MACHINE_LEARNING_FOR_SOCIAL_SCIENCE

from scratch

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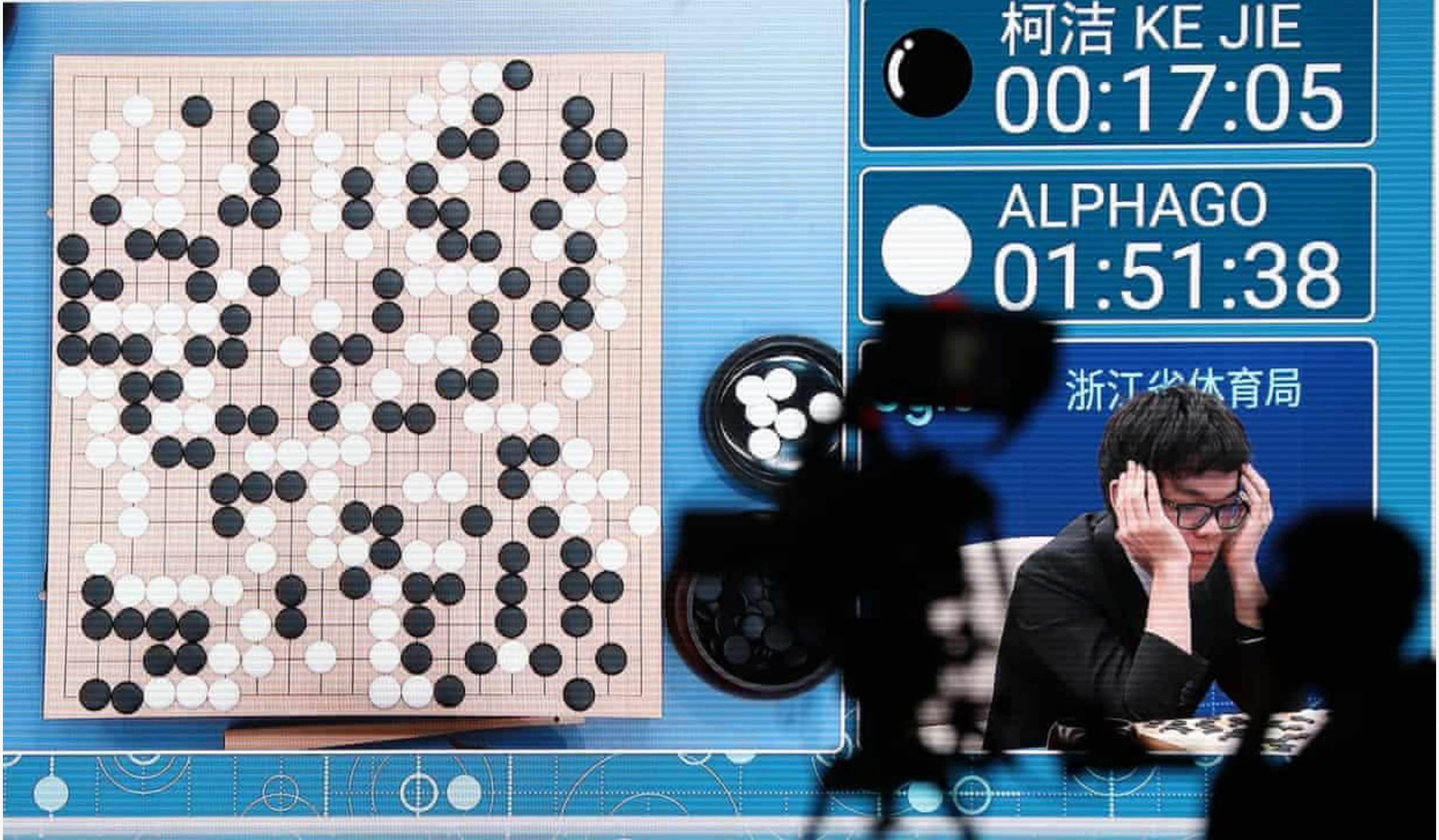
What is Artificial Intelligence?

