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## The First Machine Age

- Changing the world requires:
  - Physical power: move or transform the things
  - Mental power: decide where and how
- Industrial Revolution = Physical Power
  - Steam engine (internal combustion engine, electricity)
  - Mostly a complement to humans
- Not entirely without social resistance

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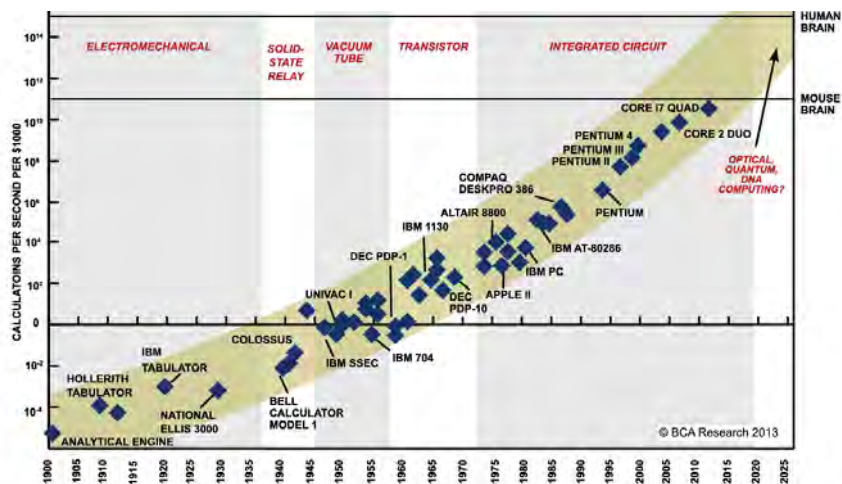
Data, Computers, Knowledge -> Mental power

# THE SECOND MACHINE AGE

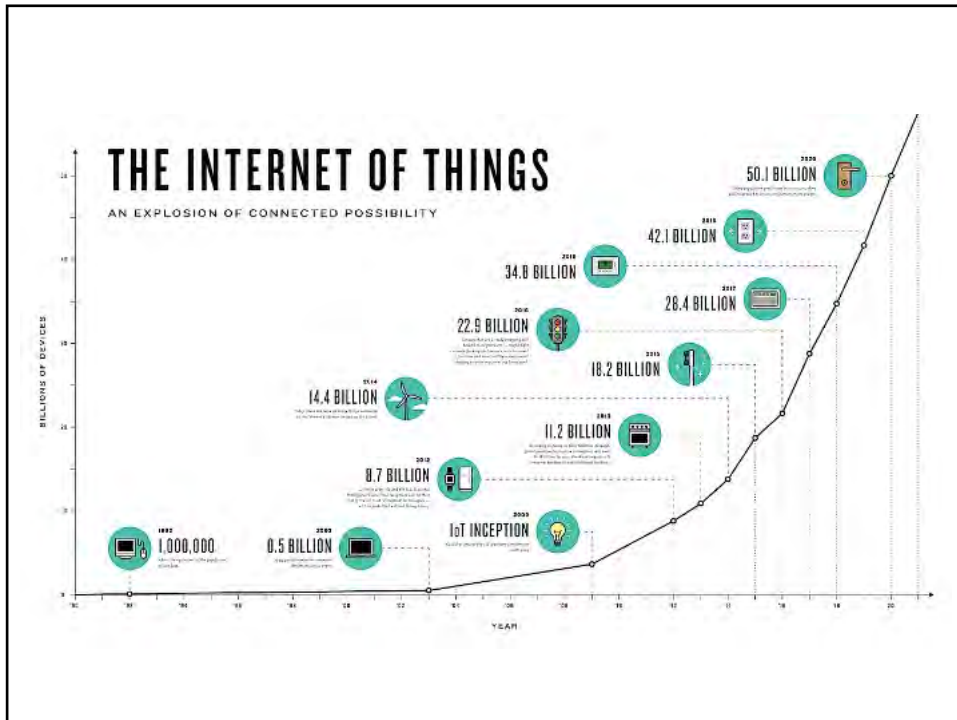
(Brynjolfsson and McAfee, 2014)

