

ARTIFICIAL INTELLIGENCE AND ITS POTENTIAL IMPACT ON THE CFA INSTITUTE CODE OF ETHICS AND STANDARDS OF PROFESSIONAL CONDUCT: A CONSULTATION

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AI AND THE CODE AND STANDARDS: A CONSULTATION

Artificial intelligence has the potential to impact the way an organization serves its clients' needs and interests. CFA Institute members and the wider investment community should consider the impact these technological advances might have on ethics and professionalism.

INTRODUCTION

Artificial intelligence (AI) and its subset, machine learning, are popular technologies in many industries today. The investment profession is no exception, and it is easy to understand why. The ability to process and store vast amounts of data beyond human capabilities in order to capture alpha is tempting. Investment management firms operate in a highly competitive environment, and many are looking at AI as a way to differentiate themselves.

One of AI's many benefits is that it can identify patterns that are not apparent to humans. Cheap computing power and the availability of vast datasets make this possible. In some ways, AI can help reveal the "unknown unknowns," which Donald Rumsfeld, former US Secretary of Defense, referenced in his now famous quote: "There are known knowns; there are things we know we know. We also know there are known unknowns; that is to say, we know there are some things we do not know. But there are also unknown unknowns; these are things we don't know we don't know."

Through this paper, CFA Institute is seeking input on how the CFA Institute Code of Ethics and Standards of Professional Conduct (Code and Standards) might reflect the increased use of this new style of technology, as well as highlighting the need for caution in implementing it.

We begin with some background on AI and how it might interact with current analytical processes. We then offer several topics for firms to consider when moving forward with AI and how a firm might develop an appropriate risk management framework in this area.

The final section is what makes this paper a consultation. Technological advances present an opportunity to review how an organization is servicing its clients' needs and interests. Providing such services in an ethical and professional manner lies at the heart of the commitment that the organization and its staff make to the client. With the addition of new technology, existing concepts of what represents acceptable ethical and professional conduct must also be reviewed.

In this light, the CFA Institute Standards of Practice Council (SPC) is taking the opportunity to review the Code and Standards. Here, we propose questions to seek input from CFA Institute and CFA® society members and non-members currently using or investigating the use of AI within their organizations. SPC will consider your feedback to determine if and/or how the use of AI should be reflected in the expectations for members and CFA® Program candidates.

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BACKGROUND ON AI AND IMPLICATIONS FOR THE INVESTMENT INDUSTRY

Investment theory and its application have evolved at a much slower pace than science and technology in other fields. Graham and Dodd's seminal 1934 publication on value investing, *Security Analysis*, remains a strong influence on stock selection in both fundamental and quantitative investment strategies of firms today. In 1952, Nobel Prize winner Harry Markowitz published his groundbreaking work on Modern Portfolio Theory (MPT) in which he articulated investors' "trade-off" between risk and return. Nearly two decades later, in the 1970s, Kenneth French and Eugene Fama introduced factor analysis and expanded the definition of common factor risk or beta. Combined, these theories serve as the foundation of quantitative investing.

In the late 1990s, the use of statistics to both measure investment outcomes and predict asset pricing behavior became more widespread as computing power further increased in the industry. As standard statistical approaches proliferated within investment management, differentiating methods and investment strategies from one firm to another became more difficult. This shift impeded the information advantage required for successful active management.

The continued growth of computing power and data storage, with the re-introduction of advanced machine-learning methods, offers a new frontier for investment managers to identify data patterns unattainable in previous eras.

The term "artificial intelligence" was coined by Arthur Samuel in 1958. It broadly describes a computer's use of algorithms to visualize data and improve the learning rate each time it "trains" or analyzes new data. AI is an umbrella concept that covers various methods to improve data analysis and predictions. Machine learning is a subset of AI. It can be thought of as an algorithm that can learn from the dataset

and improve the expected outcome through adaptive methods. The most simplistic example of this type of algorithm is linear regression. The most widely used definition of machine learning was developed by Tom Mitchell in 1997, when he stated the following:

"A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T , as measured by P , improves with experience E ."¹

This paper will work with the understanding that the technology processes of AI improve through the completion of programmed tasks and the availability of new data.²

LAYERS OF MACHINE LEARNING PROCESSES

Machine learning methods frame a problem through inputs and outputs. Inputs represent the data provided to the system for review and analysis. Outputs represents the solutions identified through the analysis. The types of tasks that are most suitable for machine learning are classification, regression, translation, anomaly detection, and de-noising. These tasks represent practices common within the investment industry.

