

# Dynamics of Disasters

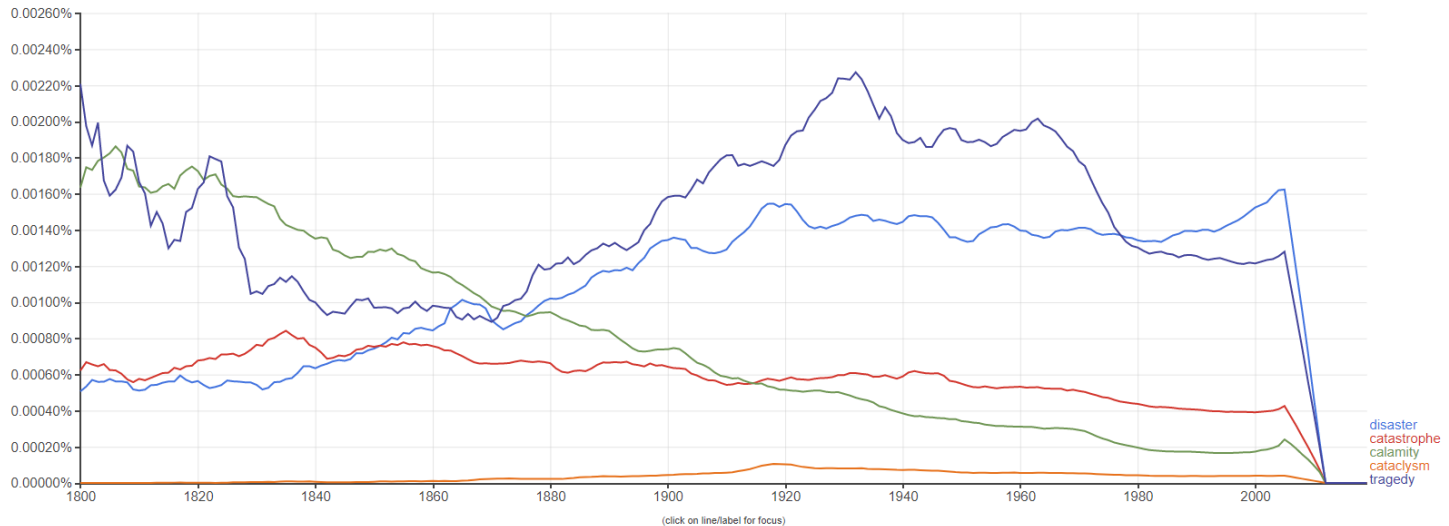
Panos M. Pardalos

<http://ww.ise.ufl.edu/pardalos>

<https://nnov.hse.ru/en/latna/>

June 25, 2020

# What is a disaster (catastrophe, calamity, cataclysm, tragedy)?



Usage frequencies of *disaster*, *catastrophe*, *calamity*, *cataclysm*, and *tragedy* over the period 1800–2020 (Google Ngram Viewer)

# Epidemic Disasters

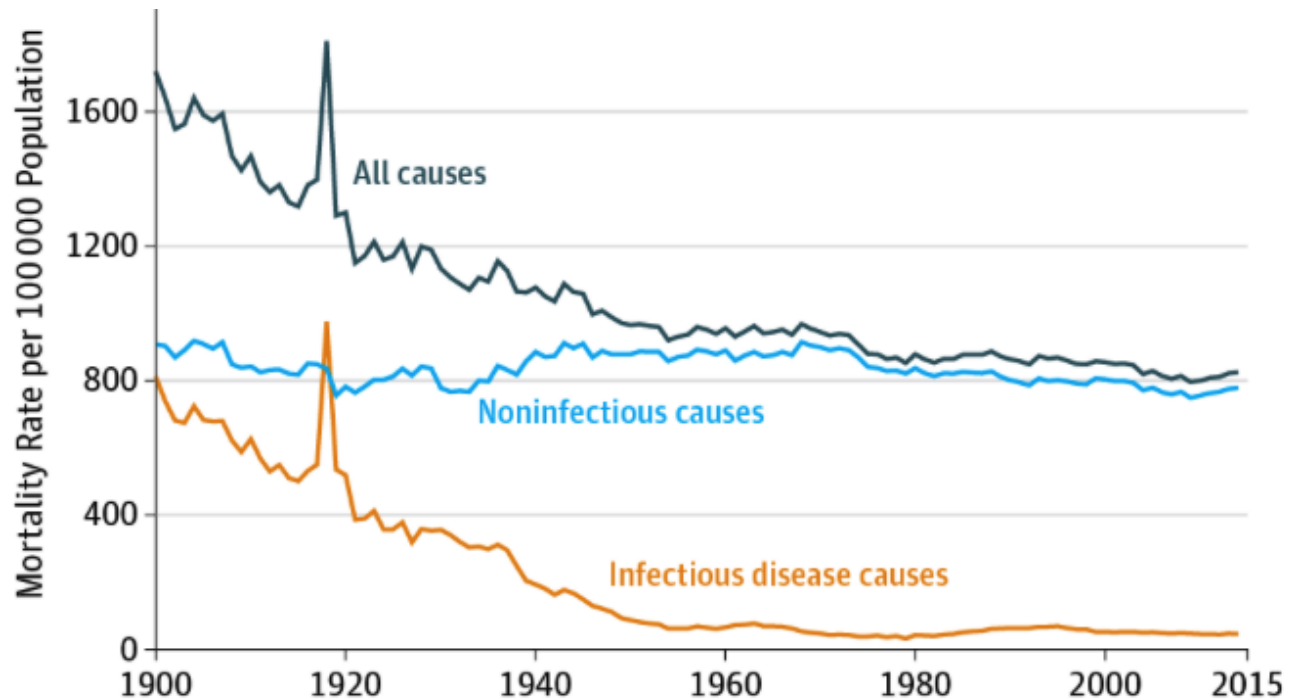
- Black death (1346-1343). **The most fatal pandemic recorded in human history, resulting in the deaths of up to 75–200 million people.**
- 1846–1860 cholera pandemic. **In Russia, more than one million people died of cholera.**
- Spanish flu (1918-1919)
- West African Ebola virus epidemic (2013)
- HIV/AIDS or Human Immunodeficiency Virus (1981-)
- **Coronavirus disease (COVID-19) pandemic**
- **Major Epidemics of the Modern Era (1899-2020) :**  
<https://www.cfr.org/timeline/major-epidemics-modern-era>

# Epidemic Disasters

- Improve **international cooperation** in the face of major outbreaks of infectious diseases. A pandemic of a new coronavirus that originated in China in 2019 underscores the urgency.
- **Medical advances**
- **Risks, impacts, and mitigation**
- **Abraham Lincoln :**  
“The best way to predict your future is to create it.”