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# Moore's Law



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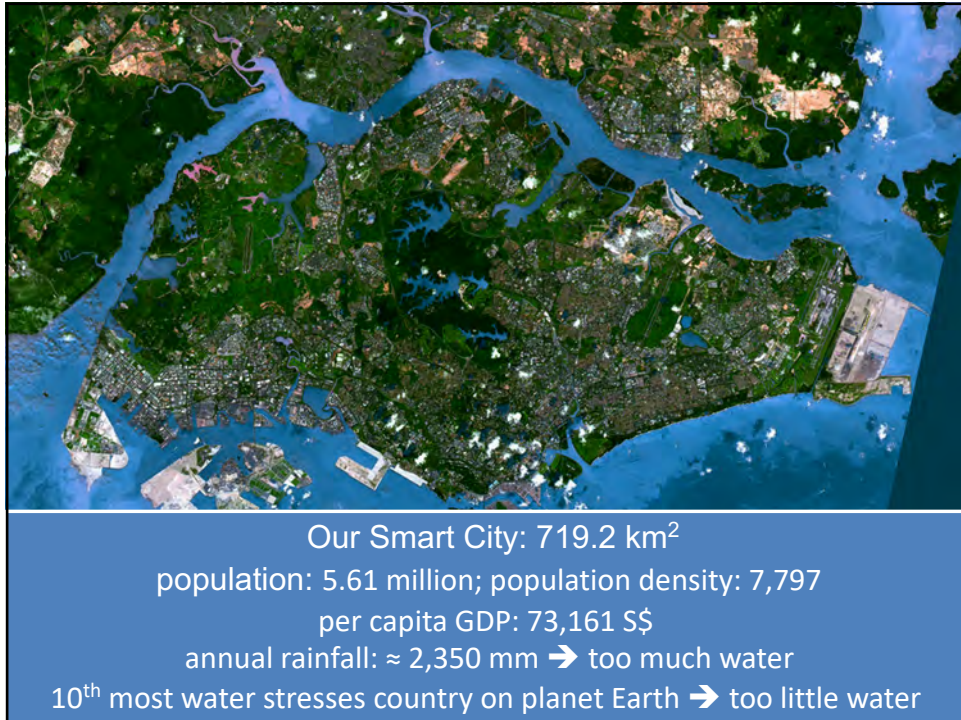


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The times, they are changin' ...

**...THE WATER PART OF THE STORY**

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It rains and  
floods in Smart  
Cities too...

Bedok, January 8,  
2018

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71.3 mm over 4 hours, out of  
which 42mm within 30 minutes



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# RADARS

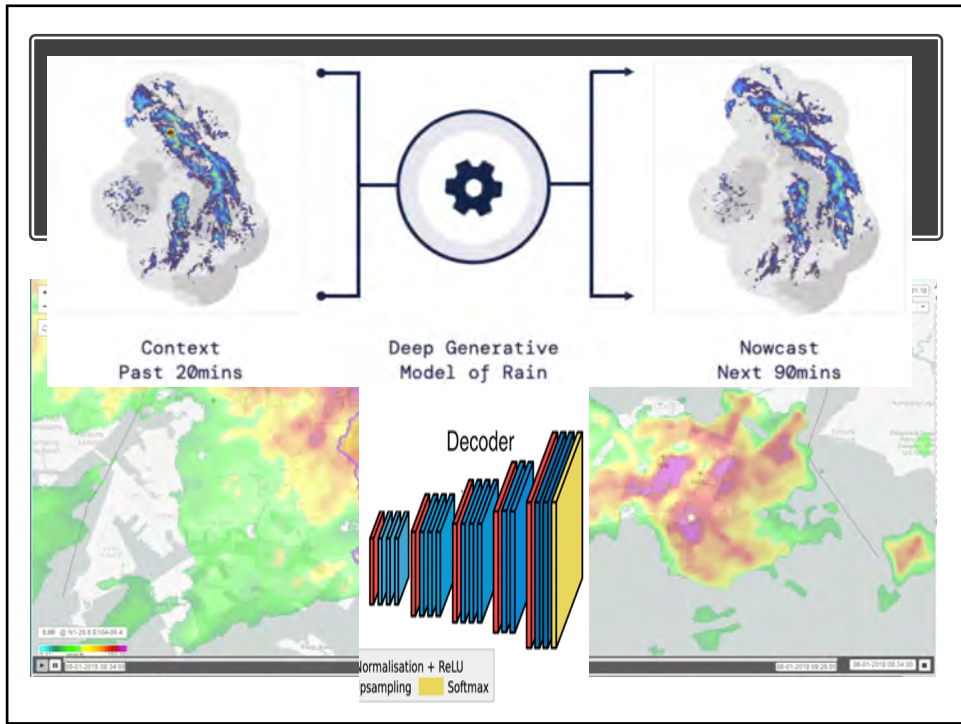
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Rainfall events in the tropics are highly localized