¹ Tom M. Mitchell, *Machine Learning* (New York: McGraw-Hill Education, 1997).

² Those who want to venture further into this subject can find several well-regarded textbooks on machine learning, including *Deep Learning* by Ian Goodfellow, Yoshua Bengio, and Aaron Courville; and *Reinforcement Learning* by Richard S. Sutton and Andrew G. Barto.

neural network to identify patterns in the data inputs. A neural network model determines the features from large datasets using supervised or unsupervised learning and creates a series of paths that identify and learn which patterns are important to determine outcomes. The neural network is designed to work like the human brain so that decisions are created in layers of neurons that serve to distill the data into features that become more recognizable as they move through each layer. The patterns identified become less complex using backpropagation techniques that eventually identify, by training on the dataset, the final output layer.

IMPLICATIONS FOR THE INVESTMENT MANAGEMENT INDUSTRY

Technology's ability to advance an information advantage will benefit firms that are cognizant of both the strengths and weaknesses of AI. The ability to mine vast quantities of data and incorporate it into asset valuation enhances the opportunity to create alpha. Computer science teams will be tasked to create models that consistently provide returns to clients. Successful model creation requires experience that will predominantly come from non-financial industries in which AI has made significant progress, such as medicine. For example, one medical radiology study using AI successfully identified 97 percent of lung cancers.³ Experienced machine learning professionals understand the iteration process necessary to successfully train models to generalize.

Investment management firms must compete with other industries using this technology in order to hire experienced and capable professionals. Once the right technical experts are on board, investment teams and technical teams will need to be integrated in a way that creates checks and balances on the models

and processes. Proper integration becomes essential because of the potential lack of transparency and interpretability in these models' decision making.

Knowledge exchange between investment teams and technical teams will be key to fulfilling the regulatory and ethical expectations of the investment management industry.

There is an ongoing dialogue in all industries using AI that contemplates the impact of automation on human capital. The use of robotics in manufacturing and the general efficiencies being created through AI in banking, medicine, and retail are disrupting traditional means of employment. In investment management, it is inevitable that human interaction with data-related functions such as custody, fund administration, and other back-office operations will continue to become more efficient and potentially redundant.

The fee structures used by investment management firms when incorporating AI is another topic for discussions with clients. AI requires something of a leap faith by investors, because of opacity surrounding the operations of the technology. There is likely a lack of transparency in how the model isolated or named signals for specific investment decisions. However, the widespread adoption of AI in non-financial industries supports the theory that AI will transform investment management. Whether the lack of transparency will support fee-sharing models that reward the investor for assuming greater risk has yet to be clarified.

The integration of AI into mainstream investing processes will further challenge prevalent theories and statistical frameworks. Portfolios supported by modern portfolio theory (MPT) and factor/smart beta investing may become supplanted by more powerful AI-based pattern recognition alternatives.

³ Nicolas Coudray, Paolo Santiago Ocampo, Theodore Sakellaropoulos, Navneet Narula, Matija Snuderl, David Fenyö, Andre L. Moreira, Narges Razavian, and Aristotelis Tsigirgos, "Classification and Mutation Prediction from Non-Small Cell Lung Cancer Histopathology Images Using Deep Learning," *Nature Medicine* 24 (17 September 2018): 1559–1567 (<https://www.nature.com/articles/s41591-018-0177-5>).