What is Artificial Intelligence?

Artificial Intelligence (AI) refers to **software technologies** that make a robot or computer act and think like a human.

McCarthy, 1995.


柯洁 KE JIE
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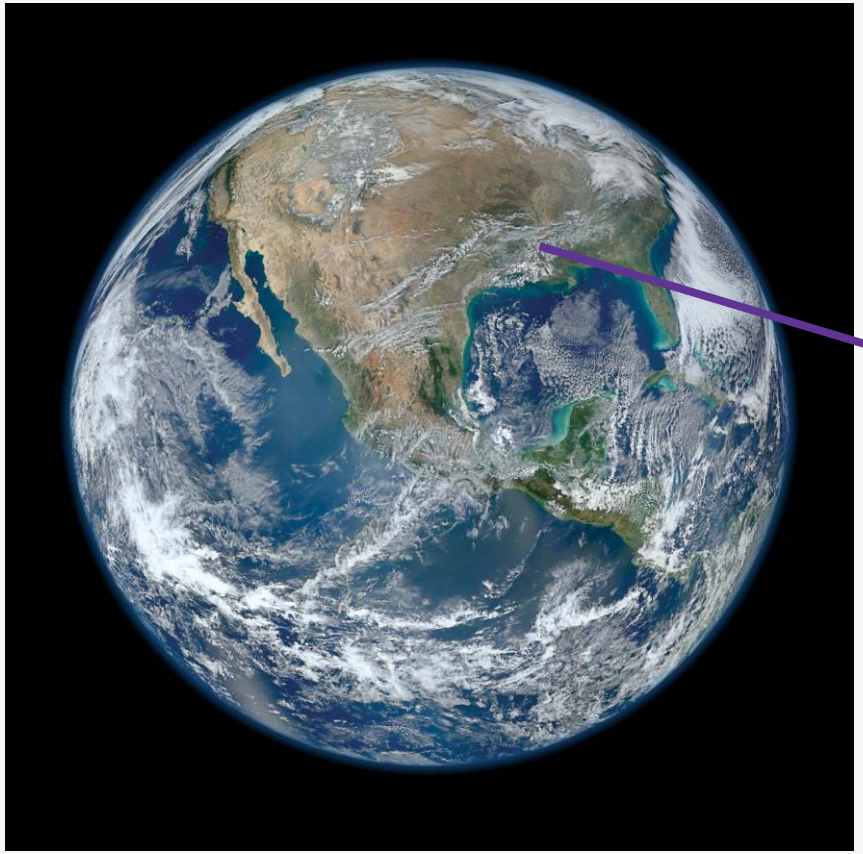
浙江省体育局

What is Machine Learning?

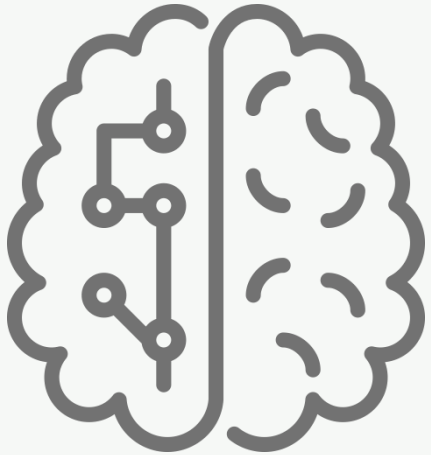
What is Machine Learning?

Machine Learning (ML) is the **scientific study of algorithms** and **statistical models** that computer systems use to perform a specific task without using explicit instructions, **relying on patterns and inference** instead.



