# The Future of Artificial Intelligence
# - Seizing New Opportunities

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# Today

- Digital Transformation
  - Punctuated Equilibrium
  - How should CEO & Leaders tackle Digital Transformation?
- Artificial Intelligence (AI) and Machine Learning (ML)
  - History
  - ML classes and perspectives
- Digital Transformation for Amorepacific
  - How to use ML
  - Ways that ML being used in Beauty Industry
  - Cloud computing for ML
- Singularity

# Digital Transformation

based on a book by Thomas M. Siebel

# Digital Transformation

- arises from the intersection of
  - Cloud Computing, Big Data, Internet of Things (IoT), Artificial Intelligence (AI)
- power of digital technology applied to every aspect of the organization
- digital technologies and advanced analytics for economic value, agility, and speed

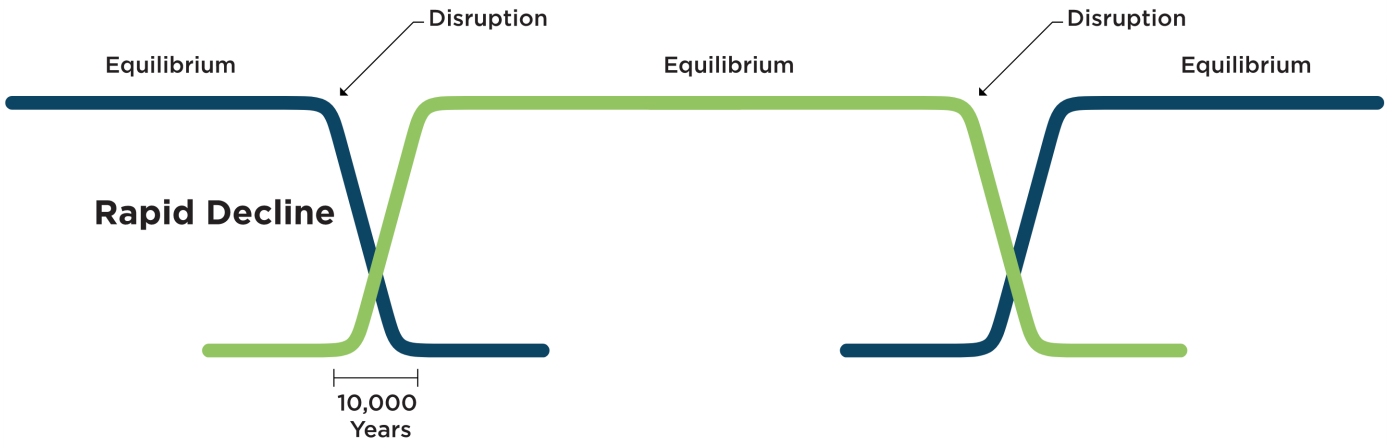
# Punctuated Equilibrium

(bit of paleontology lecture)

- early editions of Darwin's "On the Origin of Species" assumes
  - evolutionary speciation is a force of constant continuous change
- (however) species that suddenly appear/disappear (hundreds of) millions of years later
- Stephen Jay Gould's book "Punctuated Equilibrium" indicates that species change
  - does not advance gradually
  - but frequently massively disruptively

# Discontinuity driven by Disruption

- massive disruptions repeatedly caused *mass extinction* and *mass speciation*
- discontinuity is the rule, not the exception in geologic time

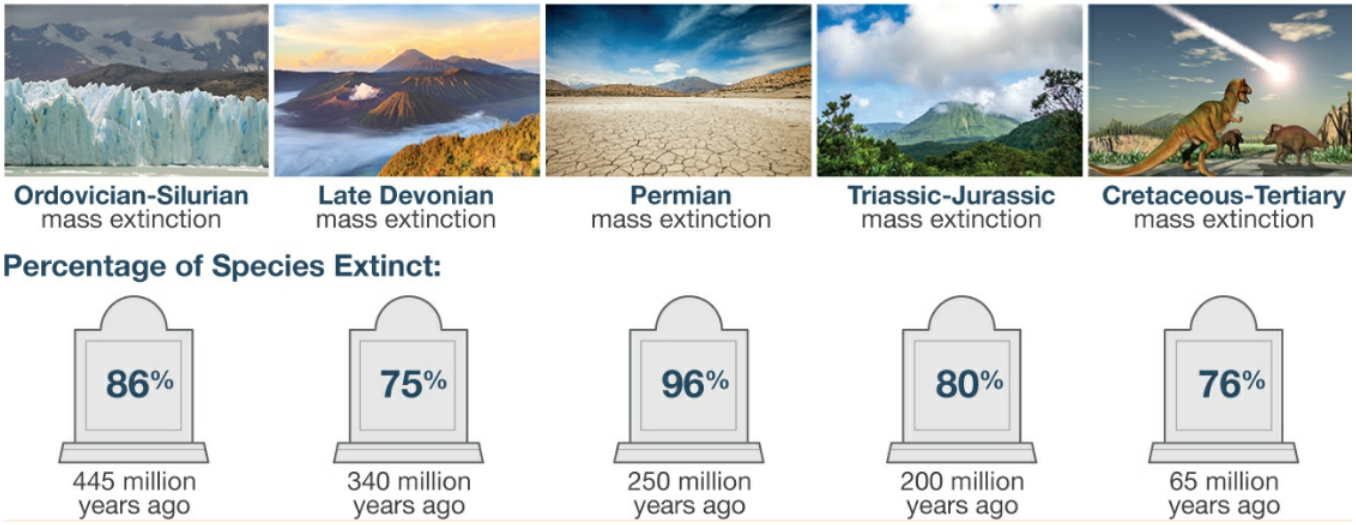


# Discontinuity driven by Disruption

- Ordovician-Silurian extinction (440 million years ago)
  - 86% of life on earth eliminated from mass glaciation and falling sea levels
- Permian-Triassic extinction (250 million years ago)
  - 96% of species on earth eliminated from enormous volcanic eruptions
- asteroid impact in Yucatan, resultant climate change (65 million years ago)
  - 76% of life on earth eliminated including dinosaurs
  - dinosaurs sustained successfully for over 150 million years of relative stasis
- past million years
  - experienced ice age on average of 100,000 year intervals

