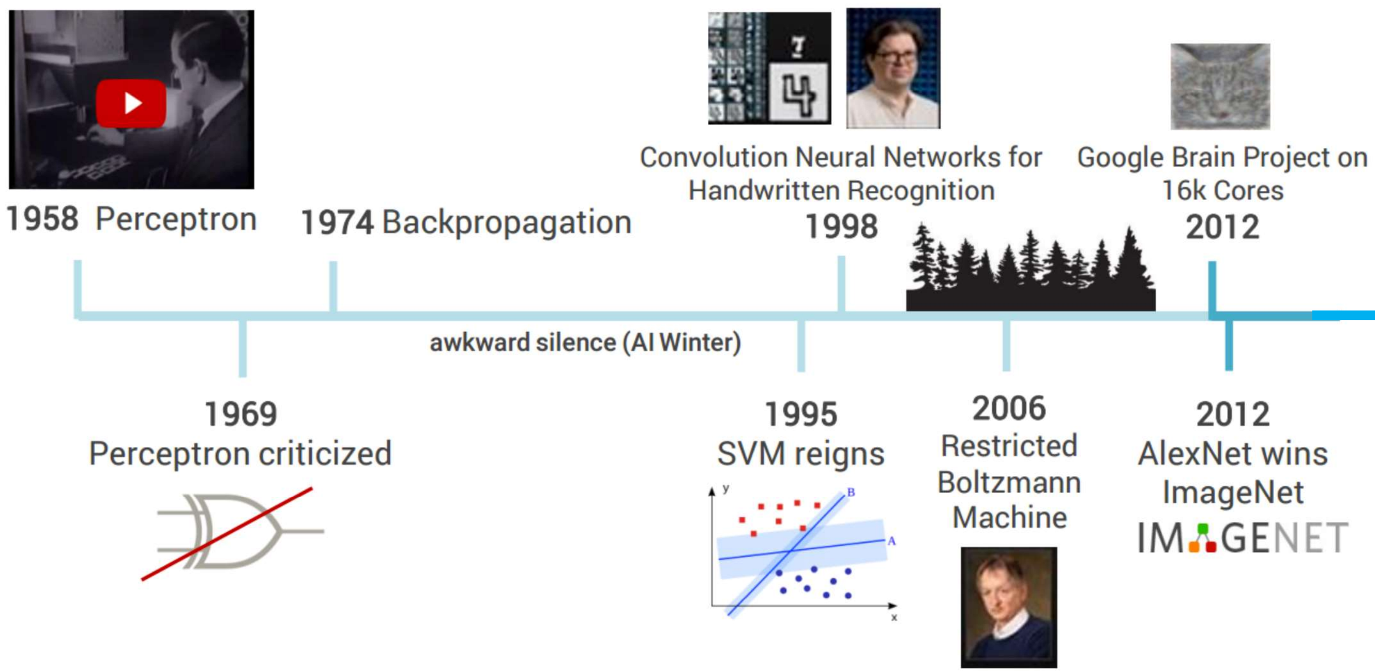
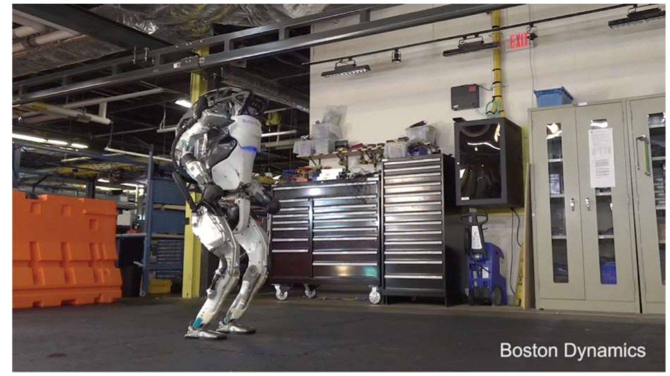
산업혁명 역사로 살펴보는 인공지능 발전방향

2019.10.23
손 영 성

인공지능 기술 발전





Boston Dynamics Parkour

Open AI Cube Solving

1997.12 Deep Blue – Chess Mastering

2012.06 NYU - MNIST Image Classification

2016.03 AlphaGo – Go Mastering

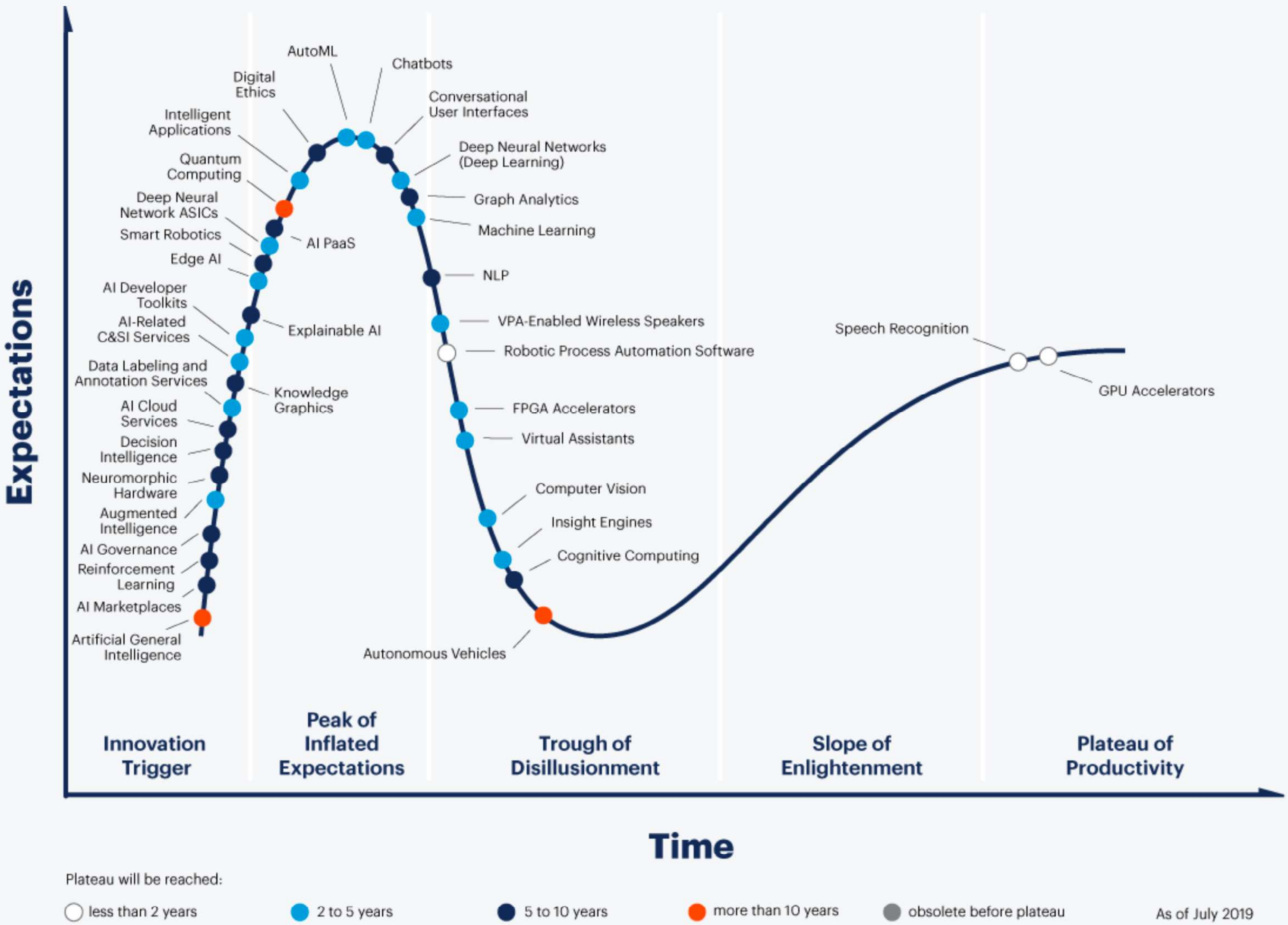
2018.06 Google Duplex – Phone Reservation

2018.06 Open AI – Dota2 Game Play

2019.10

※ 출처 : www.datasciencecentral.com/profiles/blogs/artificial-intelligence-vs-machine-learning-vs-deep-learning

Gartner Hype Cycle for Artificial Intelligence, 2019

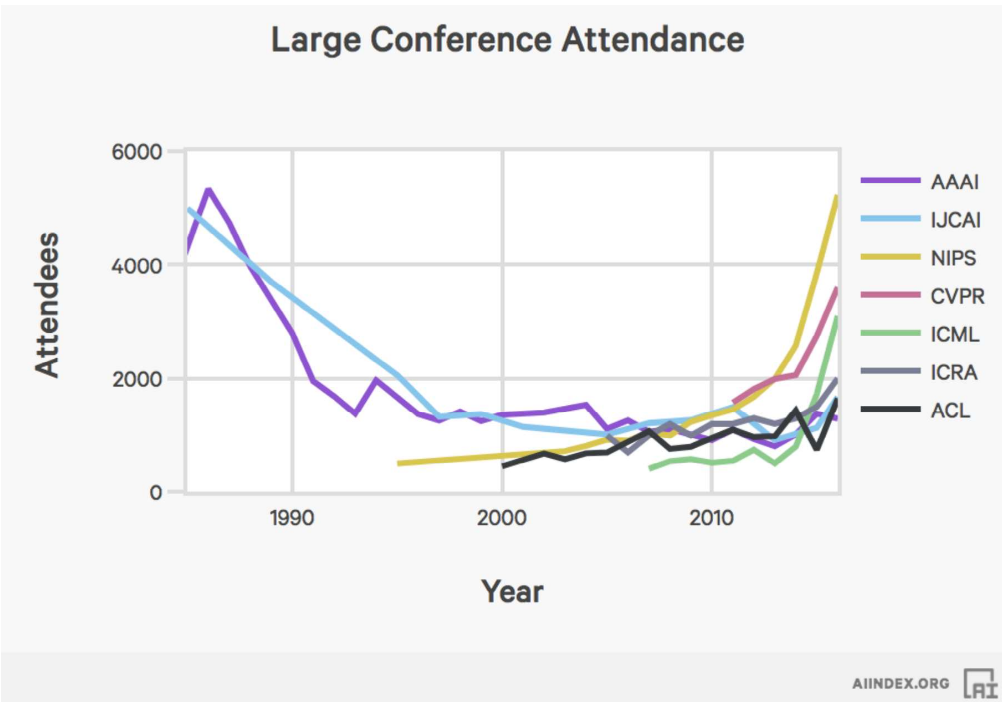


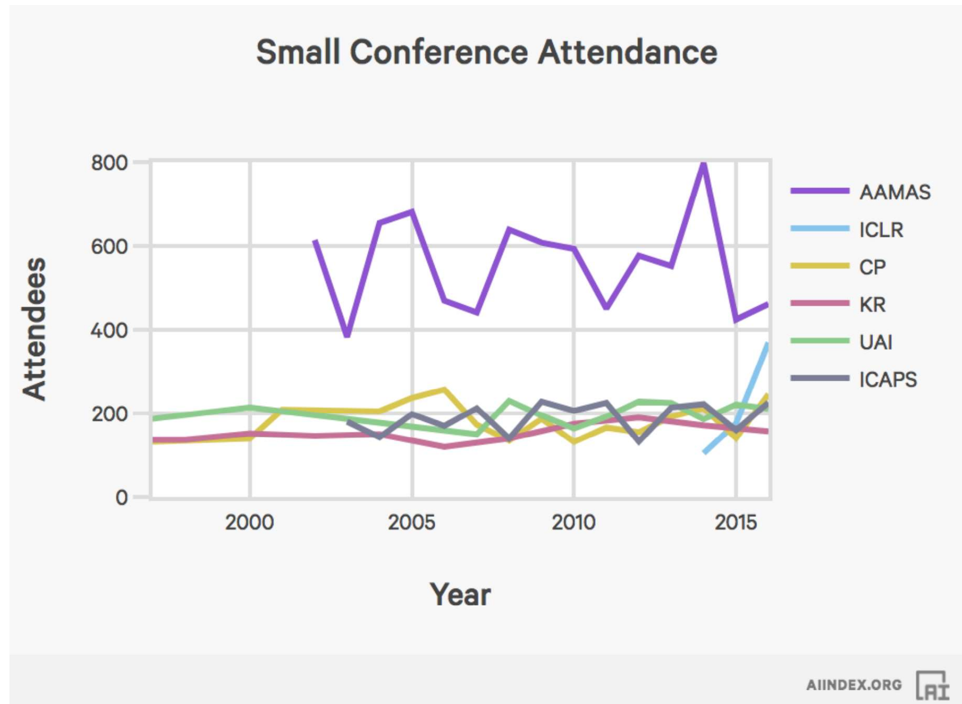
gartner.com/SmarterWithGartner

Source: Gartner

Gartner

인공지능?





※ 출처 : https://aiindex.org/2017-report.pdf

Unsupervised Minimax: Adversarial Curiosity, Generative Adversarial Networks, and Predictability Minimization

Jürgen Schmidhuber
The Swiss AI Lab, IDSIA
USI & SUPSI, Manno-Lugano
Switzerland

Abstract

I review unsupervised or self-supervised neural networks playing minimax games in game-theoretic settings. (i) Adversarial Curiosity (AC, 1990) is based on two such networks. One network learns to probabilistically generate outputs, the other learns to predict effects of the outputs. Each network minimizes the objective function maximized by the other. (ii) Generative Adversarial Networks (GANs, 2010-2014) are an application of AC where the effect of an output is 1 if the output is in a given set, and 0 otherwise. (iii) Predictability Minimization (PM, 1990s) models data distributions through a neural encoder that maximizes the objective function minimized by a neural predictor of the code components. We correct a previously published claim that PM is not based on a minimax game.

