Trends of AI:

An Industrial Perspective

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Intro & Outline

- Highlights in the 2021 final report, NSCAI
- State of AI
  - Trends of Research
  - Talent, Industry and Politics
- TW's AI efforts in the industry

Former MD of Google Taiwan
Former Research Fellow, IIS, Academia Sinica
Board member for Appier, iKala

“US must face AI competition from China”

-- The 2021 Final Report, NSCAI

- **Leadership**: The report calls for new policy councils within the White House and offices within national security departments to focus specifically on technology competition and AI development.
- **Talent**: Much of the report is dedicated to the idea that nothing will happen without the right people — from technical experts to policy wonks. Recruiting them into government underlies many of the report’s recommendations.
- **Hardware**: Work said the U.S. must retain its “two-generation” lead in developing computer chips and other hardware to continue leading in AI. With the need for massive amounts of computing power, GPUs and TPUs have spiked in demand.
- **Investment**: The government’s vast resources need to be funneled to institutions that study basic AI research and development to improve tech and make new breakthroughs. The commission recommends investing $32 billion a year by 2026 in basic AI R&D.

Eric Schmidt is chair of the National Security Commission on Artificial Intelligence. Photo: AP

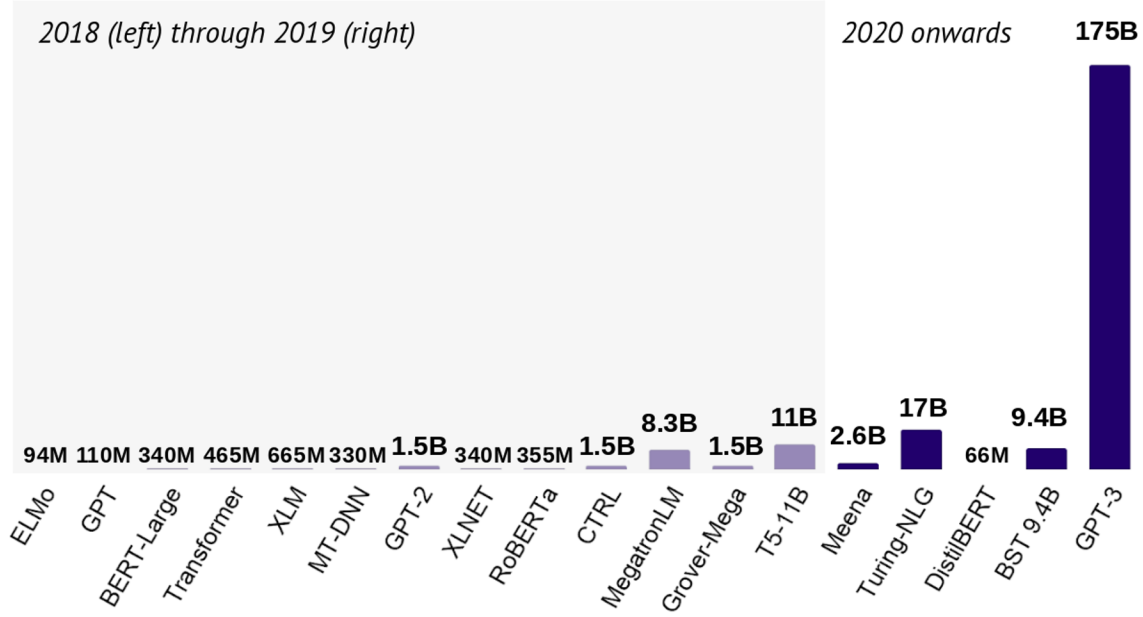
Eric Schmidt
Former Chairman of Google

Research Trends (StateOf.AI, 2020)

- A new generation of transformer language models are unlocking new NLP use-cases, e.g., GPT-3.
- Huge models, large companies and massive training costs dominate the hottest area of AI today: Natural Language Processing.
- Biology is experiencing its “AI moment”: From medical imaging, genetics, proteomics, chemistry to drug discovery.

Language models: Welcome to the Billion Parameter club

Huge models, large companies and massive training costs dominate the hottest area of AI today, NLP.