# Disruption: mass extinction events

- first forms of life occurred 3.8 billion years ago ($e.g.$, single-celled bacteria like cells)
- five global mass extinction events in past 500 million years
- each event: cataclysmic disruption, most species extinct, but *minority of species survive*
- *void rapidly filled by massive speciation*, $e.g.$, dinosaurs replaced largely by mammals



# Punctuated Equilibrium in Human History

- if science and technology meet social and economic systems, we observe *punctuated equilibrium*
  - what has been stable for long period suddenly disrupts radically
  - then settles out in new equilibrium
- examples
  - discoveries of fire
  - domestication of dogs, agriculture
  - gunpowder, Gutenberg Press
  - steam engine, Jacquard loom, locomotive
  - urban electrification, automobile
  - transistor, microprocessor, Internet

# Punctuated Equilibrium in Technology World

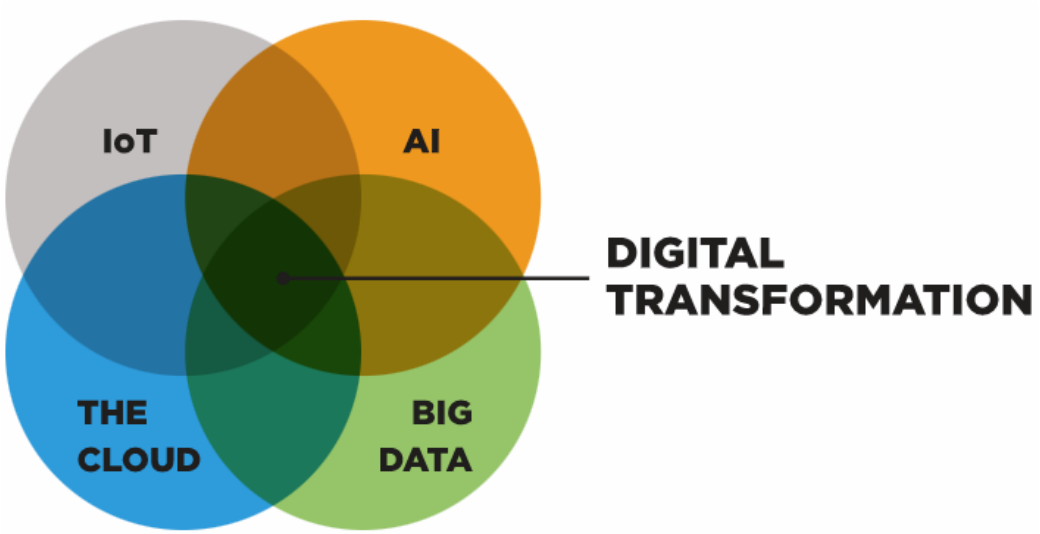
- often consider Moore's Law as force of constantly increasing change; not true!
- US auto industry relatively static since Federal interstate highway act in 1956
  - now synchronous arrival of Tesla, Uber, autonomous vehicles creating chaos
  - new equilibrium will emerge eventually
- cell phones & iPhone
  - cell phones massively disrupted land line operators
  - economic *speciation* from Motorola, Nokia, Blackberry
  - iPhone in 2007 upended cell phone industry
  - smart phones, too, settled into new stasis
  - changed very nature of interpersonal communication; over 2 billion smart phone users

# Punctuated Equilibrium in Econmony

- mass extinction event in corporate world in the 21st century
- since 2000, 52% of Fortune 500 companies either acquired, merged, or bankrupt
- (estimated that) 70% of companies in existence today will shutter operations in next 10 years
- *mass speciation* of innovative corporate entities with entirely new DNA
  - Amazon, Uber, Lyft, Google, Facebook, Square, Airbnb
  - WeWork, Twilio, Box, Shopify, Zappos, Axios
- *The causal factor is Digital Transformation*

# Digital Transformation

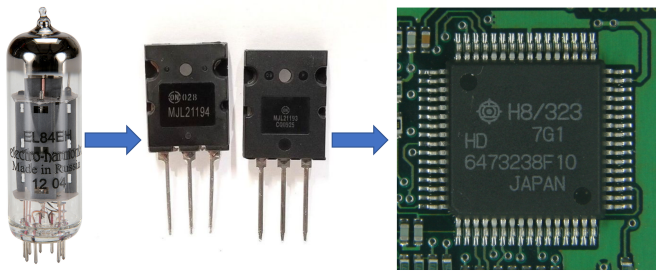
- impactful and disruptive technology vectors
  - Big Data, Cloud Computing, AI, IoT
- convergence of disruptive technologies



# Digital Transformation (DT) from the TOP

- most unique aspect of DT: *being driven from TOP*
- past 70 years of computing, the world advanced
  - vacuum tube $\rightarrow$ transistor $\rightarrow$ mainframe $\rightarrow$ personal computing $\rightarrow$ Internet
  - custom programming $\rightarrow$ enterprise application software $\rightarrow$ SaaS $\rightarrow$ cloud solutions

