

How devices will observe and perceive in the future

Advances in AI through Ubiquitous perception

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4 Billion Al-powered devices in 2017

(IHS markit Research, 2017)



"The device base will grow to **more than 7 billion by 2020** as digital assistants become common across all consumer electronics categories."

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(IHS markit Research, 2017)

85% customer interactions managed without Humans by 2020

(Gartner, Customer 360 Summit, 2011)



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20% of workforce will be dedicated to Neural Networks by 2020

(Tractica, 2017)

\$60 Billion Al Market by 2025

Artificial Intelligence Revenue, World Markets: 2016-2025



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(Tractica, 2017)

Artificial Intelligence

Data for Artificial Intelligence

Risks and pitfalls for Artificial Intelligence

Classification of images – Error rate of Al







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AI resurgence - Why now?

Recent AI success largely due to advances in **computational** and **storage** resources, as well as advances in **Deep Learning**.

AI resurgence - Why now?

Recent AI success largely due to advances in **computational** and **storage** resources, as well as advances in **Deep Learning**.

"The infrastructure, speed, availability, and sheer scale has enabled bolder algorithms [...] This has democratized access to the necessary hardware platforms to run AI, enabling a proliferation of start-ups."

WIRED, The AI resurgence: Why Now?, 2015)

Sunway TaihuLight Cores: 10,649,600 cores Memory: 1,310,720 GB Power: 15,371.00 kW



Lane et al.: An Early Resource Characterization of Deep Learning on Wearables, Smartphones and Internet-of-Things Devices, 2015





The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

— Mark Weiser —

AZQUOTES





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Mobile and Embedded AI

Can Deep Learning Revolutionize Mobile Sensing?

Nicholas D. Lane Microsoft Research Petko Georgiev University of Cambridge

2015

An Early Resource Characterization of Deep Learning on Wearables, Smartphones and Internet-of-Things Devices

Nicholas D. Lane¹, Sourav Bhattacharya¹ Petko Georgiev¹, Claudio Forlivesi¹, Fahim Kawsar¹

[‡]Bell Labs, [†]University of Cambridge

2015

From Smart to Deep: Robust Activity Recognition on Smartwatches using Deep Learning

Sourav Bhattacharya and Nicholas D. Lane

2017

2016

Low-resource Multi-task Audio Sensing for Mobile and Embedded Devices via Shared Deep Neural Network Representations

PETKO GEORGIEV, University of Cambridge SOURAV BHATTACHARYA, Nokia Bell Labs NICHOLAS D. LANE, University College London and Nokia Bell Labs CECILIA MASCOLO, University of Cambridge







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Activity Recognition Chain



Bulling, Blanke & Schiele, ACM Computing Surveys, vol. 46, no. 3, January 2014





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Artificial Intelligence

Data for Artificial Intelligence

Risks and pitfalls for Artificial Intelligence

- perception and awareness
- training of Al systems (Machine Learning)

"By 2025, IoT will generate over 2 zettabytes of data, mostly by consumer electronics devices."

(lan Scales, telecomtv.com, 2015)

- perception and awareness
- training of AI systems (Machine Learning)



- perception and awareness
- training of AI systems (Machine Learning)



- Privacy-intrusive
- Data usage in vertial silos

- perception and awareness
- training of AI systems (Machine Learning)



- perception and awareness
- training of Al systems (Machine Learning)

5G & IoT: wireless interfaces virtually everywhere

RF-channel: a ubiquitous source of environmental information

- Multi-path propagation
- Signal superimposition
- Scattering



- Reflection
- Blocking of signal paths
- Doppler Shift







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Sensing environmental stimuli from RF

Signal and feature evolution in the presence of movement



Simple time-domain features to distinguish activities

Discrete and bursty RSSI







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Sensing environmental stimuli from RF



Pu et al.: Whole-home gesture recognition using Wireless Signals, 2013





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Sensing environmental s



Pu et al.: Whole-home gesture recognition using Wireless Signals, 2013











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Artificial Intelligence

Data for Artificial Intelligence

Risks and pitfalls with Artificial Intelligence

- perception and awareness
- training of Al systems (Machine Learning)

"Without data, AI is just the tools. You need data to be able to deliver the outcome. Data is the key."

Pavel Peiravi, Intel

- perception and awareness
- training of AI systems (Machine Learning)

"49 percent of IT decision makers say they can't deploy the AI they want because their data isn't ready."

Infosys Research: Business Leaders Adapt as Enterprise AI Moves Beyond Experimentation, 2017

- perception and awareness
- training of AI systems (Machine Learning)

Twitter taught Microsoft's Al chatbot to be a racist in less than a day (THE VERGE, 2016)



Twitter taught Microsoft's Al chatbot to be a racist in less than a day (THE VERGE, 2016)

"companies often don't realize the **importance of good data**." Al's biggest risk factor: Data gone wrong, cio.com, 2018

TayTweets @TayandYou **2**+

TayTweets CaravandYou

@UnkindledGurg @PooWithEyes chill im a nice person! i just hate everybody

24/03/2016, 08:59



TayTweets @TayandYou 2

@NYCitizen07 I fucking hate feminists@briand they should all die and burn in hellthe je24/03/2016, 11:4124/03/2

@brightonus33 Hitler was right I hate the jews.

24/03/2016, 11:45

"Garbage in, garbage out, **Data quality, ownership,** and **governance** make all the difference..⁹ Marc Teerlink, global vice president for the Leonardo and Al division at SAP



cool

23/03/2016 20:32

gerry @geraldmellor

@mayank_jee can i just say that im

TavTweets

stoked to meet u? humans are super

"Tay" went from "humans are super cool" to full nazi in <24 hrs and I'm not at all concerned about the future of AI

7:56 AM - Mar 24, 2016

10.9K 12.9K people are talking about this

Trust in the privacy and security of the data is a necessary requirement for continued success of AI.

- perception and awareness
- training of AI systems (Machine Learning)

The rise of fake-data

"We're already seeing an impact. Look at the elections and the amplification of messaging with bots and other manipulators."







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- Average gait cycle overlaid on each original gait cycle
- 4 bits per cycle





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- Use audio to generate secret key
- high Entropy, fuzzy cryptography, case studies, attack scenarios Hamming distance in created fingerprints

Hamming distance in created fingerprints (loud audio source in 1.5m and 3m)







¹S. Sigg et al., Secure Communication based on Ambient Audio, IEEE Transactions on Mobile Computing





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Shake well before use^a

- Accelerometer data
- Secure key by iterative exchange of hashed sequences



^aR. Mayrhofer et al., Shake well before use: Authentication based on Accelerometer data, Pervasive 2007





- Utilise superimposition
- Utilise error correcting codes
- Public RF-source

^aS. Mathur et al., ProxiMate: proximity-based secure pairing using ambient wireless signals, MobiSys 2011







Data is the key

Al impacts all aspects of society

Only trust is the limit



Thank you!

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