Note: The number of parameters indicates how many different coefficients the algorithm optimizes during the training process.

Tuning billions of model parameters costs millions of dollars

Based on variables released by Google et al., you're paying circa $1 per 1,000 parameters. This means OpenAI's 175B parameter GPT-3 could have cost tens of millions to train. Experts suggest the likely budget was $10M.

Just how much does it cost to train a model? Two correct answers are "depends" and "a lot". More quantitatively, here are current ballpark list-price costs of training differently sized BERT [4] models on the Wikipedia and Book corpora (15 GB). For each setting we report two numbers - the cost of one training run, and a typical fully-loaded cost (see discussion of "hidden costs" below) with hyper-parameter tuning and multiple runs per setting (here we look at a somewhat modest upper bound of two configurations and ten runs per configuration).[4]

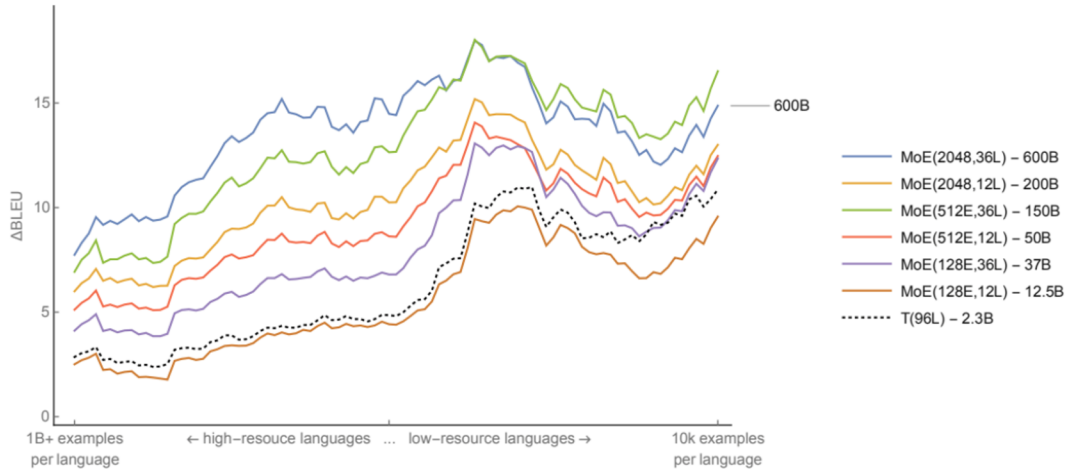
- $2.5k - $50k (110 million parameter model)
- $10k - $200k (340 million parameter model)
- $80k - $1.6m (1.5 billion parameter model)

For example, based on information released by Google, we estimate that, at list-price, training the 11B-parameter variant[5] of T5 [5] cost well above $1.3 million for a single run. Assuming 2-3 runs of the large model and hundreds of the small ones, the (list-)price tag for the entire project may have been $10 million[6].

Not many companies – certainly not many startups – can afford this cost. Some argue that this is not a severe issue; let the Googles of the world pre-train and publish the large language models, and let the rest of the world fine-tune them (a much cheaper endeavor) to specific tasks. Others (e.g., Etchemendy and Li [6]) are not as sanguine.