We offer the following important considerations for firms beginning to include AI and for those considering such a path:

Questions that should be considered include the following:

- What opportunities does AI create, and what tasks will it automate?
- What type of machine learning model is best suited for the problem?
- What data is available to inform the model?
- What processes are in place to test for biases, and does the skill set exist to challenge the model output?
- What research priorities are in place to keep the model current?
- How will AI models maintain current data and knowledge of firm clients?
- Where will the reduction in labor occur through time as AI becomes more powerful and ubiquitous?
- How should current and future staff be trained to work with investment operations that incorporate AI?
- What is the transition plan?
- How will the firm maintain investor trust and manage potential disruption through the transition period?
- Should maximum investment allocation standards be suggested beyond traditional regulatory requirements during this evolutionary period while verifiable track records are being built?
- What are the minimum investment due diligence requirements?
- Will new fee models be required?
- There is a potential for multiple new alpha signals. What is the lifespan of each signal?
What is the rate of decay?

THE NEED FOR AN APPROPRIATE RISK MANAGEMENT FRAMEWORK

Providing a risk management framework for something unknown can be quite challenging. Although there is little doubt that AI has a future within investment management, it is vitally important to determine what risk management frameworks or changes are needed to incorporate it effectively. Unfortunately, there are no easy answers.

Machine learning models that incorporate deep learning require vast datasets. As the model trains, interpreting its decisions against the initial parameters may become increasingly difficult. Advancing technology will also change the risks associated with making disclosures to clients as well as the supervisory obligations of the firms' senior management teams. Regulation changes will also affect the expectations of firms incorporating AI and how firms internally track such regulatory obligations.

The incorporation of AI is often touted through the benefits to clients and the market while the potential new or increased risks are overlooked. Appropriate risk management frameworks will differ on many factors, including the scope of AI implementation and the services provided by the firm. Once a firm decides it will implement AI within the investment decision process, it may want to consider some of the following risk-related questions.

DATA

The analysis of millions of parameters is required to divine patterns correctly. As firms move to introduce AI, there is the risk that shortcuts in both the quantity and quality of data can cause models to fail to generalize properly. This overfitting of the data is a common problem in the construction of all statistical models even today. Financial databases alone typically possess too few observations to properly train deep learning and reinforcement learning models. The wide array of structured and unstructured datasets available is evidence there remains quite a bit of art in the science of incorporating AI effectively. Experienced machine learning professionals understand the iteration process necessary to successfully train models to generalize.

- Has the quality of the data and sources been vetted?
- Is the firm entitled to use the data, or does it need to obtain licenses and permissions? For example, with the introduction of the General Data Protection Regulation (GDPR) in Europe, the rules around the use of personal data can be complex and fines for misuse can be costly.

AUDITABILITY/INTERPRETABILITY

A variety of internal stakeholders (internal audit, compliance) and external parties (regulators, external auditors, consultants) may require firms to demonstrate the rationale of AI-generated recommendations and the methodology used to test those recommendations. It is important to establish consistent processes and practices to demonstrate the implementation of AI within the decision-making process. It will be important to explain and justify investment decisions made using AI at a specific point in time.

- At a given a point in time, can the AI output be explained by the available and relevant data inputs?
- If a regulator, client, or auditor requested a sample output based on the relevant inputs, could such an output be produced?
- Is the testing methodology effectively documented and properly followed?
- Have appropriate change control procedures been implemented to monitor coding changes?
- What procedures have been established to prevent "style drift" from the original client objectives?
- If a model shifts from its original investment objectives through the iterative process of learning, are appropriate change control procedures in place to review client suitability?

DISCLOSURE

Clients rely on investment firms to deliver accurate and reliable information about the products and services offered. The use of AI within the decision-making processes may render out of date current client representations, disclosures, and prospectuses.

Either internal or external legal counsel may need to be engaged to review the effectiveness of current disclosures.

- Have the required client disclosures and client mandates been updated to reflect the use of AI in investment decisions?
- Do current prospectuses and client documentation create a misrepresentation risk in the disclosure of firm activities?
- How frequently should client material be reviewed to ensure consistency with current AI use within the decision-making processes?

