

# De waarde van data & algoritmes in de zorg

Sandjai Bhulai  
Vrije Universiteit Amsterdam

s.bhulai@vu.nl  
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VRIJ  
UNIVERSITEIT  
AMSTERDAM

Faculty of Science

# Even voorstellen



1998	Doctoraal in Bedrijfskunde & Informatica en Wiskunde
2002	Promotie in Operations Research
2002	Lucent Technologies, New Jersey, USA
2003	Vrije Universiteit Amsterdam
2016	Hoogleraar Business Analytics

- Research / Onderwijs:

- > Decision making under uncertainty
- > Control of complex high-dimensional systems
- > Predictive modeling
- > Machine learning
- > Artificial intelligence



- Door de jaren heen:

20+ consultancy projecten, 20+ R&D projecten,  
30+ PhD studenten, 100+ M.Sc. studenten



# De waarde van data

Masterclass de waarde van data & algoritmes in de zorg

# De waarde van data



06 december 2021 03:03

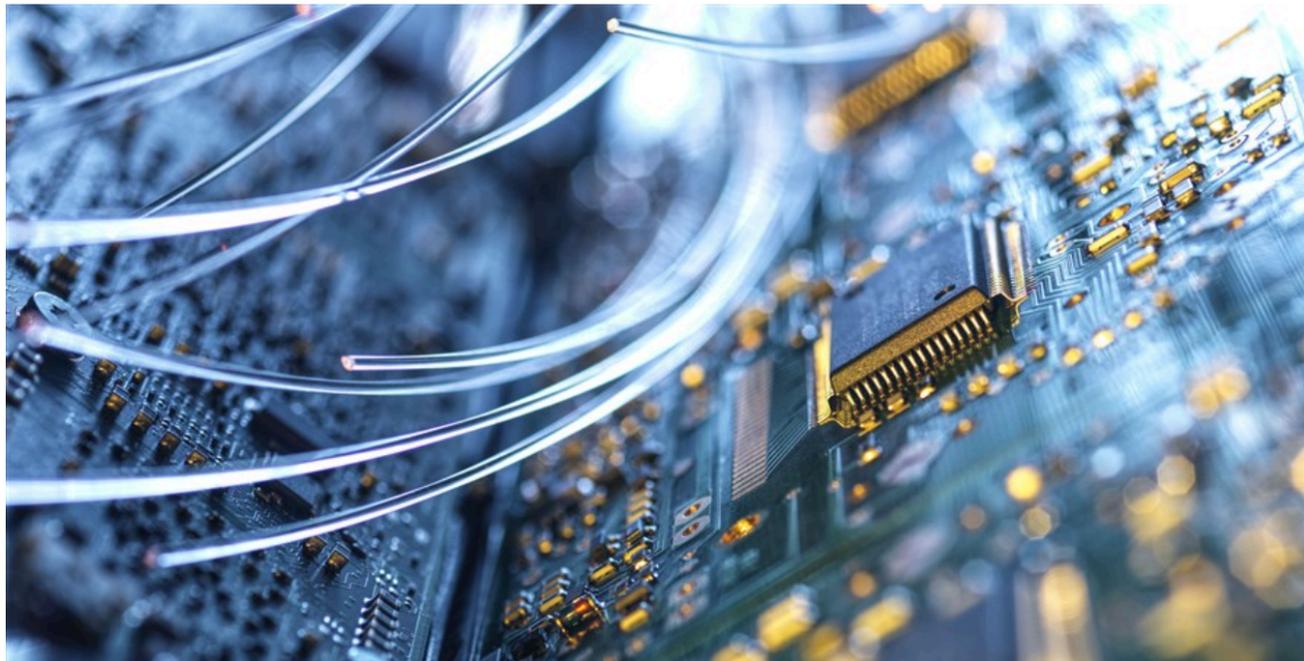
Laatste update: 06 december 2021 08:00



# De waarde van data

## CBS onderzoekt de waarde van data

12-1-2021 10:00 / Auteur: Masja de Ree



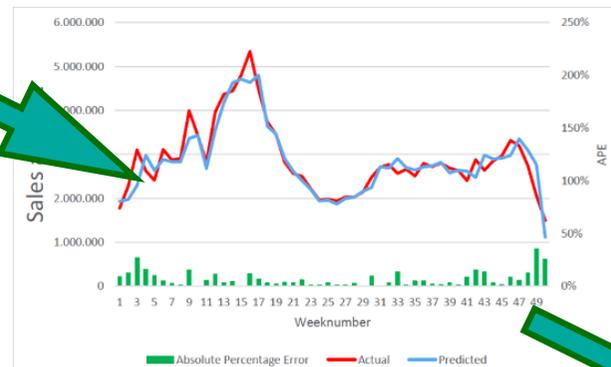
© Hollandse Hoogte / Westend61 GmbH

# De waarde van data

**data**



**inzichten en  
voorspellingen**

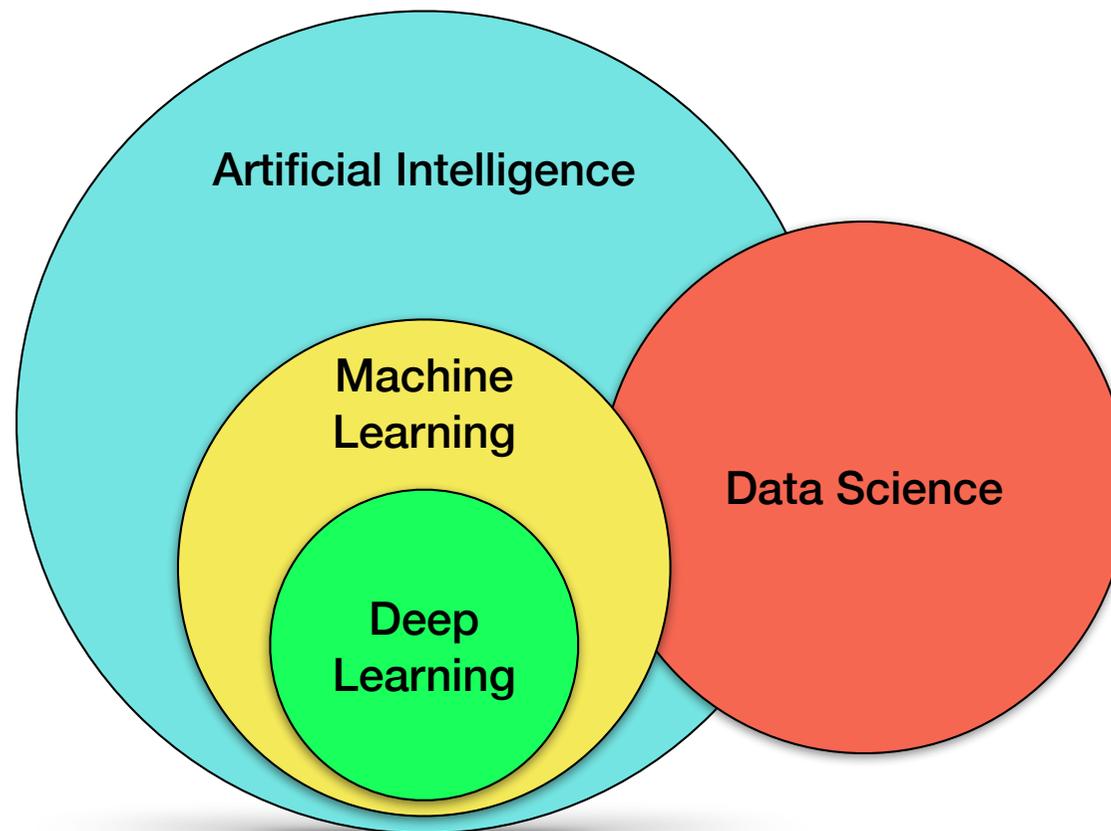


- Data mining
- Machine learning
- Neurale netwerken
- Artificial intelligence
- Predictive analytics
- Statistiek

