From: "Elon Musk" <erm@spacex.com>
To: "ilyasu@openai.com" <ilyasu@openai.com>, "gdb@openai.com" <gdb@openai.com>
Subject: Fwd: Top AI institutions today
Date: Thu, 01 Feb 2018 11:52:14 -0000
Importance: Normal
Inline-Images: pastedImage.png

Andrej is exactly right. We may wish it otherwise, but, in my and Andrej's opinion, Tesla is the only path that could even hope to hold a candle to Google. Even then, the probability of being a counterweight to Google is small. It just isn't zero.

Begin forwarded message:

United States District Court
Northern District of California
Δ DEFENDANT Δ
Case No. 4:24-CV-04722-YGR
Case Title Musk et al. v. Altman et al.
Exhibit No. DX-0749
Date Entered
Mark Busby, Clerk
By:_____, Deputy Clerk

From: Andrej Karpathy <akarpathy@tesla.com>
Date: January 31, 2018 at 11:54:30 PM PST
To: Elon Musk <erm@spacex.com>
Subject: Re: Top AI institutions today

Working at the cutting edge of AI is unfortunately expensive. For example, DeepMind's operating expenses in 2016 were at around $250M USD (does not include compute). With their growing team today it might be ~0.5B/yr. But then Alphabet in 2016 reported ~20B net income so it's still fairly cheap even if DeepMind had no revenue of its own. In addition to DeepMind, Google also has Google Brain, Research, and Cloud. And TensorFlow, TPUs, and they own about a third of all research (in fact, they hold their own AI conferences).

I also strongly suspect that compute horsepower will be necessary (and possibly even sufficient) to reach AGI. If historical trends are any indication, progress in AI is primarily driven by systems - compute, data, infrastructure. The core algorithms we use today have remained largely unchanged from the ~90s. Not only that, but any algorithmic advances published in a paper somewhere can be almost immediately re-implemented and incorporated. Conversely, algorithmic advances alone are inert without the scale to also make them scary.

It seems to me that OpenAI today is burning cash and that the funding model cannot reach the scale to seriously compete with Google (an 800B company). If you can't seriously compete but continue to do research in open, you might in fact be making things worse and helping them out "for free", because any advances are fairly easy for them to copy and immediately incorporate, at scale.

A for-profit pivot might create a more sustainable revenue stream over time and would, with the current team, likely bring in a lot of investment. However, building out a product from scratch would steal focus from AI research, it would take a long time and it's unclear if a company could "catch up" to Google scale, and the investors might exert too much pressure in the wrong directions.

The most promising option I can think of, as I mentioned earlier, would be for OpenAI to attach to Tesla as its cash cow. I believe attachments to other large suspects (e.g. Apple? Amazon?) would fail due to an incompatible company DNA. Using a rocket analogy, Tesla already built the "first stage" of the rocket with the whole supply chain of Model 3 and its onboard computer and a persistent internet connection. The "second

stage" would be a full self driving solution based on large-scale neural network training, which OpenAI expertise could significantly help accelerate. With a functioning full self-driving solution in ~2-3 years we could sell a lot of cars/trucks. If we do this really well, the transportation industry is large enough that we could increase Tesla's market cap to high O(~100K), and use that revenue to fund the AI work at the appropriate scale.

I cannot see anything else that has the potential to reach sustainable Google-scale capital within a decade.

-Andrej

From: Elon Musk <erm@spacex.com>
Sent: Wednesday, January 31, 2018 2:07:15 PM
To: Andrej Karpathy
Subject: Fwd: Top AI institutions today

fyi

What do you think makes sense? Happy to talk by phone if that's better.

Begin forwarded message:

From: <erm@spacex.com>
Date: January 31, 2018 at 2:02:37 PM PST
To: <gdb@openai.com>, <ilyasu@openai.com>, Sam Altman <shga@ycombinator.com>
Cc: <steller@spacex.com>, <Shivon@spacex.com>
Subject: Fwd: Top AI institutions today

OpenAI is on a path of certain failure relative to Google. There obviously needs to be immediate and dramatic action or everyone except for Google will be consigned to irrelevance.

I have considered the ICO approach and will not support it. In my opinion, that would simply result in a massive loss of credibility for OpenAI and everyone associated with the ICO. If something seems too good to be true, it is. This was, in my opinion, an unwise diversion.

The only paths I can think of are a major expansion of OpenAI and a major expansion of Tesla AI. Perhaps both simultaneously. The former would require a major increase in funds donated and highly credible people joining our board. The current board situation is very weak.