SENIOR MANAGEMENT SUPERVISION

Senior management has ultimate responsibility for the firm's decisions, and it is accountable to clients, shareholders, and regulators. It will be important for senior managers to be aware of and consent to the AI implementation, because they are ultimately accountable.

- Has senior management been made aware of AI use in investment decisions and formally signed off on its use in the investment process?
- Have specific senior managers been designated to remain accountable for monitoring and ongoing supervision?

REGULATION, INTERNAL POLICY, AND PROCEDURES

Firms should undertake an evaluation of the local regulatory framework at the onset of their use of AI and continually during its implementation. The firm's compliance and legal teams should map this evaluation against current internal policies and procedures. Any gaps should be documented, and proper updates approved, allowing firms to continue safeguarding client assets in an ethical and professional manner.

- Does the implementation of AI comply with local regulatory requirements?
- Does the implementation of AI require updates to the firm's internal policy and procedures?
- Does the staff have the necessary training and experience to implement AI within the investment process and in alignment with regulatory obligations?
- Do supervisors have the necessary training and experience to oversee the development of AI within the investment process?

Initial enthusiasm for AI in investment practice is not hard to find. This kind of excitement may tempt a poor manager with a poor strategy to replace its current practices with AI in the hopes of gaining new clients. Without a well-thought-out and well-defined AI strategy, however, the consequences of such a move may create a negative environment for all firms looking to implement emerging technological changes.

Market demands, competition, and increased cost pressure on investment management firms will no doubt increase AI use in the investment process. Under the guise of encouraging the investigation of AI while being cautious, firms should reflect on the adage "walk before you run."

AI AND THE CODE AND STANDARDS

So far, we have looked at considerations for firms on the decision to engage AI. Although the practices their firms may use will vary, CFA Institute members and candidates must also consider the effects of AI implementation on their individual obligations under the Code and Standards. In the following section, we are seeking insights on AI practices. The SPC wants to understand if or how the Code and Standards should address such technological changes.

Several of the Standards of Professional Conduct (Standards) come to mind immediately for members who are considering the integration of AI. For discussion purposes, we group several relevant Standards into three areas of concern: Integrity, Engagement, and Accountability.

INTEGRITY

The use of AI to make investment decisions may initially raise some questions about the application of the current Standards regarding Market Manipulation; Material Non-public Information; and Confidentiality. These Standards require individuals to act in a manner that protects the integrity of the broader capital market. By incorporating AI tools, individuals will potentially be less involved in the investment decision-making processes used to serve clients.

AI technology and practices are anticipated to learn and improve the longer they operate. Over time, AI could learn trading techniques or clarify biases ingrained in the initial coding that yield positive results for the firm and clients at the expense of a properly functioning capital market system.

REQUEST FOR COMMENT #1

How might AI techniques be tested to detect potentially manipulative trading practices?

We discussed the reliance on quality data for operational efficiency. This concern is important for both traditional quantitative models and more-advanced AI techniques. The main difference between the two is the access to a wider range of datasets for AI. When firms incorporate AI, all data made available

to the model will be usable for its analysis.

REQUEST FOR COMMENT #2

How might AI techniques be tested for the potentially inappropriate incorporation of material non-public information into investment decision-making processes?

Information provided by individuals across business sectors deserves to be maintained confidentially. Although firms have responsibilities to maintain client information effectively, mistakes are bound to happen. Without clear indicators within the dataset provided, confidential client information will appear as readily accessible for analysis.

REQUEST FOR COMMENT #3

How might AI techniques be tested for the potentially inappropriate incorporation of confidential client information into investment decision-making processes?

ENGAGEMENT

As the use of AI to make investment decisions increases, opacity around the decision-making process may increase. This reduced transparency may lead to questions on the current Standards regarding Communications with Clients; Suitability; and Diligence and Reasonable Basis. These Standards provide investors with reassurance that members are being thoughtful in managing their investments. As the member becomes less involved in the decision-making process, client assurances will still need to be maintained.

Providing clients with sufficient information about the investment process is critical to earning their trust. The Standards require effective disclosures of significant risks or limitations present in the investment strategy. Providing such disclosures may become challenging as advancing technology learns and modifies the initially developed algorithms.