extremely difficult to predict



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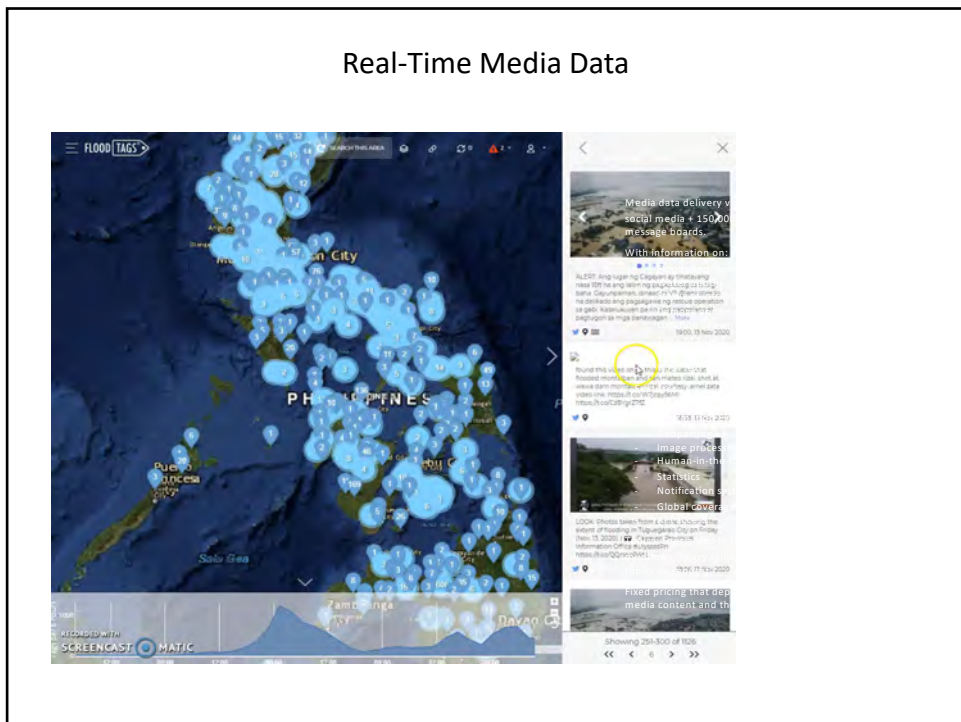
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**TWEETS**