  $\Rightarrow$ increased productivity, lower cost of operation, increased profitability, economic growth
- Chief Information Officer (CIO) responsible for DT; *CEO periodically briefed*



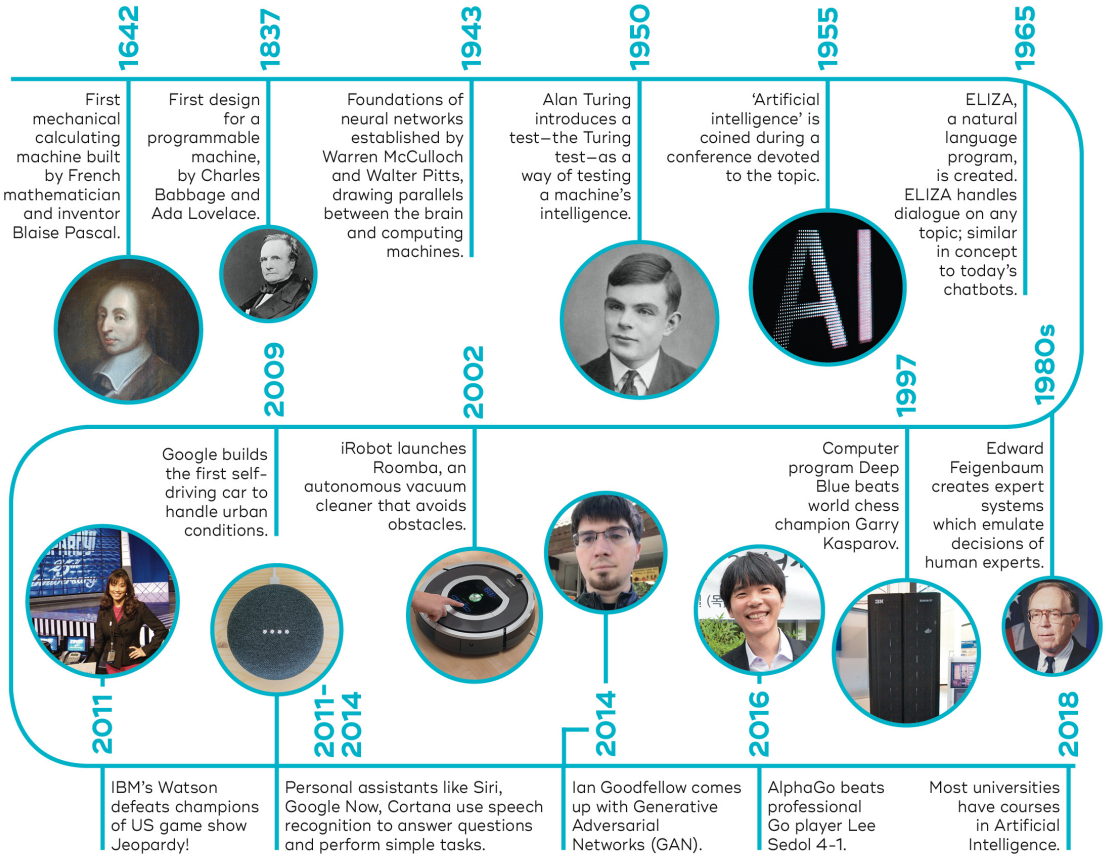

# CEO Action Plan

- CEO (or leaders) Action Plan should be
  - senior CXO team as DT engine
  - corporate executive visits at sources of disruption, $e.g.$, Amazon, Tesla, Apple, Uber
  - benchmark digital capabilities
  - observe forces of disruption to impact your industry
  - make *DT roadmap* and communicate to stakeholders
  - appoint Chief Digital Officer (CDO) with authority and budget
  - *Make Change Happen*

