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5TH ANNUAL

Industry Innovations Summit

presented by AudiologyOnline

Webinar FAQs

Deep Neural Network: The Cutting Edge of AI in Hearing Aids

Luis Camacho, Au.D.

How to Ask a Question

Click Q & A, type your question, and Send

Where to get the handout

A PDF handout for this presentation may be accessed through your Pending Courses on Audiology Online or by clicking on the link in Chat within the classroom

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Use the Q&A window

Risks and Benefits

The applicability and accuracy of the course content may vary by the clinical, geographical, and cultural context; you should evaluate the course accordingly.

As healthcare is rapidly evolving, new findings may change the validity of the information presented in this course. Providers should always consult the latest research and guidelines from professional associations.

The interventions discussed in this course may be limited in generalizability, requiring practitioners to consider specific individual and population factors.

The course may not cover all possible risk factors, diagnostic methods, or treatment options, and complex cases may require additional considerations.

Healthcare providers should apply cultural competence and sensitivity to ensure effective and respectful care based on their patients' diverse needs.

Providers should always evaluate the limitations of diagnostic and screening tools, considering their potential for false results as well as any ethical implications.

It is the responsibility of course participants to critically evaluate the evidence from multiple sources to guide professional practice.

Learning Outcomes

1

Attendees will know the definition of Deep Neural Network

2

Attendees will know the benefits of Edge Mode+ to the patient

3

Attendees will know the exercises that make up the balance assessment process

Reminders

Evidence-Based

All CE courses on continued.com must be evidence-based.

In evidence-based continuing education sessions, the presenter provides:

- The best available, current, scientific evidence to support a particular practice or guideline which can include exploratory or pilot study data and the related evidence
- Information about his/her clinical expertise, expert opinion, and experience in this topic area
- Information related to client/patient/caregiver values.
- An indication of the level of evidence (e.g., systematic review, randomized control trial, cohort study, expert opinion, etc.) for each piece of evidence presented, ensuring clarity on the strength and reliability of the supporting data.

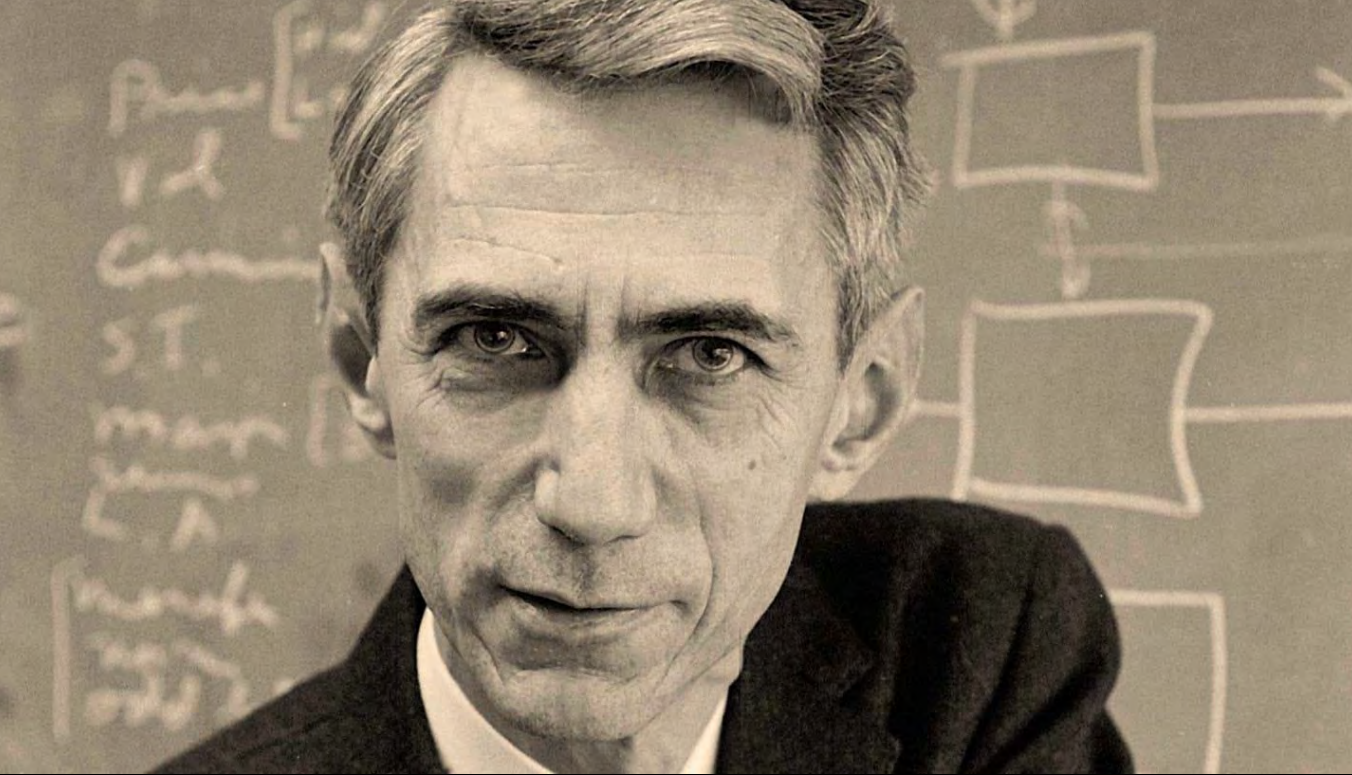


Deep Neural Network The Cutting Edge of AI in Hearing Aids

Luis Camacho, Au.D.

Manager of Education & Training





The Dartmouth Workshop

1956

“...features of *intelligence* can be so precisely described that a machine can be made to *simulate* it...”

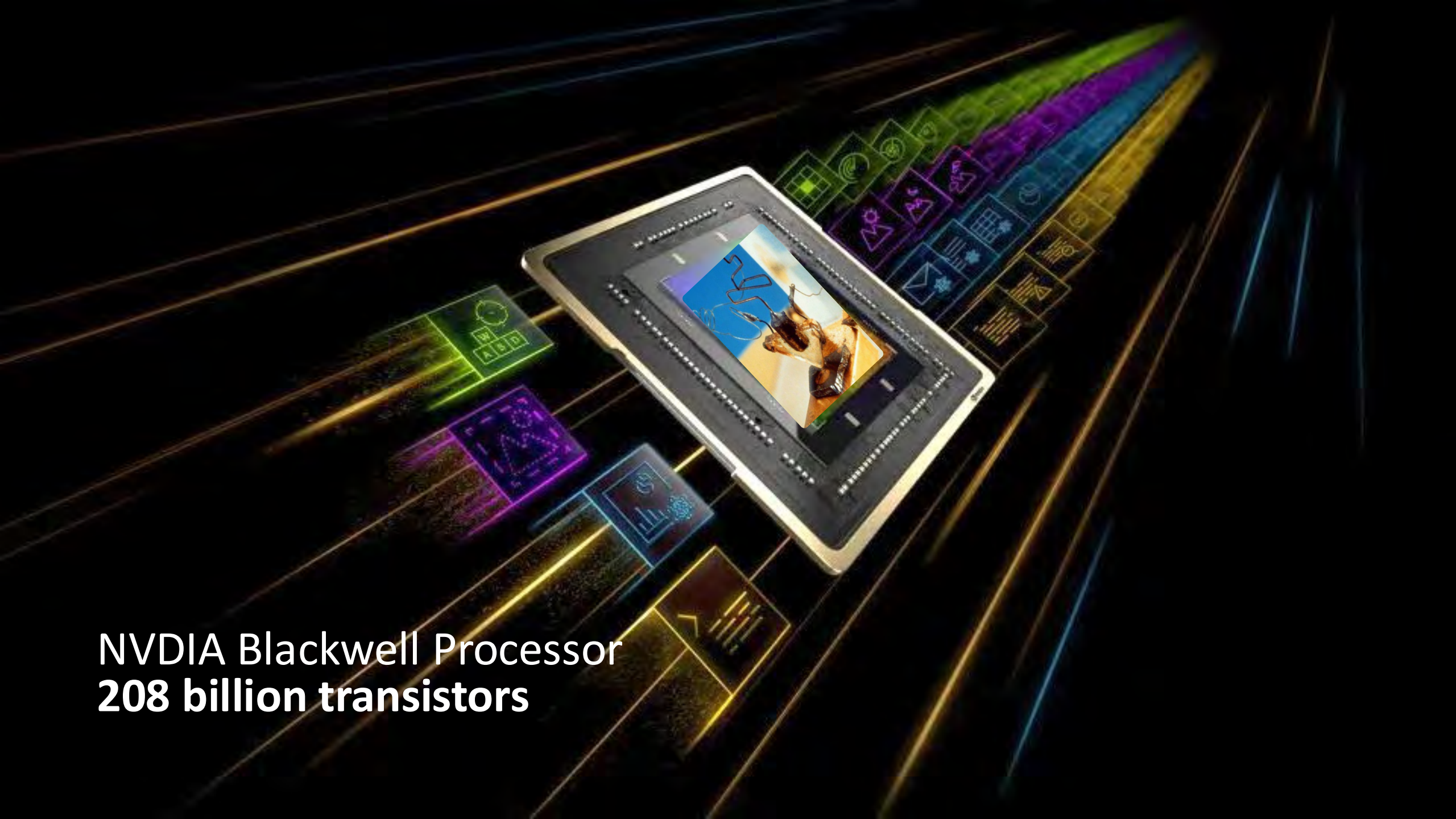
McCarthy, Minsky, Shannon + others



The human brain is a
GIANT NETWORK
of interconnected neurons





The image features a central NVIDIA Blackwell processor chip, which is a square integrated circuit with a gold-colored lead frame. The chip's surface is dark, and it has a central square area that appears to be a micro-display or a sensor, showing a detailed image of a scorpion. Surrounding the chip are numerous glowing, semi-transparent icons representing various AI and machine learning concepts, such as neural networks, data flow, and specific AI models like GPT and DALL-E. These icons are arranged in a dynamic, flowing pattern that radiates from the chip, set against a dark background with streaks of light, suggesting high-speed data processing and advanced technology.

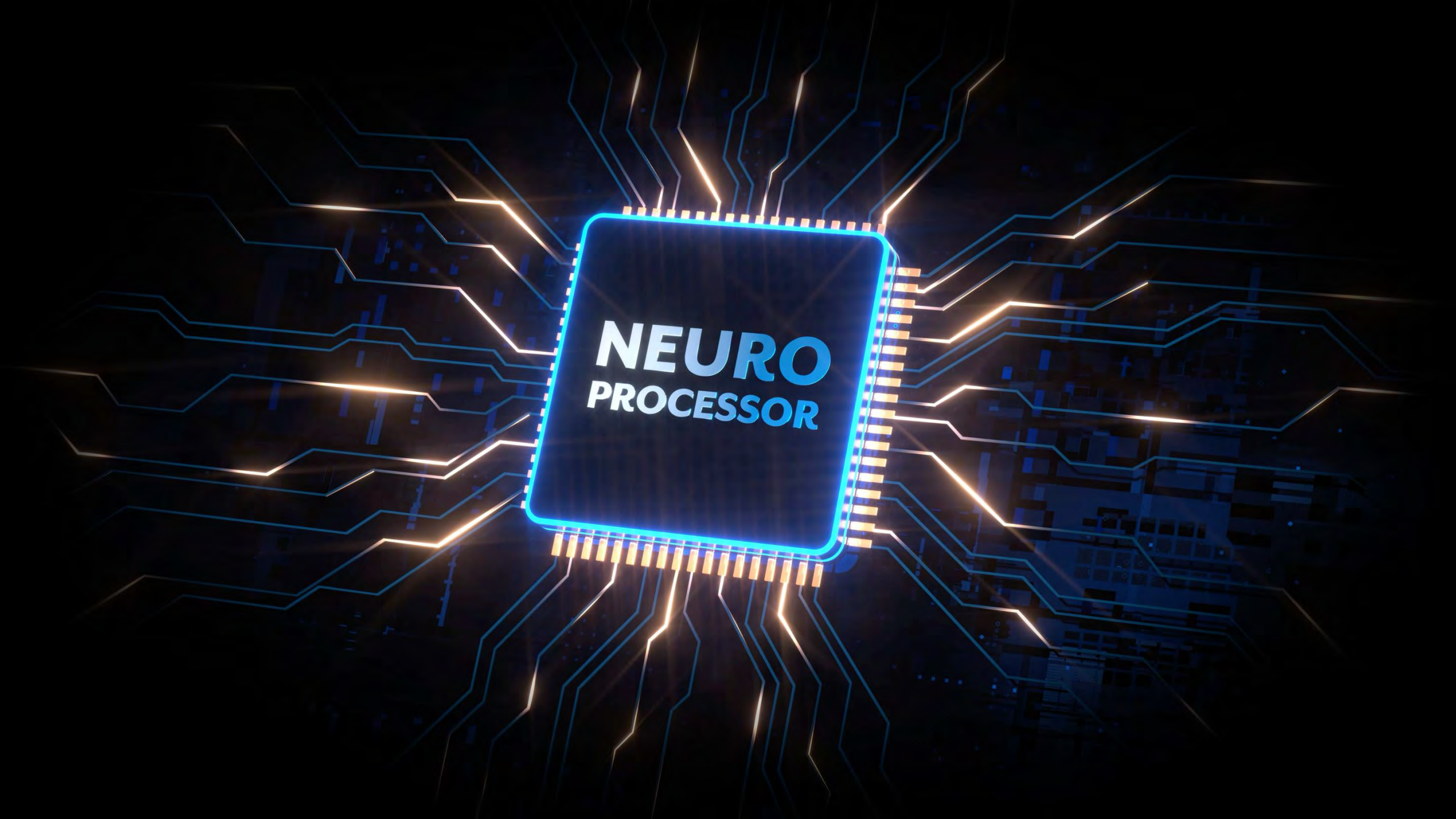
NVIDIA Blackwell Processor
208 billion transistors



