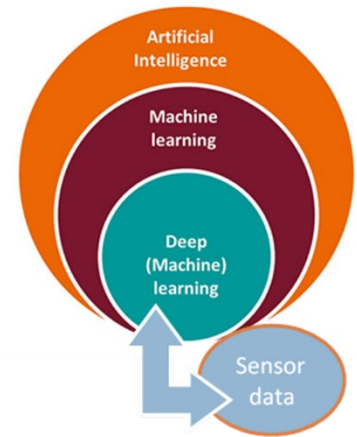


# SMART ROBOTICS: PART 2

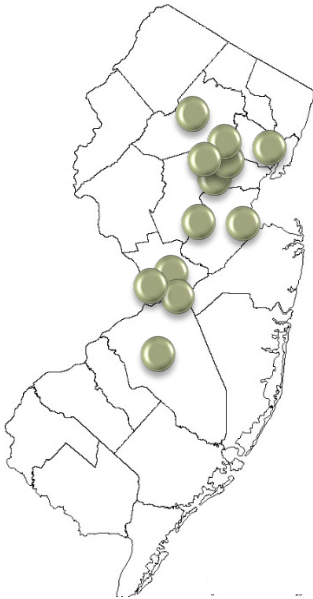
## SENSOR TECHNOLOGY AND MACHINE LEARNING

OCTOBER 2018 TECH BRIEF FOR ADVANCED  
MANUFACTURING TALENT NETWORK



### Part Two of a Two-Part Series

Sensor Technology is a New Jersey strength. The telegraph, telephone, transistor, read-only memory (ROM), charge-coupled devices and rudimentary software were invented in NJ. Fortunately for the economy and the labor market, New Jersey scientists and engineers continue to develop sensor technology. Industry Examples:



Sensor technologies include: bio, optical, infrared, linear position, rotary, pressure, signal condition, et al.

1. [Alliance Sensors Group](#), Moorestown
2. [ACCESS BIO](#), Somerset
3. GE Lifesciences' [Biacore](#), (originally) Piscataway
4. [Control Products Inc \(CPI\)](#), E. Hanover
5. [Frauscher Sensor Technology](#), Princeton
6. [Kulite Semiconductor, Inc.](#), Leonia
7. [Pendotech](#), Princeton
8. [Sensor Products Inc.](#), Madison
9. [Sensor Scientific Inc.](#), Fairfield
10. [SensorEdge](#), Parsippany
11. [Specto Technology](#), Linden
12. [TE Connectivity's](#) American Sensor Technologies, Budd Lake
13. UTC Aerospace Systems' [Sensors Unlimited Products](#), Princeton

Expanding this list to include control systems would further densify the map. Within the control systems, deep learning takes place.

Deep learning is the through-line between sensors, control systems, Big Data analysis techniques and [AI](#).

### Labor Force Takeaway

NJ is sitting on a gold mine. Sensors enable artificial intelligence (AI). The language that sensors speak within a control system enables machine learning.

Talent network directors could benefit their partner companies to add machine learning classes to the IVC. Training in machine learning would help manufacturers better understand customer needs. Even in the absence of deep mathematical expertise, an appreciation for machine/robotic learning will nurture this valuable segment of Advanced Manufacturing in NJ.

# An Economic Investment Opportunity – a workforce fluent in the fundamentals of AI.

Sensors produce electronic or optical signals. These signals constitute data that must be interpreted and acted upon. At this point we are in the realm of deep learning, machine learning and data science.

**Deep learning** (also known as deep structured learning or hierarchical learning and not to be confused with human learning) is part of a broad family of digitally-controlled machine learning methods. These are based on learning data representations, as opposed to task-specific algorithms.

Deep learning is a **class of machine learning algorithms** that use a waterfall methodology wherein each successive layer uses the output from the previous layer as input. That said, processing units may be nonlinear for feature extraction and transformation. Learning may be “supervised” (e.g., classification) and/or “unsupervised” (e.g., pattern analysis) or “reinforced” (e.g. reacting to setbacks or successes). Multiple levels of representations correspond to different levels of abstraction; the levels form a hierarchy of concepts.

Applications for machine learning include:

Automatic speech recognition Image recognition Visual art processing Natural language processing	Drug discovery and toxicology Bioinformatics Customer relationship management Recommendation systems	Mobile advertising Image restoration Financial fraud detection Military
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FIGURE 2 RAND CORP, SOPHIA LIANG, WWW.GRAPHICFOOTPRINTS.COM

Some of these applications involve Big Data. This is defined as a collection of data sets so large and complex it is difficult to process using classic database management tools. Big Data’s collection technologies include the Internet of Things (IoT), 5G wireless network data compression, distributed computing clusters and elegant reporting tools to distinguish supervised and unsupervised data elements.

It all starts with sensors. Experienced manufacturers know that the devil is in the details. The most severe vulnerabilities to hacking are at the deepest points in the digital chain of permissions. At the heart of AI are sensors and control systems. In a world where **spies trick cell phones** into thinking a listening device is a cell tower, **cyber-attacks can take down power stations**, the importance of maintaining the integrity of control systems is paramount.

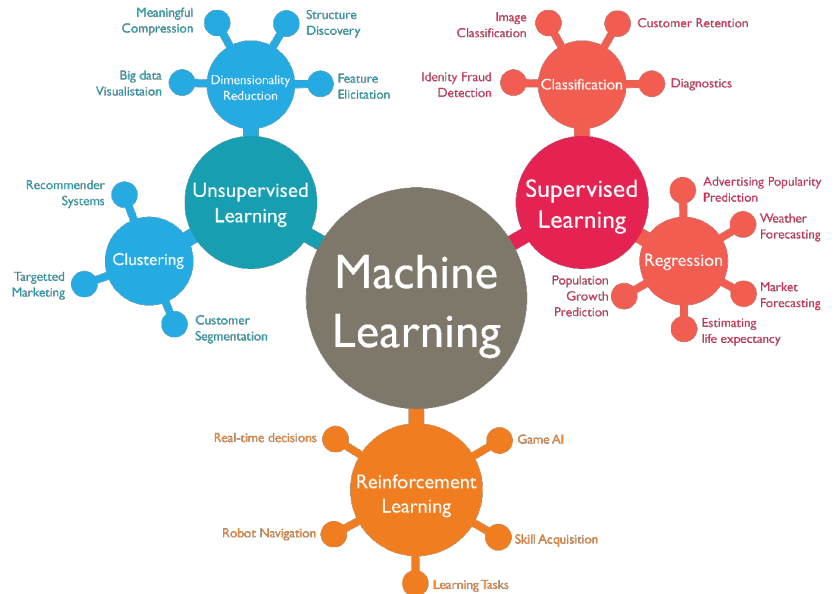


FIGURE 1: [HTTP://ISAZICONSULTING.CO.ZA/IMAGES/MACHINELEARNINGDIAGRAM.PNG](http://isaziconsulting.co.za/images/machinelearningdiagram.png)