Erik said that we should automate “dull, repetitive work” that no one wants to do. Josh said that DoNotPay exists to make it easier to carry out low skill, high transaction cost procedural/legal steps that people otherwise wouldn’t do.

Raises key questions:

Where do you draw the line on what should be automated vs. augmented?

Where should decisions like this be made?
Today’s Agenda

1. Regulating AI
2. Thinking about Regulation in Context: Automation of Work
3. Automation: Economic and Social Consequences
4. Automation: Implications for Liability
In our discussion of privacy, when I asked whether you preferred a European regulatory model or an American one, you overwhelmingly sided with Europe.

Now Europe has introduced draft legislation to govern artificial intelligence: the Artificial Intelligence Act.

It proposes a risk-based regulatory structure that bans some uses of AI, heavily regulates high-risk uses, and lightly regulates less risky systems.

Two big innovations: (1) a requirement for **ex-ante conformity assessments** to establish that high risk systems meet the relevant requirements before they can be put into market and (2) a mandated **post-market monitoring system** to detect problems.
A Risk-Based Approach

- **Unacceptable risk**
  - e.g. social scoring
  - Prohibited

- **High risk**
  - e.g. recruitment, medical devices
  - AI with specific transparency obligations
  - ‘Impersonation’ (bots)
  - Permitted subject to compliance with AI requirements and ex-ante conformity assessment
  - Permitted but subject to information/transparency Obligations

- **Minimal or no risk**
  - Permitted with no restrictions
At Higher Levels of Risk...

- The obligations are more onerous:
  - Data and data governance
  - Transparency for users
  - Human oversight
  - Accuracy, robustness, and cybersecurity
  - Traceability and auditability

- High risks includes: biometric ID, operation of critical infrastructure, education, employment, essential services and benefits, law enforcement, migration, administration of justice

- Prohibited uses: social scoring, subliminal influences, manipulation, real-time facial recognition in public places
“...attempts to regulate “AI” in general would be misguided, since there is no clear definition of AI (it isn’t any one thing), and the risks and considerations are very different in different domains. Instead, policymakers should recognize that to varying degrees and over time, various industries will need distinct, appropriate, regulations that touch on software built using AI or incorporating AI in some way.”

-- AI Study Group (2016)
1. Regulating AI
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How Concerned Are You?

To what extent are you concerned about the automation of work and its impact on your life?

Take a survey here: cs182.stanford.edu or

https://tinyurl.com/cs182survey
More Worry than Optimism

More worry than optimism about potential developments in automation

% of U.S. adults who say they are enthusiastic or worried about ...

- Future where robots and computers can do many human jobs: Worried 72%, Enthusiastic 33%
- Development of algorithms that can evaluate and hire job candidates: Worried 67%, Enthusiastic 22%
- Development of driverless vehicles: Worried 54%, Enthusiastic 40%
- Development of robot caregivers for older adults: Worried 47%, Enthusiastic 44%
Many Americans would be hesitant to use various automation technologies

% of U.S. adults who say they would or would not want to ___ if given the opportunity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Would not</th>
<th>Would</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride in a driverless vehicle</td>
<td>56</td>
<td>44</td>
</tr>
<tr>
<td>Use a robot caregiver</td>
<td>59</td>
<td>41</td>
</tr>
<tr>
<td>Apply for a job that used a computer program to select applicants</td>
<td>76</td>
<td>22</td>
</tr>
</tbody>
</table>
Broad public support for policies that limit the reach and impact of workforce automation

% of U.S. adults who say they support or oppose the following policies in the event that robots and computers are capable of doing many human jobs

<table>
<thead>
<tr>
<th>POSSIBLE POLICIES</th>
<th>Strongly oppose policy</th>
<th>Oppose</th>
<th>Favor</th>
<th>Strongly favor policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machines are limited to doing dangerous or unhealthy jobs</td>
<td>3%</td>
<td>11%</td>
<td>38%</td>
<td>47%</td>
</tr>
<tr>
<td>Govt offers all Americans a guaranteed income that would meet their basic needs</td>
<td>18</td>
<td>21</td>
<td>30</td>
<td>31</td>
</tr>
<tr>
<td>Govt creates a national service program that would pay people to perform tasks</td>
<td>12</td>
<td>29</td>
<td>37</td>
<td>21</td>
</tr>
</tbody>
</table>
Role of Private Sector