Vida real

Dataset



Machine Learning

Real Application

Real Application

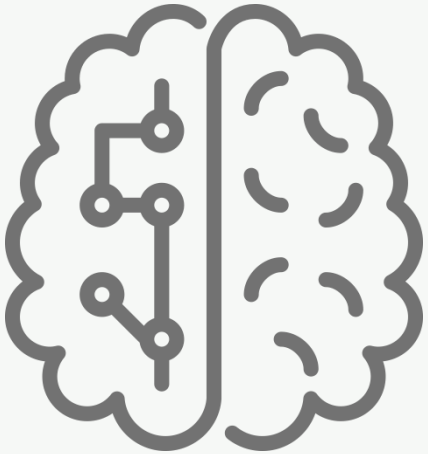
Name	Gender	Age	Race	Juv_misd_count
Miguel	Male	34	Hispanic	Aggravated Assault
Benjamin	Male	47	Caucasian	Grand Theft in the 3rd Degree

True_outcome
Positive
Negative

Historical data

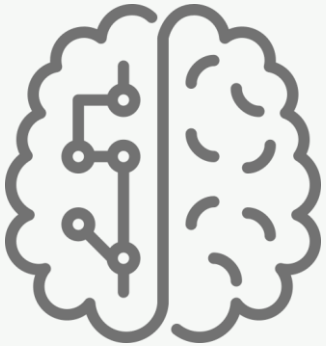
(training data set)

In two years he/she reincides?



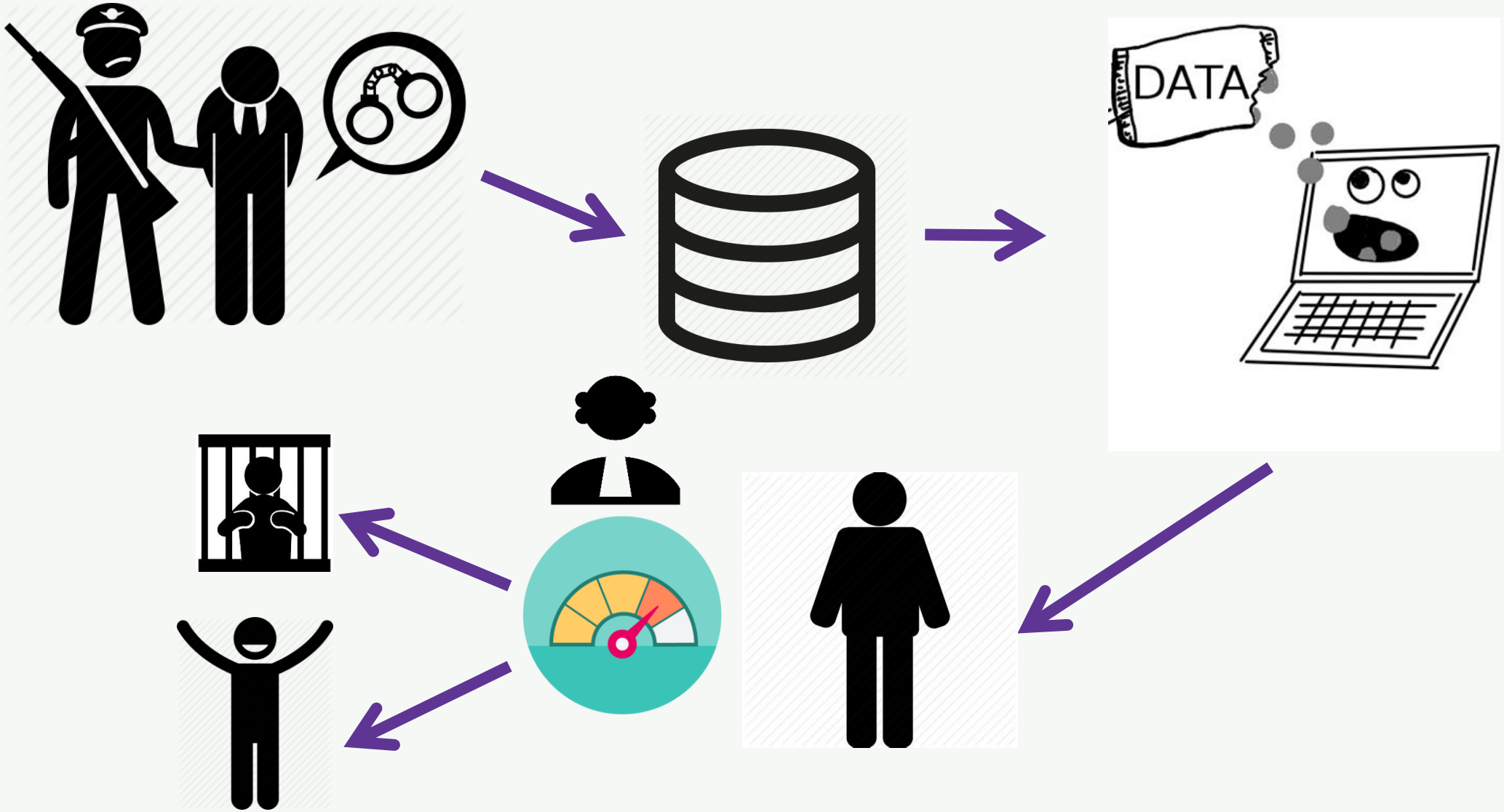
Name	Gender	Age	Race	Juv_misd_count
Darrious	Male	27	African-American	Kidnapping
Claire	Female	23	Caucasian	Possess Cannabis