**Optimalisatie**



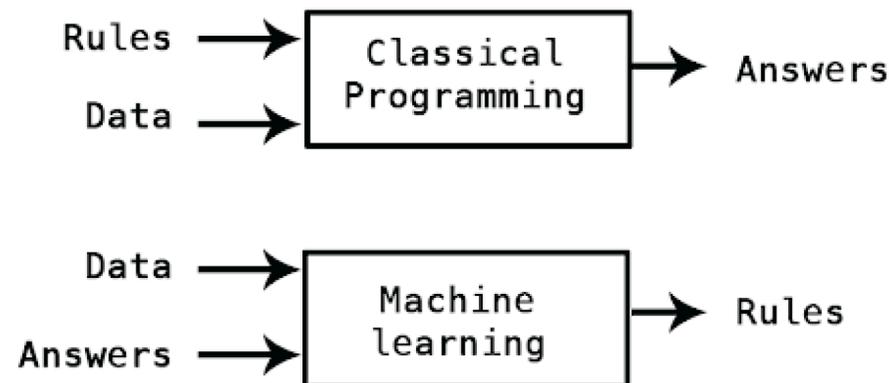
# De jungle van jargon



# De jungle van jargon

## What is machine learning?

- Machine learning is essentially a form of applied statistics with increased emphasis on the use of computers to statistically estimate complicated functions and a decreased emphasis on providing confidence intervals around these functions



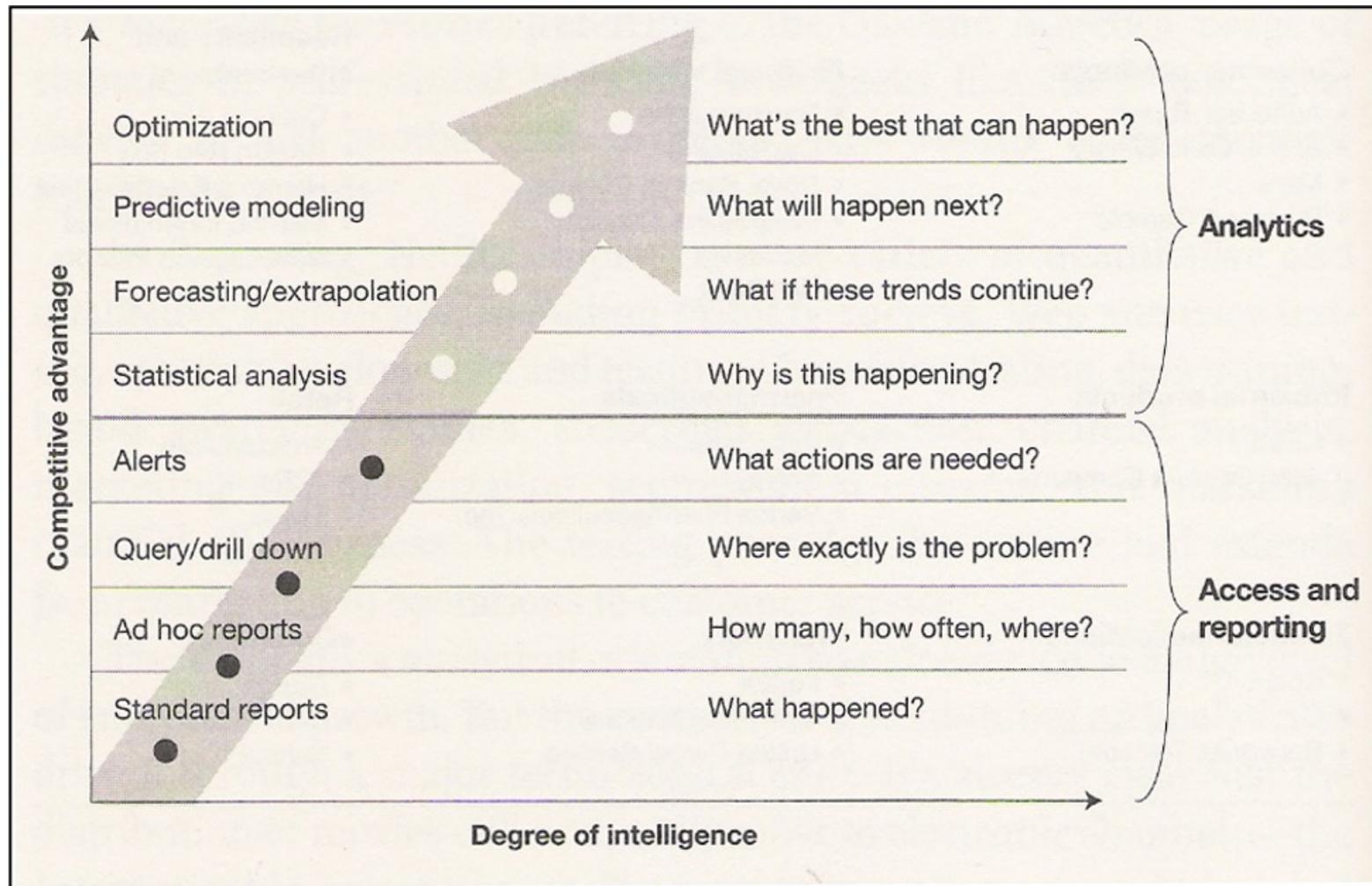
# De jungle van jargon

## What is artificial intelligence?

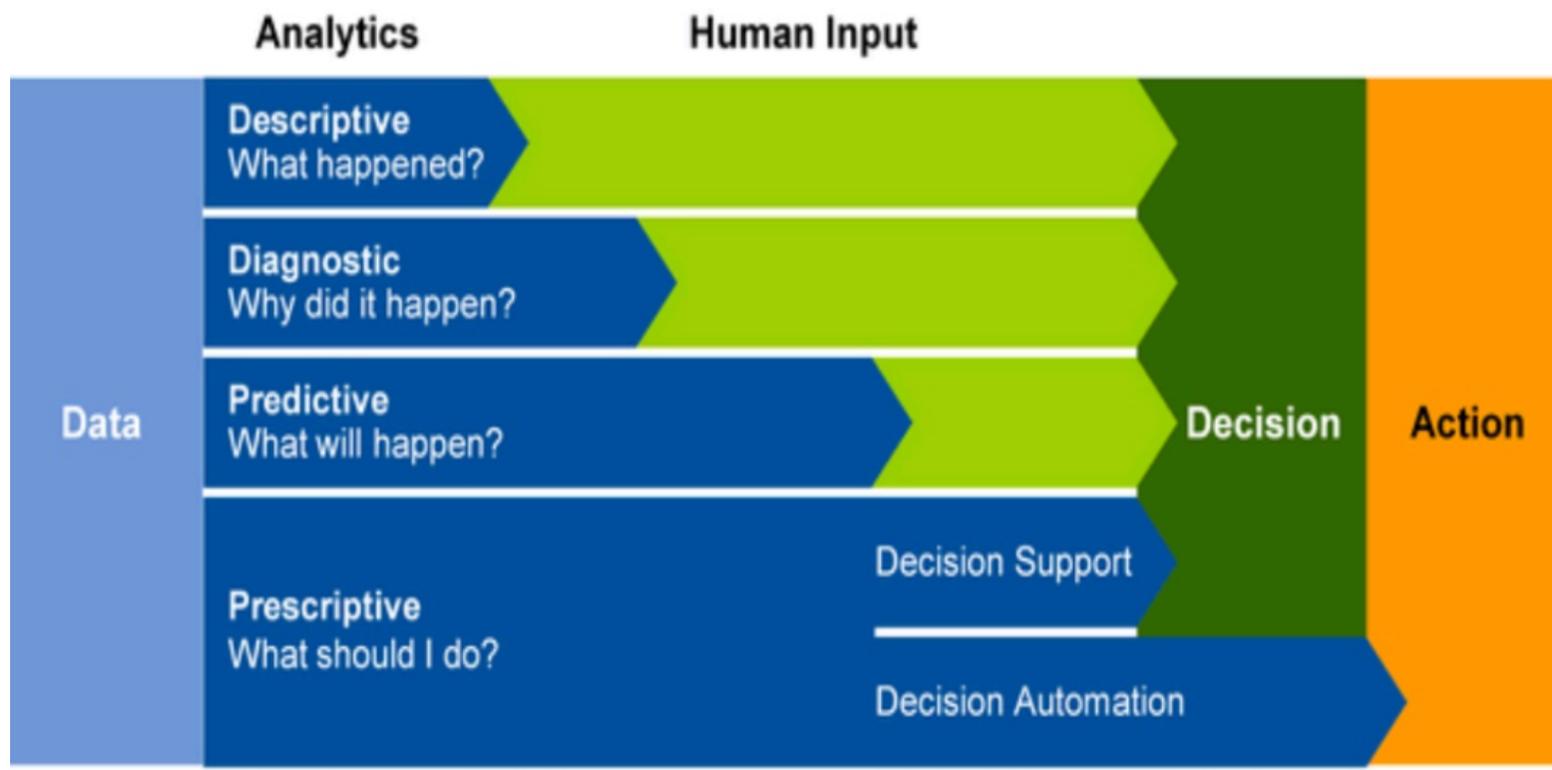
- Any task performed by a program or a machine that, if a human carried out the same activity, we would say the human had to apply intelligence to accomplish the task