# Putting COVID-19 into Perspective

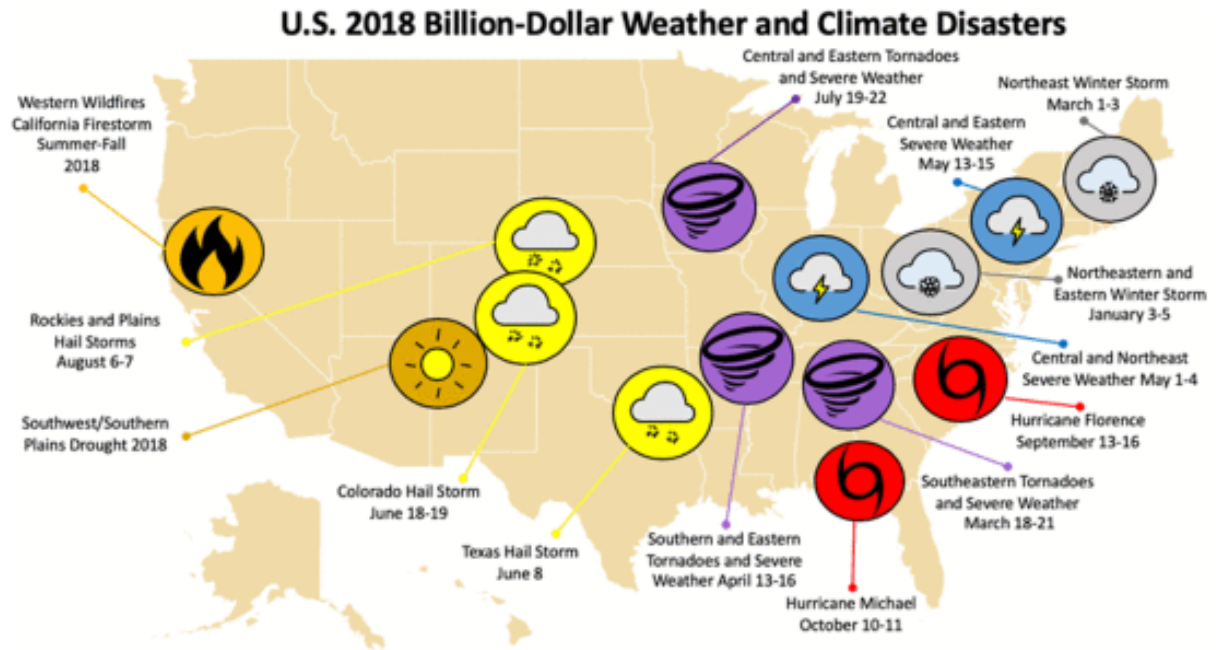
<https://www.planetizen.com/blogs/108868-planners-and-pandemics-identifying-problems-and-providing-solutions>



Between 1900 and 1950 infectious disease mortality rates declined from nearly half to less than 10% of all deaths, which significantly reduced total mortality rates. Note the large spike from the 1918 Spanish Flu and small increases 1980-1995 due to AIDS and recent tuberculosis outbreaks.

# Billion-Dollar Weather and Climate Disasters

<https://www.ncdc.noaa.gov/billions/>



# Dust Bowl (130-1936 USA)

- Dust storms
- Socio-economic disaster (**John Steinbeck: The Grapes of Wrath**)
- <https://www.history.com/topics/great-depression/dust-bowl>

# Information Age: From a Single Network to Networks of Networks

A worldwide network of interconnected objects that are uniquely addressable via standard communication protocols.

- Cooperative networks
- Multicast networks
- Interdependent networks
- Networks of networks
- Sustainable interdependent networks
- IoT (**Internet of Things**)

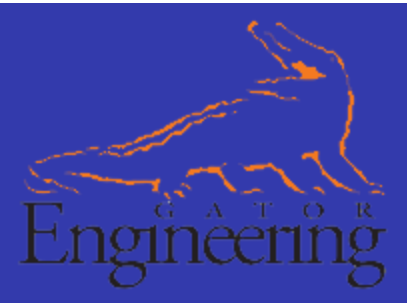


# Critical Elements and Robustness

- We studied **critical elements** in regards to connectivity
- A new **measure of robustness** has been introduced
- Work:
  - “On New Approaches of Assessing Network Vulnerability: Hardness and Approximation” (T. N. Dinh, Y. Xuan, M. T. Thai, P.M. Pardalos, and T. Znati), **IEEE/ACM Transactions on Networking (ToN)**, Vol. 20, No. 2 (2012), pp. 609-619.
  - “Detecting Critical Vertex Structures on Graphs: A Mathematical Programming Approach” (Walteros, J. L., Veremyev, A., Pardalos, P. M., and E.L. Pasiliao), **Networks**, Vol. 73, No. 1 (2019), pp. 48-88.
  - “Quantification of networks structural dissimilarities (Tiago A. Schieber, Laura Carpi, Albert Díaz-Guilera, Panos M. Pardalos, Cristina Masoller and Martijn G. Ravetti), **Nature Communications** 8, online, Article number: 13928 (2017). <https://www.nature.com/articles/ncomms13928>

# Technology Disasters

- Nuclear Warning Systems False alarms
- Smart Grid Blackouts
- Disruption of Telecommunication Networks
- Environmental Pollution and Climate Change
- Genetically modified organisms (see: **Recipe for Disaster**, Nature Biotechnology <https://www.nature.com/articles/nbt0503-465>)
- Terrorism as Disaster (e.g. Bioterrorism)
- Misinformation and Disinformation
- Big Data / Big Disasters



# What is Big Data?

- **"Big data" is high-volume, -velocity and -variety information assets** that demand cost-effective, innovative forms of information processing for enhanced insight and decision making.

