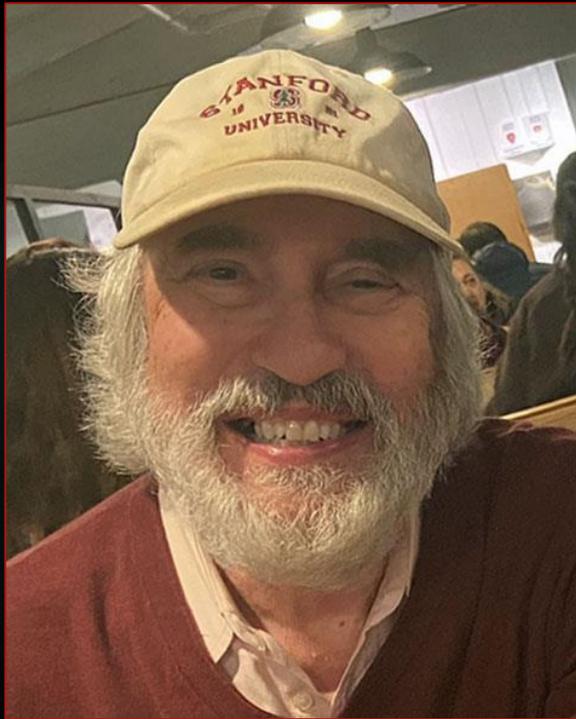


January 7, 2025  
Introduction to Assistive Technology



# ENGR110/210

## Perspectives in Assistive Technology



David L. Jaffe, MS  
Instructor

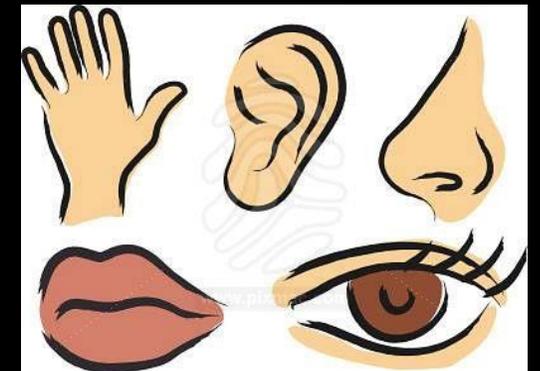
19  
Years



# Introduction to Assistive Technology



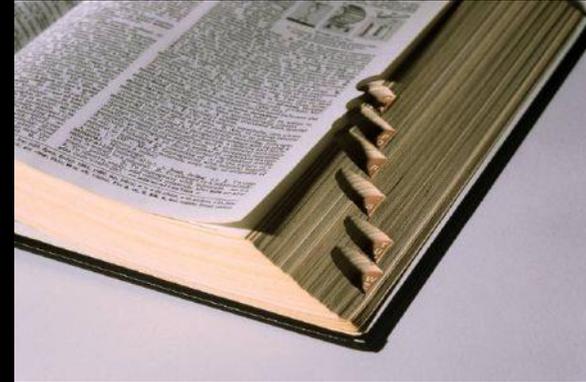
- ▶ Definitions
- ▶ Broad overview
- ▶ What is a disability?
- ▶ Range of disabilities
- ▶ People involved - demographics and numbers
- ▶ Goal of rehabilitation
- ▶ Challenges of people with disabilities
- ▶ Perception of people with disabilities
- ▶ Examples of assistive technology products and devices
- ▶ Phraseology, semantics, and social correctness
- ▶ Last year's student projects





# Definitions

- ▶ Disability
- ▶ Assistive Technology
- ▶ Rehabilitation
- ▶ Rehabilitation Engineering





# Disability

## Work-Based Definition



Persons with a disability are those who have a “health problem or condition which **prevents them from working** or which limits the kind or **amount of work** they can do”.

Current Population Survey  
Cornell University Disability Statistics

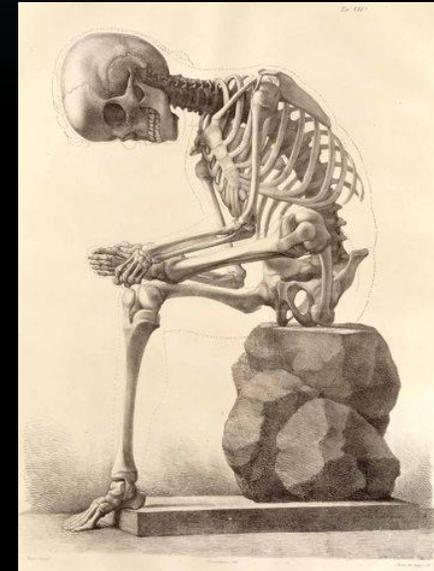
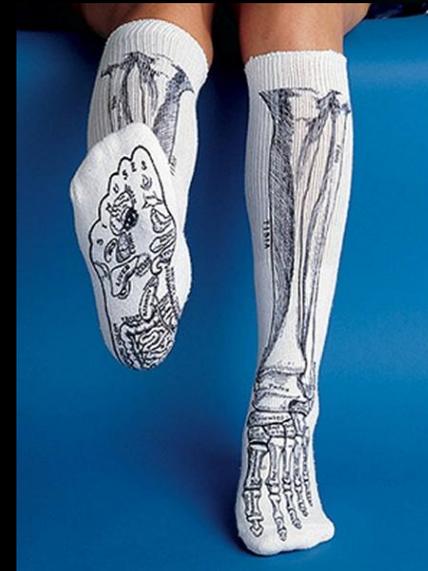




# Disability

## Anatomically-Based Definition

The Department of Veterans Affairs uses a **percent disabled** definition partially based upon loss of use of limbs, etc that “interferes with normal life functions”.



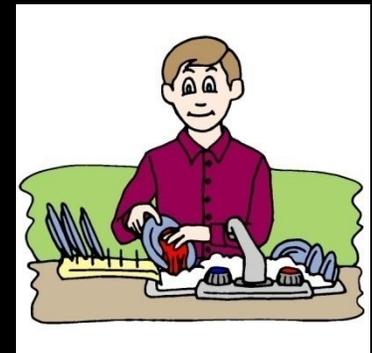


# Disability

## Activity-Based Definition

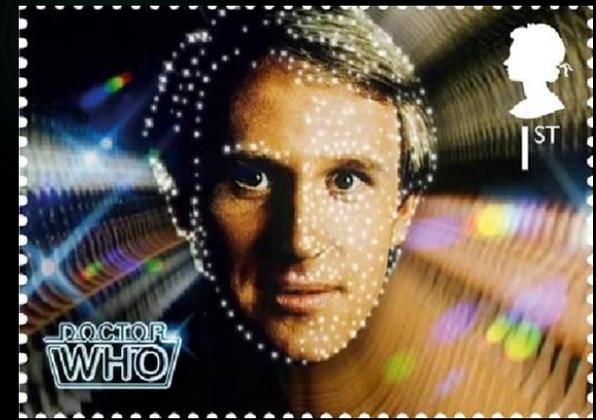


- ▶ Disability is defined in terms of **limitations in a person's activities** due to a health condition or impairment.
- ▶ **Activities** is a broad enough term to include working, doing housework, taking care of personal and household needs, and other age-appropriate activities.
- ▶ National Health Interview Survey
- ▶ UCSF Disability Statistics Center





# WHO says



Disability is an umbrella term covering **impairments**, **activity limitations**, and **participation restrictions**.

- an **impairment** is a problem in body function or structure
- an **activity limitation** is a difficulty encountered by an individual in performing a task or action
- a **participation restriction** is a problem experienced by an individual in involvement in life situations.





# WHO says



Disability is not just a health problem.

It is a complex phenomenon, reflecting the interaction between **features of a person's body** and **features of the society** in which he or she lives.

Overcoming the challenges, difficulties, problems faced by people with disabilities requires interventions to remove **environmental** and **social barriers**.



# WHO says



People with disabilities have the same health needs as non-disabled people - for immunization, cancer screening, etc.

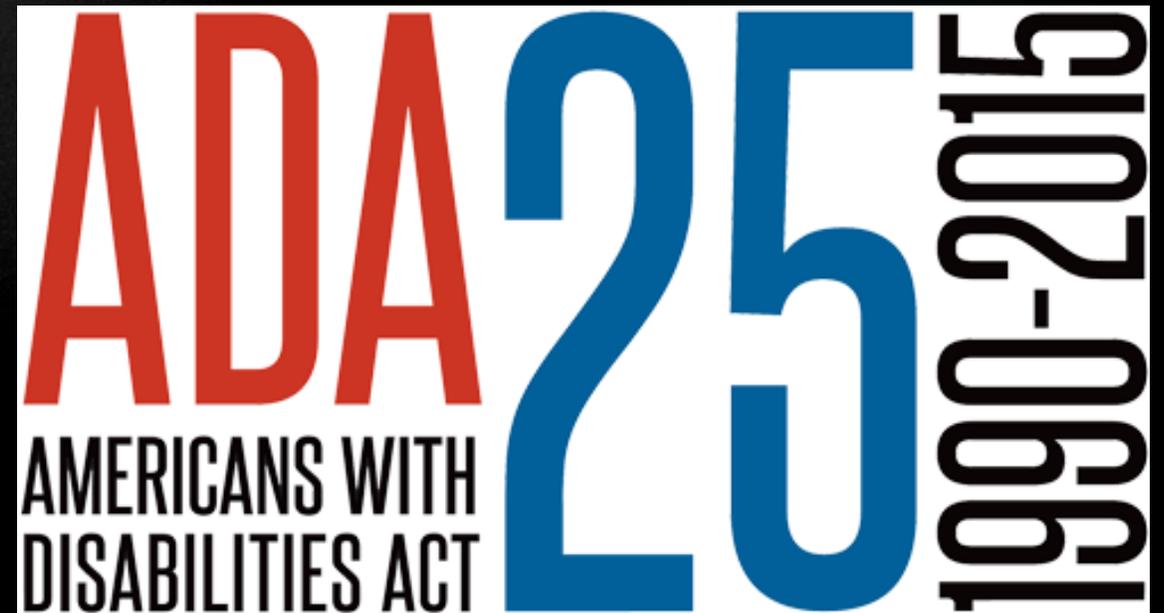
- ▶ People with disabilities (and older adults) are **healthy**
- ▶ But they also may experience a **narrower margin of health**, both because of **poverty and social exclusion**, and also because they may be vulnerable to **secondary health conditions**, such as pressure sores or urinary tract infections.
- ▶ Evidence suggests that people with disabilities face **barriers in accessing the specialized health and rehabilitation services** they need in many settings.



# Disability ADA Definition



Disability is defined as an individual's **physical or mental impairment** that substantially limits one or more major life activities.