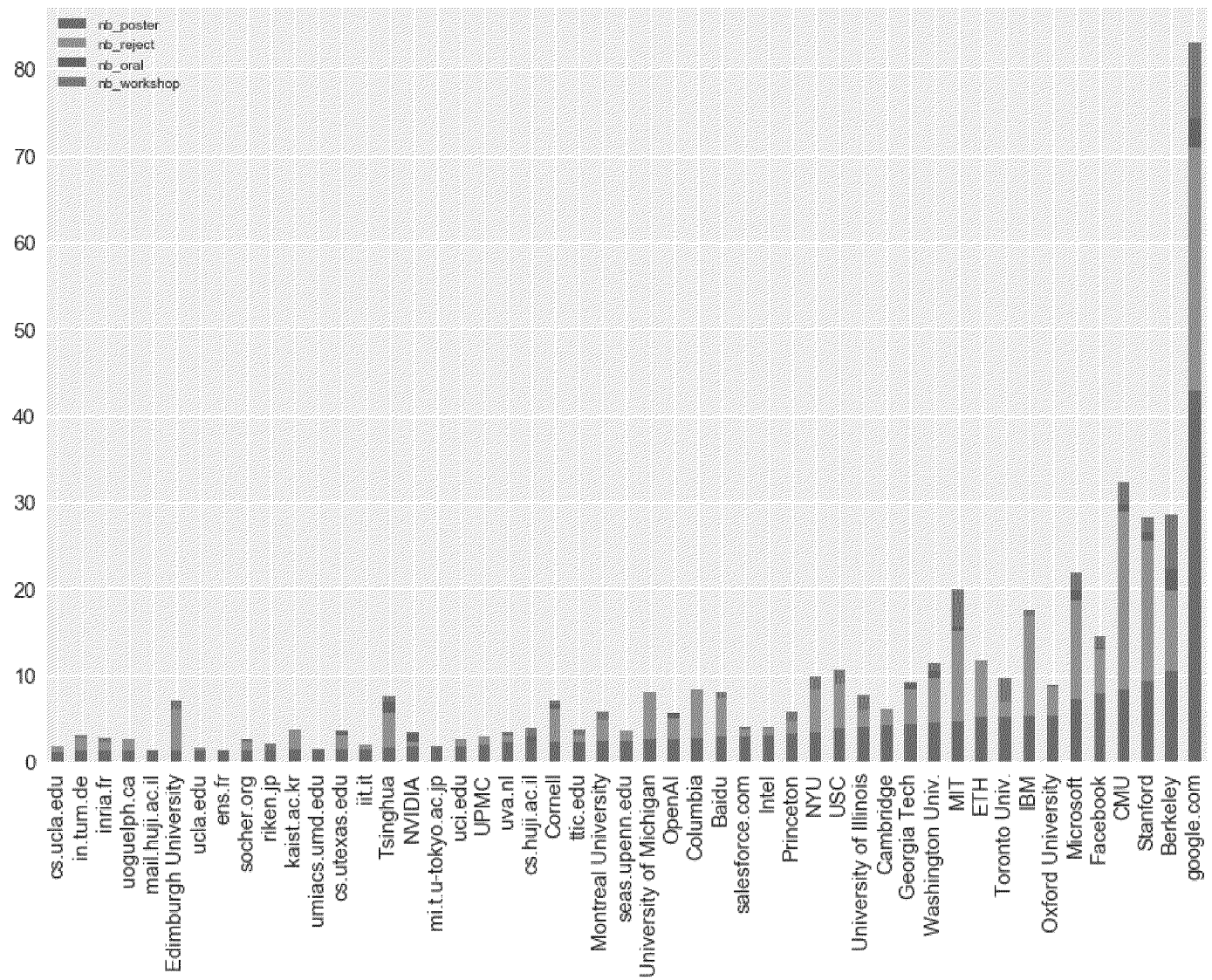
I will set up a time for us to talk tomorrow. To be clear, I have a lot of respect for your abilities and accomplishments, but I am not happy with how things have been managed. That is why I have had trouble engaging with OpenAI in recent months. Either we fix things and my engagement increases a lot or we don't and I will drop to near zero and publicly reduce my association. I will not be in a situation where the perception of my influence and time doesn't match the reality.

Begin forwarded message:

From: Andrej Karpathy <akarpathy@tesla.com>
Date: January 31, 2018 at 1:20:42 PM PST
To: Elon Musk <erm@tesla.com>
Cc: Shivon Zilis <shivon@tesla.com>
Subject: Top AI institutions today

The ICLR conference (which is the top deep learning - specific conference (NIPS is larger, but more diffuse)) released their decisions for accepted/rejected papers, and someone made some nice plots that show where the current deep learning / AI research happens at. It's an imperfect measure because not every company might prioritize paper publications, but it's indicative.

Here's a plot that shows the total number of papers (broken down by oral/poster/workshop/rejected) from any institution:



Long story short, Google is dominating with 83 paper submissions. The academic institutions (Berkeley / Stanford / CMU / MIT) are next, in 20-30 ranges each.

Just thought it was an interesting snapshot of where all the action is today. The full data is here: http://webia.lip6.fr/~pajot/dataviz.html

-Andrej