may even risk the claim that the teachers in that situation may be the same, for example, yet another device with vast data stored in it. The example of such digital teacher may be some servers, storing Internet sites; the only difference in getting the knowledge would be in acquiring it: by reading or by transferring, but isn't reading a way of transfer as well? In case of ITS, one may claim they work on the exactly the same basis: the system also needs to be "filled with" the data in order to work properly; it also need to have

working principles developed; and as the software development may be compared to storing the data within the "tester", the whole process, both in case of human and in case of a device, is similar.

In case of the APIS test, one may note that the ability "to behave oneself" also relies on the current state of knowledge about the socially accepted behaviors. It may turn out, as it is often stated in the companies of multinational staff, that a person described as a perfectly polite and apt to follow all social rules in one environment may be considered rude when meeting members of a different community where other rules of behavior apply. One may recall a situation of shaking hands: in majority of western countries such gesture is regarded as a perfectly polite start of a meeting, whereas, as it is constantly reminded on various trainings, we should not expect a Japanese to provide us with such performance, which obviously does not mean Japanese are impolite; however, they may regard a westerner, who does not bow at the beginning of each meeting, as equally lacking knowledge of socially desirable behaviors.

The Omnibus test may seem a bit more difficult to sustain such comparison at the first glance. However, basing on the assumptions presented above, one should compare the lever of the language knowledge of an average student with the data stored within any digital dictionary- would it not the latter be more able to provide the assessor with numerous synonyms, antonyms or analogies present in a given culture? Once again, the knowledge "stored" within a mind and that within a disc may be quite similar.

3. Conclusion

The theory could be stated that all the eleven elements of Wechsler test may be obtained on similar level by both a machine and a human, or by a device, in the given example ITS; it could be similarly estimated in case of other tests, as both a human and a system need first to be learnt and then one may expect a positive outcome of the task that they need to complete. The greatest difference in learning, in case of human, and acquiring, in case of machine, lays, one may conclude, in the role of a third party involved in the process. Whereas the first stage in both cases would be almost identical, meaning that both would need some tools as well as a teacher who/which would present how to use them, the second and further stages differ more and more. It means a human, having completed the first stage of learning, may proceed to the level where the role of a teacher becomes less and less important, and they may start to depend on the tools mostly, if not entirely; of course, the level of intelligence would matter in the ability to cope with the tools without the manual provided by a teacher,

as well as with the ability to define the tools they need and to find them.

Therefore, one may draw the conclusion that the difference between those two issues, AI and IQ, is the question of the distance that may be covered on the learning path. Could that mean the machine may be to cover similar way of self-developing as a human? Taking into consideration the newest surveys concerning the artificial neuron networks, perhaps one may just note that it is far too early to decide yet. AI may not equal IQ, but the way of estimating the results of both labels may be surprisingly similar. Coming back to the notion of ITS being tested on its "intelligence" it may be stated that even if the system may not be able to pass the Turing test yet, it is nevertheless intelligent, if we decide to use that word in the meaning of comparing the way it performs its "duties" and follow the tasks with the way the same work be performed by a human. It needs to be emphasized that the difference between calling a human intelligent and using the same name to

describe the system is, in fact, time- the time people need to make devices follow the path we have covered.

Bibliography

- [1] MATCZAK, A., et. all: APIS Warszawa, PTP 2006
- [2] NĘCKA, E.: Intelligence. Genesis- Structure –Functions (Inteligencja. Geneza- Struktura-Funkcje) Gdansk, GWP (2000)
- [3] SMITH, B.C.: Philosophy Encyclopedia (Encyklopedia Filozofii), <http://www.ptta.pl/pef>
- [4] Stanford Encyclopedia of Philosophy, <http://plato.stanford.edu/entries/turing-machine>
- [5] STRELAU, J.: Psychology. Academic course book (Psychologia. Podręcznik akademicki) Gdańsk, GWP (2003)
- [6] UROŠ KRČADINAC, <http://www.krcadinac.com>