



Big Health Data

Deep Machine Learning

Agenda

1. Big health data is complex.
2. IT is far from reaching its full potential in healthcare.
3. Big data tools and deep machine learning will have a big impact on healthcare IT.
4. Application: Deep learning xray image scoring

Big Health Data is Complex.

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What is big data?



CISSP Googling @cissp_googling · 9. Nov. 2015
how big is big data

85 109

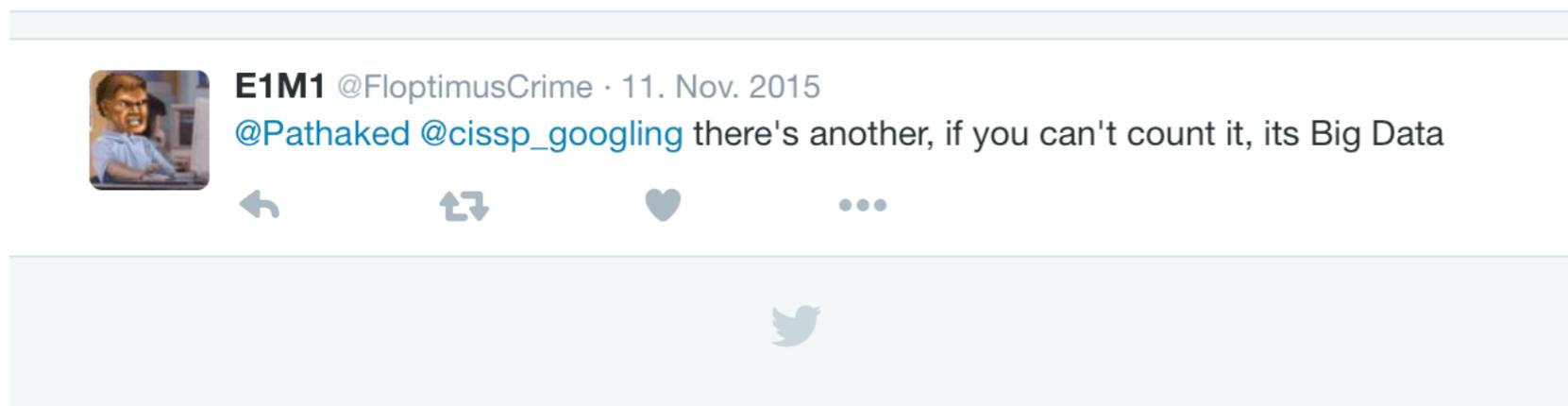


Pathaked
@Pathaked

Folgen

@cissp_googling @FLOPTIMUSCRIME Some saint once said, "Big data is simply anything that won't fit in Excel."

23:55 - 11. Nov. 2015

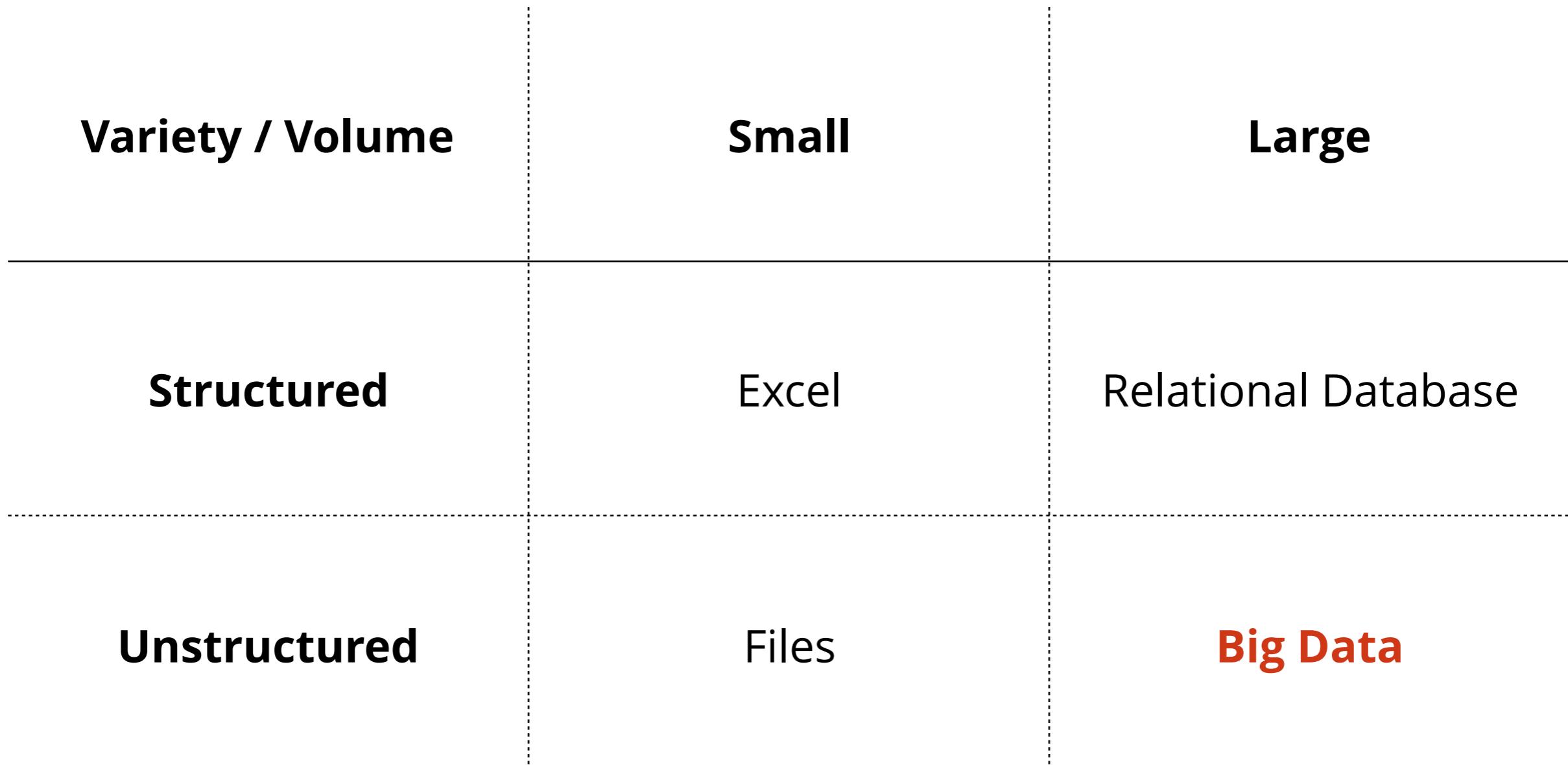


E1M1 @FLOPTIMUSCRIME · 11. Nov. 2015
@Pathaked @cissp_googling there's another, if you can't count it, its Big Data