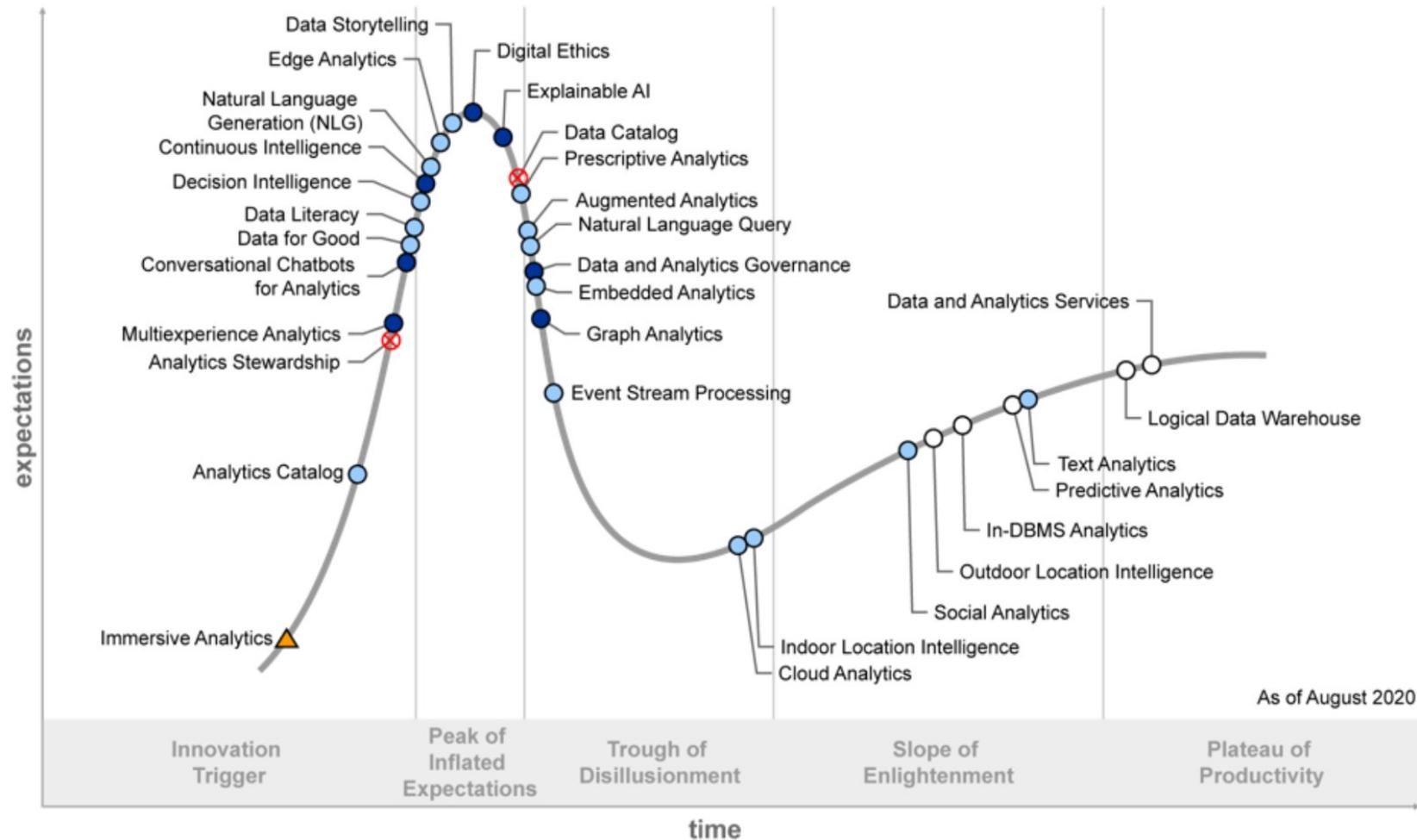
# De jungle van jargon



# De jungle van jargon



# De jungle van jargon



Plateau will be reached:

- less than 2 years
- 2 to 5 years
- 5 to 10 years
- ▲ more than 10 years
- ⊗ obsolete before plateau

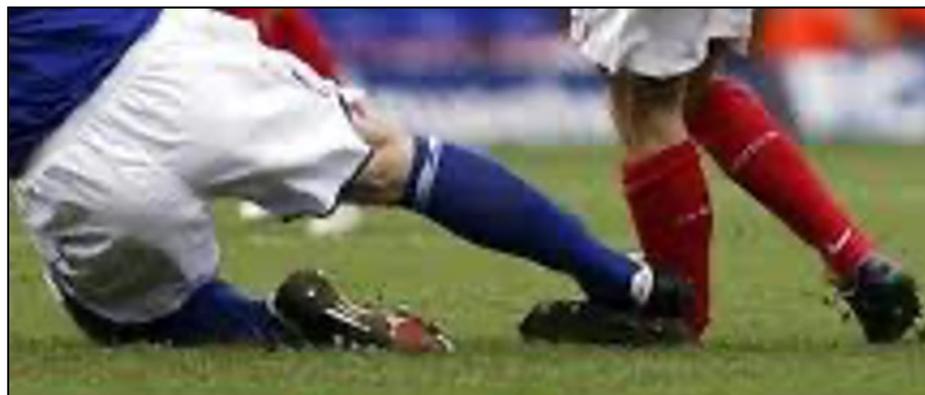
# Algoritmes in de zorg

Masterclass de waarde van data & algoritmes in de zorg

# Ambulancezorg



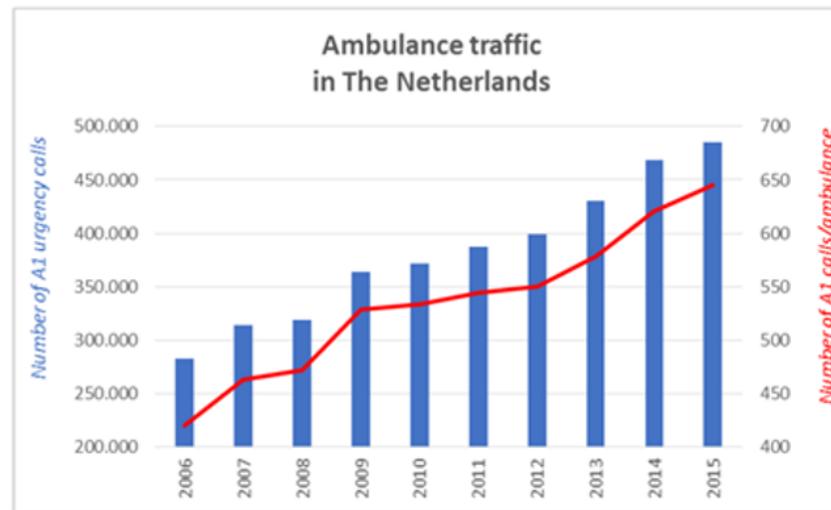
# Ambulancezorg in NL



- **A1-ritten:** Urgent en levensbedreigend < 15 min
- **A2-calls:** Urgent en levensbedreigend < 30 min
- **B-calls:** Gepland transport

