http://dx.doi.org/10.25038/am.v0i20.328

**Shi Tianyu**
*China University of Political Science and Law, College of Humanities, Beijing, China*

# As the 'Intellectual Subject' of Artificial Intelligence – The Intrinsic Understanding of Artificial Intelligence on The Ideas of 'Time' and 'Space'

**Abstract**: Presupposing artificial intelligence (AI) is an 'intellectual subject' rather than merely a product of complex operation is a prerequisite to discussing how AI and human intelligence inherently understand time and space. This article argues that AI as an intellectual subject and human intelligence have their respective origins and connotations, and different intelligent characteristics also lead to the difference between them in the way of inherently understanding time and space; different inherent understandings of time and space and whether to think with time and space as an 'object' are the underlying differences between AI and human intelligence. Meanwhile, so far AI is unable to process space-time issues by means of 'non-objectification'.

**Keywords**: artificial intelligence; intellectual subject; time; space; objectification.

## About AI as an 'intellectual subject' and 'human intelligence'

### *About AI*

Artificial Intelligence (AI) was proposed in the Dartmouth Conference in 1956, and it is a new science used for simulating, extending and expanding theories, technologies and system applications of human intelligence. In short, it "thinks like a man and acts like a man",[1] hence, it is extensively practiced and applied in numerous fields, including natural language processing, motion control, social intercourse and even human-computer games. Moreover, AI's simulation of human thinking, language and consciousness also drew forth a reflective philosophical force, and philosophical and brain science problems about 'the game between human intelligence and artificial intelligence' and economic problems like 'the application of AI to social positions' have attracted close attention from scholars. The author argues that if we want to discuss the difference between AI and human at an intelligence level, we need to presuppose AI is an 'intellectual subject', namely a process of extracting "facts, experience and

[1] Peter Norvig and Stuart. J. Russell, *Artificial Intelligence: A Modern Approach*, translated by Yin Jianping et al. (Beijing: Tsinghua University Press, 2013), 3.

*Author contact information: SWUNnewspaper@outlook.com/shitianyu@keemail.me

rules from the brains of experts or other knowledge sources (e.g., books and documents) and then changing them into computer systems",[2] rather than a scientific product of mechanical, linear operation formed in the first two industrial revolutions, the different ways of thinking of these two kinds of intelligence in 'inherent understanding' are the focus of discussion in this article.

*About philosophical approaches of 'intellectual subject'*

The interpretation of the term 'intellectual subject' is conducted according to research approaches used for 'intelligence' and 'subjectivity' in western philosophies, and the term 'intelligence' in this article is *intellectus* in Latin, and *verstand* in German. Meanwhile, the German word *verstand* also implies 'reason, 'intellectuality' and 'comprehension'. Rationalist philosopher Descartes said, "everyone knows there is a kind of clearness in reason, which refers to a kind of cognitive clarity or explicitness",[3] and he took the self-evident intellect as the logical starting point of his rationalist philosophy; Likewise, in *Ethics*, Spinoza also divided knowledge into "perceptual knowledge" – namely "opinion or imagination", "universal concept and its inferential knowledge", and "intuitive knowledge" – namely "proceeding from the correct concept of formal essence of an attribute of the god and hence reaching a correct understanding of the essence of things".[4] To rationalists at least, 'intelligence' is an ability rooted in human intuitive abilities and universal belief in knowledge and it is a primary conceptual work dispensing with deduction. While in the framework of this article, intelligence not only includes deep thinking of reason (e.g., AI's calculation and measurement of the objectification of time and space) but also contains perceptual intuitive elements (e.g., human intelligent intuitive ability is a perceptual ability).

In addition, studies about 'subjectivity' in western philosophy still need to mention a Cartesian epistemological turn, "I am an entity, all essence or the nature of this entity is just thought".[5] From the Cartesian epistemological perspective, 'I' is set as a 'subject', whose fundamental attribute is 'thinking', while thinking is manifested as an ability to doubt or reflect, or an intellectual ability to plan presentations, in a manner of speaking, 'intelligence' is given out by thinking subject; while in Kant's *Critique of Pure Reason*, the image of a highly intelligent subject was raised to *a priori* status, namely 'transcendental synthesis' and 'pure apperception' abilities. From the perspective of Kant's transcendental philosophical discourse, the intellectual subject opened up the perspective of a perceptual institution for 'time' and 'space', and the transcendental synthesis of time and space is a precondition for a human to initiate rational thinking internally.