8 10 12

[https://twitter.com/Pathaked/
status/664713086314508288](https://twitter.com/Pathaked/status/664713086314508288)

Big Data vs. Small Data



Credit Suisse Group AG

Fabian Reinhard 504745 | Abmelden
Kontakt & Support | Mein Profil | Verträge

Konto & Vermögen Zahlungen Marktdaten & Research Produktangebot Kundencenter

Einzelzahlung ändern

Zahlungen erfassen

- Einzelzahlung
- Daueraufträge
- Zahlungslisten
- LSV-Freigaben
- DTA-Freigaben

Zahlungen verwalten

- E-Rechnungen
- Filetransfer

Oranger Einzahlungsschein

Einzahlung für
Verfügbare Daten werden vom System eingefüllt.

Zugunsten von

ASSURA 1

PULLY

Konto 2

01-37897-1

Betrag 3

155.35

Währung 4

CHF Go

Referenznummer 5

10 00000 15735 13014 05909 52765

Einbezahlt von

FABIAN REINHARD, LUZERN

« Home Aktivität | English | Deutsch | Prof. Dr. med. Gregory House | Time out in 0:28:00 | Logout

Neue Medikation starten

Medikament *
Rituximab

Dosis* mg

Applikationsform

Startdatum * ~2012

Enddatum Zeitpunkt

Notizen Medikation

Speichern **Speichern & nächstes** **Abbrechen**

The interface shows a medication entry form with various input fields and buttons. The fields include:

- Medikament ***: Rituximab
- Dosis***: mg
- Applikationsform**
- Startdatum ***: ~2012
- Enddatum**: Zeitpunkt
- Notizen Medikation**

Buttons and controls include:

- Time-related buttons: morgen (2), mittag (3), nachmittag (4), abend (5), nach (6).
- Frequency buttons: Alle Tage (9), alle 2 Tage (10).
- Day-of-the-week buttons: Montag (12), Dienstag (13), Mittwoch (14), Donnerstag (15), Freitag (16), Samstag (17), Sonntag (18).
- Reason for discontinuation buttons: Mangelnde Wirksamkeit (23), Nebenwirkungen, Intoleranz, Remission, Operation.
- Other buttons: Anpassen (26), Stop (27), e Medikation starten (28), Abbrechen (29).
- Text input fields: Einheit (Einheit), Dosierung (mg), Applikationsform, Zeitpunkt.
- Form buttons at the bottom: Speichern (25), Speichern & nächstes (26), Abbrechen (27).

Einmalig am Untersuchungstag Bei Bedarf

Montag Dienstag Mittwoch Donnerstag Fre

Startdatum *

~2012



Enddatum

Zeitpunkt

Abbruchgrund

Ungenügende Wirksamkeit Nebenwirkungen Intoleran

Schwangerschaft



Notizen Medikation





12854400 tcaaagtaagttagataaaacatgatcattcacaggtcagatgtttaaaaaaa
tggactaccagaattgagttaccttagtacttctcaattcttattttaccctaace
12854200 tagaaaaagttaatgttacggcccaatcacttttaacagccaaacaacat
attgtccactcaaaacgtgacaaatggaggctaaaggagaccataacttgact
12854000 cttgtaaatgttattcacatttcattccaaagaaaaatagactgtgaagaaaata
aggtttagggtctcaatataaacacacaaagcagatagaagaagcaaaaccatt
12853800 TCTTTCTTCATCGTCTTCCAACCTTCACGTTCTCCACCTTATTGTTCA
tcacttattgggtttcaattgtgaaacagAGTTCAATTGGGAGTCATGC
12853600 ACATAGCCAACGCTGGAATCACTCATCTTGCTCCTCCTCTCAATCC
taccaatcttgttactcacfcaatcttcattcctcagGTTACTTACCGGGAAAC
12853400 AATCGTTAATCAAAGCGTTGAATCAAAAAAGGAATAAAAGCTTGGCTGATATAAC
CTGTTATTCGAAGGTGGACTTCCGATGATCGTCTGATTGGATCCTCCTT
12853200 ACCGGAGGAGATTTGATGGAGGCCCGACATCGACCACCTTAACCCCTAGAGTT
GATTCCATGGTTGGAGATTGATTGTTCTCGAGGTTATGCATCTCCATCACCA
12853000 aacagtatttagtatataagaacatagggtgagataattattactattat
ataagaaacataagtcaatgcaatcaataagaaatataagaagttcacta
12852800 ACCGGATTTCGCGGTGGGTGAGAAATGGGACGATATGAAGTACGGAGGAGACG
TGGATCGAGGAAGCGGGTGGTGTGTTGACAGCTTGATTTCACCAACCA
12852600 ACTCGCAGGGAAAACCGCCTGGTATGATAGGAATCATGCCCGGAAACGCTGTC
TGATAAAAGTCTGCTTGGATACGTTATATACTCATCCAGGAACCTT
12852400 aatcttggatatgttattttgttcagTTTATAATCATTACATAGAATG
ATGGGATTGGTAGCACAAGCTCTGTAACGATAAAAGCGGCAGAGGCGGATCTC
12852200 GCAAGATGTGGGAACACTTGTCTTCTAATTGCTTAGCTTATTAGGCC
agaaaaagtaatcgaaatgtatcttcttcatttttaataaaaacattttggcagt
12852000 taaaaagagcactagtgggtgttaaaggataacaactccagtgaaagaaaaagag
catcggtttgtttgtgcataacaactaatatattatattggccgactcgta
12851800 cacaatactgccaaaatcagaacgaatttatattttagaagaagaaaaaaa



IT is far from reaching its full potential in healthcare.