% of U.S. adults who say they agree with each statement in the event that robots and computers are capable of doing many human jobs

- Businesses are justified in replacing human workers if machines can do a better job at lower cost (41%)
- Should be limits on number of jobs businesses can replace with machines, even if they are better and cheaper than humans (58%)
- No answer (1%)
### Benefits/Costs of Driverless Vehicles

**% of U.S. adults who say the following about driverless vehicles**

**Positive views/attitudes**

- Expect they would help elderly and disabled be more independent
  - **Would not** ride in a driverless vehicle: 62%
  - **Would** ride in a driverless vehicle: 91%

- Would feel safe sharing road with a driverless passenger vehicle: 19% **Would** feel safe, 85% **Would not** feel safe

- Are very/somewhat enthusiastic about their widespread use: 13% **Would** be enthusiastic, 74% **Would not** be enthusiastic

- Expect that they would reduce traffic injuries/deaths: 17% **Would** expect reduction, 68% **Would not** expect reduction

**Negative views/attitudes**

- Would feel safe sharing road with a driverless freight truck: 10% **Would** feel safe, 66% **Would not** feel safe

- Expect that driverless vehicles would reduce traffic in major cities: 16% **Would** expect reduction, 43% **Would not** expect reduction

- Are very/somewhat worried about their widespread use: 34% **Would** be worried, 69% **Would not** be worried

- Strongly favor requiring human at the wheel in case of emergency: 38% **Would** favor, 65% **Would not** favor

- Strongly favor that they travel in dedicated lanes: 33% **Would** favor, 58% **Would not** favor

- Strongly favor restricting them from certain areas: 16% **Would** favor, 48% **Would not** favor
Differential Risks of Automation

% of U.S. adults who think it is ___ likely that the following jobs will be replaced by robots or computers in their lifetimes

- **Fast food worker**
  - Not at all: 6%
  - Not very: 17%
  - Somewhat: 39%
  - Very: 38%
  - NET likely: 77%

- **Insurance claims processor**
  - Not at all: 7%
  - Not very: 27%
  - Somewhat: 44%
  - Very: 22%
  - NET likely: 65%

- **Software engineer**
  - Not at all: 12%
  - Not very: 35%
  - Somewhat: 38%
  - Very: 15%
  - NET likely: 53%

- **Legal clerk**
  - Not at all: 12%
  - Not very: 38%
  - Somewhat: 36%
  - Very: 13%
  - NET likely: 50%

- **Construction worker**
  - Not at all: 19%
  - Not very: 39%
  - Somewhat: 32%
  - Very: 10%
  - NET likely: 42%

- **Teacher**
  - Not at all: 26%
  - Not very: 38%
  - Somewhat: 26%
  - Very: 10%
  - NET likely: 36%

- **Own job or profession**
  - Not at all: 30%
  - Not very: 40%
  - Somewhat: 23%
  - Very: 7%
  - NET likely: 30%

- **Nurse**
  - Not at all: 34%
  - Not very: 46%
  - Somewhat: 16%
  - Very: 4%
  - NET likely: 20%
Your Perspective on Work

• What is the job you’d most like to have in five years?

• How concerned are you that it might be replaced or transformed by robots or automation?

• Do you think that technology will make the job more interesting?

• Are you taking the potential for automation into account as you consider career pathways?

• If machines can do the job you are capable of better than humans, might you be happier not working? Why or why not?
Today’s Agenda

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4. Automation: Implications for Liability
Hypothesis Generation

• Let’s put on our hats as social scientists today. The big question we want to answer is this: **What are the impacts of increasing automation on society?**

• This is something we can think about empirically and measure.