# Disability

## Opportunity-Based Definition

Disability is defined as any health condition or impairment that prevents an individual from taking full advantage of life's opportunities such as education, vocation, recreation, and activities of daily living





# Situational Disability

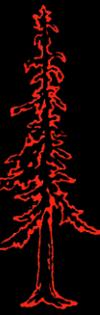
## More Inclusive Definition



Disability is any situation that prevents an individual from taking full advantage of one's **talents** and life's **opportunities** including circumstances such as political system, socio-economic status, etc



# Lack of Opportunities



abused, butchered, chained, cremated,  
dehumanized, denied the right to vote,  
discriminated, disenfranchised, dragged,  
embittered life with hard labor, enslaved, evicted,  
falsely accused & convicted, forbidden to own  
land, forced to live in a ghetto, gassed, ignored,  
imprisoned, kidnapped, killed, lynched, murdered,  
overlooked, raped, repressed, restrained,  
segregated, shackled, shot, starved, sterilized,  
targeted, violated

# Inclusive Definition of Disability



“Disability is a normal variation of the human condition.” -  
Gregor Wolbring



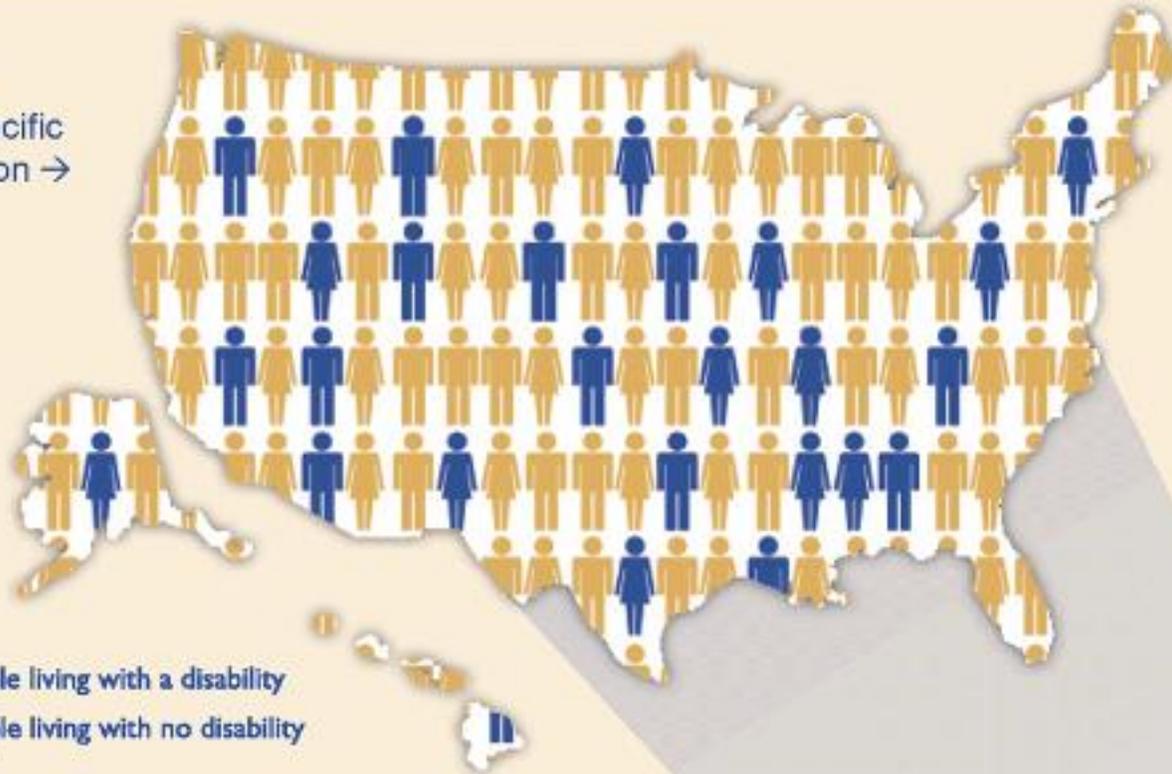
“Deep inside we’re all  
the same” - Styx



Biodiversity  
Neurodiversity  
Autism spectrum  
Ability diversity

# 61 million adults in the United States live with a disability

Click for  
state-specific  
information →



 People living with a disability  
 People living with no disability

**26%** of adults in  
the United States  
have some type  
of disability  
(1 in 4)

The percentage of people  
living with disabilities is  
highest in the South



## Percentage of adults with functional disability types

13.7%

### MOBILITY

Serious difficulty walking or climbing stairs



10.8%

### COGNITION

Serious difficulty concentrating, remembering, or making decisions



6.8%

### INDEPENDENT LIVING

Difficulty doing errands alone



5.9%

### HEARING

Deafness or serious difficulty hearing



4.6%

### VISION

Blindness or serious difficulty seeing



3.7%

### SELF-CARE

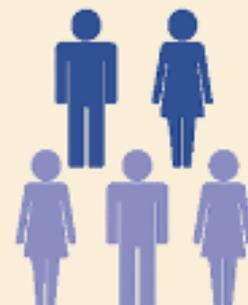
Difficulty dressing or bathing



Disability is especially common in these groups:

**2** in **5**

adults age 65  
years and older  
have a disability



**1** in **4**

women have  
a disability

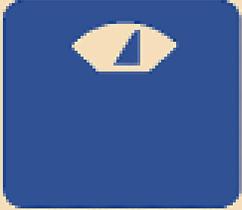
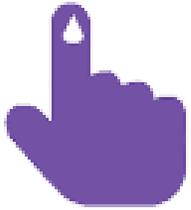


**2** in **5**

Non-Hispanic  
American Indians/  
Alaska Natives  
have a disability



## Adults living with disabilities are more likely to

		With Disabilities	Without Disabilities
	HAVE OBESITY	38.2%	26.2%
	SMOKE	28.2%	13.4%
	HAVE HEART DISEASE	11.5%	3.8%
	HAVE DIABETES	16.3%	7.2%

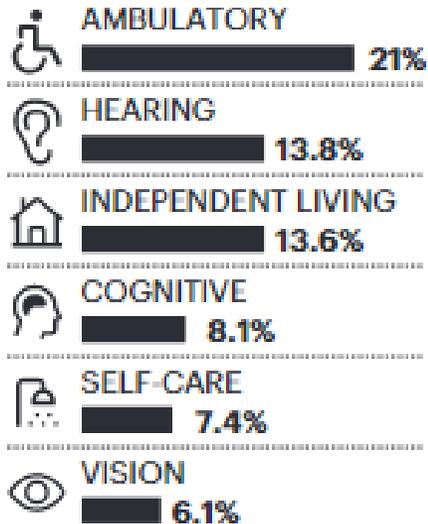




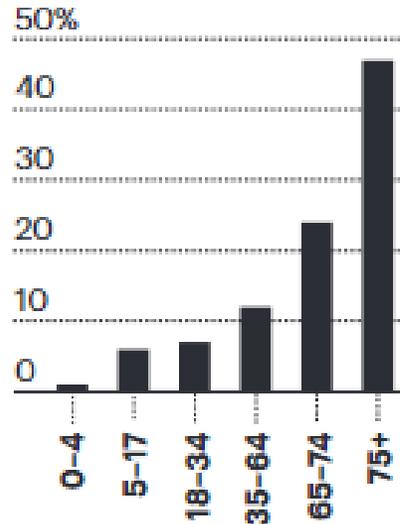
## LIVING WITH DISABILITIES

A total of 41.1 million Americans—12.6 percent of the population—live with some sort of disability. They range from hearing and vision difficulties to difficulty in living independently. Disabilities increase by age, and nearly half of those 75 and above report having one of six disabilities measured by the U.S. Census Bureau.

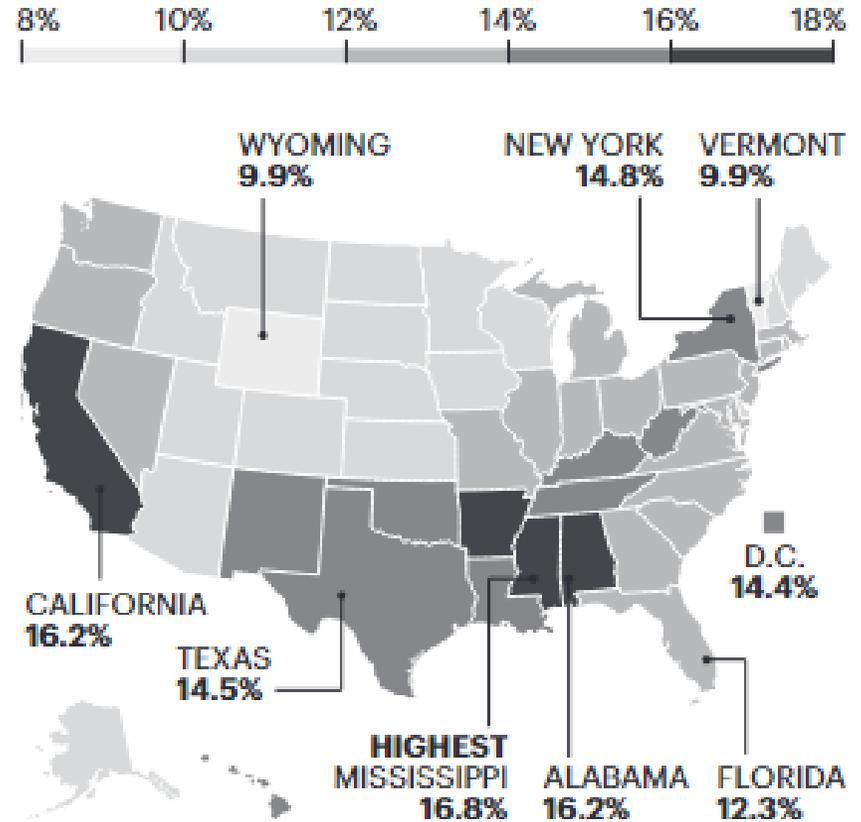
### TYPE OF DISABILITY FOR THOSE 65 AND OLDER



### PERCENTAGE WITH DISABILITY, BY AGE



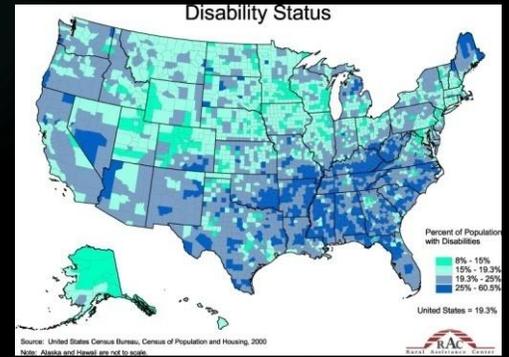
### PERCENT OF THOSE 65 AND OLDER WHO HAVE AN INDEPENDENT LIVING DIFFICULTY



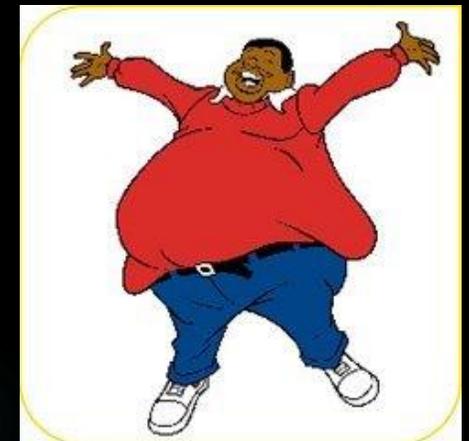
SOURCE: U.S. CENSUS BUREAU, AMERICAN COMMUNITY SURVEY, 5-YEAR ESTIMATES, 2021



# Disability in the US



- ▶ 71.4 million citizens have activity limitations ~ 23% of 308 million
  - ▶ Reports cite 32 to 78 million (over 1 billion globally - 15%)
- ▶ 24.1 million individuals have a severe disability
- ▶ 11 million children have a disability
- ▶ 25% of health care costs relate to disability
- ▶ Disability is the largest minority group
- ▶ > 22 million are 65 or older
- ▶ 10 million people with vision impairments
  - ▶ 1.3 million are legally blind (37 million blind globally)
- ▶ 24 million people with hearing impairments
  - ▶ 2 million are deaf
- ▶ > 1 million wheelchair users
- ▶ 6 million people have developmental disabilities
- ▶ Less than 5% are born with their disability
- ▶ **> 12% (3000) of Stanford students are registered with OAE**





# Disability in the US

- ▶ **Disability rates vary** by age, gender, race, ethnicity, state of residence, and economic status
- ▶ Disabilities may result in a **reduced chance for education and employment**
- ▶ Disability is associated with **differences in income** - 27.8% working-age individuals with disability live in poverty
- ▶ As the **nation ages**, the number of people experiencing limitations will certainly **increase**.
- ▶ **Disability is a normal variation** of the human condition.