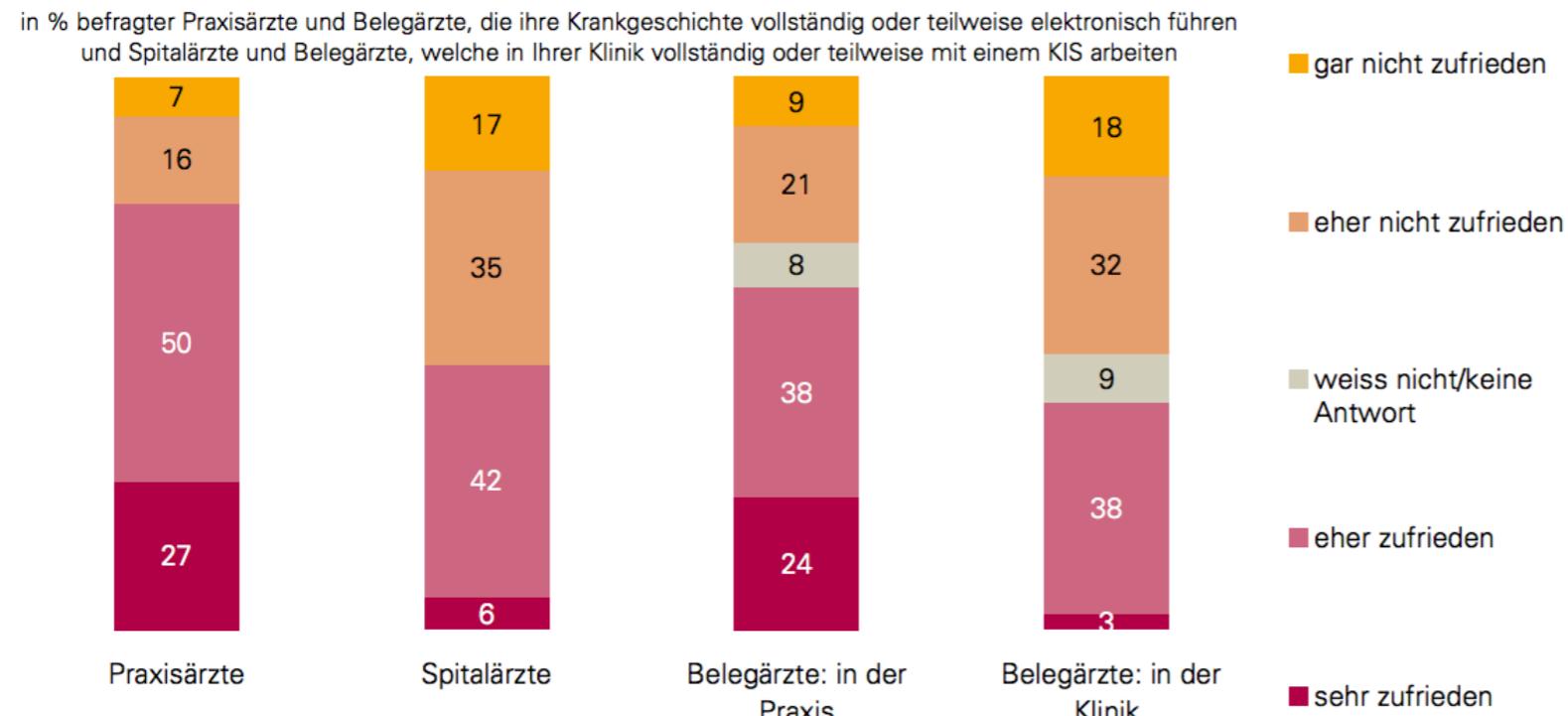
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Clinicians Disappointed by IT

Grafik 23

Filter Vergleich Beurteilung eKG / KIS*: Praxisärzte, Spitalärzte und Belegärzte

"Wie beurteilen Sie Ihre elektronische Krankengeschichte/ die elektronische Dokumentation Ihres Spitals heute? Sind Sie damit sehr zufrieden, eher zufrieden, eher nicht zufrieden oder gar nicht zufrieden."

