Disruptive Innovations:
Threats and Opportunities

Professor Manuel Trajtenberg
Tel Aviv University, NBER & Knesset

Foundation Fernando Henrique Cardoso
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Intro

- Tidal wave of innovations, focus on: ***Artificial Intelligence*** (**AI**), in particular ***Machine Learning*** (**ML**)

- Claims that ***"this time is different",*** fear that AI/ML will spread and eventually **replace all occupations**…

  [will not talk about opposite view that technical change is ***slowing down***, and hence also productivity – ***Bob Gordon***…]

- First **ask if** AI/ML is a "General Purpose Technology" – **GPT**

- Won't prophesize about distant future, claim that:
  - This time may be different for the **political-economy** of technological change – **TC**
  - Explore **policy implications**

AI/ML – the 21st century GPT?

- Whole **eras** of TC and growth driven by a few GPT's: the steam engine, the electric motor, semiconductors, computers

- GPT's characterized by:
  1. **Pervasiveness:** used by many sectors, ever expanding
  2. Potential for **continuous improvements**
  3. **"Innovational complementarities":** benefits from innovation in adopting sectors increase as the GPT improves

- As the GPT improves it **spreads throughout** the economy, bringing about **generalized productivity gains**.

AI/ML as GPT – 1. Pervasiveness

- **AI:** simulates human decision-making & execution, perform highly-skilled professional functions consistently & much faster
- **ML:** complex models & algorithms for **prediction**, uncover hidden insights from Big Data; **self, continuous learning!**
- Wide-range potential **applications:**

1. **Computer vision, object recognition, robot locomotion**
2. Internet and credit-card fraud detection
3. **Medical diagnosis, Structural health monitoring**
4. Natural language & speech understanding, translation
5. **Bioinformatics, analyzing DNA sequences**
6. Insurance, Marketing, Recommender systems
7. Adaptive websites
8. Optimization and metaheuristic
9. **Automated theorem proving – scientific research…**
10. Sentiment analysis – "opinion mining"

AI/ML – the 21st century GPT? – *cont.*

- GPT's characterized by:
  1. **Pervasiveness**
  2. **Potential for improvements -** the **very nature of ML:** unsupervised & reinforcement learning
  3. **"Innovational complementarities":** e.g. autonomous vehicles, gene-sequencing for personalized medicine

So YES, very much an incipient GPT!

Is this time different?

Political-economy implications of tech disruption

- **New GPTs** always bring disruption, **winners and losers**,

  "We enjoy higher standards of living because we are standing on the broken backs of those that paved the way for tech progress, but did not live to benefit from it." *(paraphrasing Newton's "...standing on the shoulders of giants)*

- Don't have effective mechanisms to **ameliorate impact on losers:** safety-nets can't handle large flows of **tech displaced** workers ***&*** **longer life expectancy**! *even software programmers may become obsolete by age 40!*

- **"Democratization of expectations":** harder to have **some bear costs** ("losers"), **others reap benefits ("winners").** Due to rise in living standards and spread of democracy.

- We are **more impatient**, more **demanding of governments**, more **intolerant of failures.**

Political economy implications of Tech Disruption *cont.*

- **Wider costs**, not just for **individual** tech **losers**:
  - If systematic divide of tech winners & losers coincides w/**political** divide: **dangerous**, threatens fabric of democracy
  - **Macro impact:** can't afford longer-living ***un- /under-***employed

- **Governments** have to assume wider **responsibility** for effective ***transitions***, not just for alleviating costs

- **Reduce "losers"** NOT by slowing down TC, but by making sure more can participate – **inclusion!**

Policies for inclusion - democratizing AI

- Assuming **AI** becomes a **GPT** (hence spreads widely), and
  - **employment** in occupations relying on **"old" skills** declines
  - surge of new occupations using **new skills**

- **policies** for:
  1. **Education**: change in **nature of skills**
  2. **Personal services**: **upgrade occupations** integrating **AI**
  3. **Direction of TC**: **H**uman-**enhancing** or **H**uman-**replacing**?

