Artificial Intelligence and Machine Learning and You

CHAPTER OUTLINE

LEARNING OBJECTIVES

1.1 Discuss the impact of disruptive technologies, particularly artificial intelligence and machine learning, on organizations in today's competitive environment.
1.2 Understand the evolution of artificial intelligence and machine learning from the 1950s to the 2020s.
1.3 Differentiate between artificial intelligence and machine learning and among weak AI, strong AI, and super AI.
1.4 Explain why being an AI/ML-literate user is so important today.
1.5 Explain the roles and responsibilities of business professionals, business analysts, and technical professionals in the development, deployment, and maintenance of AI/ML applications.

Introduction to Artificial Intelligence and Machine Learning, First Edition. R. Kelly Rainer.

Companion Website: www.wiley.com/go/rainer/introaiandml

Chapter Opening Case

SCM HRM Deploying Artificial Intelligence and Machine Learning at UPS

The Business Problem

United Parcel Service (UPS; www.ups.com) is a global organization with approximately 500,000 employees and 127,000 vehicles. UPS drivers deliver roughly 23 million packages daily – and far more in December – typically making between 130 and 150 "drops." In addition, the number of possible routes for UPS drivers is inconceivably vast. (The company maintains 55,000 routes in the United States alone.) Clearly, it is in the best interest of UPS and its drivers to find the most efficient routes. A very small increase in efficiency in daily operations results in significant improvements to the company's bottom line.

In addition, UPS must manage a low-margin business and a unionized workforce that is compensated at the high end of the industry scale. UPS also faces intense competition from Amazon with its low-cost package delivery service, called the Delivery Service Partner program.

At a typical UPS shipping center, 55 trucks leave every morning, each one tasked with delivering 300 packages that day. UPS must decide how to distribute these 16,500 packages among the trucks so that the operation requires as few miles and driver hours as possible. In addition, some deliveries must occur at a specific time of day, and no driver's shift can extend too long. The UPS scheduling system must handle these logistics every day for 1,000 shipping centers in the United States.

Further complicating this scenario, the UPS system must work with incomplete information. Significantly, UPS does not know many delivery destinations until very early in the morning. Therefore, its shipping centers must begin the process of planning and loading the trucks before they are aware of all the next day's deliveries.

Historically, 30 percent of deliveries were not in the system when the company had to begin planning for the next day. This situation occurred because many packages that arrived on overnight flights had missing or only partial tracking information. Some shipping customers did not upload data about their shipments in time or they used noncompliant systems. Throughout the night's loading process, some packages would not have proper coding. In these cases, handlers had to manually enter the destination address. Making matters worse, factors such as the weather caused unexpected delays.

Time zones also present problems. For instance, if an East Coast center begins its planning at midday, it is too early for the destination address to have been uploaded on the West Coast. Further, even if all delivery addresses have been uploaded, UPS frequently can only calculate the number of stops each truck must make once all the packages have been delivered. Finally, the company must complete its overall planning days ahead to identify the most efficient routes and schedule the correct number of drivers.

Packages arriving after the trucks are loaded can add miles to a truck's existing plan. If planners had known about these packages earlier, they might have distributed them differently among the trucks. However, redistributing late-arriving packages takes too long, and the fully loaded trucks must leave on schedule.

Therefore, UPS could only optimally plan the truck loading once planners knew all the deliveries that would need to be made. But, by the time they obtained this information, they would have run out of time to load the trucks. Because UPS's internal package network was so complex, the company had to implement artificial intelligence (AI) and machine learning (ML) systems.

The AI/ML Solution

Data are the key to AI/ML solutions. Since 2016, UPS has been collecting and analyzing more than 1 billion data points daily as the company tracks the real-time status of each package as it moves across the UPS shipping network.

To improve its supply chain operations, UPS has integrated AI/ML solutions into five systems: Order Entry, Package Flow Technology (PFT), Harmonized Enterprise Analytics Tool (HEAT), Delivery Information Acquisition Devices (DIADs), and Network Planning Tools (NPTs). We focus on the PFT system here.

UPS designed PFT to make operations more efficient by replacing each shipping center's legacy process with one that is more automated and centralized. Historically, human workers assigned packages to trucks. Frequently, these workers decided which packages to place on each truck ad hoc during the loading process. In some cases, they moved packages already loaded on one truck to another.

In contrast, the PFT system centralizes and semi-automates the process of assigning packages to trucks, mainly based on predicting as-yet unknown deliveries. A planning manager completes the final adjustments through a central PFT console just before truck loading begins. The console incorporates the day's predicted deliveries along with known deliveries. The PFT system then displays the forecasted effect of the managers' adjustments.

The new process dynamically incorporates predicted deliveries so workers can begin loading the trucks early for on-time departures. In addition, it centralizes decision-making across all the shipping center's trucks simultaneously.

Overall, the PFT system manages and optimizes the flow of packages through UPS's logistics network from pick-up to delivery. This process ensures that workers most efficiently sort, load, and route all packages. PFT also provides end-to-end package tracking and visibility. Each package is assigned a unique tracking number and is scanned at various points along its journey, from acceptance to delivery. This process enables both UPS and its customers to monitor the status and location of packages in real time.

PFT ensures efficient and timely delivery by utilizing sophisticated route optimization algorithms. By analyzing factors such as package destination, traffic conditions, and delivery schedules, UPS creates routes that minimize both delivery times and fuel consumption. An **algorithm** is a step-by-step procedure or formula for solving a problem or performing a task.

In addition, PFT includes inventory management systems that track the movement and storage of packages within UPS facilities. This process helps workers to accurately count inventory and quickly retrieve packages for sorting and delivery.

Finally, UPS's customer interface, powered by PFT, enables customers to track packages, schedule pickups, and manage shipments online or through mobile apps. It also provides real-time updates on shipment status, delivery estimates, and proof of delivery.

Another Business Problem

Unfortunately, when UPS integrated the PFT system, it experienced problems. Most of those problems involved the human workers carrying out the system's instructions. With the legacy process, humans had learned and applied their experience assigning packages to trucks. When they continued to rely on their package-loading routines, they overrode the centralized decisions of the PFT system. When they did so too often, the PFT system would not work.

Changing a package's truck assignment meant suboptimizing the PFT system's recommendations. This situation delayed trucks so that they would not depart on time. Even worse, when staff overrode the system's recommendations, it often failed to update them. As a result, drivers following the data on their handheld devices would try to deliver a package that was on another truck. Meanwhile, the driver of the other truck would not even know they had the package.

A Further Solution

Managing fundamental changes to existing processes is a critical success factor that must be addressed. Frequently, the key challenge is overcoming internal resistance. For AI/ML projects to deliver real value, leaders must proactively manage the operational changes involved. Generating an accurate ML model is not enough. The model must be properly deployed and integrated into an organization's decision-making routines.

When UPS introduced the AI/ML solution, operational staff frequently resisted changing their established package-loading routines. To overcome this problem, the UPS team used change management techniques. They closely supervised the staff and sometimes reassigned individuals to different, unfamiliar roles to break old habits. They also provided short-term incentives linked to leading business metrics, such as on-time truck departures. They continued the training process at each shipping center until the staff adopted the new procedures.

The Results

The PFT system helps ensure timely deliveries. It optimizes delivery routes in real time, reducing fuel consumption, delivery times, and operational costs by analyzing traffic patterns, weather conditions, package data, and many other factors. Further, it enhances customer service by providing accurate delivery time estimates, real-time tracking, and proactive communication regarding delivery status.

PFT has been a major success. It has reduced delivery traffic by 85 million miles each year, decreasing the company's carbon emissions by 100,000 metric tons per year. Significantly, after UPS integrated PFT, it implemented its On-Road Integrated Optimization and Navigation (ORION) platform to optimize driver routes. PFT and ORION have saved the company $350 million, 185 million miles, 8 million gallons of fuel, and 185,000 metric tons of emissions per year.

Sources: Compiled from I. Mazare, "We've Been Using AI/ML for Over a Decade to Fuel Logistics," *Chief Data Officer Magazine*, February 21, 2024; O. Tatlidil, "Smarter Deliveries: How UPS Drives Efficiency with AI and ML," *Medium*, November 4, 2023; M. Garland, "UPS Uses AI, Machine Learning to Match Network Capacity with Lower Volumes," *Supply Chain Dive*, August 14, 2023; E. Siegel, "To Deploy Machine Learning, You Must Manage Operational Change – Here Is How UPS Got It Right," volume 5.2, *Harvard Data Science Review*, April 27, 2023; E. Siegel, "Models Are Rarely Deployed: An Industry-wide failure in machine learning leadership." *KDnuggets*, January 17, 2022; M. Kaput, "How UPS Uses AI to Save $200 Million a Year," *Marketing Artificial Intelligence Institute*, November 15, 2021; T. Olavsrud, "UPS Delivers Resilience, Flexibility with Predictive Analytics," *CIO*, August 6, 2021; T. Davenport & K. Malone, "Deployment as a Critical Business Data Science Discipline." *Harvard Data Science Review*, *3*(1), 2021; E. Siegel, "Explainable Machine Learning, Model Transparency, and the Right to Explanation." *The Machine Learning Times*, March 5, 2021; R. Bean, "Why Is It So Hard to Become a Data-Driven Company?"

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Questions

1. **How did UPS's Package Flow Technology (PFT) system address the complex logistics challenges the company faced?**
2. **What were the key benefits of the deployment of the PFT system?**
3. **What challenges did UPS encounter when it introduced the PFT system, particularly regarding employee adoption? How did the company overcome these challenges?**

VIDEO CONTENT

1.1 The Modern Business Environment

Modern organizations are operating in a global, massively interconnected, intensely competitive, 24/7/365, real-time, rapidly changing, and data-intensive environment. (See the chapter-opening case.) Your first job and probably your entire career will be with companies that are operating in this environment! Let's look at two of these characteristics more closely: intensely competitive and data intensive.

The global environment forces organizations to compete around the world while engaging with customers, suppliers, and business partners in various locations, often across international boundaries. Significantly, each location can have specific cultural norms and regulatory systems.

To successfully compete, modern organizations must leverage data-driven decision-making in real-time or near-real-time, data-intensive environments. Technological advancements, particularly in computational capacity and storage, enable organizations to quickly capture, store, and analyze vast amounts of data to make informed decisions based on objective evidence rather than assumptions and perceptions based on past experience. These advancements are disrupting business operations.

The late Clayton Christensen of Harvard Business School, an expert in innovation and growth, defined *disruptive technology* as a new technology that initially serves a small, niche market. Established markets often consider the new technology to be inferior to existing technologies. However, over time, the technology improves and appeals to a broader market, eventually displacing the established firms.