• Talking to your neighbors, identify some hypotheses you’d want to test and how you might approach testing them? Think about:
  • Economic effects
  • Social consequences
  • Political implications
What Do the Experts Say?

**JOBS THREATENED BY AUTOMATION**
PROJECTED PERCENTAGE OF US JOBS AT HIGH RISK OF AUTOMATION BY 2030

- Frey & Osborne (Oxford): 47%
- Pricewaterhouse Coopers (PWC): 38%
- Organization for Economic Cooperation & Development (OECD): 9%

Source: PwC, Frey and Osborne, OECD
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Not a New Concern

“We are being afflicted with a new disease of which some readers may not have heard the name, but of which they will hear a great deal in the years to come—namely, technological unemployment.”

-- John Maynard Keynes (1930)

“Labor will become less and less important... More and more workers will be replaced by machines. I do not see new industries can employ everybody who wants a job.”

-- Wassily Leontief (1952)
If ‘displace more jobs’ means ‘eliminate dull, repetitive, and unpleasant work,’ the answer would be yes. How unhappy are you that your dishwasher has replaced washing dishes by hand, your washing machine has displaced washing clothes by hand, or your vacuum cleaner has replaced hand cleaning?

My guess is this ‘job displacement’ has been very welcome, as will the ‘job displacement’ that will occur over the next 10 years. The work week has fallen from 70 hours a week to about 37 hours now, and I expect that it will continue to fall. This is a good thing.

Everyone wants more jobs and less work. Robots of various forms will result in less work, but the conventional work week will decrease, so there will be the same number of jobs (adjusted for demographics, of course). This is what has been going on for the last 300 years so I see no reason that it will stop in the decade.”

-- Hal Varian, Chief Economist, Google
## Catalogue of fears

Probability of computerisation of different occupations, 2013

(1 = certain)

<table>
<thead>
<tr>
<th>Job</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreational therapists</td>
<td>0.003</td>
</tr>
<tr>
<td>Dentists</td>
<td>0.004</td>
</tr>
<tr>
<td>Athletic trainers</td>
<td>0.007</td>
</tr>
<tr>
<td>Clergy</td>
<td>0.008</td>
</tr>
<tr>
<td>Chemical engineers</td>
<td>0.02</td>
</tr>
<tr>
<td>Editors</td>
<td>0.06</td>
</tr>
<tr>
<td>Firefighters</td>
<td>0.17</td>
</tr>
<tr>
<td>Actors</td>
<td>0.37</td>
</tr>
<tr>
<td>Health technologists</td>
<td>0.40</td>
</tr>
<tr>
<td>Economists</td>
<td>0.43</td>
</tr>
<tr>
<td>Commercial pilots</td>
<td>0.55</td>
</tr>
<tr>
<td>Machinists</td>
<td>0.65</td>
</tr>
<tr>
<td>Word processors and typists</td>
<td>0.81</td>
</tr>
<tr>
<td>Real-estate sales agents</td>
<td>0.86</td>
</tr>
<tr>
<td>Technical writers</td>
<td>0.89</td>
</tr>
<tr>
<td>Retail salespeople</td>
<td>0.92</td>
</tr>
<tr>
<td>Accountants and auditors</td>
<td>0.94</td>
</tr>
<tr>
<td>Telemarketers</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Differential Effects Across Countries

Wage against the machine
Automation risk* and GDP per person, selected countries

Source: OECD

*50% risk or higher
## Benefits of AVs

### Quantified Benefits of Autonomous Vehicles

<table>
<thead>
<tr>
<th>Public Benefits by 2050 (annual)</th>
<th>$633 Billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestion Mitigation</td>
<td>$71 Billion</td>
</tr>
<tr>
<td>Accident Reduction – Economic Impact</td>
<td>$118 Billion</td>
</tr>
<tr>
<td>Accident Reduction – Quality of Life Improvements</td>
<td>$385 Billion</td>
</tr>
<tr>
<td>Reduced Oil Consumption</td>
<td>$58 Billion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumer Benefits by 2050 (annual)</th>
<th>$163 Billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of Time</td>
<td>$153 Billion</td>
</tr>
<tr>
<td>Reduction in Cost of Current Taxi Service</td>
<td>$10 Billion</td>
</tr>
</tbody>
</table>