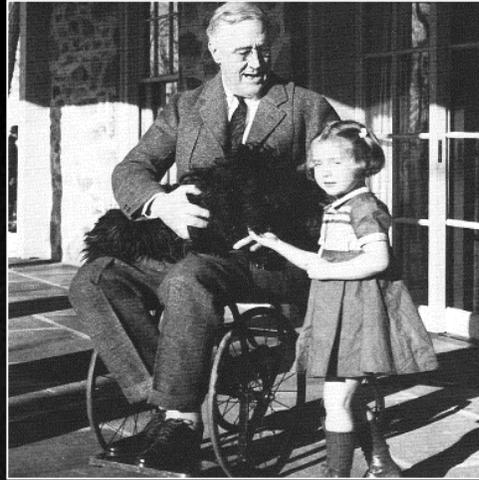




# Disability Types

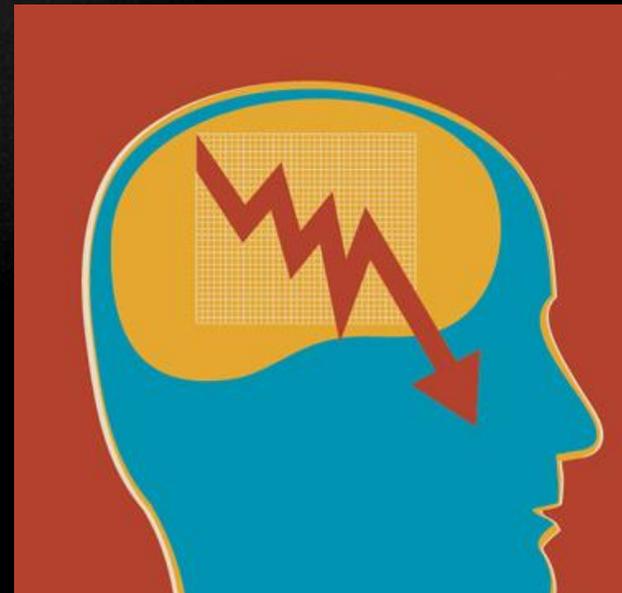
Which disabilities are most obvious?

- ▶ Congenital / acquired
- ▶ Physical
  - ▶ Sensory
  - ▶ Functional
- ▶ Psychological / neurological



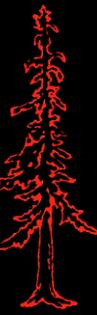
# Age-related Disabilities

- ▶ Macular Degeneration
- ▶ Sarcopenia
- ▶ Cognitive Decline
- ▶ Commercial Pilot Restrictions
- ▶ Driving Restrictions
- ▶ Presidential Age





# Desires of People with Disabilities



- ▶ Regain wellness & function
- ▶ Perform tasks independently
- ▶ Experience a high quality of life
- ▶ Take full advantage of all opportunities



- ▶ Educational
- ▶ Vocational
- ▶ Recreational
- ▶ Activities of daily living



- ▶ Pursue happiness
- ▶ Freedom to integrate into society (or be a part of their own group or be an individual)



# Perceptions of Disabilities



- ▶ In the US:
  - ▶ A diminishing stigma
  - ▶ Mainstreaming
  - ▶ ADA
- ▶ In other countries:
  - ▶ Taken care of, but often hidden away
  - ▶ Pursuit of a technology solution is a priority



# A Positive View

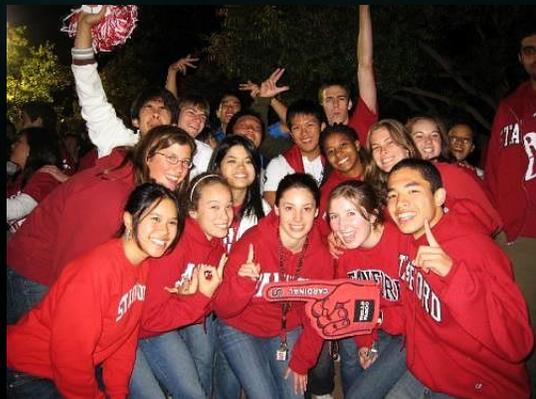




Identify a large group of individuals who spend 12 to 25 years in institutions before they can contribute significantly to society



Identify a large group of individuals who spend 12 to 25 years in institutions before they can contribute significantly to society



Students!

Is this fair?



# Downloadable Skills



Can you fly a B-212 Helicopter?

Matrix

# Over the Hill at 24!



If you're over 24 years of age you've already reached your peak in terms of your cognitive performance - and perhaps physical performance

OVER THE HILL

Simon Fraser University

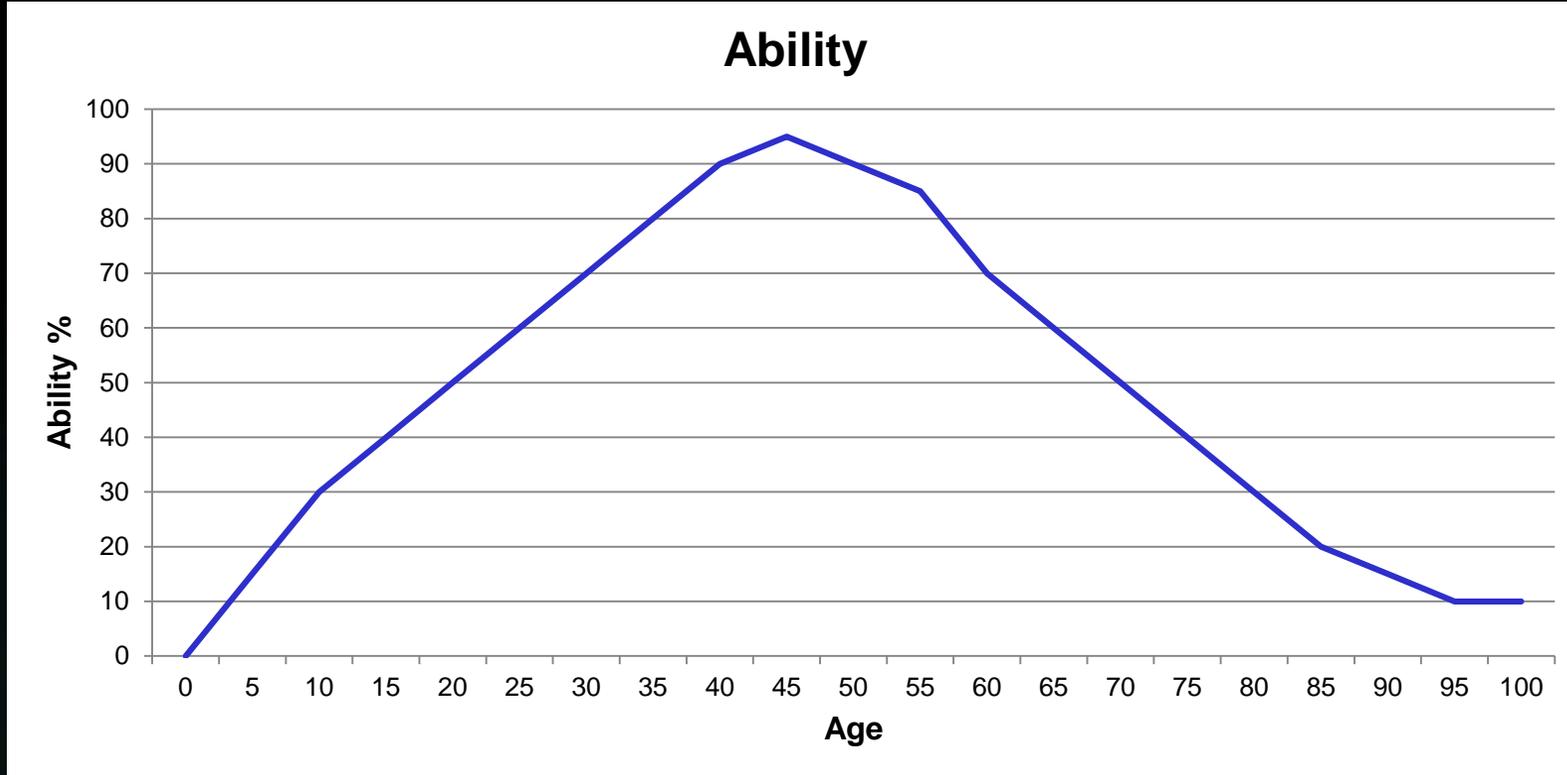


# Ability

**Ability** = Having the talents and given the opportunities to contribute to society



# A Disability View of Life

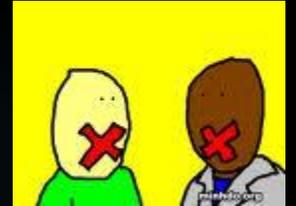


## Life events:

- Birth
- Walking
- Talking
- Bowel control
- Cursive writing
- Dressing
- Balancing
- Coordination
- Education**
- Driving
- Financial**
- Marriage
- Children
- Job
- Physical**
- Benefit society
- Legacy
- Retirement
- Death



# Social and Political Correctness



▶ Put the person rather than the condition first:

▶ Individuals or people with a disability

▶ Focus on capabilities rather than disabilities:

▶ Wheelchair user



▶ Refer to the person rather than the disability group - **be inclusive:**

▶ **NOT:** The Blind (?), the Disabled, the Deaf



UK - The People & The Royals  
US - The People & The Celebrities (?)

Exclusive



The  
People



The  
Disabled



# Inclusive

US Constitution



# People



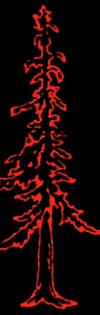
People with  
disabilities





# People First

What is your secondary attribute?



People-first language aims to avoid perceived and subconscious dehumanization when discussing people with disabilities, as such forming an aspect of disability etiquette.

The basic idea is to impose a sentence structure that **names the person first and the condition second**, ie “people with disabilities” rather than “disabled people”, in order to emphasize that **“they are people first”**. Because English syntax normally places adjectives before nouns, it becomes necessary to insert relative clauses, replacing, eg, “asthmatic person” with “a person who has asthma”.

The speaker is thus expected to internalize the idea of a **disability as a secondary attribute**, not a characteristic of a person's identity. Critics of this rationale point out that the unnatural sentence structure draws even more attention to the disability than using unmarked English syntax, producing an additional “focus on disability in an ungainly new way”.