[2] Gao Hua & Yu Jiayuan, "Philosophical Dilemma and Future Developments of Knowledge Acquisition in Artificial Intelligence," *Philosophical Trend*s (2006): 45.

[3] René Descartes, *Meditations on First Philosophy* (Beijing: Commercial Press, 1989), 194.

[4] Baruch Spinoza, *Ethnics* (Beijing: Commercial Press, 1981), 74.

[5] René Descartes, *Philosophies of Western European Countries from the 16th to the 18th Centuries* (Beijing: Commercial Press, 1975), 148.

*The interpretation of the connotations of AI as an 'intellectual subject' and 'human intelligence'*

As stated above, it is intelligence and intuitive ability in thinking that form 'subjectivity', and the formation of subjectivity becomes the foundation for intelligence. Besides, setting AI as an 'intellectual subject' is a precondition to compare it with human intelligence. The author thinks that AI as an intellectual subject has the following implications:

At first, if the intelligence of AI is from its subjectivity, then the subjectivity of AI is not primary. AI is a structure of human sciences, while scientific and technological achievements and inventions are manifestations of human creativity. Such creativity is presented as humanity trying to further pursue self-actualization with scientific and technological means, namely artificially constructing a machine to simulate, extend or expand thinking, consciousness or language, while an established machine is invented, a scientific research approach is named 'AI' – in the author's opinion – not in a sense of historical determination. Meanwhile, AI is not subject to the laws of biological evolution, because space technology, energy issues and biological evolution do not present direct causal necessity. Therefore, the subjectivity of AI is just drafting and setting of humanity, and *a priori* principle of AI as an intellectual subject is virtually derived from human experience and is not primary. For instance, before the intellectual game of *weiqi*, *weiqi* the AI program AlphaGo invented by DeepMind, a subsidiary of Google Inc., humans have primarily wrote four neural networks for it: a rollout policy, a supervised learning policy network (SL policy network), a reinforcement learning policy network (RL policy network) and a value network. In other words, deep learning function of AI "representing the universe as a nested graded conceptual system (connections between simpler concepts are defined as complex concepts), from general abstract conceptualization to highly abstract representation."[6] "It is faster than human chess players and analyzes potential possibilities more intensively, thus gaining the upper hand."[7] However, we need to know that it is undeniable that human experience input is the *a priori* principle to AI, whose subjectivity is 'artificial', as the premise to its intellectual subjectivity. In the same vein, AI's inherent understanding of time and space is based on human inputting and setting of the concepts of time and space too. For instance, the inputting and setting of time series models like the 'autoregressive-moving-average model'[8]is the precondition and prerequisite for AI to forecast and fit the trends of time series data.

[6] Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, translated by Zhao Shenjian et al. (Beijing: Posts and Telecom Press, 2017), 5.

[7] Max Tegmark, *Life 3.0: Being Human in the Age of Artificial Intelligence* (New York: Alfred A. Knopf, 2017), 78.

[8] The autoregressive-moving-average model is mainly used to forecast and fit the trends of time series data, and its function is to set up a stationary times series model. This model integrates moving-average model, autoregression model and so on, and can describe the memories about past noise, past models and so on in the system separately.

Second, AI as a subjective intelligence is manifested as an established state in a consequentialist sense. As an intellectual subject, its intelligence is always manifested as a 'result', namely constantly completing in the direction of a result presupposed by humans and continuously gaming with humanity as an intellectual subject. Constantly completing in the direction of results presupposed by human means in a given program and algorithm framework, and its intelligence moves towards a given 'goal'. For example, for AI in the field of computer vision, humans set the 'goal' of recognizing, tracking and measuring the goal and AI's completion of this goal can be nothing but a given result, even if machine vision has a greater ability to capture than human eyes. Meanwhile, as a subjective intelligence, the author regards AI which is gaming with humans as a constant completion of 'result', just as AlphaGo intellectually competed with humans in *weiqi* according to the four neural networks, every move of AI was a completion of an intellectual result, while the ceaselessness of the game means the successiveness of intellectual thinking. In addition, 'constantly' completing in the direction of a result preset by humans and 'constantly' gaming as an intellectual subject means the advancement of 'determinism', for example, the target image captured by machine vision may surpass or deviate from the 'result' expected by humans, and such deviation from the result virtually means 'determinism' is not an original point in the time dimension but a time quantum drew by constantly generated results by the intelligence of AI. The author believes that humanity's forward-looking depiction of the scenes of AI/robots attacking people in the fields like literature and film and their reasonable concern about the prospects of AI are exactly from surpassing the 'result' and the advancement of the origin of determinism in the time dimension.