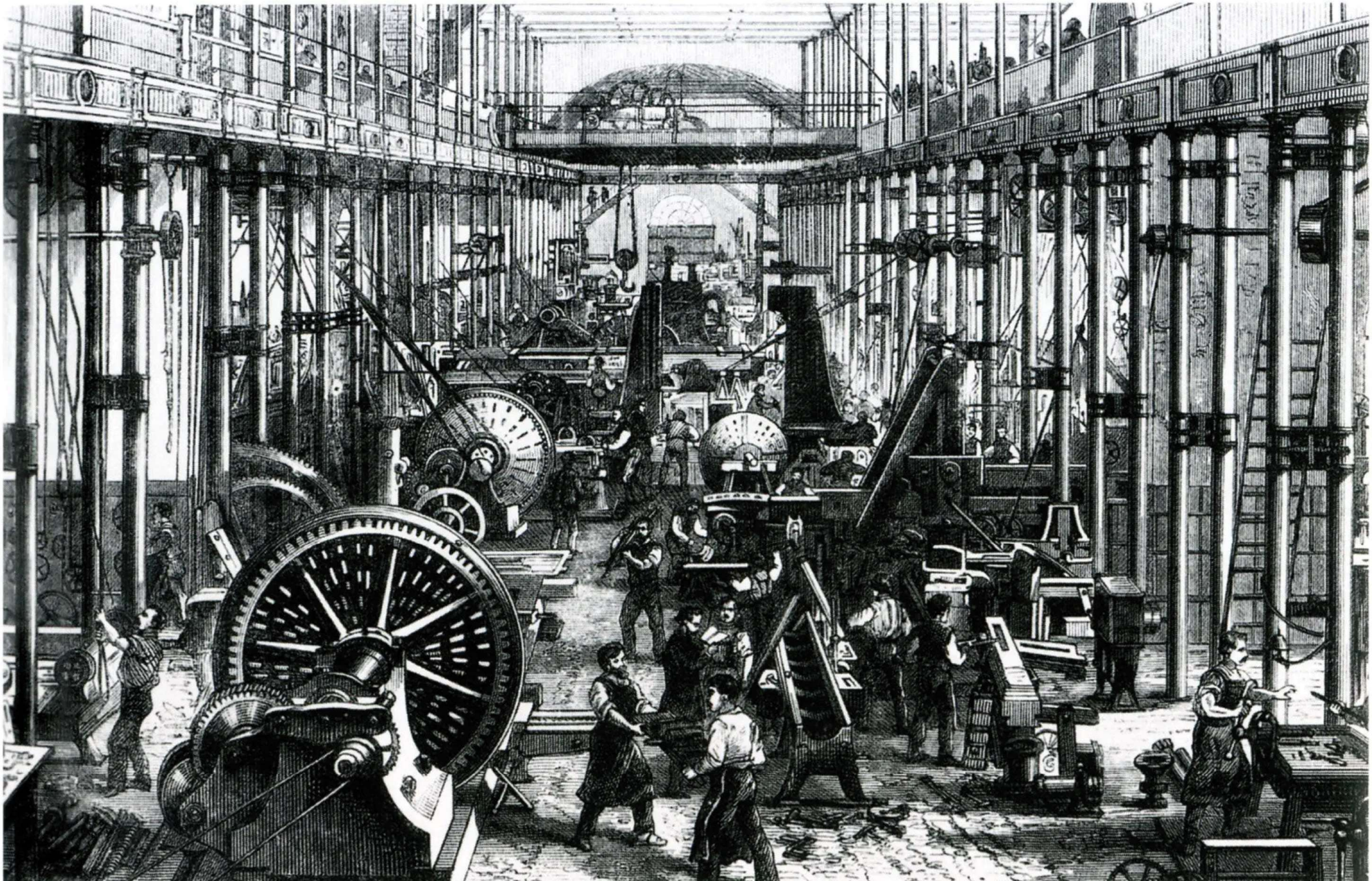
1 Introduction

Computer science has a rich history of problem solving through computational procedures seeking to minimize an objective function maximized by another procedure. For example, chess programs date back to 1945 [92], and for many decades have successfully used a recursive minimax procedure with continually shrinking look-ahead, e.g., [88]. Game theory of adversarial players originated in 1944 [37]. In the field of machine learning, early adversarial settings include reinforcement learners playing against themselves [50] (1959), or the evolution of parasites in predator-prey games, e.g., [24, 76] (1990).

Since 1990, adversarial techniques of a quite different type have also been employed in the field of *unsupervised or self-supervised artificial neural networks* (NNs) [51, 55] (Sec. 2). In such settings, a *single* agent has two separate learning NNs. Without a teacher, and without external reward for achieving user-defined goals, the first NN somehow generates outputs. The second NN learns to predict consequences or properties of the generated outputs, minimizing its errors, typically by gradient descent. However, the first NN *maximizes* the objective function *minimized* by the second NN, effectively trying to generate data from which the second NN can still learn more. In what follows, we will review such approaches, and relate them to each other.

https://arxiv.org/pdf/1906.04493.pdf

산업혁명



산업혁명?

증기 기관

가솔린 엔진

라이트 형제

플라이어

증기기차

제임스 와트

에티엔 르누아르

방직공장

니콜라우스 오토

러다이트

토마스 뉴커먼

코틀리프 다임러

매튜 볼튼

빌헬름 마이바흐

카를 벤츠

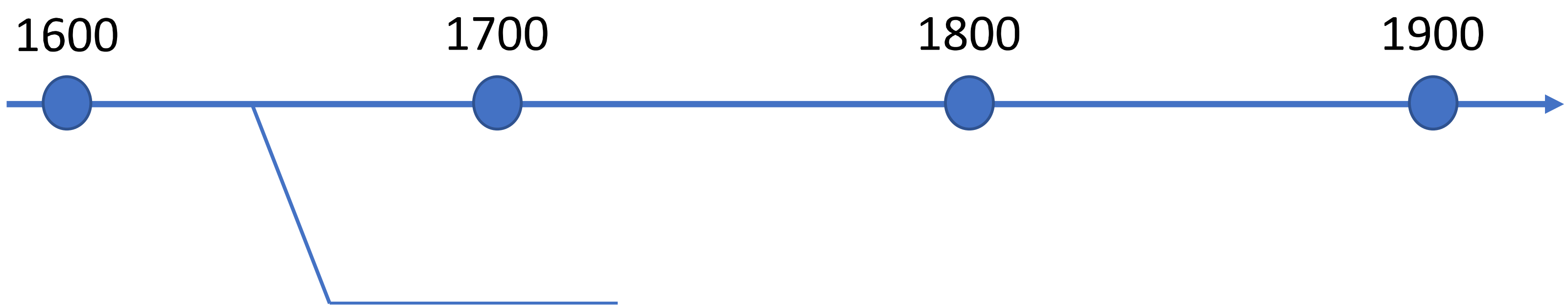
새뮤얼 크림프턴

루돌프 디젤

조지 스티븐슨

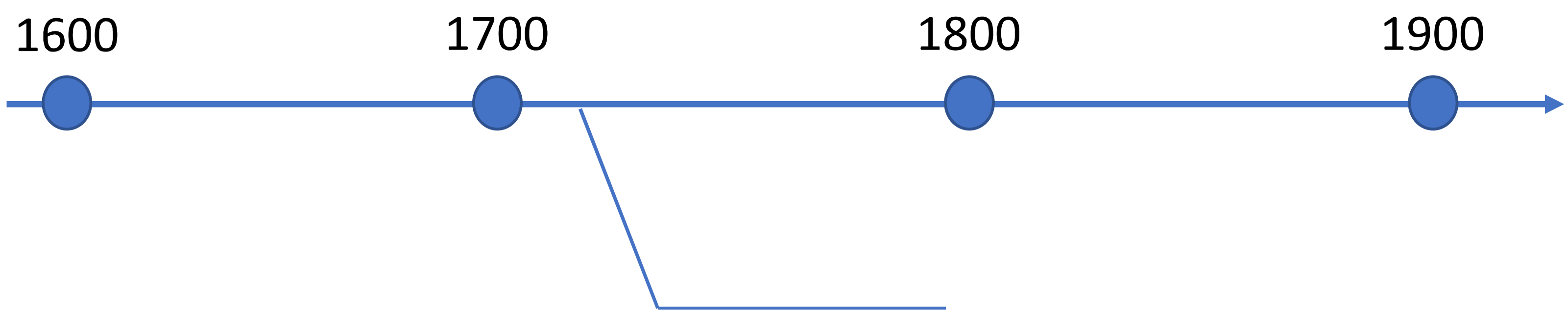
산업혁명 연표

산업혁명 연표



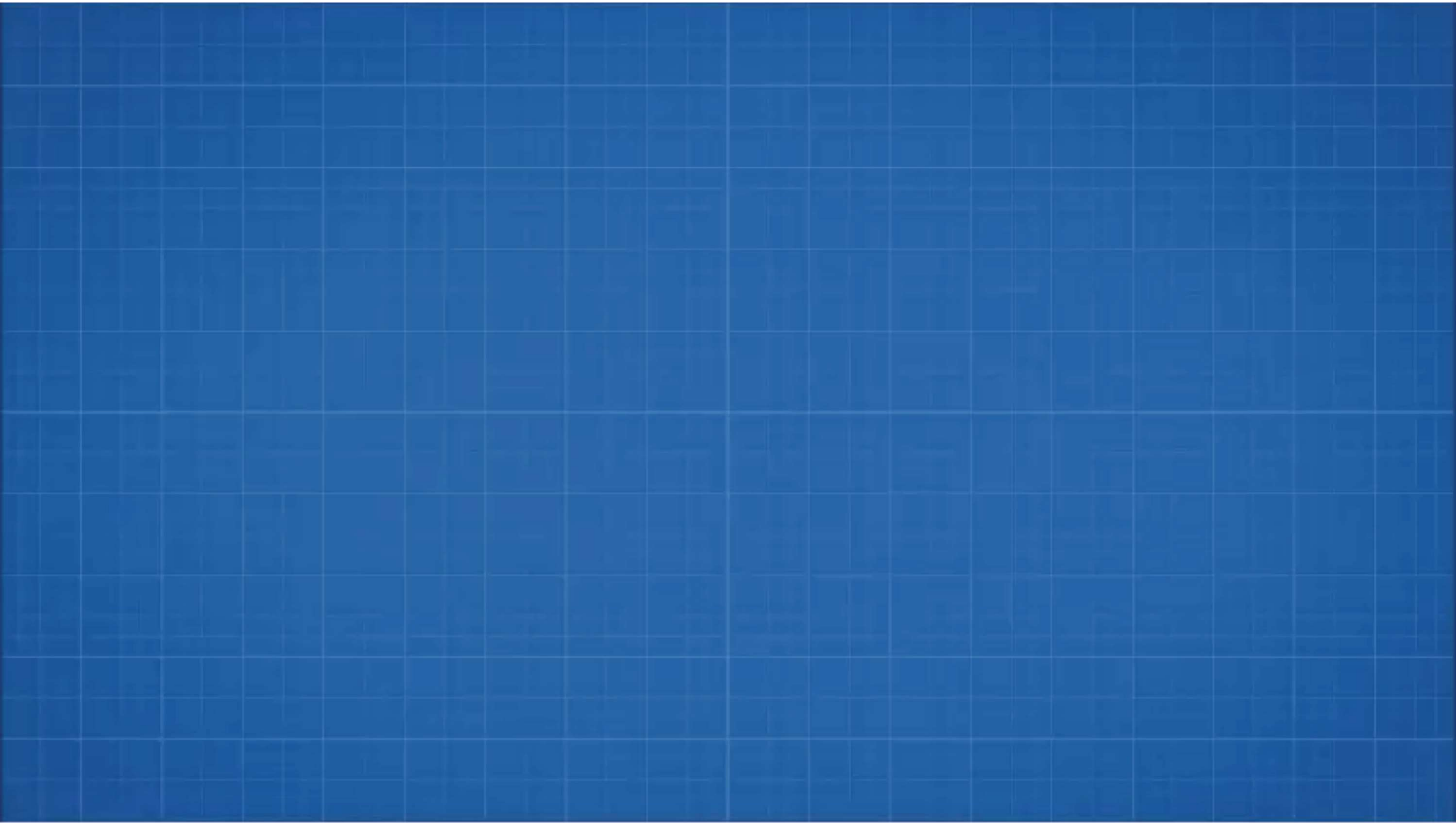
1663 에드워드 서머셋 우스터 후작 – 최초의 공업용 증기기관 제작

산업혁명 연표



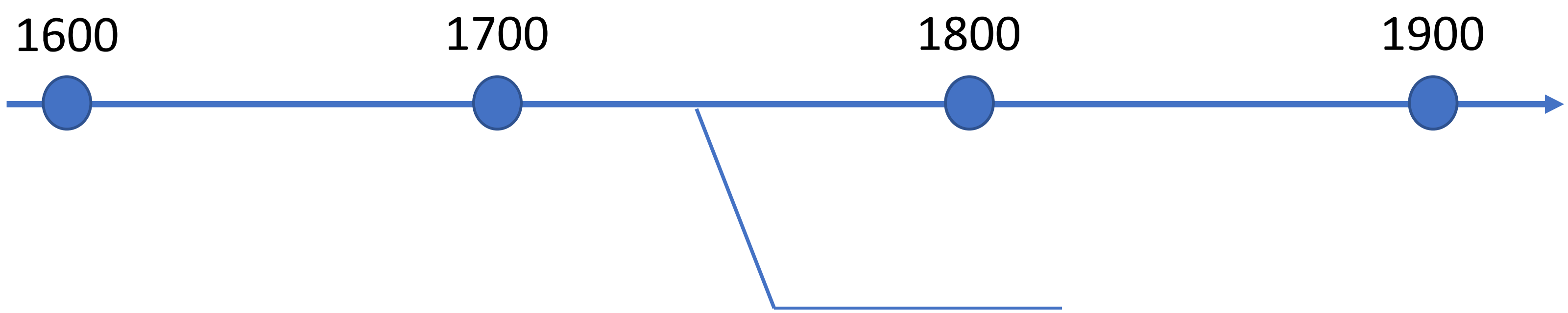
1705 토머스 뉴커먼 대기압식 증기기관 제작
1712 토머스 뉴커먼이 개량하여 실용화.
콘월의 구리 광산에 처음 뉴커먼 기관이 사용됨 (상용화)