**Volume** - scale of data

**Velocity** - analysis of streaming data

**Variety**- different form of data

- Newer definitions of big data have also added a **fourth "V"** - "veracity" - which describes the quality of captured data that can vary influence its analysis.

**Veracity** - data uncertainty



- ***There is more:***

The Fifth V: **Viability** - hidden relationships among variables

The Sixth V: **Value** – present and predict

- **We have to rewrite the rules of how and where data is stored, managed, and processed.** In addition, new technologies such as grid computing, cloud computing, quantum computing are used.

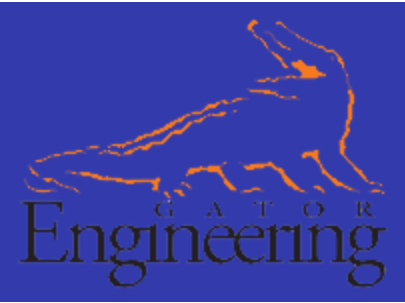


See: <https://www.wired.com/insights/2013/05/the-missing-vs-in-big-data-viability-and-value/>

Wu, X., Zhu, X., Wu, G.-Q. & Ding, W. (2014). Data Mining with Big Data. *IEEE Transactions on Knowledge and Data Engineering*, **26**, 97-107.

# The 42 V's of Big Data and Data Science.

<https://www.elderresearch.com/company/blog/42-v-of-big-data>



- **Vagueness:** The meaning of found data is often very unclear, regardless of how *much* data is available.
- **Validity:** Rigor in analysis (e.g., [Target Shuffling](#)) is essential for valid predictions.
- **Valor:** In the face of big data, we must gamely tackle the big problems.
- **Value:** Data science continues to provide ever-increasing value for users as more data becomes available and new techniques are developed.
- **Vane:** Data science can aid decision making by pointing in the correct direction.
- **Vanilla:** Even the simplest models, constructed with rigor, can provide value.
- **Vantage:** Big data allows us a privileged view of complex systems.
- **Variability:** Data science often models variable data sources. Models deployed into production can encounter especially wild data.
- **Variety:** In data science, [we work with many data formats](#) (flat files, relational databases, graph networks) and varying levels of data completeness.
- **Varifocal:** Big data and data science together allow us to see both the forest *and* the trees.
- **Varmint:** As big data gets bigger, so can software bugs!
- **Varnish:** How end-users interact with our work matters, and polish counts.
- **Vastness:** With the advent of the [Internet of Things](#) (IoT), the "bigness" of big data is accelerating.
- **Vaticination:** Predictive analytics provides the ability to forecast. (Of course, these forecasts can be more or less accurate depending on rigor and the complexity of the problem. The future is pesky and never conforms to our March Madness brackets.)
- **Vault:** With many data science applications based on large and often sensitive data sets, data security is increasingly important.
- **Veer:** With the rise of [agile data science](#), we should be able to navigate the customer's needs and change directions quickly when called upon.

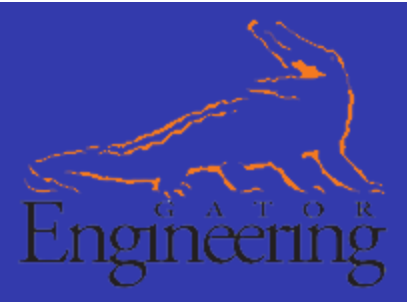
# The 42 V's of Big Data and Data Science.



<https://www.elderresearch.com/company/blog/42-v-of-big-data>

- **Veil:** Data science provides the capability to peer behind the curtain and examine the effects of latent variables in the data.
- **Velocity:** Not only is the volume of data ever increasing, but the rate of data generation (from the Internet of Things, social media, etc.) is increasing as well.
- **Venue:** [Data science work takes place in different locations and under different arrangements](#): Locally, on customer workstations, and in the cloud.
- **Veracity:** Reproducibility is essential for accurate analysis.
- **Verdict:** As an increasing number of people are affected by models' decisions, Veracity and Validity become ever more important.
- **Versed:** Data scientists often need to know a little about a great many things: mathematics, statistics, programming, databases, etc.
- **Version Control:** You're using it, right?
- **Vet:** Data science allows us to vet our assumptions, augmenting intuition with evidence.
- **Vexed:** Some of the excitement around data science is based on its potential to shed light on large, complicated problems.
- **Viability:** It is difficult to build robust models, and it's harder still to build systems that will be [viable in production](#).
- **Vibrant:** A thriving data science community is vital, and it provides insights, ideas, and support in all of our endeavors.
- **Victual:** Big data — the food that fuels data science.
- **Viral:** How does [data spread](#) among other users and applications?
- **Virtuosity:** If data scientists need to know a little about many things, we should also grow to know a lot about one thing.
- **Viscosity:** Related to Velocity; how difficult is the data to work with?
- **Visibility:** Data science provides visibility into complex big data problems.