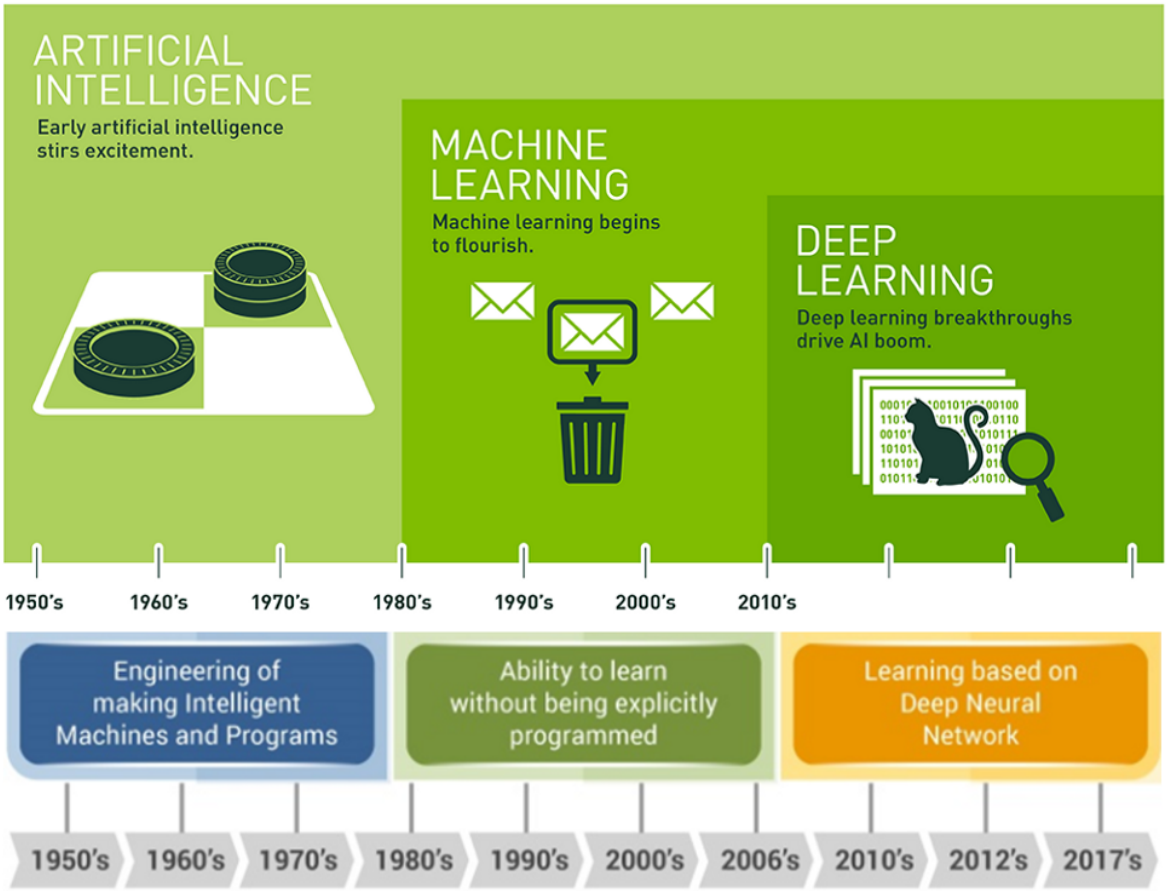
- examples
  - Jeff Bezos @ Amazon
  - Volkmar Denner @ Bosch
  - Fabrice Brégier @ Airbus

# AI and ML

# History of AI

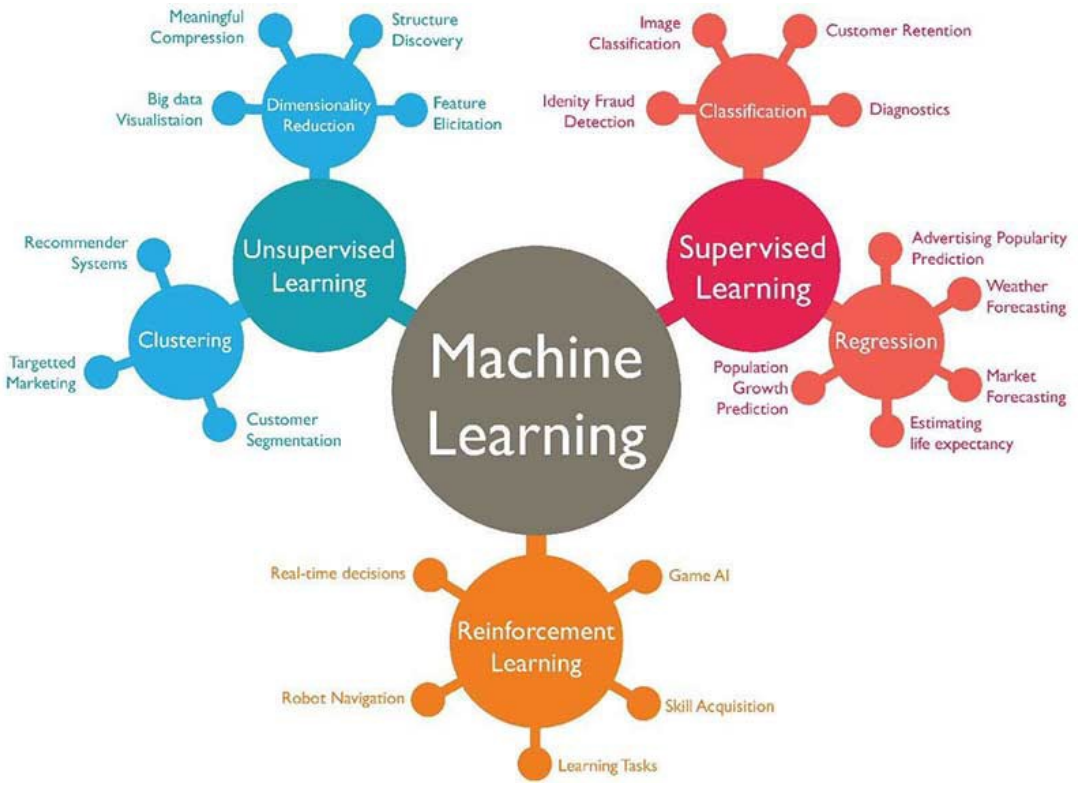


# AI, ML, and DL


ARTIFICIAL INTELLIGENCE
Early artificial intelligence stirs excitement.
MACHINE LEARNING
Machine learning begins to flourish.
DEEP LEARNING
Deep learning breakthroughs drive AI boom.
1950's
1960's
1970's
1980's
1990's
2000's
2010's
Engineering of making Intelligent Machines and Programs
Ability to learn without being explicitly programmed
Learning based on Deep Neural Network
1950's
1960's
1970's
1980's
1990's
2000's
2006's
2010's
2012's
2017's

# Three classes of ML

- supervised learning, unsupervised learning, reinforcemnet learning



# Machine Learning

- ML
  - *the most unique subject human race has ever developed!*
  - *can mean hundreds of things*
    - data collection, pre-processing, model training/inferencing, deployment