1712 Thomas Newcomen Steam Engine



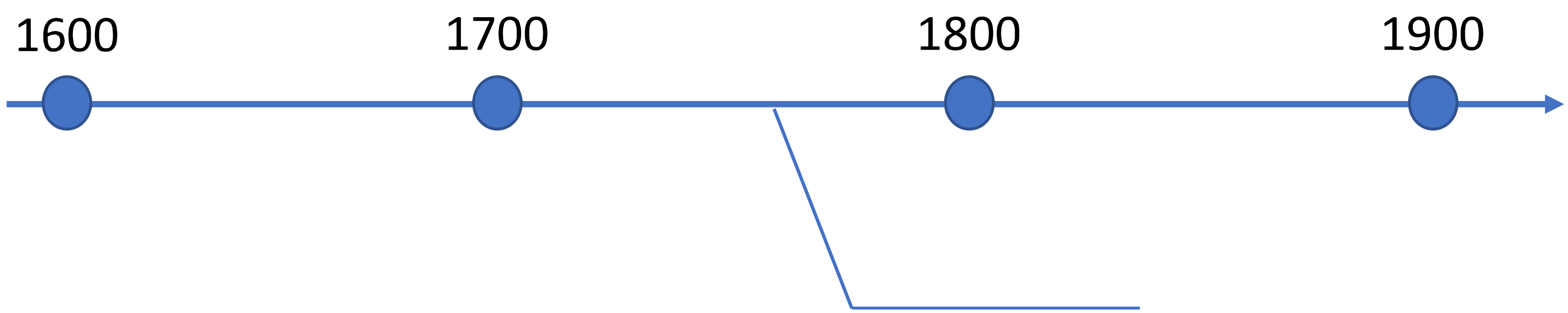
https://www.youtube.com/watch?v=fsXpaPSVasQ

산업혁명 연표



1733 뉴커먼의 특허가 만료. 이때까지 100개의 뉴커먼 기관이 만들어짐.
후기 기관은 최고 80마력까지 출력을 냄.
1776~1800년 뉴커먼 엔진은 1000대 이상 제작. 주로 탄광과 공장에서 사용

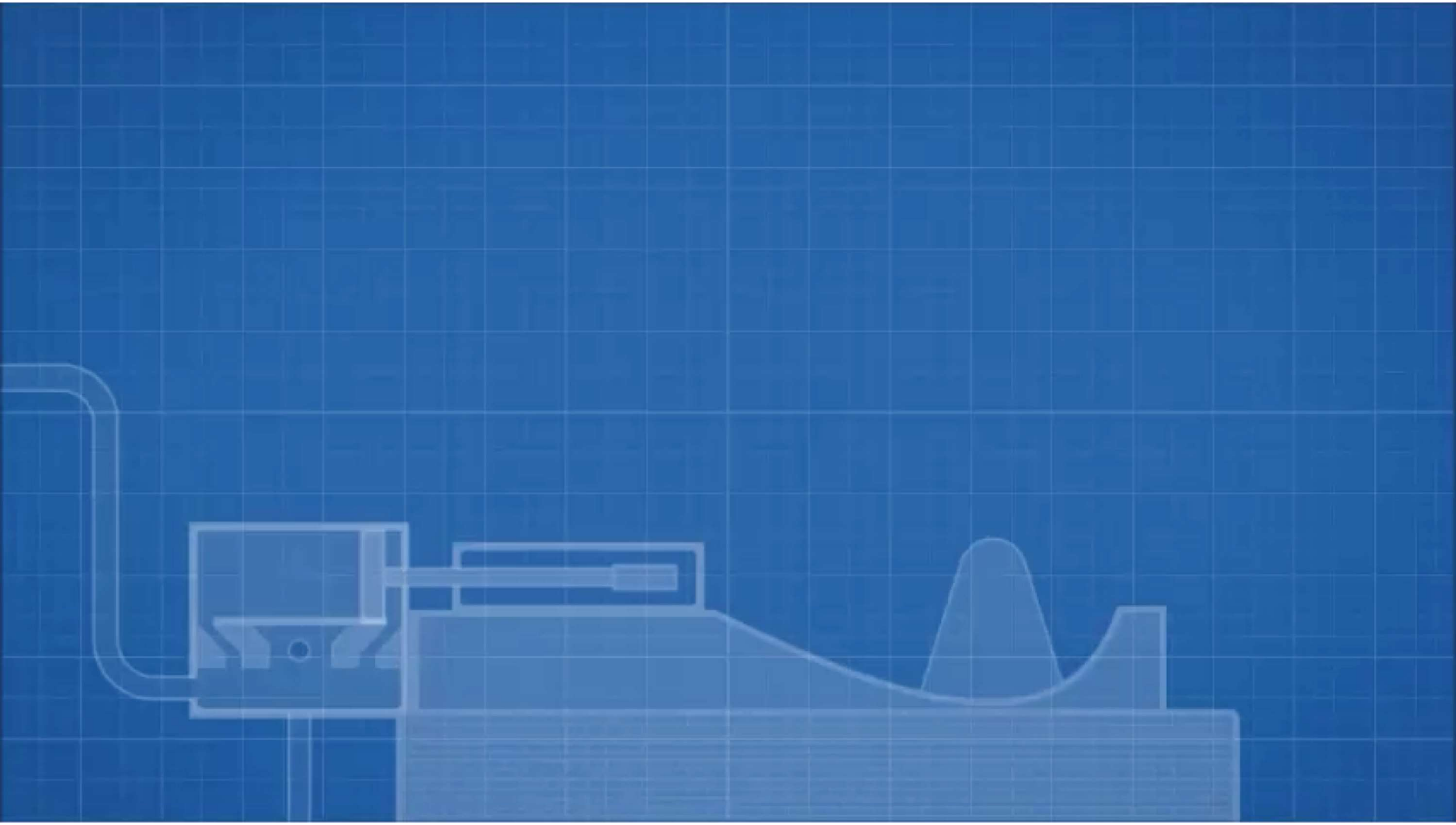
산업혁명 연표



1764년 제임스 와트 - 뉴커먼 기관의 수리를 부탁받아 대폭 개량에 착수
응축기를 분리하는 아이디어

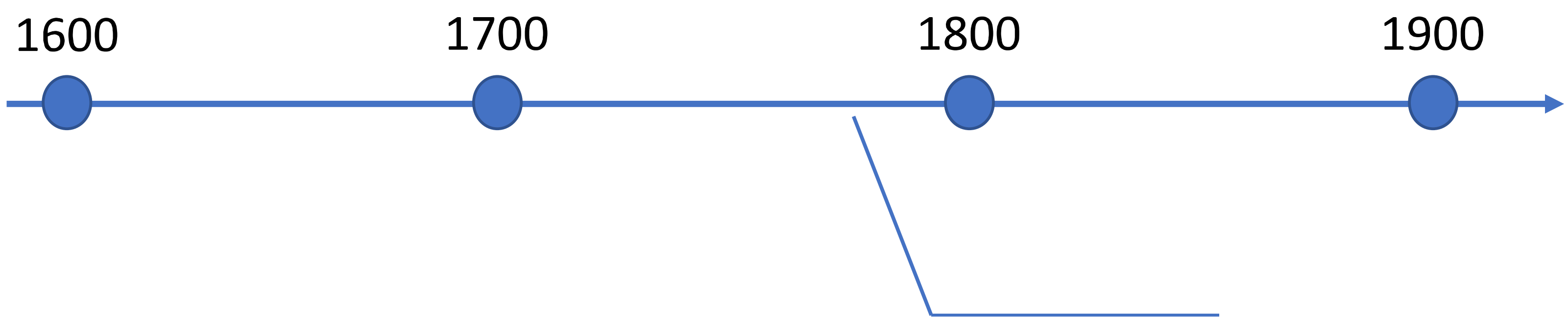
1769년 '화력기관에서 증기와 연료의 소모를 줄이는 새롭게 고안 방법' 특허 취득
석탄 소모량도 뉴커먼기관에 비해 4분의 1 이하로 줄임

1769 James Watt Steam Engine



https://www.youtube.com/watch?v=fsXpaPSVasQ

산업혁명 연표



1775년 볼턴 & 와트 (Boulton & Watt) 설립

볼턴앤드와트는 증기기관 자체를 생산하기보다는,
공장과 광산에 일종의 기술 컨설팅을 제공

와트식 증기기관을 설치한 뒤 25년에 걸쳐,
연간 채굴량 차이 분의 3분의 1을 수익으로 요구

1790년 새뮤얼 크럼프턴 - 증기기관을 바탕으로 방적기 제작

산업혁명 연표

1825년 조지 스티븐슨 - 증기기관차 상용화
1826년 증기기관 탑재한 28인승 노선버스 등장
1830년대 스팀마차 서비스
1850년대 선박용 컴파운드 엔진 제작

증기기관

- 제임스 와트는 엔진 개량
- 기술보다는 산업
- 기술자와 사업가의 협업
- 효율이 좋아져야 함
- 응용 사례가 중요함

산업혁명 연표

1860년 벨기에 에티엔 르누아르 - 휘발유 연료로 하는 내연기관 발명
1876년 니콜라우스 오토가 코틀리프 다임러, 빌헬름 마이바흐와 함께
4행정기관(오토행정) 발명
1885년 독일 카를 벤츠가 가솔린 엔진을 이용한 삼륜차 모토바겐을 발명
1892년 독일 루돌프 디젤이 디젤 엔진을 발명
1894년 세계 최초의 자동차 경기 파리-루앙 126km

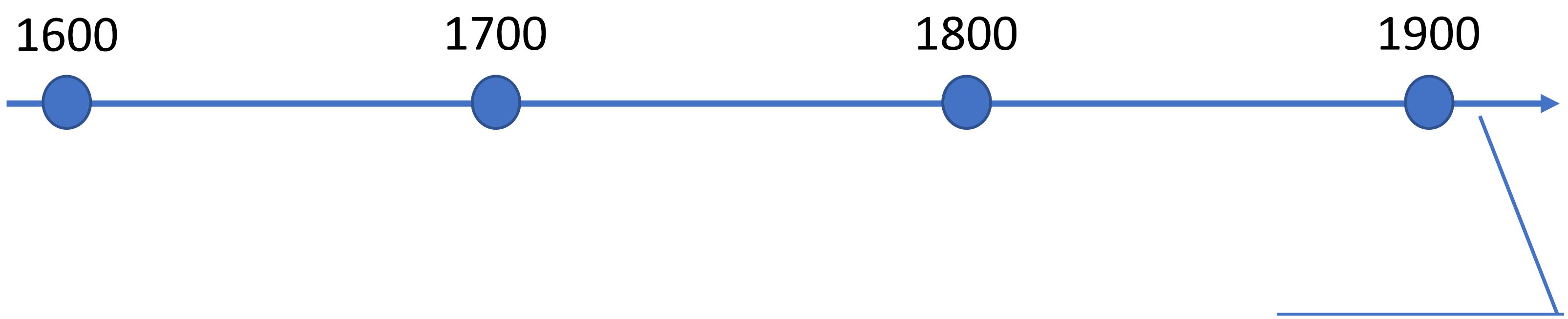
1876 Auto 4 Cycle Engine

https://ai.facebook.com/blog/open-sourcing-reagent-a-platform-for-reasoning-systems/

내연기관

- 정유기술, 소재기술, 정밀가공 기술
- 효율, 효율, 효율
- 새로운 응용 분야 진출 (자동차)
- 자동차 경주 (규격화)

산업혁명 연표



1903년 미국 라이트 형제 플라이어 1호 비행 성공
(12초간 36m, 59초간 243.84m)
1904년 45분간 34km

라이트 형제 (Wright Brothers)

1903년 최초로 비행에 성공

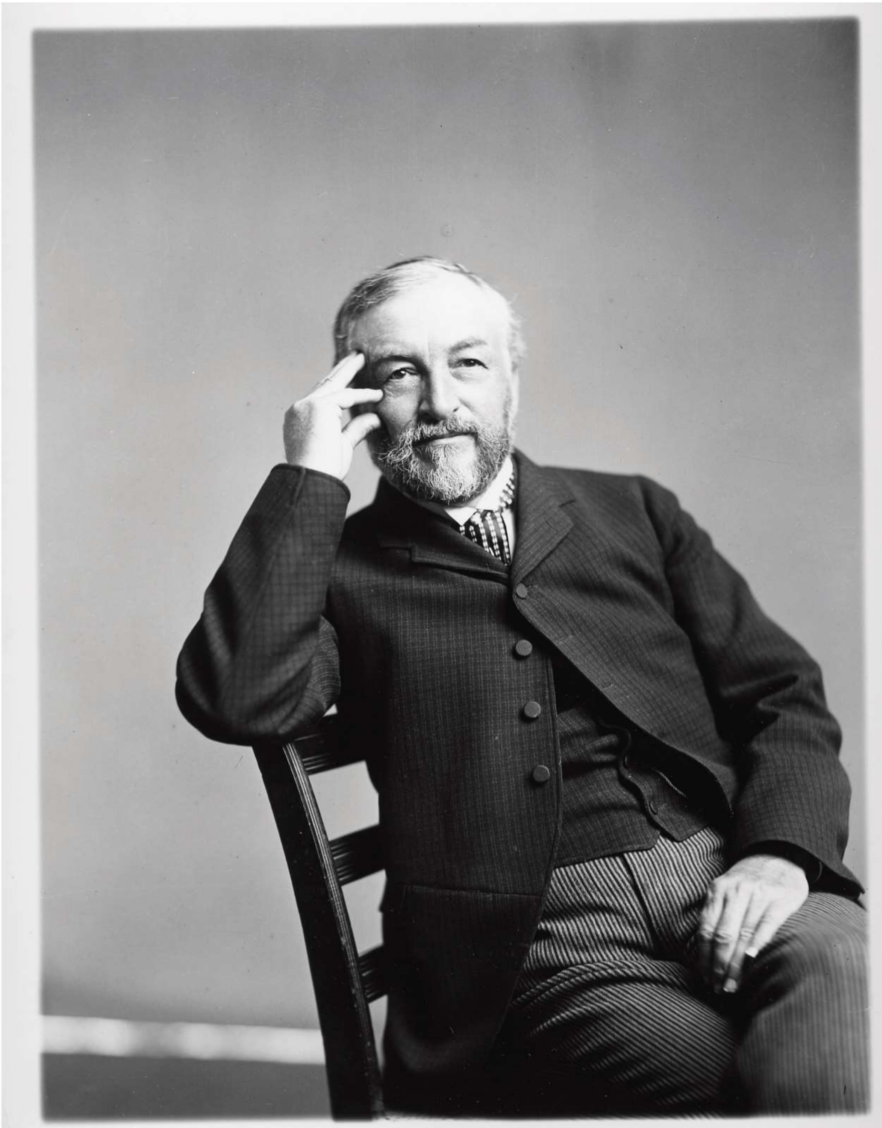
https://ko.wikipedia.org/wiki/라이트 형제

라이트 형제 (Wright Brothers)

