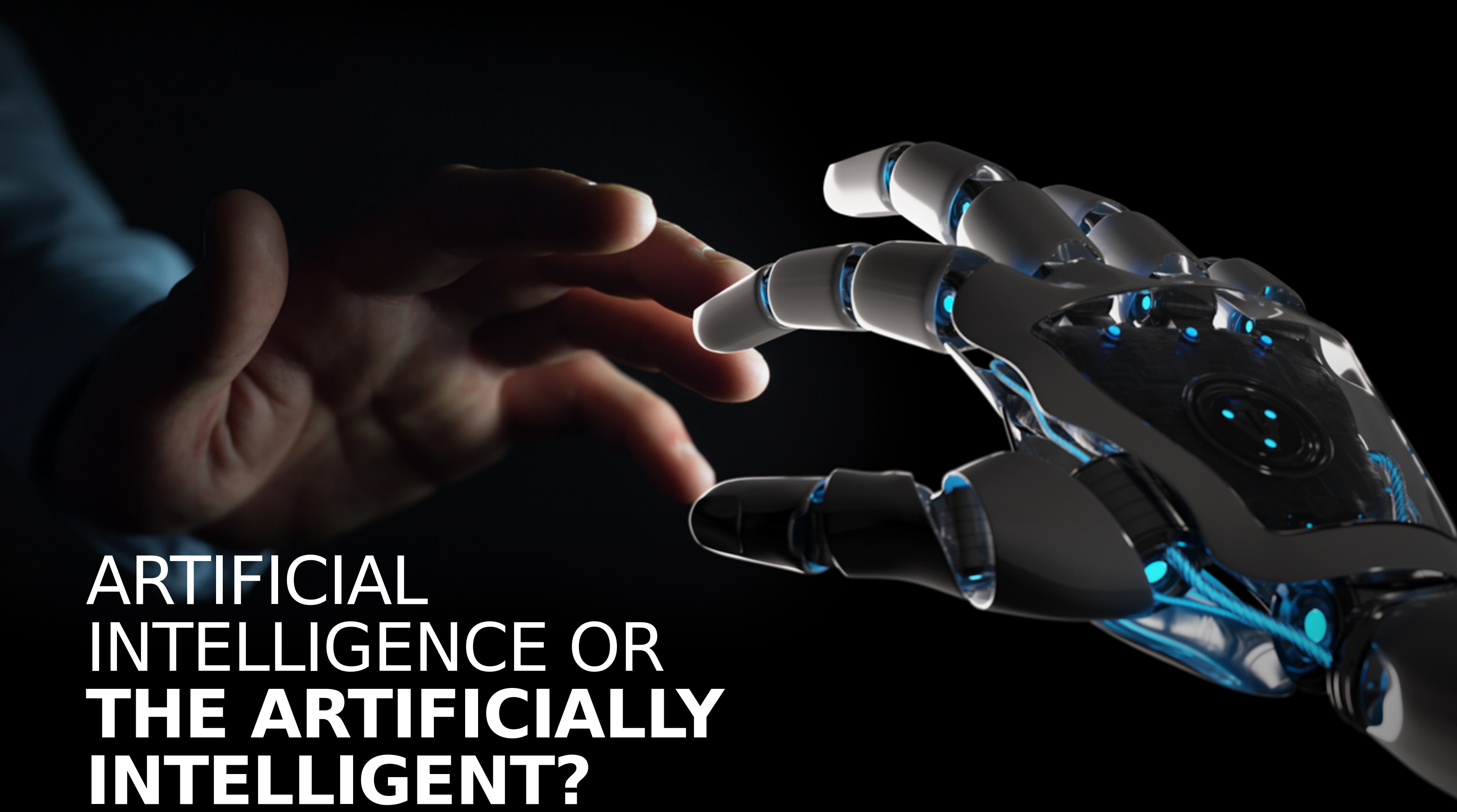
WHITE PAPER



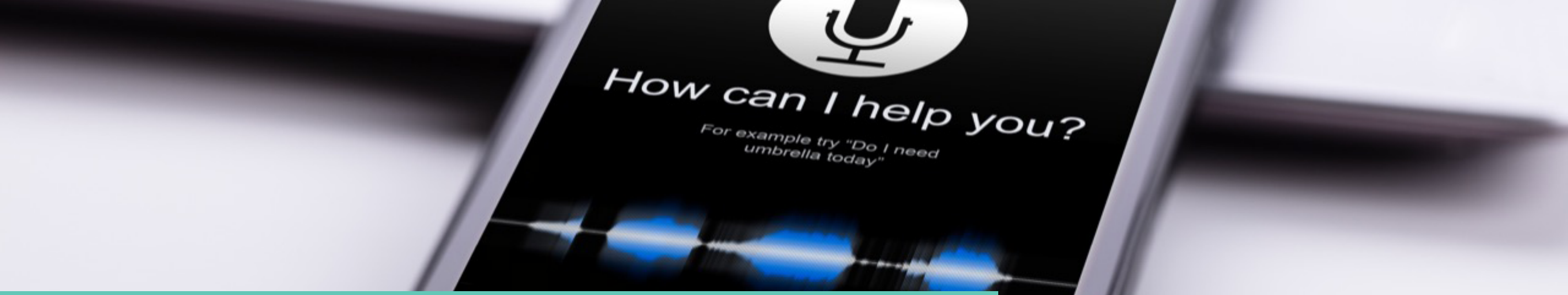
ARTIFICIAL INTELLIGENCE OR **THE ARTIFICIALLY INTELLIGENT?**

UNDERSTANDING THE ARTIFICIAL INTELLIGENCE AGE

molex

SECTION I:
INTRODUCTION

SECTION II:
AI CONCEPTS, TERMINOLOGY AND EXAMPLES



SECTION I: WHAT IS AI? APPLICATIONS AND EXAMPLES

General Artificial Intelligence (AI) is the theory and development of using computer systems to perform tasks that typically require human intelligence. Examples of high-order human tasks include visual perception, decision-making and language translation. While the human brain effortlessly processes many of the previous functions simultaneously, computers have historically struggled to achieve human-like cognition. In the past decade, enabling technologies such as computer science, increased computing power, and an abundance of data have changed the narrative that AI struggles in cognitive tasks. The Department of Advanced Research Project Agency (DARPA), calls AI's rise in skills one of the three wave of artificial intelligence (see Figure 1.1). Each wave represents new capabilities which will unlock more commercial use-cases and applications.

Figure 1.1 DARPA's Three Waves of Artificial Intelligence[1]:

Past	***Current***	***Future***
First wave	***Second wave (3-5 years to broad impact)***	***Third wave (6-12 years to broad impact)***
AI systems can **implement simple logical rules for well-defined problems,** but are incapable of learning, and have a **hard time of dealing with uncertainty**	**Use of statistical models** for certain types of problems (i.e. image recognition) coupled with **exhaustive training on large datasets** to improve efficiency in pattern recognition	All systems begin to learn more like a child through **inference and context of the experience**, then can **explain their decisions**