Wikipedia

# Social and Political Correctness



- ▶ Shorthand terms:

- ▶ Para, Quad

- ▶ Derogatory terms:

- ▶ Gimp, Crip, Spaz, Retard

- ▶ Use of terms:

- ▶ “Patient”, “User”, “Subject”, “Consumer”

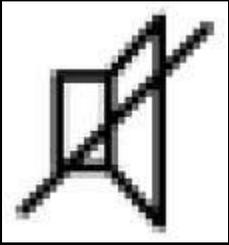
- ▶ “Suffering from”, “Afflicted with”, “Confined to”, “Victim of”

- ▶ “Diagnosed with”, “Living with”, “Survivor of”, “Recovering from”

- ▶ “Inspiring” - lack of expectation

- ▶ “Lost battle with ... “

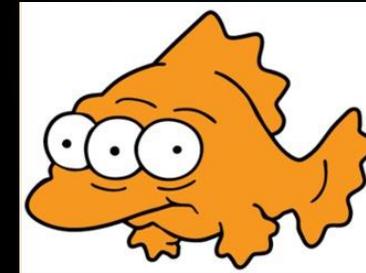




# Medical & Common Use



- ▶ Crippled, Retarded, Deaf & Dumb, Lame
- ▶ Mute, Moron, Imbecile, Idiot, Spastic
- ▶ Persistent vegetative state  
Unresponsive wakefulness syndrome



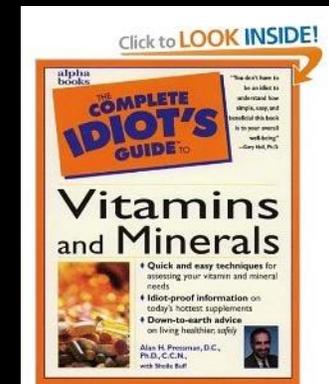
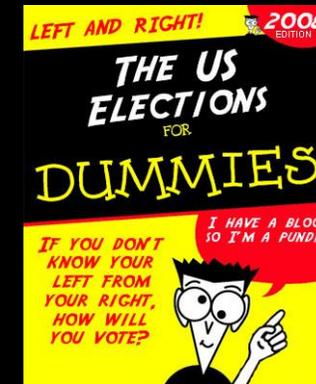
Jerry Mahoney



Knucklehead Smiff



**RETARDS**  
We all know one.





# Portrayal of People with Disabilities



Quasimodo



Joseph Merrick



Prof. Atastor "Mad-Eye" Moody

Gary Busey

Dr. Strangelove

# Famous People with Disabilities



Dalek

# New Inductees - 2017



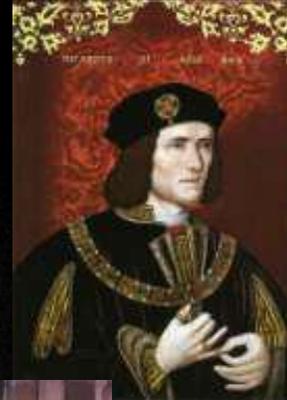
Brian Stowe



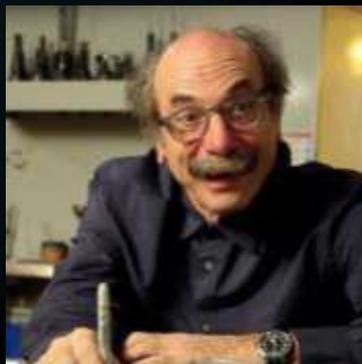
Malala



Richard III



Temple Grandin



Tracy Morgan





# New Inductees - 2018

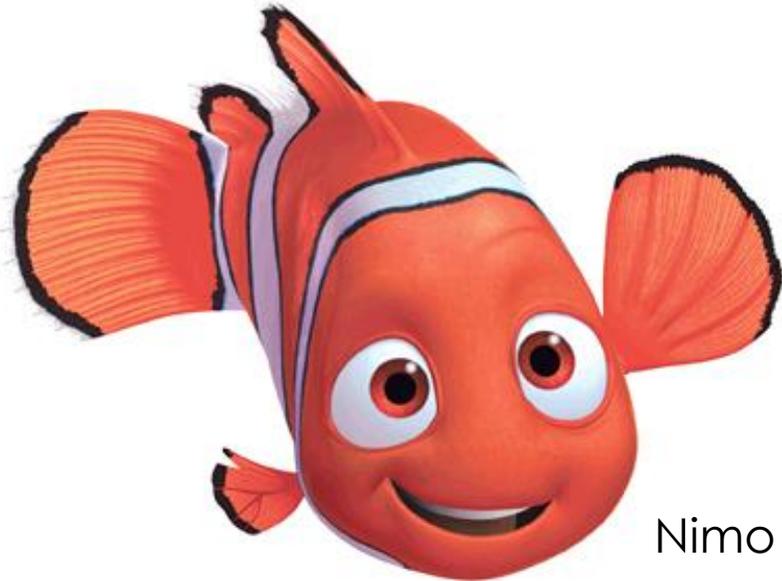
Tiny Tim



Rogue One Warrior



Geordi La Forge & Data



Nimo



Dory



Characters on Big Band Theory

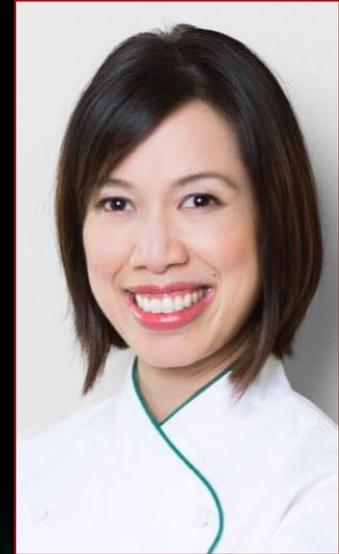
# New Inductees - 2019



Della Duck



Adam Savage



Christine Ho

# New Inductees - 2020



Bruce Springsteen



Linda Ronstadt

# New Inductees - 2022



**Elon Musk** - Asperger's Syndrome

"I'm actually making history tonight as the first person with Asperger's to host 'SNL'. Or at least the first to admit it. So I won't make a lot of eye contact with the cast tonight. But don't worry, I'm pretty good at running 'human' in emulation mode."



**Greta Thunberg** - Asperger's syndrome, OCD

"I was diagnosed with Asperger's syndrome, OCD, and selective mutism. That basically means I only speak when I think it's necessary. Now is one of those moments."

# New Inductees - 2022



**Jesse Jackson** - Parkinson's Disease



**Amanda Grayson, Spock's Mother** - Human

In a Star Trek movie, a group of Vulcan administrators called Spock "disadvantaged" because he had a human mother.

# New Inductees - 2022

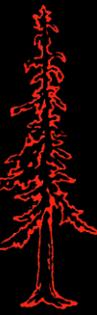


**Selma Blair** - living with Multiple Sclerosis



**Jacques-Yves Cousteau** - paralysis on his right side  
If it weren't for a severe car accident that left him paralyzed on much of his right side, Jacques-Yves Cousteau would not have been swimming incessantly off southern France to recuperate.

# New Inductees - 2022



**Gavin Newsome** - Dyslexia



**Maya** - Little person on The Simpsons

Maya is a beautiful woman whom Moe met over the Internet. She's a little person, standing at about three feet tall. Moe talked of arranging to have a risky height-reduction surgery to literally "knock himself down to her size", but she convinced him not to. She then left Moe because she was put off by his willingness to try something so crazy, and also because she wanted to be with a man who was truly comfortable with her size. Moe's seeking the surgery, therefore, showed Maya that he wasn't the right man for her.

# New Inductees - 2022



**Josh Miele** - Vision Impairment - 2021 MacArthur Fellow

Joshua Miele is a blind adaptive technology designer developing devices to enable blind and visually impaired (BVI) people to use technologies that pervade our lives. Miele's graduate work focused on psychoacoustics (the science of sound perception) and directional aspects of hearing. More recently, he is creating effective and affordable solutions to everyday problems blind people face, particularly access to digital information.



**Joe Biden** - Stuttering

# New Inductees - 2023



Christina Applegate - MS



Harriet Tubman - Head Injury



Selma Blair - MS



Roberta Flack - ALS

# New Inductees - 2023



Selina Gomez - Bipolar Disorder



Michael J. Fox - Parkinson's Disease

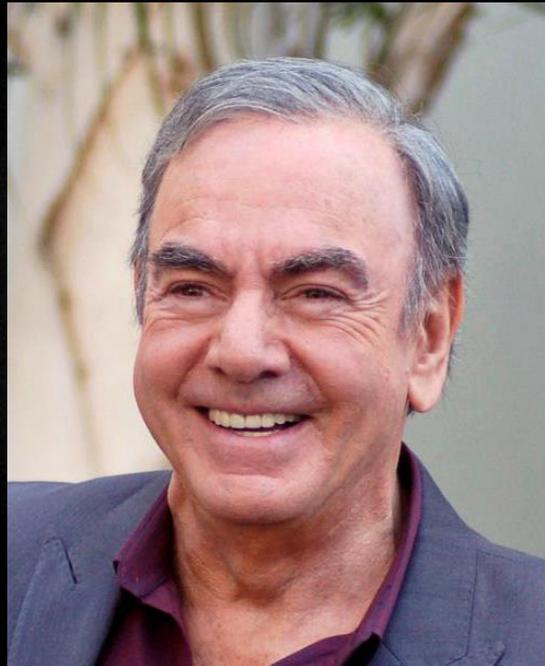


Danica Patrick - Breast Implant Illness

# New Inductees - 2023



Celine Dion - Stiff Person Syndrome

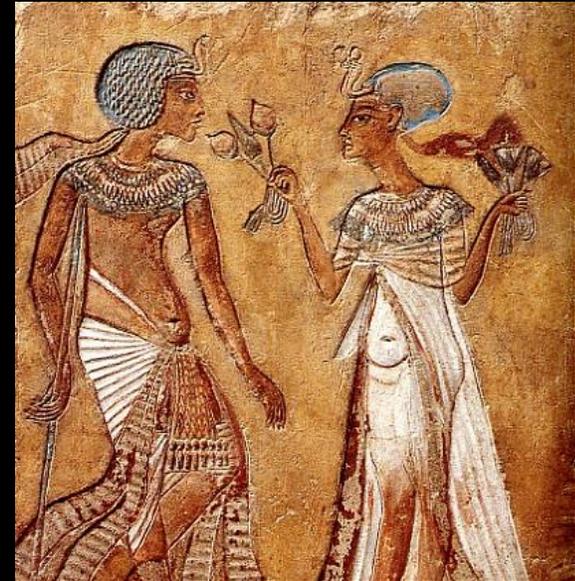
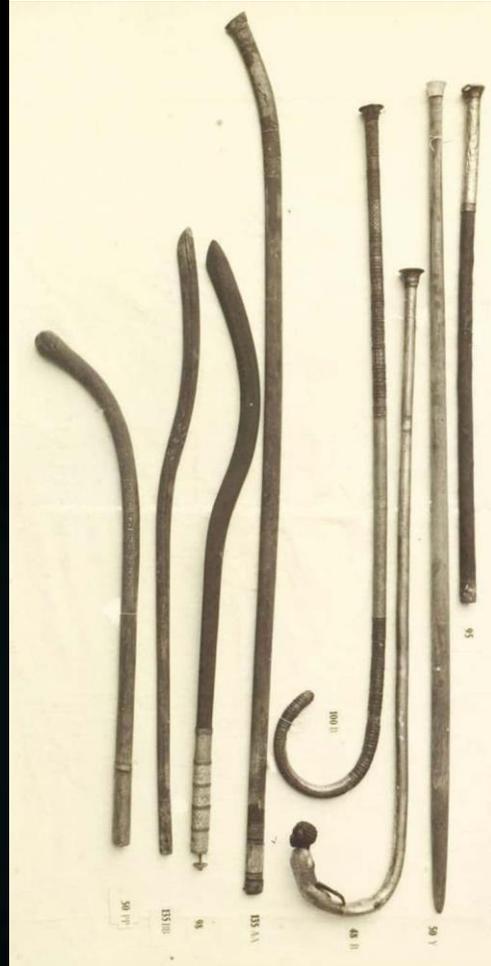


Neil Diamond - Parkinson's Disease



Ozzy Osbourne - Parkinson's Disease

# New Inductees - 2023



Tutankhamun (born c 1341 BCE) was physically disabled with a deformity of his left foot along with bone necrosis that required the use of a cane, several of which were found in his tomb. He had other health issues including scoliosis and had contracted several strains of malaria.

