INTELLIGENT TODAY, SMARTER TOMORROW:

Machine Learning in Widex Evoke

SPEAKER DISCLOSURE (JAMES W MARTIN, JR)

- Relevant Financial Relationships:
  - Is an employee of Widex USA and receives financial compensation.
LEARNING OBJECTIVES

- After this course learners will be able to describe the basic differences between supervised, unsupervised and reinforced machine learning.

- After this course learners will be able to describe how the first real-time machine learning application functions within a hearing device.

- After this course learners will be able to list two examples of how incorporating real-time machine learning in a hearing device is paving the way for better hearing personalization for end-users and the potential for less follow up for HCPs.

AGENDA FOR COURSE

- What is Artificial Intelligence?

- What is Machine Learning?

- Growth of Machine Learning:

- How Do Humans Learn?

- How Do Machines Learn?
  Application of Machine Learning

- First Real Time Machine Learning Application in a Hearing aid
WHAT'S YOUR PREFERENCE?
MOVIE #1

BRIEF HISTORY:

- 1950 - Alan Turing published paper “Computing Machinery and Intelligence” and proposed via the Turing test that a computer is thought to be intelligent if a human judge can’t tell whether he/she is interacting with a human or machine.
- 1956 - John McCarthy coined the phrase “Artificial Intelligence.”
- 1956 - Dartmouth Academic Conferences – computer scientist rallied around the term AI and birthed the field of AI.
- 1960-1980 - AI research Flourishes but technology not ready to implement concepts.
This course is presented in partnership with continued.
WHAT IS MACHINE LEARNING

- “Machine Learning is a scientific discipline that addresses the following question: ‘How can we program systems to automatically learn and to improve with experience? Learning in this context is recognizing complex patterns and making intelligent decisions based on data’”

- Machine Learning systems use algorithms that uncover knowledge from data and experiences based off of statistical and computational principles. Using these algorithms allow a system to accomplish many task such as:
  - Vision to Language processing
  - Pattern Recognition
  - Data Mining
  - Robotics.

WHAT DOES DATA LOOK LIKE?
WHAT DOES DATA LOOK LIKE?

BIG DATA AND THE CLOUD
WHAT CONCERNS STILL NEED TO BE ADDRESSED?

1. People are still struggling to hear in some of their real-life listening scenarios.

2. Clinicians are struggling to fine tune and modify the fitting in order to resolve the stated concerns the wearer is describing.
MEETING PATIENTS **WHERE THEY ARE**

Assumption  
Attention  
Motivation  
Intention

EVOKE CHIPSET SYSTEM  
DISTRIBUTED COMPUTING

Flexible Core  
Accelerated Core  
Widex Cloud

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Automation

Artificial Intelligence

Machine Learning

LEARNED vs LEARNING
Why Now?

• Todays smartphones have the Computing power of Laptop computers

• Increase in available algorithms and theories by machine scientists.

• More available data due to advancements in internet, distributed computing and the Cloud.

WHY USE MACHINE LEARNING?

• To develop systems (algorithms) that can automatically adapt and customize themselves to individual users.
  e.g. Personalize to user preferences

• Allows us to discover new knowledge from users data/preferences.
  e.g. Drink machine combinations and creations.
GROWTH OF MACHINE LEARNING
APPLICATIONS OF MACHINE LEARNING

FACIAL, VISUAL, AUDITORY RECOGNITION
HOW DO HUMANS LEARN?
The Four Human Learning Modalities

1. **Visual Preference**
   - Learns best through demonstration
   - 60% of students are visual learners

2. **Auditory Preference**
   - Learns best through Verbal instruct
   - Learn easiest through Listening

3. **Tactile Preference**
   - Learn best when they take notes during lectures or when reading something new or difficult
   - Learn easiest with hands-on activities

4. **Kinesthetic Preference**
   - Learn best when they are involved and active
   - Learn easiest when doing rather than watching or listening
The Three Ways Machines Learn

1. **Supervised Learning**
   - Learning guided by human observations and feedback from known outcomes (Training). e.g. Teacher/student

2. **Unsupervised Learning**
   - Learning relies exclusively on clustering data and modifying its algorithm (recipe) to its initial findings – all without the external feedback of humans. e.g. student alone learning

3. **Reinforced Learning**
   - Learning that is established over time via trial and error. e.g. baby learning to walk, video gaming (PacMan)

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**TAKE THE FOLLOWING TEST**

1: [0,0]  
2: [3,6]  
3: [6,12]  
4: [9,18]  
5: [12, ?]
TAKE THE FOLLOWING TEST

1: [0.0, .01, .38, .56, 1, 1.7, 2.9]
2: [3, 3.2, _, 4.1, 4.3, 4.6, 5.1]
3: [6, 6.3, 7.1, 8.3, 8.7, 8.8, _]
4: [9, 9.1, 9.7, 9.8, 10.1, _]
5: [11.7, 11.8, 12.3, _, 13.3]

LISTENING INTENTION

\[ X_{new} \]

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THE EFFICIENCY OF MACHINE LEARNING

13^3 = 2197
2197 * (2197 - 1) / 2 = 2412306
2412306 comparisons

Personalization Within Moments

EFFORTLESSLY GUIDES THE USER TO THE PERFECT SOUND
MOVIE #2

PERSONAL PREFERENCE

Individual Preferences in Real-World Environments Vary Based on Setting and Intention.

Field Trial Programs Created from SoundSense Learn Settings
WHAT ARE END-USERS SAYING?

“I was at a department lunch for more than 25 people. For the first time I was able to hear and understand all the comments from the Department Head, as well as more of the comments from around the table than before!”

“While sitting in the lounge with my children I can hear even more of what they say to each other, as well as hear the television - a revelation!”

“I managed to create a program at the swimming pool just prior to my son’s swimming lesson. This allowed me to have conversations with other parents, and my son’s swimming teacher, whilst largely excluding the ‘water’ sounds and the many ‘echoing’ sounds of the children having fun. Really wonderful, and so much less stress.”

PROOF OF BENEFIT

SUBJECTIVE IMPROVEMENT IN BOTH COMFORT AND SOUND QUALITY

Continuous Quality Scale

- Sound Quality
- Comfort

Classifier not active  Classifier active  SoundSense Learn
THREE ASPECTS OF MACHINE LEARNING

- **Induction First**: Real-time user-driven learning
- **Cloud-based Networked Learning**: Cloud-based networked learning
- **Gradual Long-term Learning**: Gradual long-term learning

**SoundSense Learn**

**SoundSense Adapt**

SOUNDSENSE ADAPT
Hearing Has Evolved!
A Symbiotic collaboration between clinicians and machines is now part of our industries future. A HCP will NOT be replaced by technology; however, HCP’s who don’t understand, use and incorporate technology into their practices will be out performed by those who do!

~James Martin

SOUNDSENSE LEARN
• Industry First Real-time Machine Learning
• Cloud-based Networked Learning

INTELLIGENT TODAY, SMARTER TOMORROW
THE POSSIBILITIES ARE ENDLESS
AND WIDEX IS BUILDING IT NOW!