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Insight to Action

Cognitive Computing: The next generation of computing

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Agenda

- What is cognitive computing?
- Where did cognitive computing come from?
- What are the foundational elements?
- How will cognitive computing be used in different industries?
- What will the future look like?

The Three Principles of Technology Transition

1. Revolutionary technologies take decades to evolve
2. Dramatic change happens when technology is mature enough and ubiquitous
3. Technology transitions can revolutionize industries

The bottom line: when these three principles converge innovation and revolutions happen

What is Cognitive Computing?

Cognitive Computing is the ability of humans and machines to collaborate by analyzing and correlating huge amounts of data.

*Cognitive computing is a problem-solving approach that uses **hardware** or **software** to approximate the **form** or **function** of natural cognitive processes.*

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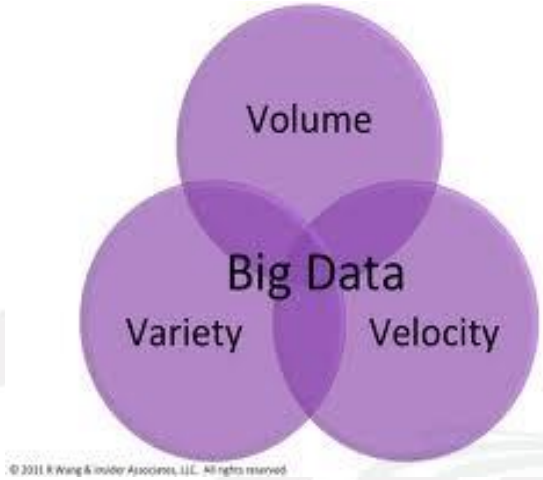
Definition of Big Data

- Volume:
  - ***Amount*** of data
- Variety:
  - ***Types*** of data - structured and/or unstructured
- Velocity:
  - ***Speed*** that data moves from one location to another
- Veracity:
  - ***Accuracy*** - do the results of the analysis make sense?



To be Useful Data Requires Context

- Big data sources need to be based on the context of how they are analyzed and used
- Determining patterns and anomalies in data is paramount
- Big data analytics are changing with the inclusion of machine learning algorithms
- The combination of big data,

Why traditional computing models are flawed

- Programs are designed based on logically assumptions about how the business operates
- Programs are not designed for changing business models or new data sources
- Data is ingested into systems after they are designed
- The programmer creates a system based on outcome assumptions

Bottom line: Traditional systems are based on the past and cannot anticipate the future

How is cognitive computing different?

- A cognitive system is designed based on data and letting the data lead to the logic
- A cognitive system changes and morphs as more data is introduced and analyzed
- A cognitive system learns from patterns and anomalies
- A cognitive system creates a model or representation of a domain based on understanding the context of a problem
- A cognitive assumes there is not a single correct answer. It is therefore probabilistic. It uses hypotheses based on the data.

Cognitive Computing is based on how the brain works

- Humans learn from observing their world and collecting and storing data
- Humans are able to make correlations based on small amounts of data
- Humans learn based on observations, reinforcement, and motivation

- Bottom line: the human brain is an amazing system of systems that cannot be easily replicated

How do Humans Learn?

- Experience
- Perception
- Memory
- Reasoning
- Conceptual development
- Deduction
- Inference

What is Machine Learning?

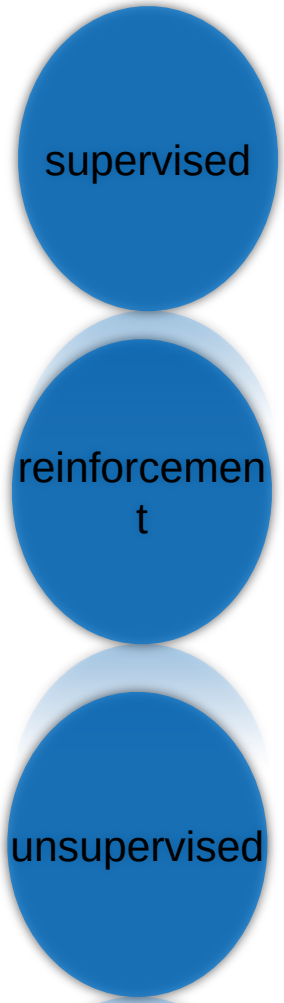
Machine learning is a discipline grounded in computer science, statistics, and psychology that includes algorithms that learn and improve their performance based on exposure to patterns in data rather than explicit programming

What are the initial applications for Cognitive Computing?