1000번의 글라이더 비행 실험

라이트 형제 (Wright Brothers)

새뮤얼 피어폰트 랭글리 (Samuel Pierpont Langley)

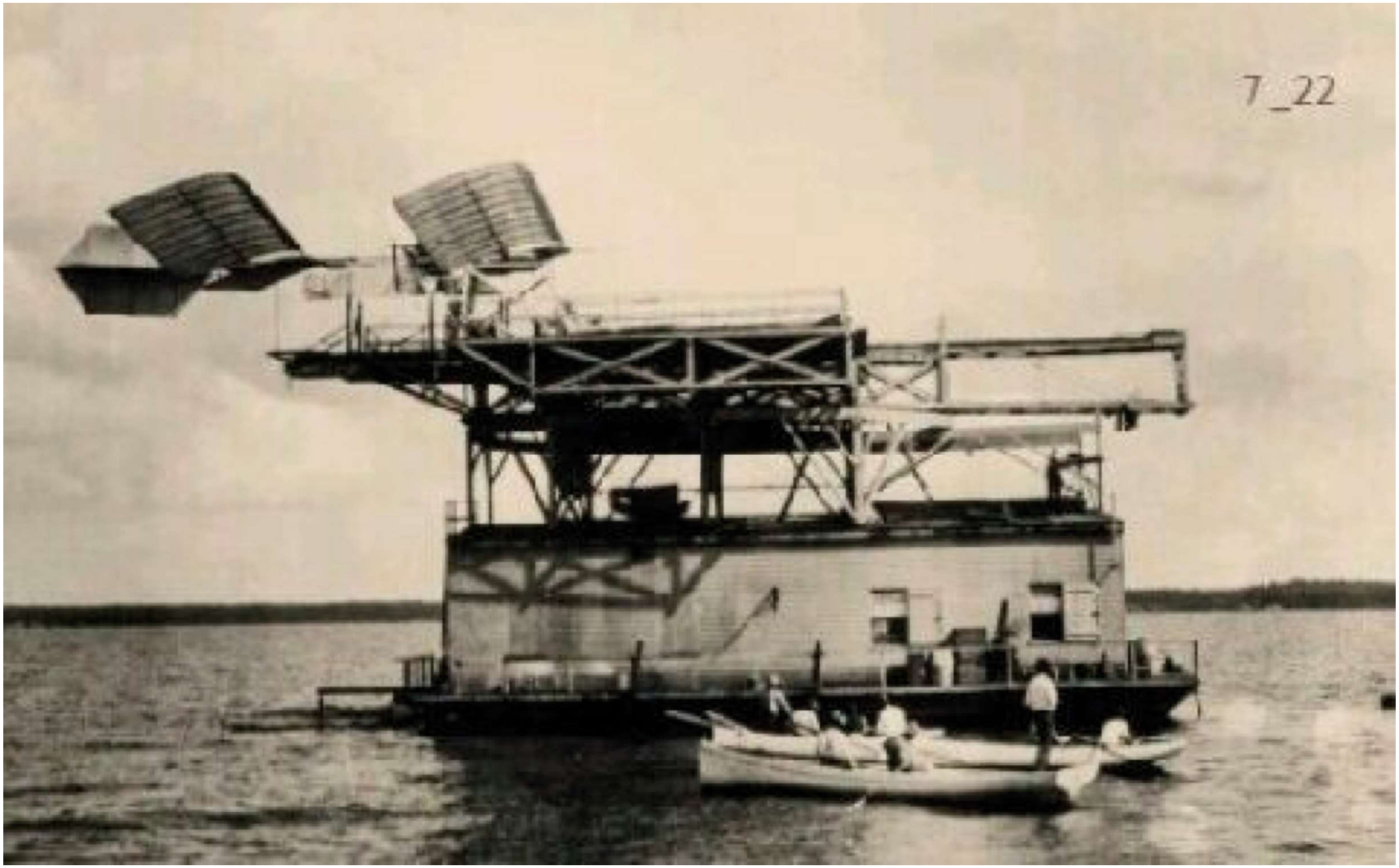


1896년 최초의 동력에 의한

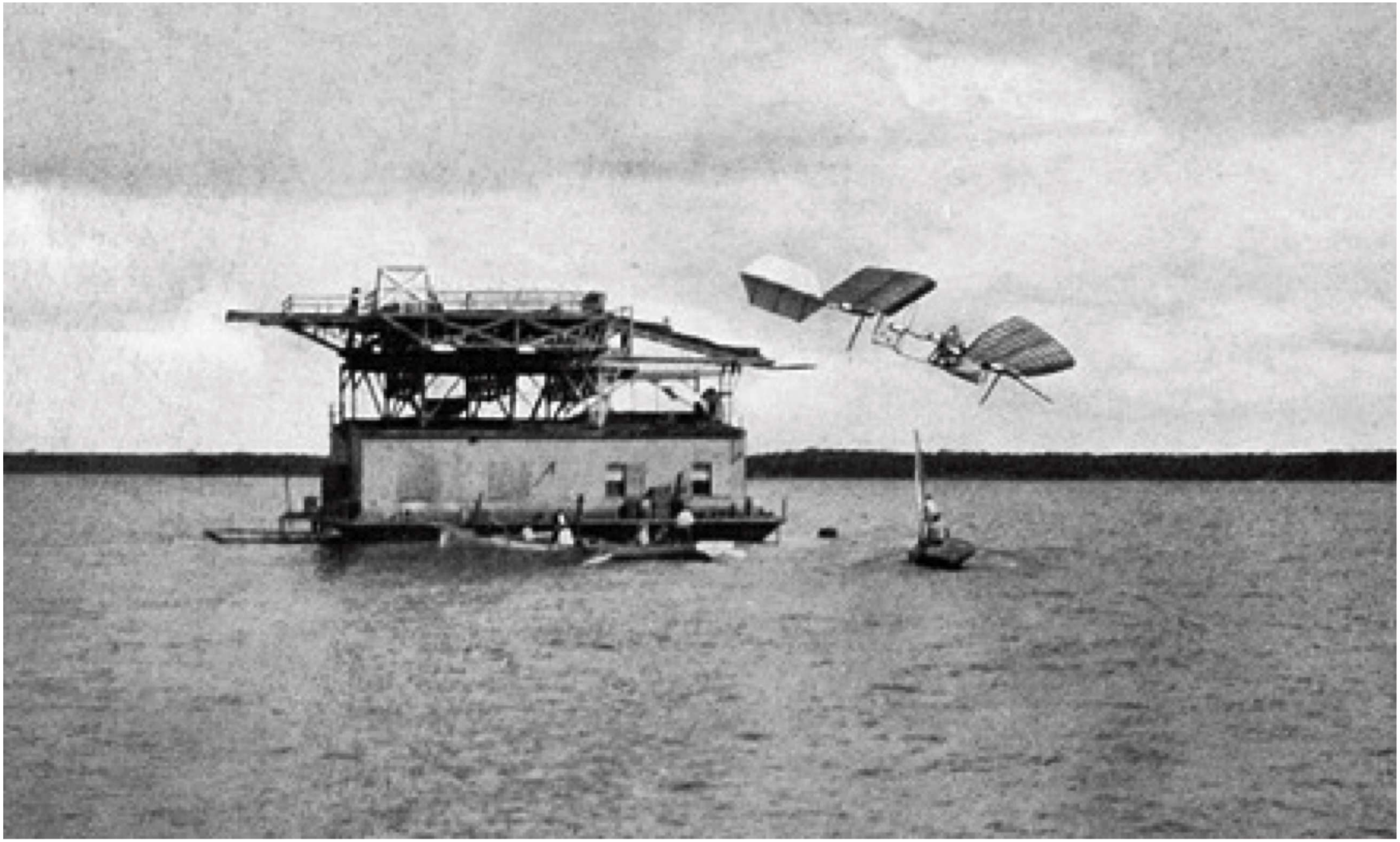
비행기를 제작하는데 성공

https://ko.wikipedia.org/wiki/새뮤얼_피어폰트_랭글리

새뮤얼 피어폰트 랭글리 (Samuel Pierpont Langley)



새뮤얼 피어폰트 랭글리 (Samuel Pierpont Langley)



최초의 비행기

- 라이트 형제가 아님
- 1000번이 넘는 비행 실험
- 문제 해결을 위한 융합적 시도
- 문제 정의가 중요함
- 실제 문제를 목표로 삼음


ARTIFICIAL INTELLIGENCE
NOW AND THE FUTURE
Retail
Automata
Analytics

인공지능 기술 발전 방향

- 컴퓨터 아키텍처 (CPU, GPU)
- 플랫폼 아키텍처 (Platform)
- 인공지능 알고리즘 (Algorithm)
- 데이터 확보 (Data)
- 다양한 시도 (Try&Error)

A New Golden Age for Computer Architecture

Figure 8. Functional organization of Google Tensor Processing Unit (TPU v1).

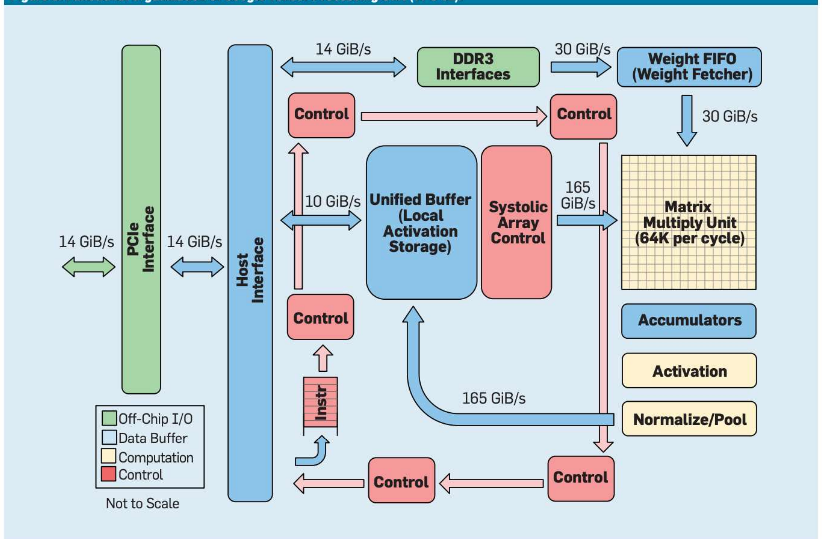
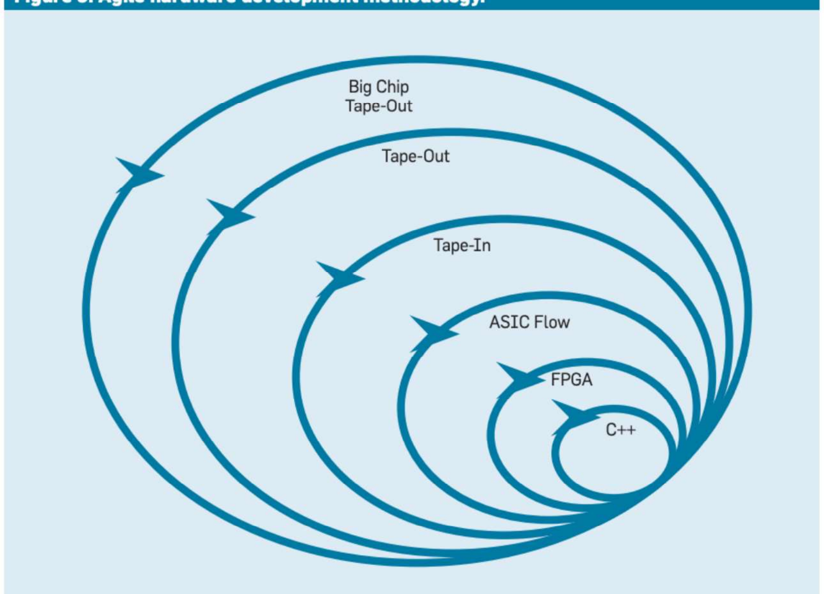
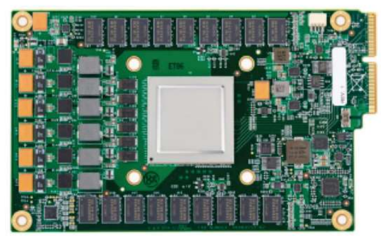


Figure 9. Agile hardware development methodology.