- different perspectives for ML
  - statistical perspective: bias & variance, maximum likelihood, Bayesian statistics
  - numerical algorithmic perspective: stochastic gradient method (SGD), matrix factorization
  - computer scientific (or engineering) perspective: Python, PyTorch, tensor flow
  - hardware: cloud computing, GPU, APU, TPU

# Statistical perspective

- suppose data set $X_m = \{x^{(1)}, \ldots, x^{(m)}\}$
  - drawn independently from (true, but unknown) data generating distribution $p_{\text{data}}(x)$
- Maximum Likelihood Estimation (MLE) is to solve

$$\text{maximize} \quad p_{\text{data}}(X; \theta) = \prod_{i=1}^{m} p_{\text{data}}(x^{(i)}; \theta)$$

- equivalent, but numerically friendly formulation:

$$\text{maximize} \quad \log p_{\text{data}}(X; \theta) = \sum_{i=1}^{m} \log p_{\text{data}}(x^{(i)}; \theta)$$

# Numerical algorithmic perspectives

- basic formulation:

$$\text{minimize} \quad f(\theta) = \frac{1}{m} \sum_{i=1}^{m} l(g_\theta(x^{(i)}), y^{(i)})$$

- formulation with regularization:

$$\text{minimize} \quad f(\theta) = \frac{1}{m} \sum_{i=1}^{m} l(g_\theta(x^{(i)}), y^{(i)}) + \gamma r(\theta)$$

- stochastic gradient descent (SGD):

$$\theta^{(k+1)} = \theta^{(k)} - \alpha_k \nabla f(\theta)$$

# Amorepacific

# Amorepacific History

- 2010: First Korean Cosmetics Company in Dow Jones Sustainability Indices (DJSI)
- 2013: *Declares a Ban on Unnecessary Animal Testing for Cosmetics*
- 2015: Amorepacific Joins the ranks of Forbes Top 100 most innovative Companies
- 2016: Amorepacific Ranks 7th on WWD Beauty Inc Top 100 for the First Time
- 2020: Declares Mission and Principles
  - "We make A MORE Beautiful world" and Five Principles

# Amorepacific Brands

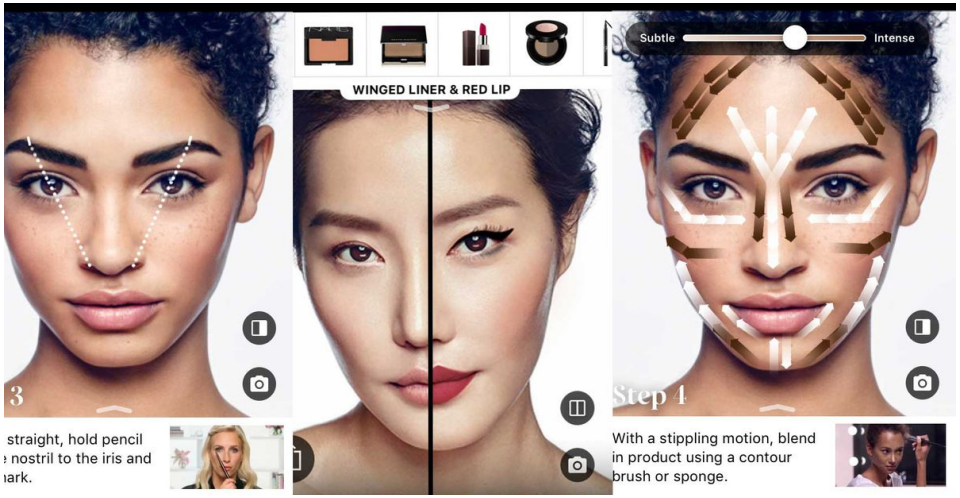



# ML changes Beauty Industry

- ML
  - provides statistical basis for attractiveness
  - helps develop products tackling specific needs of customers
- Compure Vision (CV) is the core of the future technology
  - builds systems obtaining information from images (or multi-dimensional data)
  - extracts insight or meaningful information to further guide us (for productionization)


# Virtual Product Testing

- AI-driven CV could
  - analyze a human face for testing purposes
  - help end customers choose products and techniques *for them*
  - help know how new eye shadow or face cream will actually look on skins (with no physical testing)

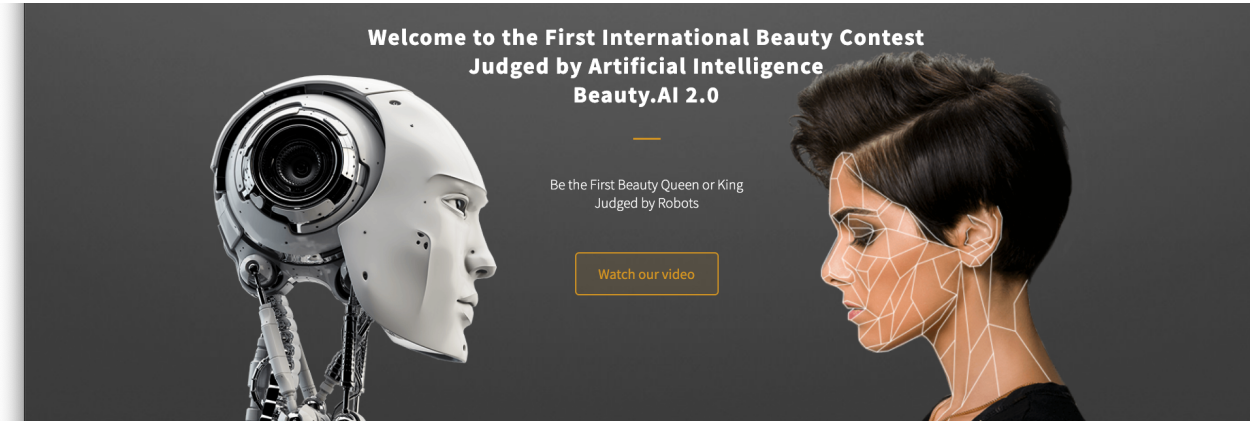


# Optimize Formulas for Productionization

- use *Data* to create better products and optimize formulas
- *Data Analytics* will lead to better cosmetics
  - leverage data for better and longer-lasting formulas