NVIDIA Blackwell GPU
15 Trillion transistors







**NEURO
PROCESSOR**



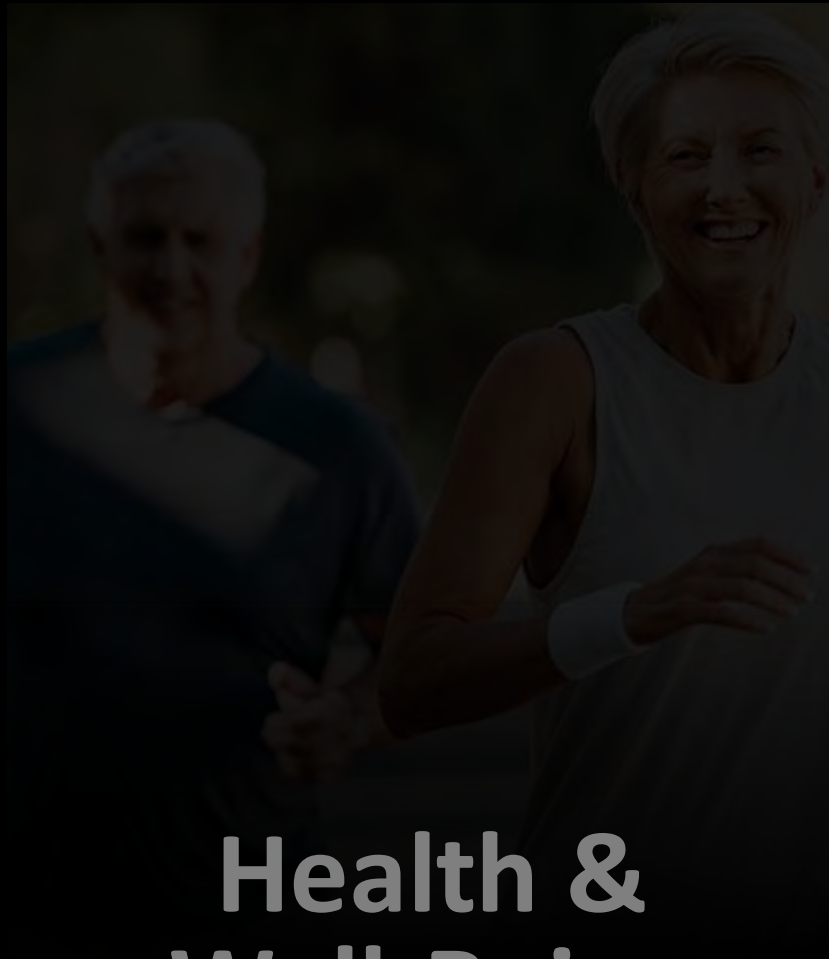
Transforming *Hearing Aids* into Multifunctional Devices with *Artificial Intelligence*



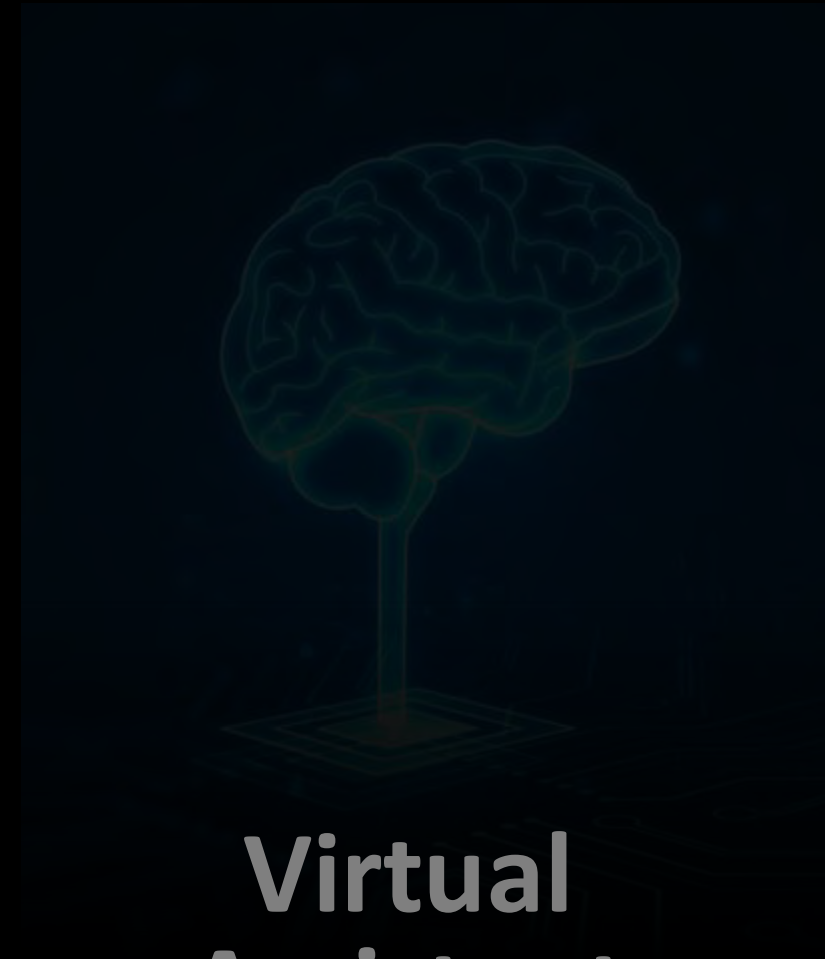
Transforming *Hearing Aids* into Multifunctional Devices with *Artificial Intelligence*



**Better
Hearing**



**Health &
Well-Being**

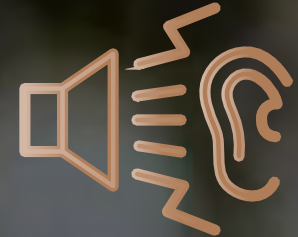


**Virtual
Assistant**

Top Drivers of Hearing Aid Performance and Sound



Natural
Sounding
Rich and Clear



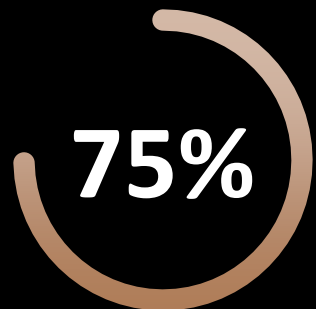
Comfort for
loud sounds



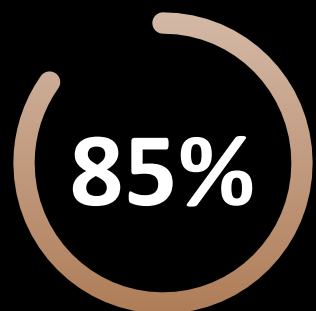
Minimize
background noise



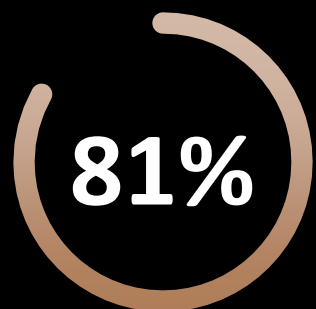
Ability to
tell direction



Stated that the **professional** played an important role in their satisfaction and benefit with hearing aids



Satisfaction with ***physical aspects*** of hearing aids (fit, comfort, size, appearance, reliability, etc.)



Satisfaction with ***sound quality*** of hearing aids (noise reduction, naturalness, clarity, feedback, etc.)

Least satisfied with noise reduction capability (**77%**)

Hearing Aid Satisfaction

Understanding speech in difficult listening environments remains a challenge for hearing aid users

Picou EM. Hearing Aid Benefit and Satisfaction Results from the MarkeTrak 2022 Survey: Importance of Features and Hearing Care Professionals. Semin Hear. 2022 Dec 1;43(4):301-316.

Percent of hearing aid owners satisfied with ability to hear in each listening situation

1:1 conversation	83%
Workplace	82%
Small group conversation	78%
Outdoors	77%
Shopping	77%
Car	76%
Large group conversation	72%
Conversation in noise	72%
Large lecture hall	72%
Classroom	70%



Sound is
personal





“We don’t hear
only with our ears.
**We hear with
our brain.**”



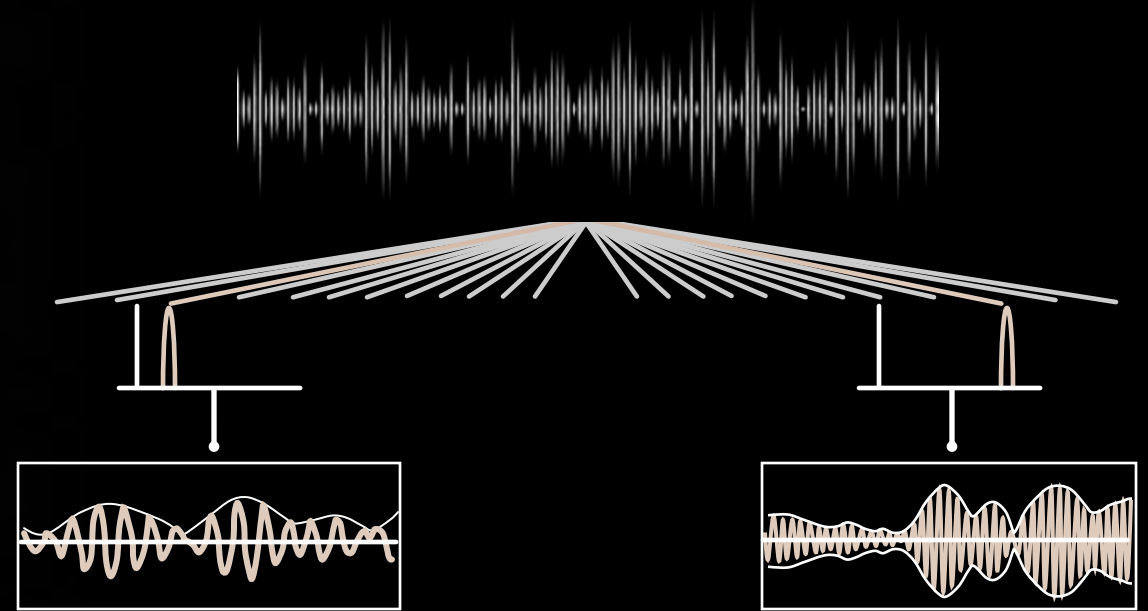
“We don’t hear
only with our ears.
**We hear with
our brain.”**