# The 42 V's of Big Data and Data Science.



<https://www.elderresearch.com/company/blog/42-v-of-big-data>

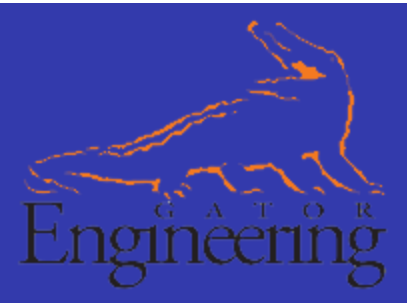
- **Visualization:** Often the *only* way customers interact with models.
- **Vivify:** Data science has the potential to animate all manner of decision making and business processes, from [marketing](#) to [fraud detection](#).
- **Vocabulary:** Data science provides a vocabulary for addressing a variety of problems. Different modeling approaches tackle different problem domains, and different validation techniques harden these approaches in different applications.
- **Vogue:** "Machine Learning" becomes "Artificial Intelligence", which becomes...?
- **Voice:** Data science provides the ability to speak with knowledge (though not *all* knowledge, of course) on a diverse range of topics.
- **Volatility:** Especially in production systems, one has to prepare for data volatility. Data that should "never" be missing suddenly disappears, numbers suddenly contain characters!
- **Volume:** More people use data-collecting devices as more devices become internet-enabled. The volume of data is [increasing at a staggering rate](#).
- **Voodoo:** Data science and big data aren't voodoo, but how can we convince potential customers of data science's value to deliver results with real-world impact?
- **Voyage:** May we always keep learning as we tackle the problems that data science provides.
- **Vulpine:** [Nate Silver](#) would like you to be a fox, please.



# Data Security, falsification, and misuse

- Cybersecurity threats
  - Data privacy, storage, and protection (protecting data from natural disasters)
  - Cloud computing risks - monopolized by [Alibaba, Amazon, Google and Microsoft](#)
  - Noisy or incomplete data (Millenium Bug: the Y2K problem was the result of early computer programmers deciding to use two-digit years for data instead of four digits—making data systems unable to distinguish the year 1900 from 2000)
  - Decision makers rely on data





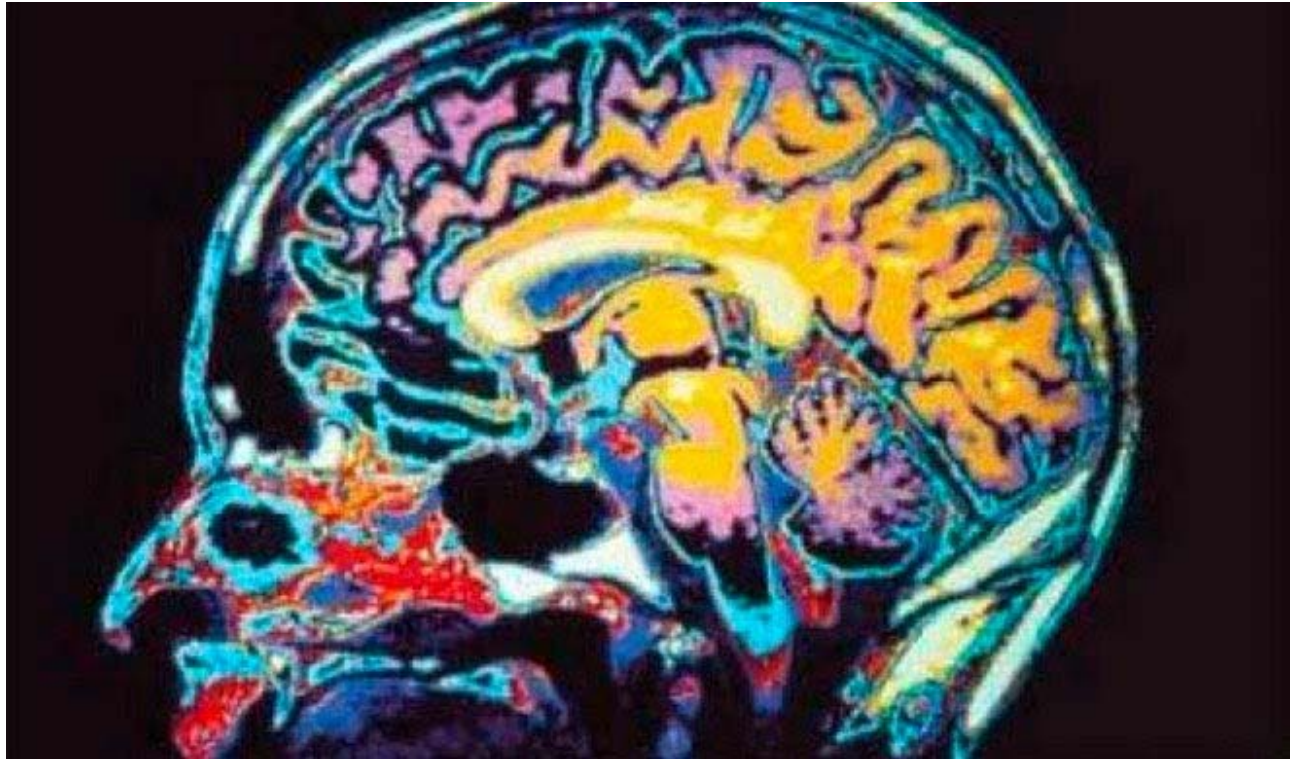
- The proliferation of massive datasets brings with it a series of special challenges.
- This **data avalanche** arises in several aspects of smart manufacturing.
- With rapid advances in computer and information technologies, many of these challenges are beginning to be addresses.



