

Lightning Talk 1: Commercialization

Class 22
April 3, 2023



Charlie Kemp
<https://charliekemp.com>

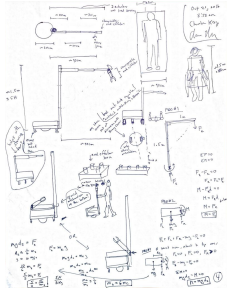
Charlie's Conflict of Interest Statement

Dr. Kemp is both an associate professor at Georgia Tech and the chief technology officer (CTO) of Hello Robot Inc. where he works part time. **He owns equity** in Hello Robot Inc. and is an inventor of Georgia Tech intellectual property (IP) licensed by Hello Robot Inc. Consequently, **he receives royalties** through Georgia Tech for sales made by Hello Robot Inc. He also benefits from increases in the value of Hello Robot Inc.

Summary: If Hello Robot does well, Charlie does well.

Commercialization

- Is open ended with many roads to success
- Depends on customers not investors
- Can empower people to create the future



2016	2017		2018	2019	2020
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“For a successful technology, reality must take precedence over public relations, for nature cannot be fooled.”

Richard P. Feynman, "Appendix F – Personal Observations on Reliability of Shuttle", NASA, 1986.



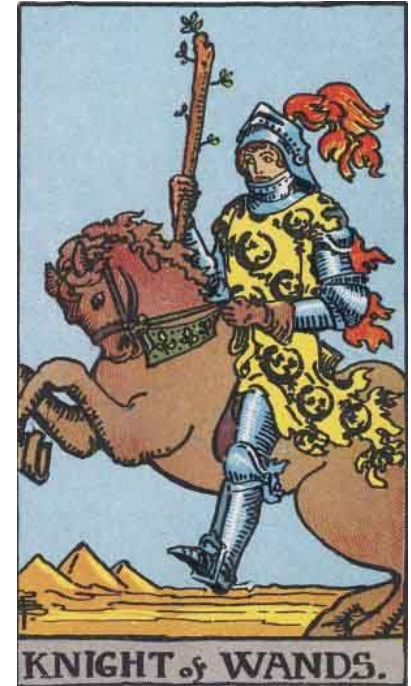
Challenges for Robotics Companies

- You need more than a good robot
- Easy to overpromise
 - Humans make navigation and manipulation look easy
 - Driving cars
 - Picking up toys
 - Experts forget how hard the real world is
 - Videos hide complexity
- “Hardware is hard.”
 - Once it’s shipped, it’s hard to fix
 - Production & inventory
 - Many components
 - One USB 3 cable can kill
 - 50 parts with 99% yield => 39% chance of failure! = $1.0 - (0.99)^{50} = 1.0 - 0.61$



Hardware is not Software

- Software is magical
 - Perfect copies
 - Replication almost free
 - Distribution almost free
- Hardware is physical
 - Variation across copies
 - Costly replication
 - Costly distribution





Aaron Edsinger, PhD

- World views aligned
- Commitment to a long-term vision
- Successful prior collaborations
- Business experience
- Strong technical skills

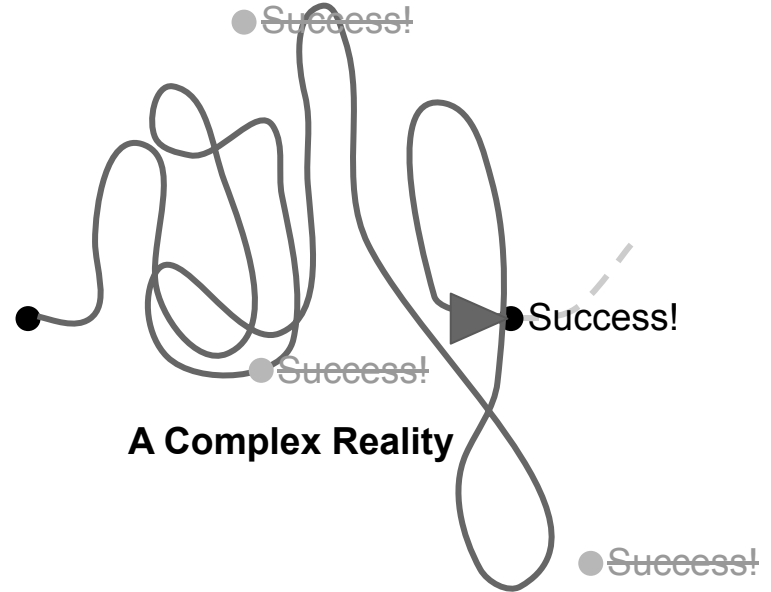


Commercialization is truly open ended.
There are many roads to success.