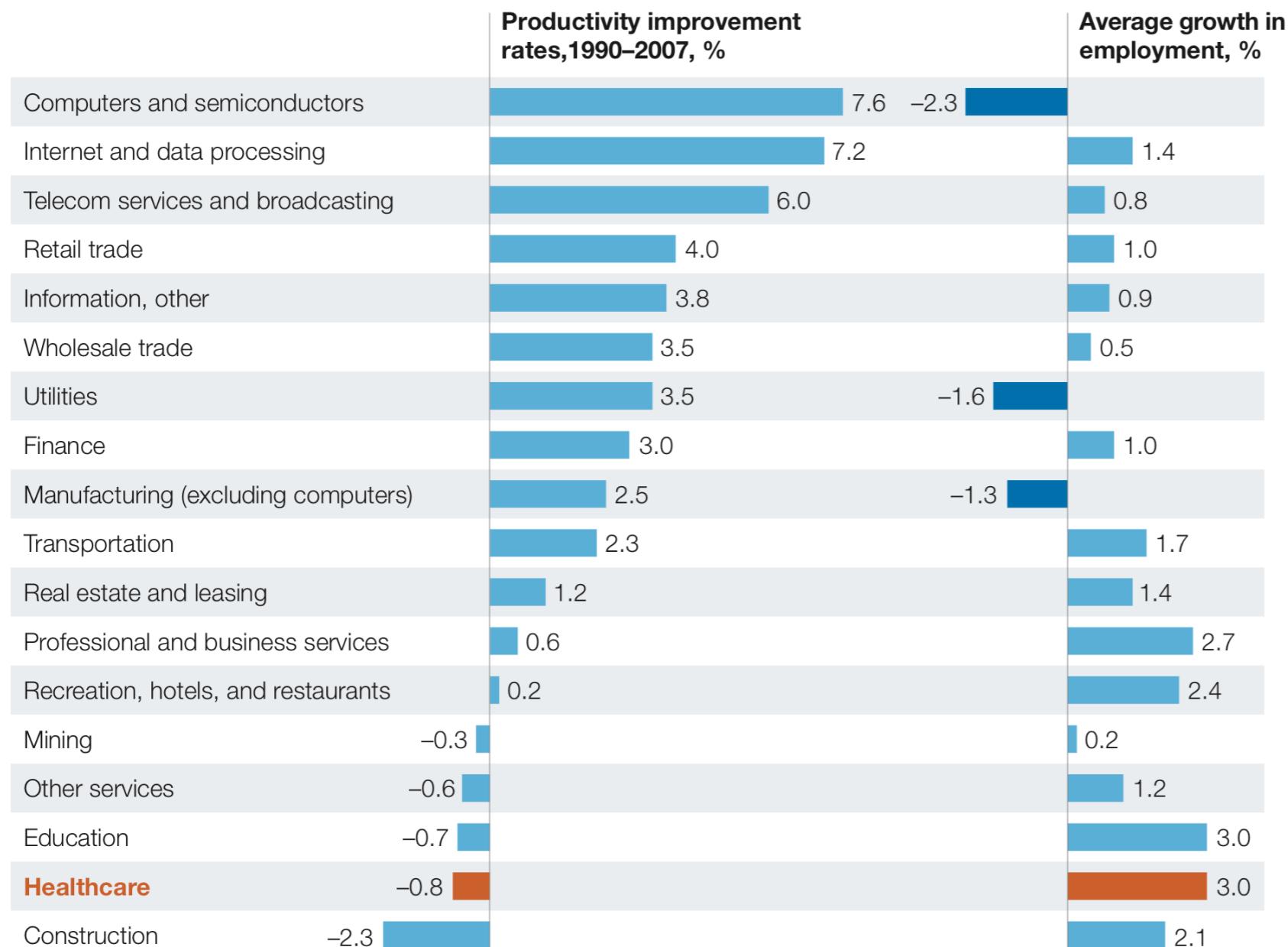


© gfs.bern, Swiss eHealth Barometer im Auftrag der InfoSocietyDays 2013, Zielgruppe Praxisärzte, Spitalärzte, Belegärzte, Januar / Februar 2013 (n Praxisärzte = 153, n Spitalärzte = 194, n Belegärzte: in der Praxis = 34, n Belegärzte: in der Klinik= 34) *eKG = elektronische Krankengeschichte / KIS = Klinikinformationssystem

> 50 % of clinicians are not happy with their clinical information system.

Swiss eHealth Barometer

Productivity Healthcare (USA)



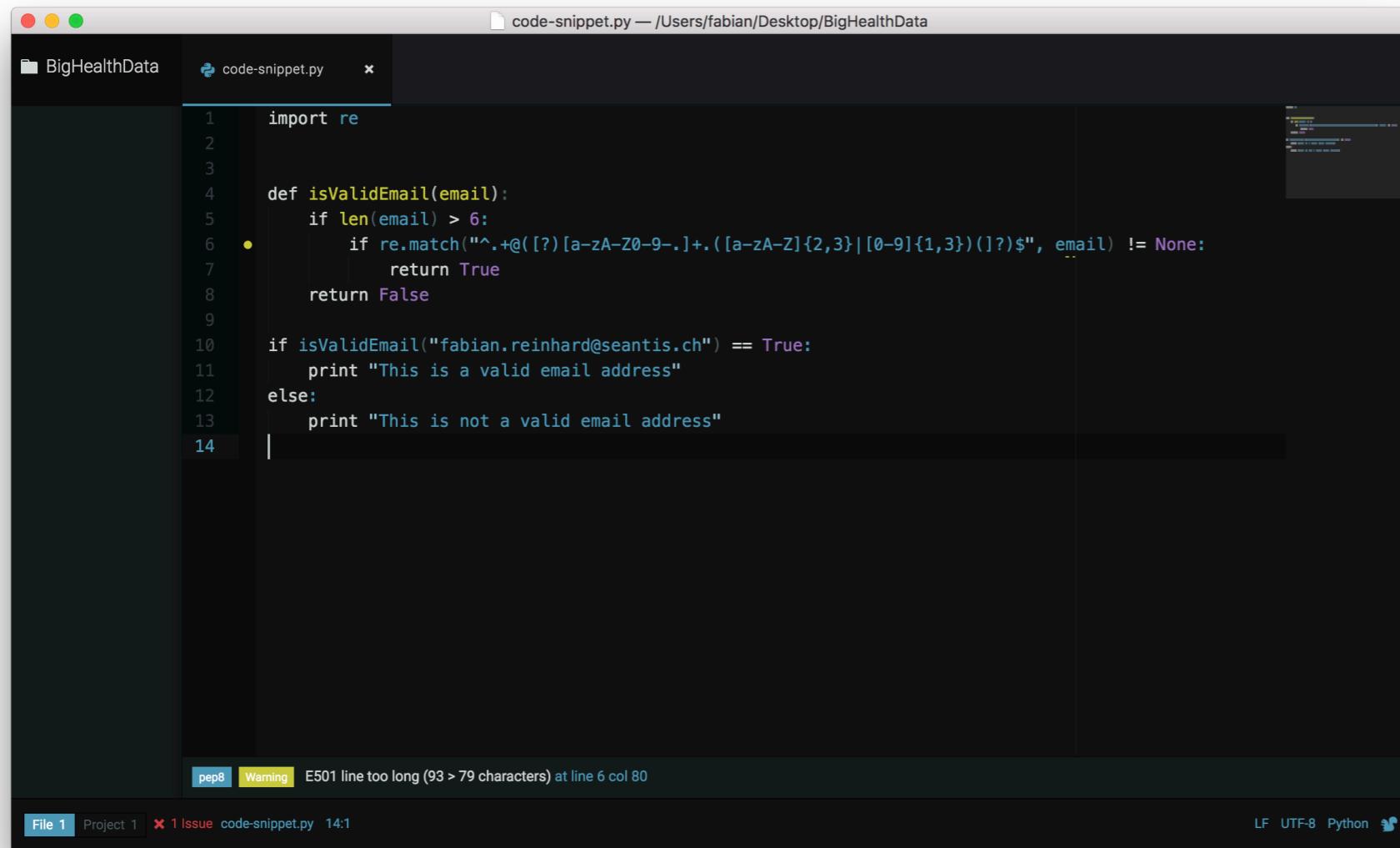
Source: Bureau of Economic Analysis; Centers for Medicare and Medicaid Services; Haver Analytics; McKinsey analysis

McKinsey Analysis (2012)

Garbage in - garbage out



Computers are exacting...