1. Education

- 19th century **industrial revolutions** ⟺ **education revolution**.

- Ever since ***more of the same*** "factory model" of education (more years, hours, subjects).

- Need **new education revolution** for 21st century, complement **AI as GPT** - shift,
  - Away from imparting outdated knowledge & uniformity, to:
    - AI-oriented knowledge - **STEM**
    - **Skills relevant for AI** economy ⇒

Top skills sought for employment

UNICEF 10 life skills	MyStartJob.com	top10onlinecolleges.org
1.problem solving	1.Communication Skills	1.Sense Making
2.critical thinking	2.Analytical & Research	2.Social Intelligence
3.effective communication	3.Flexibility-Adaptability	3.Novel Adaptive Thinking
4.decision making	4.Interpersonal Abilities	4.Cross Cultural Competency
5.creative thinking	5. Decision making	5.Computational Thinking
6.interpersonal relationship	6. Plan, Organize, Prioritize	6.New Media Literacy
7.self-awareness	7. Wear Multiple Hats	7.Transdisciplinary
8.empathy	8.Leadership/Management	8.Design Mindset
9.coping w/stress	9.Attention To Detail	9.Manage Cognitive Load
10.coping w/emotions	10. Self confidence	10.Virtual Collaboration

Most of those skills are neither imparted in the current K-12 system, nor in academia

Top skills for employment – examples:

"type I": creative, decision making, adaptive

UNICEF 10 life skills	MyStartJob.com	top10onlinecolleges.org
1.problem solving	1.Communication Skills	**1.Sense Making**
2.critical thinking	**2.Analytical & Research**	2.Social Intelligence
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Top skills for employment – examples:

"type II": interpersonal, communication

UNICEF 10 life skills	MyStartJob.com	top10onlinecolleges.org
1.problem solving	**1.Communication Skills**	1.Sense Making
2.critical thinking	2.Analytical & Research	**2.Social Intelligence**
3.effective communication	3.Flexibility-Adaptability	3.Novel Adaptive Thinking
4.decision making	**4.Interpersonal Abilities**	4.Cross Cultural Competency
5.creative thinking	5. Decision making	5.Computational Thinking
6.interpersonal relationship	6. Plan, Organize, Prioritize	6.New Media Literacy
7.self-awareness	7. Wear Multiple Hats	7.Transdisciplinary
8.empathy	8.Leadership/Management	8.Design Mindset
9.coping w/stress	9.Attention To Detail	9.Manage Cognitive Load
10.coping w/emotions	10. Self confidence	**10.Virtual Collaboration**

Most of those skills are neither imparted in the current K-12 system, nor in academia

Top skills for employment – examples:

"type III": emotional, self confidence

UNICEF 10 life skills	MyStartJob.com	top10onlinecolleges.org
1.problem solving	1.Communication Skills	1.Sense Making
2.critical thinking	2.Analytical & Research	2.Social Intelligence
3.effective communication	3.Flexibility-Adaptability	3.Novel Adaptive Thinking
4.decision making	4.Interpersonal Abilities	4.Cross Cultural Competency
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1. Education - Policy

1. **Invert the pyramid** - invest much more in **early-age** (birth to 6): critical skills acquired very early on, hard to remedy later.

2. Promote **bottom-up experimentation** in pedagogy, social skills development, classroom & school design.

3. **Don't** aim at **Gov** mandated **uniform** curriculum/"model", encourage open innovation communities.

4. Foster **research on effectiveness** of new education models, adequacy to needs, equal opportunity (*use eco tools).*

2. Personal services: upgrade occupations

- Fastest growing occupations**: personal care** (PC) – healthcare, social assistance, education, nursing, etc.