- Healthcare
- Legal
- Financial Services
- Manufacturing
- Smarter Cities
- Retail
- Travel
- Telcommunications
- Security and Threat Detection
- Marketing

Approaches to machine learning

- Learning by labeled example: supervised learning (works when you have specific examples such as spam detection or hotels for a travel application)
- Discovering patterns hidden inside a large amount of data: unsupervised learning (data from a large number of pictures of faces)
- Feedback based on understanding when an answer is right or wrong: reinforcement learning (playing a game and deducing the rules)



The system is *taught to detect or match* patterns
based on training data. Learning by example.

The system *learns/develops strategies*
based on performance feedback.

An unsupervised learning system *discovers* patterns based on experience.

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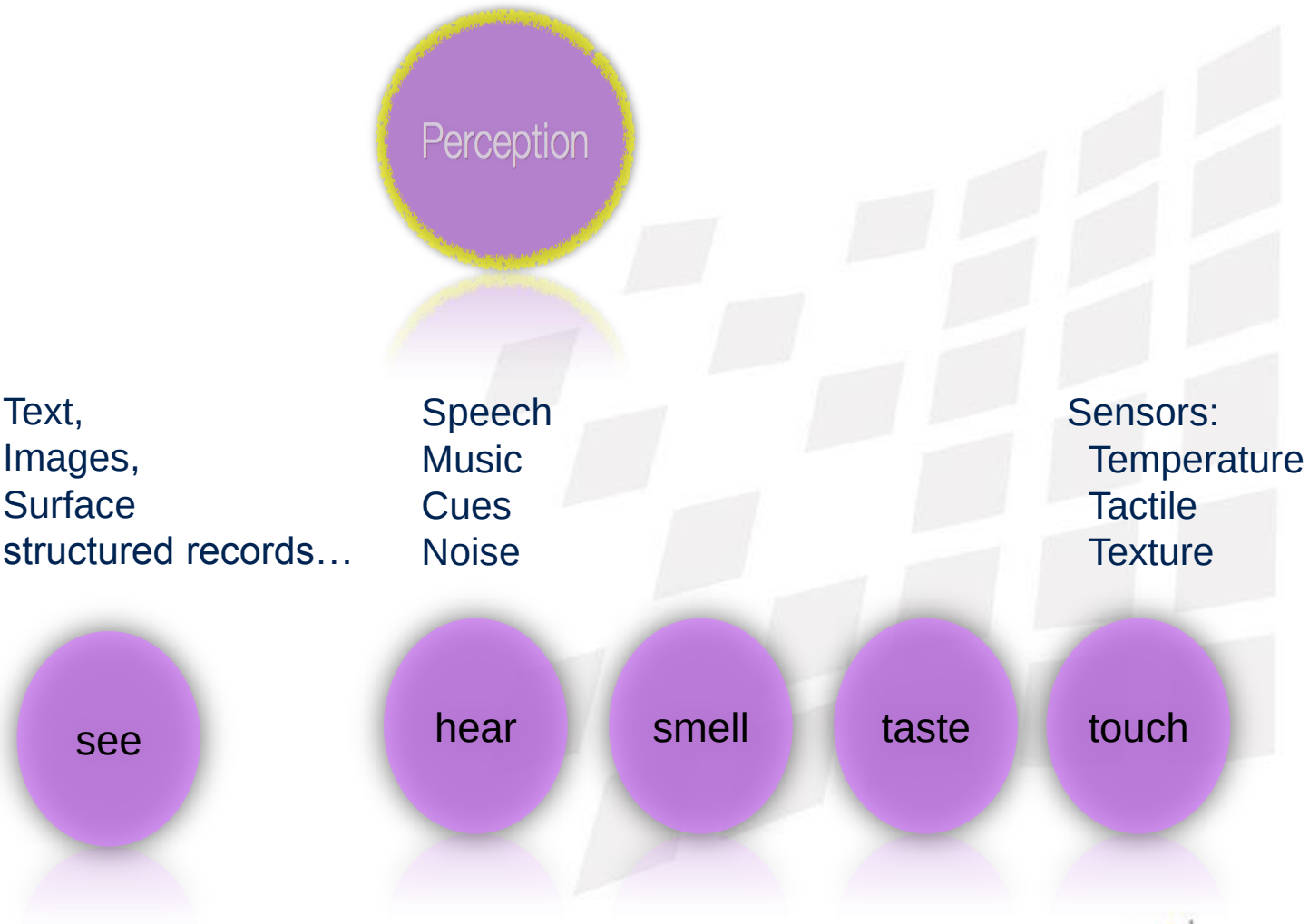
Deep Learning

- A sophisticated model of machine learning that is intended to solve complex problems by using sophisticated layers of abstractions and parallelism to learn and model data similar to how the brain functions.
- It is being used in many of the emerging applications where there is complex data from many different sources that needs to be analyzed at great speed. This would include applications in security and drug discovery.