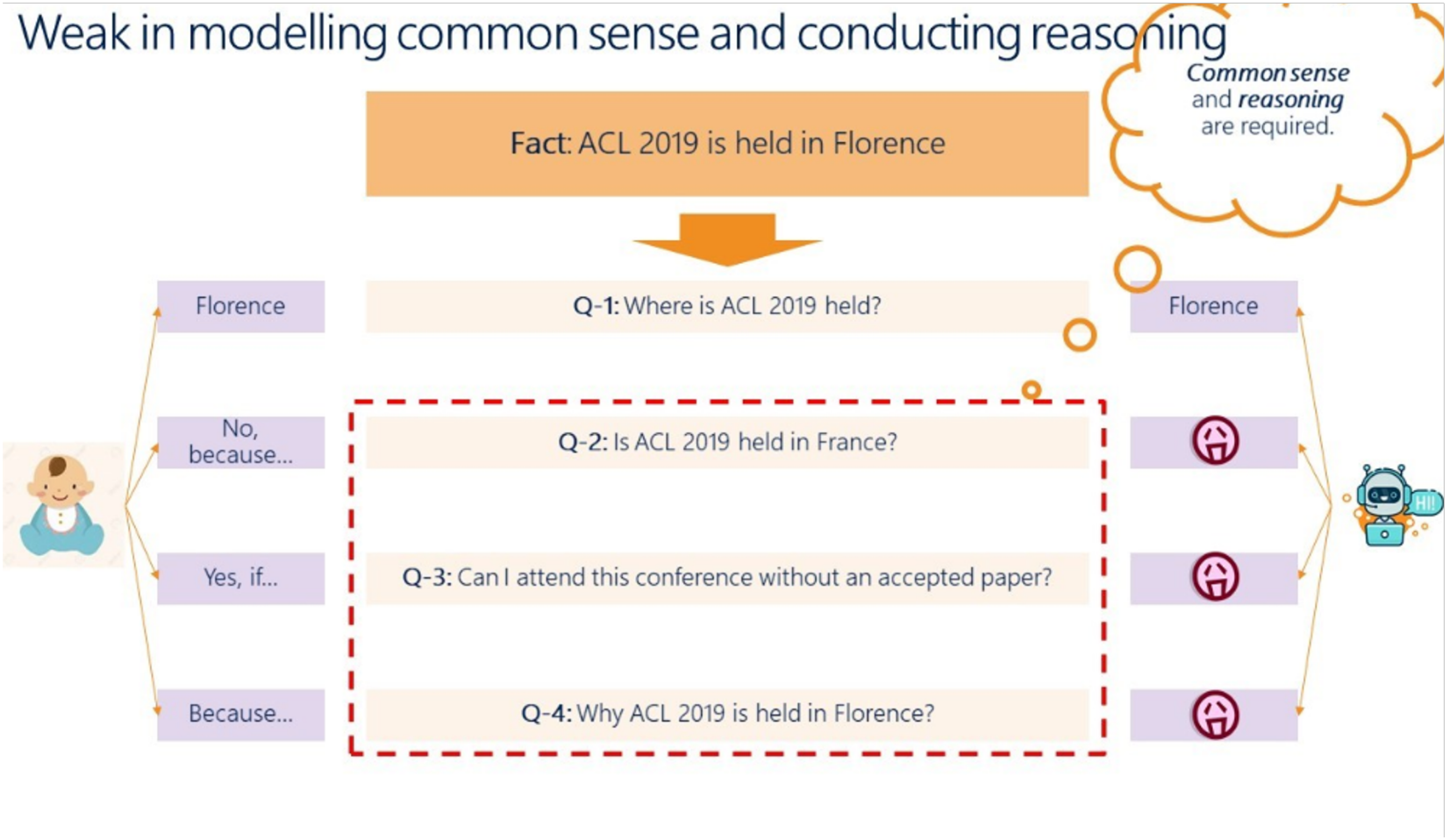
Low resource languages with limited training data are a beneficiary of large models

- **Google made use of their large language models to deliver higher quality translations for languages with limited amounts of training data, for example Hansa and Uzbek. This highlights the benefits of transfer learning.**



