Artificial Intelligence Challenges the Status Quo

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Technology...EHRs...Automation

• What is Artificial Intelligence (AI)?
• How is AI currently being used?
• How is AI challenging the way healthcare is provided?
• Looking ahead to the future of healthcare...
What is Artificial Intelligence (AI)?

• Ambiguous

• “A spreadsheet on steroids trained on big data”
Artificial Intelligence

A branch of computer science dealing with the simulation of intelligent behavior in computers.  

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The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.  

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Merriam-Webster Dictionary

Google Dictionary
Philosophy of AI

Alan Turing

• Mathematical code-breaker WWII
• Cracked the Enigma code
• Theorized the first computer
• Widely held to be father of computer science and AI

Imitation Game 2014

Duke Center for Health Informatics
Turing Test for Intelligence

- Computing Machinery and Intelligence. *Mind*, 1950

- (1) The Imitation Game. "I propose to consider the question, “Can machines think?”

- Machine vs. human using the same questions: indistinguishable
Keyword and PubMed

July 11, 2017: “artificial intelligence”= 71,828

- Machine learning
- Neural networks
- Deep learning
- Natural language processing
- Text mining
Tutorial

Machine learning (ML)
• Machine that can make a decision and learn from the errors in those decisions
• New way to solve problems
• Modeled after human brain
• Give it data, make a decision, right or wrong, adjusts, repeats

Text Mining
• Use unstructured data to derive insight from text
Natural Language Processing

- System that processes human language

Examples:
- Spam classifier (looks at title, date, return address, etc. to determine if it is spam)
- Google requests

- Key component of NLP is semantic computing
  - Uses related data to develop conclusions about meaning, content, and structure of data sets
  - Uses key elements of both computer science and linguistics

- Used for text mining, machine translation, automated question answering
Neural networks
• Algorithms that mimic biological brains with neurons and synapses
• Learn from examples to recognize similarities and cluster like groups: pattern recognition

Deep Learning
• A big neural network
• Lots of layers, generally used with large amounts of data, huge calculations, many floating point calculations with huge numbers of processors
How is AI being used?
"Artificial intelligence is one of many leading-edge technologies that China seeks and that has potential military applications“
(Sen. John Cornyn aide)

HAL 9000 (Heuristically programmed Algorithmic computer)

- Facial recognition
- Lip reading
- Natural language processing
- Speech recognition
- Playing chess
- Interpreting emotional behavior
- Art appreciation
- Reasoning


https://en.wikipedia.org/wiki/HAL_9000
“Launched a smart Wi-Fi speaker that not only hears what you say, but also shows you what it sees. This 7-inch touchscreen-equipped digital assistant — Echo Show — is the latest addition to the Alexa family, which began as a simple voice-controlled alarm clock and is fast becoming the central hub of digitally connected homes. All your home appliances and accessories, including your vehicle, will soon be connected to the Internet and voice controlled. Someday in the future, when the milk is running low, your fridge will text you a shopping list while routing your Volkswagen to the closest Walmart on the way home.”
Personal Assistants

Amazon: Alexa (Echo)
- Ford Motor Co.
- Sears’ Kenmore refrigerators
- Link to Microsoft Outlook

Samsung: Bixby
- Other Samsung products

Alphabet: Google Assistant (Cortana)
- Sony
- LG Electronics (dryers and vacuum cleaners)
- Walmart

Apple: Siri
Google Brain Research
“Make machines intelligent. Improve people’s lives.”

• Machine learning
  – Neural networks
  – Deep learning

• Natural language understanding (for machines to excel at tasks humans are good at)
  – Word2vec: Neural network, maps words to vectors (open sourced 2013)

• Perception (ability to hear and see: deep learning systems)
Google Brain Research

• Music and art (neural nets for artistic purposes)

• Robotics: Self-driving cars

Google’s self driving car drove 80 million miles before it ever touched a road

Hanson Robotics: Meet Sophia

- Natural facial expressions
- Cameras in eyes, makes eye contact
- Understands speech and remembers

[Video](https://youtu.be/wimUaNqEJyw?t=697)
Things described as using AI

• Online shopping
• Games
• Smart cars
• Credit card fraud
• Online Support (chat bots)
• Wordsmith Journalist (Automated Insights/Vista)
• Security Surveillance
• Entertainment: Pandora (thumbs up/down), Netflix, Spotify
8 more things you didn't know AI could do

- Protect the world from errant asteroids
- Encourage rape and pedophilia (4 US companies)
- Get marijuana recommendations (PotBot)
- Make roti (Rotimatic)
- Read body language (Carnegie Mellon University Robotics)
- Optimize nuclear power stations (EDF Energy, UK, sensors)
- Help particle physicists discover new subatomic particles
- Explain the birds and bees to your kids (SophiBot)

7/17/17: O'Reilly Artificial Intelligence Newsletter oreilly@post.oreilly.com
PotBot: Personalize your medical marijuana: More Science, Less Guessing

* Symptoms/conditions
* Recommended cannabinoid levels and strains
* Dispensary near you

AI in Health Care
Mycin System (1970s)

- Early expert system written in Lisp
- Identify bacteria causing severe infections and recommend antibiotics ...dosage adjusted for patient's body weight
- Proposed an acceptable therapy (69%), was better than infectious disease experts
- Diagnosis of blood clotting diseases
- Never used
The Smart-Medicine Solution

Our health-care system won't be fixed by insurance reform. To contain costs and improve results, we need the tools of information-age medicine.