New data (testing data set)



Prediction
Positive
Positive

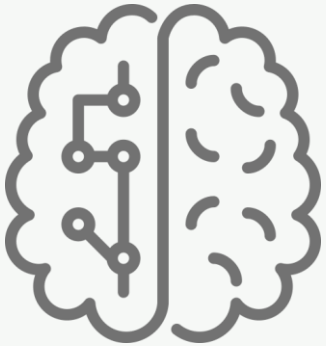
Real Application



Name	Gender	Age	Race	Juv_misd_count
Miguel	Male	34	Hispanic	Aggravated Assault
Benjamin	Male	47	Caucasian	Grand Theft in the 3rd Degree

Super important to understand!

How to evaluate the model?



Prediction	True_outcome
Positive ✓	Positive
Positive ✗	Negative

Name	Gender	Age	Race	Juv_misd_count
Miguel	Male	34	Hispanic	Aggravated Assault
Benjamin	Male	47	Caucasian	Grand Theft in the 3rd Degree

Super important to understand!

Confusion matrix

True Outcome

Prediction

	Positive	Negative
Positive	TP	FP
Negative	FN	TN

Prediction	True_outcome
Positive True Positive (TP)	Positive
Positive False Positive (FP)	Negative

Let’s practice!

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The case of the disease test

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).

The case of the disease test

Confusion matrix

Greens

True Outcome

Prediction

	Sick (P)	Health (N)
Test (+)	60^a	20^b
Test (-)	6^c	14^d

Blues

True Outcome

Prediction

	Sick (P)	Health (N)
Test (+)	16^a	5^b
Test (-)	22^c	57^d

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).

The case of the disease test

Confusion matrix

Greens

True Outcome

Prediction

	Sick (P)	Health (N)
Test (+)	60^a	20^b
Test (-)	6^c	14^d

“ Based on this data, the probability that a **Green person is sick if she has tested positive** for the Disease is (a/a+b, 60/60+20) or 0.75. ”

“ The probability that a **Green is healthy if she tests negative** for the disease is (d/c+d), 14/14+6) or 0.70. ”

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).

The case of the disease test

Confusion matrix

Blues

True Outcome

Prediction

	Sick (P)	Health (N)
Test (+)	16^a	5^b
Test (-)	22^c	57^d

“ Based on this data, the probability that a **Blue person is sick if she has tested positive** for the Disease is (a/a+b, 16/16+5) or 0.76. ”

“ The probability that a **Blue is healthy if she tests negative** for the disease is (d/c+d), 57/57+22) or 0.72. ”

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).