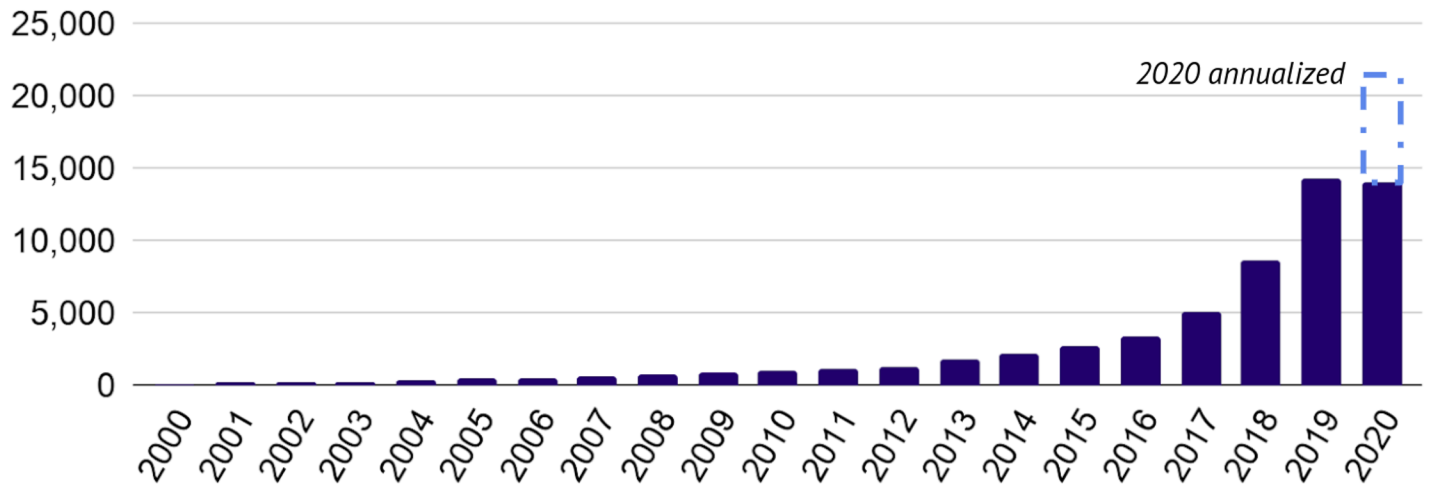
Google Search & QA

Limitations of DNN for NLU



Biology is experiencing its "AI moment": Over 21,000 papers in 2020 alone

Publications involving AI methods (e.g. deep learning, NLP, computer vision, RL) in biology are growing >50% year-on-year since 2017. Papers published since 2019 account for 25% of all output since 2000.

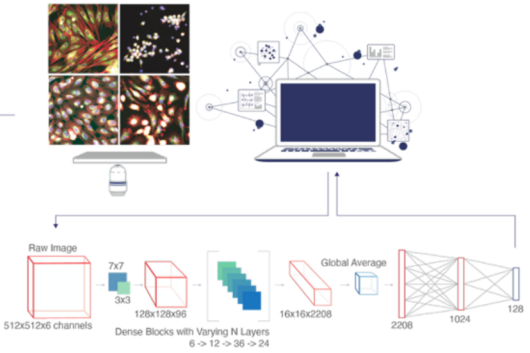


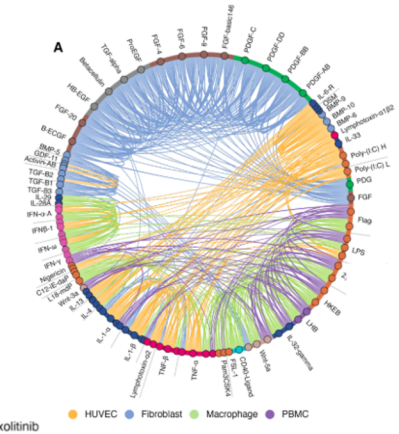
PubMed.gov

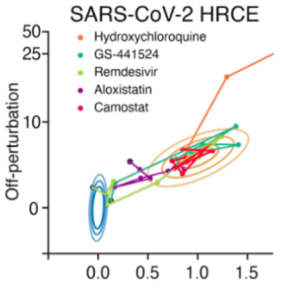
Deep learning on cellular microscopy accelerates biological discovery with drug screens

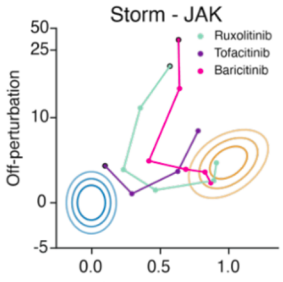
Embeddings from experimental data illuminate biological relationships and predict COVID-19 drug successes.

- Deep learning models trained to identify biologically-perturbed cells imaged by fluorescent microscopy can identify 100s-1000s of relevant features of cellular morphology.
- Applying these features makes it possible to relate the biology induced by genetic changes, immune/cytokine perturbations, and drugs.
- These models were applied to experiments on COVID-19 infection and cytokine storm, identifying repurposable candidates and correctly predicting 4 randomized clinical trial results from *in vitro* data: rxrx.ai.