In Christensen's theory, disruptive technologies typically have lower performance in the beginning. However, they have other attributes that make them attractive to a subset of customers, such as lower cost, greater convenience, or ease of use. These attributes enable a new technology to enter a market and improve over time, eventually surpassing the performance of the established technology.

Established companies often fail to adopt disruptive technologies because these firms are focused on maintaining their existing products and serving their existing customers. In fact, they may not see the value in a new technology that initially appears to be inferior. As a result, they frequently miss the opportunity to capture new markets and grow their business. Let's consider two examples: Cisco Systems and Netflix.

Example

MIS Cisco Systems Disrupts Nortel Networks

Nortel Networks, a multinational telecommunications equipment manufacturer founded in 1895, designed, manufactured, and sold a wide range of products, including optical networking equipment, routers, switches, wireless networking equipment, and voice and multimedia communications systems. Other firms used these products to build and operate telecommunications networks, both wired and wireless, that could carry voice, data, and video traffic.

Nortel also provided consulting and support services to help customers design, implement, and maintain their networks. In addition, the company licensed its technology to other equipment manufacturers and worked with industry standards bodies to develop new networking protocols and standards.

Nortel focused on circuit-switched networking. Circuit-switched networks were the first type of communication network to be developed. They operate by establishing a dedicated physical communication path between two devices for the duration of a communication session. Companies that utilized this technology had to reserve the resources required for the communication, such as bandwidth, for the entire session, even if there were periods when no data were transmitted. The traditional telephone network is an example of a circuit-switched network.

In contrast, Cisco Systems, founded in 1984, concentrated on Internet Protocol (IP) networking. IP networks are packet-switched networks that use the Internet Protocol to transmit data between devices. IP networks break data into packets and route them individually over the network to their destination. A major advantage of this process is that the network resources are used only as needed and can be shared among multiple sessions simultaneously. IP networks are used for a wide range of applications, including email, web browsing, file transfer, video streaming, and voice and video calls over the internet.

As a result of these technological differences, IP networking is more efficient and less expensive than circuit-switched networking. IP networking can also transmit over longer distances and manage higher network traffic.

As the internet grew in popularity, Nortel continued to focus on traditional, circuit-switched networking, while Cisco's IP networking technology became increasingly important. By the mid-2000s, Cisco surpassed Nortel in terms of market share and had become the dominant company in the networking industry. In 2009, Nortel filed for bankruptcy protection.

MIS Netflix Disrupts Blockbuster Video

Blockbuster Video was a video rental store chain that operated from 1985 to 2010. The chain employed a physical business model with a physical product (movie and video game tapes), a physical presence (brick-and-mortar stores), and a physical process. In this process, the chain's customers traveled physically to its stores to rent its products for short periods and then physically returned them. Customers had to return rented items within a specified time frame to avoid late fees.

Blockbuster's business model had another drawback: the Long Tail. The Long Tail is a business strategy where the total value of low-demand products sold online can exceed the volume of a small number of the most popular items. Traditional brick-and-mortar retail stores are limited by physical space and can carry only a limited number of the most popular or profitable products. However, online retailers can offer a much wider range of products, including products that might not be popular enough to justify shelf space in a physical store.

Netflix, founded in 1997, began as a DVD-by-mail service where customers rented movies online and had them delivered to their homes. This business model differed from the traditional model of video rental stores, where customers had to physically visit a store to rent a movie.

Netflix continued to innovate and introduce new features such as personalized recommendations and streaming video. In addition, Netflix's subscription-based model was more affordable than Blockbuster's pay-per-rental model. As a result, Netflix attracted a large and loyal customer base, while Blockbuster struggled to compete.

Over time, Blockbuster did expand its business model to include online DVD rentals and video streaming. However, the company did not introduce these services quickly enough and filed for bankruptcy in 2010. Today, Netflix is one of the largest streaming video services in the world.

A disruptive technology, therefore, is an innovation that significantly changes the way that businesses, customers, and industries operate by displacing or replacing established business processes, products, services, and operations. These technologies can create new markets or modify existing ones, and they can make old technologies, products, and services obsolete. Disruptive technologies also transform the way people interact with technology. Examples of disruptive technologies are the wheel, the printing press, the steam engine, electricity, the computer chip, and thousands of others.

Artificial intelligence is today's most prominent competitive advantage and disruptive technology! In fact, LinkedIn noted that the #1 in-demand technical skill for 2024 was artificial intelligence and machine learning.

Our contention is that a basic understanding of AI and ML is *not* only for technical professionals, such as computer scientists. Rather, we contend that a basic understanding of AI and ML is essential for *all* students because the AI and ML applications apply to such a large number of disciplines.

Before you go on. . .

1. What are the key characteristics of a disruptive technology, and how can a disruptive technology displace the established technologies in the market?
2. Describe the Long Tail concept, and explain why it provides a strategic advantage to online retailers over traditional brick-and-mortar stores.
3. Identify and briefly discuss three major characteristics of the modern business environment that organizations must adapt in order to remain competitive.

INTERACTIVE SELF-SCORING QUIZZES

VIDEO CONTENT

1.2 A Brief History of Artificial Intelligence and Machine Learning

The 1950s. The field of modern AI began in 1950 when Alan Turing introduced the Turing Test. This test assesses a machine's ability to exhibit intelligent behavior that could not be distinguished from human behavior. The test involves a human evaluator engaging in a natural language conversation with both a human and a machine designed to generate human-like responses. The evaluator then tries to determine which of the two is the machine. Turing argued that if the evaluator cannot reliably distinguish the machine from the human based on their conversation, then the machine demonstrated a form of intelligence.

Arthur Samuel, an American pioneer in computer gaming and artificial intelligence, developed his checkers-playing program in the early 1950s. His program was an early example of a self-learning system that could improve its performance through experience. The program played thousands of games against itself, learning from its mistakes and refining its strategies. This approach, known as *reinforcement learning*, has become a fundamental concept in machine learning.

The Dartmouth Conference, held in the summer of 1956 at Dartmouth College in Hanover, New Hampshire, was a significant milestone in the history of artificial intelligence. Leading computer scientists John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon organized the conference, bringing together researchers from various fields, including mathematics, computer science, psychology, and electrical engineering. At this conference, John McCarthy coined the term "artificial intelligence."

The goal of the conference was to explore the possibility of creating machines that could simulate human intelligence. The participants discussed a range of topics related to AI, including machine learning, natural language processing, problem-solving, and game playing. *Natural language processing* (NLP) is a field of AI focused on the development of algorithms and models that enable computer systems to understand, generate, and respond to human language in a meaningful and useful way. The participants proposed the development of AI systems that could reason, learn, and communicate. The Dartmouth Conference led to the development of many fundamental ideas and techniques that are still employed in AI today.

The researchers were overly optimistic about the progress that could be made in developing intelligent machines, and they underestimated the difficulty of solving the problems involved. They also failed to address some of the ethical and social implications of AI, such as the potential impact on employment, privacy, and security.

The 1960s. Computer scientists developed early AI programs for playing games, solving mathematical problems, and translating languages.

The 1970s. Computer scientists developed the first expert systems. **Expert systems (ESs)** are computer systems that attempt to mimic human experts by applying expertise in a specific domain. Essentially, an ES transfers expertise from a human domain expert

(or other source) to the system. This knowledge is then stored in the system, typically in the form of IF–THEN rules. The more complex ESs are composed of thousands of these rules.

There are interesting similarities between expert systems and AI/ML systems. First, both systems can make inferences and arrive at conclusions. Second, like human experts, both systems can offer advice or recommendations, and they can explain the logic behind the advice and recommendations. Third, both systems require human experts. Expert systems require human experts to provide the knowledge for the system. AI/ML systems require human experts using supervised ML algorithms to provide the labels for the features. (We discuss this topic in detail later in the text.)

However, there are also fundamental differences between the two systems. Expert systems, much like conventional programming, must be formally structured in the form of rules. By contrast, AI/ML systems learn from ingesting vast amounts of data and adjusting *hyperparameters* (discussed later in this text). Also, ESs can explain their recommendations, whereas very large and advanced AI/ML systems cannot.

Expert systems do present problems. For example, transferring domain expertise from humans to the ES can be difficult because humans cannot always explain *how* they know what they know. In addition, even if domain experts can explain their entire reasoning process, automating that process might not be possible. The process might be either too complex or too vague, or it might require too many rules. Essentially, it is very difficult to program all the possible decision paths into an expert system.

The 1980s. Computer scientists developed *neural networks*, which simulate the structure and function of the human brain. In addition, the field of machine learning emerged, with a focus on developing algorithms that can learn from data.

The 1990s. The emergence of big data, the rapid growth of the internet, the emergence of cloud computing, and the development of graphics processing units (GPUs) led to advances in machine learning.

- **Big data:** Big data refers to extremely large, complex, and diverse sets of data that cannot be easily managed, processed, or analyzed using traditional data processing tools and techniques. Big data is typically characterized by its vast volume, rapid velocity, and variety. Big data includes many different types of data, which we discuss in Chapter 5.
- **The explosive growth of the internet:** In 1990, there were an estimated 300,000 internet users worldwide. By 1999, that number had mushroomed to nearly 250 million. In 1990, there were only a few hundred websites on the internet. By 1999, there were more than 3 million.
- **Cloud computing:** *Cloud computing* is the delivery of computing resources, such as servers, storage, databases, networking, software, and analytics, over the internet. Instead of hosting and maintaining these resources on local servers or personal devices, users can access them on demand, from anywhere with an internet connection.
- **Graphics processing units (GPUs):** GPUs are specialized hardware designed to perform complex calculations in parallel. They excel at processing large amounts of data quickly. These capabilities make them well suited for training and running deep neural networks.

The 2000s. Technological advances in the 1990s, coupled with the availability of vast amounts of data, led to advances in machine learning and deep learning. *Deep learning* is a subfield of machine learning that uses neural networks with many layers. Convolutional neural networks and recurrent neural networks have become popular architectures for deep learning.

The 2010s. The development of powerful hardware, such as GPUs, and the availability of massive datasets led to breakthroughs in deep learning. *Reinforcement learning*, a type of machine learning that uses rewards to train agents, emerges.

The 2020s. The use of AI and ML continues to expand across a myriad of industries, including healthcare, finance, and transportation. Ethical concerns about the use of AI and its potential impact on society become more prominent and generate increased research on fairness, accountability, and transparency.

Two other transformative AI models – generative AI and large language models – emerged in the late 2010s and early 2020s. *Generative AI* refers to artificial intelligence systems designed to create new content based on patterns learned from training data. These systems can generate various types of content, including text, images, audio, and video that resemble human-created work. Notable examples include DALL-E and Stable Diffusion for images, AudioLM and MusicLM for audio, Sora and Gen-2 for video, and multimodal systems that work across different formats.