Pre-Defined Logic	**Perception**	**Reasoning**

AI History

The term Artificial Intelligence (AI) was coined in the summer of 1956 at Dartmouth College by John McCarthy. His goal was to investigate ways in which machines simulate aspects of intelligence.[2] AI's popularity grew from the 1950s to the 1980s but was primarily theoretical. From the mid-1970s to the 1990s, despite promising concepts, the field lacked practical results. This period is known as the first of two "AI winters" because the academic interest, funding and advancement waned. Since then, AI has undergone a renaissance period primarily due to the silicon and internet revolutions. The internet accelerated AI through inexpensive centralized computing (known as cloud computing), more software programmers and availability of data. The landmark of AI's technical feats occurred in 2011 when IBM's Watson computers used AI and machine learning to win the quiz game show Jeopardy![3]

AI Perception: The Second Wave

Presently, we are in the second wave, known as the perception wave, where computers achieve high fidelity perception by processing data. In manufacturing, the perception wave ushered computer vision systems in assembly lines that analyze quality defects in real-time with incredible accuracy. Another, more advanced example of "AI perception" is the ability of Google's translator tool to translate languages seamlessly as you type. The software uses natural language processing (looking at typed words) and data to predict what you're searching for before you can finish the phrase. Iflytek, the Chinese tech firm, uses language processing with AI to instantly translate difficult dialects and non-standard Mandarin with accents.