**Prestatienorm:** 95% van A1-ritten op tijd

# Ambulancezorg in NL



- Feiten:
  - > 1.000.000 meldingen per jaar, waarvan 500.000 A1-ritten
  - > 35.000 keer (7%) te laat
  - > Groeiende zorgvraag

**Nieuw concept**

Dynamic Ambulance Management: proactieve relocaties

# Dynamisch ambulance management



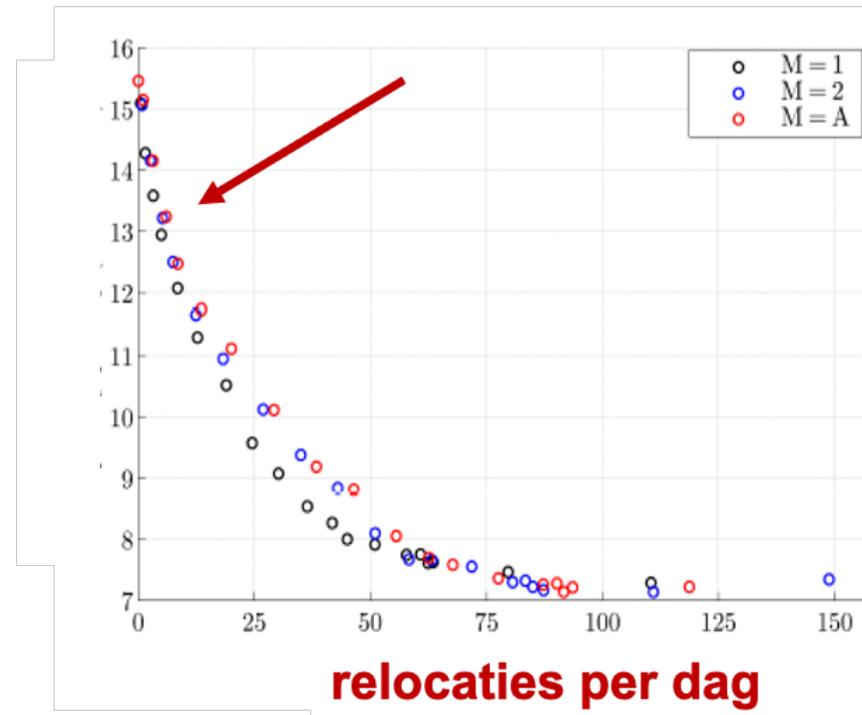


# Dynamisch ambulance management



# Dynamisch ambulance management

**% te laat**



**Goed nieuws:**  
Slechts enkele relocaties per dag nodig (“80/20-regel”)

# Dynamisch ambulance management



# Ouderenzorg



# Uitdagingen in acute ouderenzorg

## DE UITDAGINGEN IN ACUTE OUDERENZORG IN DE KOMENDE 10 JAAR

1.300.000 ouderen van 75+

2018



2.100.000 ouderen van 75+

2030



+60%

Op elke oudere 4 werkenden



Op elke oudere 2 werkenden



-50%

800.000 ouderen bezoeken jaarlijks de SEH



1.100.000 ouderen bezoeken jaarlijks de SEH



+40%

280.000 ouderen jaarlijks acuut opgenomen



390.000 ouderen jaarlijks acuut opgenomen



+40%

# Uitdagingen in acute ouderenzorg



**incident**



**overload**



**heupoperatie  
(14 dagen)**



**verzorgingstehuis**

Aankomst in  
systeem (thuis)