- Many of them require **little training** & educational requirements
  => low wages, low status, low tech

- **Policies** to **professionalize PC** occupations: **set** job, training & academic **standards**, expose them to **advanced techs**
  => develop smart human-AI/machine interfaces

- **Example - Nurses** in US post WWII: very low wages, low skills, till ***Nurse Training Act*** *of 1964* **-** upgraded curriculum, required academic degrees. Since then: wages up, **upscale roles** for nurses, **integrate medical techs!**

3. Direction of TC: H-*enhancing* or H-*replacing*?

- **Human Enhancing Innovations - HEI**: those that **magnify, enhance and extend** sensory, analytical & problem solving human capabilities (not "input saving"), e.g.,
  - **in medicine**: **AI** for diagnostics – **better doctors!**
  - **in education**: **AI** to track individual progress of pupils, **better teachers!**

- **HEI** can unleash new wave of **human creativity & productivity,** even if lower skills – finely grained **professional continuum** (e.g. in medicine…)

- **Human Replacing Innovations (HRI)** do **the opposite** – see **Walmart**: turn workers into **unthinking automatons…**

- **Can Gov affect direction of tech change,** i.e. promote HEI versus HRI? ***Maybe***, but with **great caution!**

Concluding remarks

- To unleash potential of new GPT, need changes in education, socio-economic policies, but they **take too long & are painful**
- We have **less tolerance** for the **costs**, higher expectations for sharing the **benefits** here & now, ***therefore***,
  - ✓ **Anticipate** the required changes – experiment, design and implement proactively **new policies**
  - ✓ The **new techs**: **powerful tool-kit** for new, effective policy interventions (e.g. retraining using on-line personalized instruction).

- Big **differences across countries**: educational gaps, social exclusion, the workings of markets and finance
- Need explicit **catch-up policies** to realize benefits from new GPT, & at same time improve social performance - **less inequality**

Thanks!

FUTURE WORK SKILLS OF 2020:

SENSE MAKING

ABILITY TO DETERMINE THE DEEPER MEANING OR SIGNIFICANCE OF WHAT IS BEING EXPRESSED

THE DRIVERS:

SOCIAL INTELLIGENCE

ABILITY TO CONNECT TO OTHERS IN A DEEP AND DIRECT WAY, TO SENSE AND STIMULATE REACTIONS AND DESIRED INTERACTIONS

THE DRIVERS:

NOVEL AND ADAPTIVE THINKING

PROFICIENCY AT THINKING AND COMING UP WITH SOLUTIONS AND RESPONSES BEHOND THAT WHICH IS ROTE OR RULE-BASED

THE DRIVERS:

VIRTUAL COLLABORATION

ABILITY TO WORK PRODUCTIVELY, DRIVE ENGAGEMENT, AND DEMONSTRATE PRESENCE AS A MEMBER OF A VIRTUAL TEAM

THE DRIVERS:

CROSS CULTURAL COMPETENCY

ABILITY TO OPERATE IN DIFFERENT CULTURAL SETTINGS

THE DRIVERS:

COMPUTATIONAL THINKING

ABILITY TO TRANSLATE VAST AMOUNTS OF DATA INTO ABSTRACT CONCEPTS AND TO UNDERSTAND DATA BASED REASONING

THE DRIVERS:

NEW MEDIA LITERACY

ABILITY TO CRITICALLY ASSESS AND DEVELOP CONTENT THAT USES NEW MEDIA FORMS, AND TO LEVERAGE THESE MEDIA FOR PERSUASIVE COMMUNICATION

THE DRIVERS:

TRANSDISCIPLINARY

LITERACY IN AND ABILITY TO UNDERSTAND CONCEPTS ACROSS MULTIPLE DISCIPLINES

THE DRIVERS:

DESIGN MINDSET

ABILITY TO REPRESENT AND DEVELOP TASKS AND WORK PROCESSES FOR DESIRED OUTCOMES

THE DRIVERS:

