

## Learning, Machine Learning, Symbolic Machine Learning

### Learning

**Definition:** The activity or process of gaining knowledge or skill by studying, practicing, being taught, or experiencing something.

(Source: <http://www.learnersdictionary.com/definition/learning>)

**Example:** Driving was a skill that I developed over the course of a few years. By *studying* a driver's manual, I was able to acquire knowledge on safe driving practices, the rules, of the road, etc. I *practiced* by driving a vehicle in and out of traffic at various locations while accompanied by an adult with driving experience. That same adult also *taught* me how to control my vehicle well as I drove. Through this *experience*, I was able to obtain my driver's license.

### Machine Learning

**Definition:** The field of machine learning is concerned with the question of how to construct computer programs that automatically improve with experience.

(Source: <https://machinelearningmastery.com/what-is-machine-learning>)

**Example:** *MarI/O* is a program that teaches itself to complete levels in the video game *Super Mario World* using neural networks and genetic algorithms. The program tracks Mario's progress in the level with a fitness metric, and the trial with the highest fitness in a set of trials progress is picked out and "bred" with another trial with "max fitness" in another set. By randomly combining the traits of both, there's a chance Mario will make further progress by combining the best of both traits. This process is repeated over a long period of time until the machine can finish the entire level by itself. In other words, *SethBling*, the author of the program, *constructed* a computer program that successfully taught itself to finish a level in the game after many *attempts*, steadily *improving* over time.

(Source: <https://www.youtube.com/watch?v=qv6UVOQ0F44>)

### Symbolic Machine Learning

**Definition:** Symbolic artificial intelligence is the term for the collection of all methods in artificial intelligence research that are based on high-level "symbolic" (human-readable) representations of problems, logic and search.

(Source: [https://en.wikipedia.org/wiki/Symbolic\\_artificial\\_intelligence](https://en.wikipedia.org/wiki/Symbolic_artificial_intelligence))

**Example:** An *expert system* tries to emulate the decision-making ability of a *human expert*. They are designed to solve complex problems by *reasoning* through bodies of knowledge, represented mainly as if-then rules. They incorporate a *knowledge base* containing accumulated experience and an *inference*, or rules, engine; each of these would be symbolic representations. *Machine learning* may be incorporated to expert systems as well, allowing them to improve their performance based on experience, as humans do.