Recursion

stateof.ai 2020

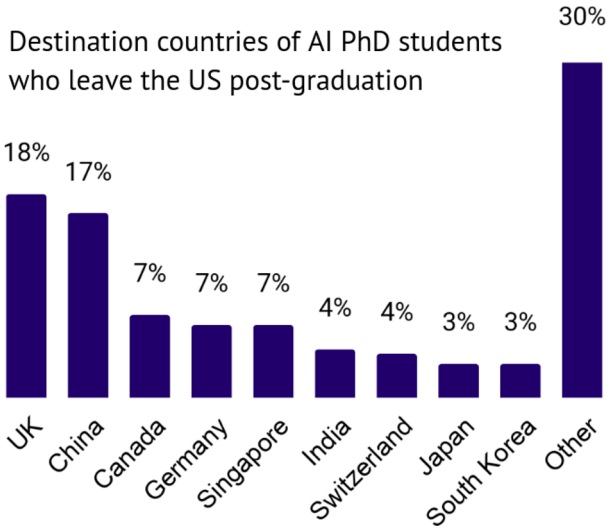
How AI is helping to fight COVID-19

- Enabling organizations to scale and adjust
  - Rapid diagnosis
  - Chat bots to answer questions
- Understanding how COVID-19 spreads
- Speeding up research and treatments

healthmantramagazines

Talent Trends

- AI talent will remain tight
- American institutions and corporations further their dominance of major academic conference papers acceptances.
- US AI ecosystem is fuelled by foreign talent and the contribution of researchers educated in China to world-class papers is clear.
- Corporate-driven academic brain drain is significant and appears to negatively impact entrepreneurshi



Industry Trends

- The first trial of an AI-discovered drug begins in Japan and the first US medical reimbursement for AI-based imaging procedure is granted.
- Self-driving car mileage remains microscopic and open sourcing of data grows to crowdsource new solutions.
- Google, Graphcore, and NVIDIA continue to make major advances in their AI hardware platforms.
- NLP applications in industry continue to expand their footprint and are implemented in Google Search and Microsoft Bing.

Robotruck TuSimple go for IPO

Other AI Trends

- AI boosts greater demands of cloud services
- AIops become popular
- AI in cybersecurity
- AI ethics is the focus
- AI will become more explainable

Politics Trends

- After two wrongful arrests involving facial recognition, ethical risks that researchers have been warning about come into sharp focus.
- Semiconductor companies continue to grow in geopolitical significance, particularly Taiwan's TSMC.
- The US Military is absorbing AI progress from academia and industry labs.
- Nations pass laws to let them scrutinize foreign takeovers of AI companies and the UK's Arm will be a key test.

Drone Swarm

Digital Economy Drives Global GDP

- > 50% of global GDP in 2023 will be driven by digital economy (IDC)
- Taiwan's digital industry accounts for 19.2% of GDP, but it focuses more on hardware rather than software
- Ratio of software services accounted for the digital economy:
  - Taiwan: 16.6%, Korea: 33% , USA: 91.5%

Taiwan's AI Efforts

- AI related hardware efforts
  - Semiconductor manufacturing, e.g., TSMC
  - Chipsets, sensors, e.g., MTK
  - Edge AI
- AI startups
- Talent training
  - AI Academy (+7,500 ppl)

Taiwan's AI Ecosystem Second Half 2020

December 2020

The categorizations depicted on the map were determined at our sole discretion and provide merely a snapshot of Taiwan's developing AI ecosystem. If you would like to be included on the map or believe your company should be edited, please contact us.