The case of the disease test

“Rather than ask **what the probability is that a Blue or Green person is sick**, given her test result, we might ask instead **what the probability is that a sick Blue or a sick Green will get an accurate** (i.e. positive) **test result.**”

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).

The case of the disease test

Confusion matrix

Greens

True Outcome

Prediction	Sick (P)	Health (N)
Test (+)	60^a	20^b
Test (-)	6^c	14^d

“ Based on this data, the probability that a **Green person gets a positive result if she is sick is** (a/a+c, 60/60+6) or 0.91. ”

“ The probability that a **Green person gets a negative result if she is healthy is** (d/b+d), 14/14+20) or 0.41. ”

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).

The case of the disease test

Confusion matrix

Blues

True Outcome

Prediction	Sick (P)	Health (N)
Test (+)	16^a	5^b
Test (-)	22^c	57^d

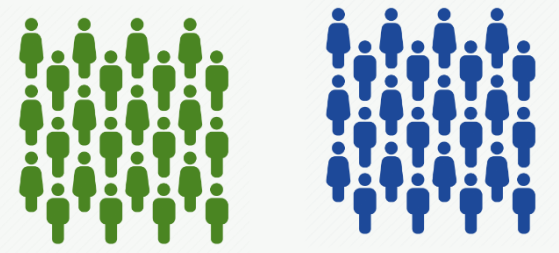
“ Based on this data, the probability that a **Blue person gets a positive result if she is sick is** (a/a+c, 16/16+22) or 0.42. ”

“ The probability that a **Blue person gets a negative result if she is healthy is** (d/b+d), 57/57+5) or 0.91. ”

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).

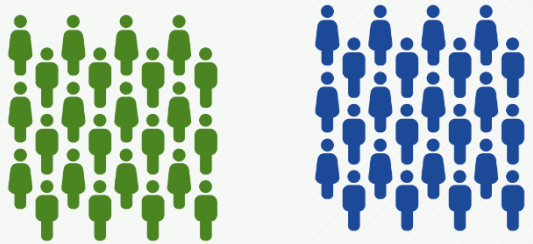
The case of the disease test

What the probability is that a Blue or Green person is sick?



sick & test +	0.75	0.76
health & test -	0.70	0.72

What the probability is that a sick Blue or a sick Green will get an accurate test result?



test + & sick	0.91	0.42
test - & health	0.41	0.91

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).

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Machine Bias (Propublica)