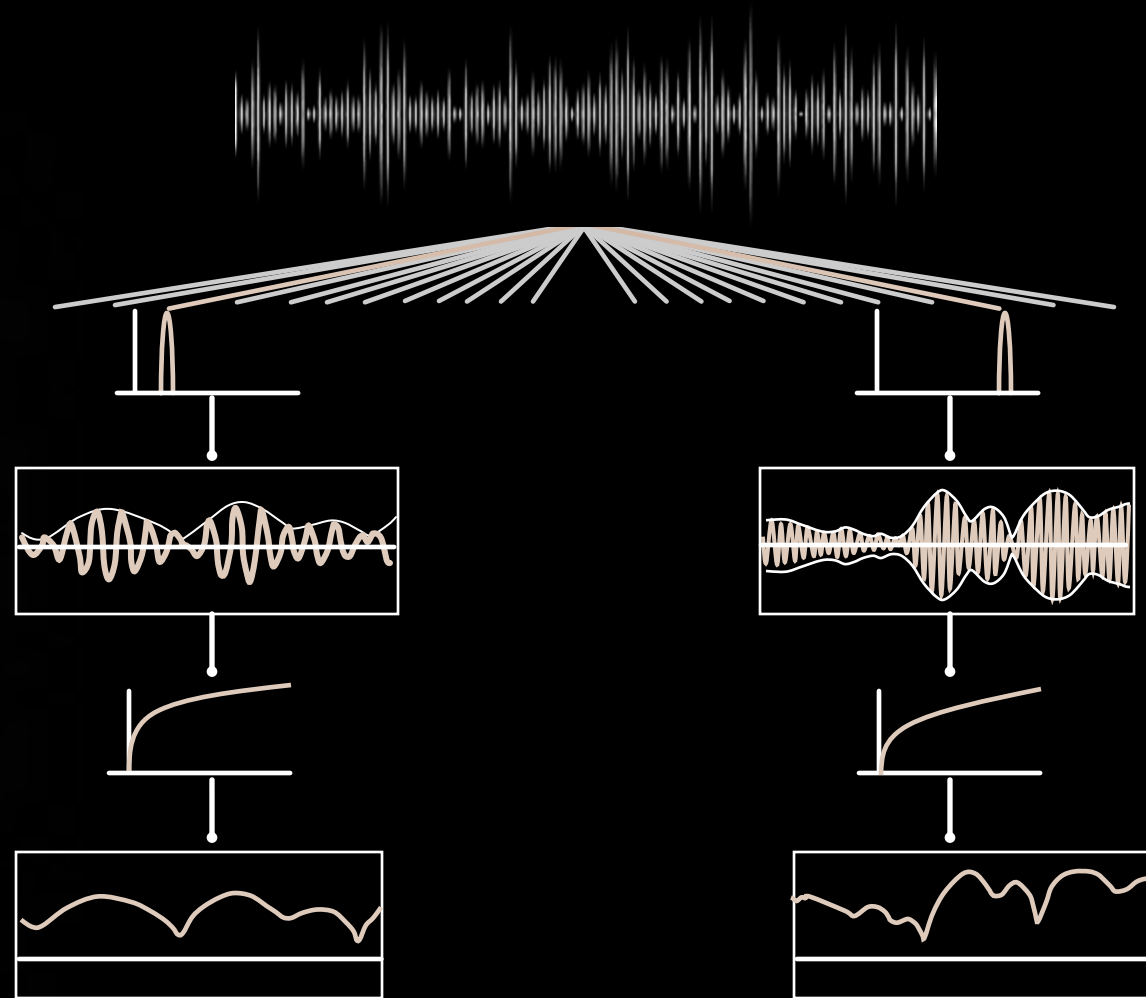
“We don’t hear
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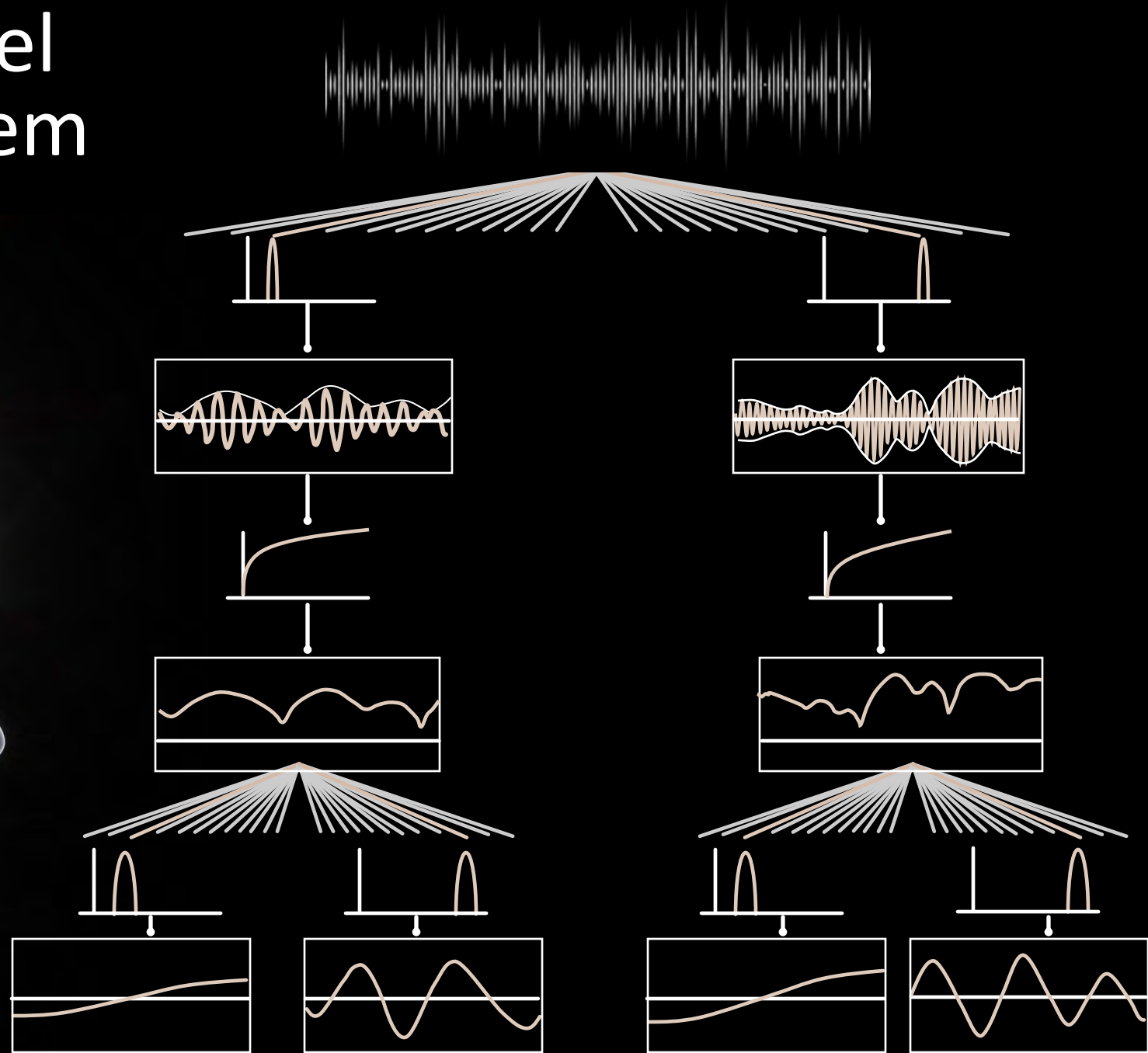
Computational Model of the Auditory System



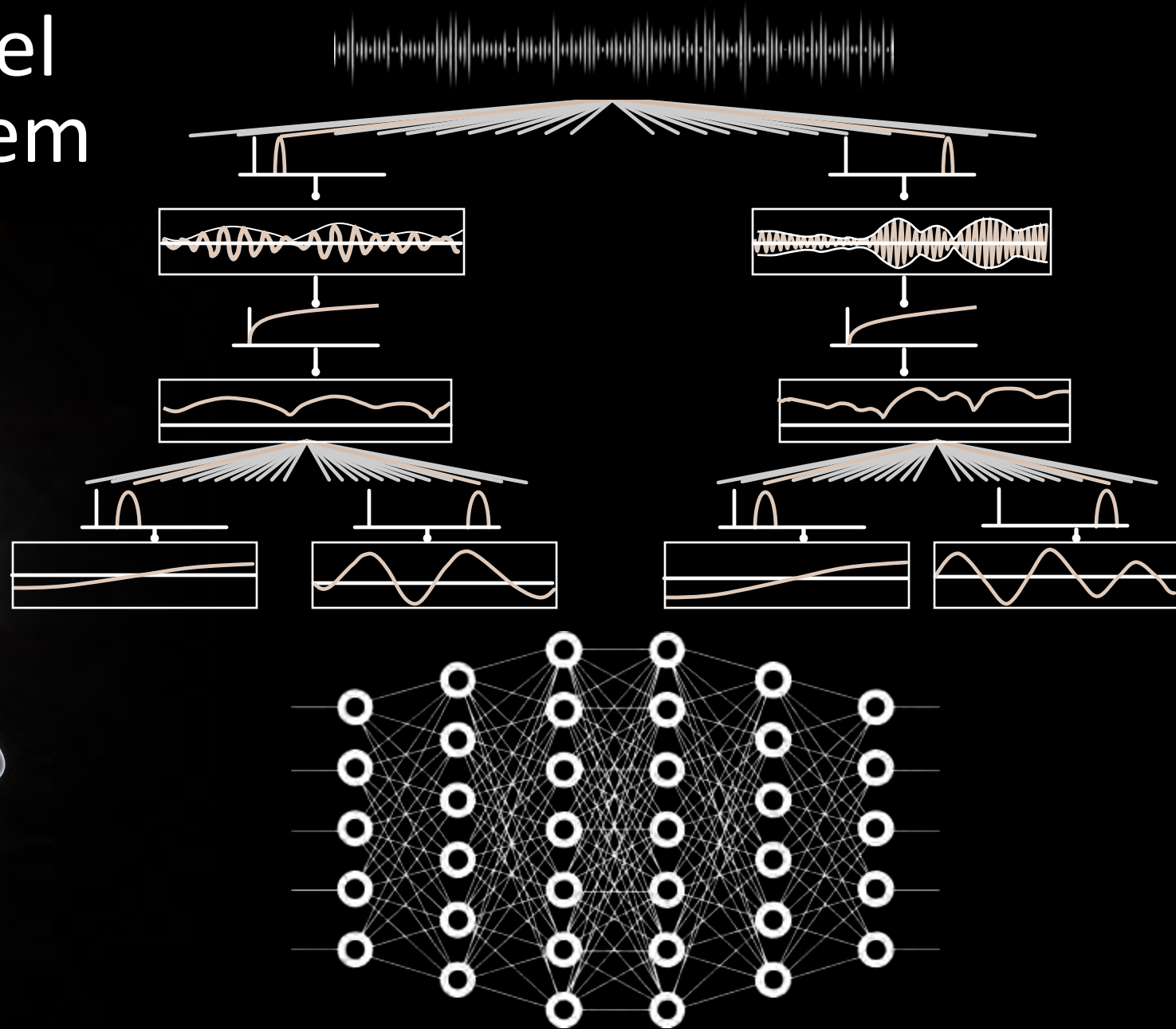
Computational Model of the Auditory System



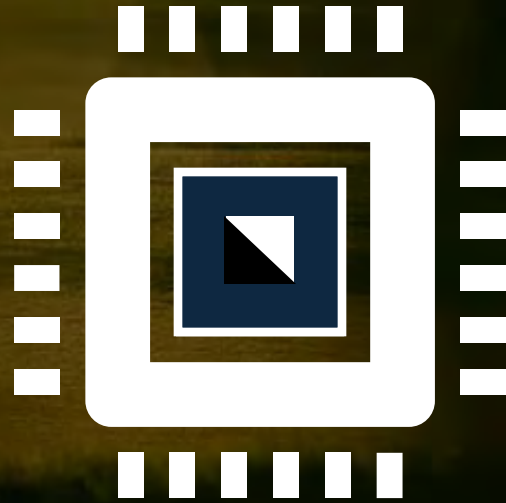
Computational Model of the Auditory System



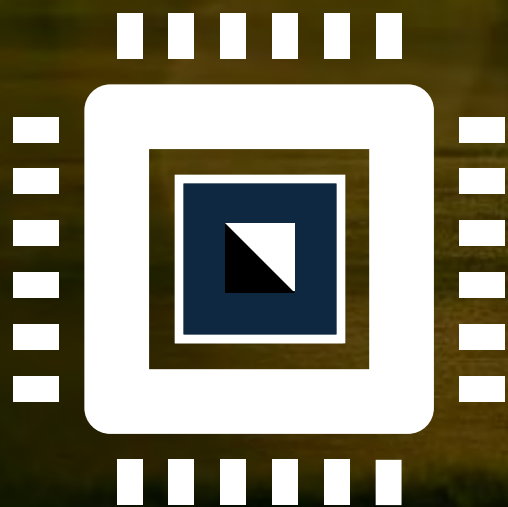
Computational Model of the Auditory System