A screenshot of a code editor window titled "code-snippet.py — /Users/fabian/Desktop/BigHealthData". The code defines a function to validate email addresses using regular expressions. A pep8 warning is shown at the bottom: "Warning E501 line too long (93 > 79 characters) at line 6 col 80".

```
import re

def isValidEmail(email):
    if len(email) > 6:
        if re.match("^.+@[?][a-zA-Z0-9-.]+.[a-zA-Z]{2,3}|[0-9]{1,3}()?$", email) != None:
            return True
        return False

if isValidEmail("fabian.reinhard@seantis.ch") == True:
    print "This is a valid email address"
else:
    print "This is not a valid email address"
```

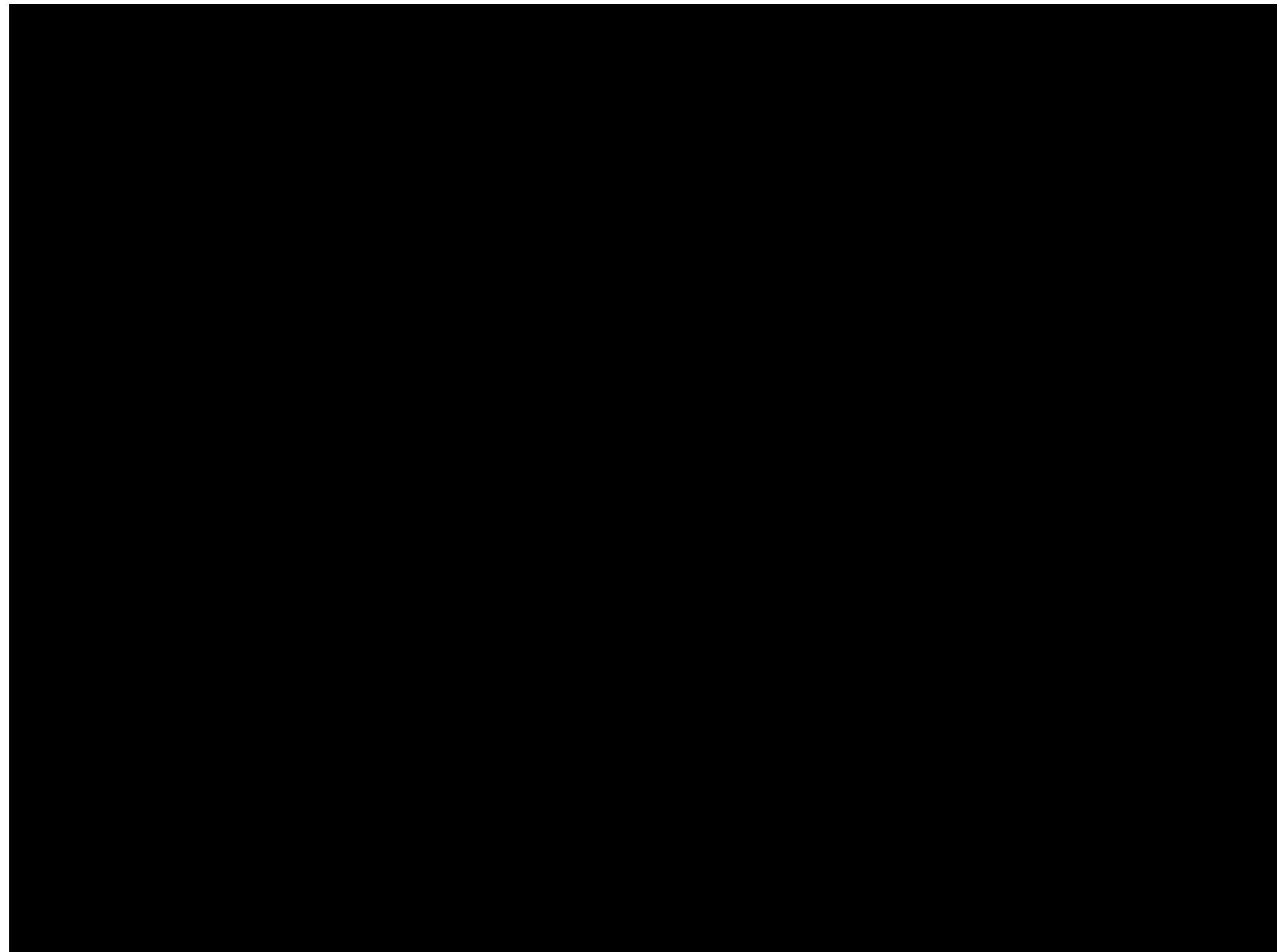
they will do exactly what you program them to do, nothing more, nothing less.

<https://www.quora.com/Why-is-programming-so-hard-1>

Big data tools and deep
machine learning will have a
big impact on healthcare IT.