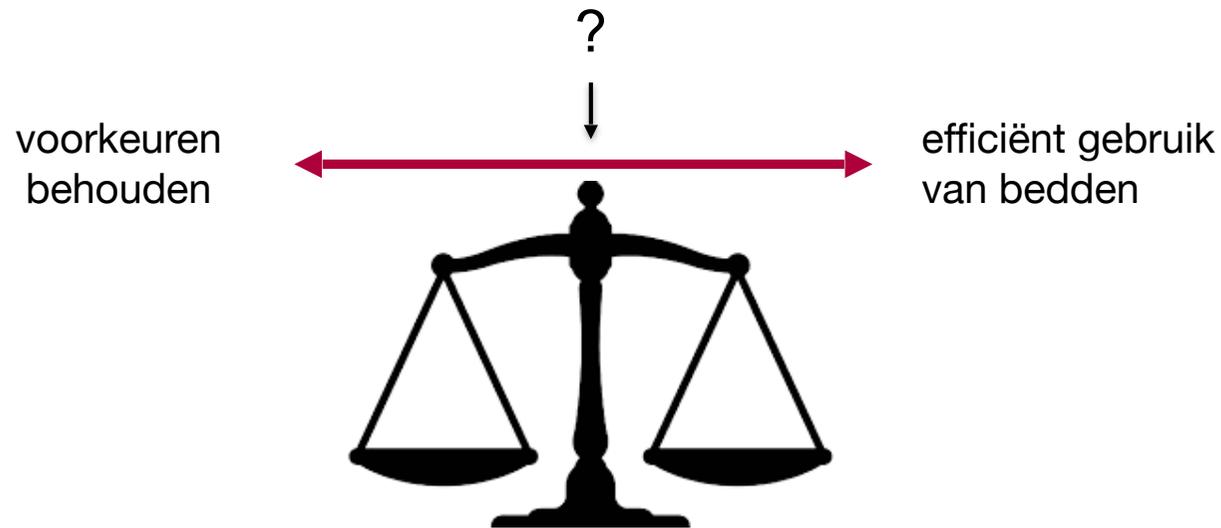
Plaatsing in  
tijdelijk  
verpleeghuis

Plaatsing in  
voorkeurs-  
verpleeghuis

Overlijden

tijd

# Uitdagingen in acute ouderenzorg

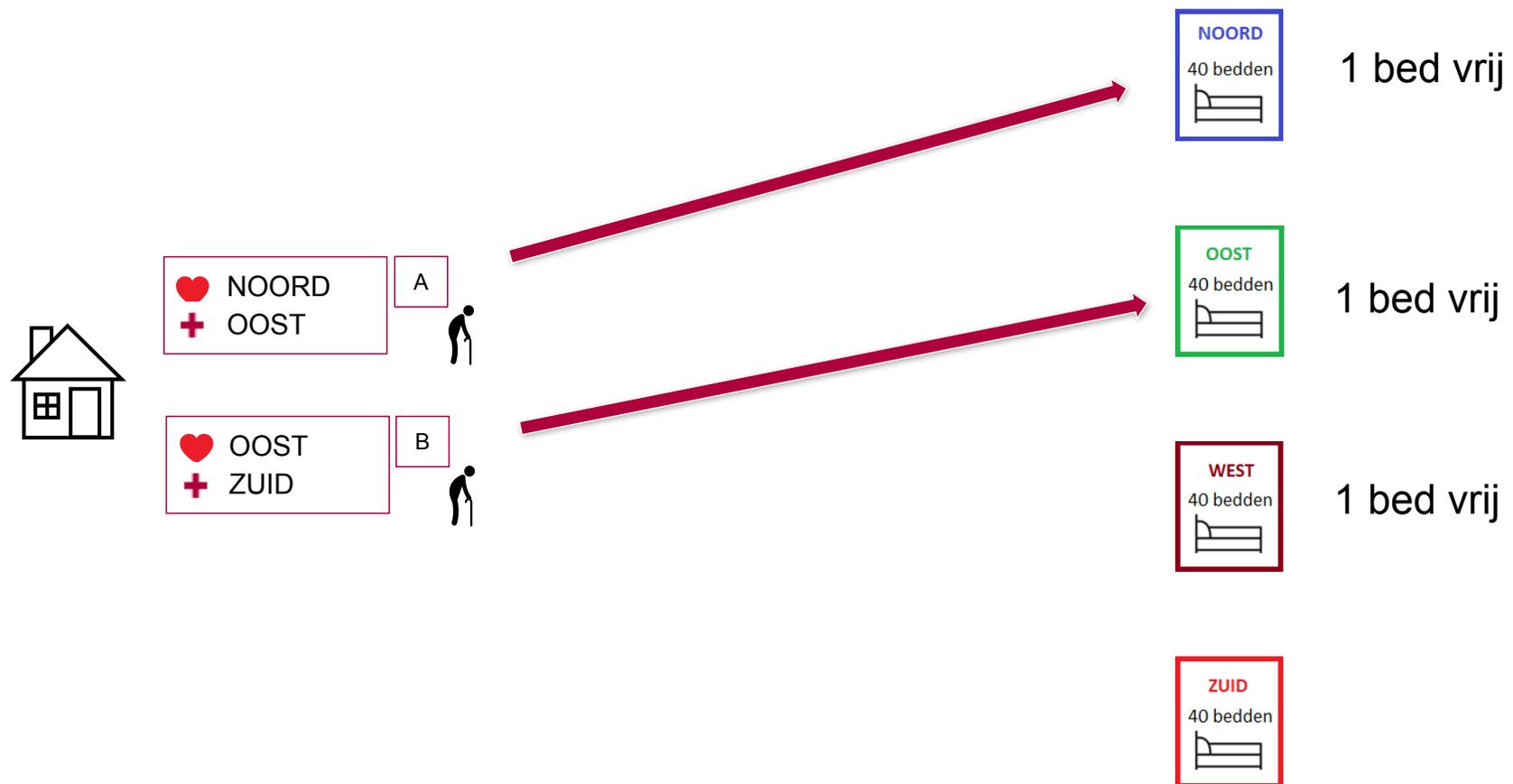


## Vragen:

1. Hoe presteert de simpele oplossing om patiënten meerdere voorkeursverpleeghuizen te laten kiezen?
2. Hoe presteert een toewijzingsmodel waarin individuele patiëntvoorkeuren meegenomen worden?