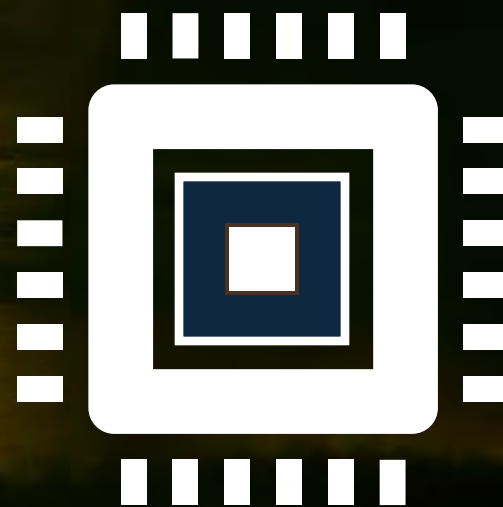
CORTICAL PROCESSING



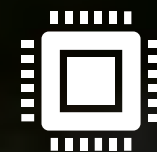
Embedded DNN

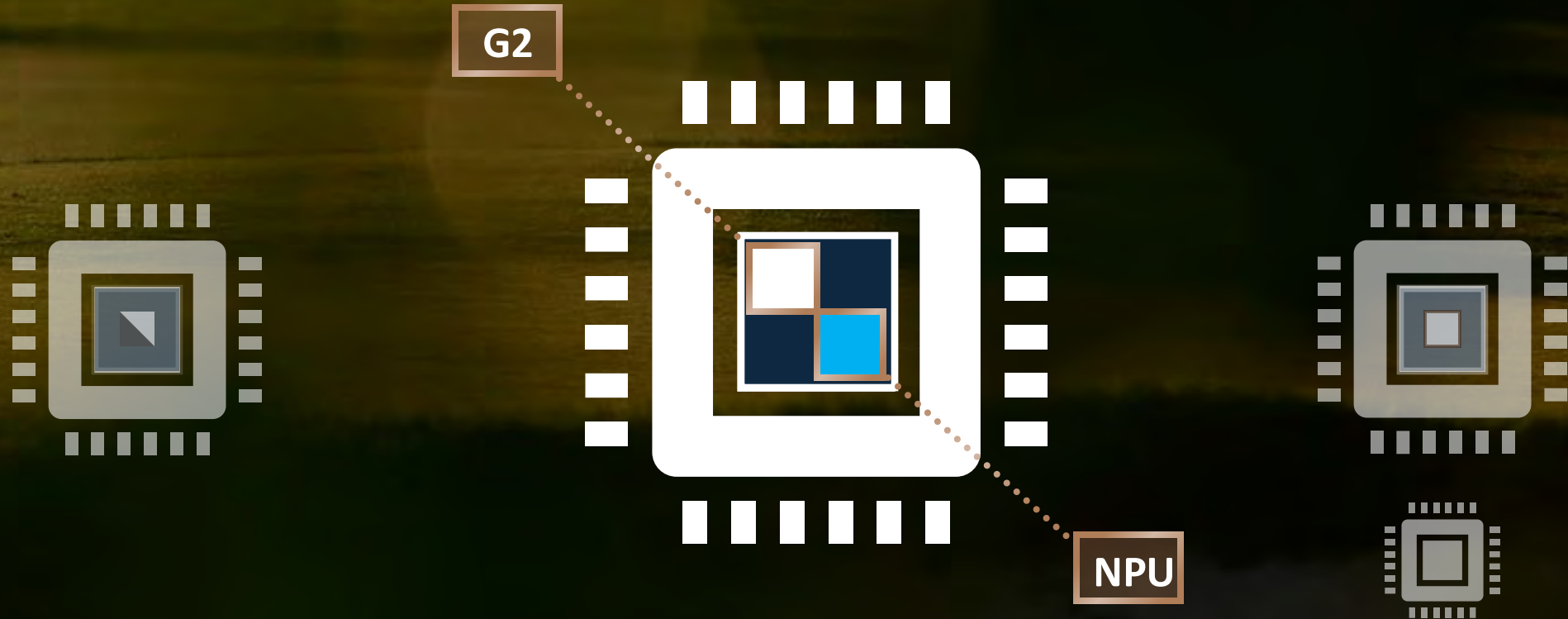


Embedded DNN



Dedicated AI chip





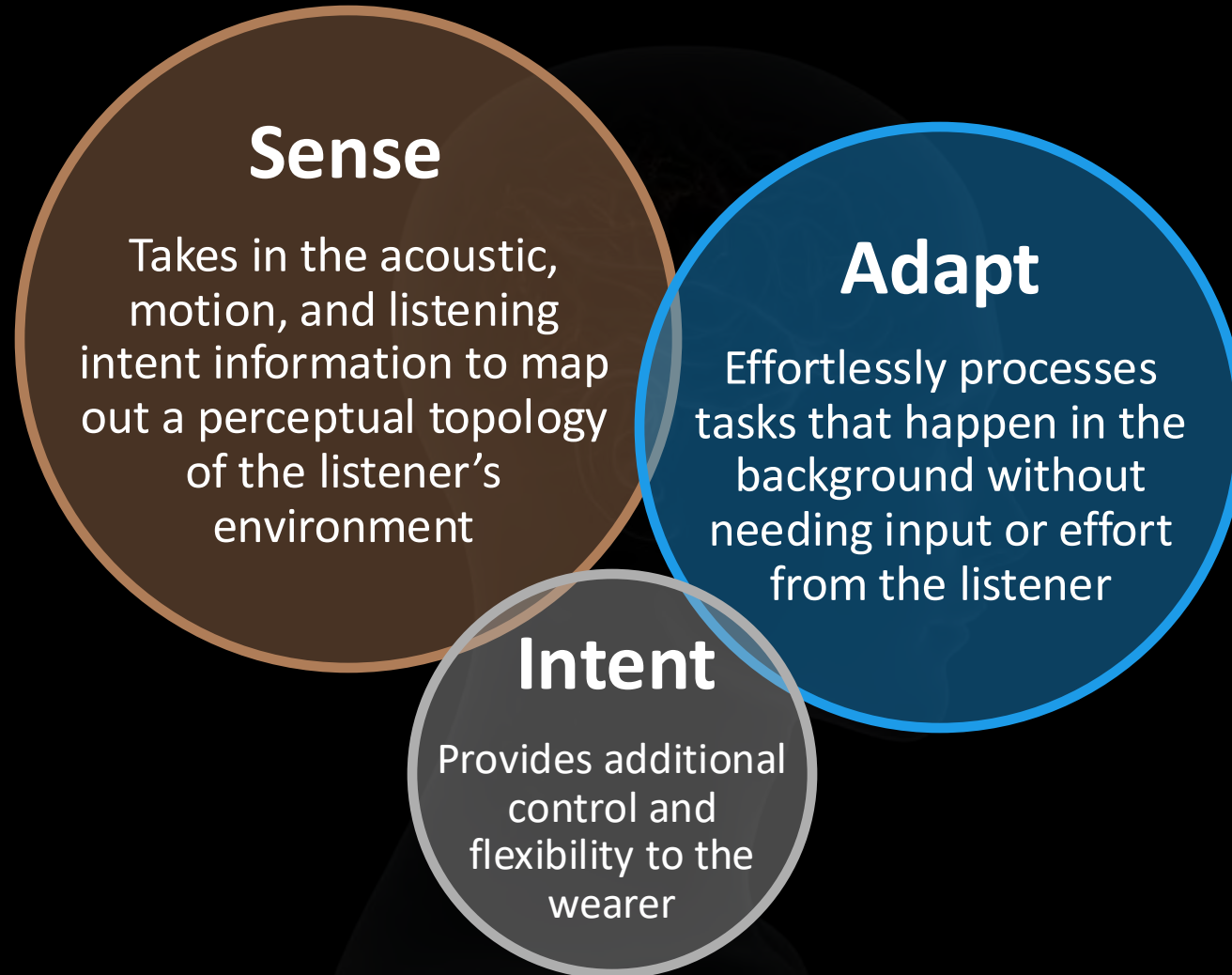
Embedded DNN

Integrated Neural Processing Unit (NPU)
dedicated to DNN processing, runs in
parallel with our G2 Neuro Processor

Dedicated AI chip

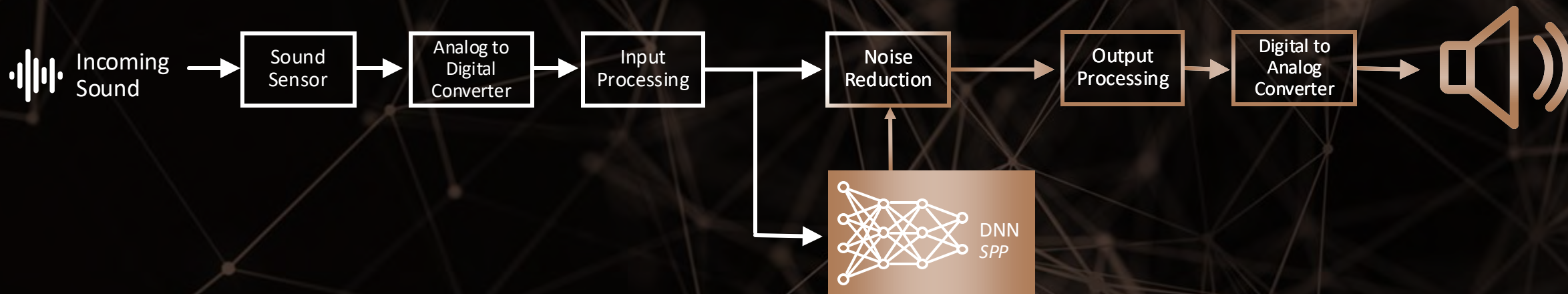
Mimic the human brain

To better replicate how a “normal” hearing system works



Edge AI Conventional Noise Reduction

Always on DNN



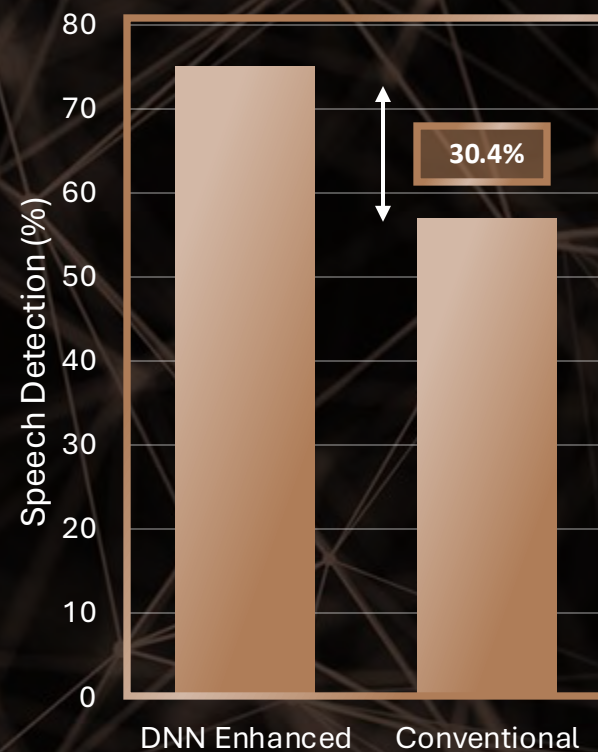


In

NEURO
PROCESSOR

Out





The DNN-enhanced algorithm is 30% better than legacy modulation-based approaches for speech in noise, when tested using 12 common noise types



**APPROPRIATELY CLASSIFIES
MULTI-TALKER BABBLE**

13^{UP TO}_{dB} SNR
IMPROVEMENT
IN NOISY ENVIRONMENTS



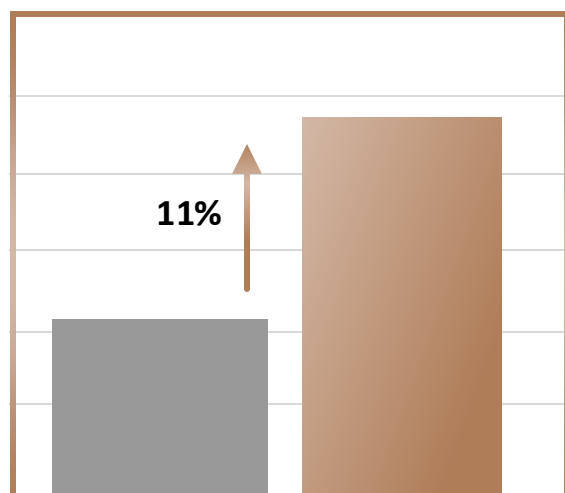
Edge Mode+

On-demand ability to zero-in on
speech in challenging environments



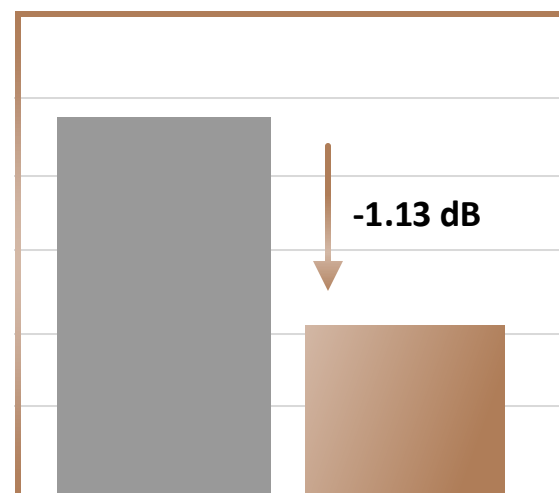
**Edge Mode+ has been shown to
improve speech recognition
and decrease listening effort**