Commercialization Trajectories



A Simple Story



A Complex Reality

Investment is Not Enough



\$260M raised

Founded 2010

bankrupt April 2019



\$150M raised

Founded 2008

sold assets October 2018



\$73M raised

Founded 2012

sold assets June 2018



Mark Cuban 

@mcuban

raising money isn't an accomplishment, its an obligation

<https://twitter.com/mcuban/status/1373751313134202887>

Venture Capital Funding Risks

- Lose control of the company
 - Board control
 - Ability to make big decisions
 - Equity ownership
- Lose focus on customers
 - Raising money takes resources
 - Optimize for investors instead of customers
 - Depend on investment instead of sales
- Raise the bar for success
 - Founders & employees get nothing if the company sells for less than the total money raised
 - High expectations
 - Increased burn rate ← idle money has low return

VC

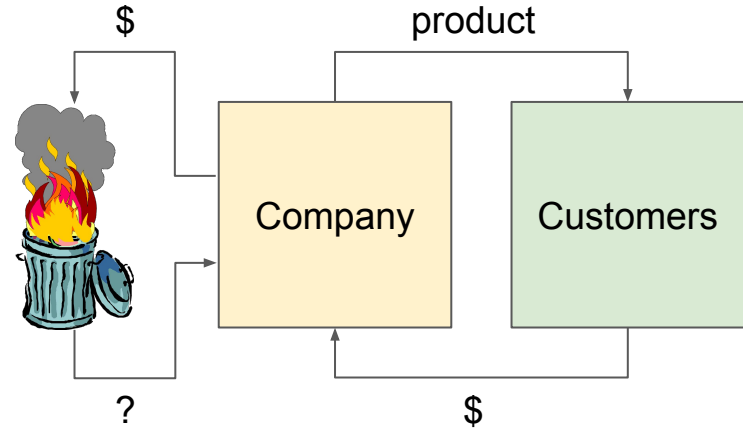
<https://www.crunchbase.com/>

The Basics

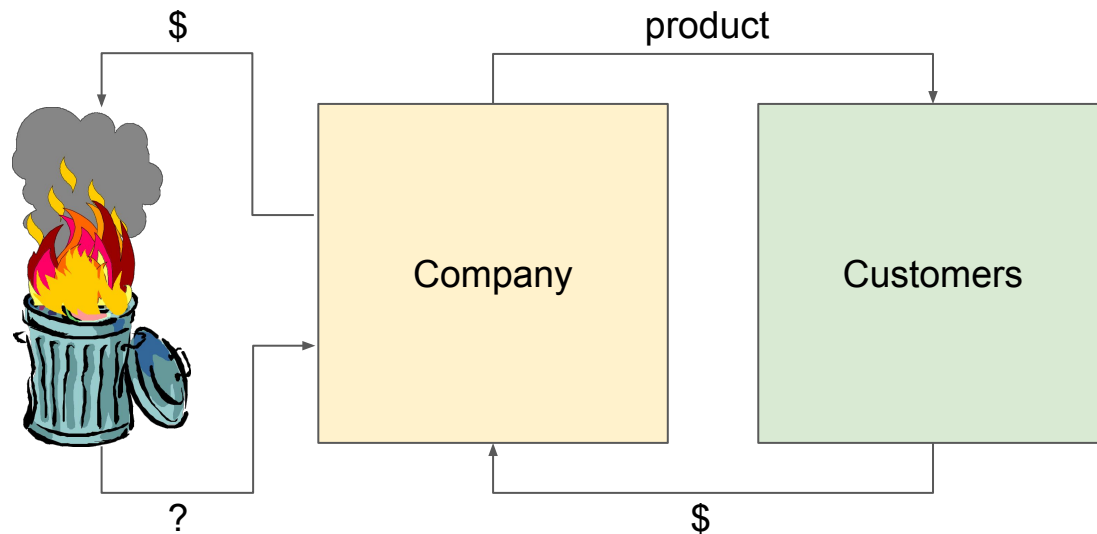
What is the product?

Who are the customers?

Can you make the math work?

