The Boundaries and Hierarchy of AI Explainability from a Legal Perspective

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Abstract

The " black box " nature of AI algorithms presents a profound challenge to the foundational principles of modern legal systems, specifically the attribution of liability and procedural justice. This article addresses the legal boundaries and implementation mechanisms of explainability by proposing an integrated framework that combines a hierarchical model with indirect methods. We argue that the duty to explain must be governed by the principle of proportionality, dynamically calibrating its scope to the risk level of the algorithm. A novel "systemic-contextual-outcome " three-tier explanation model is constructed, delineating distinct responsibilities for developers, deployers, and users. To resolve the inherent tension between transparency and intellectual property, an indirect explanation mechanism is proposed, utilizing alternative technical solutions for compliance. At the governance level, a public-private collaborative path is advocated, wherein the state sets mandatory framework standards and supervises enforcement, while enterprises independently develop compliance tools. This research provides critical theoretical support for advancing AI legislation and constructing a secure and self-governing AI governance framework for China.

Introduction

The issues of " algorithmic black boxes " and opaque decision-making in artificial intelligence are impacting the existing legal order and governance frameworks. Their deep integration into domains such as social welfare, economic trade, and national defense touches upon critical areas including social equity, state security, and international competition. Algorithmic "explainability" has thus evolved from a purely technical issue into a normative proposition requiring urgent legal response, constituting a central challenge within the artificial intelligence governance system. However, the law faces inherent difficulties in regulating rapidly iterating AI technologies, while algorithmic opacity simultaneously challenges fundamental legal principles such as accountability and reviewability, thereby eroding the authority of law as a behavioral norm and adjudicative benchmark. Consequently, establishing explainability as the legal cornerstone of trustworthy artificial intelligence is a prerequisite for safeguarding individual rights, realizing procedural justice, and ensuring technology remains within the bounds of the rule of law.

Explainability in artificial intelligence entails more than mere technical parsing of code; it necessitates clarifying the subjects bound by the duty to explain and their corresponding legal boundaries. Confronted with global artificial intelligence governance challenges such as cross-border data flows and algorithmic collaboration, it is imperative to establish connections between the protection of individual rights and international regulatory efforts. Simultaneously, rigid standards should be abandoned in favor of constructing multifaceted explanation mechanisms that incorporate proportionality, hierarchy, and indirectness to balance diverse interests. This article seeks to clarify the boundaries of the explanatory duty for artificial intelligence, construct explanation mechanisms centered on hierarchy and indirectness, and explore pathways for public-private collaborative governance, thereby providing theoretical support and institutional design for building a robust and resilient legal governance system for artificial intelligence and for contributing to the development of global governance models.

1. The Explainability Crisis in Artificial Intelligence and its Legal Origins

The "black box" nature of artificial intelligence triggers a crisis of explainability. Its roots lie not only in technical characteristics but are also deeply embedded within the legal system itself. The vague legal conceptualization of artificial intelligence leads to unclear regulatory objects, while algorithmic opacity directly impacts the legal foundation of attribution of liability, which is centered on clarity of rights and responsibilities, thereby shaking the foundations of judicial review and procedural justice.

Therefore, explainability should be elevated to a fundamental legal principle that trustworthy artificial intelligence must follow.

1.1. The Evolution of the Connotation and Denotation of Artificial Intelligence from a Legal Perspective

The legal concept of artificial intelligence continuously adapts alongside the expansion of its technical capabilities and social functions. Early legal approaches tended to regard it as a neutral tool or product, its connotation focusing on automation and efficiency, and its denotation limited to hardware and software systems executing specific commands. However, as the technological paradigm shifts towards artificial general intelligence centered on big data and large models, it is gradually evolving into a new type of actor possessing certain decision-making and learning capabilities, capable of producing unpredictable outputs, thereby unsettling the anthropocentric logic of legal attribution.