Large language models (LLMs) are a specific type of generative AI that focuses on processing and generating human language. They are trained with massive amounts of text data from sources such as books, articles, and websites to learn language patterns. This training enables LLMs to perform tasks such as text completion, summarization, question answering, and translation. Well-known LLMs include OpenAI's GPT series, Anthropic's Claude, Google's PaLM, and Meta's LLaMA.

Before you go on. . .

1. Describe the goals and outcomes of the Dartmouth Conference in 1956 and compare the researchers' expectations to the actual progress made in AI.
2. What are the similarities and differences between expert systems (ES) and AI/ML systems?
3. Explain how advancements in big data, internet growth, cloud computing, and GPUs in the 1990s contributed to the progress of machine learning.

1.3 Definitions

Artificial intelligence (AI) is the theory and development of information systems that are capable of performing tasks that normally require human intelligence. A key point here is that we define AI in terms of how humans *perform tasks* rather than how they *think*.

This definition raises the question, "What is intelligent behavior?" The following capabilities are considered to be signs of intelligence:

- learning or understanding from experience,
- making sense of ambiguous or contradictory messages, and
- responding quickly and successfully to new situations.

The goal of AI is to build systems that mimic human intelligence. Alan Turing, a British AI pioneer, designed a widely used test to determine whether a computer system exhibits intelligent behavior. The Turing test proposes a scenario in which a person and a computer are hidden from an interviewer. If the interviewer cannot distinguish which is the computer or the human, then the computer has passed the Turing test. Based on this standard, some commercial AI products, such as ChatGPT-4o, can be said to have passed the Turing test.

TABLE 1.1 The Capabilities of Natural Versus Artificial Intelligence

Capabilities	Natural Intelligence	Artificial Intelligence
Preservation of knowledge	Perishable from an organizational point of view	Permanent
Duplication and dissemination of knowledge in a computer	Difficult, expensive, time consuming	Easy, fast, inexpensive
Total cost of knowledge	Can be erratic, inconsistent, and incomplete at times	Consistent and thorough
Documentation of process and knowledge	Difficult, expensive	Fairly easy, inexpensive
Creativity	Can be very high	Low, uninspired
Use of sensory experiences	Direct and rich in possibilities	Must be interpreted first; limited
Recognizing patterns and relationships	Fast, easy to explain	Machine learning is still not as good as people in most cases, but in some cases, better than people
Reasoning	Making use of a wide context of experiences	Good only in narrow, focused, and stable domains

We can better understand the potential value of AI by contrasting AI with natural – that is, human – intelligence. AI has several important advantages over natural intelligence, but it also displays some limitations. We outline these strengths and limitations in Table 1.1 and then provide an example that illustrates the capabilities of natural versus artificial intelligence.

Example

MKT AI in Customer Service

This example examines how companies implement AI in customer service, particularly through chatbots and automated support systems. An **AI chatbot** is a software application designed to simulate conversation with human users. Well-known AI chatbots include ChatGPT (OpenAI), Siri (Apple), Alexa (Amazon), Google Assistant, and Cortana (Microsoft). We differentiate between human and artificial intelligence in the eight capabilities listed in Table 1.1.

Preservation of Knowledge. Human customer service representatives might forget details or require reminders regarding company policies and products. AI chatbots consistently maintain and apply a vast, up-to-date knowledge base, without forgetting or overlooking details.

Duplication and Dissemination of Knowledge. Training customer service staff is resource intensive, and the transfer of knowledge may be inconsistent. AI systems can be duplicated and deployed instantly across various platforms and locations, ensuring that knowledge and service quality are uniform.

Total Cost of Knowledge. Human expertise varies, and the quality of service can fluctuate based on factors such as experience and mood. AI offers consistent responses and service levels. However, it may lack the nuanced understanding of a seasoned human agent.

Documentation of Process and Knowledge. Documenting human interactions and decisions can be complex and prone to human errors. AI systems automatically log interactions and decisions, generating a clear and easily accessible record.

Creativity. Human agents can think creatively, adapting responses to unique or complex customer issues. Traditional AI systems demonstrate low creativity. However, generative AI models, such as OpenAI's GPT series, can analyze vast amounts of data to generate creative and contextually relevant responses that resemble human creativity. However, generative AI models still function within the limits of their training data and algorithms.

(Continued)

Use of Sensory Experiences. Humans can pick up on nuances in tone, emotion, and context during customer interactions. AI cannot fully understand or interpret emotional subtleties and complex human sentiments.

Recognizing Patterns and Relationships. Customer service representatives can understand customer issues in a broader context, recognizing patterns based on experience. Although AI can quickly identify patterns in customer queries, its understanding is limited to the data it has been trained on.

Reasoning. Human agents use a wide range of experiences and contextual knowledge to address customer issues.

AI excels in specific, focused tasks, but it lacks humans' broader contextual reasoning capabilities.

Conclusion

In the customer service function, AI exhibits significant strengths in maintaining and disseminating knowledge and in documenting interactions. However, it is far more limited in areas requiring creativity, emotional intelligence, and broad contextual understanding. This example illustrates how AI can enhance certain aspects of customer service, but it also highlights the irreplaceable value of human insight and creativity in business operations.

Weak AI, Strong AI, Super AI, and Machine Learning

Before we proceed, it is important to distinguish among weak AI, strong AI, and super AI. **Weak AI** – also called *narrow AI* – performs a useful and specific function, or a set of related functions, that formerly required human intelligence and does so at human levels or better. Weak AI systems are designed to perform specific tasks, but performing other tasks is difficult. Typical examples are character, speech, and image recognition; machine vision; robotics; data mining; medical informatics; and automated investing.

Today, systems that are labeled "artificial intelligence" are weak AI. However, weak AI is already powerful enough to make a dramatic difference in human life. Weak AI applications enhance human tasks by complementing what people can do. Examples of narrow AI are virtual assistants (e.g., Siri, Alexa), image recognition systems, and fraud detection systems.

Strong AI – also known as *artificial general intelligence* – is hypothetical artificial intelligence that matches or exceeds human intelligence. A strong AI could successfully perform any intellectual task that a human being can and understand, learn, reason, and apply knowledge across multiple domains, much like the human brain. Strong AI systems could learn and adapt to new situations and tasks, understand and process natural language, solve complex problems, make decisions, and exhibit creativity and emotional intelligence.

Super AI – also known as *artificial superintelligence* (ASI) – refers to a hypothetical AI system that surpasses human intelligence in virtually all domains, including scientific creativity, general wisdom, and social skills. An ASI system would be able to outperform humans in every cognitive task, possess unparalleled problem-solving abilities, and understand and navigate complex social and emotional interactions.

Machine learning (ML) is a subfield of artificial intelligence that focuses on developing algorithms and statistical models that enable computer systems to improve their performance on a specific task without being explicitly programmed. A **machine learning algorithm** is a set of instructions that enables a model to learn from data, identify patterns, and make predictions or decisions without being explicitly programmed for each specific task.

In other words, ML enables systems to learn and make predictions or decisions by utilizing data rather than following predetermined rules. Examples of ML applications are recommendation systems, predictive maintenance, demand forecasting, sentiment analysis, and thousands more. As businesses generate and collect vast amounts of data,

machine learning has become an essential tool for extracting valuable insights, automating processes, and making data-driven decisions.

In discussions about technology, the terms artificial intelligence (AI) and machine learning (ML) are often used interchangeably. This situation can sometimes lead to confusion, as AI and ML refer to very closely related but distinct concepts. In this book, we use the combined prefix *AI/ML* when discussing models, systems, and applications to address this potential confusion and to simplify the conversation for business students who may be new to these topics.

Before you go on. . .

1. What are three differences between artificial intelligence and natural human intelligence?
2. Explain the differences among weak AI, strong AI, and super AI.
3. Explain the differences between AI and ML.

1.4 Why You Should Learn About AI and ML

AI/ML is today's central organizational disruption. Failure to prepare for this disruption is not an option. As a business professional, you must understand how AI/ML works; how AI/ML systems are designed, built, and deployed; and how to work with AI/ML systems.

This section explains why it is so important that you learn about these topics. We start with an organizational perspective.

AI and ML are revolutionizing how businesses operate, from automating repetitive tasks to optimizing decision-making. (See the chapter opening and closing cases for examples.) In addition, companies that aggressively implement AI/ML systems achieve a significant competitive advantage over competitors that are slower to do so. Similarly, students who understand these technologies will be better equipped to identify and pursue opportunities to leverage them in business. Finally, AI/ML can help businesses make better decisions by providing insights and predictions based on vast amounts of data.

Now let's take a personal perspective. In modern organizations, working with AI/ML applications is no longer the exclusive responsibility of technical professionals. Rather, professionals in all business functional areas play key roles in developing and using AI and ML applications.

Therefore, it is vital that you become **AI/ML literate**. AI/ML literate users have a basic understanding of AI/ML concepts, technologies, and their applications in real-world contexts. An AI/ML-literate individual can critically assess how AI/ML systems work, understand the ethical and practical implications of their use, and make informed decisions about the adoption and deployment of AI/ML systems in an organization. They can communicate effectively with technical teams, leverage AI/ML to enhance business strategies, and recognize the opportunities and risks associated with AI/ML-driven solutions. You will enjoy many benefits from being AI/ML literate.

You will benefit more from your organization's AI/ML applications because even as a new or recent graduate, you will understand how to develop and use these applications. For example, a marketing manager at a retail company employed her knowledge of AI/ML-powered customer segmentation to create targeted marketing campaigns that increased sales conversions by 20 percent. By understanding how the AI/ML system works, she was able to provide valuable input in the system's development and effectively improve the results of the marketing campaign.

You will be able to keep up with current developments in AI and ML. In that way, you will be able to anticipate the impacts that AI and ML will have on your organization and make recommendations regarding the adoption and use of these technologies. For example, a financial analyst at a bank followed the latest developments in AI/ML-based fraud detection systems. When the bank considered implementing a new system, the analyst was able to provide informed recommendations based on his knowledge, helping the bank make a sound investment decision.

You will understand how using AI and ML can improve your organization's performance and teamwork as well as your productivity. For example, an HR professional at a large corporation understood how AI/ML could streamline the recruiting process. She helped implement an AI/ML-powered resume-screening tool that saved the HR team hours of work while improving the quality of the candidates who were interviewed.

You will also be able to identify situations in which AI/ML applications are *not* appropriate. For example, when a vendor proposed an expensive AI/ML system for demand forecasting, the supply chain manager used their understanding of the technology to ask critical questions and ultimately recommend a simpler, more cost-effective solution.