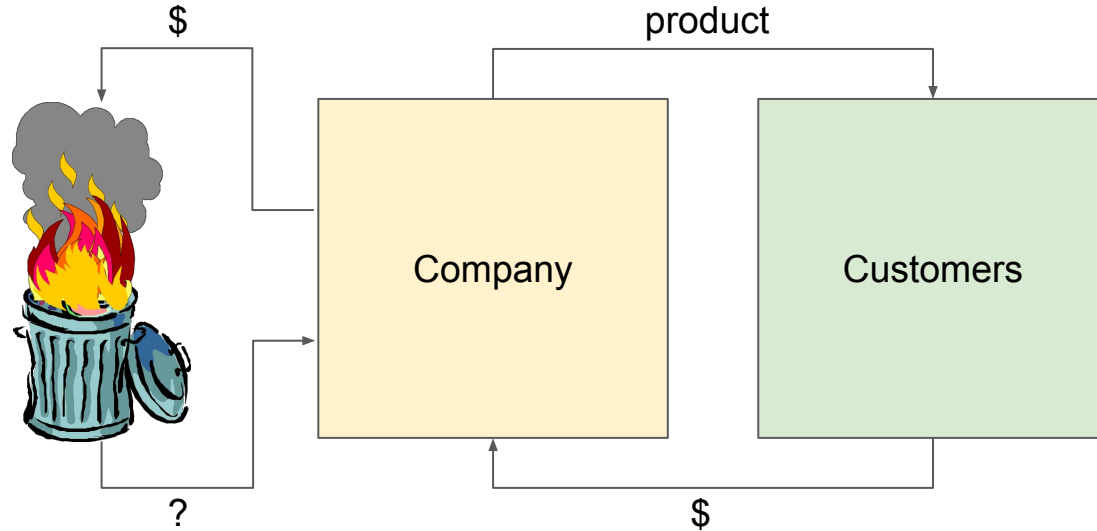


A Simple Model of Success



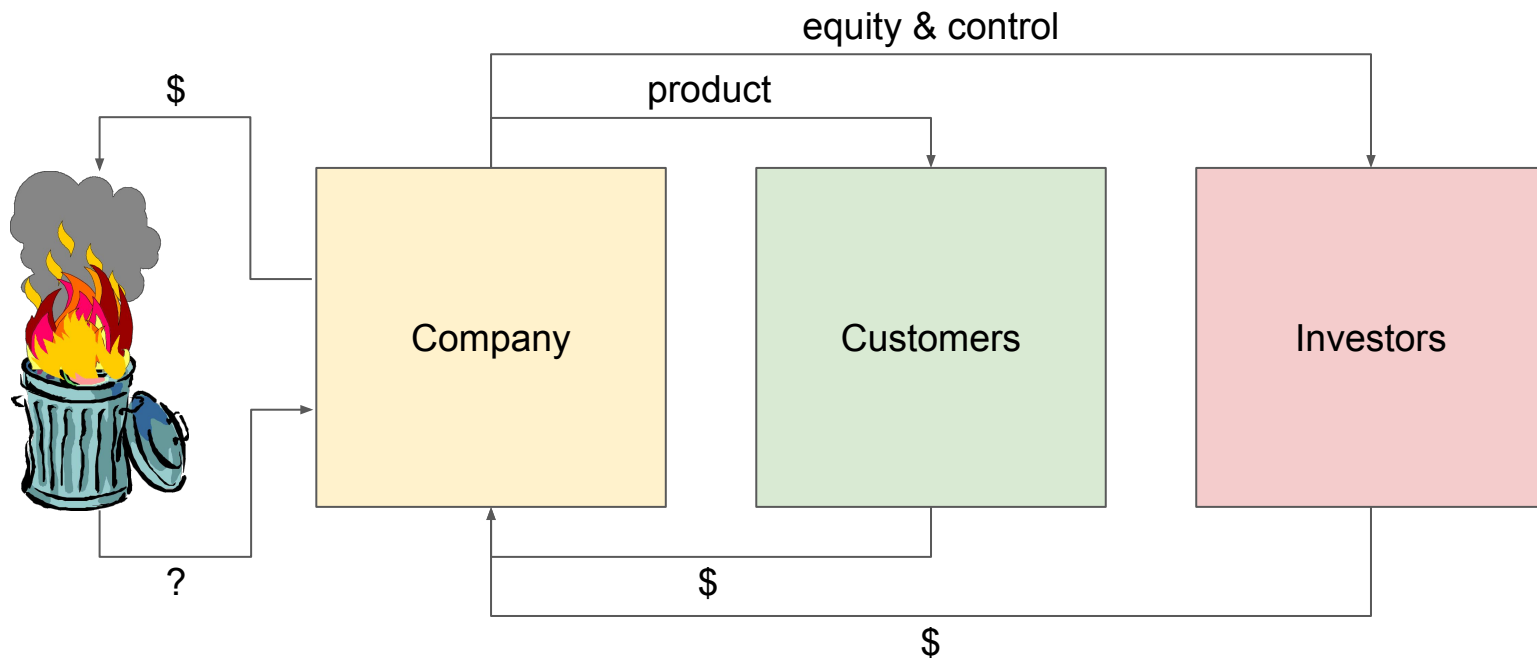
$$\int_0^T \$_{burned}(t) < \int_0^T \$_{from_customers}(t)$$