Artificial intelligence is increasingly becoming a core force influencing power structures and resource allocation. Its operational model, reliant on cross-border data flows and cloud-based collaboration, endows it with potential characteristics that transcend sovereign boundaries. (Arefin, Zannat, and Global Health Institute Research Team United States 2025) Consequently, the legal definition of artificial intelligence must incorporate a dimension of international law regulation. Furthermore, vagueness and lag in its legal conceptualization lead to inaccuracies in governance objectives, forming the logical starting point of the explainability crisis. Artificial intelligence should be regarded as an autonomous technical entity and, based on its application scenarios and risk levels, classified as a product, a tool, or a special actor, thereby facilitating the construction of a graded responsibility system that spans its entire lifecycle.

1.2. Algorithmic Black Boxes Challenge Legal Constraints

The "black box" nature of artificial intelligence algorithms is fundamentally eroding the normative effectiveness of modern legal systems. The operation of law relies on a clear and traceable chain from behavior to responsibility, a chain that algorithmic opacity severs. In substantive law, when autonomous decision-making causes harm, the elements of causation and subjective fault requisite for attribution of liability become difficult to prove due to the black box, causing remedial mechanisms such as tort law and product liability law to falter.(De Bruyne and Ooms 2025) In procedural law, parties' rights to information, defense, and a fair trial all presuppose the ability to comprehend the reasons for adverse decisions; the uninterpretability of algorithmic decisions effectively hollows out these fundamental due process guarantees. (Karlan and Kugelberg 2025) Furthermore, when black boxes are deployed in administrative discretion or judicial assistance, they not only directly contravene the public law principle of transparent power exercise but may also, in cross-border applications, engender state responsibility for failing to satisfy international human rights law requirements for fair trial and effective remedy. Therefore, algorithmic black boxes challenge the entire legal system's foundational values of certainty, predictability, and accountability.

1.3. Explainability as the Legal Foundation of Trustworthy Artificial Intelligence

Confronted with the systemic challenges that algorithmic black boxes pose to legal certainty, accountability, and procedural justice, establishing explainability as a core legal principle for trustworthy artificial intelligence constitutes an inevitable adaptation of the rule of law to technological transformation. This positioning is not merely a requirement for technical transparency but, more significantly, represents a structural adjustment undertaken by the legal system to maintain its normative authority.

On one hand, explainability serves as the logical prerequisite for reconstructing the foundation for attributing legal liability. Only when the reasoning path and key factors influencing an artificial intelligence decision can be traced and articulated can the resulting consequences be effectively linked to the specific legal subject — whether developer, deployer, or regulator — responsible for the system, thereby repairing the chain of responsibility ruptured by the black box.(Wang and Chen 2025) On the other hand, explainability constitutes the cornerstone for safeguarding citizens' procedural rights and constraining state power. Within administrative and judicial contexts, the right of the affected party or litigant to be informed of the reasons for an adverse decision is a fundamental requirement of due process. Unexplainable algorithmic decisions effectively deprive individuals of their right to information and to mount a defense, while also preventing judicial review of administrative action, ultimately eroding the foundations of a society governed by the rule of law.(Wang 2024) Therefore, explainability must be established as a statutory obligation, forming a normative bridge between technology and law, ensuring that artificial intelligence is controllable, trustworthy, and accountable, and ultimately enabling it to become a normative cornerstone compatible with a rule-of-law society.

2. The Boundaries of the Explanatory Duty in Artificial Intelligence

Having established explainability as a legal cornerstone of artificial intelligence governance, there is an urgent need to define its clear and reasonable scope of obligation. Excessive explanatory demands risk inhibiting innovation and potentially violating the principle of proportionality. To this end, it is essential to clarify both the subjects and the boundaries of the duty to explain: firstly, the responsibility for explanation should encompass the multi-actor chain comprising algorithm developers, deployers, and users; secondly, a dynamic equilibrium between ensuring transparency and safeguarding other rights and interests must be established through case-guided and typological methodologies; finally, owing to the cross-border nature of the technology, the definition of the explanatory duty must expand from domestic regulation to encompass dimensions of international law.