Word Recognition Score



Default Settings Edge Mode+ Enhance Speech

Listening Effort SNR

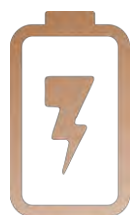


Default Settings Edge Mode+ Enhance Speech

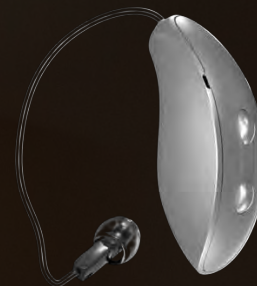
Edge Mode+

Utilizes the integrated Neural Processing Unit to process the environment and uses AI to select the best settings based on that sound scene

The user can further clarify their intent to enhance speech or reduce noise

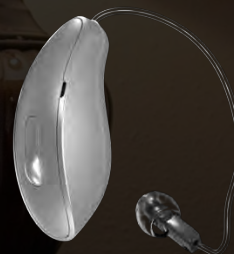


**The industry's
longest lasting
battery life**

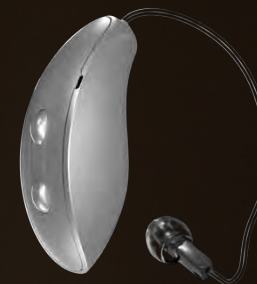


RIC RT up to
51 hours

CROS up to
29 hours



mRIC up to
41 hours



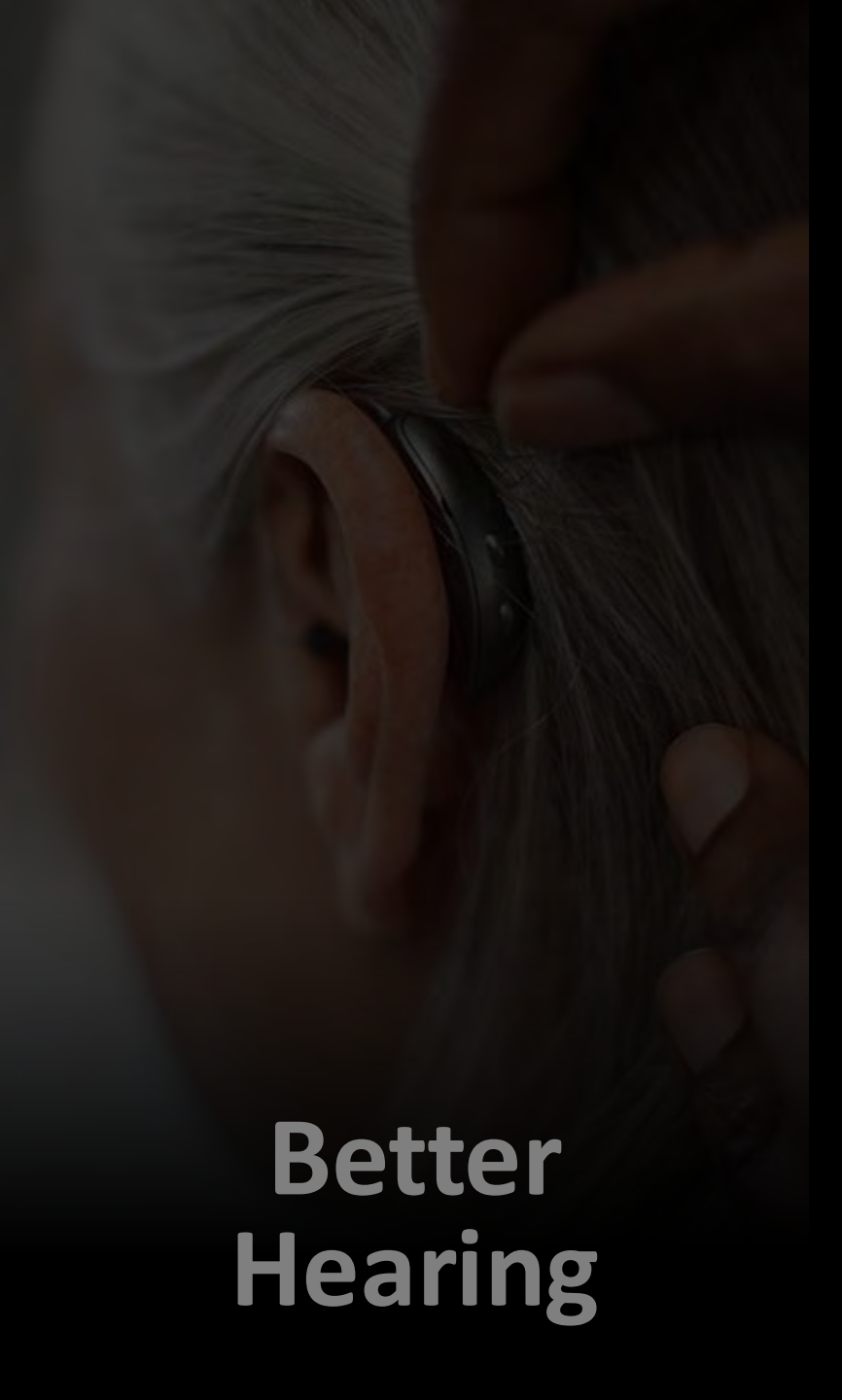
RIC 312 up to
6 days



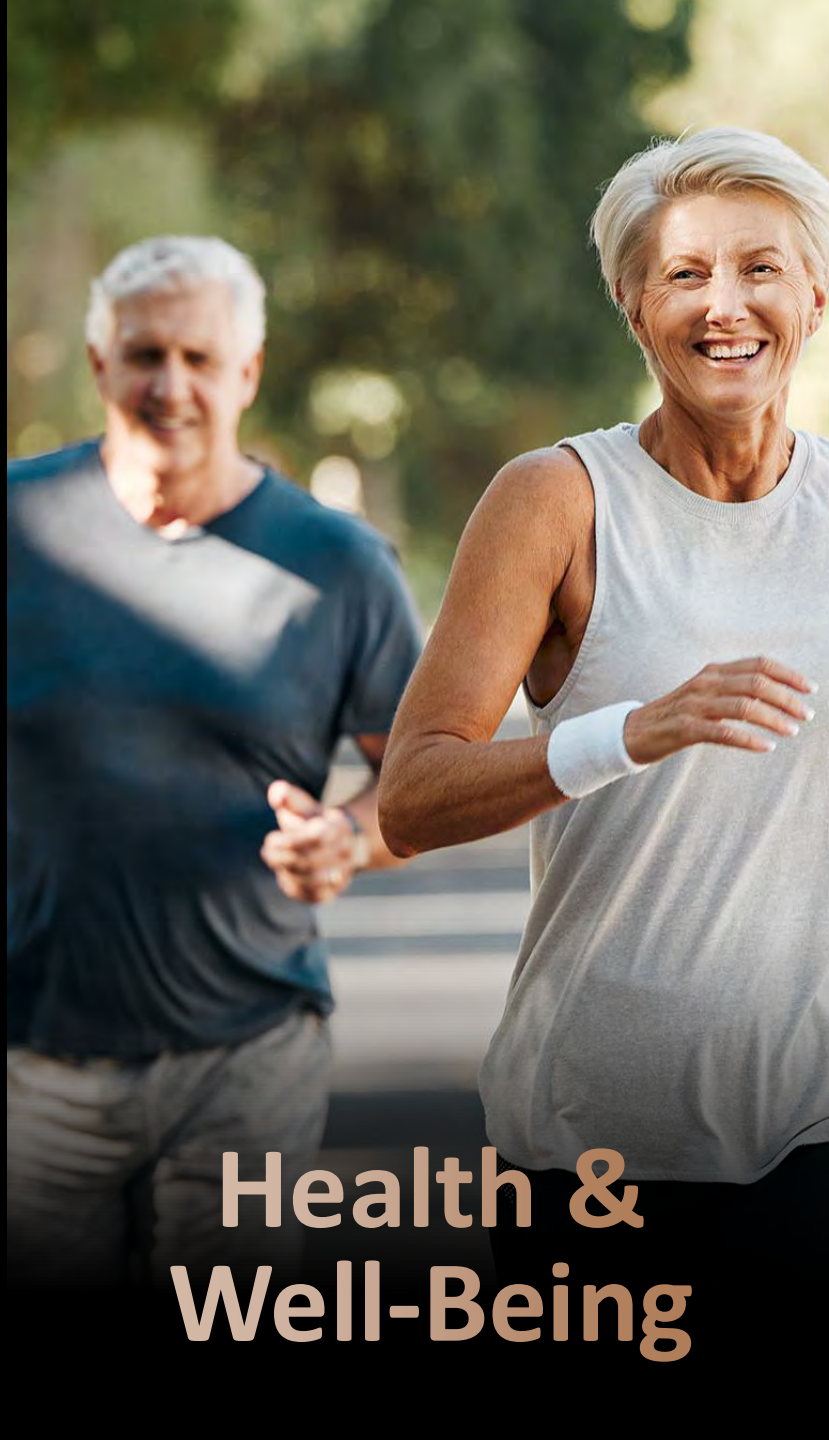
CIC 312 up to
7 days



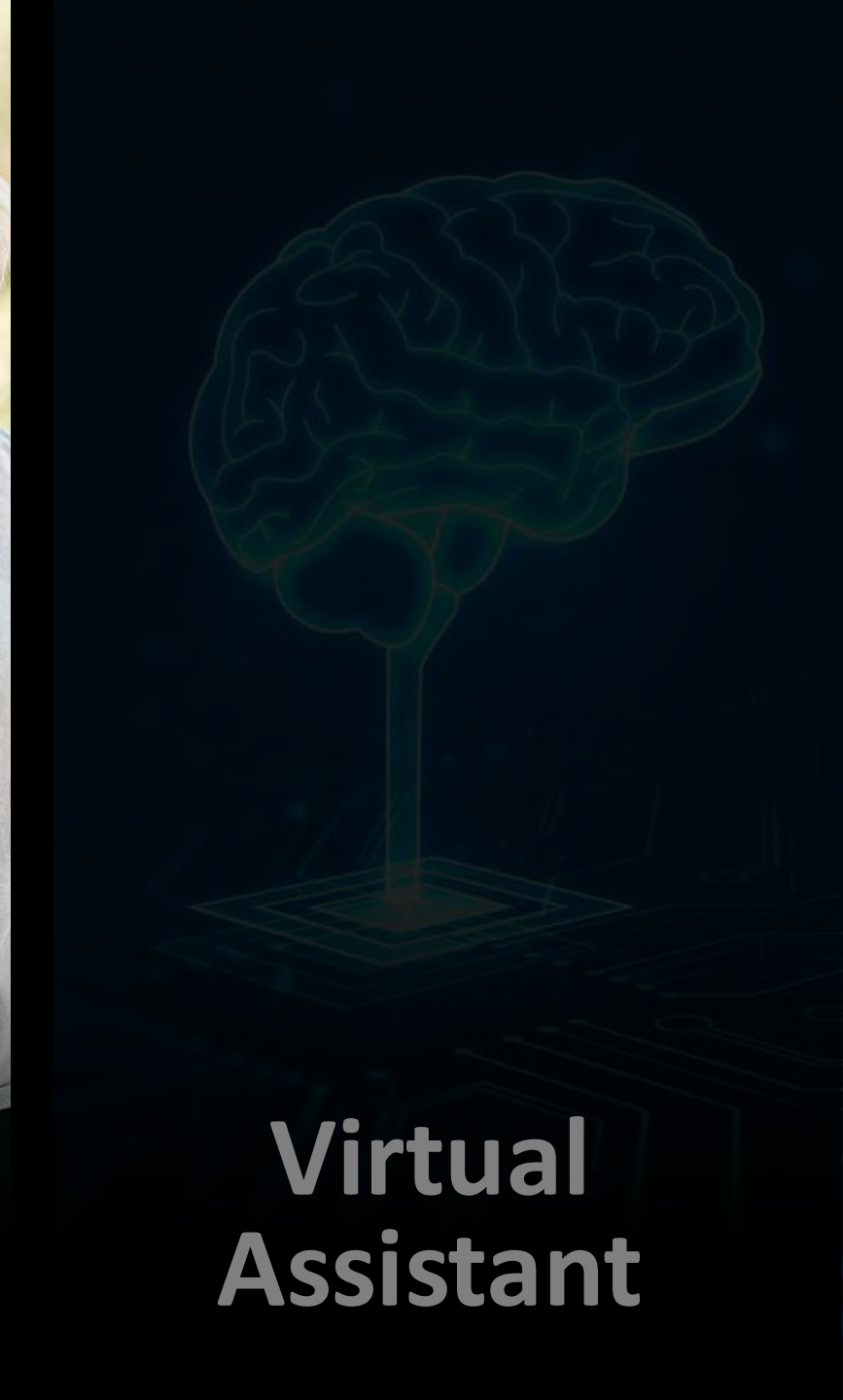
Custom R up to
42 hours

A close-up, dark-toned photograph of an elderly person's ear. A small, dark hearing aid is visible, tucked into the ear canal. The skin around the ear is wrinkled, and the overall lighting is soft and focused on the ear.