AI and ML are creating new career opportunities in many fields, many of which are not technical. With a strong understanding of these technologies, you will be better positioned to pursue these in-demand roles. For example, a business student who understands AI/ML is recruited by a top management consulting firm to join their AI advisory practice. The student's knowledge will enable them to quickly contribute to client projects.

AI and ML are changing the job market by automating routine tasks and creating new job roles that require a different set of skills. As an AI/ML-literate user, you will be able to "future-proof" your career with your new set of AI/ML skills. Becoming AI literate is important to your career, your future, and your ability to stay relevant and make meaningful contributions in the workplace. For example, a manager in the healthcare industry recognizes the potential of AI/ML to transform patient care. They enroll in an online introductory course on AI/ML. They apply the knowledge gained to propose and help implement an AI/ML-powered patient triage system at their hospital, thereby improving patient outcomes and reducing costs.

If you have ideas of becoming an entrepreneur, then being an AI/ML-literate user will help you utilize these technologies when you start your business. For example, an entrepreneur with a background in AI/ML developed a business plan for a personalized fitness app that uses ML to create customized workout plans and provide real-time feedback. Their business plan was unique and attracted investors.

Our overall goal is to provide you with an understanding of AI/ML concepts, techniques, and applications that are relevant to business contexts. Specifically, we want you to:

1. Understand the fundamental concepts and terminology of AI and ML.
2. Recognize the potential business applications of AI/ML across various industries and functional areas such as accounting, finance, marketing, human resource management, supply chain management, analytics, and management information systems.
3. Evaluate the strategic implications of AI/ML for businesses, including its impact on competitive advantage, innovation, and organizational change.
4. Assess the ethical and social considerations surrounding the use of AI/ML in business, such as data privacy and job displacement.
5. Apply AI/ML concepts and techniques to real-world business problems and case studies, demonstrating the ability to formulate and interpret AI/ML-driven solutions.

6. Communicate effectively about AI/ML with technical and nontechnical audiences, including senior management, clients, and cross-functional teams.
7. Identify and evaluate the key challenges and best practices associated with implementing AI/ML in organizations, such as data quality, talent acquisition, and change management.
8. Gain hands-on experience with AI/ML tools, platforms, and algorithms used in operational contexts. We would like you to be able to:
   - Identify a business problem;
   - Determine if this problem can or should be addressed with AI/ML applications;
   - Select and prepare the appropriate dataset needed to address that problem;
   - Select an appropriate ML algorithm;
   - Input the data into this algorithm;
   - Analyze the results;
   - Improve those results;
   - Formulate an actionable business decision;
   - Effectively communicate those decisions to your organization's decision-makers.

Before you go on. . .

1. Why is it important for students to learn about artificial intelligence (AI) and machine learning (ML)?
2. As an AI/ML-literate user, how can you contribute to your organization's success? Provide two examples that illustrate the benefits of being knowledgeable about these technologies in a business context.
3. As an AI/ML-literate user, what steps should you take to effectively leverage these technologies in addressing a business problem?

INTERACTIVE SELF-SCORING QUIZZES

1.5 Organizational Roles in AI/ML Projects

VIDEO CONTENT

There are many diverse roles in developing and using AI/ML applications in organizations, and different organizations employ different job titles. To simplify, we place these roles into three primary groups: business professionals, business analysts, and technical professionals. All three groups play distinct roles and contribute distinct skills and expertise to the success of an AI/ML project. Figure 1.1 shows the three organizational roles in AI/ML projects.

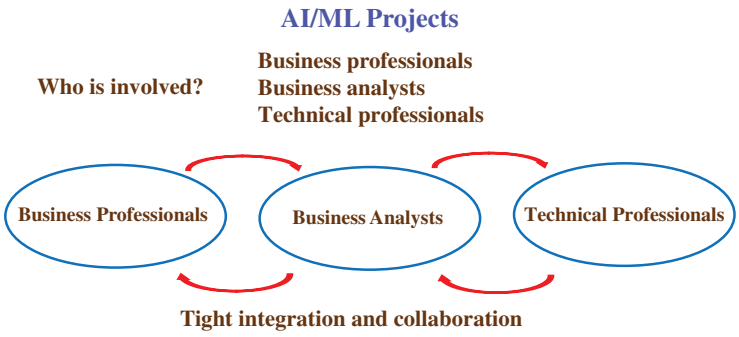

FIGURE 1.1 Organizational Roles in AI/ML Projects

Business Professionals

Business professionals possess a deep understanding of the business domain, goals, and objectives. A *domain expert* is a person with deep knowledge, skills, and experience in a particular functional area. This expertise includes knowledge of specific tools and business processes. Business professionals also possess expertise with the range of systems and applications that their business function and organization use. Remember, domain experts prioritize the *why* rather than the *how* of AI/ML model development. Note: As college students, you are developing domain expertise in your major field of study. As you gain experience in your career, your domain expertise will deepen.

Business professionals are responsible for identifying business problems or opportunities that can be addressed using AI/ML. Significantly, they can come from any university major. Key responsibilities of business professionals include:

- Defining the business case and objectives for the AI/ML project.
- Providing domain expertise and insights to guide the project.
- Communicating business requirements and constraints to the project team.
- Making strategic decisions and ensuring the project aligns with the company's business goals.
- Securing necessary resources and support for the project.

Business professionals are the experts in their organizations. They provide relevant background information and play a key role in defining actionable use cases for AI/ML applications, and relevant organizational objectives for those applications.

In addition, business professionals work with business analysts to identify and define the business requirements for new products, services, or processes. Business professionals also work with technical professionals to develop AI/ML models to ensure that business requirements are met. Business analysts and technical professionals rely on business professionals to provide as much business context as possible to help them derive the correct approach to a potential AI/ML application. This context includes, for example, whether the organization has developed conventional applications that address use cases in the past and, if so, how these applications performed.

Business professionals also help business analysts and technical professionals design, develop, implement, maintain, and oversee AI/ML applications that the organization deploys. For this reason, they should know how to work with and utilize AI/ML applications and interpret their recommendations.

Business professionals can provide valuable insights into how to select, prepare, and analyze data that will provide inputs to the AI/ML applications. They perform a critical role in selecting input features (variables), a process at the center of AI/ML application development. *Feature selection* is the process whereby data scientists choose and refine the data they will work with.

At each step of AI/ML model development, business professionals can preemptively anticipate biases, ethical concerns, risks, and potential regulatory problems. Their domain knowledge enables them to critically interpret the outputs of AI/ML models. They can conduct "sanity checks" because they understand what is plausible and what is not. They can also provide insights into which results are important and which are trivial.

Business professionals also have an essential role in maintaining AI/ML applications. By design, AI/ML models change over time. Unless they are closely and continuously monitored, they may drift or deteriorate. Business professionals' domain knowledge enables them to review the broader landscape and business climate to ensure that the model remains relevant. For example, if some aspect of the business changes

after an AI/ML model has been deployed, then the model's underlying assumptions may no longer be valid.

Overall, an effective AI/ML system requires substantial input from domain experts to understand, anticipate, and mitigate potential problems and comply with all regulatory requirements. On the other hand, an ineffective AI/ML system can act in an unexpected, unintended, or uncontrolled manner, often causing harm or damage. Such systems may result from poor design, programming errors, unanticipated interactions with the environment, or the AI/ML system learning and evolving in ways its developers did not anticipate.

MIS For example, Knight Capital Group used an AI/ML-driven automated trading system to buy and sell stocks. In August 2012, the firm deployed new computer code in the trading system. Unfortunately, the code contained an error. As a result, the trading system began making unauthorized trades, purchasing and selling millions of shares across multiple stocks within just 45 minutes.

The rogue AI/ML system's actions caused Knight Capital Group to accumulate a substantial position in some stocks while selling off holdings in others, leading to massive losses. By the end of the trading day, the company had lost over $440 million, nearly bankrupting the firm.

Let's look at how business professionals contribute to each step of developing and deploying an AI/ML project at a retail chain.

Example

MKT Retail Chain Implementing AI/ML for Personalized Marketing

A large retail chain plans to implement an AI/ML system for personalized marketing. The system will analyze customer data to tailor marketing campaigns and offer personalized product recommendations. Business professionals make important contributions at each stage of AI/ML model development and deployment.

Expertise in Organization and Past Projects. Business professionals provide insights into previous marketing campaigns and their effectiveness, helping to identify potential use cases for AI/ML. They offer historical context on how conventional marketing applications have performed, guiding the technical team on what improvements AI/ML can bring. Drawing on their experience, business professionals suggest specific areas where AI/ML could have a significant impact, such as customer segmentation and targeted promotions.

Understanding Available Data. Business professionals inform the AI/ML team about the types of customer data available, such as purchase history, online browsing behavior, and customer feedback. They provide advice on which data might be most relevant for personalized marketing efforts.

Data Maintenance Insights. Business professionals share how the data have been maintained and documented, providing crucial information on data quality and structure. They also offer insights into how data might have changed over time, anticipating problems such as outdated customer information.

Domain-Specific Data Selection. Business professionals help identify which features, or data inputs, are most likely to accurately predict personalizing marketing efforts, such as frequency of purchases, average spend, and product preferences. Their insights ensure that the AI/ML system focuses on the most relevant data.

Conducting "Sanity Checks." Business professionals use their domain knowledge to evaluate whether AI/ML-generated recommendations are plausible and align with business realities. They help distinguish between significant findings and trivial or erroneous patterns that the AI/ML model might generate. Specifically, they evaluate AI/ML recommendations against known customer behavior patterns and market dynamics. They identify AI/ML-suggested marketing strategies that might not align with brand values or customer expectations.

Monitoring Model Relevance. Business professionals regularly review AI/ML outputs to ensure they continue to align with changing market trends and customer preferences. If there are significant changes in market conditions or customer behavior, the professionals guide the technical team in adjusting the AI/ML models accordingly. They regularly review the performance of AI/ML-driven marketing campaigns, assessing their return on investment (ROI) and customer engagement levels.

Ethical and Bias Considerations. Business professionals anticipate how AI/ML-driven marketing might impact different customer segments, ensuring that the campaigns are ethical and unbiased. They work with the technical team to mitigate potential biases in AI/ML algorithms.

Regulatory Compliance. Business professionals ensure that the use of customer data in AI/ML applications complies with data privacy laws and industry regulations. They proactively identify and address potential regulatory issues that may arise from the use of AI/ML in marketing.

Business Analysts

Business analysts serve as a bridge (or translators) between business professionals and technical professionals. They possess a combination of business expertise and technical knowledge. Like business professionals, business analysts can come from any university major. However, they typically take several AI/ML courses in addition to their major field. Their primary responsibilities include:

- Facilitating effective communication and collaboration between business and technical teams.
- Gathering and documenting business requirements for the AI/ML project.
- Analyzing and translating business needs into specific AI/ML problem statements.
- Collaborating with business professionals to identify relevant data sources and define success metrics.
- Communicating technical concepts and solutions to business stakeholders in a clear and accessible manner.
- Assisting in data exploration, feature selection, and model evaluation from a business perspective.