Different from AI as an intellectual subject, human intelligence as a concrete subject is universally understood by humans. At first, human intelligence will develop 'consciousness' of non-concrete objects and reduce them to 'concepts' (e.g., the concepts of 'time' and 'space'), and meanwhile, human experience and perception will form the initial understanding of the world. Moreover, the understanding depends on human intelligence, so it is 'inherent'.[9] Meanwhile, the intellectual characteristics of AI also give it inherent understanding, and the application of the time series data model makes it an inherently understandable time series. When AlphaGo operates with the Monte Carlo tree, it also internally relies on the one-dimensionality and successiveness of time which enables the algorithm; in addition, when 'rollout policy', one of AlphaGo's four neural networks, was rapidly simulating a chess game and evaluating moves, it was inherently understanding the existence of temporality (shown as fast and slow at this moment) through the intelligence of the subject itself.

Next, according to the book *Critique of Pure Reason* by Kant, when human intelligence is perceiving, both three-dimensional schema in a geometrical sense and concrete aesthetic schema can be transcendentally made sense by a human. Moreover, intelligent intuitive activity conducted by humans as a subject makes time and space

[9] To the understanding of the author, this 'inherence' is shown as understanding without depending on the other and is a manifestation of subjective independence; meanwhile, inherence in the context of this article belongs to every independent individual or intellectual subject.

inherently understandable. Besides, in the author's opinion, the ability of human intelligence to capture the characteristics of non-concrete objects makes the concepts of 'time' and 'space' emerge, which becomes one of the domains of discourse about 'consciousness', while the intelligent intuitive spirit enables pure apperception of time and space later.

At last, after intuition, the role played by human intelligence in the thinking process is not an expansion of linear thinking nor the deduction of pure formal logic but is developed out of combined action of the subject's mind and body. Under the combined action of the mind and body of the subject, intelligence's intuition of representations will form the perceptual impression of primary being of the entities, namely the impression of time and space of things sensed by intelligence. While bodily and mental functions which form this impression come from 'bodily intentionality' or 'combined action of previous impressions'. In bodily intentionality, a viewpoint proposed by Merleau-Ponty – "the posture that my body adapts in the face of actual or possible tasks"[10] – is the best interpretation of bodily intentionality, and "explain diplopia in normal vision and a single object with the functions of visual organ and the use of visual organs by mental subjects"[11] is a manifestation of the functions of bodily intentionality. The author argues that the combined action of bodily intentionality on the intelligent thinking process is rooted in human existence because bodily intentionality itself contains original bodily experience of time and space and this combined action of perceptual experience cannot be achieved by AI by learning formulas and accumulating algorithms. Meanwhile, 'combined action of previous impressions' is also a participant of intelligent thinking, e.g., personal experience of a religious rite will form a transcendental mystical experience in the sub-consciousness, such previous inner impressions will be recalled in later intellectual intuition out of the control of the subject's will and become an inner combined action, e.g., the worship conducted by European church members in the Dark Ages often had transcendental experience in intellectual intuition. The author claims that bodily intentionality's original experience of time and space and time and spatial awareness captured by intellectual intuition have become an essential condition for the combined action, and combined action of the two makes intelligent thinking nonlinear. While in the inherent understanding of time and space, AI as an intellectual subject and human intelligence show the most fundamental difference.

[10] Maurice Merleau-Ponty, *Phenomenology of Perception*, translated by Jiang Zhihui (Beijing: Commercial Press, 2001), 137.

[11] Ibid., 295.