J. Abello, P.M.Pardalos, M.G.C. Resende (Eds.).  
**Handbook of Massive Data Sets**, Kluwer  
Academic Publishers, 2002.



## *Human Brain: the next domain of warfare*



<https://www.wired.com/2012/12/the-next-warfare-domain-is-your-brain/>

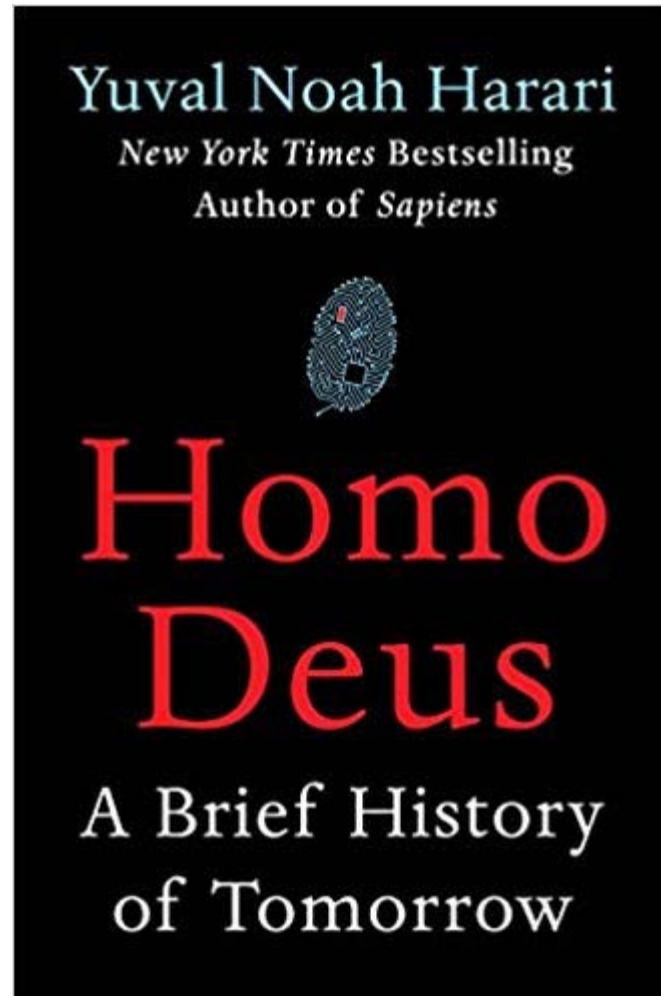
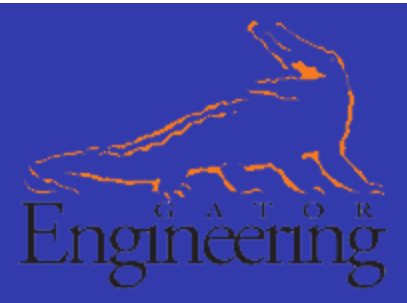
# *Human-Robot Interface*



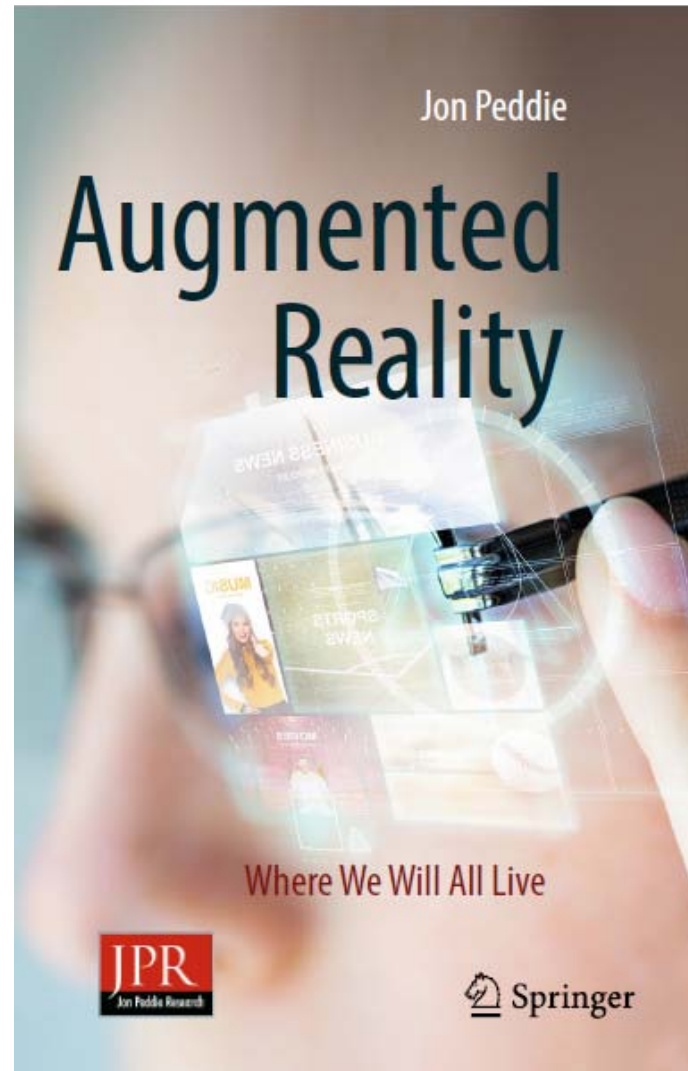
*The Digital Revolution & Artificial Intelligence steal people's jobs*

Ford M. **Rise of the Robots: Technology and the Threat of a Jobless Future.** Basic Books; 2015 May 5. <https://www.psychologytoday.com/blog/the-human-beast/201510/the-human-robot-interface>