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DARPA Grand Challenge



DARPA 2004

Mojave Desert
0 Finishers

DARPA 2005

5 Finishers

DARPA 2007

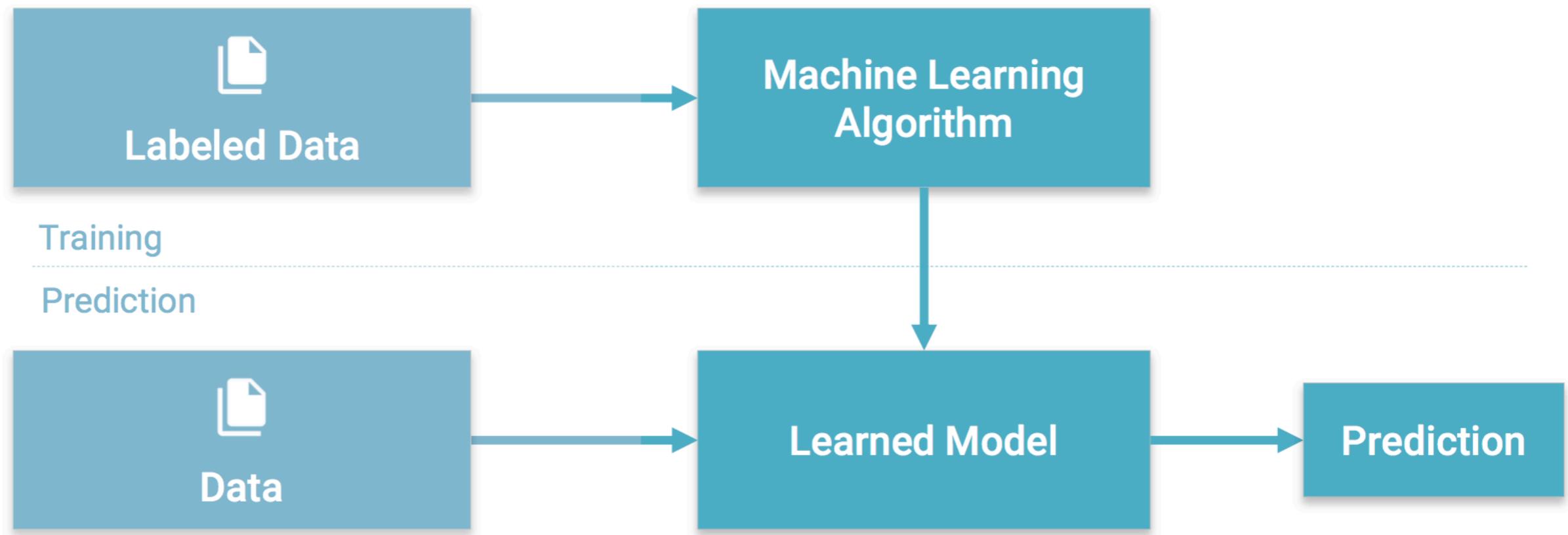
Urban Challenge: traffic regulations, traffic

Tesla 2016

First fatal crash after 130m miles (average 94m miles)

Pattern-Recognition Machines

Machine Learning is a type of Artificial Intelligence that provides computers with the ability to **learn without being explicitly programmed**.





ANTI FRAUD