A Simple Model of Success



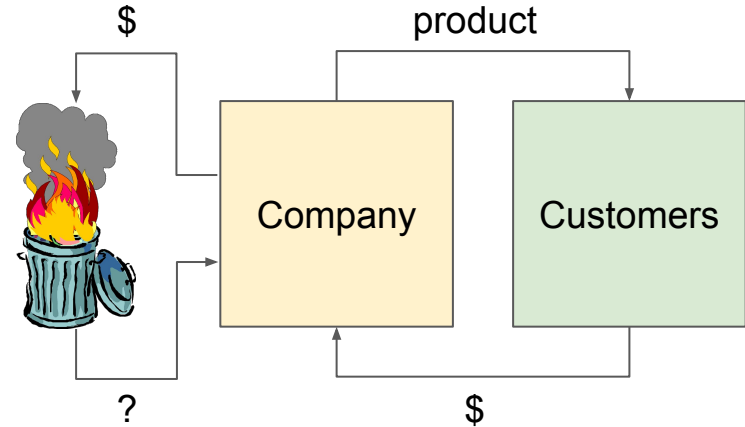
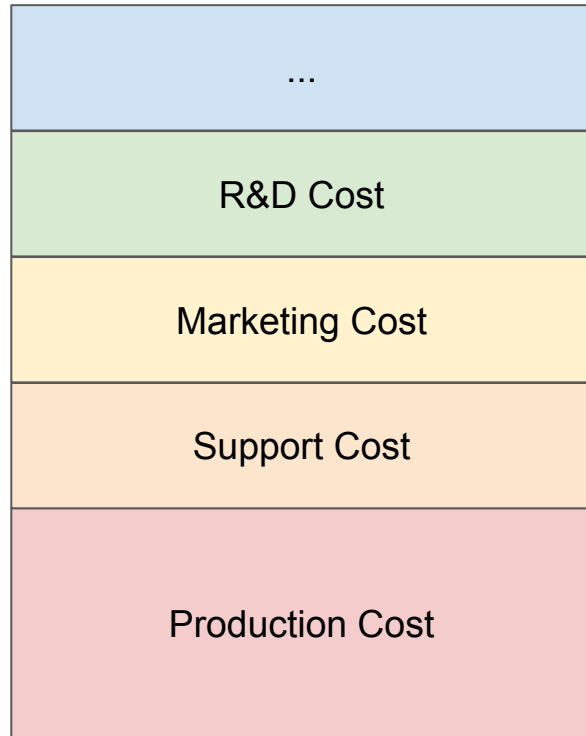
$$reward = \int_0^T (\$_{from_customers}(t) - \$_{burned}(t))$$

Getting Started is More Complex



$$\int_0^T \$_{burned}(t) < \int_0^T (\$_{from_customers}(t) + \$_{from_investors}(t))$$

What's in a price?



$$\int_0^T \$_{burned}(t) < \int_0^T \$_{from_customers}(t)$$

Is the price right?

- Take your customers' perspective when selecting a price
 - What is their price sensitivity?
 - What are their alternatives?
 - Will they decide to buy and be happy with their purchase?
- Too high
 - Not enough people buy the product
 - Limited growth in terms of revenue and profit
 - Risk of competitor capturing the market
- Too low
 - Risk of selling the product at a loss
 - Risk of misestimating the true cost
 - Customers have less incentive to make a careful decision, so they may be a poor match for your product.