# *Human-Robot Interface*

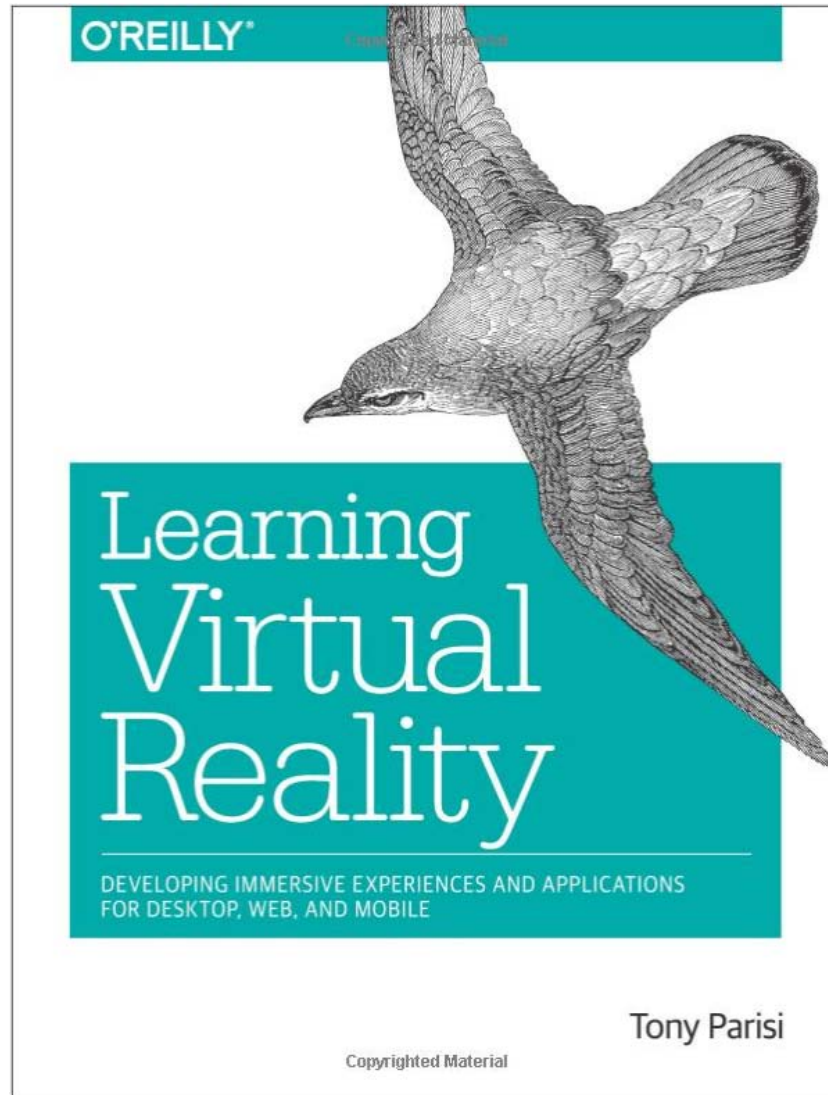
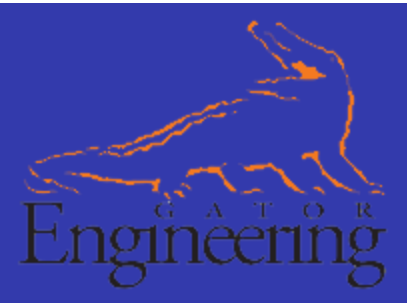


# *Augmented Reality*



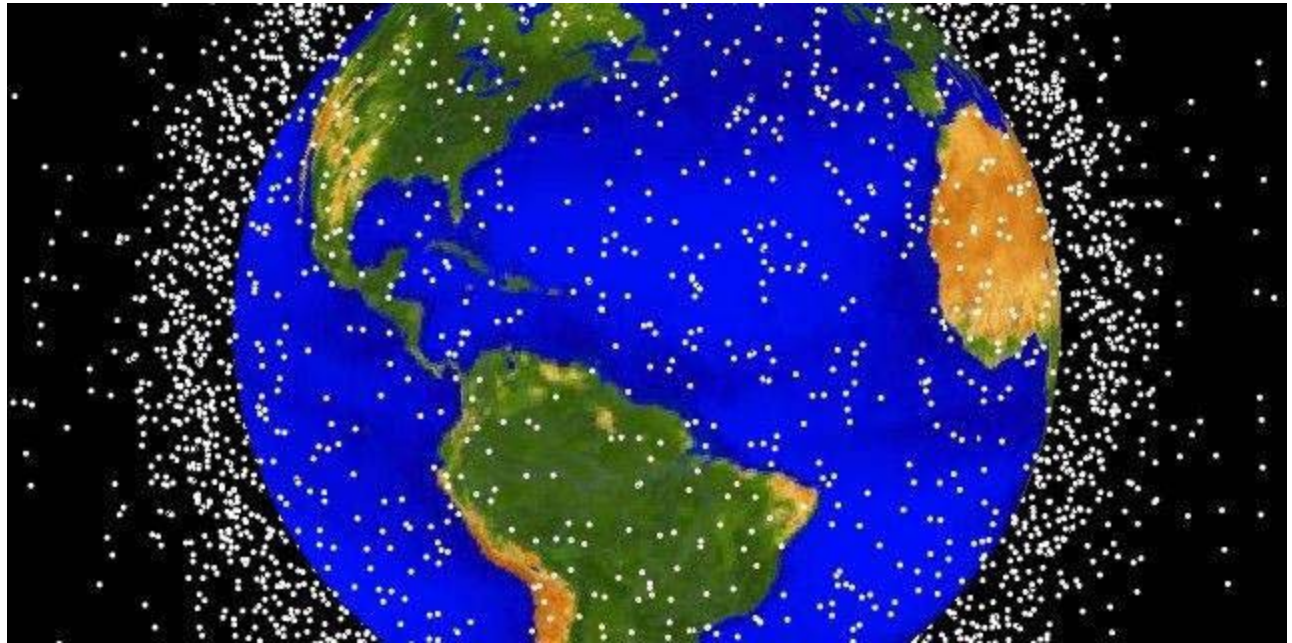


# *Virtual Reality*

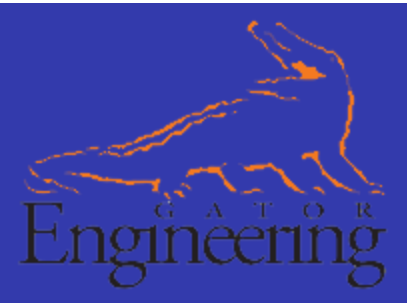




## *Space Debris*



[https://www.nasa.gov/mission\\_pages/station/news/orbital\\_debris.htm](https://www.nasa.gov/mission_pages/station/news/orbital_debris.htm)  
!