**Better
Hearing**

A photograph of an elderly couple jogging outdoors. The woman in the foreground is smiling broadly, wearing a light gray tank top and a white wristband. The man behind her is also smiling, wearing a blue and white t-shirt. They are running on a paved path with green trees in the background.

**Health &
Well-Being**

A stylized, glowing green illustration of a human brain. The brain is positioned above a series of concentric squares and lines that resemble a circuit board or a digital interface. The background is dark, making the glowing green elements stand out.

**Virtual
Assistant**

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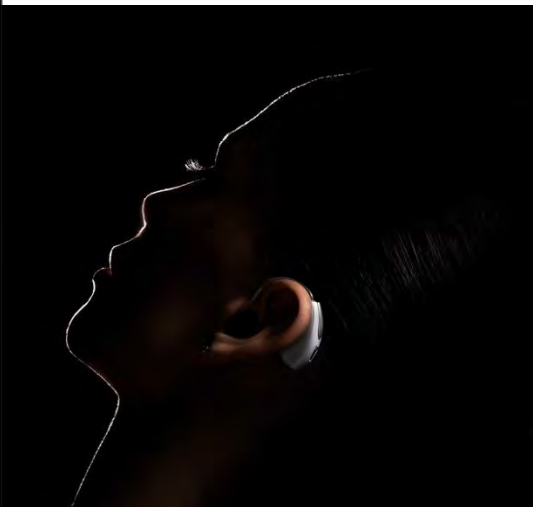
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Businessweek | Feature

The Future of Wearable Tech Is Called a Hearing Aid

Even if your ears are fine, you might want a device that translates 27 languages, tracks fitness, and monitors vital signs.

Benefits *beyond* better hearing

Accurately track health and engagement,
and achieve well-being goals



IMU

Inertial Measurement Units





Personal Health and Well-Being

Helps patients accurately count steps, track engagement, and achieve well-being goals



Walking



Aerobics



Running



Biking



Personal Health and Well-Being

Taking advantage of all the ear
has to offer



**First and only
Fall Detection system**

AI Engine



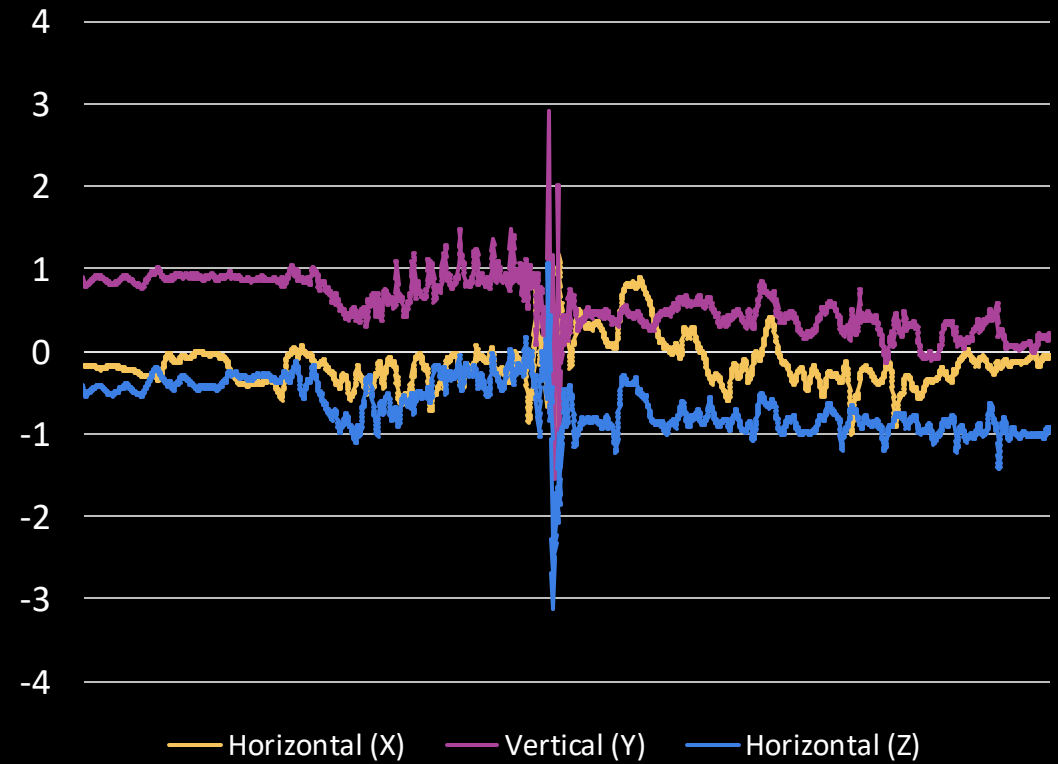
Transforming *Hearing Aids* Multifunctional Devices with *Artificial Intelligence*

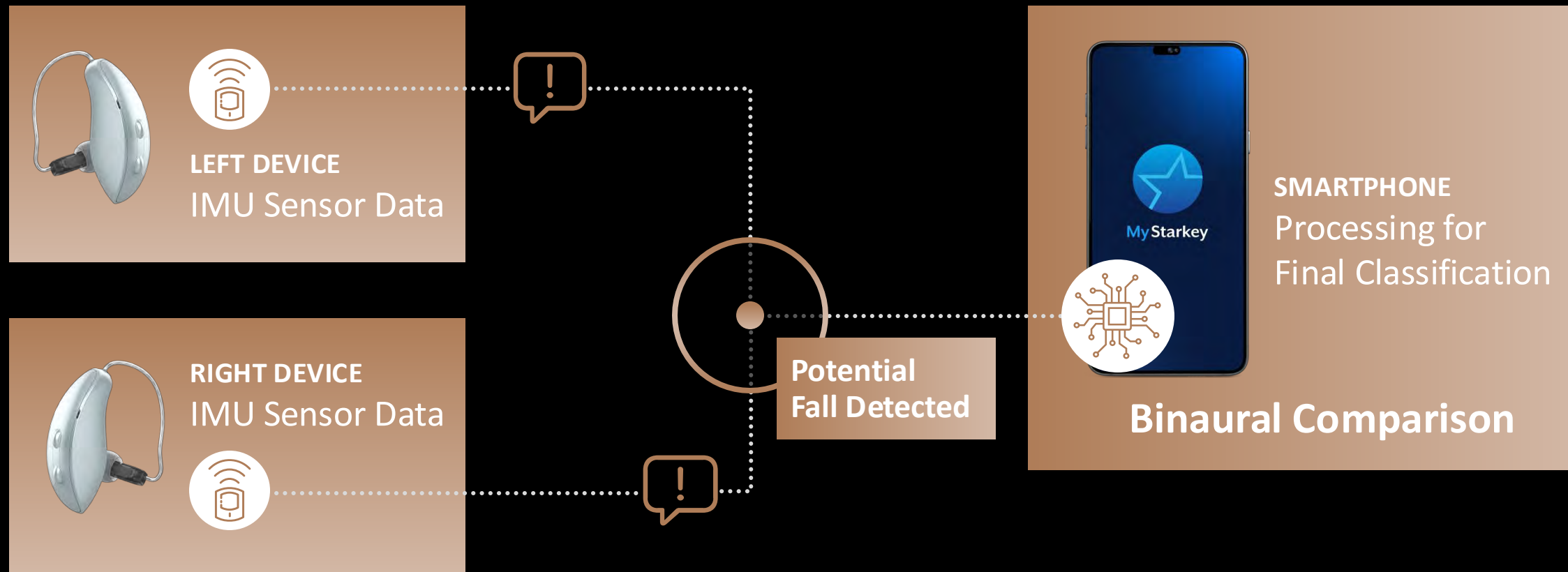


AI Engine



Falls







Going *beyond* fall detection



People with mild hearing loss are **3X more likely** to have a history of falling



40% increased incidence of falls for every 10 dB of measured hearing loss



+



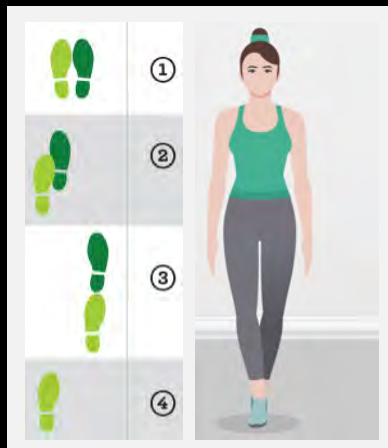
Stanford
University

Toward *preventing* falls!