AI Reasoning: The Third Wave

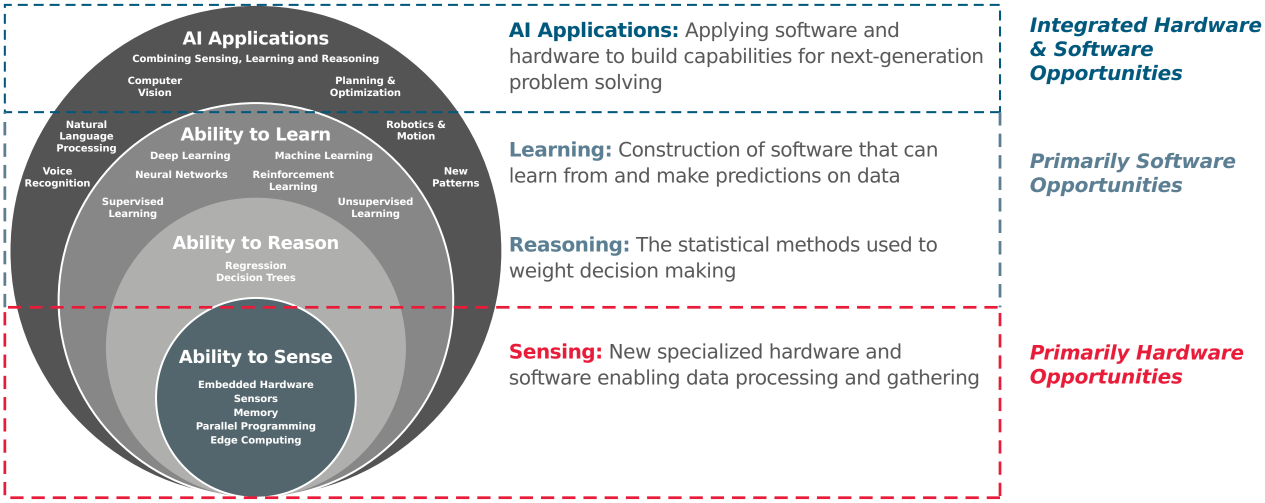
The next and most promising wave — the third wave — will feature computers with causal understanding and contextual reasoning, generally termed as causal awareness. With causal awareness, machines will connect causes and effects from their surroundings. In this wave, projected to start around 2025, AI's value to Molex could potentially grow exponentially. Not only will computers identify patterns, they will also explain decisions and make new suggestions. For Molex, the third wave AI capabilities could recommend new product features and predict production quality before ramping.

SECTION 2: AI CONCEPTS, TERMINOLOGY AND EXAMPLES

General AI — Combining Sensing, Reasoning, Engaging and Learning:

Like an oak tree with many branches and deep roots, AI represents an amalgam of concepts and techniques that perform high- and low-level cognition. From Figure 1.2, **AI's broad enabling concepts** represent the high-order fields, which generally aid a machine's ability to sense, reason and learn. Each field serves an end application, such as **language processing** (understanding written language), **voice recognition** (understanding spoken linguistics), **robotics** (machines with coordinated motion) and **computer vision** (how computers see their environments). Such areas require both advanced hardware and software. For example, in robotics for placing components, machines need software to discern objects and plan placement motion using high-fidelity sensors. In subsequent sections, Molex Ventures will articulate each high-order field (sensing, reasoning, learning) and provide context for the technical concepts that enable AI applications.

Figure 1.2 AI Concepts and Enabling Technologies



AI Learning:

Drilling down one level further in AI's applications hierarchy, are **AI techniques** used in many of the AI applications (machine vision, voice recognition, etc.) to **learn**. New systems and methods are published daily, but Molex Ventures has tried to categorize each concept into concrete buckets that are easily understood. One prevalent technique used in AI applications is called **machine learning (ML).** ML is a set of technologies that feature algorithms that act as the needle weaving a fabric: slowly stitching multiple pieces together accelerates a computer's ability to learn. For example, imagine a supercomputer "self correcting" its decisions by doubling down on successful strategies and cutting the losing ones over time. Related concepts in ML include supervised learning, unsupervised learning and reinforcement learning. **Supervised learning** is when humans aid the computer in identifying and "doubling down" on successful strategies while cutting the losing ones. The inverse, **unsupervised learning**, is when a computer identifies and chooses winning strategies entirely on its own. Slightly different but used with both learning techniques is **reinforcement learning,** where a computer not only doubles down on winning strategies but is rewarded for selecting the winning strategy. Think of this technique as an external party incentivizing outcomes through rewards.

There are two types of special ML techniques called **neural networks** and **deep learning. Neural networks (NN)** are networks that stimulate a computer's ability to learn in a way that mimics the human brain. The technical explanation is that each digital "neuron" takes in multiple sensory inputs and stimulates an output based on the neuron's purpose. For example, computer scientists in image classification (field for labeling objects in pictures) strive to assemble a group of neurons to describe a golden retriever based on its physical features: tail, hair color, number of legs and ears. If you feed a picture of a golden retriever image through a set of neurons or neural networks, they match and fire the output "golden retriever."

Neural networks stimulate a computer's ability to learn in a way that mimics the human brain.

