Week 1: Core A.I. Technologies

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# Core A.I. Technologies

## What exactly is “artificial intelligence”

Dreams of artificial intelligence trace back to philosophical debates in ancient Greece. Prometheus would mold handfuls of clay into images of the gods, and later these creatures were given life. The sprouting of ideas came from mathematics, biology, and computer science before eventually producing modern artificial intelligence. While these different domains have unique perspectives, they collectively land at four categories of intelligent systems (Lukac, Milic, & Nikolic, 2018). The first divide asks if the system *thinks* or *acts*, or more precisely, can reason about the problem. Each of these top-level categories contains subcategories of applications that mimic *humans* versus *rational* actors.

Within a smart car are multiple features that fit into these various areas. For instance, traditional cruise controls attempt to *act human* by following a fixed speed. Meanwhile, a vehicle with an adaptive cruise will *act rationally* through avoid an accident by compensating to slow traffic. The design of some autonomous cars includes capabilities to *think human*, like crawling toward a stop sign, giving the appearance of a human driver.

## Description of Technology

There are three high-level categories of artificial intelligence, specifically rules and heuristics, machine learning, and deep learning (Buchanan, 2005).

1. Before 1962, applications would rely on practical techniques for reducing the trial-and-error search space. This heuristic-centric approach is useful for chess and other video game engines. Despite criticism for being naïve, many LOB (Line of Business) applications continue to leverage this technique successfully.
2. In 1963, Edward Feigenbaum and Julian Feldman’s *Computers and Thought* centralized many ideas across the computing industry. Their literature and new programming paradigms, such as McCarthy’s LISP, lay the foundation that became machine learning. Researches use these tools to build statistical models that represent a situation. For instance, if a customer purchases bread, what else could you recommend? Perhaps butter, jam, and deli meat.
3. In 1949, neural scientists found that the human brain transmits signals between a weighted graph of neurons (Lukac, Milic, & Nikolic, 2018). Despite unlocking the biological key to mimicking cognitive learning, the processing power was unavailable until the early 2000s. Today, researchers use neural networks to extract patterns to nebulous problems that met or exceed human capacities.

## Purpose and Function

Traditional software follows the model of *data* plus *rules* equals *outcomes.* In contrast, intelligent systems use data and outcomes to derive rules. This distinction can be valuable when the *rules* are fuzzy or not entirely understood. After extracting those rules into a model, researchers and engineering teams can predict actions across mechanical, thinking, and feeling tasks (Huang, Rust, & Maksimovic, 2019).

* Mechanical tasks are actions that are highly repetitive and benefit from automation. These are operations like turning on lights or assembly-line construction.
* Thinking tasks are operations that require analysis and rationalization. For instance, “does this picture contain a hotdog,” or “is this sentence grammatically correct?”
* Feeling tasks, emulate interpersonal experiences, and express empathy toward the users. These autonomous systems might replace a call center or control support chatbots.

## Example Use Cases

Numerous business scenarios can leverage artificial intelligence through heuristics, machine learning, or deep neural networks. Under each type are several subcategories, like natural language processing. These technologies allow the software to reason about a textual source, then project capabilities such as translation or autocomplete predictions. Another use case is fraud detection, which attempts to stop criminals from exploiting payment processing systems. Researchers create evolutionary intelligence, like Google’s AlpaGo, to learn new strategies for playing complicated games, far superior to humans (Silver, Huang, & Maddison, 2016). Many times the concepts that flow into these intelligent systems are adaptable to other scenarios.

## Levels of Success versus Alternatives