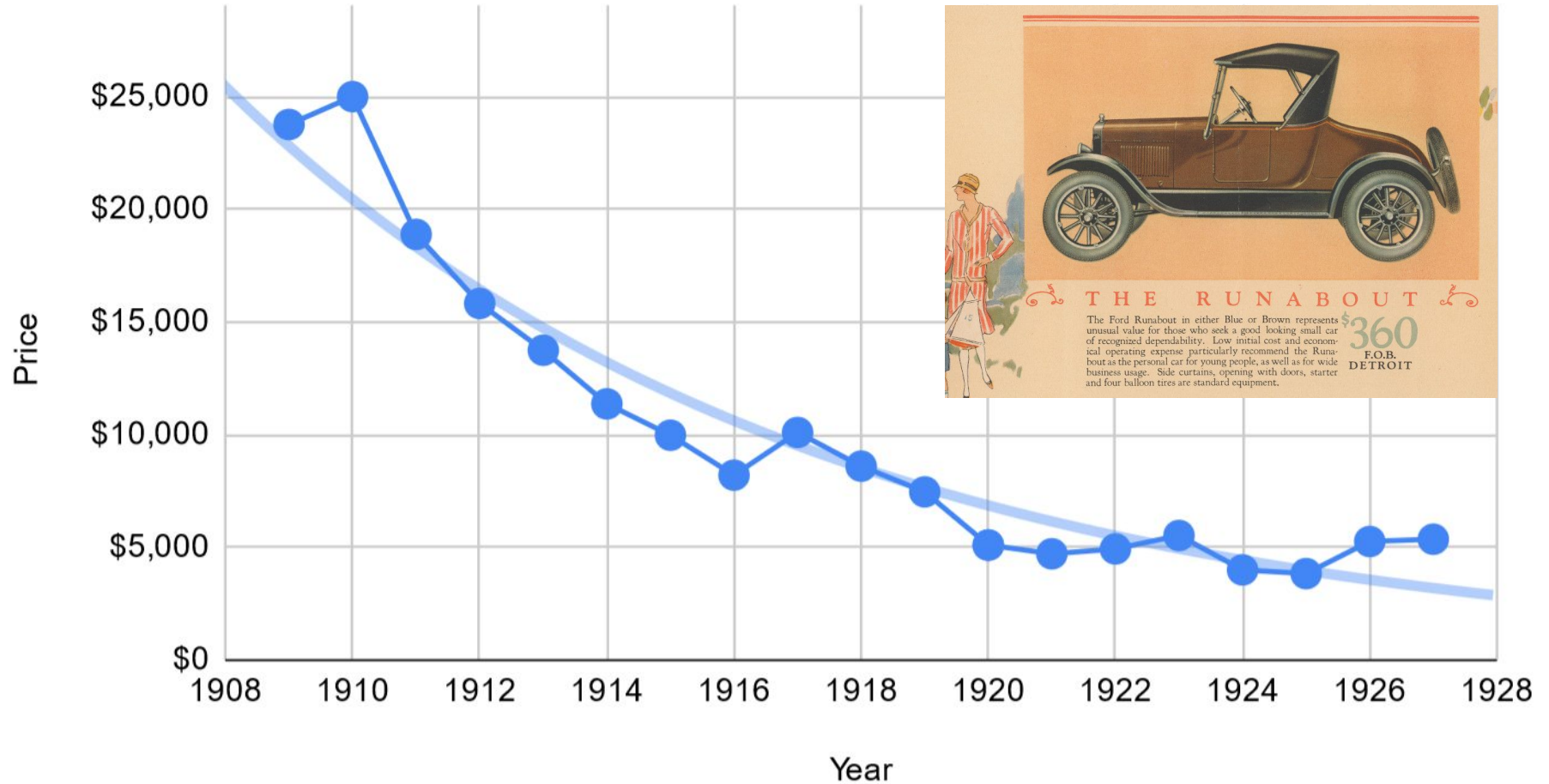


Prices for Emerging Technologies

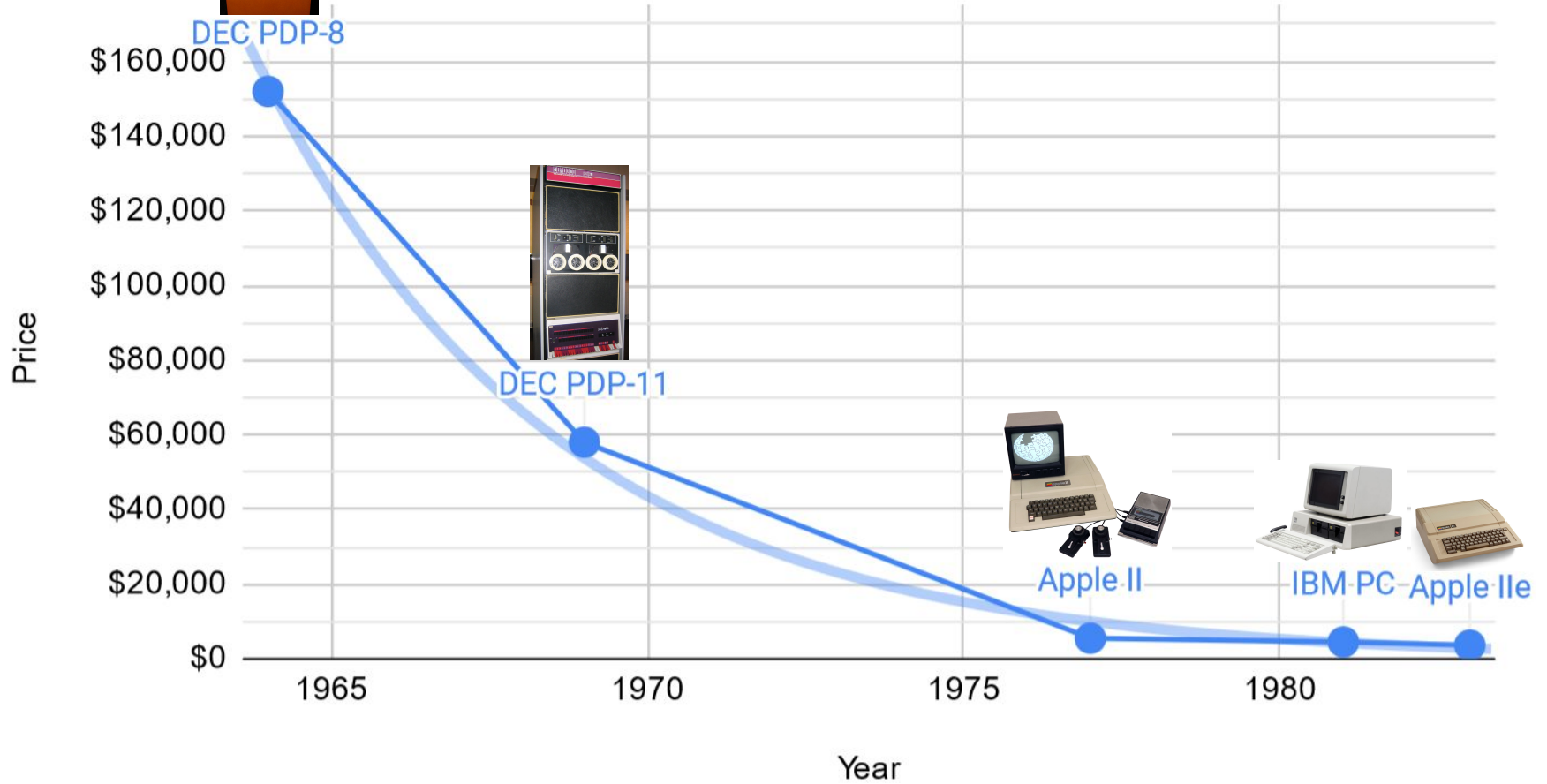
All prices inflation adjusted to 2020-2021 US dollars