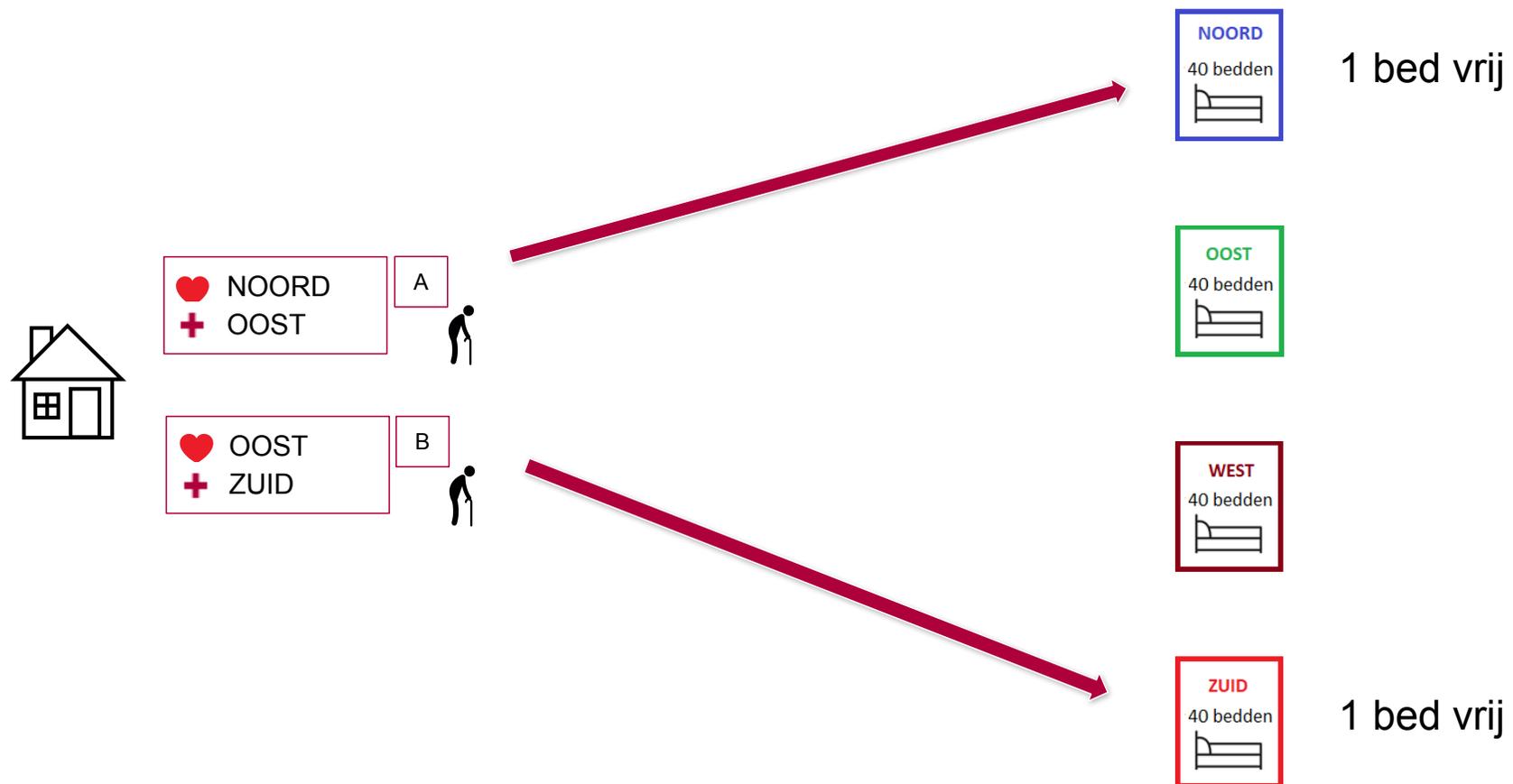
# Speelgoed voorbeeld

## 1. Voorkeuren van cliënten



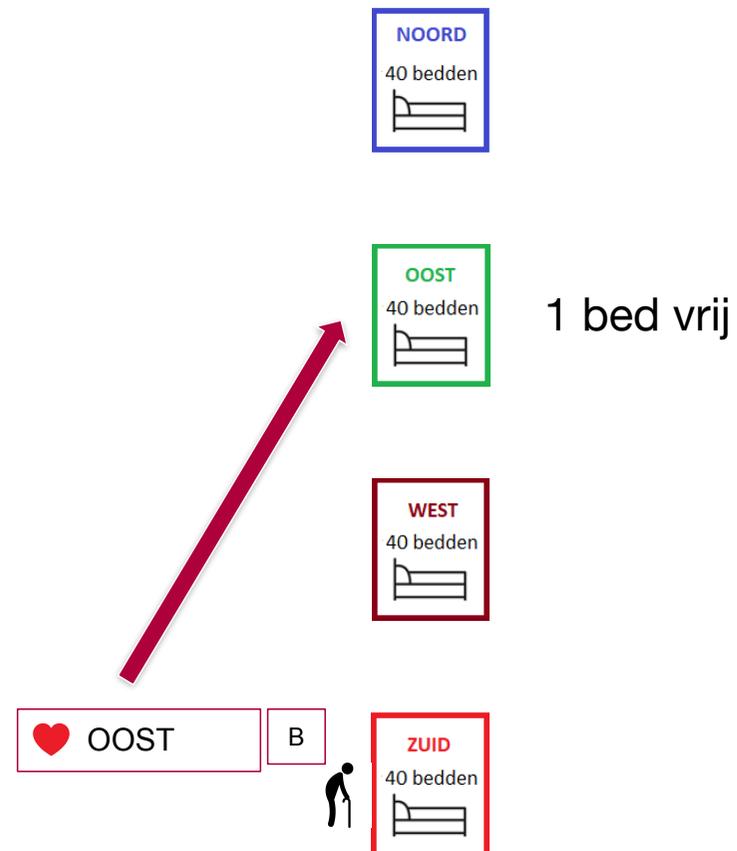
# Speelgoed voorbeeld

## 2. Verplaatsen tussen verpleeghuizen



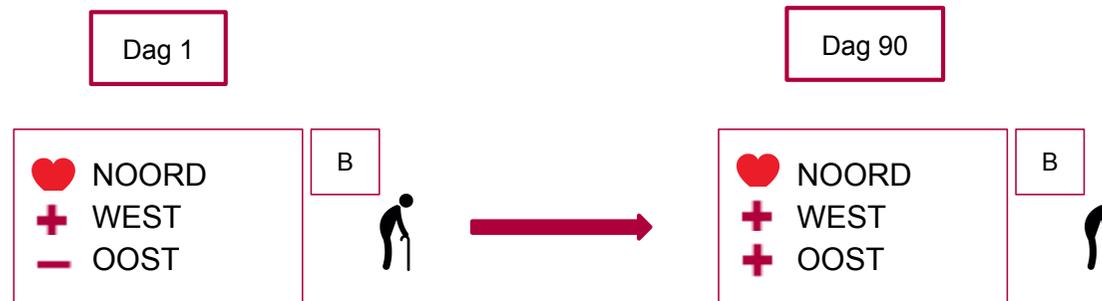
# Speelgoed voorbeeld

## 2. Verplaatsen tussen verpleeghuizen



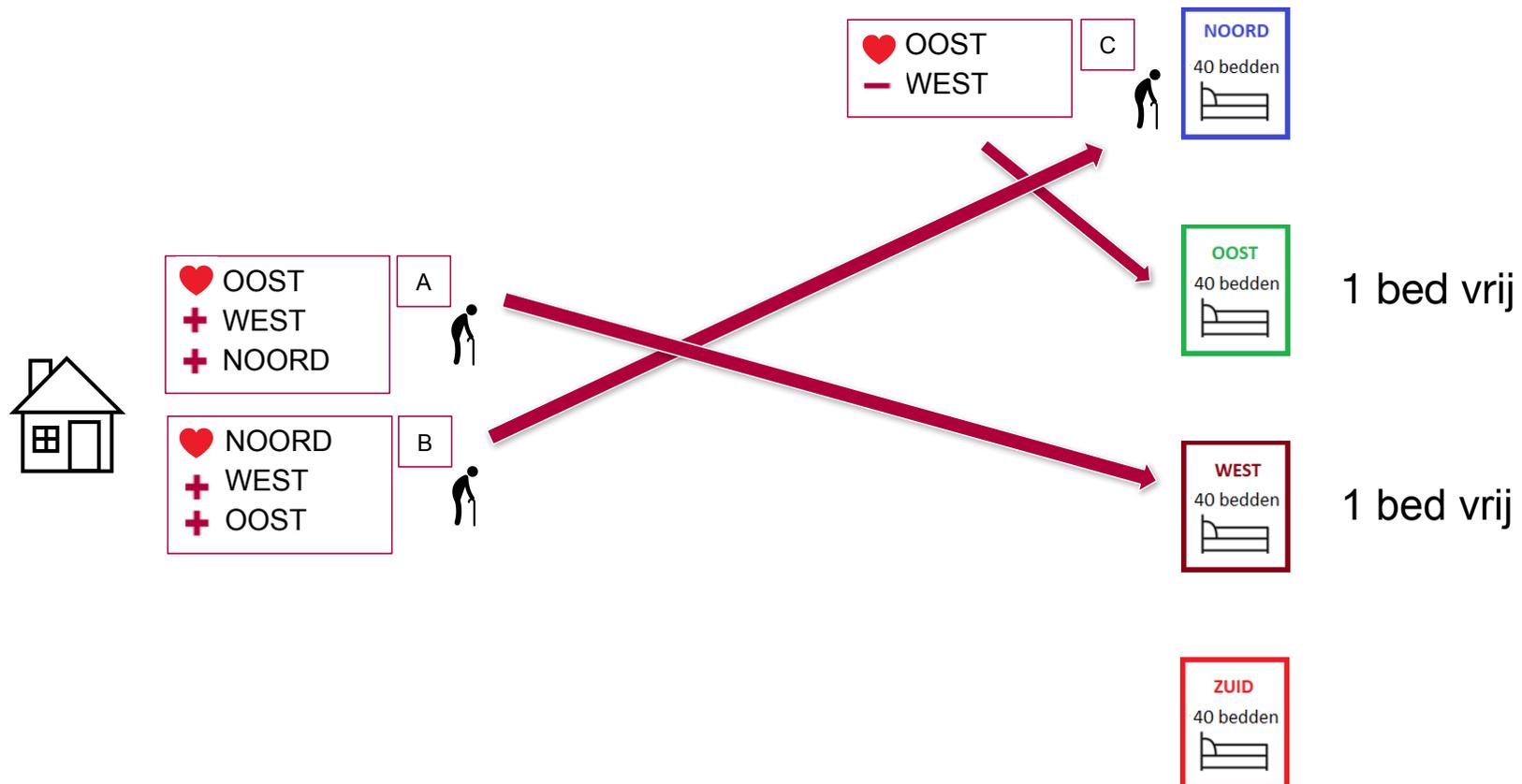
# Speelgoed voorbeeld

## 3. Toename in urgentie



# Speelgoed voorbeeld

## Voorbeeldsituatie



# Resultaten Amsterdam

- Huidige werkwijze:
  - > Wachtijd tot plaatsing **211** dagen (**232** tot voorkeur)
- Toewijzingsmodel met **1** voorkeurs verpleeghuis:
  - > Wachtijd tot plaatsing **51** dagen (**177** tot voorkeur)
- Toewijzingsmodel met **2** voorkeurs verpleeghuizen:
  - > Wachtijd tot plaatsing **33** dagen (**105** tot voorkeur)