Perception is a key requirement for cognitive computing

- How do we sense/recognize data in the outside world?

Some data structures are easier to understand than others



Elements of a Cognitive System

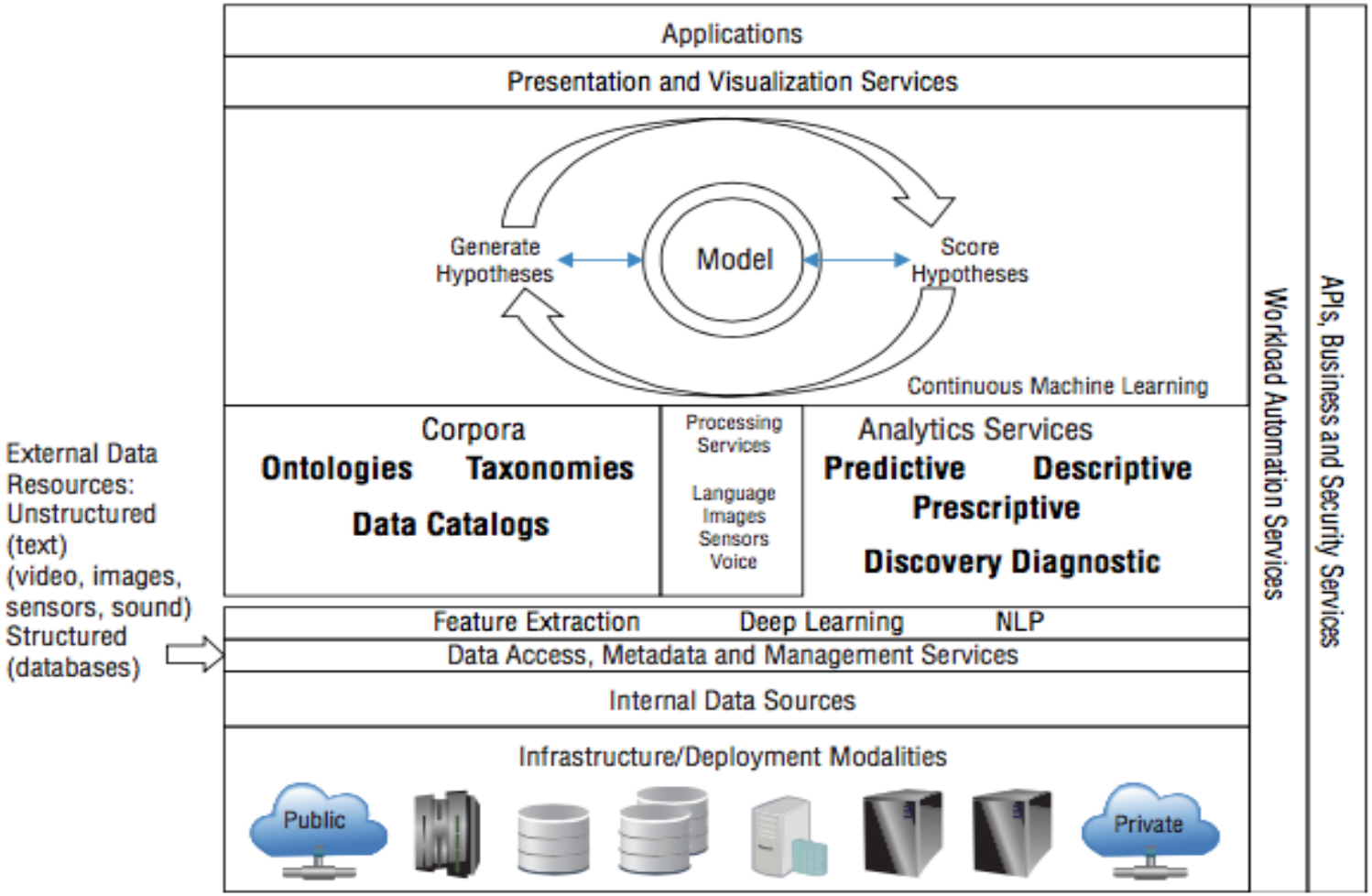


Figure 1-2. Foundations of Cognitive Computing for Smarter Cities
from Cognitive Computing and Big Data Analytics, Hurwitz, Kaufman & Bowles, 2015