TPU v1 and v2



TPU v1

Launched in 2015

Inference only

TPU v2

Launched in 2017

Inference and training

Coral Dev Board, Edge TPU

https://dl.acm.org/citation.cfm?id=3282307

Edge TPU performance benchmark

Table 1. Time per inference, in milliseconds (ms)

Model architecture	Desktop CPU [1]	Desktop CPU [1] + USB Accelerator (USB 3.0) *with Edge TPU*	Embedded CPU [2]	Dev Board [3] *with Edge TPU*
DeepLab V3 (513x513)	394	52	1139	241
DenseNet* (224x224)	380	20	1032	25
Inception v1 (224x224)	90	3.4	392	4.1
Inception v4 (299x299)	700	85	3157	102
Inception-ResNet V2 (299x299)	753	57	2852	69
MobileNet v1 (224x224)	53	2.4	164	2.4
MobileNet v2 (224x224)	51	2.6	122	2.6
MobileNet v1 SSD (224x224)	109	6.5	353	11

https://coral.withgoogle.com/docs/edgetpu/benchmarks/

New Computer Architecture

GPU보다 100배 빠른 '멤리스터' 칩 개발

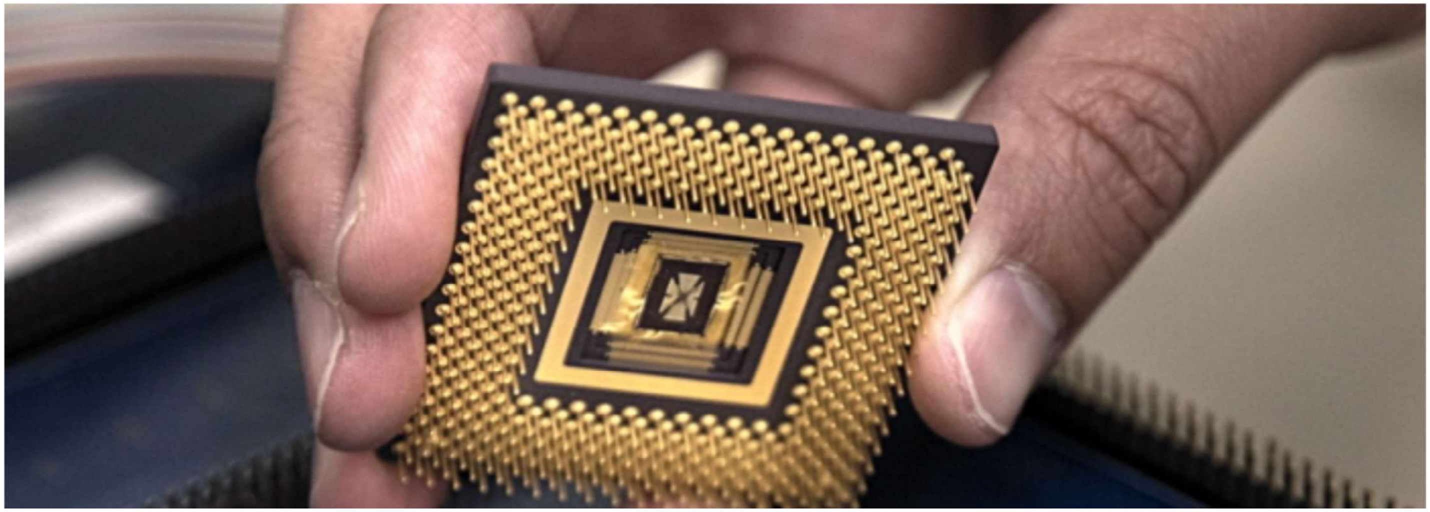
- 미시간 대학 웨이 루 교수팀, 머신러닝 처리 '메모리 스타칩' 프로토타입 개발

2019년 8월 5일

CPU보다 최대 1만 배 빠른 속도로 연산 가능한 머신러닝 처리 장치 '메모리 스타칩' 프로토타입이 등장했다.

미시간 대학 웨이 루 교수 연구팀은 꿈의 소자로 여겨지는 '멤리스터'를 사용해 현재 컴퓨터에 탑재된 CPU보다 최대 1만 배나 빠른 속도로 머신러닝을 처리할 수 있는 연산 장치를 개발했다.

연구 성과는 네이처지에 논문명 '효율적인 다중 연산을 위한 완전히 재구성 가능한 memristor-CMOS 시스템(A fully integrated reprogrammable memristor–CMOS system for efficient multiply–accumulate operations)'으로 7월 15일(현지시간) 게재됐다.



https://www.nature.com/articles/s41928-019-0270-x

Platform Architecture

Building an AI Chip Saved Google From Building a Dozen New Data Centers

Server racks loaded with TPUs GOOGLE

https://www.wired.com/2017/04/building-ai-chip-saved-google-building-dozen-new-data-centers/

Platform Architecture

Research | Open Source

Open-sourcing ReAgent, a modular, end-to-end platform for building reasoning systems

October 16, 2019 작가 Jason Gauci, Honglei Liu, Mohammad Ghavamzadeh, Ralfi Nahmias

공유하기 f

Whether they're designed to surface product recommendations or navigate busy highways, reasoning systems for real-world decision-making require some of the most sophisticated policies in machine learning. But despite advances in reinforcement learning (RL) and other reward-based approaches, learning through trial and error is difficult in unpredictable environments, and developing policies that can achieve complex objectives is often time- and resource-intensive. To overcome challenges like this, we are introducing ReAgent, a full suite of tools designed to streamline the process of building models that make and rely on decisions.

관련된 게시물

Open-sourcing mvfst-rl, a research platform for managing network congestion

October 14, 2019

https://ai.facebook.com/blog/open-sourcing-reagent-a-platform-for-reasoning-systems/

Platform Architecture

Scalable Deep Learning on Distributed Infrastructures: Challenges, Techniques and Tools

RUBEN MAYER, Technical University of Munich, Germany
HANS-ARNO JACOBSEN, Technical University of Munich, Germany

Deep Learning (DL) has had an immense success in the recent past, leading to state-of-the-art results in various domains such as image recognition and natural language processing. One of the reasons for this success is the increasing size of DL models and the proliferation of vast amounts of training data being available. To keep on improving the performance of DL, increasing the scalability of DL systems is necessary. In this survey, we perform a broad and thorough investigation on challenges, techniques and tools for scalable DL on distributed infrastructures. This incorporates infrastructures for DL, methods for parallel DL training, multi-tenant resource scheduling and the management of training and model data. Further, we analyze and compare 11 current open-source DL frameworks and tools and investigate which of the techniques are commonly implemented in practice. Finally, we highlight future research trends in DL systems that deserve further research.

CCS Concepts: • **Computing methodologies** → **Neural networks**; • **Computer systems organization** → *Parallel architectures*; *Distributed architectures*;

Additional Key Words and Phrases: Deep Learning Systems

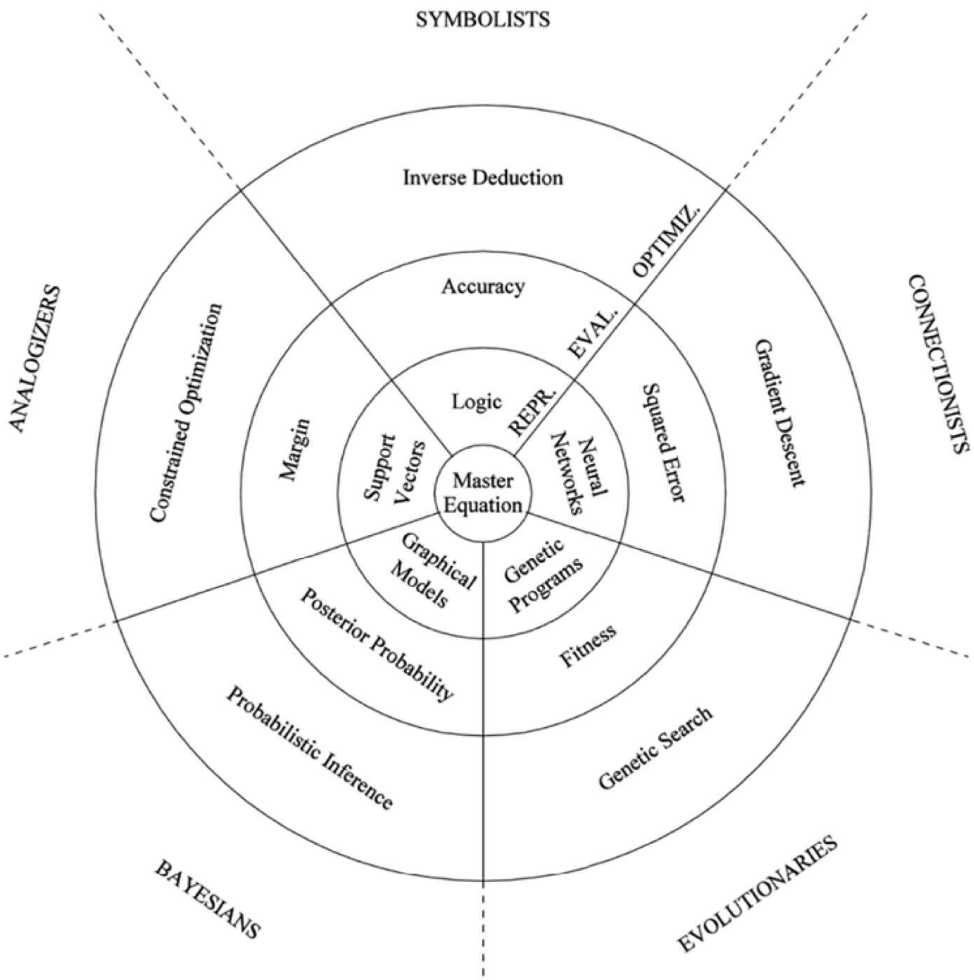
ACM Reference Format:
Ruben Mayer and Hans-Arno Jacobsen. 2019. Scalable Deep Learning on Distributed Infrastructures: Challenges, Techniques and Tools. *ACM Comput. Surv.* 1, 1, Article 1 (September 2019), 35 pages. https://doi.org/0000001.0000001

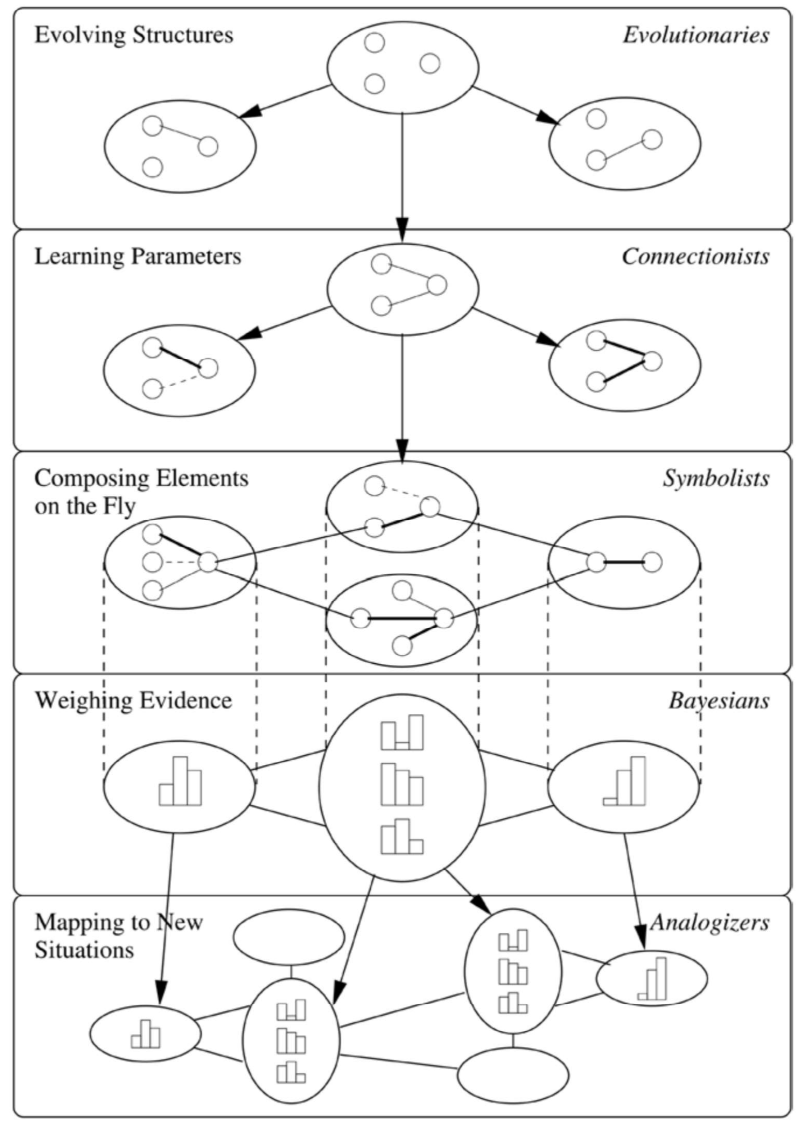
1 INTRODUCTION

Deep Learning (DL) has recently gained a lot of attention due to its superior performance in tasks like speech recognition [65, 69], optical character recognition [20], and object detection [95]. The application of DL poses a tremendous potential in numerous areas like medical image analysis (e.g., breast cancer metastases detection) [107], machine translation [84], image restoration (e.g., automatically colorize grayscale images) [75], image captioning [68] (i.e., creating a description of an image), and as agents in reinforcement learning systems that map state-action pairs to expected rewards [10]. In DL, a network of mathematical operators is trained with classified or unclassified data sets until the weights of the model are ready to make correct predictions on previously unseen data. Major companies and open source initiatives have developed powerful DL frameworks such as TensorFlow [4] and MXNet [125] that automatically manage the execution of large DL models developed by domain experts.

https://arxiv.org/pdf/1903.11314.pdf

The Master Algorithm – Pedro Domingos





https://www.amazon.com/Master-Algorithm-Ultimate-Learning-Machine/dp/0465094279

New Computational Algorithms

BLOG POST
RESEARCH

12 OCT 2016

Differentiable neural computers

SHARE

AUTHORS

GW Greg Wayne

AG Alexander Graves

FURTHER READING

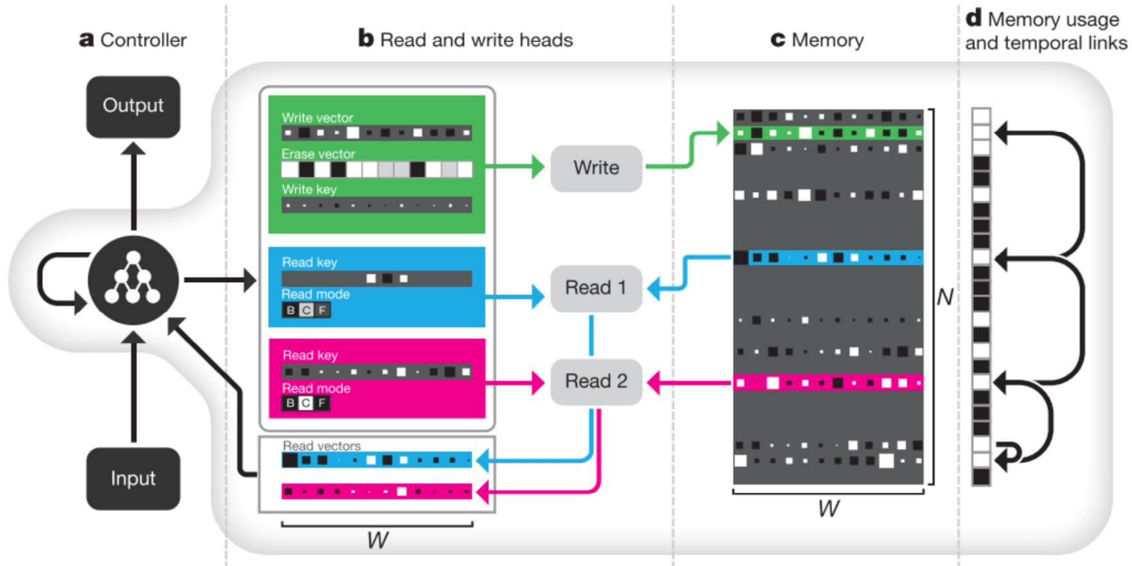
- Abstraction & Concepts
- Deep Learning
- Deep Reinforcement Learning
- Language
- Memory