Technical Professionals

Technical professionals are responsible for the hands-on development and implementation of the AI/ML solution. They typically major in Analytics, Data Science, Computer Science, Mathematics, Machine Learning, and Software Engineering. Technical professionals encompass several roles:

- *Data engineers* collect, aggregate, clean, and transform the data into inputs for the AI/ML algorithms.
- Once the data are prepared, *data scientists* design and implement AI/ML models that learn from data in large datasets to make accurate predictions or decisions. Specifically, they use statistical and mathematical methods to build predictive models, and they employ AI/ML to produce meaningful insights from these data. Then they evaluate the performance of the AI/ML models and fine-tune them to improve their accuracy and efficiency.
- *Machine learning engineers* integrate the AI/ML models developed by data scientists into production systems. They ensure that the models can manage real-world data and provide actionable insights to business professionals. Machine learning engineers also monitor the models' performance in production, continuously updating them as new data become available.

Key responsibilities of technical professionals include:

- Designing and architecting the AI/ML system based on business requirements.
- Collecting, preprocessing, and transforming data for AI/ML model training and evaluation.
- Selecting appropriate AI/ML algorithms and frameworks for the project.
- Developing, training, and optimizing AI/ML models.
- Evaluating model performance, validating and testing the model, and evaluating its performance.

- Deploying the AI/ML solution and integrating it into existing systems.
- Collaborating with business analysts to ensure that technical solutions align with business objectives.
- Providing technical guidance and support to the project team.

Often, business professionals lack technical expertise, and technical professionals lack business expertise. This situation results in communication problems between the two groups. The solution to this common problem is for all three groups to collaborate closely. Specifically, business professionals provide the strategic direction and domain expertise, business analysts help translate business requirements into technical specifications, and technical professionals build and implement the AI/ML system. This collaboration is often the most important factor in successful AI/ML projects. The following example illustrates the contributions of each group and the collaboration among them at each stage of the project.

Example

MKT A Customer Churn AI/ML System

A retail company wants to develop an AI/ML-based customer churn prediction system to identify customers at risk of leaving and take proactive measures to retain them. The contributions of the three groups at each step of the project ensure that the system aligns with business objectives, leverages relevant data, and delivers actionable insights to drive customer retention strategies.

Project Initiation

Business Professionals

- Define the business objectives for reducing customer churn and increasing retention.
- Allocate the budget and resources for the project.
- Identify key stakeholders and establish project governance.

Business Analysts

- Gather and document business requirements for the churn prediction system.
- Identify potential data sources such as customer transactions, interactions, and demographics.
- Define success metrics such as reduced churn rate and improved retention rates.

Technical Professionals

- Assess the project's technical feasibility and propose suitable AI/ML approaches.
- Identify the necessary tools, technologies, and infrastructure for the project.
- Collaborate with business analysts to understand data requirements and project scope.

Data Collection and Preparation

Business Professionals

- Facilitate access to customer data from various departments and ensure compliance with data privacy requirements.
- Emphasize the importance of data quality and its impact on the project's success.

Business Analysts

- Define data requirements and collaborate with technical professionals to identify relevant data.
- Assist in ensuring that the data are accurate, complete, and consistent.
- Create data dictionaries and document data lineage for better understanding and transparency. *Data lineage* is the process of tracking and documenting the path of data from its origin to its destination, including all changes and movements. It provides a comprehensive view of the data's lifecycle, enabling users to understand, trace, and verify its sources and processing.

Technical Professionals

- Collect and integrate customer data from multiple sources, such as customer relationship management (CRM), billing, and customer support systems.
- Perform data cleaning, preprocessing, and transformation to prepare the data for analysis.

(Continued)

- Manage data security and privacy during data collection and storage.

Feature Engineering and Selection

Business Professionals

- Provide domain expertise to help identify customer behavior patterns and churn indicators.
- Offer insights into customer segments, preferences, and engagement channels.

Business Analysts

- Collaborate with domain experts to translate business knowledge into actionable features.
- Analyze the feasibility and potential impact of incorporating specific features into the model.
- Document feature definitions, rationale, and any assumptions made during feature selection.

Technical Professionals

- Perform exploratory data analysis to identify meaningful patterns and correlations.
- Engineer relevant features, such as customer lifetime value, purchase frequency, and support interactions.
- Apply feature selection techniques to identify the most impactful features for churn prediction.

Model Development and Training

Business Professionals

- Provide guidance on model interpretability and explainability requirements.
- Ensure that the model development process aligns with ethical and fairness considerations.

Business Analysts

- Define model evaluation criteria and performance metrics that are aligned with business objectives.
- Collaborate with technical professionals to validate model assumptions and limitations.
- Document model development decisions and communicate progress to stakeholders.

Technical Professionals

- Select appropriate AI/ML algorithms such as logistic regression, decision trees, and neural networks.
- Design the model architecture, tune hyperparameters, and train the models using the prepared dataset.
- Implement techniques such as cross-validation and regularization to prevent overfitting and ensure model generalization. We discuss these techniques in Chapter 6.

Model Evaluation and Validation

Business Professionals

- Review model evaluation results and assess their impact on business goals and customer retention strategies.
- Provide feedback on model performance and suggest areas for improvement.

Business Analysts

- Analyze model evaluation metrics and translate them into business-relevant insights. We discuss these metrics in Chapter 6.
- Validate model predictions against domain knowledge and business expectations.
- Document model validation findings and communicate them to stakeholders.

Technical Professionals

- Evaluate the trained models using appropriate metrics.
- Perform model validation using techniques such as holdout validation or K-fold cross-validation. We discuss model validation techniques in Chapter 6.
- Collaborate with business analysts to interpret model results and assess their business impact.

Deployment and Integration

Business Professionals

- Define the deployment strategy and ensure it is aligned with organizational processes and systems.
- Communicate the value and impact of the churn prediction system to stakeholders.

Business Analysts

- Manage the integration of the churn prediction system and existing customer touch points.
- Manage user acceptance testing to ensure the system is functional and usable.
- Create guides, training materials, and documentation for users.

Technical Professionals

- Deploy the churn prediction model in a production environment.
- Integrate the deployed model with existing systems such as CRM and marketing automation platforms.
- Ensure the model meets performance, scalability, and security requirements.

Monitoring and Maintenance

Business Professionals

- Monitor the adoption and usage of the churn prediction system across various business units.
- Provide ongoing support and resources for system maintenance and updates.

Business Analysts

- Continuously monitor system performance and track key business metrics related to churn and retention.
- Gather user feedback and identify areas for improvement or additional features.
- Collaborate with technical professionals to plan and prioritize system enhancements.

Technical Professionals

- Set up monitoring and alerting mechanisms to detect anomalies or performance degradation.
- Perform regular maintenance tasks such as model retraining, data pipeline updates, and security patches.
- Provide technical support and troubleshoot any issues reported by users.

Continuous Improvement

Business Professionals

- Assess the impact of the churn prediction system on customer retention and business revenue.
- Make data-driven decisions to optimize customer engagement strategies and retention campaigns.

Business Analysts

- Analyze system performance data and user feedback to identify opportunities for improvement.
- Propose and prioritize enhancements to the churn prediction system based on business value and feasibility.
- Document lessons learned and best practices for future AI/ML projects in customer retention.

Technical Professionals

- Continuously monitor the model's performance and gather feedback from business users.
- Explore advanced AI/ML techniques and incorporate new data sources to improve prediction accuracy.
- Collaborate with business analysts to implement approved enhancements and optimizations.

Before you go on. . .

1. Briefly describe the roles and responsibilities of business professionals in developing and deploying AI/ML applications within an organization.
2. Explain how business analysts act as "translators" between business professionals and technical professionals in AI/ML projects.
3. Briefly describe the roles and responsibilities of technical professionals in developing and deploying AI/ML applications within an organization.

1.6 What's in AI/ML for Me?

ACC for the Accounting Major

- AI/ML technologies are increasingly being adopted in various accounting tasks such as auditing, financial reporting, and fraud detection.
- AI/ML tools can help accountants analyze vast amounts of financial data, obtain insights, and make more accurate predictions.
- Accountants have a responsibility to ensure the integrity, transparency, and fairness of financial information. As AI/ML systems become more prevalent in accounting, students must be able to identify and mitigate potential biases and ethical concerns in these systems to maintain the trust and credibility of the profession.
- AI/ML tools can automate manual and time-consuming tasks such as data entry, reconciliations, and transaction categorization. This process frees up accountants to focus on higher-value tasks that require professional judgment and critical thinking.

- AI/ML algorithms can analyze large volumes of financial data in real time, identifying anomalies and potential fraud indicators more efficiently and accurately than traditional methods.
- AI/ML algorithms can analyze historical financial data, market trends, and other relevant factors to generate more accurate financial forecasts and projections.
- AI/ML technologies can enable continuous auditing, which enables auditors to monitor financial transactions and controls in real time.
- AI/ML-powered chatbots and virtual assistants can provide personalized financial advice and support to clients based on their specific needs and preferences.
- AI/ML algorithms can analyze various data sources to predict potential financial risks such as credit defaults and market fluctuations.

FIN for the Finance Major

- AI/ML technologies are being rapidly adopted in various financial applications such as algorithmic trading, portfolio optimization, and risk management.
- AI/ML tools enable finance professionals to analyze vast amounts of financial data, identify patterns, and make more accurate predictions.
- Finance professionals have a fiduciary duty to act in the best interests of their clients. As AI/ML systems become more integrated into financial decision-making, students must be able to identify and address potential biases and ethical concerns associated with these technologies.
- AI/ML algorithms can analyze real-time market data, news, and social media sentiment to make split-second trading decisions.
- AI/ML algorithms can analyze historical market data and identify optimal portfolio allocations based on an investor's risk tolerance and investment goals.
- AI/ML tools can analyze financial transactions in real time, identifying anomalies and potentially fraudulent activities more accurately than traditional methods. (This capability also applies to Accounting majors.)
- AI/ML algorithms can analyze various data sources to identify and quantify financial risks such as credit risks, market risks, and liquidity risks.
- AI/ML-powered robo-advisors can provide automated, low-cost investment advice to clients based on their financial goals and risk tolerance.