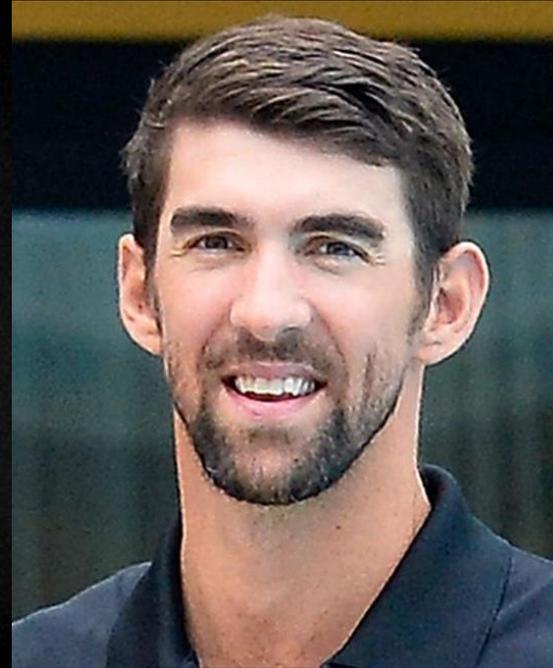
# New Inductees - 2024



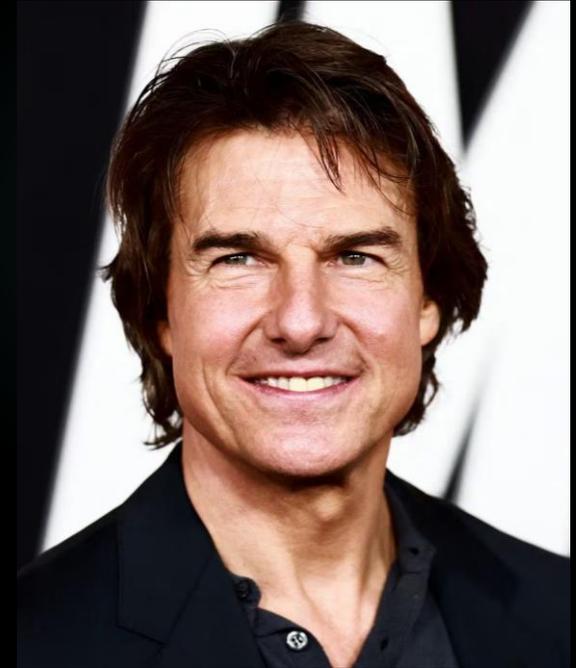
Bruce Willis - Dementia



Justin Timberlake - ADHD

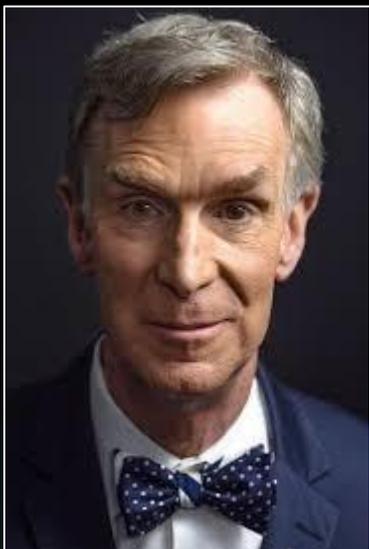


Michael Phelps - ADHD



Tom Cruise - Dyslexia

# New Inductees - 2025



Bill Nye - Ataxia



Brett Favre – Alzheimer's



Elon Musk  
Autism Spectrum



Elton John – Vision Loss



Paul Simon – Hearing Loss



Stevie Nicks – Macular  
Degeneration & Stuttering



Kim Kardashian  
Foot Injury



Bedazzled Scooter



Nancy Pelosi – Hip Fracture

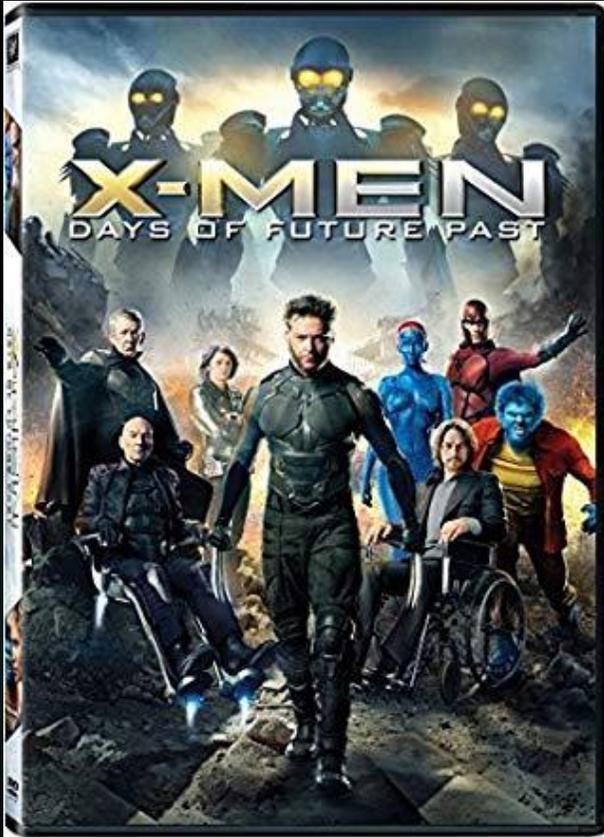


Wendy Williams  
Aphasia & Dementia

# A Superhero with a Disability



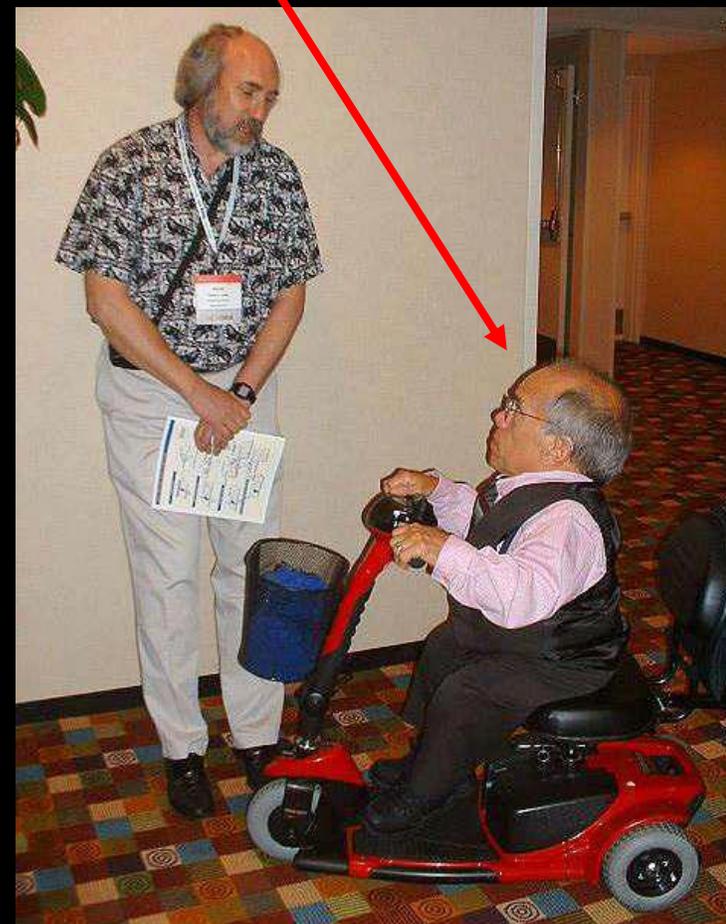
# Superheros with a Disability



# Robert Van Etten



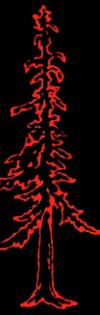
- ▶ Dwarf
- ▶ Midget
- ▶ Shorty
- ▶ Little person
- ▶ Munchkin
- ▶ Elf
- ▶ Height challenged
- ▶ Scooter-guy
- ▶ Something else?



# Bob



# Device Definition of Assistive Technology



The Technology Related Assistance Act of 1988 (P.L. 101-407) and the Assistive Technology Act of 1998 (P.L. 105-394) provide a standard definition of assistive technology as “any item, piece of equipment, or product, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities.”

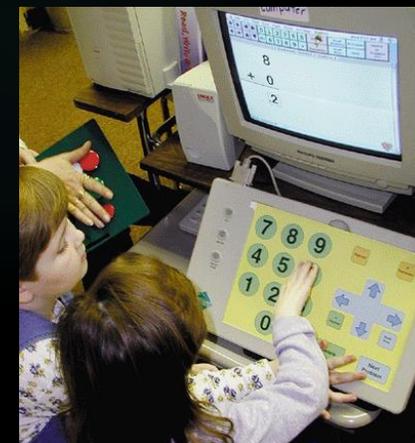
South Carolina Assistive Technology Program - [link](#)

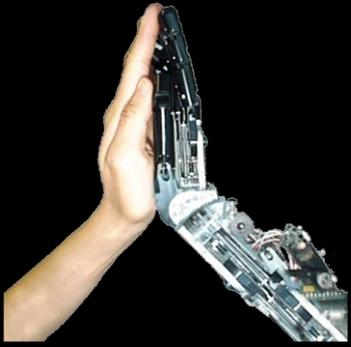


# My Definition of Assistive Technology



- ▶ Assistive Technology (AT) is a generic term that includes:
  - ▶ Devices, services, and policies that benefit people with disabilities
  - ▶ Institutions and facilities where the work takes place
  - ▶ The process that makes them available to people with disabilities.
- ▶ An AT device is one that has a diagnostic, functional, adaptive, or rehabilitative benefit.
- ▶ An AT service provides various resources.
- ▶ AT policies, laws, and legislation that mandates the provision of devices and services
- ▶ Engineers employ an AT process to specify, design, develop, test, and bring to market new devices.





# Assistive Technology



AT devices provide greater independence, increased opportunities for participation, and an improved quality of life for people with disabilities by enabling them to perform tasks that they were formerly unable to accomplish (or had great difficulty accomplishing or required assistance) through enhanced or alternate methods of interacting with the world around them.

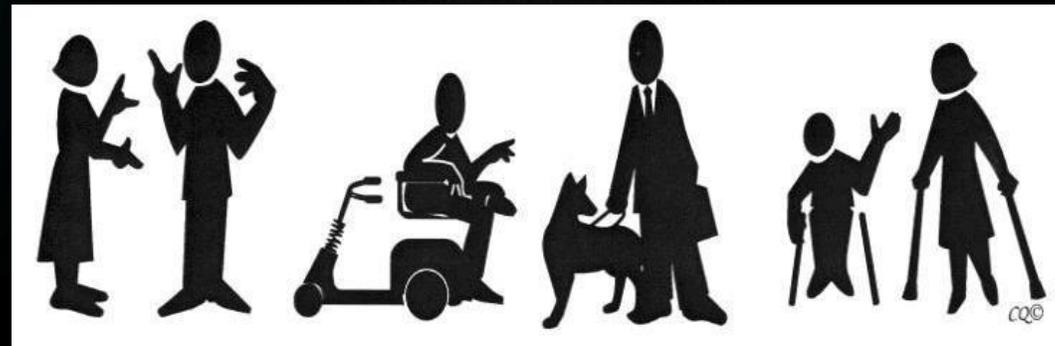


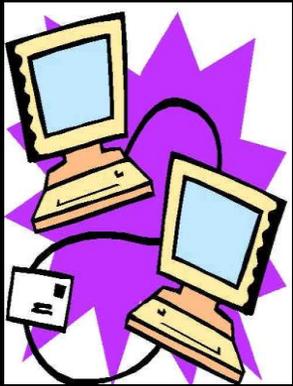


# Assistive Technology



Devices provide greater independence, increased opportunities for participation, and an improved quality of life for everyone by enabling us to perform tasks that we were formerly unable to accomplish (or had great difficulty accomplishing or required assistance) through enhanced or alternate methods of interacting with the world around us.