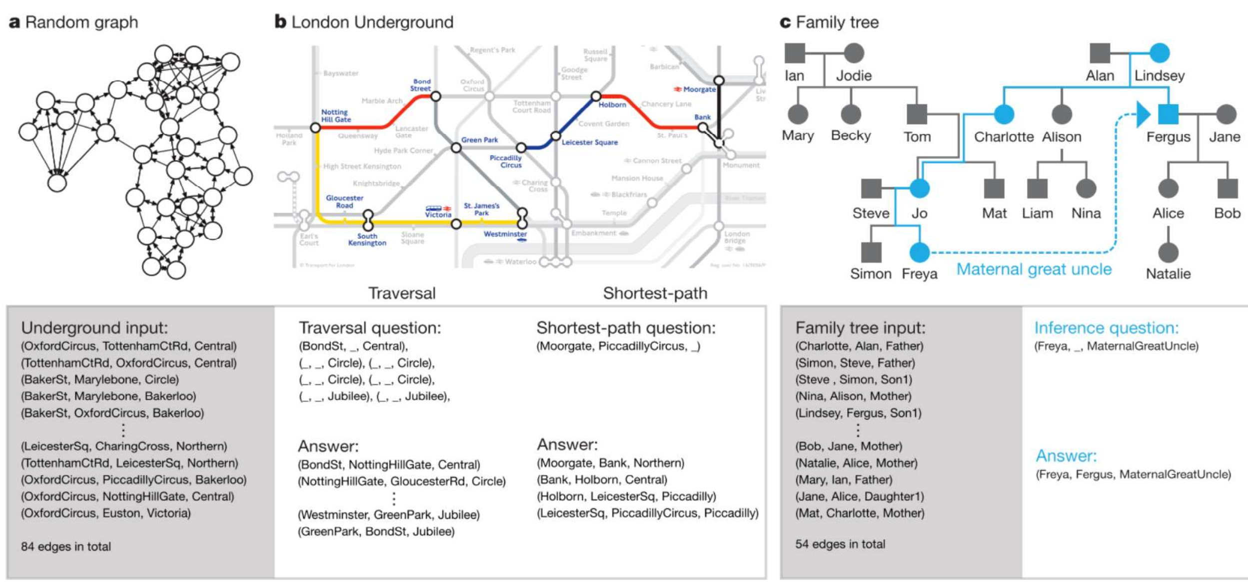
In a recent study in Nature, we introduce a form of memory-augmented neural network called a differentiable neural computer, and show that it can learn to use its memory to answer questions about complex, structured data, including artificially generated stories, family trees, and even a map of the London Underground. We also show that it can solve a block puzzle game using reinforcement learning.

Plato likened memory to a wax tablet on which an impression, imposed on it once, would remain fixed. He expressed in metaphor the modern notion of plasticity – that our minds can be shaped and reshaped by experience. But the wax of our memories does not just form impressions, it also forms connections, from one memory to the next. Philosophers like John Locke believed that memories connected if they were formed nearby in time and space. Instead of wax, the most potent metaphor expressing this is Marcel Proust's madeleine cake; for Proust, one taste of the confection as an adult undammed a torrent of associations from his childhood. These episodic memories (event memories) are known to depend on the hippocampus in the human brain.

https://deepmind.com/blog/article/differentiable-neural-computers

New Computational Algorithms

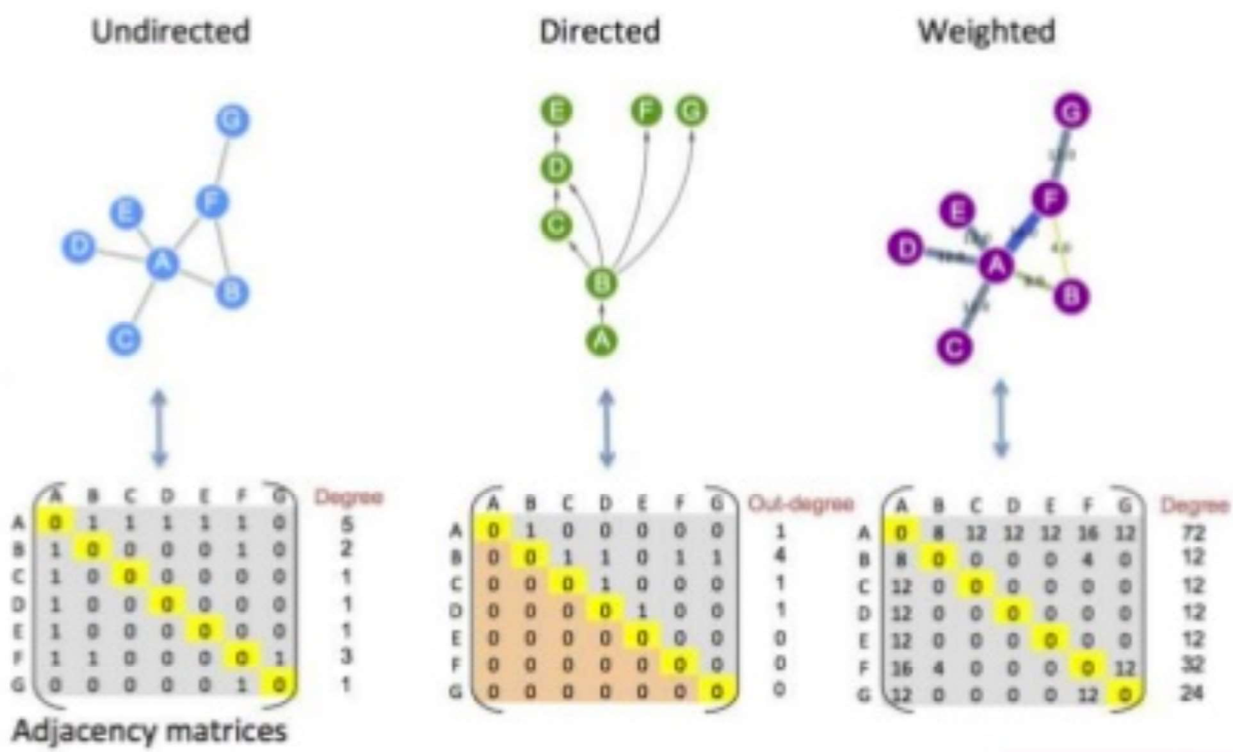




https://www.nature.com/articles/nature20101

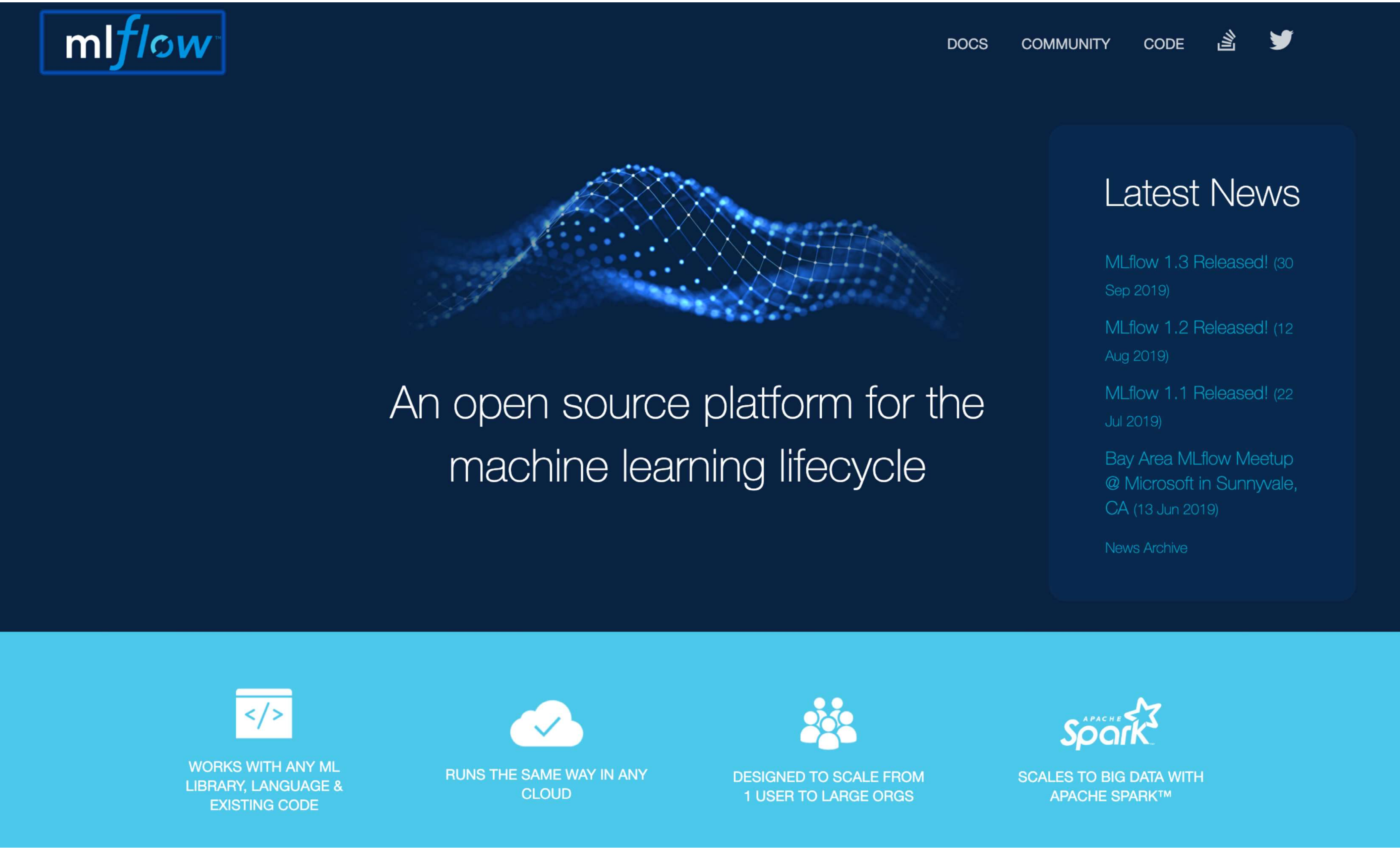
New Computational Algorithms

GNN (Graph Neural Network)



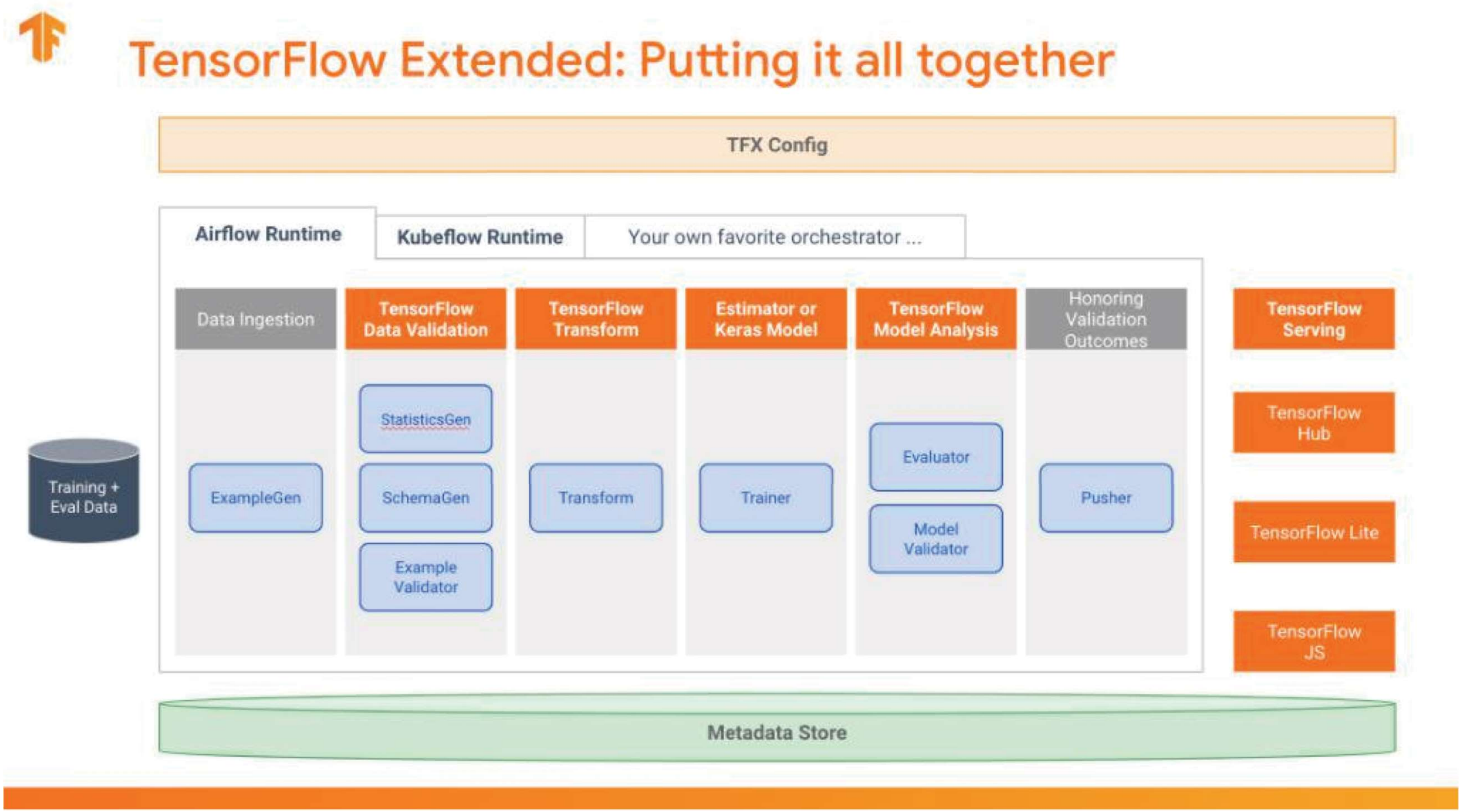
https://www.slideshare.net/JungwonKim10/graph-neural-network-introduction