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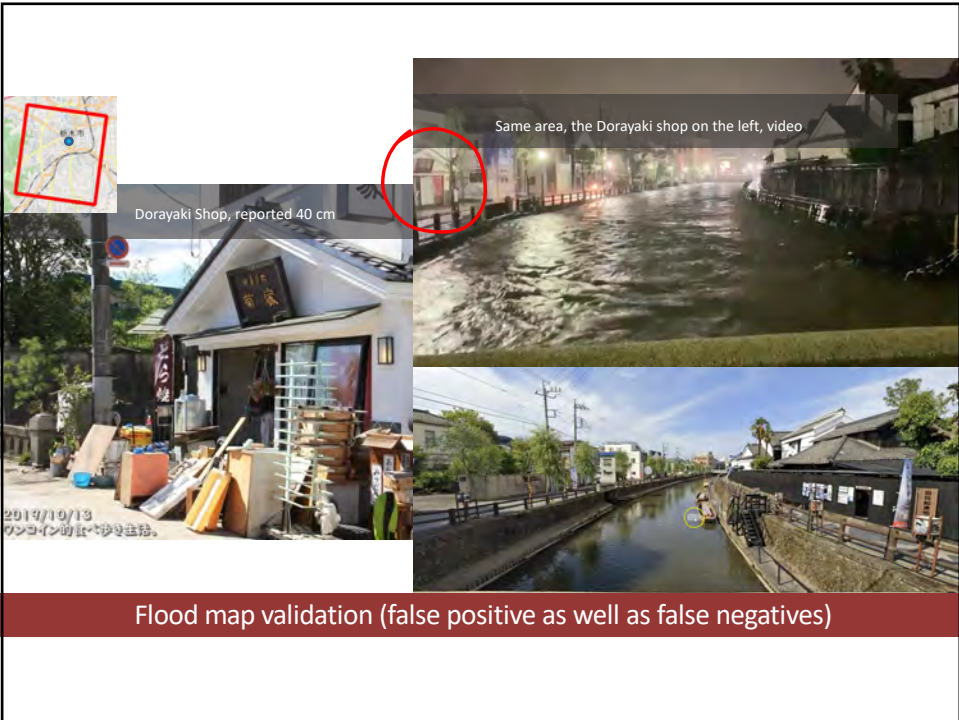


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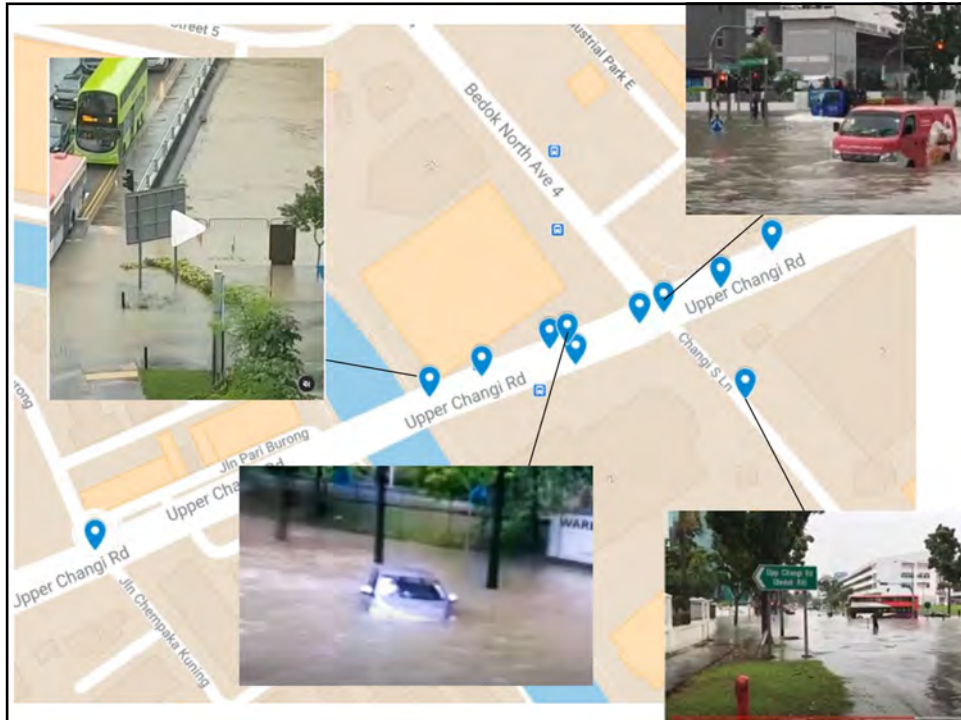