[Google Spreadsheet Used to Generate Graphs](#)

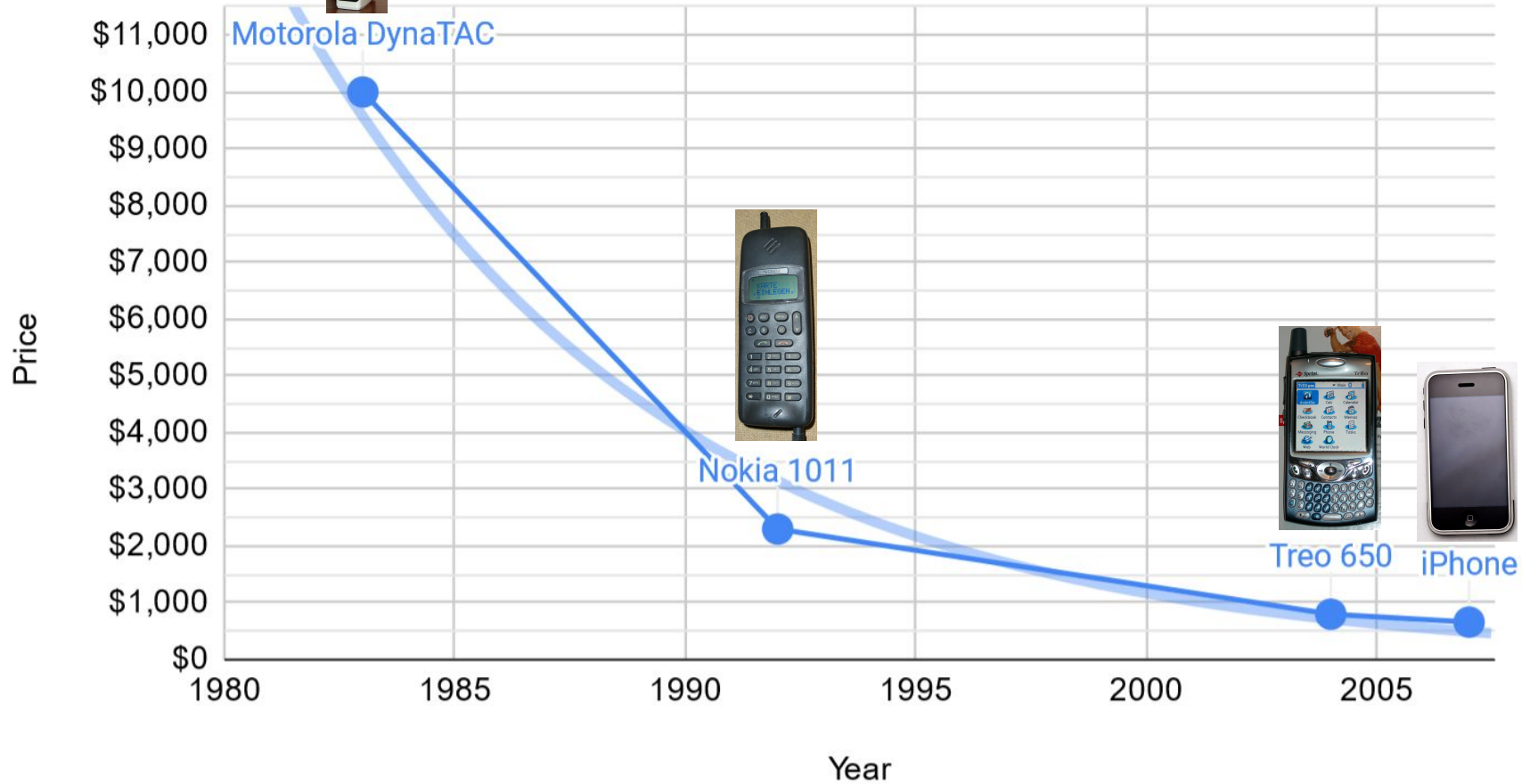
Ford Model T Runabout



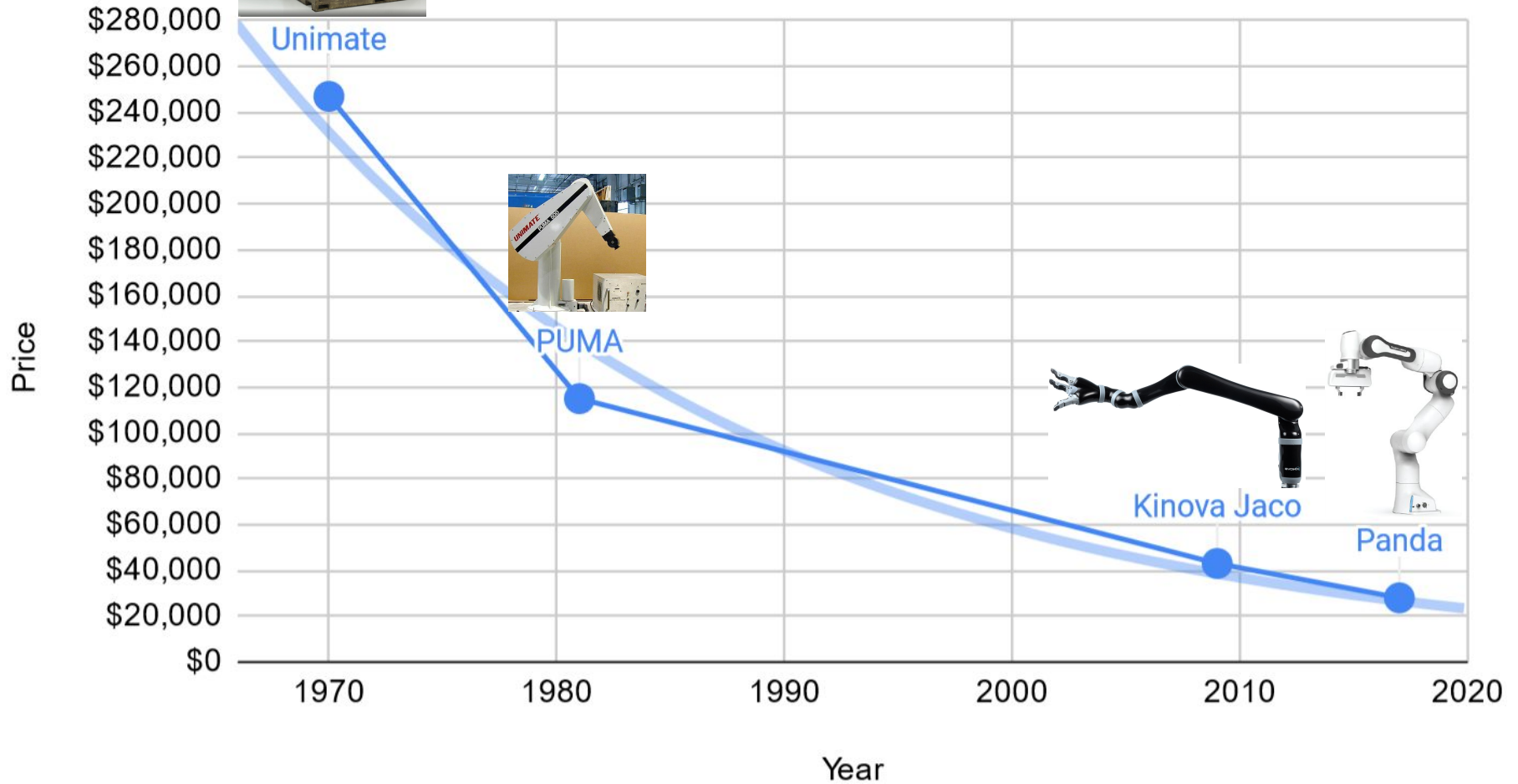
Computers



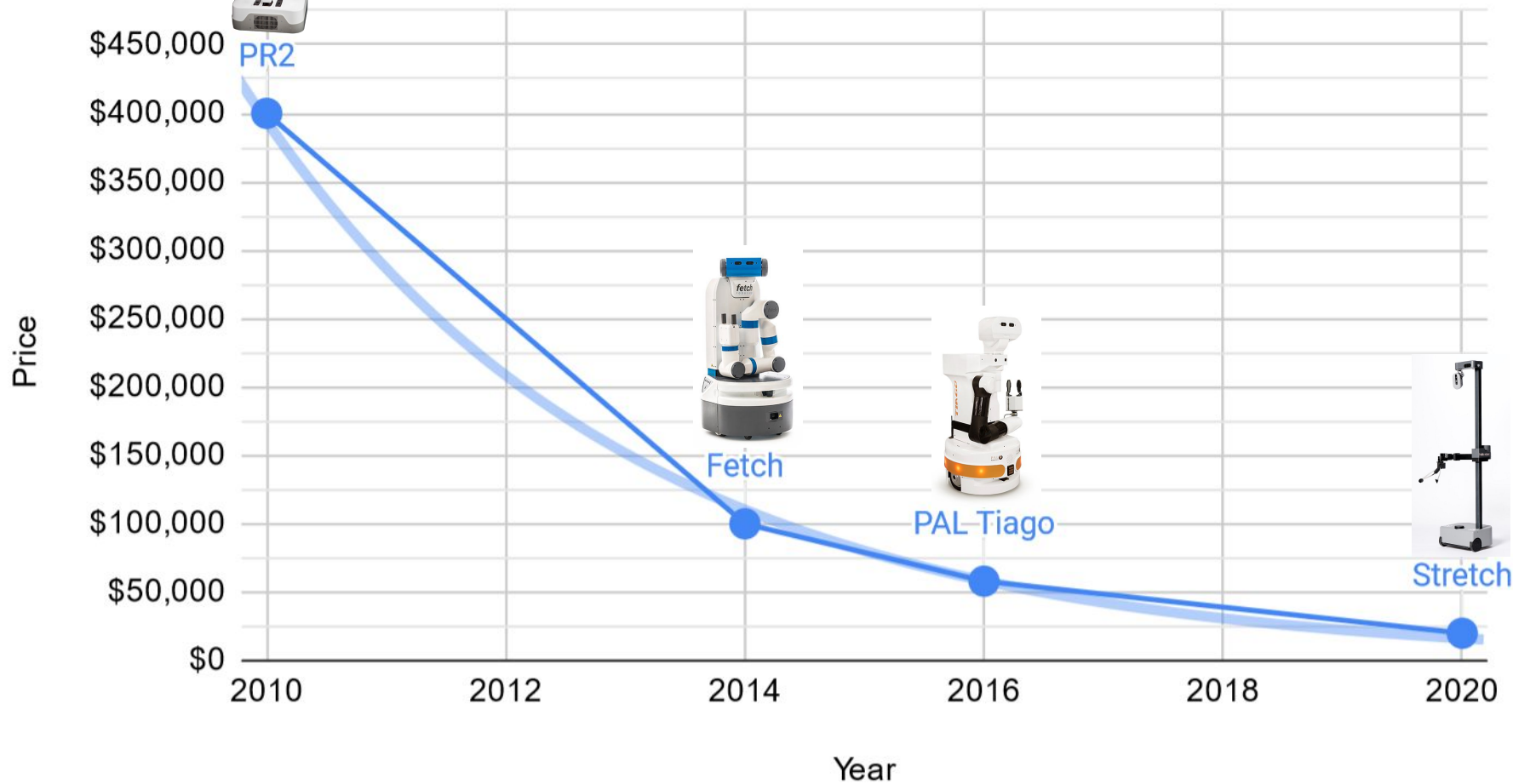
Mobile Phones



Robot Arms



Mobile Manipulators



New Devices are Just the Foreground

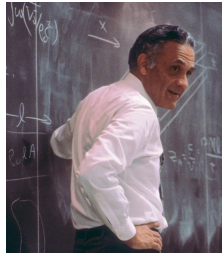
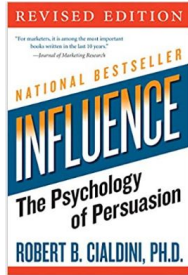
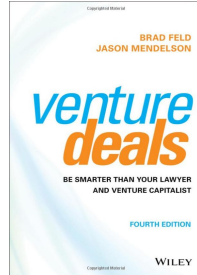


Chicken-or-Egg Problems

- Which comes first?
 - Supply or demand?
 - The problem or the solution?
 - Applications or the robot?
- Emerging technologies
 - Are novel, reducing understanding
 - Are scarce, inhibiting learning and exploration
 - Have uncertain value, reducing demand that could increase prevalence
- Iteration is a useful heuristic for solving these types of problems



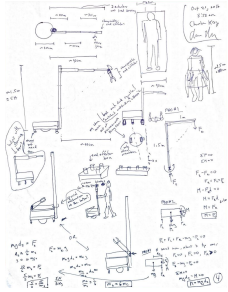
Learning Resources I've Found Valuable



- [Shark Tank](#)
- [How I Built This with Guy Raz](#)
- [Venture Deals](#)
 - by Brad Feldman and Jason Mendelson
- [Influence: The Psychology of Persuasion](#)
 - by Robert B. Cialdini
- [The late Prof. Amar Bose](#)
 - I took his class in the fall of 1994, and still think of it often.
 - <https://teachingexcellence.mit.edu/category/inspiring-teachers/amar-g-bose-6-312-acoustics>

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Q&A