## Toewijzingsmodel:

1. Houdt rekening met **individuele** voorkeuren
2. Gigantische reductie wachtijd

*ook psychiatrie, jeugdzorg,...*

# Algoritmes in de zorg

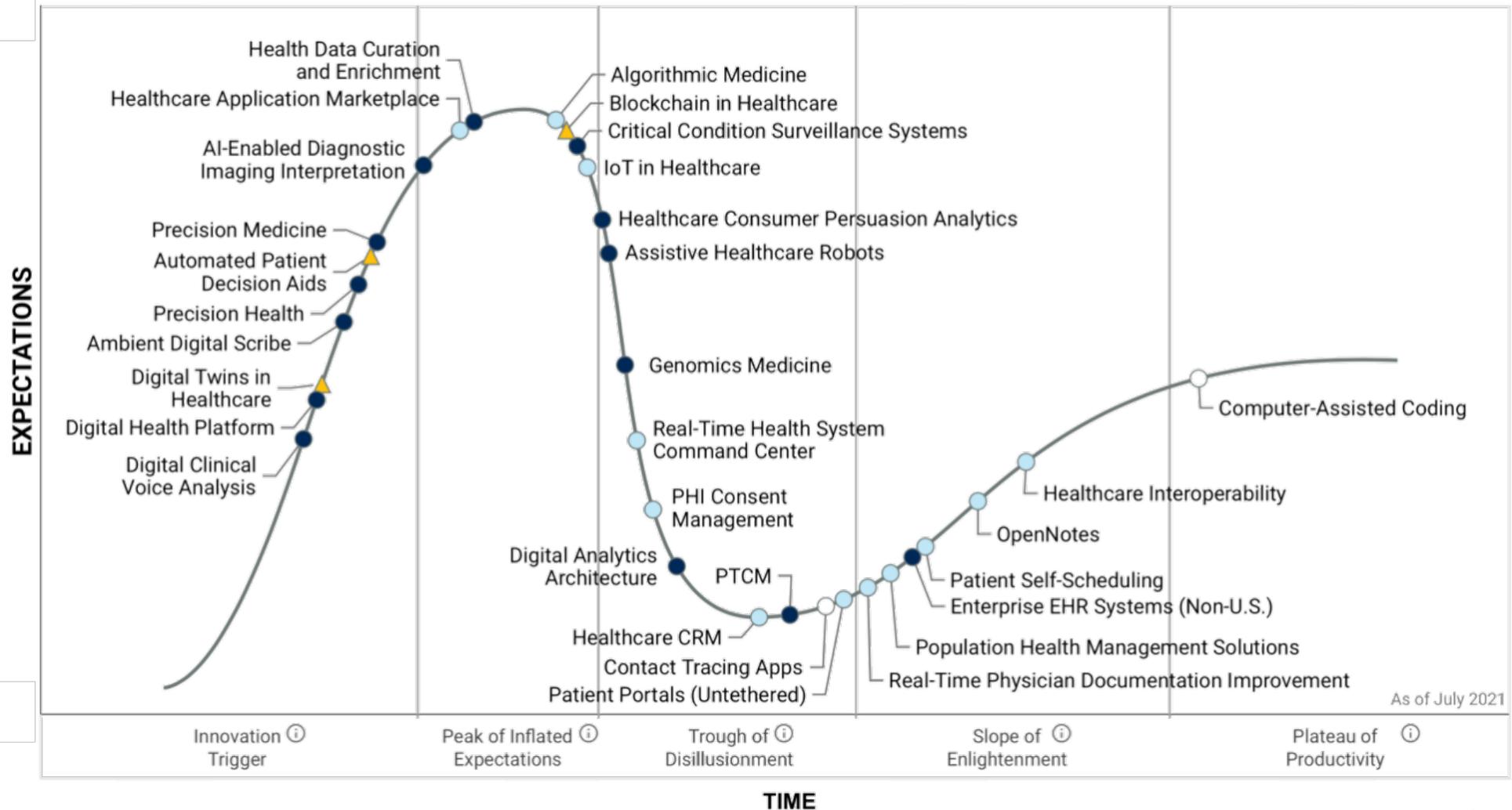
Time To Plateau Will Be Reached:

○ < 2 yrs.

● 2-5 yrs.

● 5-10 yrs.

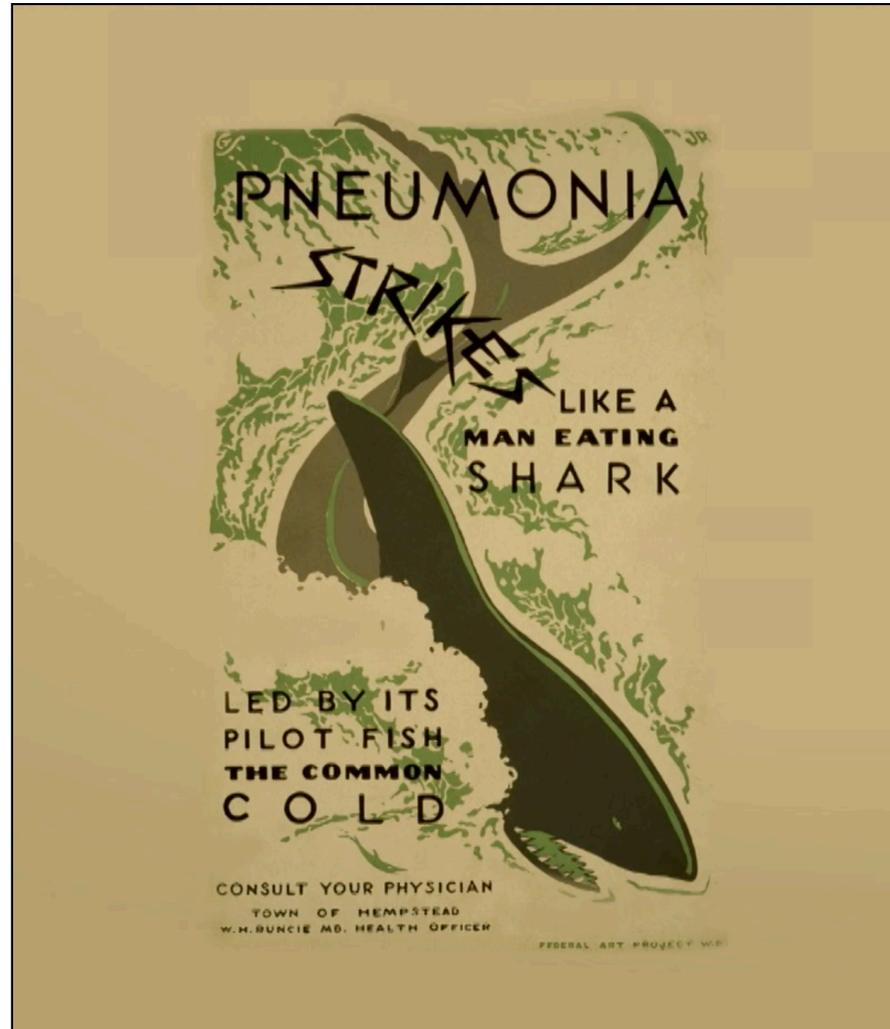
▲ > 10 yrs.



# XAI - Explainable AI

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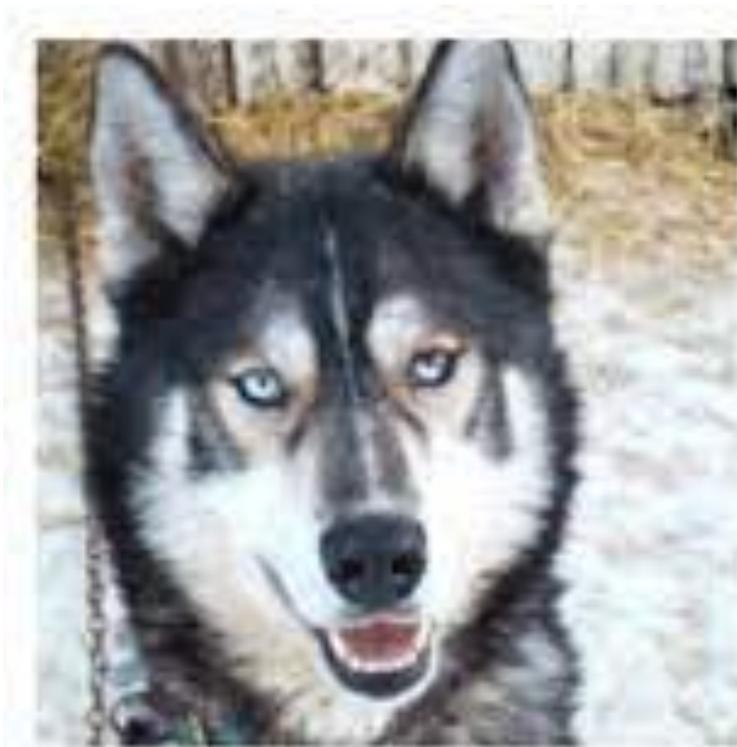
# Responsible data science