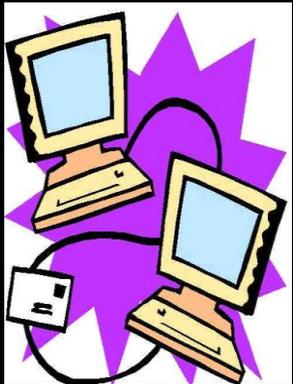
# Assistive Technology



New AT devices incorporating novel designs and emerging technologies have the potential to further improve the lives of people with disabilities.

- ▶ Computers, IoT
- ▶ Robotics & Mechatronics
- ▶ Nanotechnology
- ▶ Medical technologies
- ▶ Wearable devices





# Assistive Technology



New devices incorporating novel designs and emerging technologies have the potential to further improve the lives of everyone.

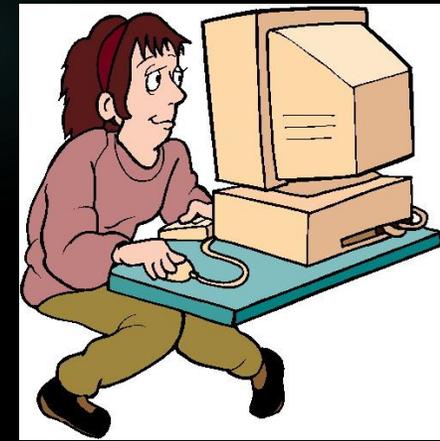
- ▶ Computers, IoT
- ▶ Robotics & Mechatronics
- ▶ Nanotechnology
- ▶ Medical technologies
- ▶ Wearable devices



This leads me to conclude that:



# Everything is Assistive Technology!



- ▶ Technology
- ▶ Transportation
- ▶ Institutions
- ▶ Organized government
- ▶ Networks: TV, Radio, Internet, Highway, Electricity, News, Gas, Food, Commerce, Money, Entertainment, Sports, Computers



The universe seems neither benign nor hostile, merely indifferent to the concerns of such **puny creatures** as we are.  
Carl Sagan



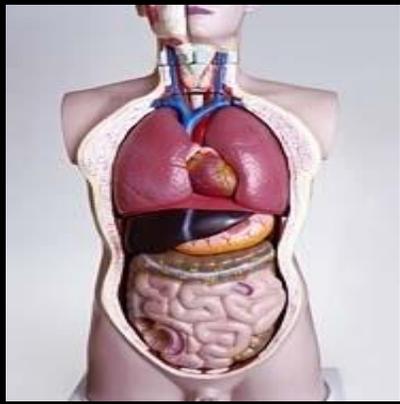
# Assistive Technology Workers



Health care professionals (not just engineers) are involved in evaluating the need for AT devices; working on research, design, and development teams; prescribing, fitting, and supplying them; and assessing their benefit.

- ▶ Physicians
- ▶ Clinicians
- ▶ Therapists
- ▶ Suppliers
- ▶ Policy makers
- ▶ Educators
- ▶ Caregivers

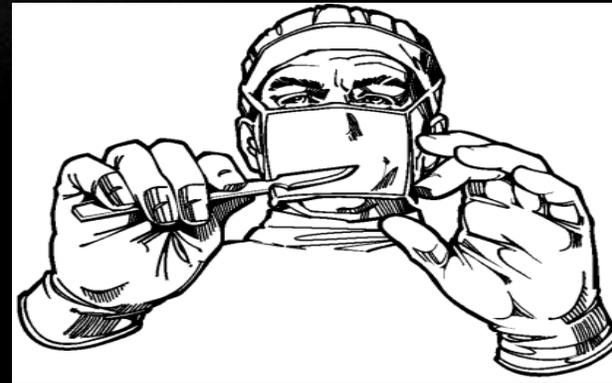
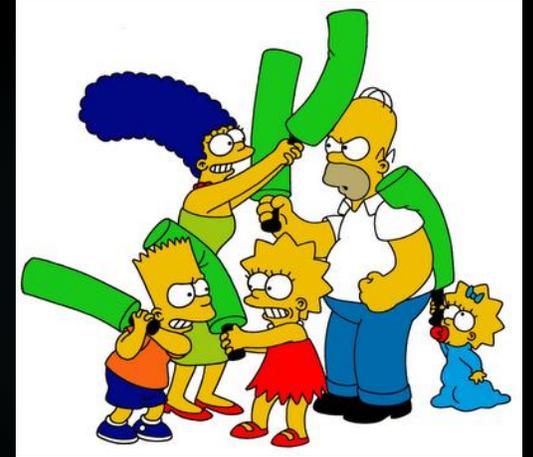


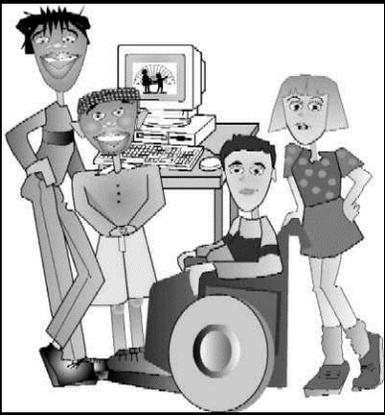


# Rehabilitation



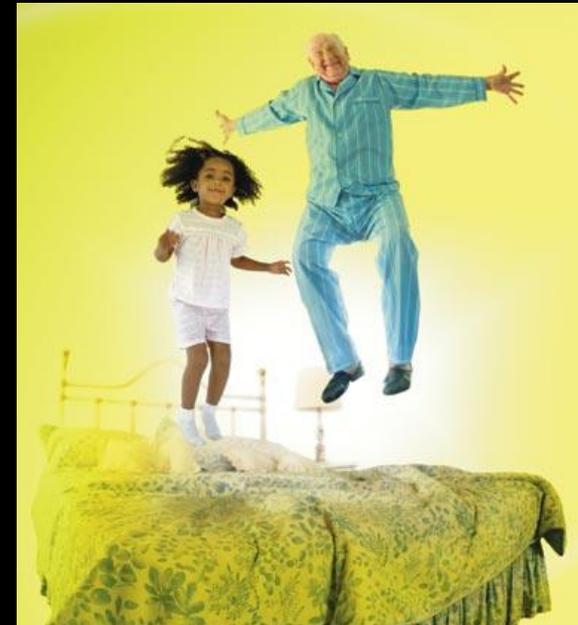
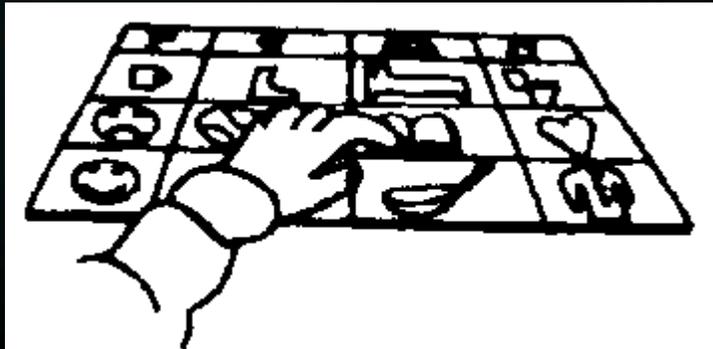
- ▶ Medical model: Restoration of function caused by disability - through surgery, medication, therapy, and/or retraining - “fix broken people”
- ▶ More inclusive model: Includes Assistive Technology





# Goals

- ▶ Goal of Rehabilitation
  - ▶ Restore function and wellness
  
- ▶ Goals of Assistive Technology
  - ▶ Increase independence
  - ▶ Improve quality of life



# Scientific Definition of Rehabilitation Engineering



Rehabilitation Engineering may be defined as a **total approach to rehabilitation that combines medicine, engineering, and related sciences to improve the quality of life of persons with disabilities.**

How and when did the rehabilitation engineering center program come into being? - James R. Reswick, ScD, DE - NIDRR - [link](#)



# Rehabilitation Engineering



**Rehab Engineers** assist people who have a functional impairment by engaging in one or more of these activities:

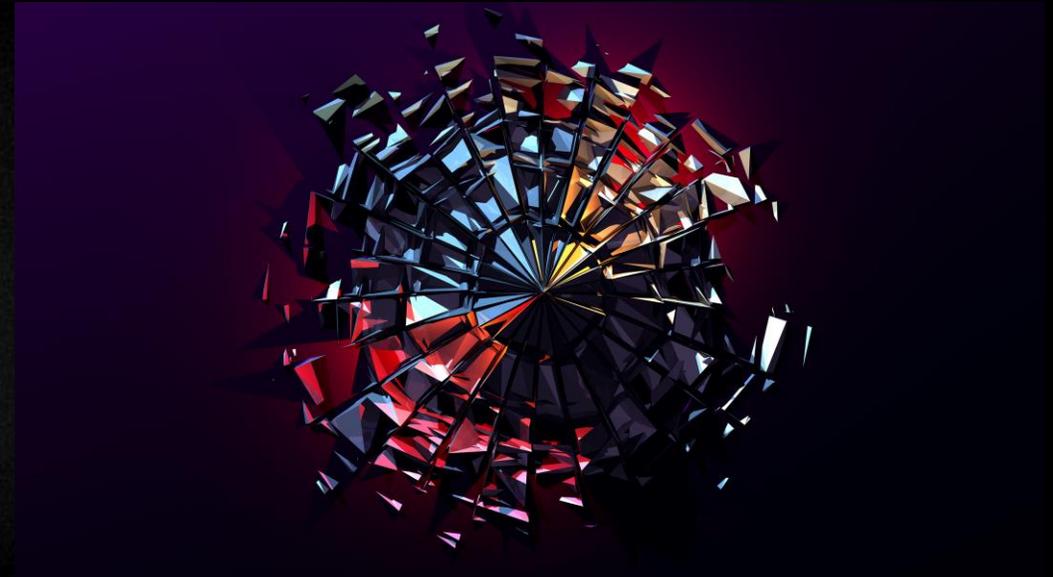
- ▶ Device Design
- ▶ Research & Development
- ▶ Technology Transfer
- ▶ Marketing
- ▶ Provision
- ▶ Education & Training



# Facets of Rehabilitation Engineering



- ▶ Personal Transportation (vehicles and assistive driving)
- ▶ Augmentative & Alternative Communication
- ▶ Dysphagia: Eating, Swallowing, Saliva Control
- ▶ Quantitative Assessment
- ▶ Technology Transfer
- ▶ Sensory Loss & Technology
- ▶ Wheeled Mobility & Seating
- ▶ Electrical Stimulation
- ▶ Computer Applications
- ▶ Rural Rehabilitation
- ▶ Assistive Robotics & Mechatronics
- ▶ Job Accommodation
- ▶ Gerontology - Technology for Successful Aging
- ▶ International Appropriate Technology
- ▶ Universal Access



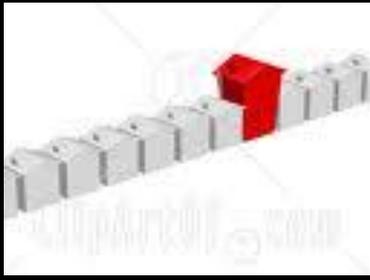
# Rehabilitation Technology



The term rehabilitation technology refers to the systematic application of technologies, engineering methodologies, or scientific principles to meet the needs of and address the barriers confronted by individuals with disabilities in areas which include education, rehabilitation, employment, transportation, independent living, and recreation. The term includes rehabilitation engineering, assistive technology devices, and assistive technology services.