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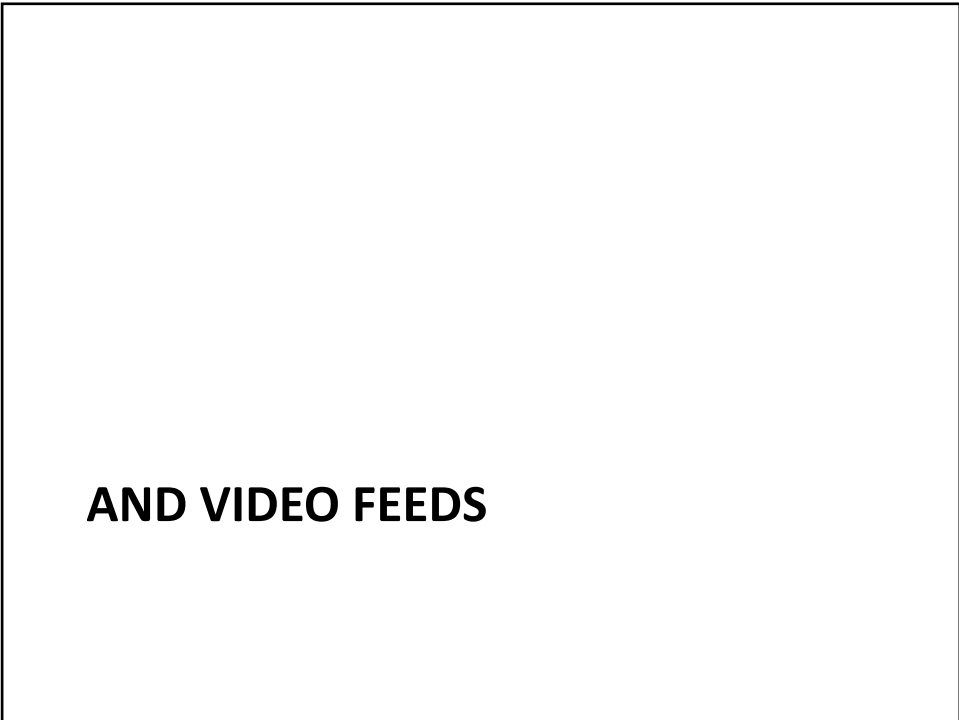
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|                         |   |   |
|-------------------------|---|---|
| <p>Posted<br/>10:45</p> |  | <p>Index: #36<br/>                 Approximate location: Area 1<br/>                 Time of upload: 10:45<br/>                 Title/ Text: Heavy rains cause flash floods in Singapore<br/>                 Type: Photo<br/>                 Source: AsiaOne<br/>                 Source link:<br/> <a href="https://www.asiaone.com/multimedia/gallery/heavy-rains-cause-flash-floods-singapore">https://www.asiaone.com/multimedia/gallery/heavy-rains-cause-flash-floods-singapore</a><br/>                 Google street view link:<br/> <a href="https://www.google.nl/maps/@1.3346952,103.9505457,3a,36.7y,211.71h,93.72t/data=!3m6!1e1!3m4!1sgWm2-CSY7YGE0XtE-t1O2gI2e0!7!16384!8!8192">https://www.google.nl/maps/@1.3346952,103.9505457,3a,36.7y,211.71h,93.72t/data=!3m6!1e1!3m4!1sgWm2-CSY7YGE0XtE-t1O2gI2e0!7!16384!8!8192</a></p> <p>Caption with photo: Flooding in Bedok, in front of Changi Fire Station, caused by the heavy rain.</p> |
| <p>Posted<br/>10:17</p> |  | <p>Index: #15<br/>                 Approximate location: Area 1<br/>                 Time of upload: 10:17<br/>                 Title/ Text: Several places in Singapore's east affected by flash floods, including Changi, Bedok, Tampines, Paya Lebar<br/>                 Type: Photo<br/>                 Source: @ChannelNewsAsia<br/>                 Source link:<br/> <a href="https://twitter.com/ChannelNewsAsia/status/950189581286096897">https://twitter.com/ChannelNewsAsia/status/950189581286096897</a><br/>                 Google street view link:<br/> <a href="https://www.google.nl/maps/@1.3345251,103.9510379,3a,75y,261.8h,103.65t/data=!3m6!1e1!3m4!1zOZLdX1fz4V60gLLt-kDcgl2e0!7!16384!8!8192">https://www.google.nl/maps/@1.3345251,103.9510379,3a,75y,261.8h,103.65t/data=!3m6!1e1!3m4!1zOZLdX1fz4V60gLLt-kDcgl2e0!7!16384!8!8192</a></p>  |