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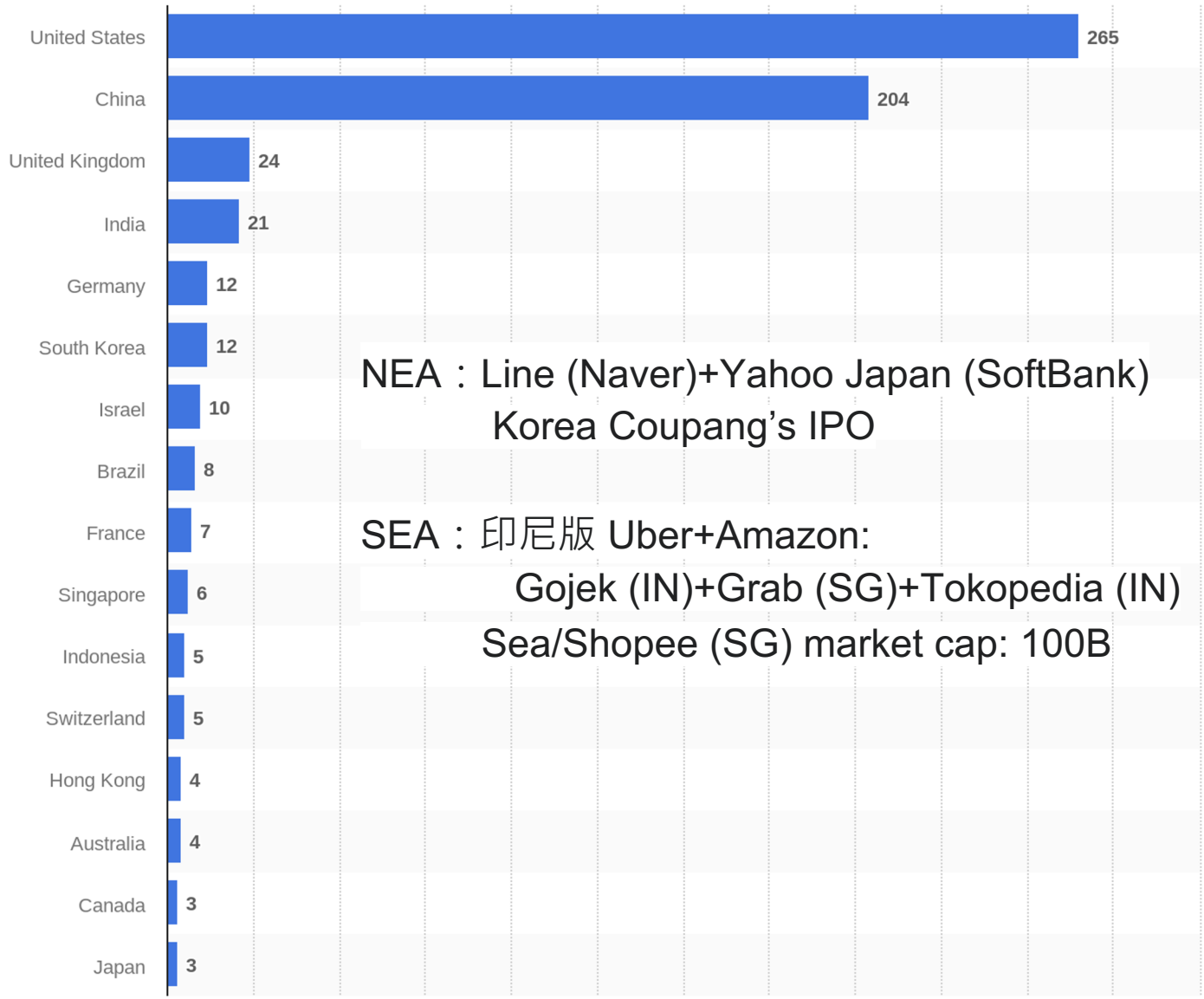
AppWorks

Appier's IPO

https://www.topbots.com/ai-companies-transforming-marketing/

Appier’s Business Operations and Markets

Number of unicorns worldwide as of January 2020, by country



台灣數位新創近一年獲得百億投資

- KKDay, 75M USD, JP/Asia, 09/20
- Perfect, 50M, WW, 01/21
- VPon, 40M, KR, JP, 09/20
- M17, 30M, JP, US, 05/20
- iKala, 17M, SEA, 08/20
- NextDrive, 10M, JP, 03/20
- CloudMile, 10M, MY, IN, 01/21
- iChef, 5M, MY, SG, HK, 09/20

Plus Appier's 80M, Mobegal's 5M, …, in 2019

Thanks !