MKT for the Marketing Major

- AI/ML technologies are increasingly being used in various marketing applications such as personalization, customer segmentation, and predictive analytics.
- AI/ML tools can analyze vast amounts of customer data from various sources including social media, website interactions, and purchase history.
- Because AI/ML systems rely heavily on customer data, marketing professionals have a responsibility to ensure that these data are collected, used, and protected in an ethical and transparent manner. Marketing students need to understand the potential privacy and ethical concerns associated with AI/ML in marketing.
- By understanding the capabilities and limitations of AI/ML, marketing students can identify areas where these technologies can be applied to improve customer experiences, optimize marketing campaigns, and drive business growth.
- AI/ML algorithms can analyze customer data to create highly personalized marketing messages, product recommendations, and experiences.
- AI/ML algorithms can analyze customer data to identify distinct customer segments based on their behavior, preferences, and characteristics. This information

can help marketers create more targeted and effective marketing strategies for each segment.

- AI/ML algorithms can analyze historical customer data, market trends, and other relevant factors to predict future customer behavior including churn, lifetime value, and purchase propensity.
- AI/ML-powered chatbots and virtual assistants can provide instant, personalized support to customers, answering their questions and guiding them through the purchase process. This support can improve customer satisfaction and reduce the workload on human customer service representatives.
- AI/ML algorithms can analyze real-time market demand, competitor prices, and other relevant factors to optimize product prices. This information can help marketers maximize their profits and remain competitive.
- AI/ML algorithms can analyze customer feedback, reviews, and social media mentions to gauge customer sentiment and identify areas for improvement. This process helps marketers address customer concerns, improve product offerings, and maintain a positive brand reputation.

HRM for the Human Resource Management Major

- AI/ML technologies are being adopted in various HR functions including recruitment, employee engagement, and performance management.
- AI/ML tools can analyze vast amounts of HR data such as employee performance metrics, turnover rates, and job candidate information. HR students who become proficient with these technologies can make more informed decisions related to talent acquisition, employee development, and workforce planning.
- HR professionals have a responsibility to ensure that AI/ML systems used in HR processes are fair, unbiased, and transparent. HR students need to understand the potential biases and ethical concerns associated with AI/ML in HR and develop strategies to mitigate these risks.
- AI/ML tools can automate resume screening, candidate matching, and initial interviews, helping HR professionals identify the most suitable candidates more efficiently.
- AI/ML-powered chatbots and sentiment analysis tools can help HR professionals monitor employee sentiment, identify potential issues, and provide personalized support to improve employee engagement and reduce turnover.
- AI/ML algorithms can analyze employee performance data, providing insights into individual and team performance trends. These data can help HR professionals make more objective and data-driven decisions related to promotions, compensation, and training needs.
- AI/ML tools can personalize learning experiences based on individual employee needs, skills, and learning styles. This process can help HR professionals create more effective and engaging training programs.
- AI/ML algorithms can analyze workforce data such as skills, demographics, and attrition rates to predict future workforce needs and identify potential skill gaps. This process helps HR professionals make more-informed decisions related to talent acquisition, succession planning, and workforce optimization.
- AI/ML tools can help HR professionals identify and mitigate unconscious bias in HR processes such as recruitment and performance evaluations. However, HR professionals need to regularly audit these tools for fairness and transparency to ensure they are not perpetuating biases.

SCM for the Supply Chain Management Major

- AI/ML technologies are being rapidly adopted in various supply chain functions such as demand forecasting, inventory management, and logistics optimization. Supply chain students need to stay updated with these developments to remain competitive in the job market and drive innovation.
- AI/ML tools can analyze vast amounts of supply chain data such as sales data, supplier performance metrics, and transportation costs. By understanding these technologies, supply chain students can make more informed decisions related to demand planning, procurement, and distribution.
- Supply chain professionals have a responsibility to ensure that AI/ML systems employed in supply chain processes are transparent, fair, and align with corporate social responsibility goals. Supply chain students need to understand the potential ethical concerns associated with AI/ML in supply chain management such as data privacy and environmental sustainability.
- By understanding the capabilities and limitations of AI/ML, supply chain students can identify areas where these technologies can be applied to optimize supply chain processes, reduce costs, and enhance customer service.
- AI/ML algorithms can analyze historical sales data, market trends, and external factors to generate more accurate demand forecasts. These forecasts can help supply chain professionals optimize inventory levels, reduce stockouts, and improve customer satisfaction.
- AI/ML tools can optimize inventory levels based on real-time demand data, supplier lead times, and other relevant factors. This capability can help supply chain professionals reduce inventory costs, improve inventory turnover, and minimize obsolescence.
- AI/ML algorithms can optimize transportation routes, modes, and schedules based on real-time traffic data, weather conditions, and other external factors. This process can help supply chain professionals reduce transportation costs, improve delivery times, and minimize carbon emissions.
- AI/ML tools can analyze supplier performance data, financial stability, and other risk factors to identify potential supply chain disruptions. This information can help supply chain professionals proactively mitigate supplier risks and ensure business continuity.
- AI/ML algorithms can analyze sensor data from supply chain equipment such as trucks and warehouses to predict maintenance needs and prevent unplanned downtime. By employing these data, supply chain professionals can improve equipment reliability, reduce maintenance costs, and minimize supply chain disruptions.
- AI/ML technologies can enable the firm to automate various supply chain tasks including warehouse picking, packing, and material handling. This innovation can help supply chain professionals improve operational efficiency, reduce labor costs, and enhance worker safety.

ANL for the Analytics Major

- AI/ML technologies are foundational to modern analytics practices. They enable analysts to extract insights and make predictions from large and complex datasets.
- Analytics professionals are often responsible for developing and implementing AI/ML models to resolve business problems.
- Analytics professionals have a responsibility to ensure that AI/ML models are developed and used in an ethical, transparent, and accountable manner. Analytics

students need to understand the potential biases and ethical concerns associated with AI/ML and develop strategies to mitigate these risks.

- Deploying AI/ML solutions often requires analytics professionals to collaborate with domain experts, particularly business professionals and subject matter experts. Analytics students need to develop a strong understanding of AI/ML concepts to communicate and work effectively with these stakeholders.
- AI/ML tools can automate data processing tasks such as data cleaning and transformation and feature engineering. This process helps analytics professionals save time and focus on higher-value tasks such as model development and interpretation.
- AI/ML algorithms can enable more accurate and sophisticated predictive modeling, including deep learning and ensemble methods. (We discuss ensemble methods in Chapter 6.) These methods help analytics professionals generate more reliable and actionable insights from data.
- The development of explainable AI/ML techniques helps analytics professionals better understand and interpret the decisions made by AI/ML models. This process improves the transparency and accountability of AI/ML solutions and promotes better collaboration with business stakeholders.
- AI/ML models can be designed to continuously learn and adapt to new data, enabling analysts' solutions to improve over time.
- AI/ML technologies can augment human analytics capabilities by automating routine tasks, generating insights, and providing recommendations. This process helps analytics professionals focus on more strategic and creative tasks such as framing problems and designing solutions.
- AI/ML technologies can enable analytics solutions in various domains including computer vision, natural language processing, and robotics. These solutions can help analytics professionals expand their skills and expertise and create value in new application areas.

MIS for the Management Information Systems Major

- AI/ML technologies are being integrated into various information systems including enterprise resource planning (ERP), customer relationship management (CRM), and decision support systems (DSS).
- AI/ML tools can analyze vast amounts of data from various sources such as transactional data, social media, and sensor data.
- MIS professionals have a responsibility to ensure that AI/ML systems are developed and used in an ethical, transparent, and accountable manner. MIS students need to understand the potential biases and ethical concerns associated with AI/ML and develop strategies to mitigate these risks.
- AI/ML technologies can enable firms to automate multiple business processes, including invoice processing, customer service, and supply chain management. MIS professionals will need to design and implement intelligent automation solutions that can adapt to changing business needs and optimize process efficiency.
- MIS professionals will need to design and implement conversational AI/ML solutions (e.g., chatbots) that can understand user intent, provide relevant responses, and integrate with backend systems.
- AI/ML technologies can enhance cybersecurity by detecting and preventing cyber threats such as malware, phishing, and insider threats. MIS professionals will need to develop and deploy AI/ML-based security solutions that can adapt to evolving threat landscapes and protect organizational assets.

- Major cloud providers, such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP), offer various AI/ML services that can be integrated into applications. MIS professionals will need to leverage these cloud-based AI/ML services to rapidly develop and deploy AI/ML solutions without the need for extensive infrastructure and expertise.
- As AI/ML models become more complex and autonomous, there is a growing need for explainable AI/ML techniques and model governance frameworks. MIS professionals will need to ensure that AI/ML models are transparent, accountable, and aligned with organizational values and regulations.

Summary

1.1 Discuss the impact of disruptive technologies, particularly artificial intelligence and machine learning, on organizations in today's competitive environment.

The modern business environment is global, intensely competitive, and dynamic. Disruptive technologies are innovations that initially serve a small market but eventually displace established firms by offering attributes such as lower cost, greater convenience, and ease of use. Established companies often fail to adopt disruptive technologies due to their focus on existing products and customers. These companies are ultimately overcome by competitors that utilize these disruptive technologies.

Artificial intelligence (AI) and machine learning (ML) are today's most prominent disruptive technologies. It is critical that organizations utilize these technologies to remain competitive and take advantage of new opportunities. Therefore, a basic understanding of AI and ML is essential for all students, not just technical professionals, given the wide-ranging applications of these technologies across disciplines.

1.2 Understand the evolution of artificial intelligence (AI) and machine learning (ML) from the 1950s to the 2020s.

The field of modern AI began in the 1950s with the introduction of the Turing Test and the development of early self-learning systems such as Arthur Samuel's checkers-playing program. The 1956 Dartmouth Conference brought together researchers from various disciplines to explore the possibility of creating intelligent machines.

In the 1960s and 1970s, computer scientists developed early AI programs and expert systems (ESs).

The 1980s witnessed the development of neural networks and the emergence of machine learning.

In the 1990s, advancements in big data, internet growth, cloud computing, and graphics processing units (GPUs) led to further progress in machine learning.

The 2000s and 2010s brought about significant breakthroughs in deep learning and reinforcement learning, driven by technological advancements and the availability of large datasets.

In the late 2010s and early 2020s, large language models (LLMs) and generative AI (GenAI) models emerged.

1.3 Differentiate between artificial intelligence and machine learning, and among weak AI, strong AI, and super AI.

Artificial intelligence (AI) is the theory and development of information systems that are capable of performing tasks that normally require human intelligence.

Strong AI – also known as *artificial general intelligence* – refers to a hypothetical system that could successfully perform any intellectual task that a human being can.

Weak AI – also called *narrow AI* – performs a useful and specific function or task that once required human intelligence to perform and does so at human levels or better.

Super AI – also known as *artificial superintelligence* (ASI) – refers to a hypothetical AI system that surpasses human intelligence in virtually all domains, including scientific creativity, general wisdom, and social skills.

Machine learning (ML) is an application of artificial intelligence that provides systems with the capability to automatically learn and improve from experience without being explicitly programmed.