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Inspired by Laio, Alamano

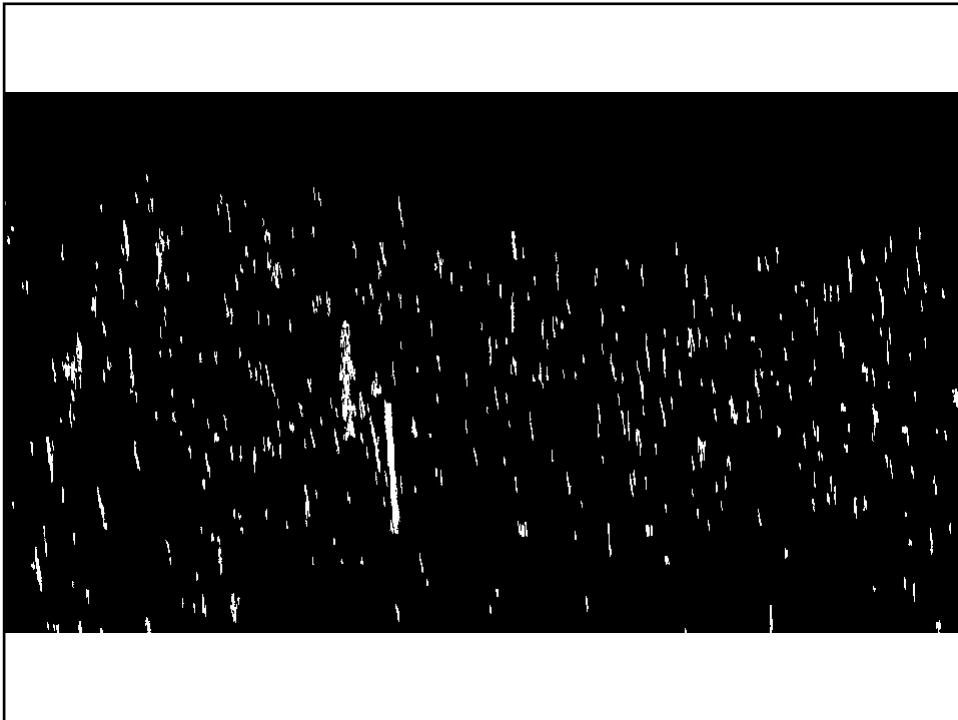
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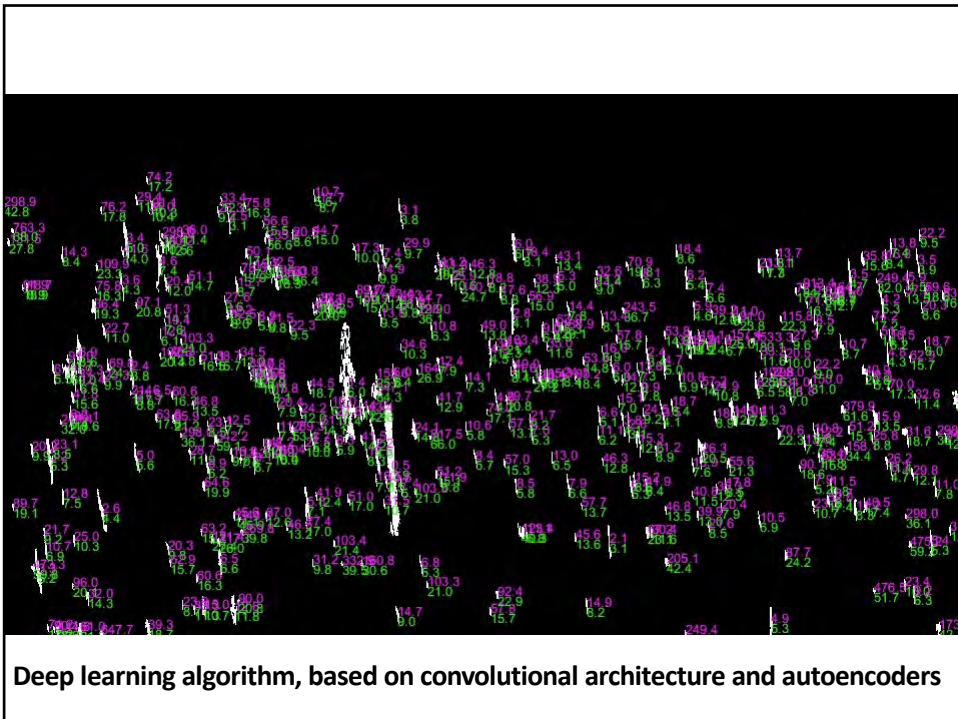