**Total Annual Benefits (by 2050)** $796 Billion

Impact on Professional Drivers

- ~3.5 million professional truck drivers in the U.S.
- Additional 5.2 million people employed in trucking
- Approximately 40% are ethnic minorities
How can we think systematically about the effects of automation on wages, employment, and economic growth? Acemoglu and Restrepo (2018) offer an economic framework for assessing the impact of automation:

1. A *displacement effect* where by AI and robotics replace workers in tasks they previously performed
2. A *productivity effect* as the cost of production declines
3. *Capital accumulation* triggered by increased automation will increase the demand for labor
4. *Deepening of automation* as productivity increases further in already automated tasks
5. A *reinstatement effect* in which *new tasks* increase the demand for labor
Historical Examples: Agriculture

The mechanization of agriculture transformed agricultural production processes and reduced the demand for labor.
Historical Examples: Manufacturing

**Not what it was**

US employment by sector, % of total employment

- Services
- Manufacturing
- Government
- Agriculture

Source: US Bureau of Labour Statistics

**Rise of the machines**

US manufacturing

- Employment, m
- Output, 2007=100

Sources: BLS; Federal Reserve

Economist.com
Acemoglu and Restrepo (2017) measure the empirical effects of automation on employment and wages.

They exploit variation in the degree to which different commuting zones were exposed to automation in their major industries.

Quantitatively, they find that robots decrease both employment and wages. One additional robot per thousand workers is associated with a drop in employment of 6.2 workers and a decrease in wages of 0.73 percent.
Empirical Estimates
Acemoglu and Restrepo (2021) examine the role of automation in understanding inequality dynamics. Here are the big takeways:

• Between 1947-1987, the average “displacement” (job loss) was 17 percent of jobs while average “reinstatement” (new opportunities) was 19 percent.

• But from 1987-2017, displacement was 16 percent and reinstatement was 10 percent.

In short: the new tasks are coming more slowly and benefiting the highly skilled.
The old framework was “skill-biased technological change”. Technology benefits select high-skilled workers more than low-skill workers, helping the wages of the high-skilled while low wage workers stagnate.

The new framework: low-skilled workers are not just failing to make gains; they are being pushed backward financially.

This is because “so-so technologies” replace jobs without adding much productivity to the economy.

Think about: self-checkout systems, automated customer service
Social Consequences?

While we do not have estimates of the impact of automation on social dynamics, there is a growing literature on the political and social impacts of off-shoring induced job losses:

- Feigenbaum and Hall (2015) find that job losses drive politicians to adopt much more protectionist positions in Congress
- Ballard Rosa et al (2018) find that job losses drive the adoption of more “authoritarian values” and support for anti-establishment parties (in both the U.S. and U.K.)
Trade Shocks and Job Loss in the U.S.
Authoritarian Values

Change in Chinese Import Penetration 1991-2007

Change in Chinese Import Penetration 1991-2007, Controlling for Initial Manufacturing
ABSTRACT

We Were the Robots: Automation and Voting Behavior in Western Europe*

We investigate the impact of robot adoption on electoral outcomes in 14 Western European countries, between 1993 and 2016. We employ both official election results at the district level and individual-level voting data, combined with party ideology scores from the Manifesto Project. We measure exposure to automation both at the regional level, based on the ex-ante industry specialization of each region, and at the individual level, based on individual characteristics and pre-sample employment patterns in the region of residence. We instrument robot adoption in each country using the pace of robot adoption in other countries. Higher exposure to robot adoption is found to increase support for nationalist and radical-right parties. Unveiling some potential transmission channels, higher robot exposure at the individual level leads to poorer perceived economic conditions and well-being, lower satisfaction with the government and democracy, and a reduction in perceived political self-efficacy.
The Costs of Adjustment

Even if the displacement effects of automation may potentially be counteracted by other forces, we should not underestimate just how challenging it might be.