Rehab Act





# Assistive Technology Market



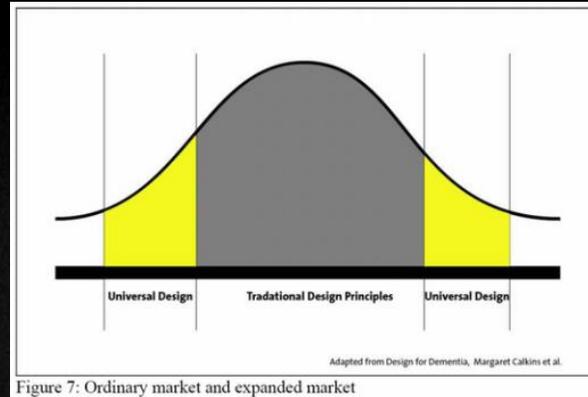
- ▶ Many people with a disability - in US and world-wide (over 1 billion)
- ▶ Largest **non**-homogeneous group in the US is wheelchair users (several million)
- ▶ **Every consumer has a unique personality, challenges, circumstances, goals, and aesthetic preferences**
- ▶ **The lack of a well-defined mass market means that companies serving individuals with disabilities and older adults are small and their products are expensive**



# Universal Design

**Universal design** (often called **inclusive design**) refers to a **design strategy** meant to produce buildings, products, and environments (shared resources) that are inherently accessible to the greatest number of individuals including older adults, people without disabilities, and people with disabilities.

The term "universal design" was coined by the architect Ronald L. Mace to describe the concept of designing all products and the built environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability, or status in life.



Meyer Library



Terman Fountain



# Universal Design Examples



The Problems with Ramps  
Blended into Stairs



Ed Roberts Campus

We have the  
solution  
for you!

# Individual Design



- ▶ Individuals with disabilities and older adults may have personal challenges that can only be addressed by a custom solution
- ▶ The specific challenge, personal preference, and **coolness** direct prototype design in the course
- ▶ Examples:
  - ▶ Wheelchair seating
  - ▶ Prosthetic fittings
  - ▶ Wheelchair laptrays
  - ▶ Devices to aid with activities of daily living



# Example Assistive Technology Devices



- ▶ Projects I worked on at the VA RR&D Center
- ▶ Commercial devices and research projects
- ▶ Technologies that have made an impact



# Head Control Interface



- Features

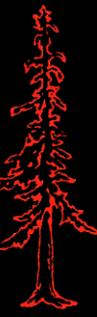
- 2 degrees of freedom
- real-time operation
- non-contact interface
- front or rear sensing
- mouse or joystick substitute

- Applications

- control of mobility (electric wheelchair) contrast with voice control alternative
- control of cursor position with hands on keyboard
- demonstrated robot control



# Head Control Interface Video



[YouTube link](#)

# Ralph Fingerspelling Hand



- ▶ Ralph offers individuals who are deaf-blind improved access to computers and communication devices in addition to person-to-person conversations.
- ▶ Enhancements of this design include better intelligibility, smaller size, and the ability to optimize hand positions.



# Ralph Video



[YouTube link](#)

# Driving Simulator



- The goal of this project was to evaluate the potential of a high-quality computer-based driving simulator to accurately assess and improve the driving ability of veterans with Stroke and Traumatic Brain Injury (TBI).
- Create realistic driving scenarios to address specific cognitive, visual, and motor deficits in a safe setting
- Compare driving performance with traditional “behind-the-wheel” assessment and training



DriveSafety Model 550C 3-Channel Simulator with Saturn car cab.

# Example Assistive Technology Devices



Bionic Hand  
Luke Arm  
Prosthetic Arm Design  
Bionic Eye  
Joint Implants  
Personal Robot  
Brain Computer Interface  
3-D Printing  
Cyborg Beast  
Google Glass  
Bionic Pets  
Essential Tremor  
Ralph Fingerspelling Hand

Bionics  
Terminator Arm Fingers  
iBot Wheelchair  
Cochlear Implants  
Advanced Prosthetics  
Exoskeleton  
Mind-controlled Limbs  
Project Daniel  
Robot Bed / Wheelchair  
Designs for People with Dementia  
Steampunk Wheelchair  
Head Control Wheelchair  
Whill Wheelchair

# Brain Computer Interface



- ▶ Noninvasive - picks up surface EEGs
- ▶ Determines 6 mental states - concentration / meditation
- ▶ Detects blinks
- ▶ Controls computer games
- ▶ Open API for other applications



NeuroSky's MindSet

\$200

# Mind-controlled Limbs



Humans can now move robotic limbs using only their thoughts and, in some cases, even get sensory feedback from their robotic hands. [60 Minutes](#)

# 3D Printing



“Officially launched in January 2012, Robohand creates **affordable mechanical prosthetics** through the use of 3D printers. Not only that, but it has made its designs open source, so that anyone with access to such printers can print out fingers, hands, and now arms as well.”

# Project Daniel



“A company called **Not Impossible Labs** has come up with one of the best uses for 3D printer technology we've ever heard of: **printing low-cost prosthetic arms** for people, mainly children, who have lost limbs in the war-torn country of Sudan.”



# Cyborg Beast



“Jeremy Simon from 3D Universe was able to create a **3D-printed hand** that he calls the Cyborg Beast. It's a completely mechanical device made from ABS plastic with a series of flexible cords that allow it to act like a real hand. It turned out so well that the patient says he prefers it for day-to-day use.”

# Robot Bed / Wheelchair



“A bed that transforms directly into a wheelchair. The mattress is split in half, with one side remaining firmly in place when the other half is separated to form the body of the chair. A patient simply needs to move over a few inches to one side, and with a few adjustments they'll be sitting upright in a powered wheelchair. A single caregiver assists during the transformation process, significantly reducing the burden on staff.”

Panasonic



# Google Glass



Tammie Lou Van Sant of Santa Cruz is a quadriplegic. She has wanted to take pictures for years and now is able to do it independently using Google Glass - with a nod, swipe, or verbal command.

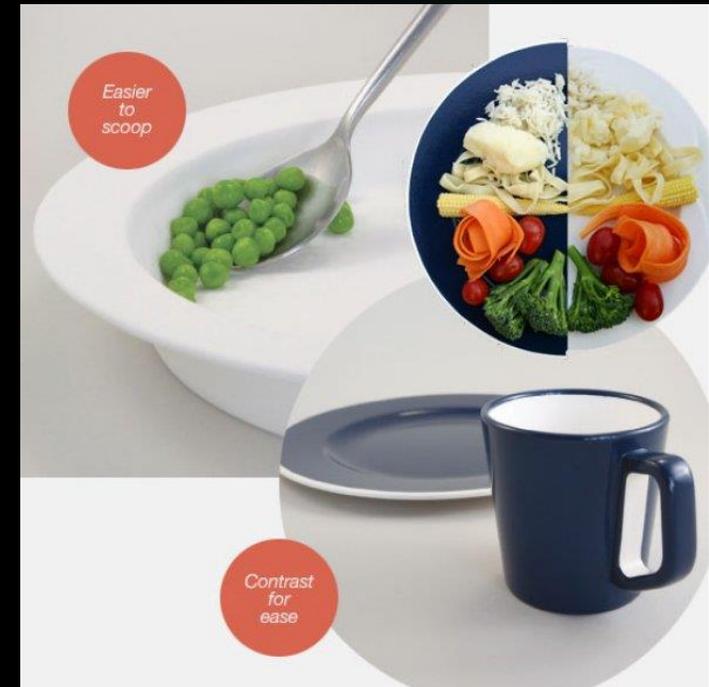


"I am a New Yorker, a law student, a **quadriplegic**. With Google Glass I could finally capture my life on my own. I would show the world how to thrive with physical limitations in the most interesting city on the planet. With Glass, paralysis doesn't have to be paralyzing." Alex Blaszcuk

# Designs for People with Dementia



“A re-thinking of a table setting specifically tailored to help those with cognitive impairment eat without assistance.” Sha Yao



# Winner of Stanford Center on Longevity First Design Challenge





# Bionic Pets

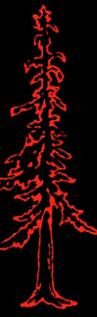


“Sometimes individual animals need our help. Left disabled without fins, flippers, beaks, or tails because of disease, accidents, or even human cruelty, these unfortunate creatures need what amounts to a miracle if they are to survive. Luckily for them, sometimes miracles do happen. Amazing prosthetics made possible by the latest engineering and technology are able to provide just what they need, and scientists are finding that innovations created in the process are **benefiting both animals and humans.**”

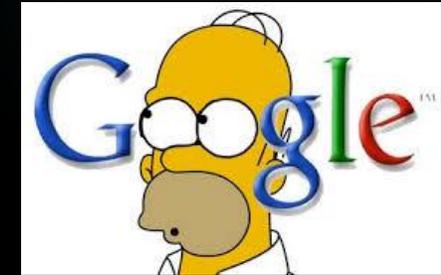
# Steampunk Wheelchair



“Help us construct a retro-futuristic Steampunk Wheelchair for a 14 year-old boy with Muscular Dystrophy. We want to modify a wheelchair to take it from ‘functional’ to ‘awesome’ to will help him gain confidence in his interactions by changing the focus of the conversation and **expressing his uniqueness and individuality through his mobility device.**”



# Essential Tremor



“A motion sensor and a tiny computer in Liftware’s rechargeable base work together to analyze movement frequencies and distinguish unintentional tremor from intentional movements like bringing the spoon to your mouth. Based on that feedback, the utensil attachment **compensates for the involuntary motion**; if the tremor sends the base stabilizer to the left, the spoon head will adjust to the right.”

# iBot Wheelchair

- ▶ The **Balance Function** elevates the user to move around at eye level and to reach high places independently. In this function, the front wheels rotate up and over the back wheels, while the user remains seated at an elevated position.
- ▶ The **Stair Function** enables the user to safely climb up and down stairs, with or without assistance, giving them access to previously inaccessible places.
- ▶ The **4-Wheel Function** enables the user to climb curbs as high as five inches and to travel over a variety of uneven terrain, such as sand, gravel, grass, thick carpet and other surfaces.
- ▶ Johnson & Johnson Independence Technology
- ▶ Toyota Research Institute
- ▶ Mobius Mobility



[Web link](#)



**I AM NOT  
DISABLED** I JUST  
**REALLY LIKE  
WHEELCHAIRS!**



Whill Wheelchair



Alexis Wheelchair



# Student Projects from 2024



STUDENT  
PROJECT  
GALLERY

# Student Projects from 2024



# Student Team Projects

- ▶ Ten-week course conducted in-person, in classroom
- ▶ Five teams of four, two teams of three, and one team of two students
- ▶ Four students just attended lectures, no project involvement
- ▶ Thirty-two students enrolled
- ▶ Fabrication projects addressed challenges experienced by people with disabilities and older adults in the “local” community
- ▶ Deliverables included presentations, reports, and individual reflections

# Accessible and Inclusive Playground Attractions (1)



Explore designs to create new play and educational experiences incorporating multiple senses, actions, and outcomes for all playground users and visitors, especially those with visual impairments and diminished fine motor skills.