# Beauty Industry Examples

- Beauty.ai uses deep learning to determine the most beautiful people on earth.
  - algorithms analyze wrinkles, face symmetry, skin color, gender, age group, and ethnicity
- Yahoo! Research developed a deep learning model to categorize photographic portraits
  - provides scientific evidence that "race, gender, and age are largely uncorrelated with photographic beauty"
  - (Predictive Analytics by Eric Siegel, 2016)

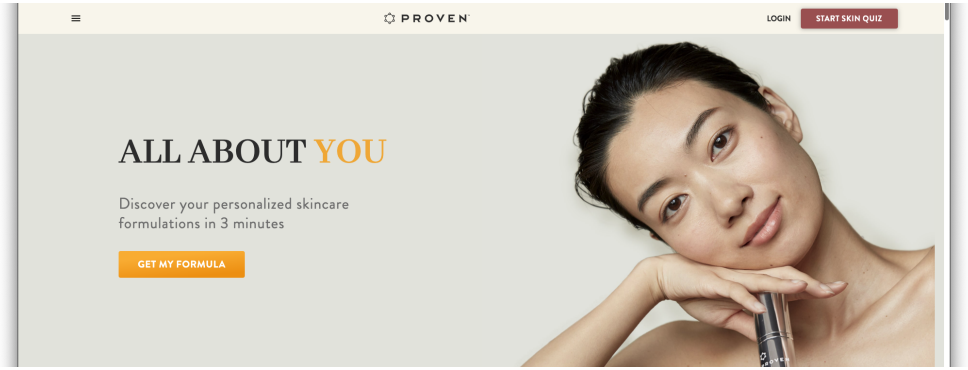


# Personalized Approach to find your style

- startups and industry leaders offer machine-based advice on finding your personal style
  - makes feel more attractive in eyes of others (statistically proved)
- Sephora uses worldwide tests and more than 1,000 combinations of foundation to help customers find their perfect match using the ColorIQ app
- Mira uses CV to find influencers, images and videos for specific eye shape

# AI for creating new personalized skincare products

- Proven creates personalized skincare products based on the "largest beauty database in the world"
  - uses ML to learn connections between different product categories, ingredients and review ratings
  - offers ingredient recommendations for consumer products
- Function Of Beauty (FoB)
  - uses ML to create customized shampoo and conditioners with different ingredient combinations based on the hair type, hair structure, hair goals

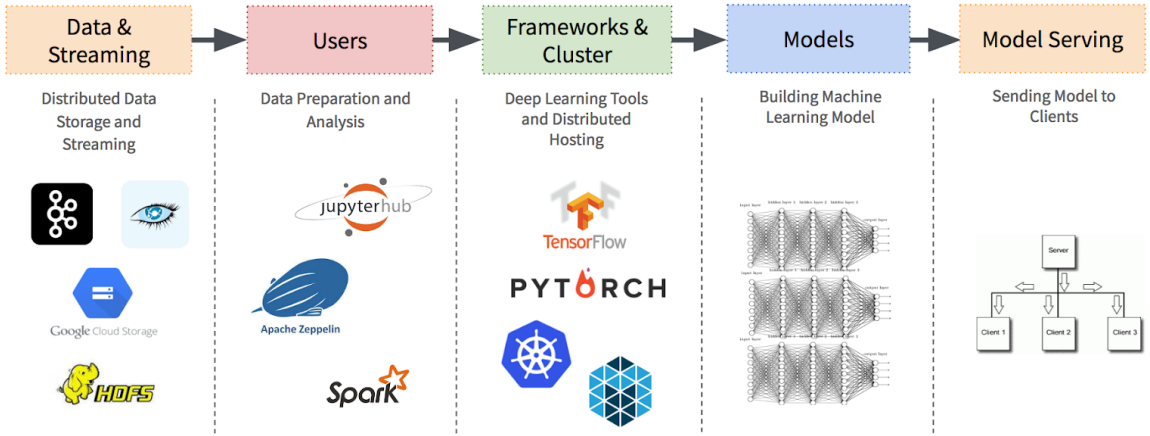


# Research in Academia

- academia and research teams often ahead of the industry
  - Identification of the face shape using machine learning and image processing techniques (Gunasinghe et al., 2016)
  - Virtual makeup using image processing techniques (Oztel et al., 2015)
  - Detection of facial retouching using supervised deep learning (Bharati et al., 2016)
  - Detection, analysis and digital removal of makeup from an "image of a human face wearing makeup" in order to predict facial beauty (Patents, 2015)