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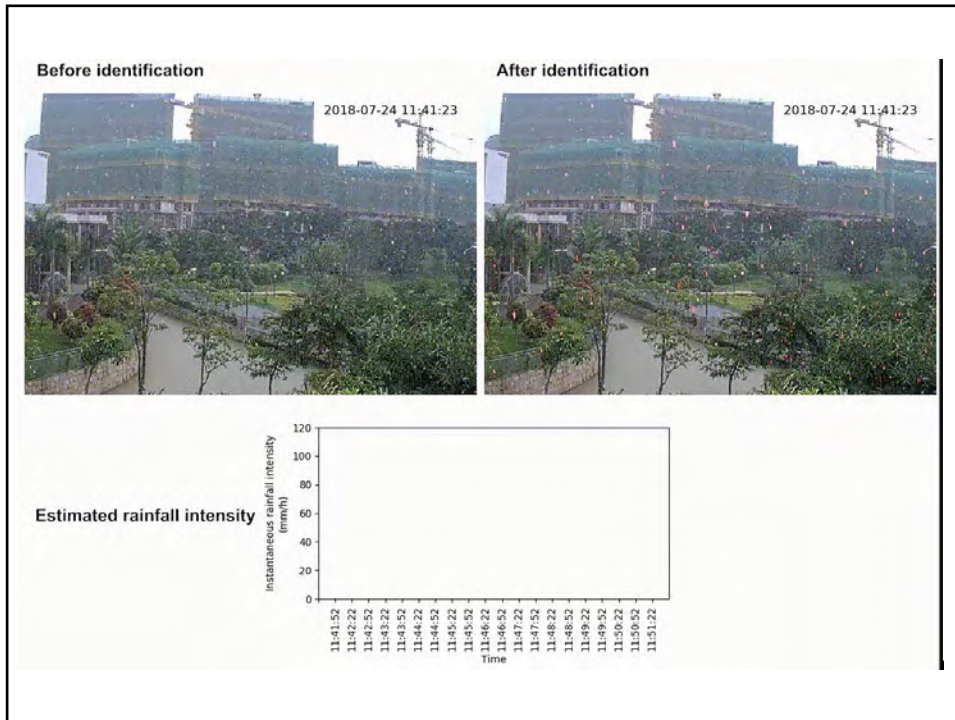
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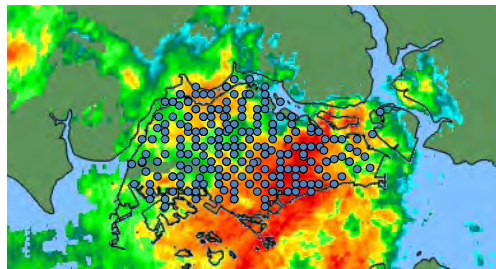