# Creative Expression for Sylvia



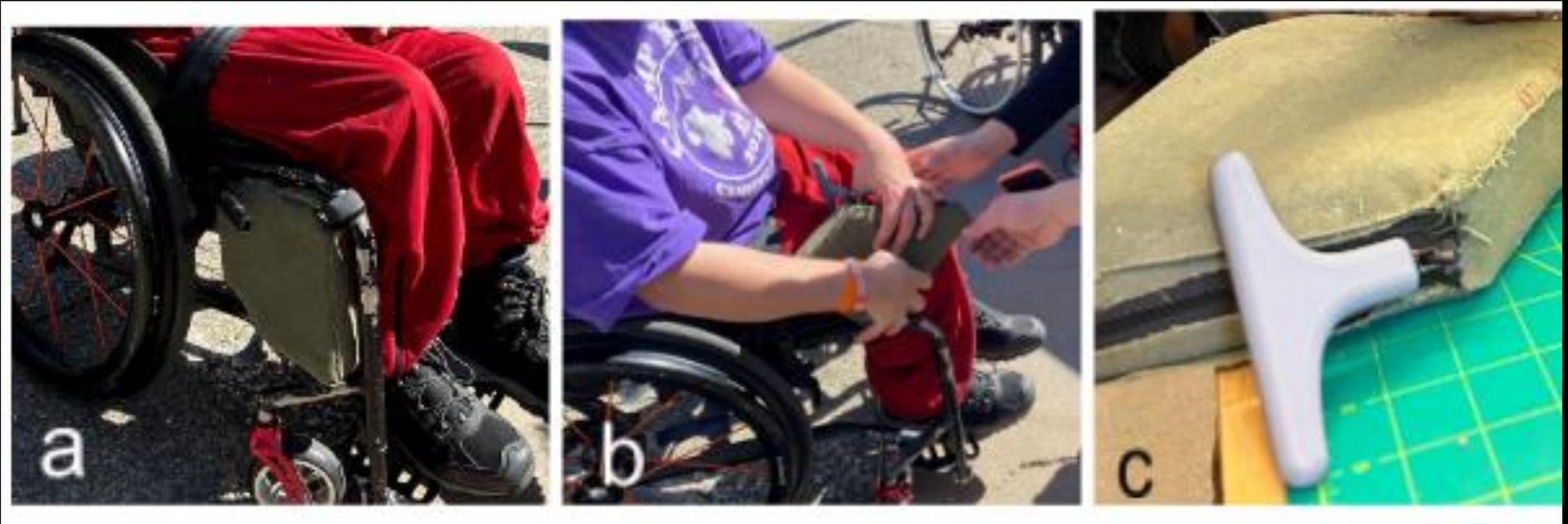
Explore ways to enhance creative expression for Sylvia, a wheelchair user who wears a catheter.

# Dog Kennel Project for Danny's Service Dog Korey



Explore designs that would enable Danny to independently care for his service dog, Korey, by providing an easier way to open & close and latch & unlatch Korey's kennel door.

# Storage Solution for Danny



Explore designs for an accessible storage solution for Danny, a wheelchair user with CP.

# Laptray for Danny



Explore ways for Danny to easily access his personal items on his wheelchair.

# Accessible and Inclusive Playground Attractions (2)



Explore designs to create new play and educational experiences incorporating multiple senses, actions, and outcomes for all playground users and visitors, especially those with visual impairments and diminished fine motor skills.

# Accessible Storage Solution for Abby



Explore designs for an accessible storage solution for her scooter and wheelchairs.

# Treats for Nathan



Explore solutions that would enable Abby to easily reward Nathan, her service dog.

# Candidate Student Projects



- ▶ Solicited from community
- ▶ Suggested by Dave
- ▶ Student-defined projects



# Team Project Offerings

This year's candidate team projects:

- ▶ Projects with Abby, Olenka, Gary, Danny & Stanford & Kiara
- ▶ Projects suggested by Dave
- ▶ Student-defined projects
- ▶ **Bring your laptop on Thursday**



# Individual Project Offerings



This year's candidate individual projects:

- ▶ Report on an advance in assistive technology
- ▶ Report on a disability-related topic
- ▶ Report on a local disability or aging organization
- ▶ Pursue a paper or CAD design
- ▶ Pursue an “appearance model”
- ▶ Create a work of art
- ▶ Engage in an aftermarket aesthetic design
- ▶ Engage in an aftermarket functionality / usability design
- ▶ Student-defined projects

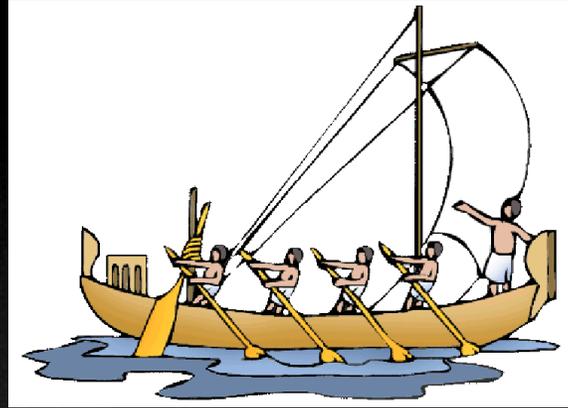


# Project Pitches & Team Formation



Dave's suggested projects:

- ▶ Creative Expression
- ▶ Designing Your Afterlife
- ▶ Tactile Art



# Student Project Resource People



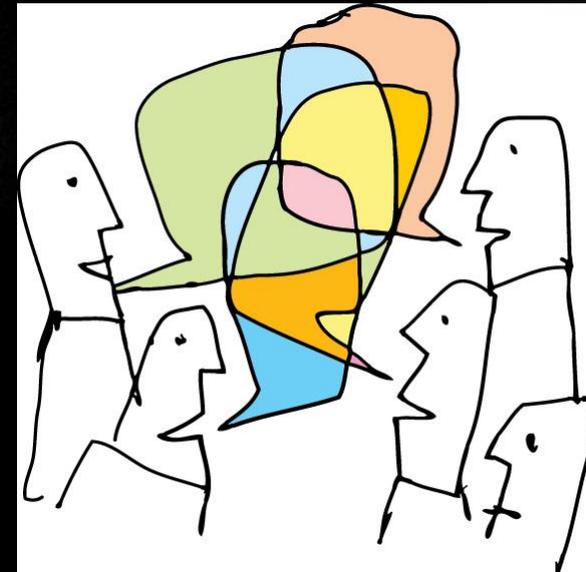
- ▶ Debbie Kenney - Occupational Therapist
- ▶ Doug Schwandt - Mechanical Engineer Consultant
- ▶ Gary M. Berke - Director of Prosthetics
- ▶ Jules Sherman - Designer & Entrepreneur



# Other Involved People



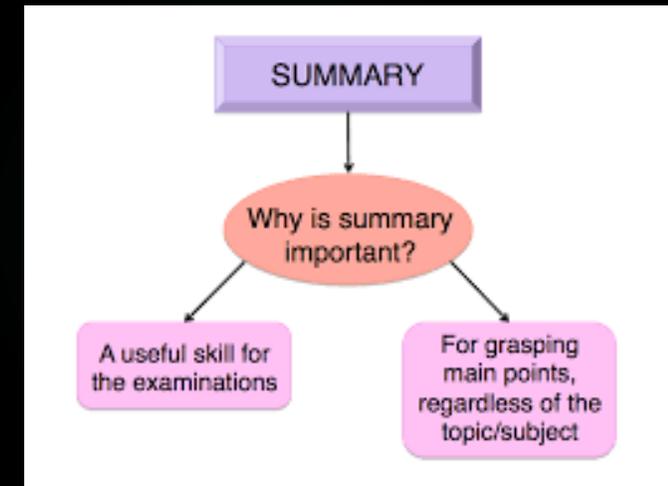
- ▶ Project suggestors
- ▶ Individuals with disabilities
- ▶ Community members attending lectures



# THE EXECUTIVE SUMMARY



- ▶ Flexible course focusing on **building confidence and enhancing professional skills**
- ▶ Lectures, projects, field trip, assistive technology faire, mid-term & final presentations and reports, project demonstration
- ▶ Opportunities for in-class participation and reflection
- ▶ Lots of assistive technology products, research, student projects, and remaining challenges
- ▶ Assistive technology benefits everyone
- ▶ **Everything is assistive technology!**



# Contact Information

- ▶ Website:

- ▶ <http://enr110.stanford.edu>

- ▶ Email addresses:

- ▶ Dave - [davejaffe@stanford.edu](mailto:davejaffe@stanford.edu)

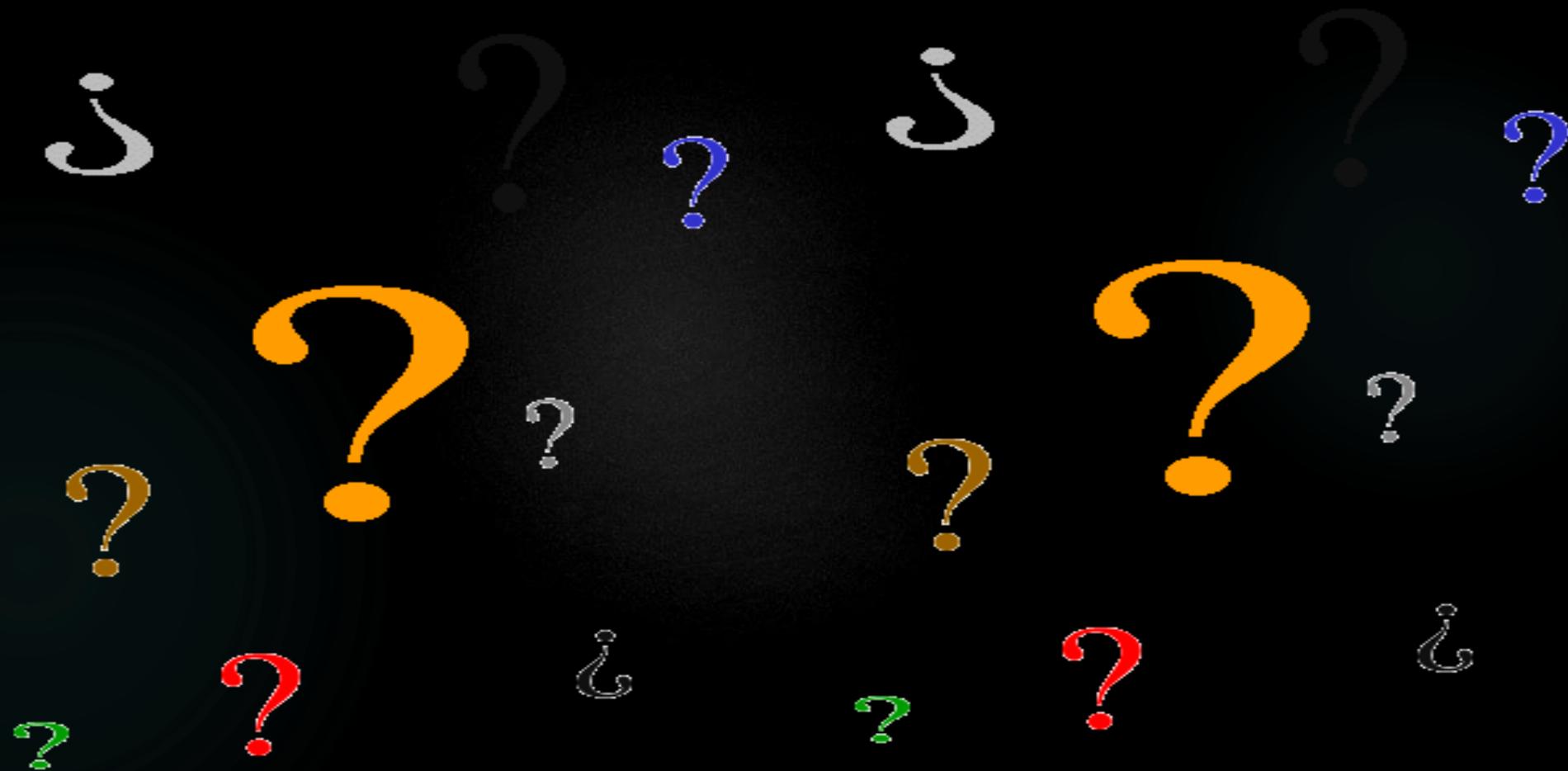
- ▶ Mathilda - [mathilda@stanford.edu](mailto:mathilda@stanford.edu)

- ▶ Lance - [lkeneley@stanford.edu](mailto:lkeneley@stanford.edu)





# Questions?



Adjourn



class dismissed