## The intrinsic understanding of 'time' and 'space' of artificial intelligence as 'intellectual subjective'

As mentioned above, presupposing AI is an intellectual subject not only has scientific payoffs as evidence but also has philosophical studies as necessary preparations for the discussion. An object with intelligence means it can inherently understand time and space, even if in a way different than humans. The author believes that the meaning of 'understanding' here does not refer to pure reason, nor a reflective judgment, nor perceptual empathy or subjective ingestion of an observed object, rather, 'understanding' here means knowing about something, namely recognizing its basic abilities, which is an ability shared by all biological existences; while the 'inherence' of understanding means the independence of the subject in understanding, and it is a possibility of free thinking without the other as evidence in time, as the understanding of time and space is also inherent in the subject.

The author argues that AI as an intellectual object inherently 'objectifies' time and space when understanding time and space.[12] First, based on the presupposition of conditions such as AI installation program, algorithm setting and deep computing of data, all intellectual activities of AI are conducted according to 'temporality', for example, 'time-series data model' as one of the forms of AI's inherent understanding of time forecasts and fit time series data according to the one-dimensionality of time; machine vision takes in and measures the displacement of a space object in accordance with the extension of space. Under this circumstance, when AI is intelligently thinking about time and space under the program, time and space are 'objectified' as an observable object, 'objectification' is the premise for observation and intelligent expansion; meanwhile, physical time and space as a support becomes a fundamental condition for AI as an intellectual subject that AI's inherent understanding of time and space is impossible without the premise of physical time and physical space. This also means space and time which 'relies on a subject' has an objective relationship with 'subject itself', rather than a 'non-objective' relationship. In other words, AI is unable to be aware of truly primary time and space, and only by taking this primary time-space view as an operational goal can time and space truly enter the sight of its intellectual subject and be inherently understood, namely 'objectifying' it.

Next, according to the viewpoints stated by the author earlier, the time quantum formed by AI advancing 'the origin of determinism' and constant generation of a 'result' are intellectual results of inherent understanding of space and time. AI is likely to surpass or deviate from the expected 'result' in the process of determinism-prone (i.e. the setting of manual program) thinking, while the 'result' caused by intelligent thinking makes the origin determinism move ahead in the time dimension; when AI obtains this intellectual result, the process of delineating the time quantum of

[12] 'Objectification' here refers to an incongruous relationship and it reveals an incongruous state between an intellectual subject and one thing, and this status is the premise to recognizing and reflecting on this thing; meanwhile, here 'objectification' does not draw on the definitions of objectification such as 'alienation of self-consciousness' proposed by Hegel or 'the process of purposed objective activity' by Marx.

determinism and the unremittance of intelligent thinking is virtually still based on physical time and space, physical time and space are still the essential conditions for the achievement of AI intellectual results. Therefore, when AI has an inherent understanding of time and space (i.e. acquiring the intelligent result about time and space), it still relies on physical time and space. Hence, it can be assumed that inherent understanding of time and space depends on the primariness of time and space, and at this moment AI's attitude towards time and space is also its attitude towards the 'objectification' in its inherent understanding.

## Inherent understanding of 'time' and 'space' of human intelligence

There are great differences between human intelligence and AI in an inherent understanding of time and space. As mentioned above, human consciousness can be aware of non-physical time and space, and intuitive abilities can make transcendental apperception of sundry perceptual presentations possible, while Merleau-Ponty's 'phenomenology of perception' also can combine the human body and mind to act on intelligence. While the author argues that the most underlying behavior of human intelligence's understanding of time and space is human 'recollection', which refers to human recombination of past experience, time and space. People's dreams and usual recollection can all be considered as different ways of recalling. Besides, the recollection of presentations of everything and the essence of things as well as 'non-objectification' characteristic of recollection itself are the most fundamental characteristics of human understanding of space and time, and this characteristic distinguishes human intelligence from AI.

The author holds that the one-dimensionality of time and three-dimensionality of space are broken in the process of recalling, and physical properties of primary time and space are condensed in recollection, and time and space overlay, integrate, derange and even rupture in recollection. When discussing 'duration', Bergson said: "inside the self, a process of organizing conscious states and making them infiltrate each other is happening, and this process is real duration".[13] Moreover, Bergson argues that the real-time should be objective and is a duration formed by multiple moments during inter-infiltration, while deep self-consciousness is continuous, "inner continuousness perceived by consciousness is nothing but mutual melting of conscious states and the growing of self".[14] This duration can be the form of human intelligence's inherent understanding of time and space, but this form is incomprehensible to AI as an intellectual subject. Meanwhile, the author also believes that recollection is the best means of expression of this kind of inherent understanding that only when a man is recalling what Bergson called mutual melting of the conscious state and representations and the understanding of the essence of things that man has experienced at the

[13] Henry Bergson, *Time and Free Will* (Beijing: Commercial Press, 1997): 73.