2.1. Subjects of the Explanatory Duty

Establishing the duty to explain for artificial intelligence first requires identifying the responsible subjects. Given that the design, deployment, and application of artificial intelligence constitute an interlinked chain of responsibility, confining the duty to explain to any single segment is insufficient. It is necessary to construct a multi-subject responsibility framework that spans the entire algorithm lifecycle. Algorithm developers and designers bear the foundational explanatory duty. Their core obligation lies in verifiably clarifying the model's internal logic, data dependencies, and decision boundaries, thereby providing source-level transparency concerning the system's capabilities and limitations. This establishes the necessary technical foundation for subsequent accountability tracing and system auditing.

However, source-level explanation alone is inadequate for addressing dynamic risks. Algorithm deployers and users, particularly those utilizing algorithms for commercial profit or public decision-making, bear a crucial operational duty to explain. Positioned at the forefront of interaction with affected individuals, they are responsible for providing timely and comprehensible, case-specific justifications for particular decisions, tailored to the concrete context. The focus of their obligation is to elucidate the connection between input and output, as well as to explain how they themselves supervise and utilize the algorithm.(Ding 2022) In light of the increasingly profound and widespread societal impact of algorithms, a shared responsibility model is required, wherein developers provide systemic, global explanations and users provide concrete, case-level explanations, forming a collaborative governance architecture that ensures the duty to explain permeates both technological implementation and social application from beginning to end.

2.2. Legal Boundaries of the Explanatory Duty and the Role of Case Guidance

The legal boundaries of the explanatory duty must be dynamically defined through the balancing of interests within the context of individual cases. The principle of proportionality holds pivotal significance here, requiring that the scope, depth, and manner of explanation correspond to the importance of the rights and interests involved and the risk level of the algorithmic decision. From a comparative law perspective, the Dutch "SyRI" case serves as a negative exemplar, delineating a bottom line for the explanatory duty in high-risk domains. In that case, the government deployed an algorithmic system within the high-risk sphere of social welfare, yet the algorithm's logic remained entirely secret, affording virtually zero transparency. The Hague court adjudged that this vast disparity between "high-intensity intervention" and "zero-specification explanation" constituted a disproportionate infringement of rights.(Balakrishnan 2024) In contrast, the Bulgarian "YETTEL" case (C-806/24) directly engaged with the issue of how the duty to explain should be concretized in response to escalating risks. The case, referred to the Court of Justice of the European Union, involved a dispute concerning the transparency of an automated billing system, with the core legal questions centering on whether the scope of explanation must encompass algorithm parameters, whether its depth can extend to source code, and whether it necessitates manual review by a judge.(Intelligent Rule of Law Research Institute, Tsinghua University 2025) Practice demonstrates that the boundaries of the explanatory duty cannot be definitively and permanently fixed through rigid statutory provisions. Instead, they rely on regulatory agencies and judicial organs providing continuously optimized normative guidance through the accumulation of typified cases, thereby establishing explanatory standards, exemption scenarios, and compliance pathways appropriate for diverse contexts.

2.3. Horizontal Expansion: The Extraterritorial Scope of the Explanatory Duty

The cross-border fluidity of artificial intelligence technology necessitates that the scope of its explanatory duty transcend the jurisdictional confines of domestic law, achieving a horizontal expansion from national regulation to international governance. When algorithmic decisions involve cross-border data flows or their outputs affect citizens of other nations, the domestic regulations of a single legal jurisdiction prove difficult to enforce effectively and can readily instigate jurisdictional conflicts

and regulatory competition. Consequently, fulfilling the duty to explain cannot be satisfied merely by compliance with national law.

On a substantive level, the duty to explain must be responsive to the fundamental requirements of international human rights law. In scenarios where algorithms assist judicial or administrative decision-making with cross-border implications, a transnational duty to explain, consistent with international standards, inevitably arises. A state cannot legitimately invoke lower domestic standards for algorithmic transparency to justify derogating from its binding international human rights protection obligations.(Naama and Bourane 2025) On procedural and cooperative levels, the fulfillment of the explanatory duty necessitates support from international judicial and administrative collaboration mechanisms. This includes cross-border evidence gathering, the cross-border service of legal documents, and information sharing among regulatory bodies across different jurisdictions, ensuring that explanatory responsibility can penetrate sovereign barriers and be effectively enforced on a global scale. Ultimately, the explanatory duty for artificial intelligence must be internalized within global governance frameworks, evolving from a purely domestic compliance obligation into a global legal requirement through mechanisms such as international treaties and the mutual recognition of standards.