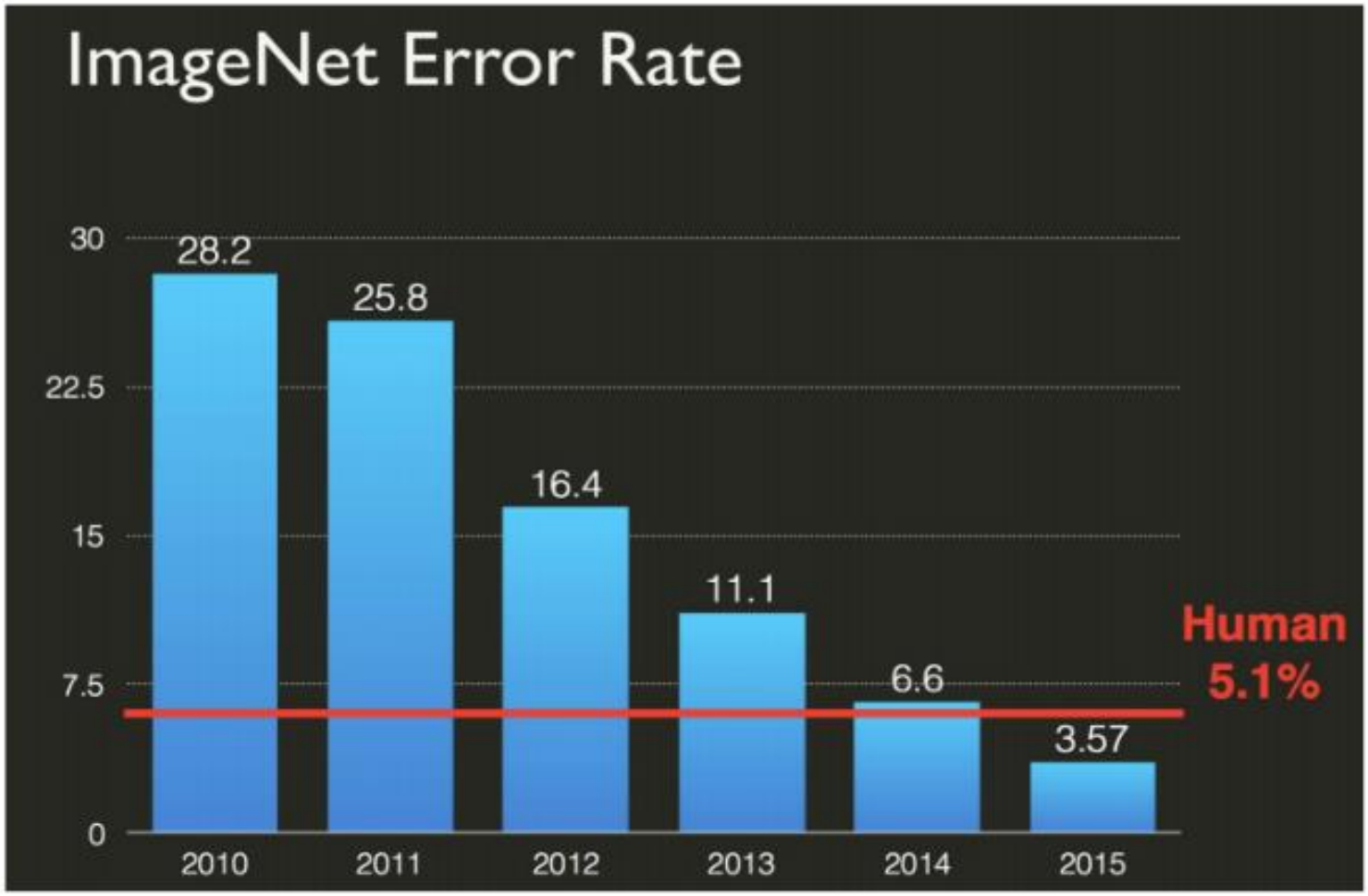
COGNITIVE LOAD MANAGEMENT

ABILITY TO DISCRIMINATE AND FILTER INFORMATION FOR IMPORTANCE, AND TO UNDERSTAND HOW TO MAXIMIZE COGNITIVE FUNCTIONS

THE DRIVERS:

Source: http://www.top10onlinecolleges.org/

Dramatic Progress in image recognition



Data Size Held Constant - Improvement Due to Hardware and Software
Source: Stanford ImageNet