The controversy over Obamacare and now the raucous debate over its possible repeal and replacement have taken center stage recently in American politics. But health insurance isn't the only health-care problem facing us—and maybe not even the most important one. No matter how the debate in Washington plays out in the weeks ahead, we will still be stuck with astronomical and ever-rising health-care costs. The U.S. now spends well over $10,000 per capita on health care each year. A recent analysis in the journal Health Affairs by the economist Sean F. Keehan and his colleagues at the federal Centers for Medicare and Medicaid Services projects that health spending in the U.S. will grow at a rate of 5.8% a year through 2025, far outpacing GDP growth.

Medical professionals. In medical training, private sector R&D, doctor-patient relations and public policy, we need to move much more aggressively into the era of smart medicine, using high-tech tools to tailor more precise and economical care for individual patients. This transition won't be easy or fast—the culture of medical practice is famously conservative, and new technologies always meet some spikes in his evening blood pressure, all had already changed the dose and timing of his medication; the spikes were now nicely controlled. Having lost 15 pounds in the past four months, he had also been pleased to see that he was having fewer atrial fibrillation episodes—which he attributes to the credit-card-size electrocardiogram sensor attached to his smartphone.

In my three decades as a doctor, I have never seen such an acceleration of new technology, both hardware and software, across every dimension of medical practice. I have also had the opportunity to advise and collaborate with several companies on these developments. The new tools are not just more powerful, precise and convenient; they are also more economical, driven by the information revolution's ability to deliver, as Moore's Law holds, at lower cost.
Microsoft Seeing AI App

“Uses Artificial intelligence and camera on iPhone.”

- Reads documents
- Barcode identification
- People identification: facial recognition
  - Sex, facial expression, age, other identifying conditions
- Surroundings (Beta testing)

Seeing AI App is Now Available in the iOS app store. July 12, 2017
How an iPhone app could diagnose jaundice in babies

BY LUKE DORMEHL • 6:01 AM, AUGUST 28, 2014

https://www.cultofmac.com/293066/iphone-app-diagnose-jaundice-babies/
Ophthalmology

• Long, et al. used deep learning algorithms
• Training set: 410 images of congenital cataracts + 476 images disease-free
• “Complement the physician”

• DeepMind and Mooresfield Eye Hospital 2016
  ➢ Diabetic retinopathy + macular degeneration
Google DeepMind

- University College London Hospital
  - August 2016
  - 700 scans of head and neck cancer
  - Identify cancerous tissue versus non-cancerous (segmentation)

- Can AI identify areas to be treated?
- Could reduce time from 4 to 1 hrs.
Google, Verily Life Sciences

- Alcon: smart lens, glucose monitoring
- Debug: mosquitoes...good bugs versus bad bugs
- GlaxoSmithKline...*Galvani Bioelectronics*: inflammatory, metabolic, and endocrine disorders using miniaturized devices/ precise peripheral nerves
- Sanofi...*Onduo*: Type 2 diabetes. Using devices, software, medicine, professional care for intelligent disease management
- Ethicon (J&J)...*Verb Surgical*, platform using robotics, visualization, machine learning, advanced instrumentation to assist OR team
Verily Science Watch

• UNC, Harvard…Aurora Study
  5,000 post-traumatic conditions
• Duke and Stanford: Project Baseline
  Longitudinal study; transitions between health/disease
• Netherlands: Personalized Parkinson’s Project
  Molecular analysis, brain imaging, sensors
  Characterization of disease
Google Brain

- “Deep learning AI research project”
- Breast cancer
- Neural network architecture with images
  - Applied to digital pathology
  - Surveying the data on a pixel-by-pixel basis
  - Heat maps to predict likelihood of tumor cells
- 89% accuracy vs. 73% pathologist accuracy
Project combines mobile tech, AI to detect skin diseases

By
Joseph Goedert
Published
September 05 2017, 7:25am EDT

Kyocera (Electronics manufacturer) and University of Tsukuba

• “AI-based image recognition system” that classifies set of images based on deep-learning technology (20,000 clinical images from last 20 years)
• Melanoma, then other skin diseases

Duke Center for Health Informatics
Motivation

**TIME**

- 30 hours for 130 slides (4.3 slides/hr.)
  vs.
- 280 million slides / day (11,666,666/hr.)

50/day = 15,342 years
200/day = 3,836 years
IBM and Watson

• Technology: includes 64 of IBM’s TrueNorth chips in a standard server shelf
  – capable of scaling to *half a billion* artificial neurons with its modern architecture

• By 2020, will have a “*10 billion* neuron-equal system that can fit in a two-liter box and need only 20 watts to operate, would provide a desktop operation with roughly *10%* the computing ability of the human brain that could simply run on a smartphone battery”
Looking ahead to ........................
the future of health care
China’s Plan for World Domination in AI Isn’t So Crazy After All

Mark Bergen and David Ramli
August 14, 2017, 7:53 PM EDT
Artificial Intelligence Could Take Over Surgical Jobs by 2053

Artificial intelligence could advance far enough to take over surgical duties by the middle of the century, machine learning experts predicted.

HealthIT Analytics  June 7, 2017
The Real Threat of Artificial Intelligence

• A.I. products that now exist are improving faster than most people realize and promise to radically transform our world.…

• They are only tools, not a competing form of intelligence….will reshape what work means …. will eliminate many jobs…. radiologists will gradually be replaced by such software.

Driverless cars and trucks don’t mean mass unemployment—they mean new kinds of jobs

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Cathy Engelbert
CEO at Deloitte
Workers: Fear Not the Robot Apocalypse

Automation commonly creates more, and better-paying, jobs than it destroys. A case in point: U.S. retailing

By Greg Ip
Sept. 5, 2017 1:11 p.m. ET
The Real Advantage of Artificial Intelligence

- Relieve provider shortage
- Offer more healthcare choices
- Improve accuracy
- Improve patient outcomes
- Reduce costs
In its infancy…
but potential contribution is immense

Think ahead 10, 20, 30 years!
Thank you!