PRO PUBLICA

Donate

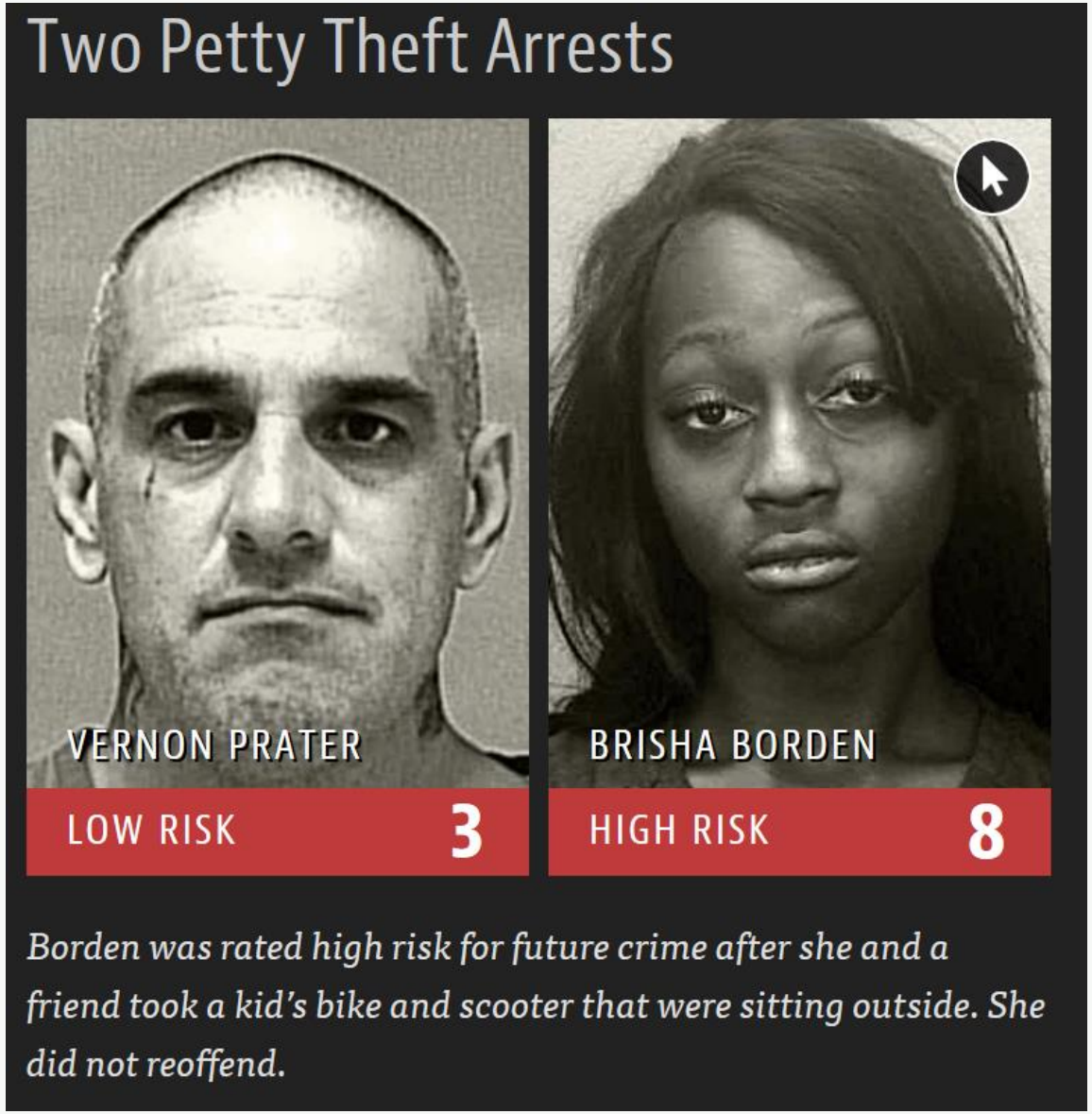
Machine Bias

There's software used across the country to predict future criminals. And it's biased against blacks.