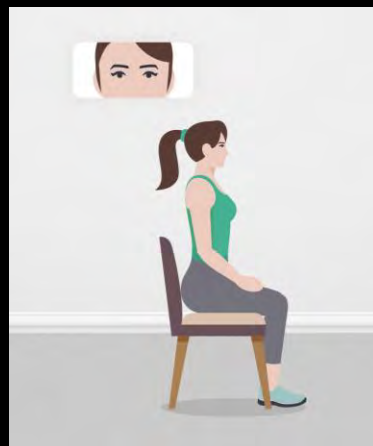
ALL
NEW

Self-guided balance assessment

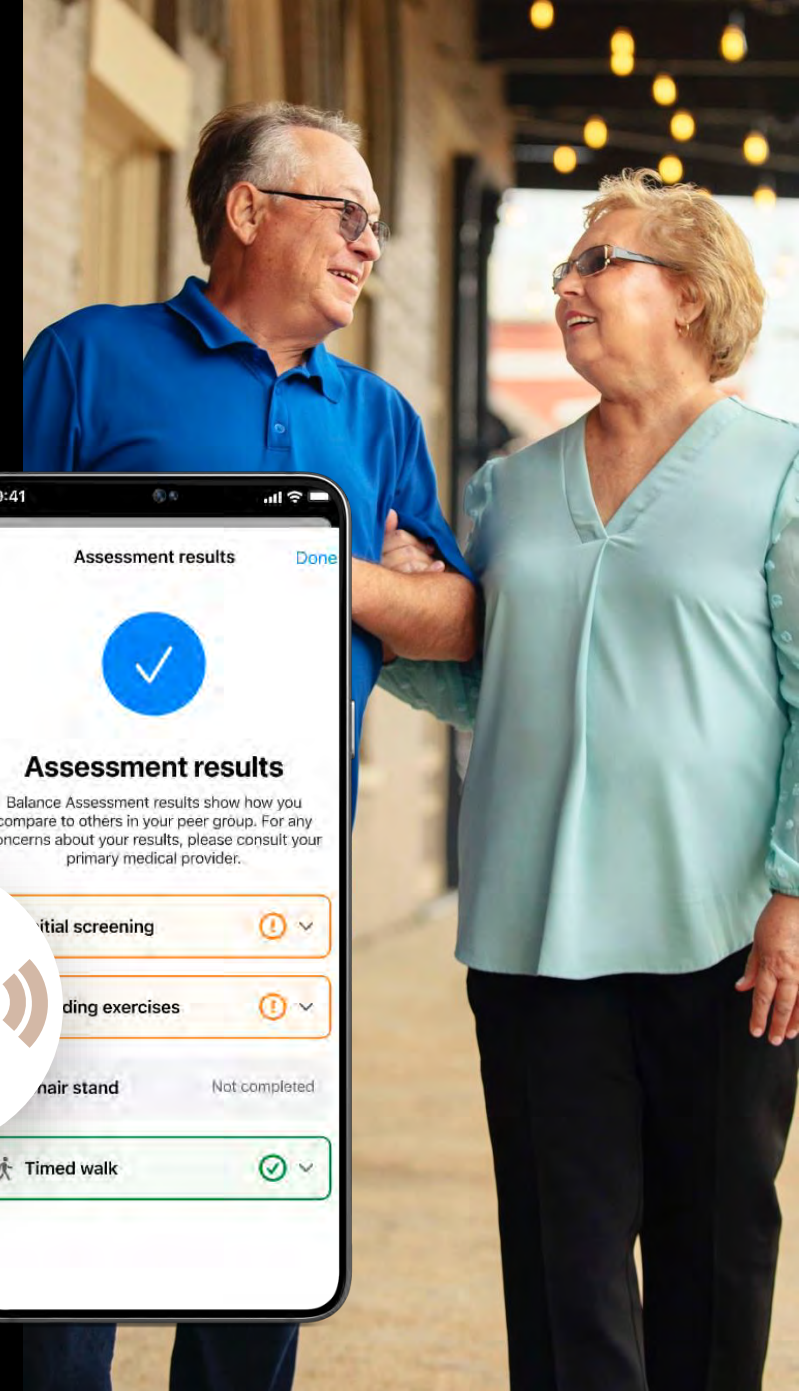
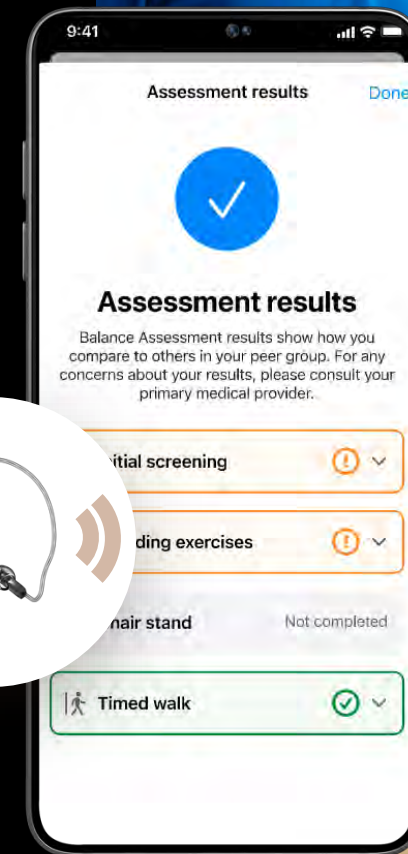
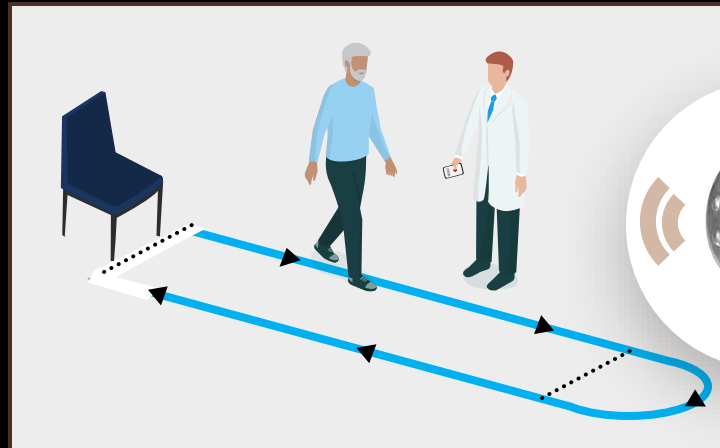
Static Balance tests



Chair Stand tests



Timed Up & Go Test



My Starkey Balance Assessment

My Starkey's Balance Assessment provides a way to **Screen** and **Assess**



1 Initial Screening
Via a validated fall risk self-assessment tool

2 Self-Assessment
Utilizing common measures for evaluating gait, strength, and balance that can be completed at home

4 Standing Exercises

2 Chair Exercises

Why Offer Balance Assessment?

Balance Assessment is a tool for promoting wellness for all ages and is great for:



Someone who has some early concerns but are not yet ready to see a professional about it



Someone who has already seen a professional and may want to periodically reassess themselves

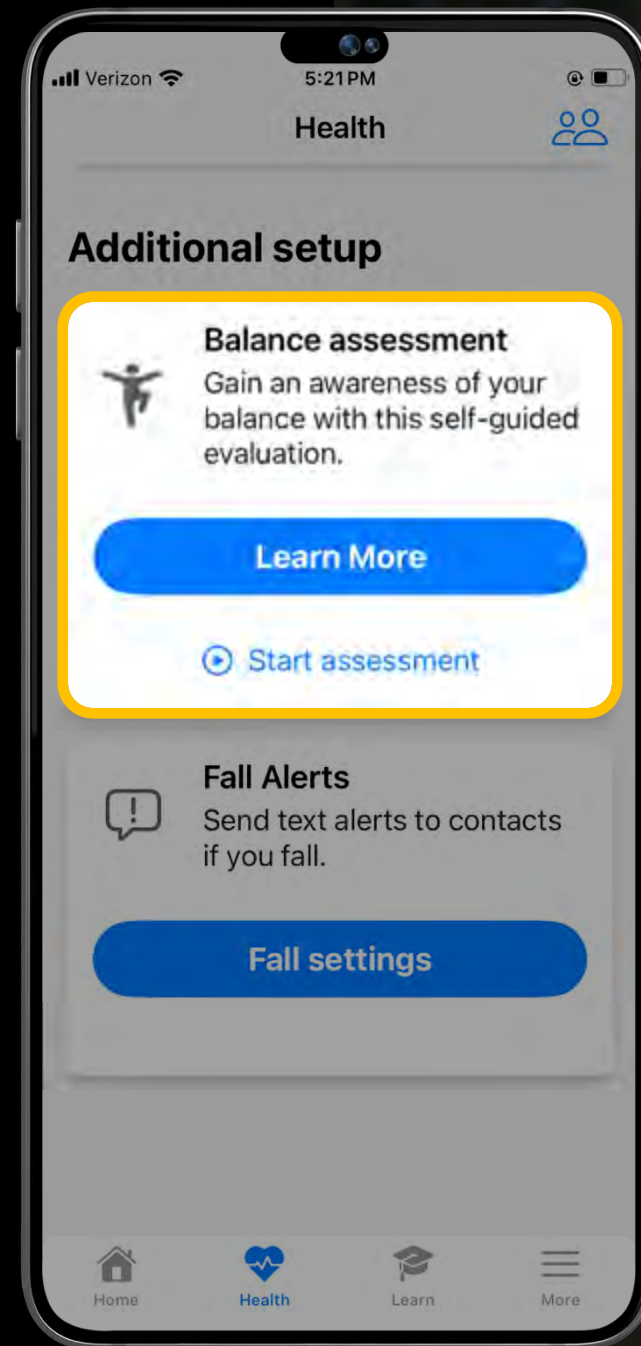
Getting Started Balance Assessment

Includes 6 exercises focused on three elements:
somatosensory balance, functional lower body
strength, walking balance

4-Stage Balance Test → **4 Standing Exercises**

30-Second Chair Stand → **Chair Stand**

Timed Up & Go → **Timed Stand-Walk**





Good to Know

The user will be guided and appropriately cautioned throughout the assessment

The user can:

- Exit at any time

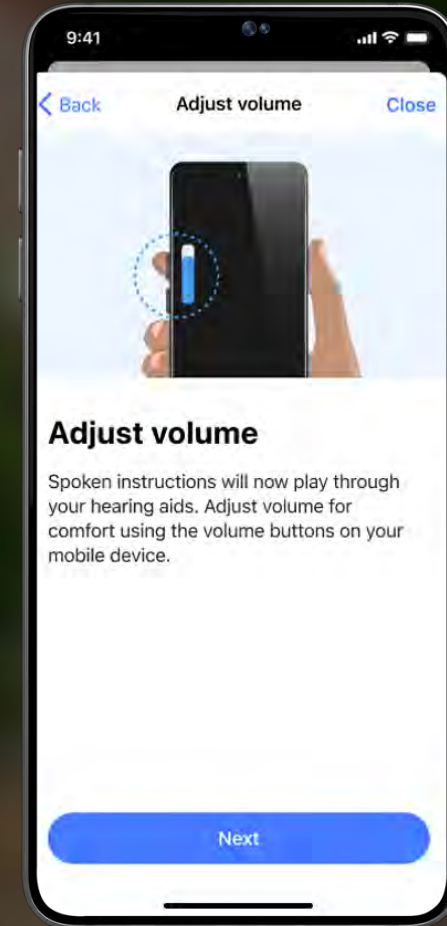
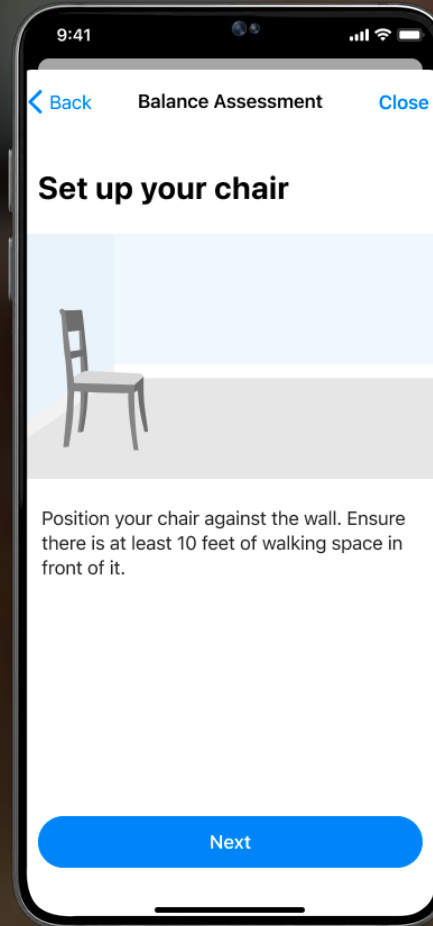
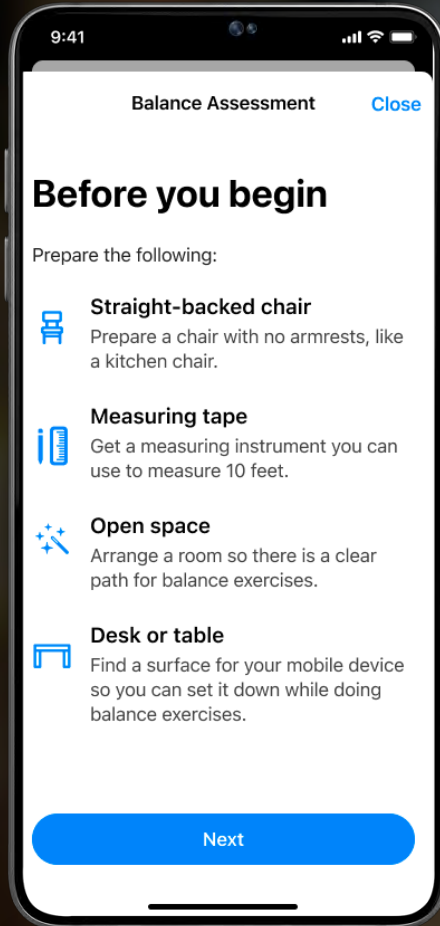
- Attempt every exercise