ML Flow



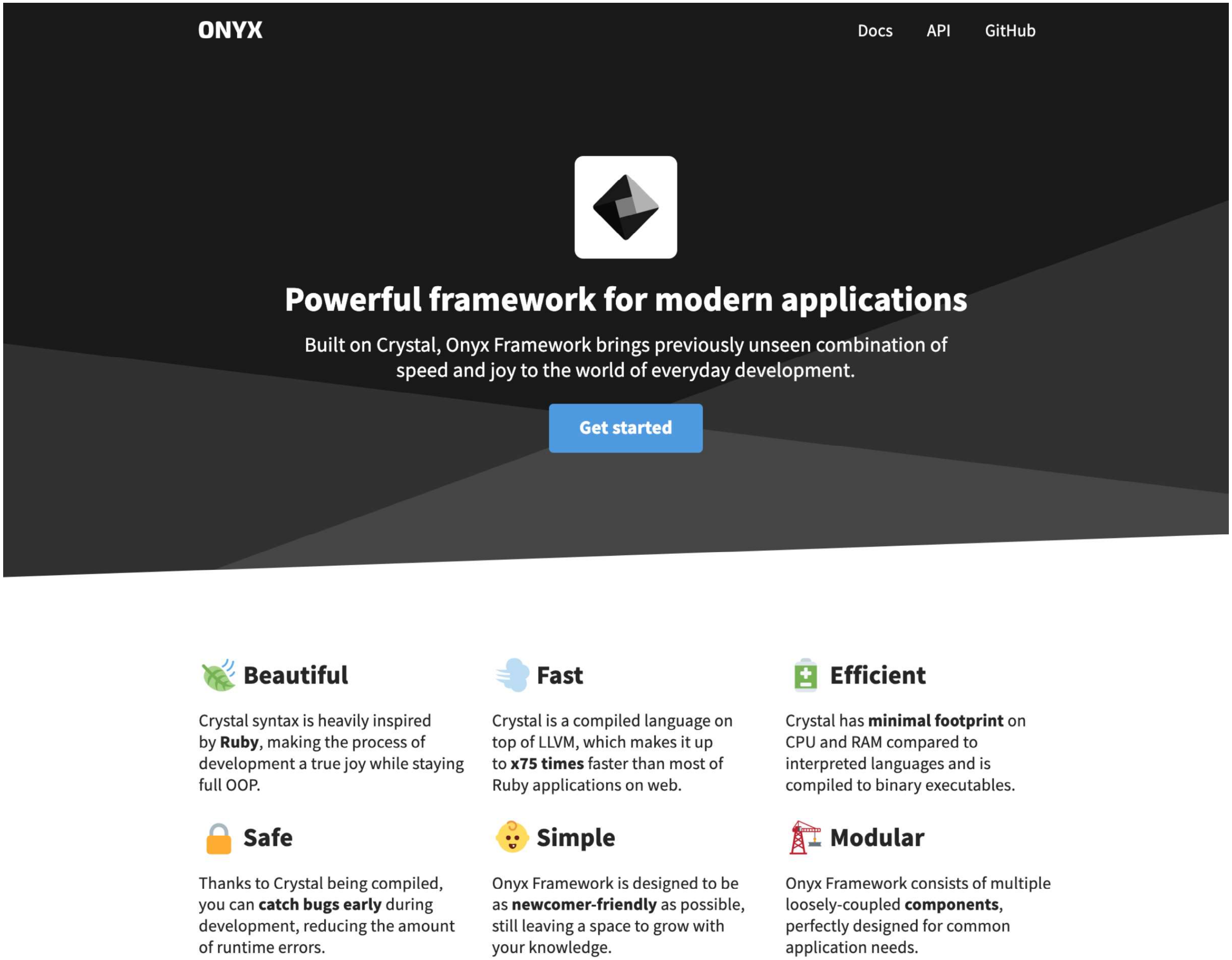
https://mlflow.org/

Tensorflow Extended



https://www.tensorflow.org/tfx

Onyx Framework



https://onyxframework.org/

데이터 확보

AI음성인식 위한 학습에 인문학도들 나서...

정한영 기자 | 승인 2019.10.18 07:48 | 댓글 0

> 전남대 인문대생 50여명, 대화패턴 6만건 생성...'음성인식 앱' 지능 향상 시키는 학습훈련 참여

AI 음성인식 위한 학습에 인문학도들 나서...(사진:Pixabay, 편집:본지)

공학의 전유물로 여겨지는 인공지능(AI)을 학습시키는 일을 인문학이 맡게 돼, 새로운 직업군 탄생으로 이어질지 주목되고 있다.

전남대학교(총장 정병석)는 AI 음성인식 애플리케이션을 위한 말뭉치(CORPUS)를 수집하고 생성하는 실습 프로젝트에 1차적으로 국문학과를 비롯한 인문대 학생 50여명을 투입해 '동영상을 찾는 상황'과 '음악을 찾는 상황'을 가정해 인공지능(AI)과 연속해서 주고받을 수 있는 6만여건의 대화를 만들어 내기로 했다.

http://www.aitimes.kr/news/articleView.html?idxno=14483

데이터 확보


크라우드웍스, 100억 규모 시리즈B 투자 유치

김민정 POSTED ON 2019/09/17

좋아요 48개

크라우드웍스(대표 박민우)는 8개 투자사로부터 총 100억원 규모의 시리즈B 투자를 유치했다고 17일 밝혔다.

이번 투자에는 한국투자파트너스, SW인베스트먼트, 산업은행, KEB하나은행, HB인베스트먼트, 쿨리지코너 등 8개 투자사가 참여했다. 크라우드웍스는 지난해 DSC 인베스트먼트, BA 파트너스로부터 시리즈 A 투자를 유치한 바 있다.

크라우드웍스는 인공지능(AI) 학습에 필요한 데이터를 수집하고 가공해주는 국내 최대 규모의 'AI 학습데이터 플랫폼'이다. 2017년 4월 설립 이후 현재 70여개 고객사를 확보했으며, 30,000여명의 참여자로 활용하여 3,300만 건의 학습데이터를 생산했다.

크라우드웍스를 통해 생산된 데이터는 네이버, 카카오, 삼성전자, SK텔레콤, KT, LG-CNS 등의 대기업과 마인즈랩, 우아한형제들 등의 스타트업, KAIST, 포항공대, 경북대학교, ETRI등의 대학 및 정부연구기관에 등에서 쓰이고 있다.

https://platum.kr/archives/128141

데이터 확보

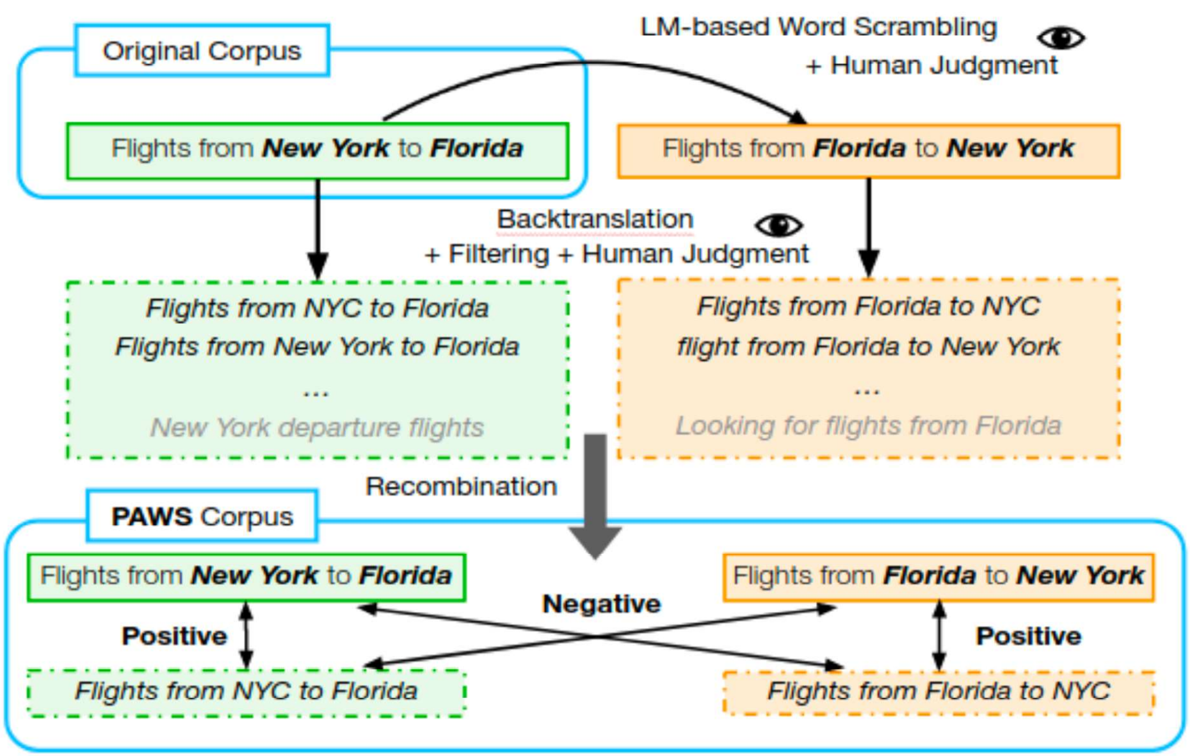
Releasing PAWS and PAWS-X: Two New Datasets to Improve Natural Language Understanding Models

Wednesday, October 2, 2019

Posted by Yuan Zhang, Research Scientist and Yinfei Yang, Software Engineer, Google Research

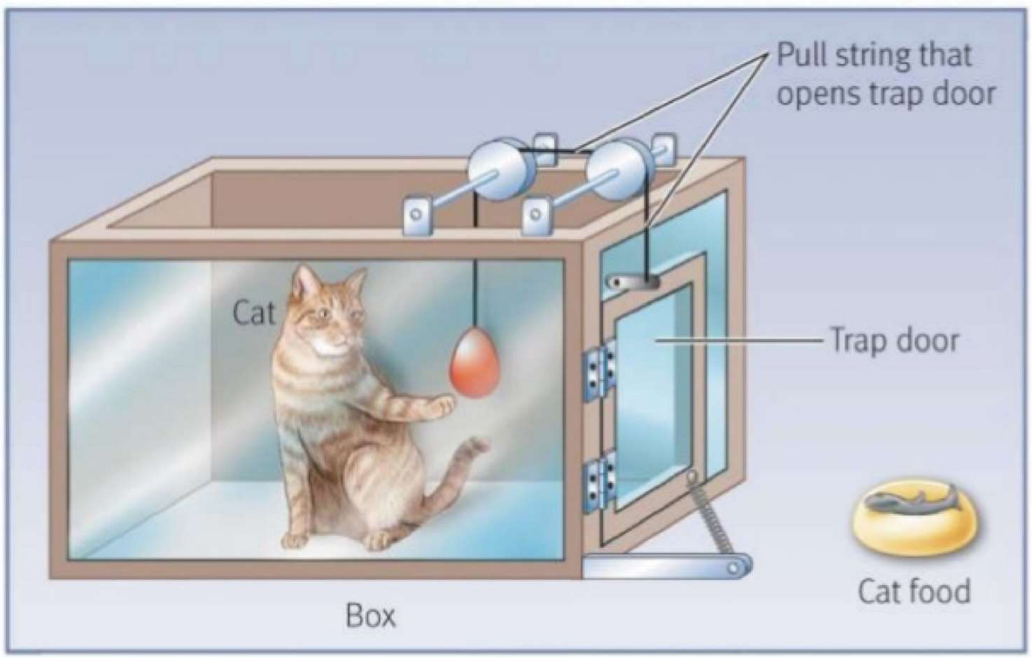
Word order and syntactic structure have a large impact on sentence meaning — even small perturbations in word order can completely change interpretation. For example, consider the following related sentences:

1. Flights from New York to Florida.
2. Flights to Florida from New York.
3. Flights from Florida to New York.



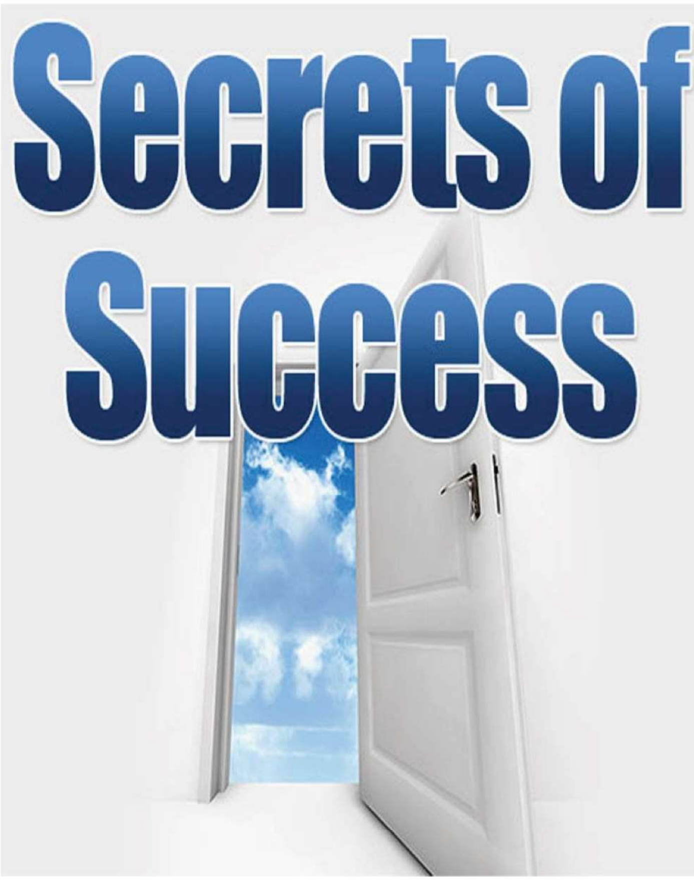
https://ai.googleblog.com/2019/10/releasing-paws-and-paws-x-two-new.html