[14] Ibid, 72.

level of one-dimensionality of time and three-dimensionality of space can continuously break, overlay, fuse or rupture. That is to say, "When you are concentrating on something – taking walking stick of the blind – your mind seems not to isolate to see the attribute of this stick ... You have integrated with this stick into one, feeling the world at the tail end of the stick."[15]

It follows that when reminiscent human intelligence inherently understands time and space, what it captures is recombined 'human experience', rather than the form of time and space itself. The author believes that under human experience and consciousness, experience itself and the form of space and time bearing the experience are graded, and the experience that people recall is an essential condition for the formation of memory, so it is superior; whereas the form of space and time bearing the experience will not be first observed by recollection itself (or 'recollection' cannot be possible), so it is superior. Furthermore, due to perceptual characteristics of recollection, those who concentrate on past experience and inherent understanding cannot become aware of the existence of time and space in intelligence, for instance, when cherishing the memory of and recollecting one's native land; what man inherently understands is experience related to homeland, and human intelligence focuses on the content of the experience recalled. "Enlightenment means this mind realizes and identifies with its complete temporal structure, means it is no longer obsessed with the power of objectification and means it has acquired morals inevitably contained in wisdom."[16] This shows that human reminiscent nature makes time and space unable to be confirmed as an 'object' that a subject is unable to truly realize 'the existence of time and space' when inherently understanding past experience in the form of recollection, namely time and space cannot be 'objectified'.

## The fundamental difference between the intelligence of AI and human intelligence in the inherent understanding of time and space

As mentioned earlier, since recollection is a means of expression unique to human intelligence, time and space at this time are changed to the form subject to human in comparison with physical time and space. This change is humanity's unique way of understanding time and space. Here, intelligence as AI and human intelligence have both similarities and differences.

As for the similarity, AI and human intelligence both need to rely on dimensions of time and space to initiate intellectual thinking, but AI conducts intelligent thinking in one-dimensional time, 'constant generation' of the 'result' obtained is generated in one-dimensional time; likewise, when people are dreaming, recalling and cherishing memories, they are also doing it in the time dimension, e.g., the duration

[15] Cheng Sumei & Yao Yanqin, „The Confluence between Philosophy and Artificial Intelligence: Interviewing Hubert Dreyfus and Stuart Dreyfus," *Philosophical Trends* 11 (2013): 105.

[16] Zhang Xianglong, "Artificial Intelligence and General Philosophy of Mind-On the Connotations of Deep Learning and Time in Mind," *Philosophical Trends* 4 (2018): 21.

of a beautiful dream and recollection that brings tears to one's eyes. Therefore, original physical space and time enable the thinking of these two kinds of intelligence, the intellectual thinking process of the two both need time and space for maintenance. In human-related and 'human technology' related fields, all existences are revealed by the existence of space and time, and this is *a priori* foundation and prerequisite to the occurrence of these two kinds of intelligence and their subjectivity that we discuss today.

But in terms of the difference, AI and human intelligence inherently understand time-space issues differently, such as 'different ways of inherently processing time and space', and 'whether to objectify time and space', and 'non-objectification' of time and space are insurmountable obstacles for AI. At first, the two show 'different ways of inherently processing time and space'. According to the abovementioned standpoints, AI's inherent understanding of time and space has not broken the framework of one-dimensional time and three-dimensional space from beginning to end. For instance, the path of advancing the origin of determinism still is the path of the one-dimensionality of time, because at this moment operating is still conducted under procedure setting in one-dimensional time, unable to break the framework of one-dimensionality at root; whereas as for human intelligence, constant mashup and recombination of time and space in recollection means time and space in the inherent understanding are not the time and space with rigid physical attributes, but the space and time-stretched and distorted by human intelligence. And this is the underlying difference between AI and human in time-space issues because the interweaving of two dimensions-time and space is the primary reason why all things in the world were created, so, different ways of thinking about time and space should be fundamental. Meanwhile, due to 'recollection', only in human intelligence can time and space show different features, while AI's way of inherently understanding time and space shows its characteristics as a subject at root.