- The reallocation of workers from existing jobs and tasks to new ones is a complex and often slow process
- The transition might be associated with a period of stagnant wages, expanding poverty, and unemployment ("living standards paradox")
- Adjustment depends on the educational system providing the training, skills that people need for new jobs, tasks
- Some groups may be disproportionately affected by automation (e.g. men with a high school degree or less)
The Critical Role of Policy

Rather than regulating AI per se, it may make more sense to explore the role of policies in mitigating the costs of adjustment.

For example, addressing the potential of AI and automation to increase inequality is one valid societal concern.
Plight of Low-Skilled Americans

Case and Deaton (2020)
What are the Policy Options?

• Universal Basic Income vs. Social Safety Nets
  • A regular, unconditional cash grant to every individual instead of traditional, means-tested social benefits

• Investments in education and skills training
  • To reverse the decline in labor force participation among people without a college education, policies that address skills deficits may make a big difference

• Changing the ownership structure of companies
  • Better distribute the returns to increasing productivity and manage the transition costs with attn. to workers’ needs
We could establish policy frameworks that incentivize AI that augments human labor, rather than replacing it. How?

- Address distortionary tax policies that subsidize automation at expense of labor
- Government R&D in AI that is job-creating, capability-enhancing
- Social norms in AI development that are attentive to social harms
- Democratic oversight of AI
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Are Crashes Inevitable?

One of the promises of autonomous vehicles is a reduction in crashes and human injury. More than 40,000 people are killed each year in crashes, and 2.5m are injured. Most crashes are the result of human error.

If autonomous vehicles are adopted broadly, what should happen when the inevitable crash occurs? Who should be responsible and to what extent?
Not a Hypothetical Question

An Uber self-driving car in Scottsdale was involved in a fatal accident with a pedestrian in March 2018. This was the first known fatal accident involving a driverless car.

- The vehicle was operating in autonomous mode at the time of the crash
- A human operator was in the vehicle
- The car did not slow down before hitting the pedestrian
- The pedestrian was jaywalking in the dark

Who should be held legally responsible for the accident?
We have liability and regulatory regimes in place in order to:

1. Incentivize safe driving behavior, given the potential costs associated with accidents
2. Encourage automobile companies to adopt safe technologies and to innovate in these areas
3. Facilitate corrective justice and compensate victims when accidents occur
In terms of civil liability, a person is liable for a harm they cause if there is the existence of a duty, the breach of that duty, causation, and injury. The duty is a reasonable care in operation.

Parties are held liable for negligence if they *unreasonably* fail to prevent the risk. But measuring reasonableness is difficult!

Many states have adopted a *no-fault* system to avoid litigation around crashes unless the severity of injuries surpasses a *threshold*.

Self-driving cars will likely dilute the sense that drivers are directly and solely responsible for their automobiles.
With self-driving cars, we can expect a shift in liability from the driver to the manufacturer.

Theories of manufacturer liability include: (1) negligence (2) tortious misrepresentation (3) violation of warranty and (4) strict products liability.

Manufacturers can also be held responsible for: manufacturing defects, design defects, and warning defects.

Manufacturer liability is likely to be a major area of contestation around driverless cars, and concerns about legal exposure may impede the adoption of these technologies.
What About Criminal Liability?

Can autonomous systems be held criminally liable for a harm they cause?

Criminal liability depends on the commission of a crime which involves an *act* by an individual (not simply thoughts, beliefs, or intentions). Some have defined an act as involving “bodily movement”; others focus on acts as “controllable” by the person.

- Are AI agents acting in the sense of criminal law?
- Should the crime be attributed to the human operator in the vehicle or the author of the algorithm?
- Should the act be attributable to bad luck or nature?
Arizona Governor Doug Ducey, who had previously criticized other states for over-regulating autonomous vehicles, has now put a halt to the testing of self-driving cars in the state. The state and the governor are also being sued by the family.

Raises key questions:

Under what conditions should states allow the use of self-driving cars?

Should the federal government regulate autonomous vehicles?