REQUEST FOR COMMENT #4

How might clients be effectively informed of the use and therefore the risks and limitations of AI in the investment decision-making process?

Managers are engaged to invest either toward a specific fund mandate used by all clients or to a specific client's investment policy statement. Either engagement places a responsibility for the manager to ensure any investment aligns with the parameters of the clients' goals. As AI learns and improves the analytical processes, concern may arise about the suitability of investment decisions.

REQUEST FOR COMMENT #5

How might AI techniques be tested to ensure alignment of client mandates within the investment decision-making process?

Investment decisions are expected to be based on sound research and independent consideration of relevant information and factors. Such parameters are at the core of the analysis completed by individuals and quantitative models today. Similarly, the coding of initial advanced technological process will incorporate a level of diligence appropriate for the investment strategy's complexity. As the AI technique learns and evolves, however, the certainty of the initial diligence may diminish.

REQUEST FOR COMMENT #6

How might AI techniques be tested to ensure the investment decision-making process remains diligent to develop a reasonable basis for a recommendation?

ACCOUNTABILITY

Previously in this paper, the notion of computers learning and improving on the investment decision-making process was introduced. Even with these advancements in technology, the firm and its employees are ultimately responsible for the services provided to clients. These responsibilities relate to the current Standards regarding Misrepresentation; Record Retention; and Supervisor Responsibilities.

Clients will look to the firm to ensure that managers can address questions about the successful, as well as unsuccessful, decisions made using AI.

Clients rely on the information provided by the manager to make informed investment decisions.

A manager must faithfully describe the processes it uses, including those involving AI. As the technological processes learn and evolve, clients must receive sufficient information to make an informed decision to remain in the strategy. This information will include understanding the current decision-making focus of the AI techniques.

REQUEST FOR COMMENT #7

How might AI techniques be tested and communicated with respect to how the current investment decision-making process aligns with the process previously described to clients?

Records, including analytical processes and information sources, are critically important to representing the diligence of the investment decision-making process. The transition to computer-based investment decision making will put pressure on the current understanding of what are considered necessary or appropriate recordkeeping practices. This current understanding will be further tested as the availability of information from alternative sources continue to increase.

REQUEST FOR COMMENT #8

How might a firm maintain records to support the AI investment decision-making process?

Investment clients expect their managers to protect their interests. This principle is the overarching theme of the CFA Institute Code and Standards. Those responsible for developing advanced technological techniques may not possess an investment background and thus may lack this foundational expectation. Firm leadership and managers will therefore need to implement practices that keep clients' interests at the forefront for all employees.