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## Rainfall is only one of many environmental variables of interest

A dense network of millions of affordable devices with real-time telemetry to capture variability

Opportunistic Sensing



Ongoing explosion in smart phones and wearables will bring even more data. At greater temporal and spatial resolution. Even more diverse environmental data. Temperature, atmospheric pressure, humidity...

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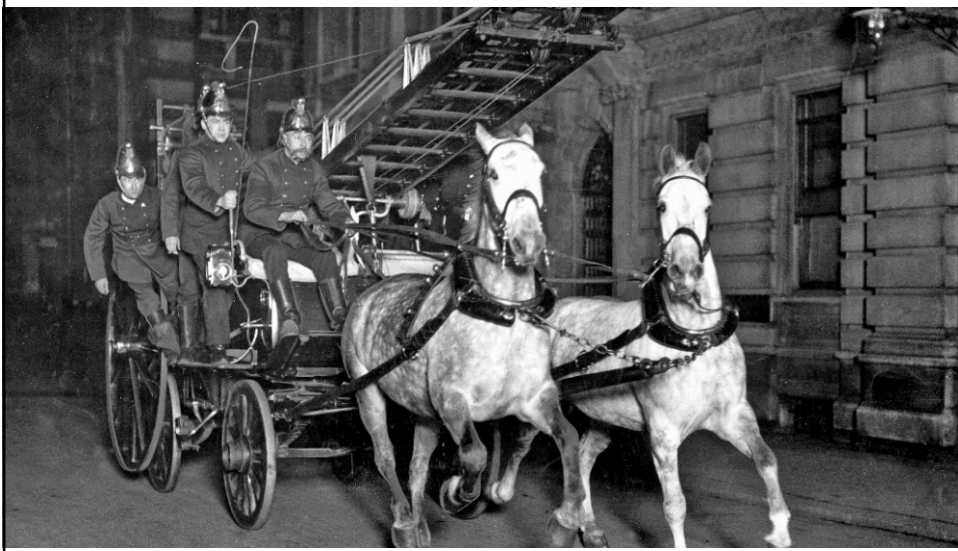
## The shift in authority?

- What was once done by humans is increasingly controlled by AI
- This is the greatest revolution of 21<sup>st</sup> century, likely since beginning of life
- For 4 billion years, all life on planet Earth was controlled by natural selection
- New era of Intelligent Design

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## Will Humans Go Way of Horses?

Wassily Leontief, 1983



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## Extended Intelligence

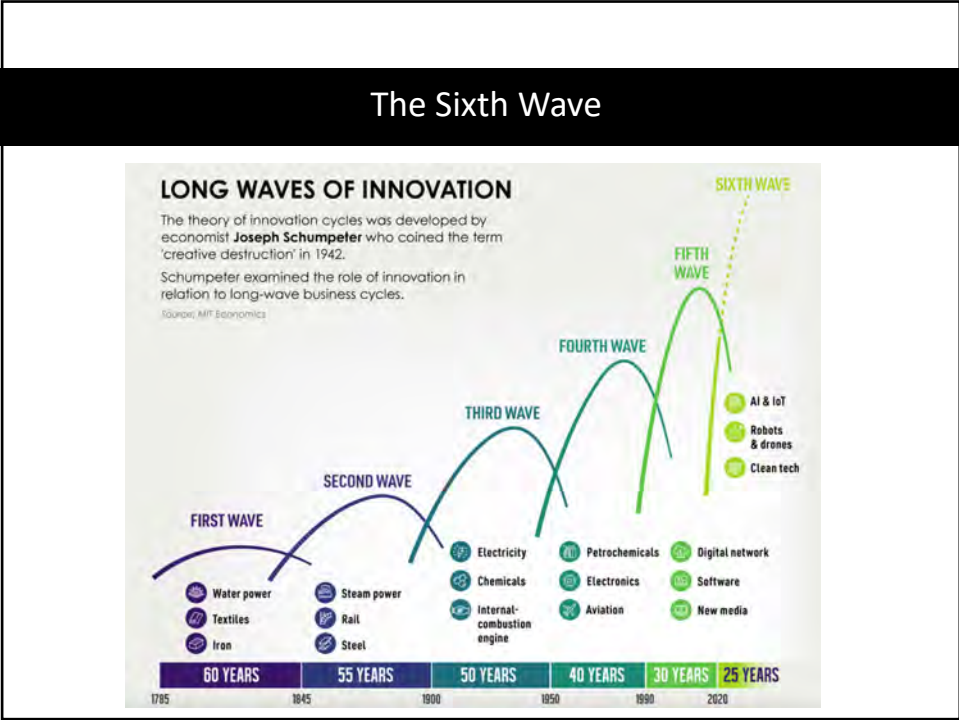
There is a deep fear that human jobs will be replaced by AI.

Rather than racing against the machines, the aim should be to show that a human-AI combination will perform better than humans and AI working alone.

No man is better than a machine for some task

No machine is better than a man with a machine

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