# The Rise of Computational Entrepreneurship

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**Abstract:** This short manuscript proposes a new academic discipline of computational entrepreneurship, which centers on: i) An exponentially growing (and less expensive) computing power, to the extent that almost everybody in a modern society can own and use that; ii) Omnipresent high-speed Internet connectivity, wired or wireless, representing our modern day's economic connectomics; iii) Growing concern of exploiting "serendipity" for a strategic commercial advantage; and, iv) Growing capabilities of lay people in performing calculations for their informed decisions in taking fast-moving entrepreneurial opportunities.

**Keywords:** Computing power, high-speed connectivity, entrepreneurship, economic calculations, connectomics.

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## Unnatural high-entropy settings

In the increasingly connected world, the future job prospects for Ph.D. students is highly uncertain. Statistics have shown that only 3-4% of the PhDs students can find a tenured academic position. However, in a recent survey of 5,700 Ph.D. students worldwide, *Nature* finds that graduate programs do not seem to prepare the junior scientists for their future jobs. About 30% of the respondents stated they did have useful conservations about careers with their supervisors, and the same percentage finds their supervisors' advice on non-academic careers (Editorial, 2017). It is reasonable to assume that most of them are not learning any useful entrepreneur skills.

Meanwhile, in the world of startups, things seem to be refreshing with the arrival of a new form of digital economy. The new economy has been referred to by many names: "the platform economy," "the gig economy," "the sharing economy," "the peer-to-peer economy," etc. (Bodie, 2017). Whichever name it goes by, the new phenomenon is characterized by four elements: real-time data, mobile payments, on-demand delivery, and flexible pricing; these elements enable the success of Uber, which in turn inspires a blooming of copycat startups—the Uberization of everything (Freeman, 2015). The reaction toward this new economy has varied greatly. At the one end of the spectrum, people worry this technological-driven economic shift will only exacerbate income inequality, at the other end, there is a beaming optimism about a post-capitalist world (McAfee & Brynjolfsson, 2017).

It is uncertain how the shift will unfold is uncertain, what is clear is the business world has never witnessed such disruptive change of this volume and velocity before. This level of disruption, which is powered by an unprecedented level of inexpensive advanced computation and network, suggests it is time to revise our understanding of how business startups work. We need a new model of entrepreneurship.

## Traditional vs. computational entrepreneurship

Entrepreneurship as an academic discipline started with the Austrian school of economics whose founder were Menger, Wieser, and Schumpeter (Campagnolo & Vivel, 2014). It is interesting that while most other economics schools developed mathematical models, the theory of entrepreneurship and innovation of Joseph Schumpeter has never followed this direction (Pacher, 2014). Many researchers in this school of thought even distanced their works from statistical analyses. The Austrian school of economics is famous for their methodological opposition to classical economics which utilized mathematics (Yeager, 1997). As the consequences, although the theory of entrepreneurship has become more increasingly more important, entrepreneurship has always been considered an upstart, even an outsider of the mainstream economic theories.

Conventional entrepreneurship possesses three main characteristics: risk-taking, small-scale, and self-employment. The development of small and medium enterprises in Vietnam during 1990 (Hoang & Dung, 2009) or the booming of large-scales start-ups programs (Vuong, 2016) could illustrate these characteristics. In these periods, many start-ups operate according to the family business model at small or medium scale (Pham, Bell & Newton, 2018). The traditional taxi business is also a type of entrepreneurship with a kind of "linear business development": the drivers usually start off working for a taxi company, then gradually move toward using their cars to make more profit. In education, the lecturers or professors also start their businesses by offering tutorials to their classes; some offer their expertise in the form of consulting (Bercovizt & Feldman, 2008). All of these traditional start-ups require risk-taking, substantial efforts and some luck to achieve some level of success.

However, perhaps the Austrian economists did not envision how modern computing power and connectivity would have influenced entrepreneurship. The following examples illustrate this point clearly. A group of scholars and scientists who are originally teaching at universities, rather than starting their business the traditional ways as mentioned above, they became famous in social media with their unrelenting attitude in addressing controversial topics; people refer to them as the Intellectual Dark Web (Weiss, 2018). All of them started as a kind of intellectual YouTube stars, then they create their channels, making profits from either direct viewers-sponsorship, advertisements, books, or speaking engagements. In any event, it is clear the digital platforms play a key role in their success. Another example is the family of Ryan ToysReview, which according to Forbes, earns USD22 million in 2018 with about 17 million subscriptions for their attractive children videos channels (Robehmed & Berg, 2018).

All of these stories of successful start-ups points to three outstanding features: the increasingly networked world, the increasing number of small and super small businesses, and the lowering computational cost. These features signal the need to studies a new field: "Computational Entrepreneurship." This phrase is mentioned in passing in *Dark Deleuze* of Andrew Culp. However, the concept has not been developed fully (Culp, 2016). The author assesses this

concept from the viewpoint of a traditional start-up, perhaps, that is why further development is limited.