REQUEST FOR COMMENT #9

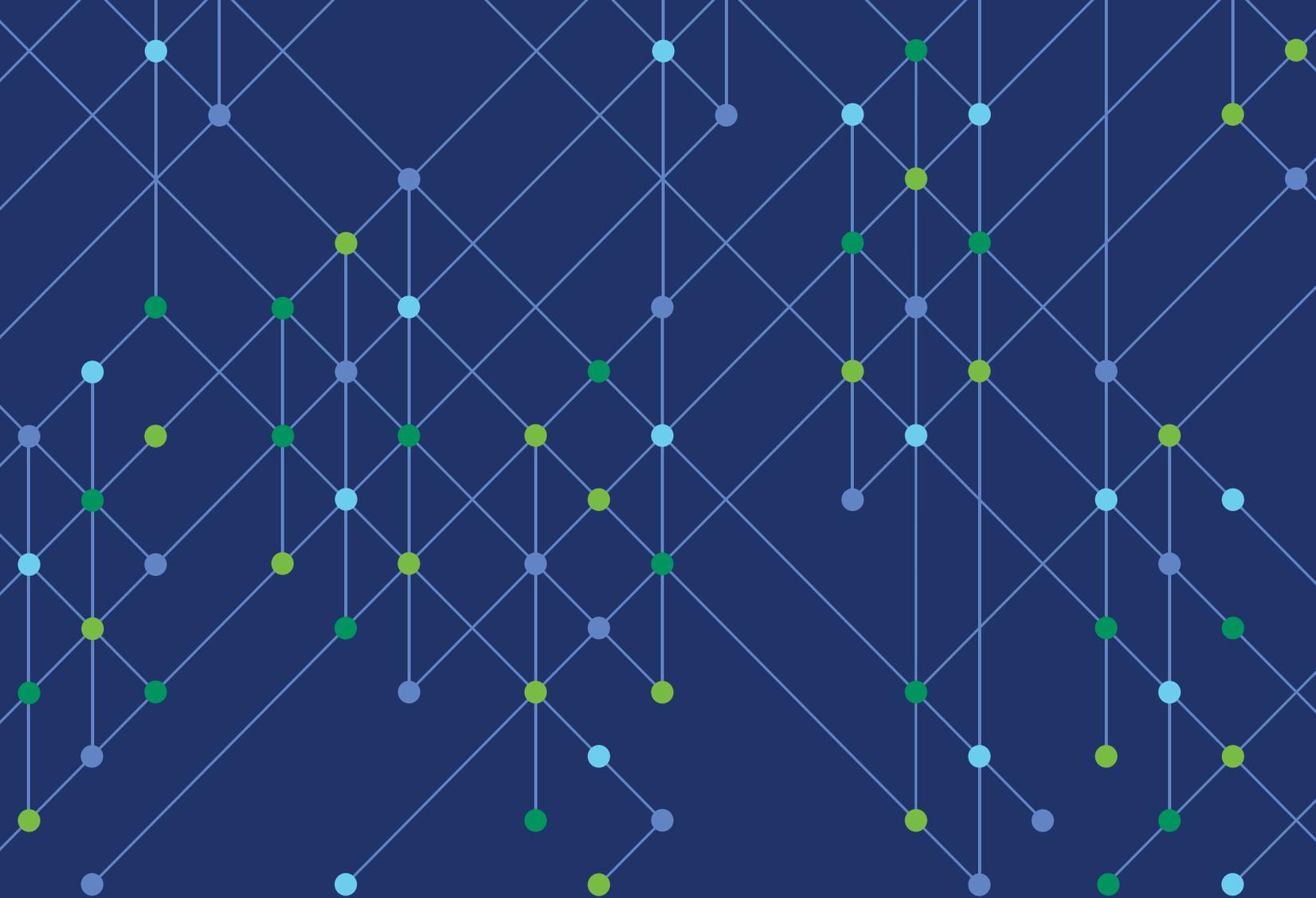
How might a firm educate those developing AI investment decision-making techniques around the fact that maintaining a commitment to protecting clients' interests is paramount?

Other concerns will likely arise as you either begin or continue to include more advanced AI techniques within your firm. We present the ones identified in this paper as a means of starting the discussion to ensure such techniques continue to advance the industry while protecting the integrity of capital markets.

Alternatively, the concerns presented may lead firms to avoid incorporating AI practices. A movement into machine-based investing is not without risks. Firms need to be diligent in their decision-making process regarding how well this technology fits with the services they offer.

The SPC, through this paper, is seeking to provide a platform for discussing the benefits and concerns about the growing incorporation of AI within the investment management industry. We look forward to receiving your thoughts and feedback to the questions proposed, especially those questions related to specific elements of the Code and Standards. The insights of those applying or considering AI practices, as well as those who elected to pass on incorporating AI, will be useful as we strive to maintain the CFA Institute Code and Standards as the model of proper conduct for the investment management professional.

Send your responses to ethics@cfainstitute.org or submit online at <http://bit.ly/AIConsultation> by 29 March 2019.



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CFA Institute is the global association of investment professionals that sets the standard for professional excellence and credentials. The organization is a champion for ethical behavior in investment markets and a respected source of knowledge in the global financial community. The end goal: to create an environment where investors' interests come first, markets function at their best, and economies grow. CFA Institute has more than 155,000 CFA® charterholders in 165 markets. For more information, visit www.cfainstitute.org



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