- Repeat any exercise if desired or the hearing aids detect unsteadiness

- Skip any exercise

Results are saved regardless of assessment completion

Balance Assessment Set Up

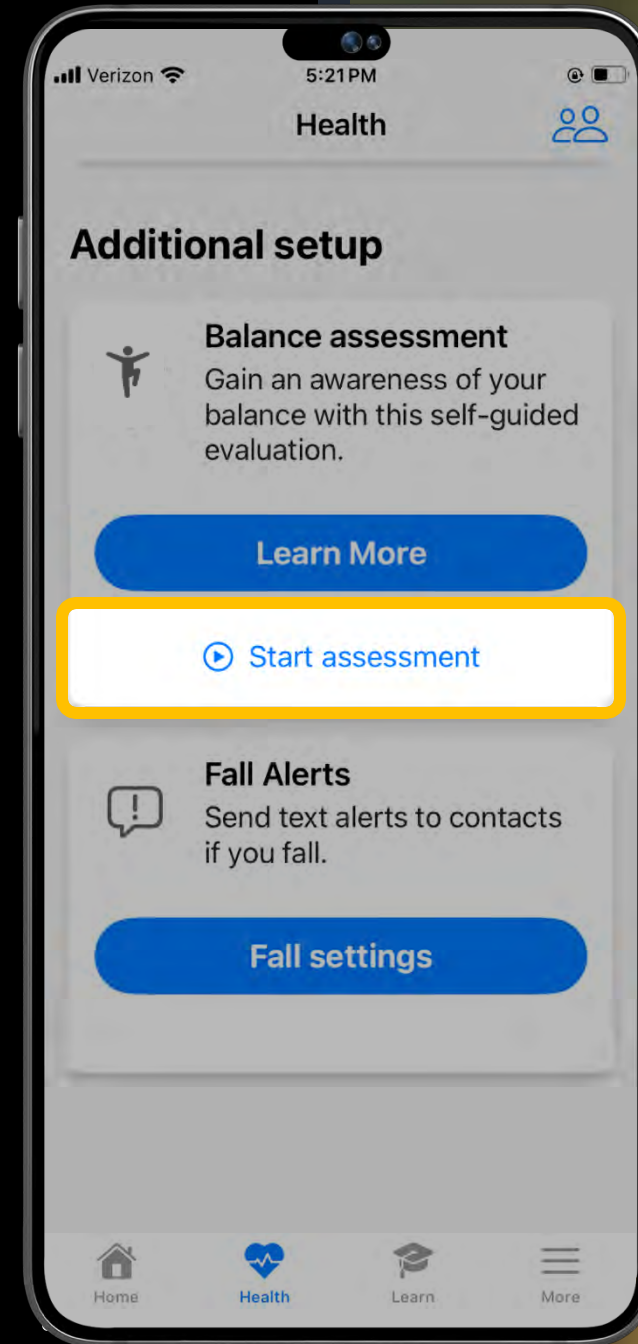


Balance Assessment

During the assessment, the user receives on-screen and voice instructions

Inertial sensors measure how the user performs, then stream the data to My Starkey

An algorithm in My Starkey determines the results



Results Balance Assessment



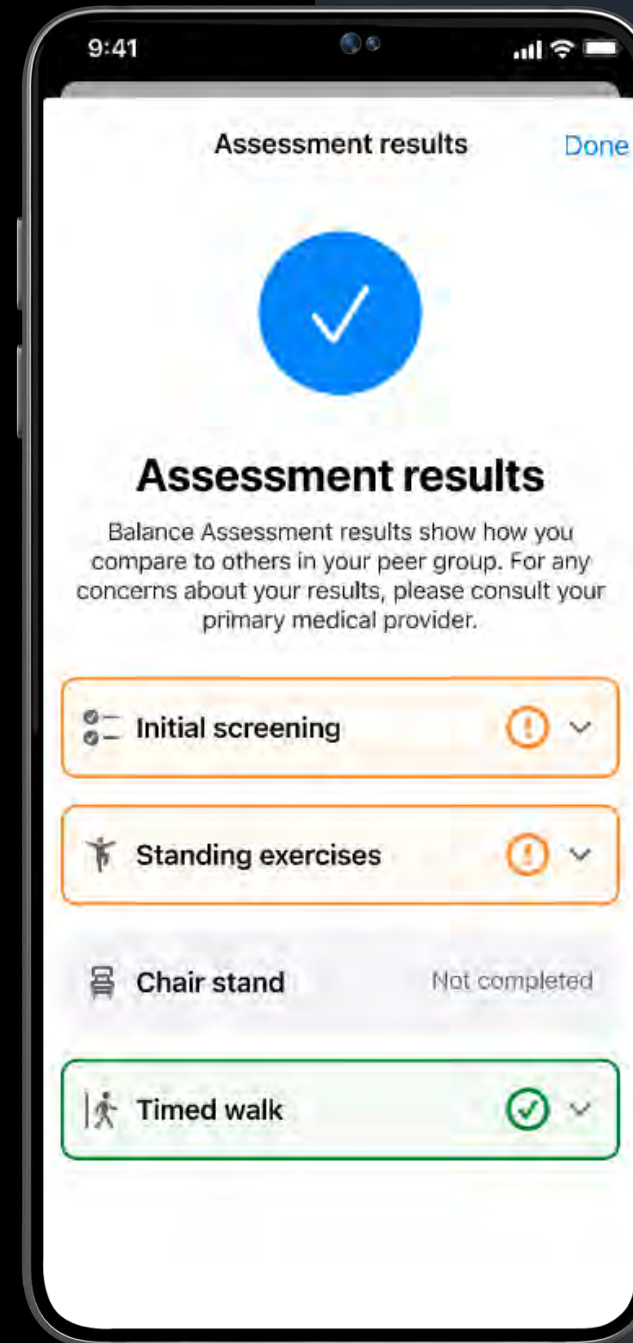
Balance concerns/Inconsistent
with peer group



No balance concern/Consistent
with peer group

Not completed

Section incomplete or skipped





**Better
Hearing**



**Health &
Well-Being**



**Virtual
Assistant**



Tap Control



Translate



Transcribe



Smart Assistant
with Voice Commands



Reminders



Self Check

Smart Assistant

Intelligent Reminders

Set audible reminders for appointments, hearing aid maintenance, and important tasks



ROUGHLY

50%

ADHERENCE

to medications for chronic conditions

Homebound adults with hearing loss are **2X** more likely to be non-adherent with medication

¹<https://www.uspharmacist.com/article/medication-adherence-the-elephant-in-the-room>

²<https://www.advisory.com/daily-briefing/2017/04/19/medication-adherence>

Google



amazon

 Microsoft

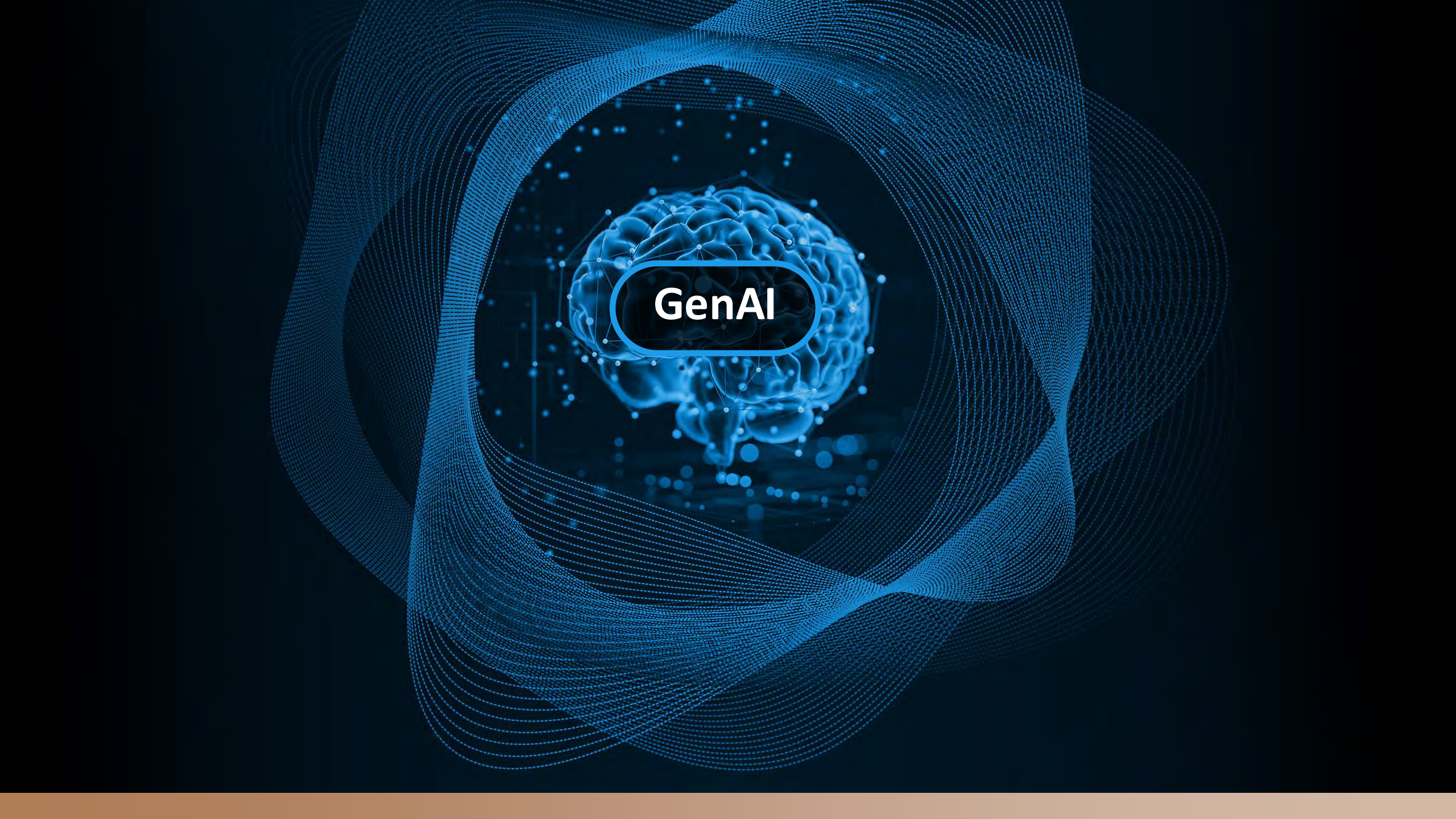


 Stanford
University

intel®

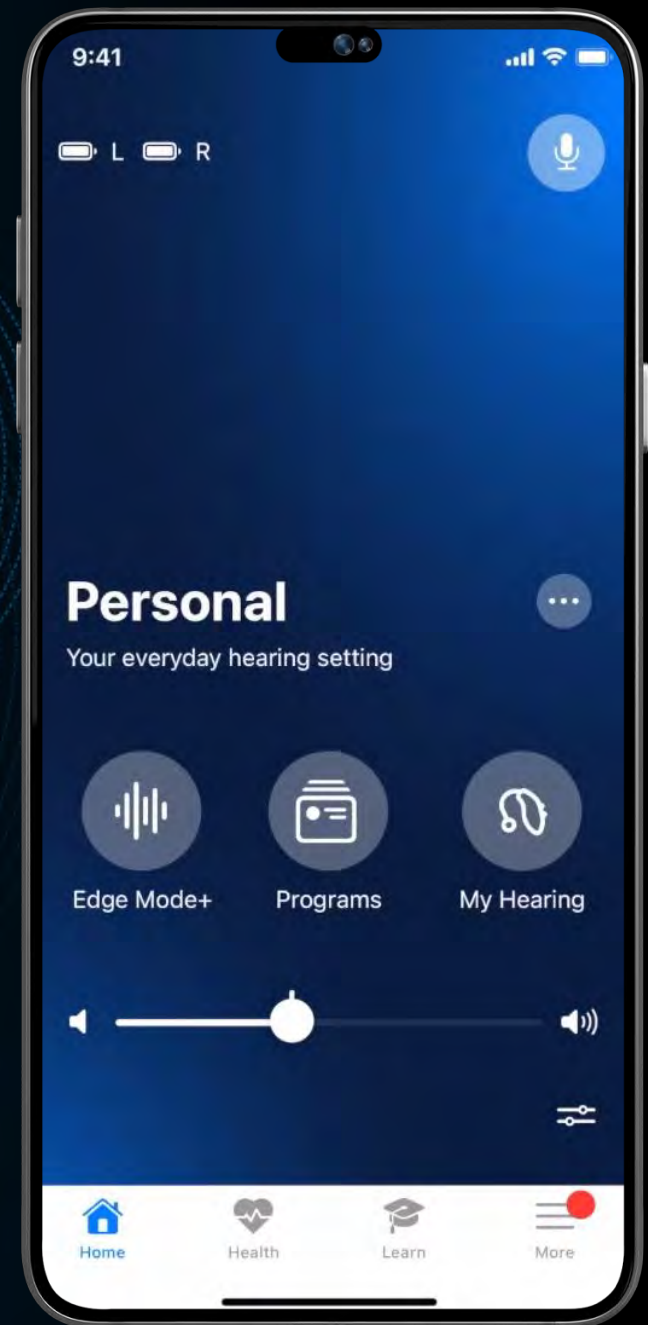
AMD 

 OpenAI



GenAI

GenAI







**Better
Hearing**



**Health &
Well-Being**



**Virtual
Assistant**



Thank you



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