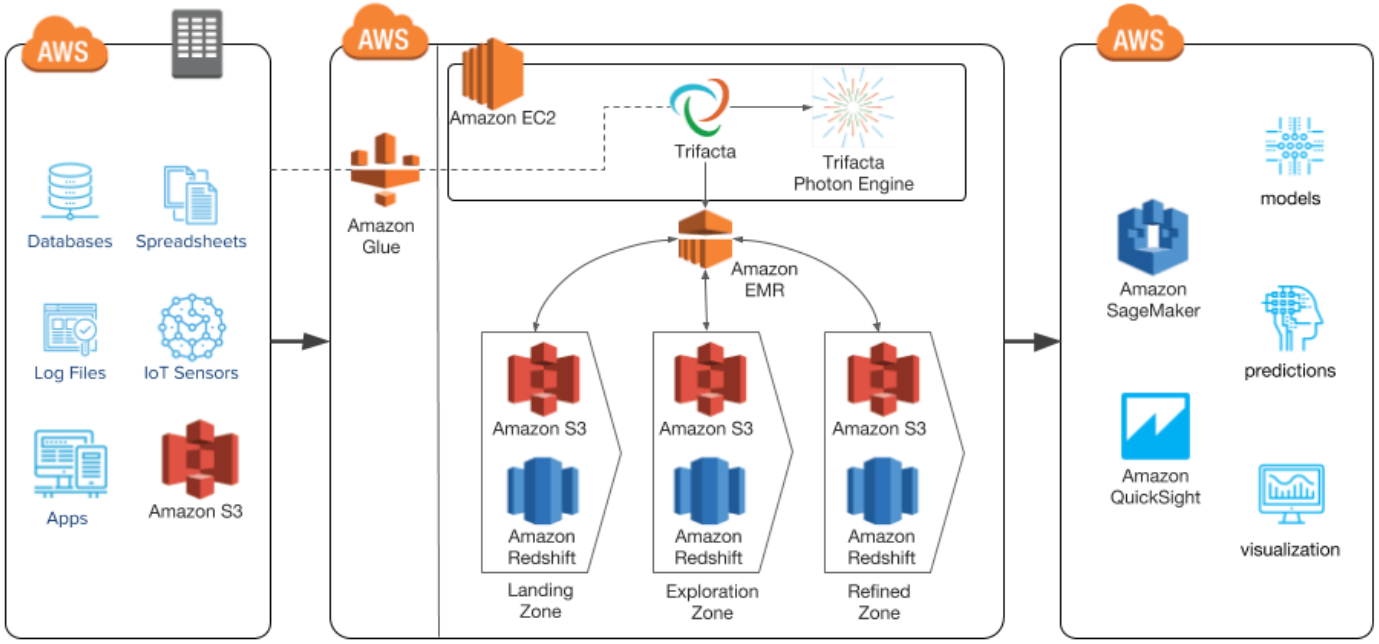
# Typical ML Pipeline in Products

- data collution $\rightarrow$ ML modeling (train/test) $\rightarrow$ deployment
- Pratical and Crucial Tips from Industry Practitioners
  - data pre-processing, $e.g.$, cleansing, structurizing, missing value imputation
  - sytem monitorning and maintenance, $e.g.$, online learning



# Using Cloud Computing: Amazon Web Services (AWS)

- serverlessness $\rightarrow$ no provisioning
  - system and hardware maintenance, security, vast array of tools
  - pay only for computing power used



# Take Away

- global spends on skincare tops many billions
- much of it goes to waste on ineffective or incompatible products
- AI and ML with CV provides opportunities to change the rules and finally fully satisfy the customers