3. Constructing Hierarchical and Indirect Explanation Mechanisms

Having clarified the boundaries of the algorithmic duty to explain, it is imperative to construct mechanisms that are hierarchical in vertical structure and indirect in functional approach. Adherence to a single, uniform standard is ill-suited to the diversity of artificial intelligence application scenarios and risks excessively constraining innovation. The paradigm should shift towards dynamically configuring differentiated explanatory obligations based on system risk levels and application domains, while strictly adhering to the principle of proportionality to carefully balance the tensions between transparency and competing rights such as trade secrets and privacy. This provides a technical pathway for achieving an equilibrium between effective legal regulation and sustained industrial innovation.

3.1. A Three-Tiered Model for Algorithmic Explanation

To address the challenges of actor diversification and responsibility complexity arising from the expansion of algorithmic applications from virtual space into the physical world, it is necessary to establish a "Three-Tiered

Explanation Model" commensurate with the scope of algorithmic impact and the control capacity of involved actors. The first tier is the "systemic explanation," directed at the technical source, with the obligated subjects being the end-developers of the algorithm. They are required to disclose the fundamental model design philosophy, the overall characteristics of the training data, the decision-making logic framework, and the system's inherent limitations, thereby providing "meta-transparency" accessible for regulatory review and technical evaluation. The second tier is the "contextual explanation," directed at specific applications, with the obligated subjects being the algorithm deployers. They must explain the adjustments made to the original algorithm within the specific application context, the settings of operational parameters, and the risk control measures implemented. The third tier is the "outcome explanation," directed at the decision audience, requiring that specific output results be justified in a manner comprehensible to an ordinary reasonable person, clarifying the basis and reasons for the particular outcome. Collectively, these three tiers constitute an explanatory spectrum ranging from the abstract to the concrete, and from the technical to the social, ensuring that explanatory responsibility is precisely aligned with the subject's degree of control and benefit derived, while simultaneously requiring reference to the principle of proportionality to avoid unduly restricting scientific and technological development.

This three-tiered model jointly forms an explanatory spectrum progressing from abstraction to concreteness, and from technology to society, ensuring a precise correspondence between explanatory responsibility and the subject's control capacity and benefit level. However, the specific scope of obligations and degree of responsibility for each subject must still be determined with reference to the principle of proportionality, thereby avoiding excessive constraints on technological development.

3.2. The Principle of Proportionality in Algorithmic Explanation

The fulfillment of the algorithmic duty to explain is not absolute; its concrete implementation must scrupulously adhere to the principle of proportionality, carefully balancing potential conflicts between transparency requirements and other significant legitimate rights and interests. An explanation process devoid of necessary limits could unduly intrude upon core algorithm logic protected as trade secrets, compromise privacy interests associated with training data, or even threaten system security and stability. Consequently, the principle of proportionality provides an indispensable calibration framework for the exercise of the explanatory duty.

Firstly, the principle of suitability requires that the explanatory means adopted must effectively contribute to achieving legitimate objectives such as enhancing transparency, safeguarding rights, or implementing regulatory oversight. For instance, providing highly technical model weight information to an ordinary user neither aids their understanding nor falls within the necessary scope of explanation. Secondly, the principle of necessity demands that, among the various methods capable of achieving an equivalent explanatory purpose, the option that least infringes upon the relevant legal interests must be selected. When "indirect explanation" methods can satisfactorily meet the requirements of the explanatory duty, there should be no compulsory mandate to disclose source code, which constitutes the core carrier of intellectual property. Finally, the principle of balancing requires that the public interest pursued through explanatory measures must be proportionate to the injury inflicted upon interests such as technological innovation and trade secrets. Requiring deep, systemic explanations in low-risk scenarios may impose compliance burdens that substantially outweigh the resultant public benefit, thereby constituting a disproportionate intervention.