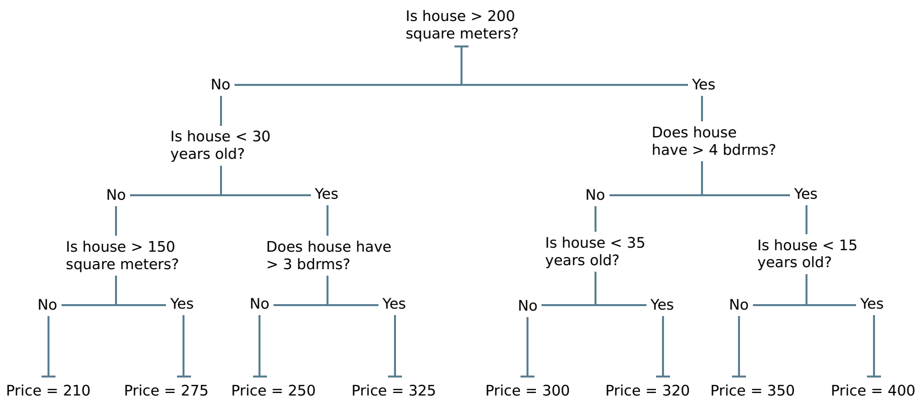
Deep learning (DL) is simply the concept of stringing multiple neural networks together. With deep learning, scientists, for example, strive to combine a deep learning network capable of identifying every type of dog that ever existed. Scientists then might try to take it a step further and use the deep learning model to predict next-generation dog breeds based on their data — a common theme with neural networks and deep learning techniques in identifying and correlating patterns. NN and DL algorithms are the foundation for many popular AI embedded applications such a Google's translate and Apple's Siri. In Siri, when neurons programmed to understand a single word or phase hear your voice, they "fire" off and dictate the phrase.

AI Reasoning:

AI methods, as seen in the third circle in Figure 1.2, are methods typically grounded in mathematical logic and statistics which enable ML and general AI. Molex Ventures has selected the most prevalent AI methods to illustrate. Many practitioners rely on the statistical concept of **linear regression,** which is synonymous with plotting data points on a graph and drawing a trend line representation of the pattern in data. Computers are experts in graphing and recalculating data slopes faster than humans can imagine.

Decision trees, or also known as **logic diagrams,** are ways of representing a sequence of branching or related events. ML can formulate sequences of actions very quickly. In the example below, a decision tree estimated the price of a home by its features like square meters, age and the number of bedrooms. The concept of branching events isn't new; however, with AI, the branches are re-weighted continuously in real-time to reflect the latest information.

Figure 1.4 Decision Tree for House Pricing Example



AI Sensing:

AI enabling technologies grant computers the ability to sense and detect vast amounts of information. **Sensors** detect changes in an environment and provide information to other electronics. For analyses in the physical world, AI needs accurate sensors to provide them with data streams to process insights. For example, the airplane manufacturer Bombardier's C-Series is heavily outfitted with sensors to detect engine performance problems immediately. In just 12 hours of flying, the airplane generates 844 terabytes (TB) of data. To get a sense of scale for terabytes of data, one TB is the equivalent of storing 250 full-length movies in one place. So, in 12 hours, Bombardier must store and process the equivalent of 211,000 full-length movies.[4] **Edge computing** solves the storage challenge on the aircraft by processing real-time data offline without having to worry about storage constraints, so the company can proactively deal with engine issues.

Specialized chips and AI hardware pack more computational power into tighter physical spaces and run AI on far less energy than in the cloud infrastructure. **Specialized AI chips** are active silicon processors, microcontrollers and memory chips developed to process AI algorithm's insights most efficiently. The specialized hardware embeds AI methods such as decision trees and neural networks into the processing.

Specialized chips and AI hardware pack more computational power into tighter physical spaces

AI’s Risks and Challenges to Impact: Unintended Biased AI

Biased AI is when models constructed during training improperly weight values that show prejudice against people or processes. To avoid issues, AI requires clean and diverse data to avoid bias decision making. For example, Apple and Goldman Sachs released a joint credit card that synchronizes with Apple’s iPhone software. When the AI models assigned credit limits to new enrollees, it gave men higher credit limits than their female spouses with identical traits. Both Apple and Goldman claim to use gender-blind data in their AI model development; however, the AI still constructed a gender correlation with credit scoring. AI practitioners will need to exercise extreme caution in deploying artificial intelligence.

Operational Risk

Scaling algorithms from proof of concept to resilient, commercial-scale code carry unknown risks. Researchers, for example, proved it is possible to take an image of a stop sign, and by adding a few stickers, they convinced the machine that it was looking at a 45-mph speed limit sign. The consequences of a mistake could be catastrophic for autonomous vehicle passengers. Extra measures will need to be in place to ensure that algorithms account for minor physical differences.

Bringing AI to Industry

Artificial intelligence has come a long way since its theoretical beginnings in the mid-20th century. Now, thanks to changes in computer power and data, the field is entering a once unimaginable third wave in which computers may reason and understand. Molex remains involved in AI’s evolution, supporting this higher-order development and applying AI-enabled capabilities to our customers’ product innovation, quality, efficiency and more.

1. A DARPA Perspective on Artificial Intelligence. DARPA. Data retrieved in April 2019.
2. “One-hundred-year study on Artificial intelligence”. Stanford. September 2016.
3. Artificial Intelligence Index 2019 Report
4. “The Race For AI: Here Are The Tech Giants Rushing To Snap Up Artificial Intelligence Startups”. CBInsights. February Edition, 2019.