1.4 Explain why being an AI/ML-literate user is so important today.

Failure to prepare for this disruption is not an option for business professionals. Business professionals now play key roles in developing and using AI/ML applications. Being an AI/ML-literate user offers many benefits:

- Obtaining greater value from an organization's AI/ML applications
- Staying current with AI/ML developments and anticipating their impact on the organization
- Improving organizational performance, teamwork, and personal productivity
- Recognizing situations where AI/ML may not be appropriate
- Pursuing new career opportunities created by AI/ML
- Future-proofing your career with AI/ML skills
- Utilizing AI/ML when starting a business

1.5 Explain the roles and responsibilities of business professionals, business analysts, and technical professionals in the development, deployment, and maintenance of AI/ML applications.

Business professionals use their domain expertise in these roles and responsibilities:

- Identify business opportunities that can be addressed with AI/ML applications
- Provide relevant background information, define use cases, and ensure that AI/ML applications align with organizational objectives
- Help other groups design, develop, implement, and maintain AI/ML applications
- Provide valuable insights into data selection
- Anticipate biases and ethical concerns
- Conduct "sanity checks" on AI/ML outputs
- Ensure that the models remain relevant and comply with regulations

Business analysts, who also possess domain expertise and organizational knowledge, have these roles and responsibilities:

- Provide insights into AI/ML project design, development, deployment, and maintenance
- Work with business professionals to identify business requirements
- Work with technical professionals to develop AI/ML models
- Act as "translators" between business professionals and technical professionals, ensuring that the AI/ML project prioritizes the correct initiatives and aligns with expectations

Technical professionals have these roles and responsibilities:

- Building AI/ML systems
- Data engineers collect, clean, and transform raw data into a suitable format for AI/ML algorithms.
- Data scientists design and implement AI/ML models, evaluate their performance, and fine-tune them.
- Machine learning engineers integrate the models into production systems, ensure they are scalable and reliable, and continuously update them with new data.

Chapter Glossary

AI chatbot	A software application designed to simulate conversation with human users.
Algorithm	A step-by-step set of instructions formula for solving a problem or performing a task.
Artificial general intelligence	(see **strong AI**)
Artificial intelligence (AI)	The theory and development of information systems that can perform tasks that normally require human intelligence.
Artificial superintelligence	(see **super AI**)
Business analysts	Individuals who have a combination of business expertise and technical knowledge and serve as a bridge (or translators) between business professionals and technical professionals.
Business professionals	Individuals who possess a deep understanding of the business domain, goals, and objectives.
Machine learning (ML)	An application of artificial intelligence that enables systems to learn from data and improve their performance on tasks over time without being explicitly programmed.
Machine learning algorithm	A set of instructions that enables a model to learn from data, identify patterns, and make predictions or decisions without being explicitly programmed for each specific task.

Narrow AI	(see **weak AI**)
Strong AI (artificial general intelligence)	A hypothetical system that could successfully perform any intellectual task that a human being can. Strong AI, therefore, could be considered to have consciousness or sentience.
Super AI (artificial superintelligence)	A hypothetical AI system that surpasses human intelligence in virtually all domains including scientific creativity, general wisdom, and social skills.
Technical professionals	Individuals who are responsible for the hands-on development and implementation of the AI/ML solution.
Weak AI (narrow AI)	A system that performs a useful and specific function or task that formerly required human intelligence to perform and does so at human levels or better.

Discussion Questions

1. How can businesses effectively leverage AI and ML to achieve a competitive advantage in their respective industries? Provide specific examples.

2. Discuss the importance of collaboration among business professionals, business analysts, and technical professionals in the successful development and deployment of AI/ML applications.

3. How can organizations ensure that their AI/ML systems are designed and implemented in an ethical and unbiased manner? What steps can they take to mitigate potential biases?

4. Analyze the potential impact of AI/ML on various business functions such as marketing, finance, human resources, and operations. How can each function benefit from the adoption of AI/ML technologies?

5. How can organizations balance the need for data privacy and security with the benefits of using AI/ML systems that require vast amounts of data?

6. Analyze the potential long-term effects of AI/ML on the job market and the workforce. How can organizations and individuals adapt to these changes?

7. Discuss the role of business professionals in identifying and mitigating risks associated with AI/ML systems including damaged reputations, legal liabilities, and unintended consequences.

8. Analyze the importance of having a clear AI/ML strategy that is closely aligned with the organization's overall objectives. How can organizations develop and implement such a strategy?

9. Discuss the potential impact of AI/ML on customer experience and engagement. How can organizations use AI/ML to personalize and enhance customer interactions?

10. Analyze the potential impact of AI/ML on society as a whole, considering factors such as privacy, fairness, and the digital divide. What role can businesses play in addressing these societal concerns?

Problem-Solving Activities

1. Analyze an organization that has successfully implemented AI/ML technologies. Identify the key factors that contributed to their success and discuss how other organizations can learn from their experience.

2. Develop a hypothetical business case for implementing an AI/ML system in a specific business function (e.g., marketing, finance, or operations). Outline the expected benefits, costs, and risks associated with the project.

3. Create a roadmap for an organization looking to adopt AI/ML technologies. Include steps such as assessing readiness, defining goals and objectives, acquiring talent, and implementing and monitoring the system.

4. Develop a data governance framework for an organization implementing AI/ML systems. Consider factors such as data quality, privacy, security, and ethical use of data.

5. Conduct a SWOT analysis of an organization's readiness to adopt AI/ML technologies. Identify strengths, weaknesses, opportunities, and threats, and propose strategies for addressing each one.

6. Design a training program for business professionals to become AI/ML-literate users. Outline the key topics to be covered and the learning objectives for each topic.

7. Develop a set of ethical guidelines for an organization that is developing and deploying AI/ML systems. Consider factors such as transparency, accountability, fairness, and privacy.

8. Create a communication plan for an organization that is implementing an AI/ML system. Consider how to effectively communicate the benefits and risks of the system to various stakeholders including employees, customers, and investors.

9. Analyze the potential impact of AI/ML on a specific industry (e.g., healthcare, finance, or retail). Identify the key opportunities and challenges for organizations operating in that industry and propose strategies for successfully adopting AI/ML technologies.

Chapter Closing Case

MKT SCM MIS HRM Amazon

Founded in 1994, Amazon (www.amazon.com) is a multinational technology company that focuses on e-commerce, cloud computing, digital streaming, and artificial intelligence. The company's success can be largely attributed to its early adoption and continuous investment in AI/ML technologies.

Amazon is a world leader in leveraging AI and ML to drive decision-making and enhance real-time customer experiences. Because Amazon has customers worldwide, the company generates massive volumes of data that would be impossible for humans to analyze quickly enough to respond to customer needs and preferences. However, using AI/ML algorithms, Amazon can rapidly process these vast datasets to provide personalized product recommendations, optimize pricing and inventory, forecast demand, automate customer service interactions, and streamline supply chain and fulfillment operations. The data that Amazon collects from numerous and diverse sources include the following.

Customer Data. Amazon collects clickstream data from its website. These data help Amazon personalize product recommendations, improve search results, and optimize the customer experience. The data include:

- **Purchase history:** What customers have bought, how often they buy, and their preferred shopping categories.
- **Browsing behavior:** How customers browse the site, including pages visited, session duration, and products viewed but not purchased.
- **Search queries:** What customers search for, including the keywords they use and how frequently they search.
- **Reviews and ratings:** The feedback that customers provide on products and services.
- **Interaction data:** How customers interact with various Amazon services such as Amazon Prime, Alexa, and Kindle, including voice commands and reading habits.

For example, as a customer adds items to their online shopping cart, AI/ML algorithms immediately analyze the products' availability in Amazon's gigantic inventory, rapidly calculate optimal shipping options, and offer precise delivery time estimates. If a less expensive shipping method becomes feasible, the algorithms proactively notify the customer and provide an updated lower price and delivery timeline.

Seller Data. Amazon collects data on seller performance, product listings, pricing, and customer interactions. The company utilizes these data to improve the marketplace experience for both sellers and customers, detect fraudulent activities, and develop AI/ML-powered tools to manage inventory and optimize pricing. Seller data include:

- **Seller transactions:** Data on seller activities, including sales volumes, inventory management, and pricing strategies.
- **Seller performance metrics:** Ratings and reviews of sellers by customers, response times to customer inquiries, and resolution of disputes.

Amazon Web Services (AWS) Data. AWS, Amazon's cloud computing platform, collects data on customer usage patterns, resource utilization, and application performance. It utilizes these data to optimize the performance and cost efficiency of AWS services and develop new AI/ML-powered tools for customers.

Logistics and Supply Chain Data. Amazon collects data on inventory levels, shipment tracking, warehouse operations, route optimization for deliveries, returns, and overall delivery performance across its global logistics network. It employs these data to optimize warehouse operations, predict demand, and develop AI/ML-powered tools for route optimization and robotics control.

Operational Data. Amazon collects data from its devices, such as Echo, Fire TV, and Kindle, including device performance metrics, usage patterns, and functional feedback. The company also collects transaction data, which include details such as time, monetary value, payment methods, and transaction outcomes (successful, failed, or refunded).

Advertising Data. Amazon's advertising platform collects data on ad impressions, clicks, conversions, customer demographics, and interests. The company uses these data to improve ad targeting, measure campaign performance, and develop AI/ML-powered tools to optimize advertisements and detect fraud.

Product Data. These data include detailed attributes of products listed on Amazon, including category, brand, price, and manufacturer. Amazon also collects data on produce listings, changes in product listings, new product additions, and historical trends in product offerings.

Device and Sensor Data. Amazon collects data from various Internet of Things (IoT) devices and sensors, including warehouse cameras, Ring security devices, Alexa-enabled devices, and Kindle e-readers. The company employs these data to improve device performance, personalize user experiences, and develop new AI/ML-powered features and services.

For example, Amazon collects data from interactions with Alexa – the company's voice assistant – including voice commands and recordings, transcripts, language preferences, and queries. It also collects visual data from services such as Amazon Prime Video and Amazon Photos.

External Data. Amazon collects data on market trends, consumer behavior, and economic indicators that impact purchasing behavior. The company also collects data from social media platforms regarding public sentiment about Amazon products and services.

Business Problems and AI/ML Solutions

Despite its massive success and scale, Amazon faces a variety of business challenges across its operations. We discuss the major problems here and AI/ML solutions for each one.

(Continued)

Problem: Regulatory Compliance. Because Amazon operates globally, it is subject to many regulatory environments and legal frameworks. Regulators examine the company over data privacy, antitrust concerns, tax policies, and labor practices. Managing compliance across different countries and regions is a complex and ongoing challenge.