Through this graduated, three-stage scrutiny, algorithmic explanation is transformed from a rigid obligation into a refined management tool capable of dynamic adaptation within specific contexts, thereby identifying an equilibrium point between the duty to explain and the promotion of innovation.

3.3. Independently Developing Indirect Explanation Mechanisms

Building upon the hierarchical explanation model and the incorporation of the principle of proportionality, establishing an "indirect explanation mechanism" is pivotal for reconciling the tension between algorithmic transparency and the protection of core rights and interests such as intellectual property. This mechanism does not pursue direct disclosure of source code or internal model weights, but instead aims to satisfy fundamental explanation and accountability requirements by developing alternative technical solutions, while preserving the core secrets of the algorithm.

Its concrete implementation rests upon two main pillars. The first involves encouraging enterprises to undertake independent research and development of explanation tools. As the primary entities driving technological innovation, enterprises possess the greatest capacity to develop technologies such as simplified surrogate models, feature importance analysis, or decision path simulation, which can verify the decision logic and fairness of their systems to regulators and specific audiences without exposing the original underlying code. The second pillar entails clarifying the statutory and finite nature of the explanation scope. The content subject to indirect explanation should be strictly limited to core matters explicitly stipulated by law that are pertinent to high-risk decisions, potentially supplemented by voluntary explanatory additions based on corporate social responsibility and business ethics. This audited indirect explanation system should become a mandatory compliance threshold for market access of algorithmic products.

It is crucial to emphasize that the legitimacy of the indirect explanation mechanism is founded upon the separation of the "duty to explain" from "substantive liability bearing." Even if an enterprise fulfills its statutory obligations through compliant indirect explanations, should the algorithm cause actual harm during operation, the relevant responsible subjects must still bear corresponding legal liability in accordance with product liability, tort law, and other relevant regulations.

4. Rebalancing Independent Development and Centralized Public Oversight

In the implementation pathway for algorithmic explanation, independent research and development of explanation systems by market entities and centralized supervision by public authority institutions constitute two governance paradigms characterized by inherent tension. The former leverages endogenous technological motivation, offering flexibility and adaptive capacity; the latter employs state coercive power, pursuing uniform standards and enforcement authority. However, exclusive reliance on corporate self-regulation can easily lead to superficial "explanation washing" and a crisis of public trust, while mandatory, rigid centralized oversight faces challenges of regulatory lag and innovation suppression. Particularly within the context of globalization, the cross-border penetrative nature of algorithms renders centralized supervision by any single state inadequate, urgently necessitating the exploration of collaborative governance within an international legal framework. Therefore, achieving a prudent balance between autonomous innovation and public authority supervision, and constructing a governance ecosystem that seamlessly connects domestic and international rules, has become a critical imperative for deepening the rule of law in artificial intelligence.

4.1. Advantages and Challenges of Central Regulatory Agencies

The advantage of central regulatory agencies constructing a centralized audit system for algorithmic explanation lies in their ability to leverage state public power to establish the legitimacy, uniformity, and authority of regulation.

This model can transcend corporate private interests, establish mandatory minimum explanation standards, and create a foundational barrier of trust throughout society. Concerning high-risk artificial intelligence systems involving significant public interest, the capacity for central ex-ante access review and ex-post accountability serves as a vital safeguard against systemic risks.

Nevertheless, governmental centralized supervision confronts structural challenges. Regulatory lag and complex legal amendment procedures struggle to keep pace with the rapid iteration of algorithms, resulting in standards that trail the technological frontier. Excessively stringent and inflexible explanation requirements, particularly those involving disclosure of core logic, can impose heavy compliance burdens, dampening corporate research and development motivation. Compelling enterprises to disclose source code or model details regarded as core assets to regulatory agencies, even with confidentiality assurances, inevitably raises concerns regarding technology leakage and loss of competitive advantage, creating a dilemma for intellectual property protection.(Kahl 2025) Without establishing a credible "safe harbor" mechanism that balances transparency and property rights protection, centralized supervision may encounter significant resistance, potentially even leading to the diversion of innovation resources towards jurisdictions with less demanding regulations.