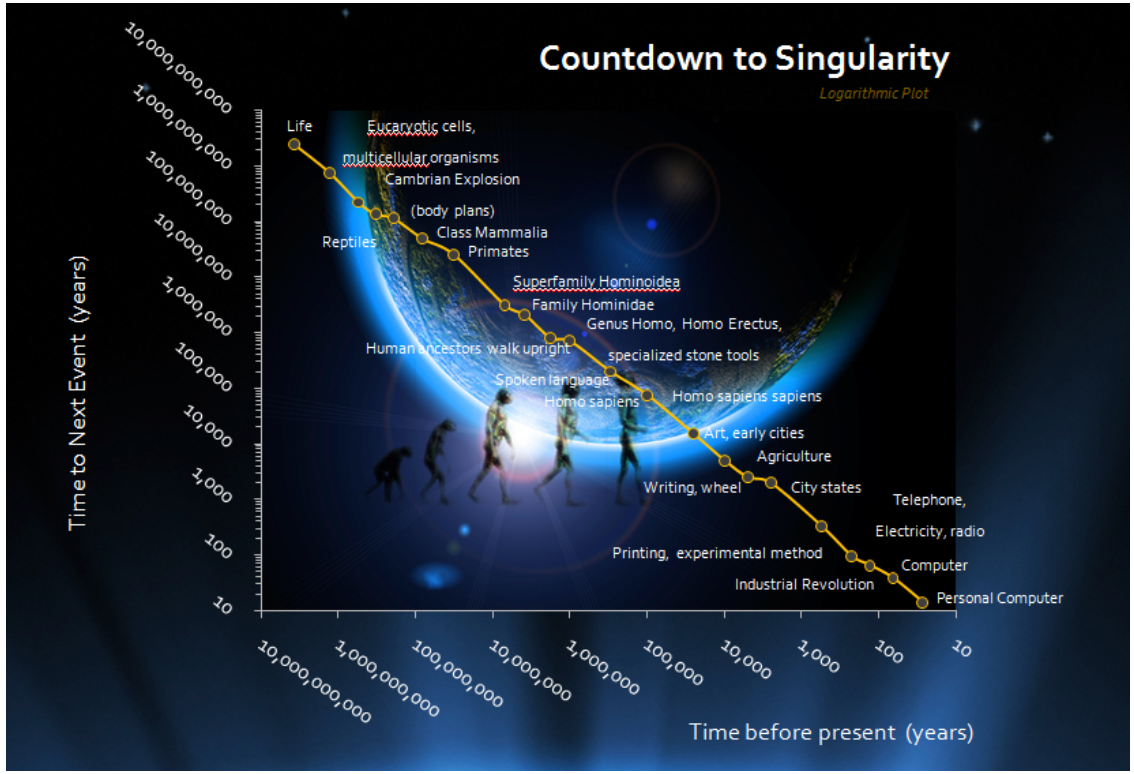
# Singularity

# What is Singularity?

- (technological) singularity is hypothetical point in time where
  - technological growth becomes uncontrollable and irreversible, $e.g.$, Skynet
  - intelligence "explosion"
  - powerful superintelligence that qualitatively far surpasses *all human intelligence*

# Plausibility

- speed improvements
- exponential growth
- accelerating change
- algorithm improvements



# Criticisms

- philosopher Hubert Dreyfus asserts that computers or machines cannot achieve human intelligence
- physicist Stephen Hawking holds that the definition of intelligence is irrelevant if the net result is the same
- Psychologist Steven Pinker (2008)

  > . . . There is not the slightest reason to believe in a coming singularity. The fact that you can visualize a future in your imagination is not evidence that it is likely or even possible. . . .

- UC Berkeley philosophy professor John Searle writes

  > (Computers) have, literally . . . , no intelligence, no motivation, no autonomy, and no agency. We design them to behave as if they had certain sorts of psychology, but there is no psychological reality to the corresponding processes or behavior. . . . The machinery has no beliefs, desires, or motivations.

- *I AM with them!*

# Gauss Labs

# Gauss Labs: Industry AI Startup Company

## SK하이닉스, 첫 AI 전문회사 '가우스랩스' 출범

이정민 기자 | 승인 2020.09.22 15:29 | 수정시간 2020.09.22 15:29 | 댓글 0

### SK그룹 전액 투자 결정...지난달 美 실리콘밸리서 본사 설립

▲ '가우스랩스' 김영한 대표(사진 왼쪽)와 윤성희 연구개발(R&D) 최고책임자. 사진제공=가우스랩스

투데이코리아=이정민 기자 | SK하이닉스가 산업용 인공지능(AI) 전문회사 '가우스랩스'를 미국 실리콘밸리에 출범한데 이어 한국 사무소를 설립키로 했다. AI 솔루션을 통한 반도체 제조 혁신을 이끌 수 있을지 업계의 관심이 집중된다.

The Korea Times ☰ All

## SK hynix invests in AI specialized Gauss Labs for future growth

SK hynix logo

By Kim Hyun-bin

SK hynix is set to invest $55 million in Gauss Labs through 2022 to better lead innovation with industrial artificial intelligence (AI) solutions.

Later this month, Gauss Labs is scheduled to open its Korean branch just a month after establishing its headquarters in Silicon Valley.

SK Group has been working to push various AI businesses with its affiliates.

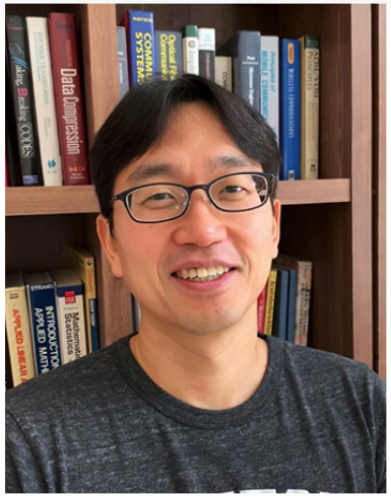
"We should utilize innovative technologies such as AI and digital transformation (DT) to create social value, expand our market and help our customers pursue happiness," SK Group Chairman Tae-won Chey said at the SK Icheon Forum in August last year. "If we fail to utilize innovative technologies, we cannot guarantee the future of SK."

# Join Us!

- `http://www.gauss-labs.com`

GAUSS LABS

About Us Gaussian Principles Join Us




**Head of R&D Sunghee Yun** has led research and development of machine learning and optimization technologies in diverse areas such as semiconductor design and manufacturing, marketing and sales, and retail shopping business. Before joining Gauss Labs, Sunghee led several high-profile machine learning (ML) projects at Amazon.com using deep reinforcement learning, recommender system, and anomaly detection where one of his project increased the sales by $200 million at Amazon mobile shopping app. Prior to Amazon, he worked as a Principle Engineer for Samsung Electronics leading artificial intelligence (AI) and ML projects for reducing cost and improving performance for circuit design and manufacturing process. Currently more than 200 semiconductor designers and test engineers use the AI platform Sunghee developed everyday. He received MS and Ph.D. degrees from Electrical Engineering Department at Stanford University and BS degree from Seoul National University.

# Q&A

# Thank You!

# Expected Questions

- Can you advise on data collection, storage, analysis, application, and optimization?
- Can you guide us for taking most out of the data using image processing (IP), CV, manufacturing, and supply chain?
- Can you advise on whether Amorepacific should train existing employees or hire new ones for data science?
- Can you advise on whether Amorepacific should try to obtain as much data as possible or as clean data as possible?
- Can you advise use on how Amorepacific can become a data-driven AI company?
- What technology should Amorepacific R&D apply to use the skin, and hair data?
- How will you advise on people collectin and using data in silos?