Aristotle and AI: From the dialectics of being and thought to reflecting on automata and the camera obscura

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In Πολιτικά [1], the philosopher states: $\tilde{e}i \gamma \dot{a}\rho \eta \dot{\delta} \dot{v} v \alpha \tau \sigma \ddot{e} \kappa \alpha \sigma \tau \sigma v \dot{\sigma} \rho \dot{a} v \dot{a} \rho \kappa \delta c \sigma \dot{e} v \dot{\eta}$ προαισθανόμενον άποτελεῖν τὸ αὑτοῦ ἔργον, ὥσπερ τὰ Δαιδάλου φασὶν ἢ τοὺς τοῦ Ἡφαίστου τρίποδας, οὕς φησιν ὁ πριητὴς αὐτρμάτους θεῖον δύεσθαι ἀγῶνα, οὕτως αἱ κερκίδες ἐκέρκιζον αύταὶ καὶ τὰ πλῆκτρα ἐκιθάριζεν, οὐδὲν ἂν ἔδει οὔτε τοῖς ἀρχιτέκτοσιν ὑπηρετῶν οὔτε τοῖς δε- σ πόταις δούλων." The most important point here is perhaps not that Aristotle is making reference to automated machines ("automata"); besides, similar references exist in Greek mythology, with tales shaped long before Aristotle's time. Even if noted under a hypothetical form, he speaks about machines that could, in particular, replace man with respect to his being as a worker, or as a generator of labor. Hence, he puts forward a substantial difference in comparison to machines that merely exist as "όργανα ποιητικά" - means of production, which presuppose active participation on behalf of the human counterpart. For the contemporary reader of the $\Pi o \lambda \iota \tau \kappa \dot{\alpha}$, a juxtaposition of this idea to the modern notions of Artificial Intelligence and Artificial General Intelligence is virtually inevitable. The complete retraction of the need for a human worker, and his replacement by a Deadalic automatum, the weaving loom that weaves "by itself", or the guitar that plays its song "on its own", is perhaps conceptually the closest counterpart to these contemporary notions, that the antiquity has put forward. In the previous excerpt, the αρχιτέκτων will concoct the general plan of the desired outcome, with no need for living $\nu\pi\eta\rho\epsilon\tau\alpha$. This point is especially noteworthy with respect to parallels to the contemporary scientific status and social being. For Aristotle it seems natural that the existence of machines that would in today's terms be considered intelligent, must lead to the consequence of a complete abolishment of the necessity of labor (``οὐδεν ἂν ἔδει οὕτε [..] τοῖς δεσπόταις δούλων"). On the note of the - largely of dystopian nature - impact that goes together in estimates and predictions over the evolution of AI, we believe that this particular societal dimension of the philosopher's thinking should be the basis for a broader discussion and consideration by experts and laymen alike.

Aside from the aforementioned excerpt from the works of Aristotle, a number of parallels of modern AI practice to other parts of his work can be drawn. We shall mention two of the most interesting, in our opinion:

Matter and thought. Aristotle has criticised severely Plato's theory about "ideas". In "Metá $\tau \alpha \Phi \upsilon \upsilon \kappa \dot{\alpha}$ " [4], he asserts that the Platonic ideas end up in multiplying the intellectual labor that is required to explain reality, instead of aiding to facilitate the process. In particular, ideas double the number of notions that demand a rational explanation. For Aristotle, the essence of things lies within themselves, and within themselves only. In this sense, the ideas of the idealist philosophers and the ideas of Aristotle clashed (cf. the beautiful depiction of this collision of ideas in the "School of Athens" of Raphael). Today, this position of Aristotle finds confirmation within some of the fundamental notions in data science and machine learning. Over a series of practical problems, the best solution is shown to require taking advantage of observations (data) themselves. Perhaps the most widely known application of this idea is related to Large Language Models (ChatGPT, DeepSeek, etc.). Billions of data samples – natural language sentences, "scraped" to a large degree off public repositories – form the input raw materials with which AI is running. The general form of the AI model itself, in its modern, deep learning variant, can be used in a diverse range of problems, with the prime difference between applications being the quality or type of input data. The premise of machine learning is indeed that using extensive observations of the reality of the problem at hand, will lead to a better solution than any hand-crafted modeling of reality, no matter how well-crafted it is, if it does not use data to fine-tune itself. Hence, in a way, it is a clash between the material world and the world of ideas, and it is *matter* that leads to the best solutions. In reference to an axiom of dialectics, we could state that the quantitative plethora of observations-data translates to qualitatively superior characteristics.

Image, optics and computer vision. AI, since its very beginnings as a distinct field of computer science [6], is intertwined with the evolution of the field of computer vision and image understanding. In Aristotle's works we can find a diverse set of stated problems regarding the nature of optics and image formation, as for example in "Περί χρωμάτων" [3], in "Προβλήματα" [2, 5], and elsewhere. In "Προβλήματα", we read: "Διὰ τί ὁ ἥλιος διὰ τῶν τετραπλεύρων διέχων ούκ εὐθύγραμμα ποιεῖ τὰ σχήματα ἀλλὰ κύκλους, οἶον ἐν ταῖς ῥιψίν; ἢ ὅτι ἡ τῶν ὄψεων ἔκπτωσις κῶνός ἐστι, τοῦ δἑ κώνου κύκλος ἡ βάσις, ὥστε πρὸς ὃ ἂν προσπίπτωσιν αἱ τοῦ ἡλίου ἀκτῖνες, κυκλοτερείς φαίνονται.". This excerpt goes on with forming a set of similar problems, followed by argumentation and attempts of explanation. Aristotle is interested here in studying what is today called image formation, or broadly the dialectics of (2D) image and (3D) space. Even though his analysis is far from being considered complete or accurate by today's standards, what is important is that he is forming argumentation that is integral as groundwork for the contemporary fields of Photogrammetry, Vision and Computer Graphics. He describes correctly light source rays as straight lines that lay in space (' $\kappa \alpha i \alpha \dot{\sigma} \tau \alpha i \varepsilon \dot{\sigma} \theta \varepsilon \tilde{\alpha} i \varepsilon \dot{\sigma} \iota \nu$ ') and is alluding to elements of central projection ($\delta \sigma \pi \epsilon \rho \delta \iota' \delta \pi \eta \varsigma \epsilon \delta \mu \pi \eta \epsilon \delta \gamma \omega \nu (\delta \nu \tau \delta \phi \tilde{\omega} \varsigma')$. However, a major obstacle in forming a correct theory is his hypothesis that vision manifests itself through optical rays that depart from the eve and towards the objects (a hypothesis that will in fact be corrected only centuries later; perhaps unexpectedly and quite interestingly, this "reverse" trajectory will be in a sense a fundamental aspect of the modern "Raytracing" technique in Computer Graphics).

References

- [1] Aristotle, *Politika*, Bekker:1253b. Kaktos publishing.
- [2] Aristotle, Problemata, Bekker:911b. Kaktos publishing.
- [3] Aristotle, *De coloribus*, Bekker:791a. Kaktos publishing.
- [4] Aristotle, *Metaphysics*, Bekker:990b. Kaktos publishing.
- [5] Aristotle, *Problemata*, Bekker:912b. Kaktos publishing.
- [6] Rosenblatt F., "The Perceptron": A probabilistic model for information storage and organization in the brain, Psychological Review, 1958.