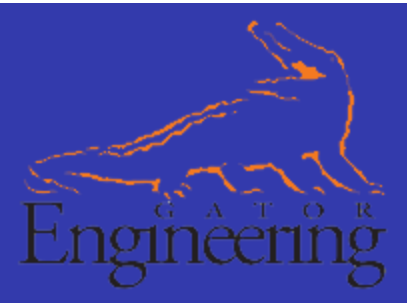


## *The Plastic Bottle Horror*

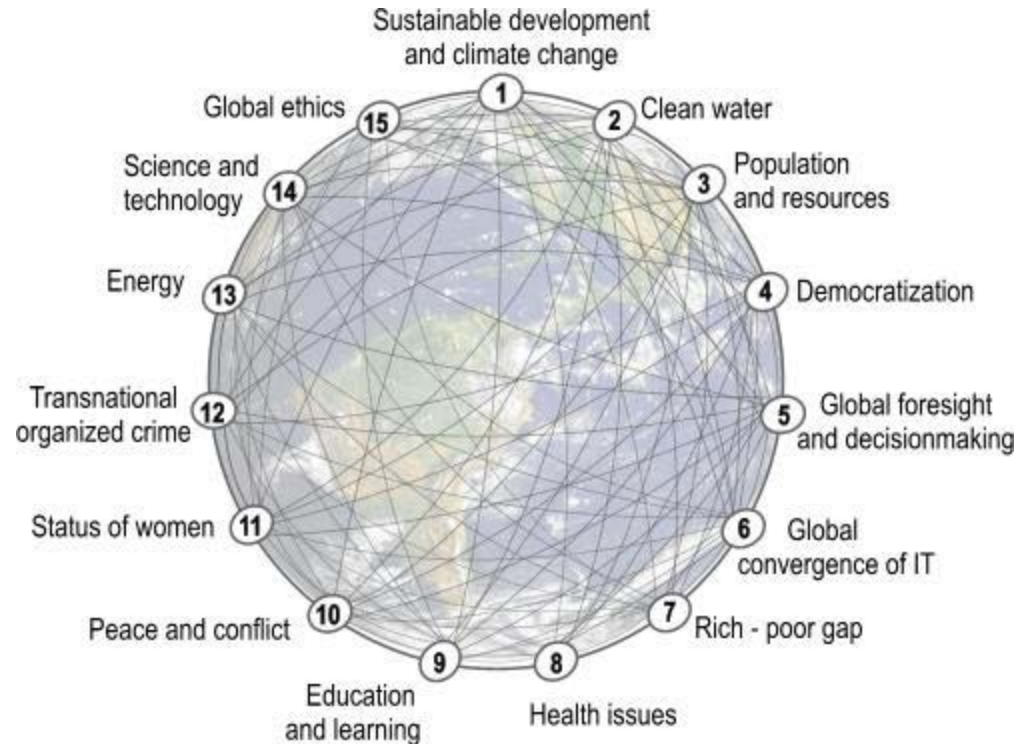


<http://foresternetwork.com/daily/waste/waste-sorting/the-plastic-bottle-horror/>



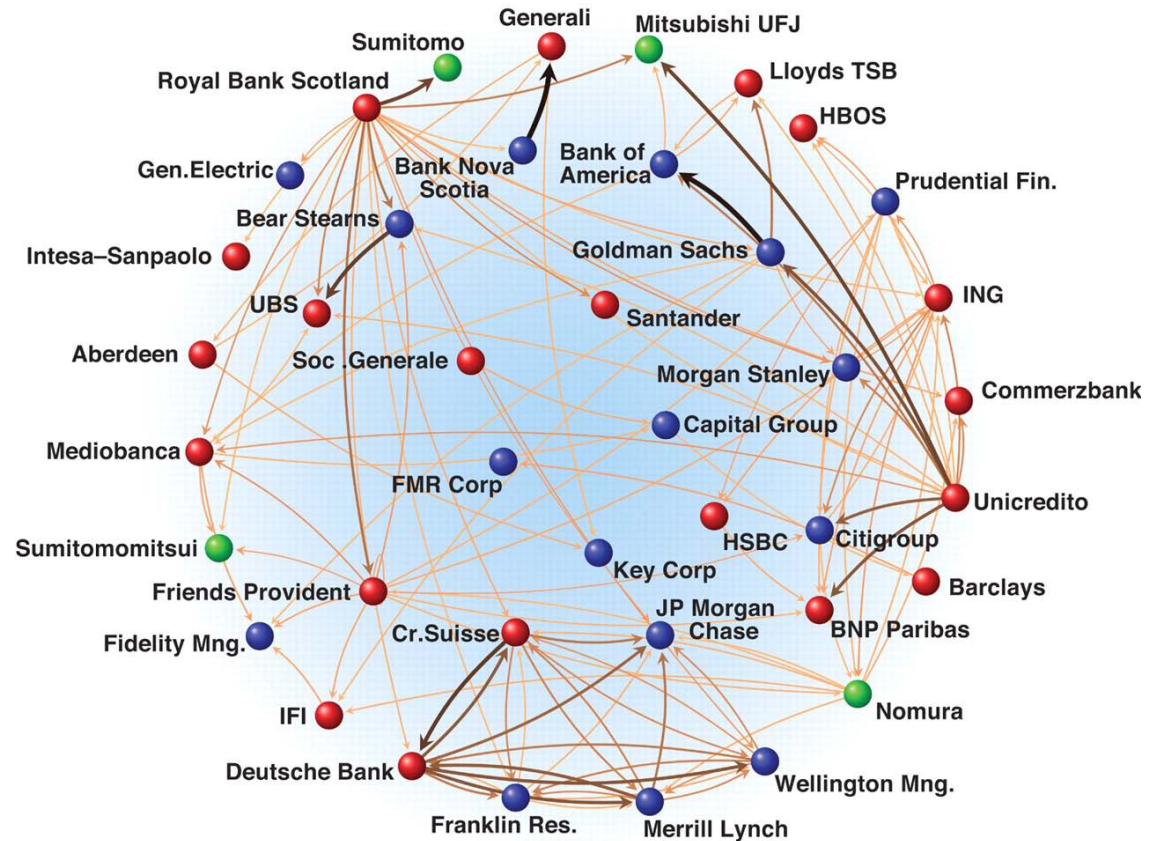


# Global Challenges



- The 15 Global Challenges provide a framework to assess the global and local prospects for humanity.
- <http://www.millennium-project.org/millennium/challenges.html>