다양한 시도 (Try & Error)



- 유명 모델 적용
- 모델을 재구현
- 다른 분야에 적용
- 환경 변화
- 데이터 변화
- 캐쉬 활용

성공하는 시도 (The secret of Success)

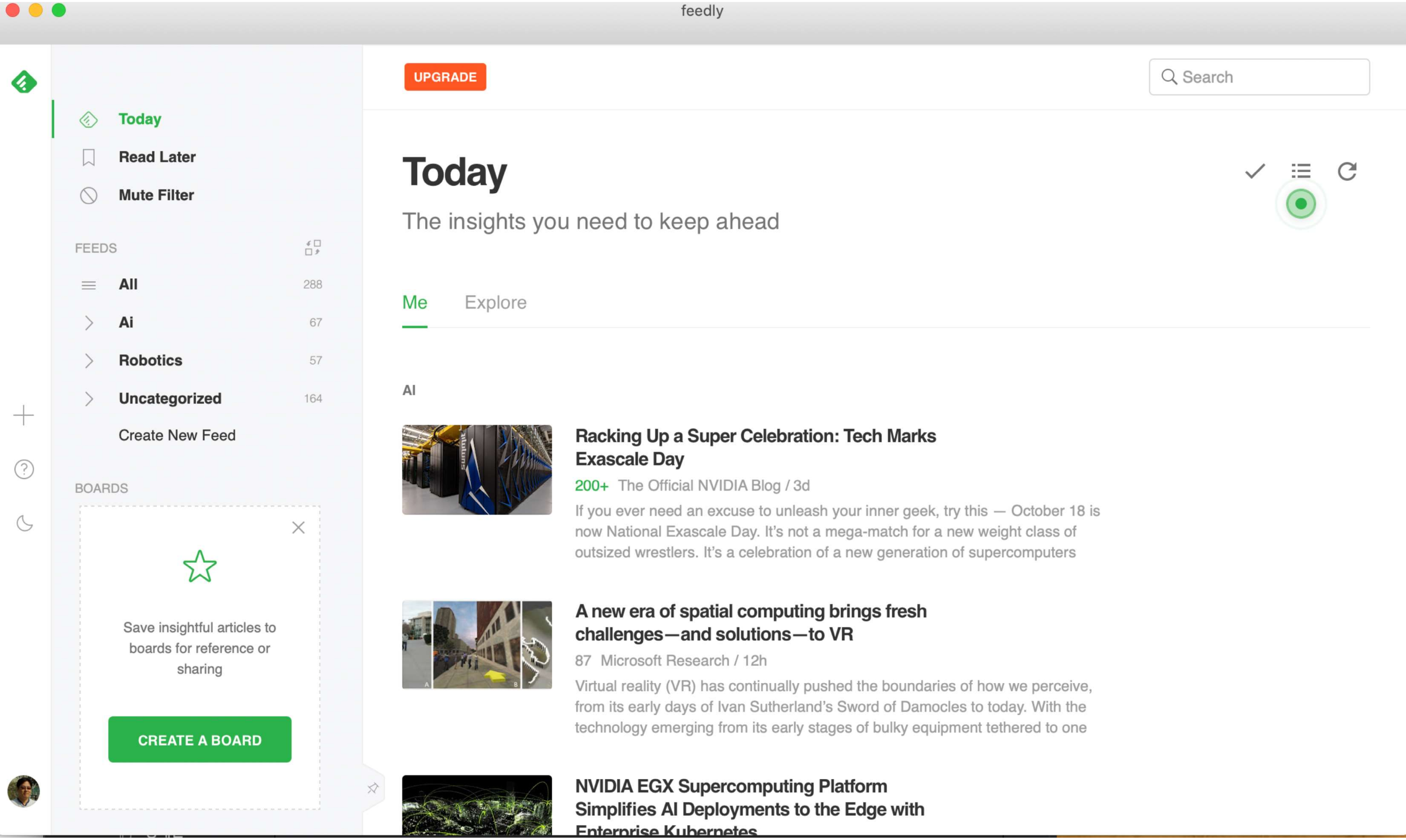


- 문제 정의가 중요 (What?)
- Literature Survey (수백편)
- Baseline (비교대상)
- Execution Environment (Mobile? Car?)
- Data (공개데이터, 확보가능한가?)
- PoC (한정된 환경, 중간산출물)
- Process (Deployment)
- Evaluation (다양한 매트릭스)

개인은 어떻게?

- 기술 트랜드 (Survey)
- 소소한 경험 (Kaggle?)
- 데이터, 데이터, 데이터
- 공유 (Publication, Presentation, …)
- 연대 (기술&비지니스&펀딩&
  디자인&사용자)

Feedly



https://feedly.com/i/my

Tech Digest Report

RL Weekly

RL Weekly is a weekly newsletter highlighting important progress in reinforcement learning in research or industry.

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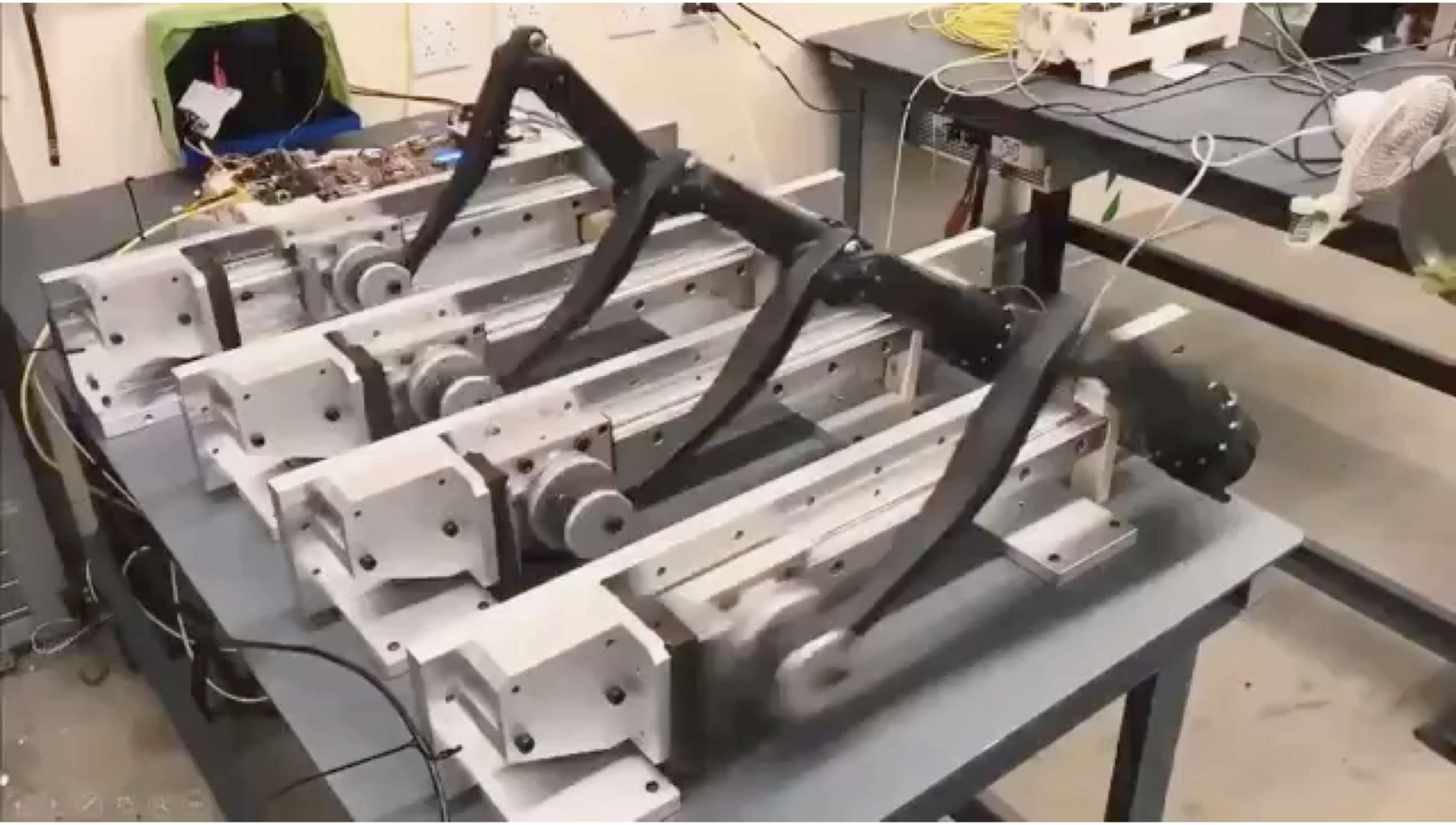
RL Weekly 33: Action Grammar, the Squashing Exploration Problem, and Task-relevant GAIL

reinforcement-learning | rl-weekly

In this issue, we look at Action Grammar RL, a hierarchical RL framework that adds new macro-actions, improving performance of DDQN and SAC in Atari environments. We then look at a new algorithm that borrows just the benefits of SAC's bounded actions to TD3 to achieve better performance. Finally, we look at an improvement to GAIL on raw pixel observations by focusing on task-relevant details.

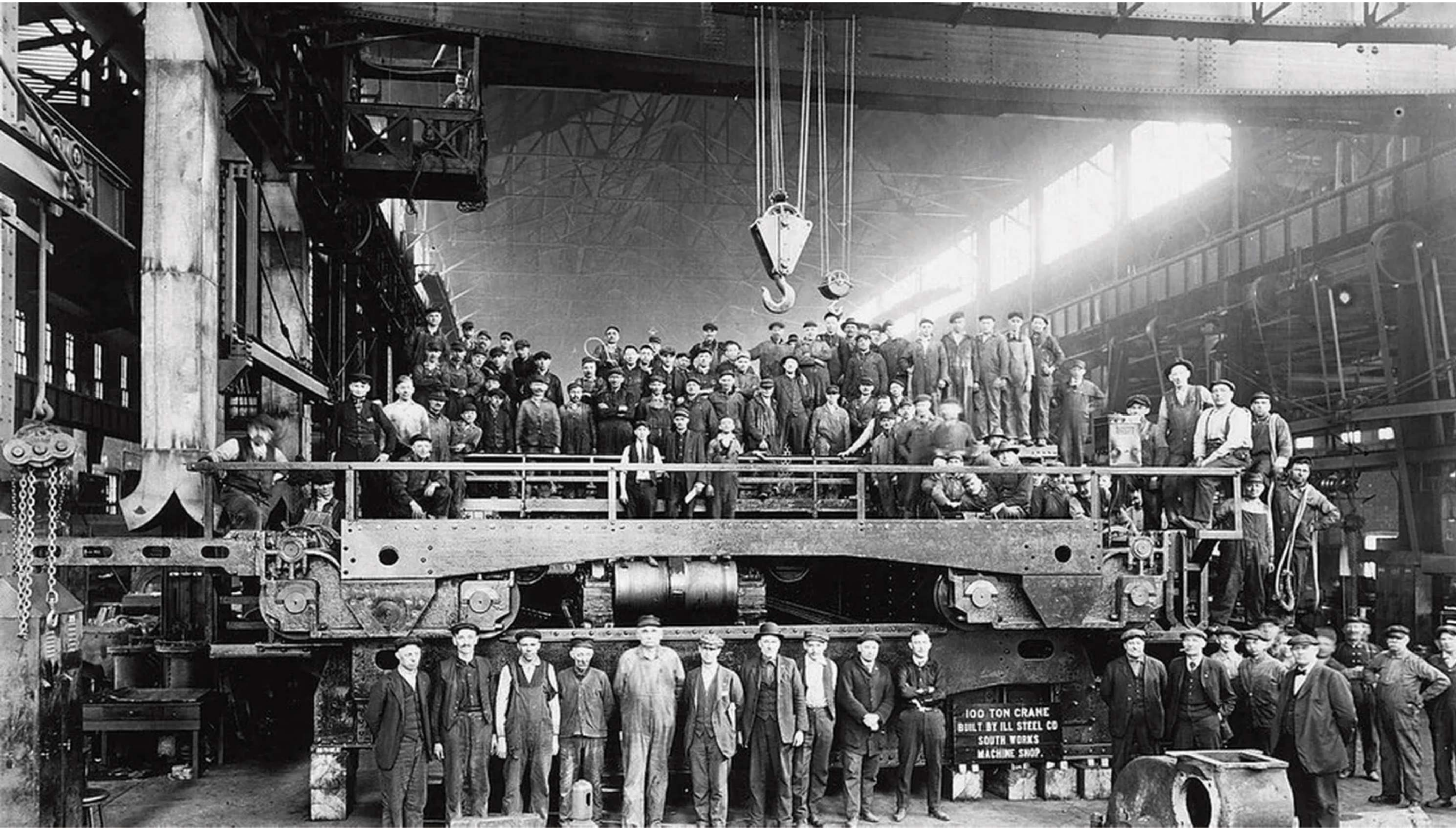
https://www.endtoend.ai/rl-weekly/

Data! Data! Data!



https://www.youtube.com/watch?v=_10csAY9cmo

https://www.endtoend.ai/rl-weekly/


100 TON CRANE
BUILT BY ILL STEEL CO
SOUTH WORKS
MACHINE SHOP.

Those who **cannot remember the past** are condemned to **repeat it**.

George Santayana, 1905

감사합니다

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