Palantir Anti-Fraud enables commercial enterprises and government organizations to detect and eliminate sophisticated criminal activity, including credit card busts, money laundering, check kiting, mortgage fraud, tax fraud, tax evasion, and synthetic identity fraud.



Application: Deep learning xray image scoring

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Rheumatoid Arthritis: Joint Erosions

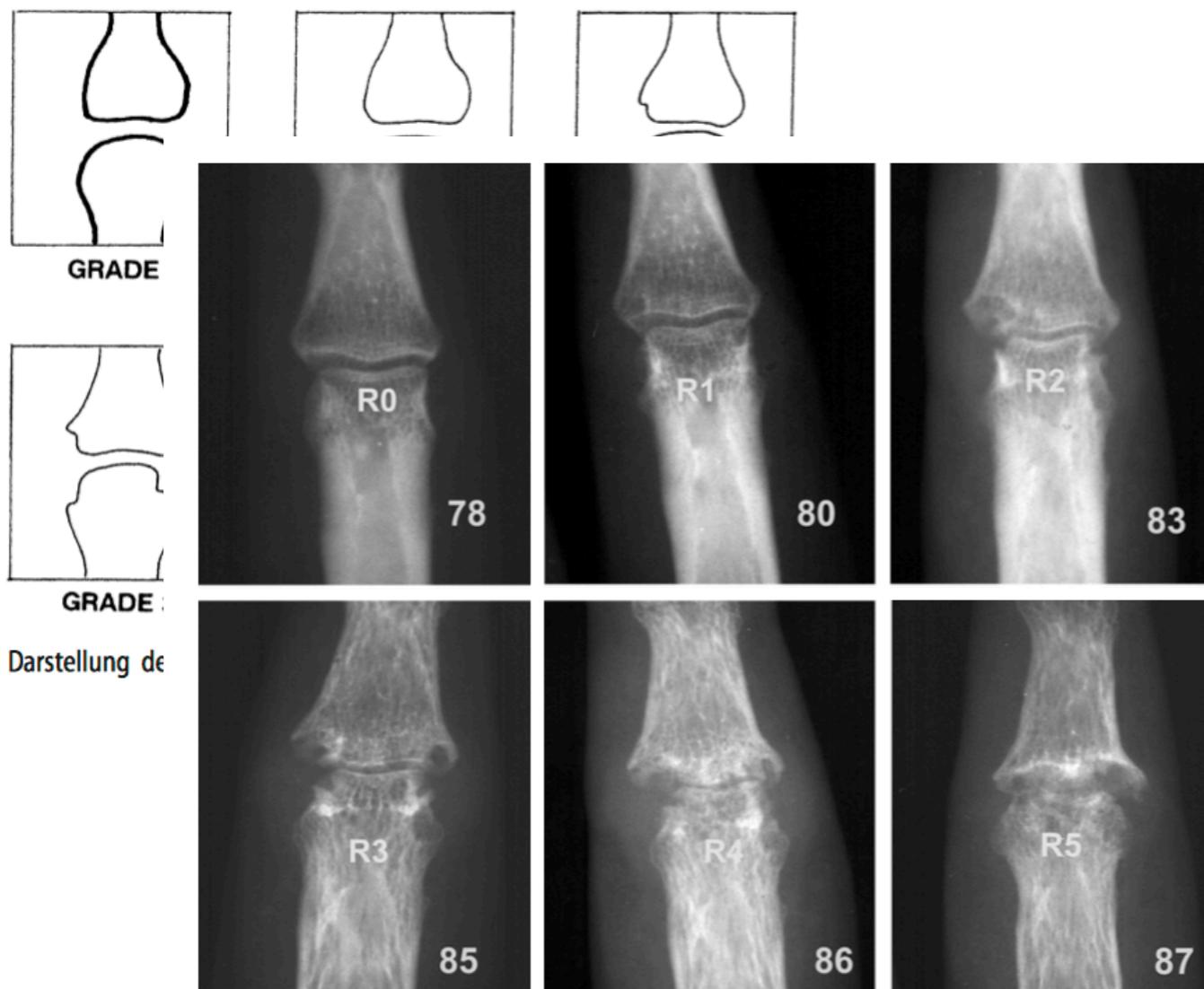
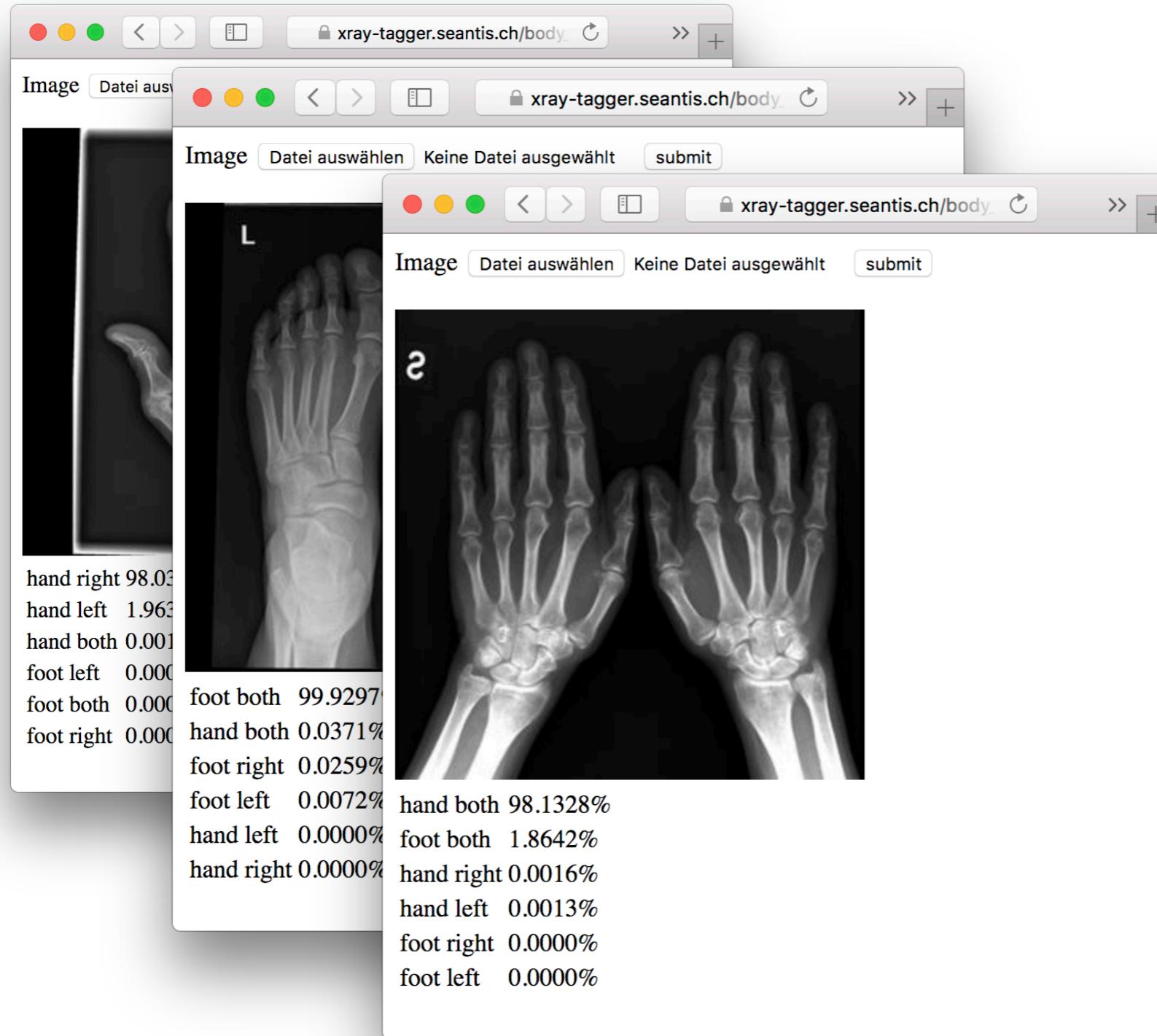