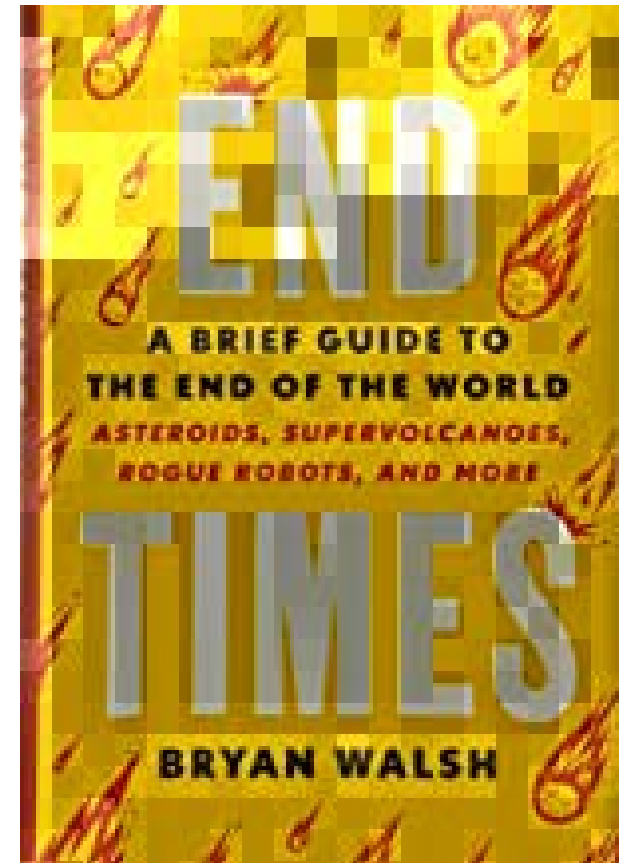
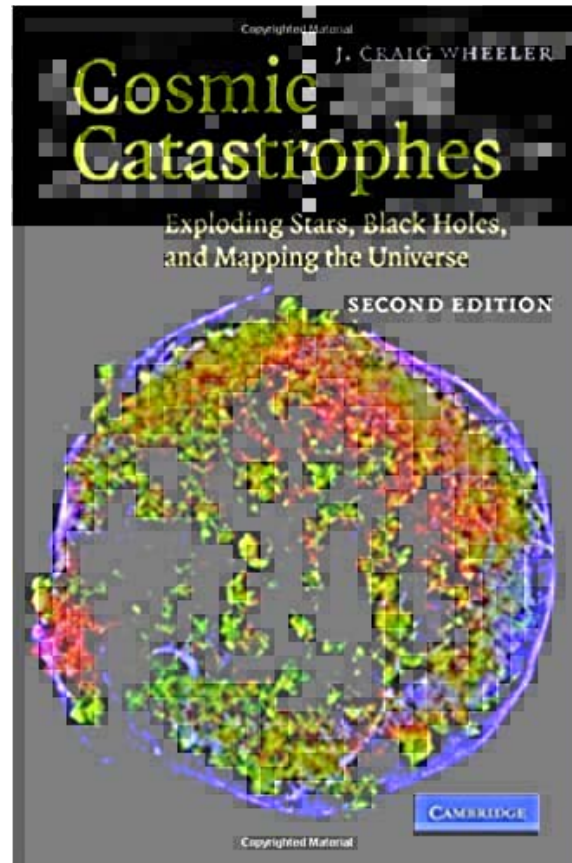
# Economic Disasters

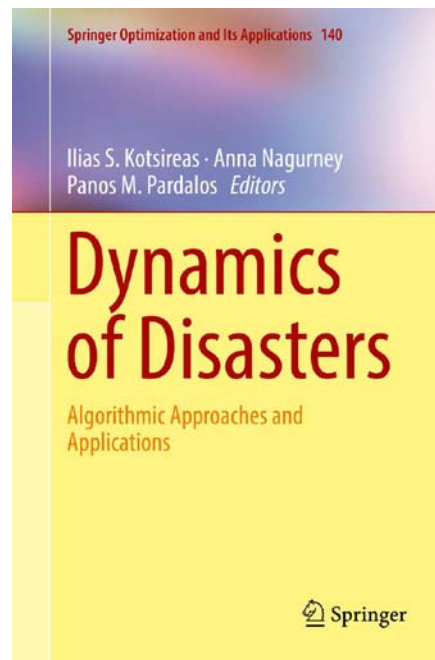
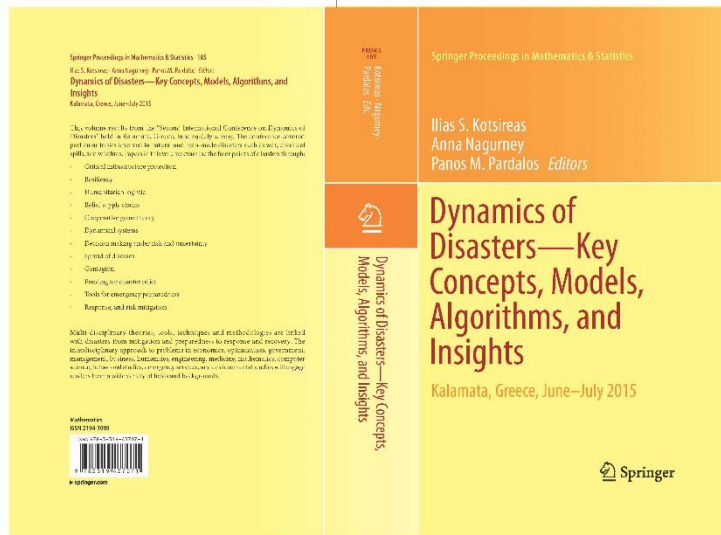


# Cosmic Disasters

- Asteroid Impacts and Moving Stars
- Sun's energy fluctuations (high energy solar flares)
- Radiation from Gamma ray bursts and nearby supernovas
  
- How to protect earth from cosmic disasters?
- Can we have a planetary safeguard system?

Heraclitus: *This universe, which is the same for all, has not been made by any god or man, but it always has been, is, and will be, an ever-living fire, kindling itself by regular measures and going out by regular measures.*





# DOD 2021

- **5TH INTERNATIONAL CONFERENCE ON DYNAMICS OF DISASTERS, DOD 2021**
- July 14-19, 2021  
Athens, Greece
- <http://www.caopt.com/DOD2021/>