# Responsible data science



# Responsible data science



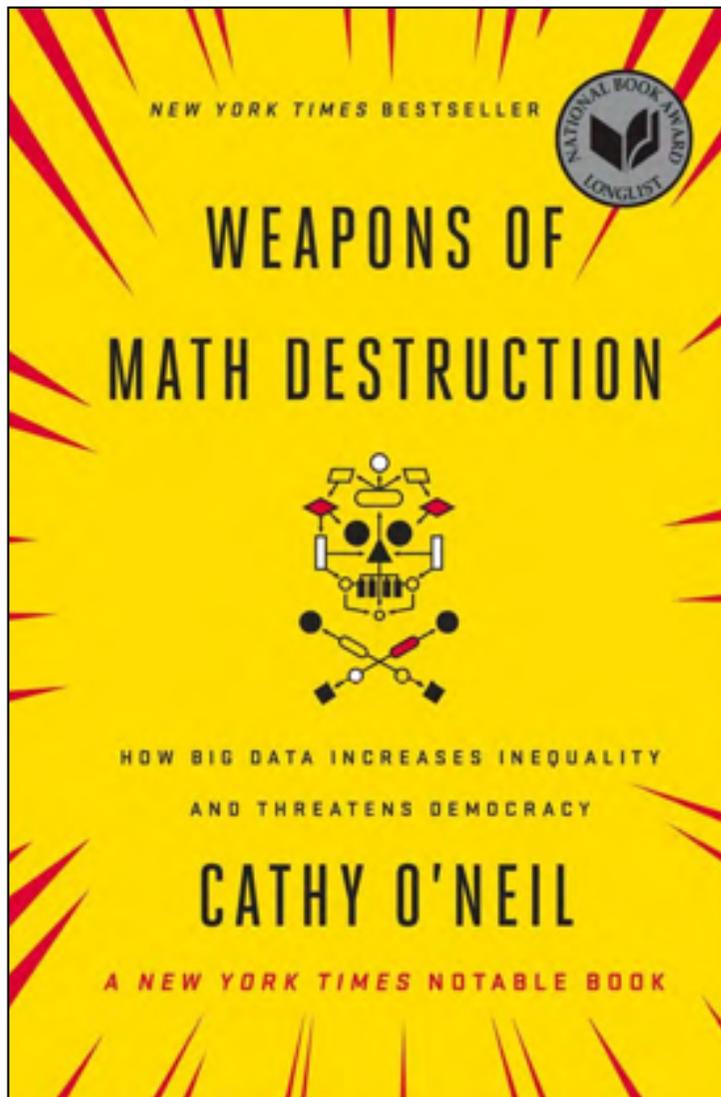
# Responsible data science

- A potential disadvantage of predictive modeling is that insights about the data and the task the machine is solving are hidden within increasingly complex models

## **Questioning the model:**

- **Fairness:** are predictions unbiased and not discriminating?
- **Privacy:** is sensitive information in the data protected?
- **Reliability:** do small changes lead to big prediction changes
- **Causality:** are only causal relationships picked up?
- **Trust:** can the model explain its decisions?

# Responsible data science



- We live in the age of the algorithm
- Increasingly, the decisions that affect our lives are being made not by humans, but by mathematical models
- In theory, this should lead to greater fairness: everyone is judged according to the same rules, and bias is eliminated

# Responsible data science

- “setting the gender to female resulted in getting fewer instances of an ad related to high paying jobs than setting it to male”

Automated Experiments on Ad Privacy Settings

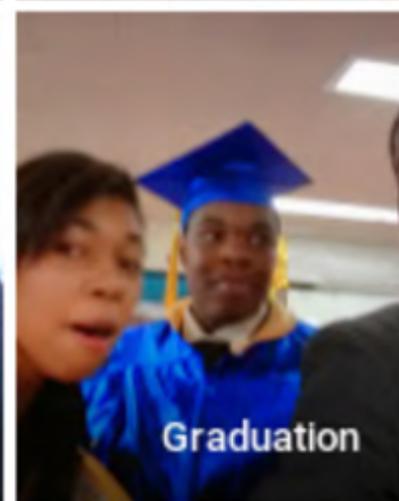
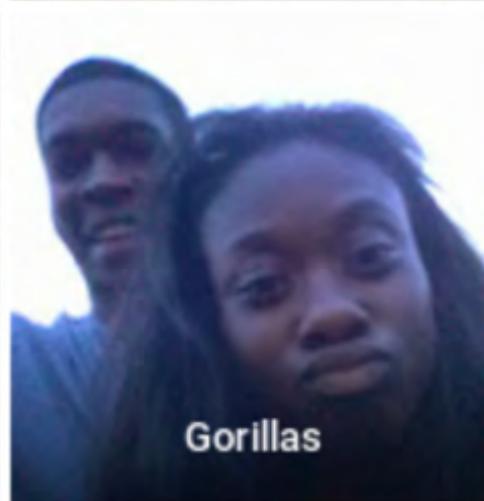
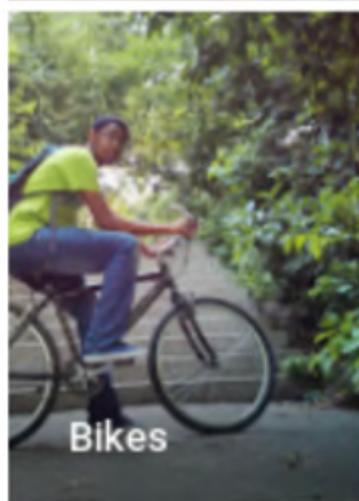
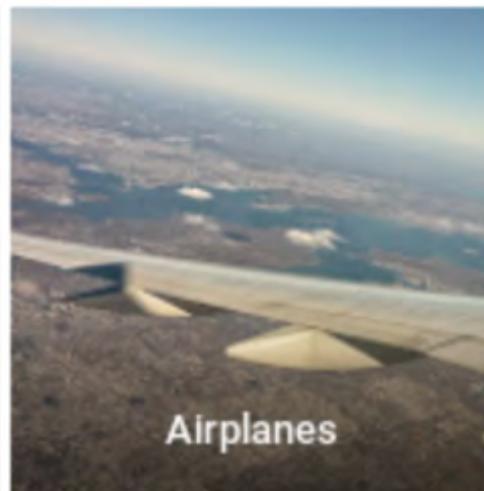
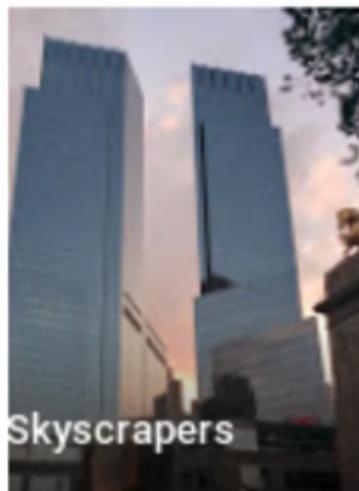
<http://www.andrew.cmu.edu/user/danupam/dtd-pets15.pdf>

- ads for arrest records were significantly more likely to show up on searches for distinctively black names or a historically black fraternity

<http://dataprivacylab.org/projects/onlineads/1071-1.pdf>

- target people who live in low-income neighborhoods with high-interest loans

# Responsible data science



# Responsible data science

You got this ad because you're a **newlywed pilates instructor** and you're **cartoon crazy**.

This ad used your location to see you're in **La Jolla**.

You're into **parenting blogs** and thinking about **LGBTQ adoption**.



You got this ad because you're a **certified public accountant** in an **open relationship**.

This ad used your location to see you're in **South Atlanta**.

You're into **natural skin care** and you've supported **Cardi B** since day one.



You got this ad because you're a **Goth barista** and you're **single**.

This ad used your location to see you're in **Clinton Hill**.

And you're either **vegan** or **lactose intolerant** and you're really feeling that **yoga** lately.



# Responsible data science

- Police, security, intelligence – screening suspects
- Judges – deciding on pre-trial period of suspects
- eCommerce – cookie-based price adjustments
- Education – giving a (negative) study advice
- Medical diagnostics, personalized medicine, ...
- Mortgages, car insurances, CV screening, jobs, salaries, funding decisions, ...
- ...

# Succes!