How companies are preparing to build solutions

- Select a domain
- Choose a machine learning model
  - Supervised learning when you know the key attributes and sources of training data (you have a marketing goal with the specific types of data you need)
  - Reinforcement learning when you see if the results of the actions supported by the data have the impact you want (results from playing a game)
  - Unsupervised learning to understand patterns where you can't anticipate the outcome (drug discovery)
- Identify important initial data sources
- Build or Buy a solution

The Lifecycle of Knowledge Management

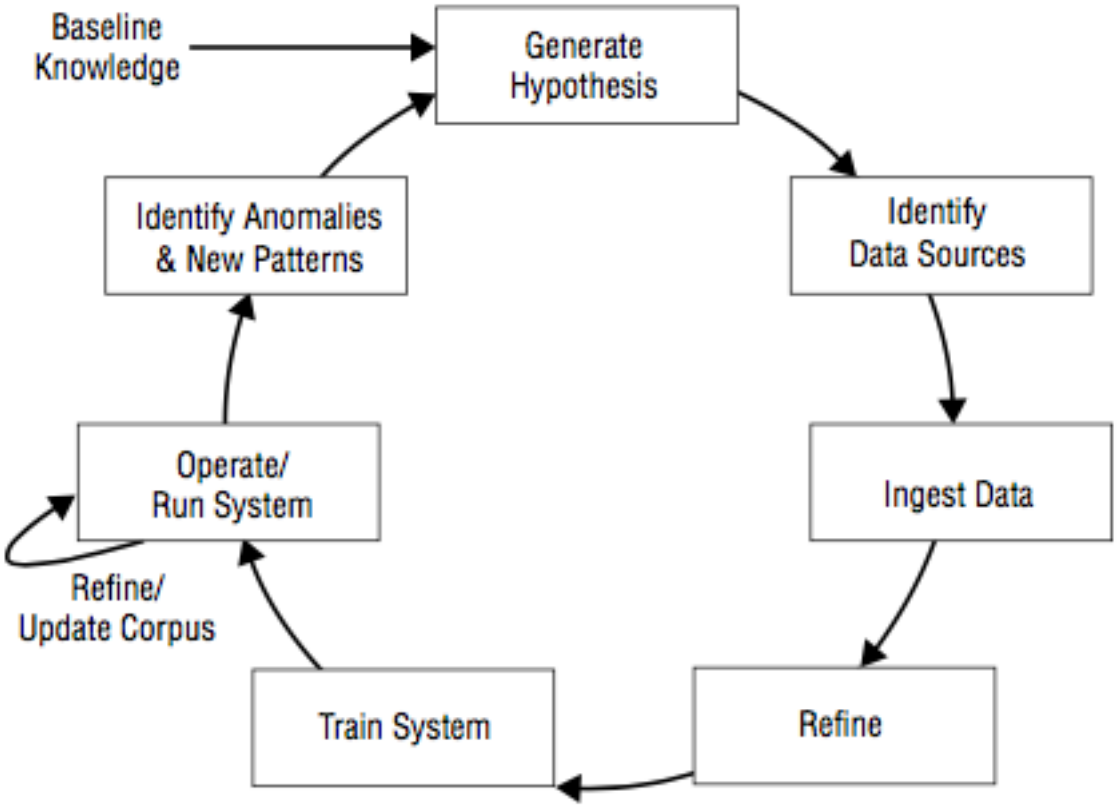


Figure 14-1. Foundations of Cognitive Computing for Smarter Cities
from Cognitive Computing and Big Data Analytics, Hurwitz, Kaufman & Bowles, 2015

How companies begin to experiment

- Choose a primary machine learning model
  - for general supervised learning, identify the attributes and sources
    of training data for reinforcement learning, identify events/states that need to be reinforced (positive or negative); for unsupervised learning, identify discovery parameters
- Identify the data sources
- Define a hypothesis
- Train and test and determine the impact of results

The Transition to a connected technology world

- Shifting away from the programming paradigm
- Emerging technology as the secret sauce of business innovative
- Transforming the customer experience

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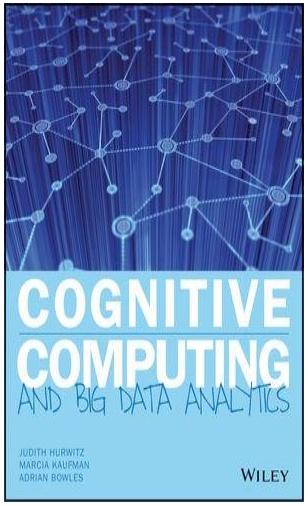

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