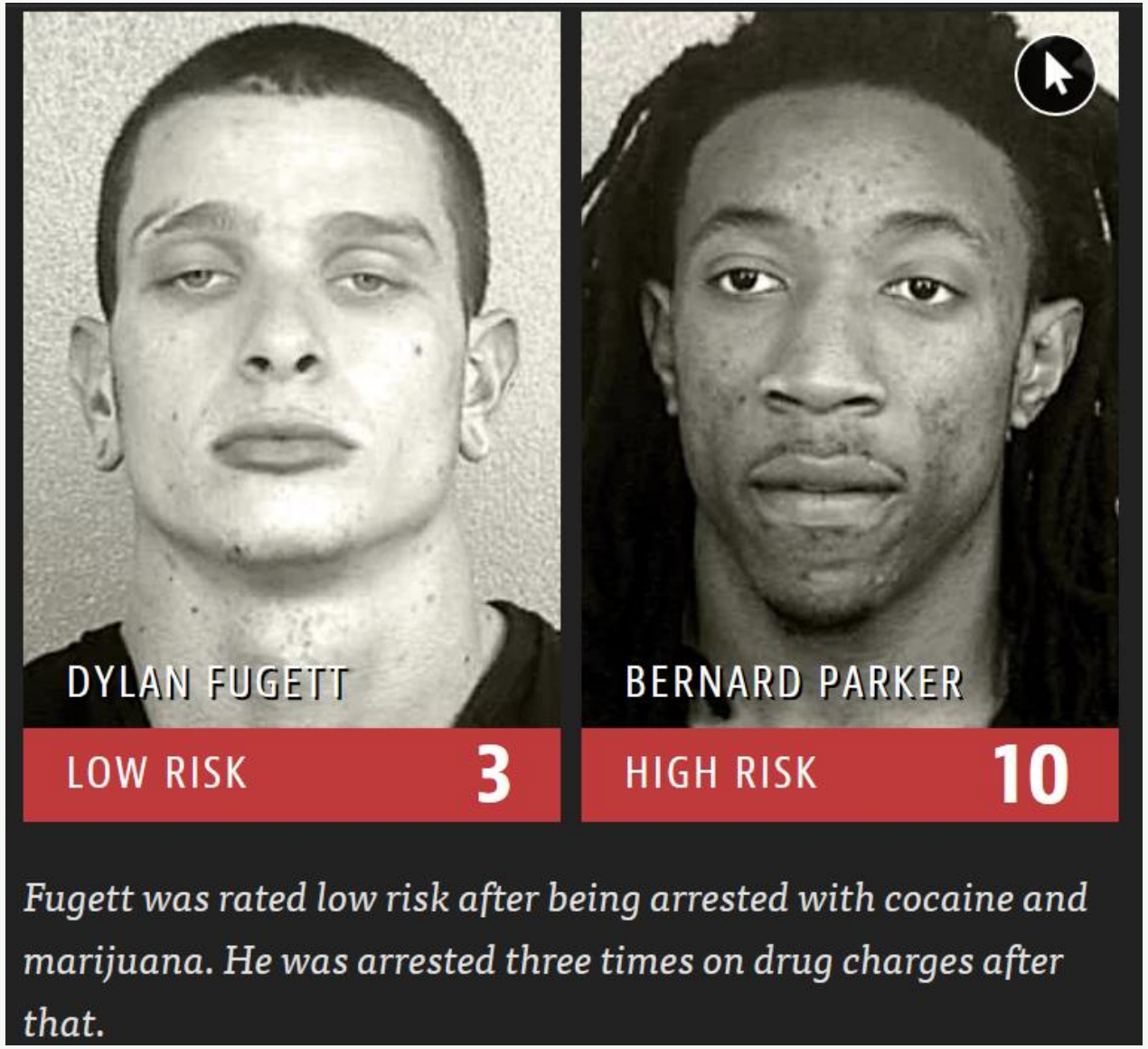
by Julia Angwin, Jeff Larson, Surya Mattu and Lauren Kirchner, ProPublica

May 23, 2016

Machine Bias (Propublica)



Machine Bias (Propublica)



Machine Bias (Propublica)

Confusion matrix

Blacks

True Outcome

Prediction	Will Recidivate	Will not Recidivate
High Risk	60^a	20^b
Low Risk	6^c	14^d

Whites

True Outcome

Prediction	Will Recidivate	Will not Recidivate
High Risk	16^a	5^b
Low Risk	22^c	57^d

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).

Machine Bias (Propublica)

True Outcome

Prediction

Blacks

	Will Recidivate	Will not Recidivate
High Risk	60^a	20^b
Low Risk	6^c	14^d

Whites

	Will Recidivate	Will not Recidivate
High Risk	16^a	5^b
Low Risk	22^c	57^d

- Does this hypothetical risk assessment tool **treat blacks fairly** as **compared to how it treats whites**?
- Which **solution** you propose to **address this situation**?

Hellman, Deborah. "Measuring Algorithmic Fairness." Virginia Public Law and Legal Theory Research Paper 2019-39 (2019).