## An emerging academic discipline

Here, we propose that besides inheriting the basic characteristics of the traditional entrepreneurship, "computational entrepreneurship" has the following new elements which create a substantial change in the behaviors as well as the ability to mitigate risks of entrepreneurs:

*First*, computational entrepreneurship utilizes low-cost extensive computing power, user-friendly algorithms, high connectivity, and the use of technologies across platforms. This leads to the second characteristics.

*Second*, computation entrepreneurship takes place on a very large scale, which is supported by the high speed of the Internet as well as the development of social media. These platforms enable the ability to connect at the same time billions of consumers.

*Third*, the differential calculation for cost-benefit analysis is performed to the utmost details, even down to the level of payment method (such as cash) that has very low value, but in a very large scale. There are millions of these calculations done at the same time thanks to the inexpensive computing cost. This implies the possibility of not only peer-to-peer but also hierarchical or multi-level start-ups, indeed, an ecosystem of newborn start-ups.

To illustrate these characteristics and understand their implications, we need only to look at the obvious examples of Uber and YouTube. These computational platforms enable a multi-level ecosystem of entrepreneurs. For example, Uber founders are not the only entrepreneurs but thousands of drivers as well. Here computational entrepreneurship forces entrepreneurs of all level must calculate to make the most profit. While Uber must make thousands of calculations simultaneously to arrange bookings to make a profit, the drivers must also make detailed calculations to make the most profit, e.g. which hours of a day pay the most, whether to go a short distance many times or a long distance fewer times, which booking to receive, which to cancel.

As millions of people enjoy watching others play videos and comments, YouTube enables many young adults to start-up as a professional game. For example, a famous game streamer called PewDiePie on Twitch can serve 75 million followers on YouTube by uploading video daily. PewDiePie used to hire a team for creating contents, but after a while, he decided to fire everyone in order to be more himself (PewDiePie, 2017): "I thought I had to be more professional. But I think, in reality, the more I try to be a professional, the more I sort of lost

touch and just the direct connection with what's so good about YouTube." This is how computational entrepreneurship takes the concept of self-employment to another level: it has created a one-person army.

As for the ideas of an ecosystem of newborn start-ups, a successful YouTube star can attract the sponsorship of other entrepreneurs, such as food producers, e-legal service, fitness equipment producers in the case of Joe Rogan, who is a member of the Intellectual Dark Web (Weiss, 2018). As the success of YouTube stars can be attributed to the fact that their personalities are attractive to certain niches of viewers, the sponsors, by choosing the right person to fund, can advertise to a massive number of customers that have a high probability of enjoying their products. Traditionally, this kind of effective marketing is impossible. Advanced algorithms and low-cost computing power arguably enable all of these.

In the future, the systems can be further improved and become even more advanced computational platforms. Here, it is likely that the entrepreneurs will still be individuals, they will keep creating an ecosystem themselves through the real-time data generated in their economic activities, such as price information, transaction time, the total value of a transaction, the demand-supply equilibrium.

## Scientific and societal implications

For the study of economics, the rise of computational entrepreneurship might be disruptive and subversive for the modern mainstream economic theory championed by Keynes and Hicks, which is translated to mathematical models of Arrow and Samuelson. These models are static; they started with the assumptions of a closed economy with two goods. Arguably, in the chaotic and uncertain business environment that we live in today, these models might not be helpful. Perhaps, with the rise of a new type of entrepreneurship perhaps, it is necessary to build new mathematical models start with the basic assumption of an extremely open economy in a greatly connected world with many goods.

As the rise of computational entrepreneurship has caught the academic world by surprise, governments and other smaller-scale social organizations are no exception. With the proper understanding of the new economy powered by the new entrepreneurship, these bodies can form plans to navigate the unusually high-entropy world better. In 2015, the global protests against the rise of Uber arguably might have been a result of such lack of comprehension (Arthur, 2015). It is clear the clash between the new and the traditional business is inevitable, but how to survive it without losing too much depends on the creating new knowledge suited for the new situation. Economic policies of governments need to adapt to the new phenomenon in startups, business strategies for companies also need an update. For businessmen and women, computation entrepreneurship means they are operating in an environment filled with a vast amount of moving-information and intense competition. Information quickly piles up, and it can spread to many

people at the same time, this situation creates a very fast-closing window of opportunity. To spot the opportunity, entrepreneurs need an ability to filter and make a judgment based on the "serendipity" principle (Napier & Vuong, 2013).

Science started when Socrates walked around Athens and debated with the citizens. Gradually, the reasoning process is supplanted with statistics, and in the beginning, statistics is used from an adjective that comes before a field such as "statistical mathematics" (Aitken, 1942). With time, science keeps branching out and develops more in-depth fields. This is why statistics becomes too large, and other terminologies must be applied including "computational." The terminology computational was first used in chemistry, physics and biology (Clark, 1985; Krogh et al., 1994; Potter, 1973) and then it spread to the social sciences such as computational economics (Amman et al., 1996) or computational folkloristics (Vuong et al., 2018); now it can handle a huge volume of complex data and supplement theoretical studies. The complexity of data and algorithms does not exclude entrepreneurship. For that reason, we believe "computational entrepreneurship" will develop further and become a new academic discipline. The current movement of the world's economy, with its revolving around start-ups, will bring "computational entrepreneurship" back to the mainstream of economics.

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