AI/ML Solutions. Amazon uses natural language processing and AI/ML to continuously scan, analyze, and interpret legal and regulatory documents across different regions to identify relevant changes and requirements. AI/ML models can predict areas of potential noncompliance by analyzing transactional data against these evolving rules. The company has developed AI/ML-powered tools to help ensure compliance with data privacy regulations, such as automatically detecting and redacting sensitive information.

Problem: Supply Chain Resilience. With its global network of suppliers and fulfillment centers, Amazon's supply chain and logistics network is critical to ensuring timely delivery and maintaining customer satisfaction. Disruptions, whether due to natural disasters, geopolitical events, or other factors such as the COVID-19 pandemic, can severely impact its operations.

AI/ML Solutions. Amazon uses AI/ML algorithms to forecast demand, optimize routes in real time based on traffic and weather conditions, and proactively identify potential supply chain disruptions. The company has deployed AI/ML-powered risk assessment tools to monitor geopolitical events, weather patterns, and other factors that could impact the supply chain.

Amazon's AI/ML models optimize logistics routes, reduce delivery times, and minimize the impact of disruptions. AI/ML-driven systems manage inventory by anticipating supply needs and adjusting orders accordingly. Demand-forecasting algorithms integrate historical data with external signals such as weather to predict purchasing surges by geography. These algorithms enable Amazon to dynamically adjust pricing and inventory levels for efficiency. In fulfillment centers, AI/ML-powered robots can pick, pack, and ship while avoiding collisions through sensor integration and situational analysis. The result is greater output with less human labor required.

Problem: Global Competition. Amazon faces significant competition in nearly all areas in which it operates, from traditional retail competitors to other technology giants. In e-commerce, Amazon competes with Walmart and Alibaba, while in cloud computing, AWS competes with Microsoft Azure and Google Cloud.

AI/ML Solutions. Amazon utilizes its AI/ML models to monitor competitor activities and gather actionable insights. AI/ML-driven dynamic pricing models can automatically adjust prices based on market conditions, competitor pricing, and customer demand.

Amazon also uses AI/ML systems to develop innovative products and services that differentiate Amazon from its competitors. For added competitive advantage, Amazon employs AI/ML to personalize the customer experience, improve product recommendations, and optimize pricing strategies.

Problem: Security and Privacy. As privacy concerns increase globally, consumers and regulators are demanding transparency and control over personal data. Because Amazon manages vast amounts of customer data, the company has implemented sophisticated security measures to protect against breaches and cyberattacks.

AI/ML Solutions. Amazon's AI/ML algorithms monitor its systems in real time to detect anomalies and identify and prevent data breaches and cyberattacks. Other AI/ML algorithms classify and protect sensitive data while ensuring compliance with data privacy regulations.

Amazon has developed explainable AI/ML tools that provide customers with insights into how their data are being used and give them control over their privacy settings. The company uses AI/ML to encrypt and anonymize personal data to enhance privacy.

Problem: Labor Practices. Amazon has been criticized for its labor practices, particularly in its warehouses. Employees and labor advocates frequently raise issues such as worker safety, working conditions, fair wages, the impact of automation on jobs, and the right to unionize. Managing a large workforce while controlling operational costs presents a major challenge.

AI/ML Solutions. Amazon AI/ML algorithms optimize workforce scheduling, considering factors such as demand forecasting, employee skills, and labor regulations. The firm's AI/ML-powered safety monitoring systems identify and prevent potential workplace hazards in real time. Amazon ML systems automate repetitive tasks to reduce human error and fatigue.

The company uses AI/ML-based tools to assess employee engagement and sentiment analysis to address concerns and improve worker satisfaction. These tools analyze worker satisfaction through chatbot feedback and performance data, helping to improve workplace policies and conditions. AI/ML-driven surveillance systems ensure that Amazon warehouses follow safety protocols. Ergonomic AI/ML tools can analyze worker movements to suggest improvements and reduce the risk of injury.

Problem: Fake Reviews. Fake reviews mislead customers by artificially inflating a product's perceived quality or sabotaging competitors with negative reviews that do not reflect the actual product experience. They also undermine trust in the platform and harm the reputation of legitimate sellers.

Fake review schemes have become more sophisticated, making them harder to detect. Given the vast number of products and reviews on Amazon, monitoring and ensuring the authenticity of every review is a massive challenge.

There are many fake review schemes. For example, sellers sometimes pay for positive reviews, offering incentives for favorable ratings. They also use fake accounts to post inauthentic reviews. These practices falsify product ratings and make it more difficult for customers to make informed purchasing decisions. Also, individuals with a vested interest in promoting or disparaging a product – such as competitors, disgruntled employees, and paid reviewers – can write biased or misleading reviews. Organized groups and "review farms" specialize in creating fake reviews on a large scale. These operations can have a significant impact on product rankings and sales. Unfortunately, they can be difficult to detect.

AI/ML Solutions. Amazon AI/ML models detect fake reviews by considering language patterns, reviewer behavior, and network analysis. Amazon uses sentiment analysis and NLP to identify biased or misleading reviews and flag them for manual review. AI/ML-powered identity verification methods can prevent the creation of fake accounts used to post inauthentic reviews. The firm's AI/ML algorithms monitor, detect, and take down large-scale fake review operations. Amazon's AI/ML models can identify patterns that indicate fake reviews, such as anomalies in account creation dates, frequency of reviews, and linguistic cues. AI/ML models can also identify more subtle and sophisticated fake review patterns by analyzing factors such as network behavior analysis – identifying groups of linked accounts – and temporal analysis – the timing of reviews relative to product releases.

Problem: Third-Party Sellers. A significant portion of Amazon's revenue comes from third-party sellers on its marketplace. This dependence can make the company vulnerable to seller disputes, quality control problems, and changes in seller behavior.

Third-party sellers engage in fraudulent activities, including selling counterfeit goods, falsely advertising products, and failing to deliver items as promised. Counterfeit products on Amazon's marketplace can undermine customer trust and damage the company's reputation. Combating counterfeit goods requires continuous monitoring and enforcement efforts.

AI/ML Solutions. Amazon uses AI/ML models to continuously monitor third-party seller behavior data, customer feedback, and compliance with Amazon's policies. In this way, the AI/ML models can identify patterns that might indicate fraudulent activities.

The company has deployed AI/ML-powered tools to detect and remove counterfeit product listings. Amazon utilizes image recognition and computer vision to authenticate products by comparing product images to registered, genuine items. Further, AI/ML systems scan product listings for keywords and imagery typically associated with counterfeit goods.

Sentiment analysis AI/ML tools can evaluate public perception from social media, providing Amazon with insights into brand reputation and areas for improvement. AI/ML-driven quality control systems analyze return rates and customer complaints and review trends to assess seller reliability and product quality.

The Results

In 2024, Amazon's net sales totaled $638 billion. The company reported North America sales of $388 billion, international sales of $143 billion, and AWS sales of $108 billion.

Amazon has a number of AI and ML initiatives underway. Let's examine them in more detail.

Amazon Robotics. In its fulfillment centers, Amazon employs thousands of robots that work alongside human workers to pick, sort, and transport products. These robots use AI/ML and computer vision to navigate large warehouses and perform tasks more efficiently than humans possibly could. The robots speed up the processing time and reduce the physical strain on human workers.

Amazon Scout is an autonomous six-wheeled delivery robot that delivers packages to customers. These robots employ computer vision and other AI/ML technologies to navigate and deliver goods in suburban environments, reducing the company's reliance on traditional delivery methods.

Language Translation. Amazon Translate is a machine translation service that uses AI/ML models to deliver accurate and natural language translation. This service is essential for Amazon's global operations, helping to translate product descriptions, reviews, and customer communication into multiple languages.

Healthcare and Biotechnology Ventures. Amazon is exploring the application of AI/ML in healthcare through Amazon Web Services and specific initiatives such as Amazon Comprehend Medical. This service employs natural language processing to extract relevant medical information from unstructured text. This process helps healthcare providers make better decisions, manage patient data, and streamline operations.

Customer Service Automation. Amazon uses AI/ML to enhance its customer service operations. This application includes chatbots powered by Amazon Lex – an AI/ML service for building conversational interfaces into any application using voice and text – that handle routine inquiries as well as automated systems that can predict and address customer issues before they become significant problems. This proactive approach improves customer satisfaction and reduces the workload on human service agents.

Sources: Compiled from "Amazon Sales Surge as Company Trains Focus on Artificial Intelligence," *Fox Business*, April 30, 2024; D. Pantoja-Navajas, "Unlock Supply Chain Value with Data and AI," *AWS Blog*, March 1, 2024; "A New Study Reveals 5 Ways AI Will Transform the Workplace as We Know It," *aboutamazon.com*, December 7, 2023; C. O'Donovan, "Regulators Struggle to Rein in Amazon on Safety for Warehouse Workers," *The Washington Post*, September 18, 2023; C. Wilkinson, G. Wheelwright, & A. Wöhlke, "AWS Offers New Artificial Intelligence, Machine Learning, and Generative AI Guides to Play Your AI Strategy," *AWS Machine Learning Blog*, July 26, 2023; "How Amazon Deploys Collaborative Robots to Benefit Employees and Customers," *aboutamazon.com*, June 26, 2023; S. McCallum, "Amazon Cracks Down on Fake Reviews with AI," *BBC*, June 12, 2023; A. Kharpal, "Amazon Is Focusing on Using A.I. to Get Stuff Delivered to Your Faster," *CNBC*, May 15, 2023; M. Law, "Amazon Warehouse Robot Uses AI to Handle Millions of Items," *Technology Magazine*, November 15, 2022; "Predicting the Future of Demand: How Amazon Is Reinventing Forecasting with Machine Learning," *Forbes*, December 3, 2021; N. Karlinsky, "How Artificial Intelligence Helps Amazon Deliver," *aboutamazon.com*, June 5, 2019; B. Morgan, "How Amazon Has Reorganized around Artificial Intelligence and Machine Learning," *Forbes*, July 16, 2018; S. Levy, "Inside Amazon's Artificial Intelligence Flywheel," *Wired*, February 1, 2018; www.amazon.com, accessed May 1, 2024.

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Questions

1. **Identify three key sources of data that Amazon collects and explain how the company uses these data to train its AI/ML algorithms to improve its operations and customer experience.**
2. **Amazon faces significant competition in various business areas. Explain how the company leverages AI and ML to achieve a competitive advantage in two of these areas.**
3. **Discuss the challenges presented by fake reviews on Amazon's platform. How does the company utilize AI and ML to detect and combat fake reviews? Provide two specific examples.**
4. **Labor practices and worker satisfaction are significant challenges for Amazon, particularly in its warehouses. Describe two ways in which Amazon is using AI and ML to address these issues and improve working conditions.**