Abb. 2.2. Schematische Darstellung der Modifikation [13]

Abb. 2.5. Beispiele von Röntgenbildern des PIP-Gelenks III der gleichen Patientin (E, I) in den verschiedenen Stadien des Ratingen-Scores

R. Rau, S. Wassenberg 2007:
Scoringmethoden bei der
rheumatoide Arthritis
[http://dgrh.de/fileadmin/media/
Die_DGRH/Publikationen/
Bildgebende_Verfahren/
KAPITEL02.pdf](http://dgrh.de/fileadmin/media/ Die_DGRH/Publikationen/Bildgebende_Verfahren/KAPITEL02.pdf)

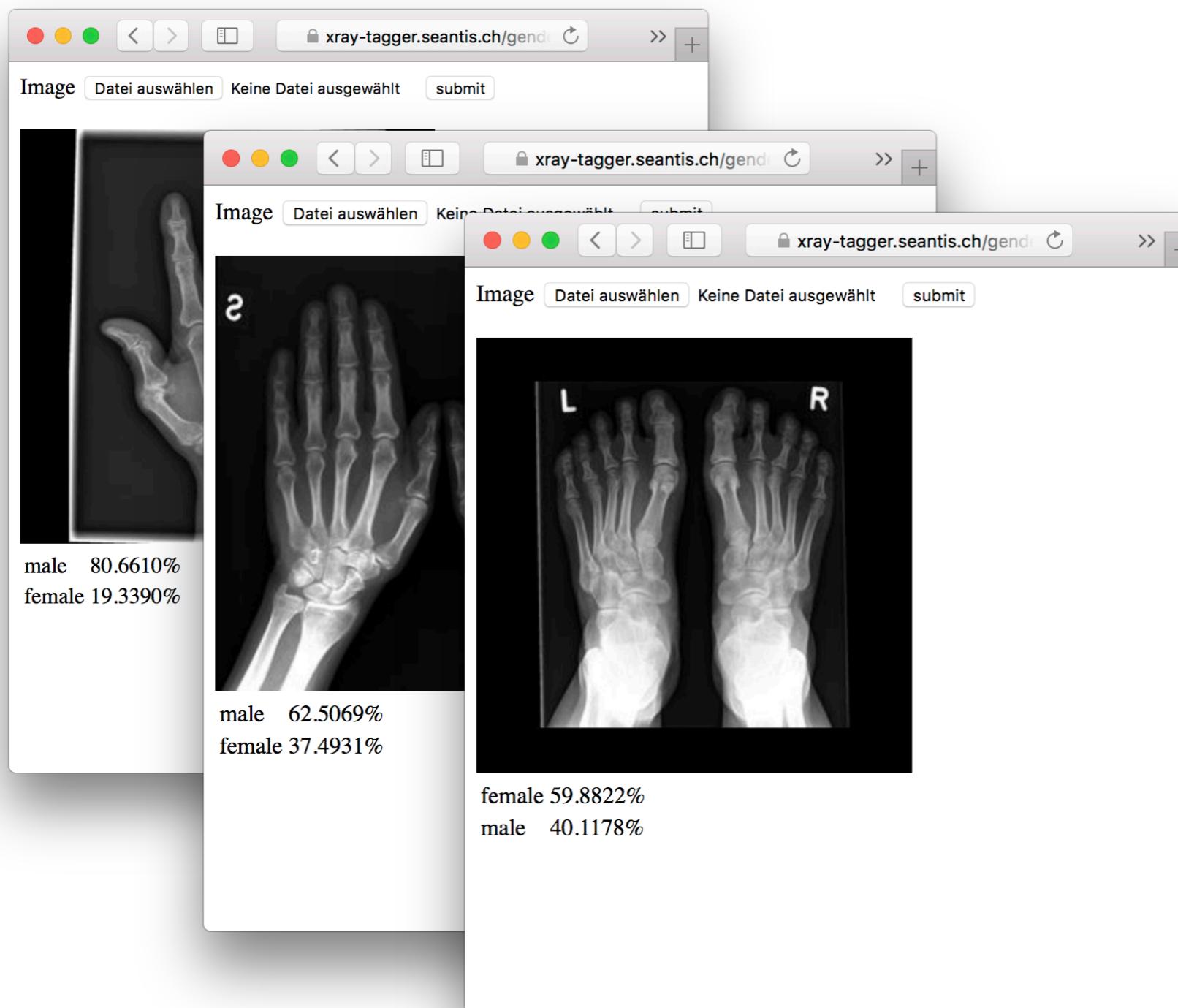
Body Part Classification



Hands and feet left and right

Current test accuracy:
93.4%

Patient Sex Classification



Hands and feet

Current test accuracy:
75.2%



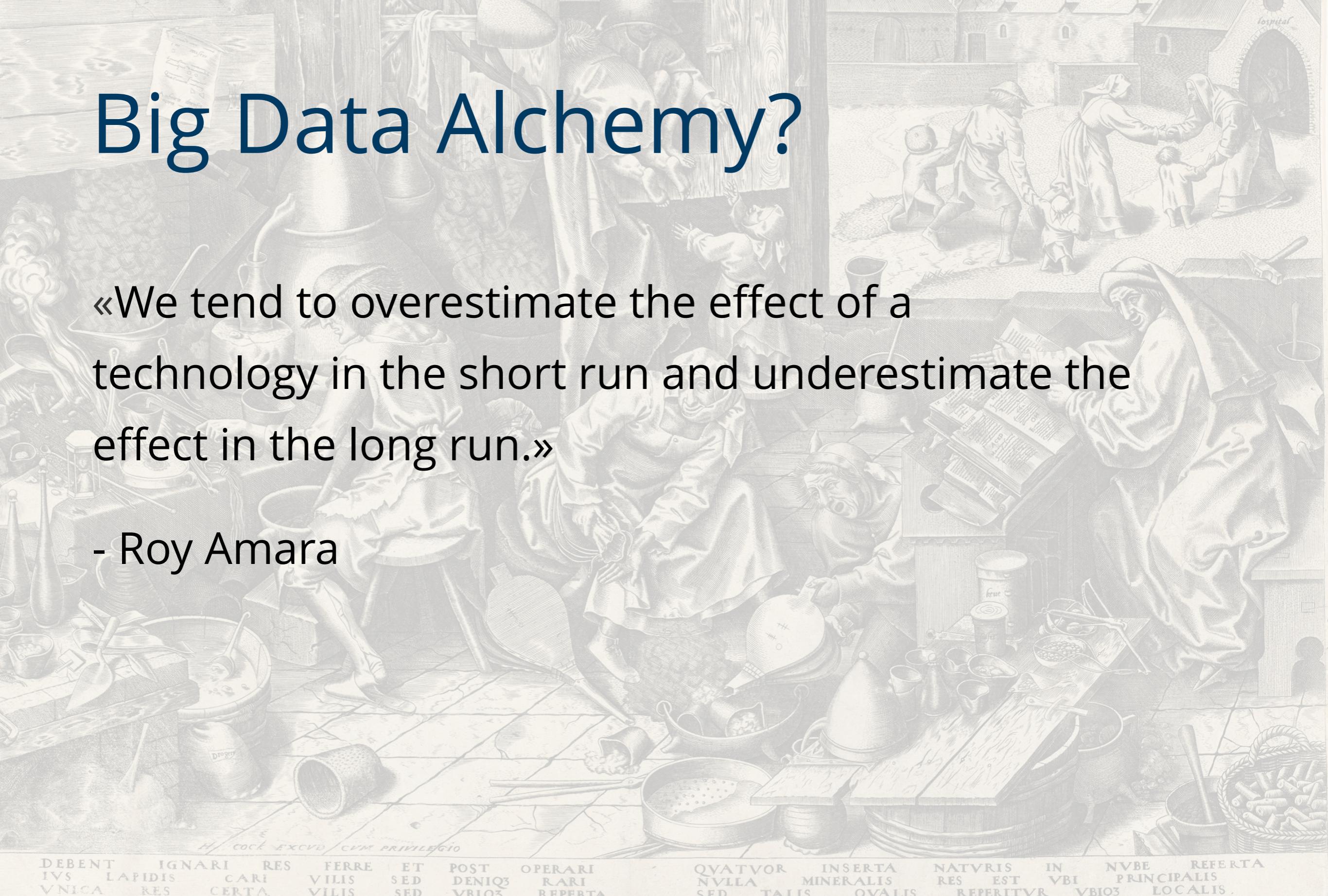
Garbage in - gold out



Big Data Alchemy?

«We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.»

- Roy Amara



Thank you!

Questions?

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