4.2. A Novel Pathway for Public-Private Collaborative Governance

In light of the potential problems associated with mandatory government supervision, the state can transition from directly reviewing algorithms to implementing indirect oversight of explanation mechanisms. The government should establish legally binding framework rules that clarify the baseline for explanatory duties, responsibility attribution, transparency levels, and consequences for violations, thereby providing compliance expectations and innovation space for enterprises to autonomously develop or adopt suitable explanation tools. Within this framework, the task for enterprises is to autonomously select or develop explanation tools appropriate for their specific technological systems and business scenarios while meeting statutory standards, and to demonstrate the effectiveness of these tools to regulatory agencies. The government, in turn, supervises the reliability and authenticity of these explanation systems through auditing, certification, and accountability mechanisms. This division of labor assigns the day-to-day responsibility for explanation to the entities possessing the greatest technical capability, while concentrating administrative resources on ensuring the effective operation of the overall governance system.

However, it is crucial to recognize that collaborative governance does not negate the ultimate coercive power of public authority. Clear risk trigger thresholds must be established. When an artificial intelligence system poses a clear and significant imminent risk to societal public interests or national security, regulatory agencies must retain reserve powers to initiate direct, centralized review of the original algorithm in accordance with the law. This layered intervention mechanism safeguards corporate innovation autonomy and core technology security under normal conditions, while ensuring the government fulfills its statutory duty to protect public interests in crisis situations, ultimately achieving a dynamic equilibrium between safety and innovation.

4.3. Extraterritorial Effect and Global Compliance of Algorithmic Explanation Mechanisms

The cross-border application of artificial intelligence inevitably endows domestic algorithmic explanation rules with extraterritorial effect, giving rise to complex international compliance issues.(Khan 2025) When a state's regulatory agency demands explanations for a system operating within its territory but where the algorithm itself is located abroad, it touches upon the boundaries between national sovereignty and corporate interests. Although such unilateral regulation aims to protect the rights of its own citizens and ensure national security, it may provoke conflicts between the explanation standards of different legal jurisdictions, plunging multinational enterprises into multiple compliance dilemmas.

Confronted with this issue, reliance solely on domestic regulation is insufficient; coordination must be pursued through the principles of international law and the facilitation of international organizations. In the short term, equivalence determinations or regulatory mutual recognition mechanisms among major legal jurisdictions can alleviate the repetitive compliance burdens on enterprises. For the long term, minimum standards for algorithmic explanation, cross-border audit cooperation, and legal assistance mechanisms for high-risk artificial intelligence systems should be established within international frameworks such as the United Nations and the World Trade Organization. This does not seek to eliminate regulatory differences between nations but rather to construct an international framework capable of coordinating conflicts and fostering cooperation, thereby enabling algorithmic explanation mechanisms to be compatible with the global digital governance system while simultaneously upholding domestic rule of law.

5. Conclusion and Outlook

The systemic impact of algorithmic opacity on rule of law principles, including clear attribution of responsibility and procedural justice, renders explainability in artificial intelligence a legal necessity. Promoting the development of explainable and trustworthy artificial intelligence can not only protect individual rights and safeguard public interests but also foster the healthy development of the technology within a normatively sound legal framework. The limitations inherent in regulation by a single state can be mitigated through the synergistic application of soft law and hard law, promoting the formation of a global governance consensus. Consequently, it is imperative to construct an artificial intelligence explanation mechanism that embodies hierarchy, indirectness, and compliance with the principle of proportionality, thereby balancing the multifaceted values of transparency, innovation, and security.

Looking towards the future, legal frameworks and explanation standards must undergo dynamic evolution alongside technological iterations to prevent regulatory obsolescence. Simultaneously, the mechanisms linking algorithmic operation to legal accountability must be continuously refined, with auditing and certification systems substantially strengthened. China should vigorously cultivate interdisciplinary talent proficient in both law and technology, and incentivize enterprises to pursue research and development oriented towards compliance and ethical considerations. On the international stage, leveraging international organizations such as the United Nations and the WTO to promote the establishment of minimum standards for algorithmic explanation and cross-border cooperation mechanisms is essential for achieving the global co-governance of trustworthy artificial intelligence.

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