Then, AI as an intellectual subject must 'objectify' space and time to truly inherently understand space and time; while the human does not need to understand inherently the premise of the objectification of space and time, as humans understand space and time in a unique way – 'non-objectification'. As previously mentioned, AI is much better than human intelligence at grasping time and space, and the premise of this grasp and thinking is the objectification of time-space, or, intellectual object's 'thinking' process is out of the question; whereas when a human is recalling, past experience will constitute an essential condition to make recollection possible, and people who are recalling (namely those who are in a mixed, superposed and ruptured space and time) cannot be aware of the existence of space and time in intelligence, namely they inherently understand with a 'non-objectification' thinking. Hence, the author argues that whether to inherently understand time and space with objectification thinking constitutes the most fundamental difference between AI and human intelligence. So far, in the field of AI studies, non-objectification-based intellectual thinking to understand time and space remains unimaginable, even though human

beings have simulated AI with powerful memory function afterward, then when AI recalls past experience by means of 'data retrieval', retrieval itself and space-time as a carrier for data generation remains an 'object'. Hence, only humans are in the torrent of time but do not know why.

## Conclusions

AI vs human intelligence in different games is currently the hottest topic around us, and the passion for this topic is from AI surpassing human intelligence, which is manifested as a human reflection on their situation. This article argues that presupposing AI is an 'intellectual subject' is a prerequisite to comparing it with human intelligence, and that AI will surpass or deviate from the intelligent 'result' preset by humans to some extent with its unique intelligence and subjectivity – shown as the advancement of the origin of 'determinism', while the constant completion of 'result' makes this advancing process manifest as the extension of the one-dimensionality of time. Meanwhile, initial concepts of time and space and human intuitive abilities together with the effectiveness of mind and body depicted in the phenomenology of perception make human intelligence present features different from AI.

Next, even if these two kinds of intelligence both base their thinking process on primary physical time and space, only by 'objectifying' time and space can AI start intellectual thinking in inherent understanding; while human's recollection mashups and recombines space and time in human intelligence, which is a thinking process of breaking one-dimensionality of time and three-dimensionality of space; meanwhile, the empiricalness of what is recalled constitutes definite evidence for 'non-objectification' is human's unique way of inherently understanding time and space. The most underlying difference between AI as an intellectual subject and human intelligence is precisely embodied in their different ways of processing time and space, and by far AI is still unable to process time and space by means of non-objectification.

## References

Bergson, Herni. *Time and Free Will*. Beijing: Commercial Press, 1997.

Descartes, René. *Meditations on First Philosophy*. Beijing: Commercial Press, 1989.

Descartes, René. *Philosophies of Western European Countries from the 16th to the 18th Centuries*. Beijing: Commercial Press, 1975.

Goodfellow, Ian, Yoshua Bengio, Aaron Courville. *Deep Learning*. Translated by Zhao Shenjian et al., Beijing: Posts and Telecom Press, 2017.

Hua, Gao & Yu Jiayuan. "Philosophical Dilemma and Future Developments of Knowledge Acquisition in Artificial Intelligence." *Philosophical Trends* 4 (2006): 45–50.

Merleau-Ponty, Maurice. *Phenomenology of Perception*. Translated by Jiang Zhihui, Beijing: Commercial Press, 2001.

Norvig, Peter and Stuart. J. Russell. *Artificial Intelligence: A Modern Approach*. Translated by Yin Jianping et al. Beijing: Tsinghua University Press, 2013.

Spinoza, Baruch. *Ethics*. Beijing: Commercial Press, 1981.

Sumei, Cheng & Yao Yanqin. "The Confluence between Philosophy and Artificial Intelligence: Interviewing Hubert Dreyfus and Stuart Dreyfus." *Philosophical Trends* 11 (2013): 102–107.

Tegmark, Max. *Life 3.0: Being Human in the Age of Artificial Intelligence*. New York: Alfred A. Knopf, 2017.

Xianglong, Zhang. "Artificial Intelligence and General Philosophy of Mind-On the Connotations of Deep Learning and Time in Mind." *Philosophical Trends* 4 (2018): 13–22.

Article received: April 26, 2019
Article accepted: July 6, 2019
Original scholarly paper