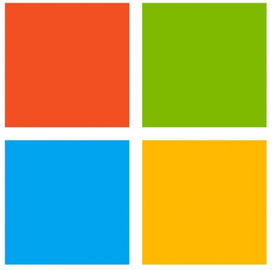
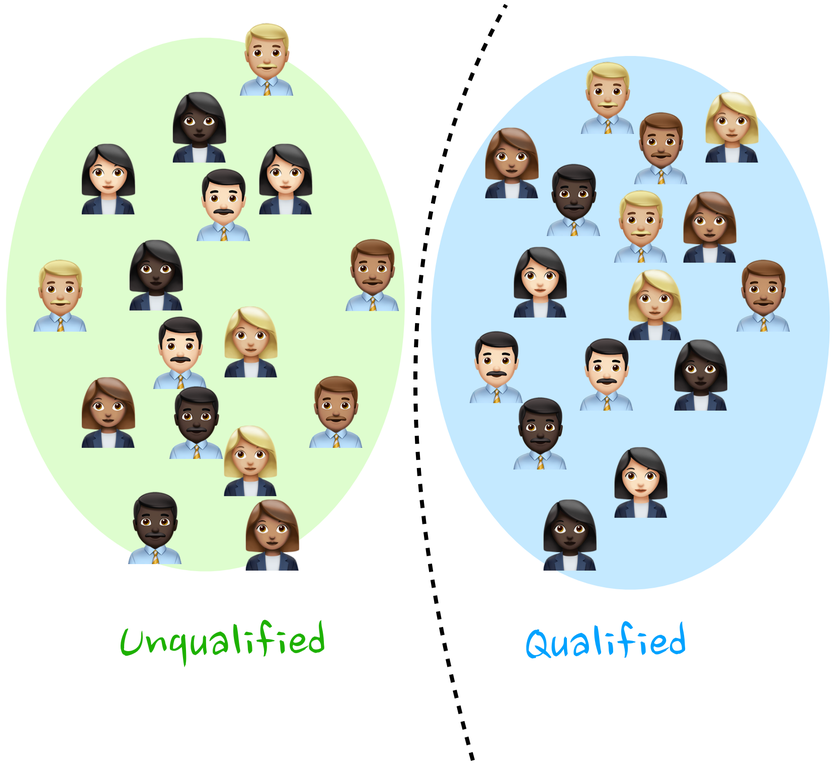
NEURAL INFORMATION PROCESSING SYSTEMS

How Do Fair Decisions Fare in Long-term Qualification?

Xueru Zhang*, Ruibo Tu*, Yang Liu, Mingyan Liu, Hedvig Kjellström, Kun Zhang, Cheng Zhang



YEAR ONE



picture from “https://b2bstorytelling.files.wordpress.com/2015/03/complex_machine.jpg"

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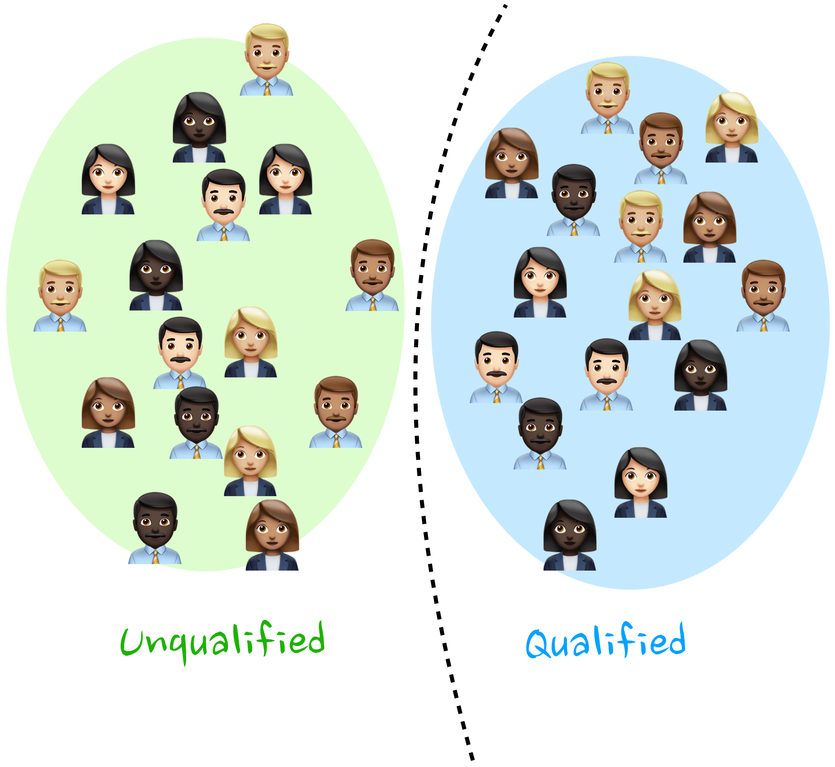

Gender	F	M	F	M	M	F	M	F
Test	75	80	85	74	77	84	83	90
Experience	0	1	1	0	1	0	0	1
	...	...	...	...	...	...	...	...
Height	170	190	165	188	178	168	177	162

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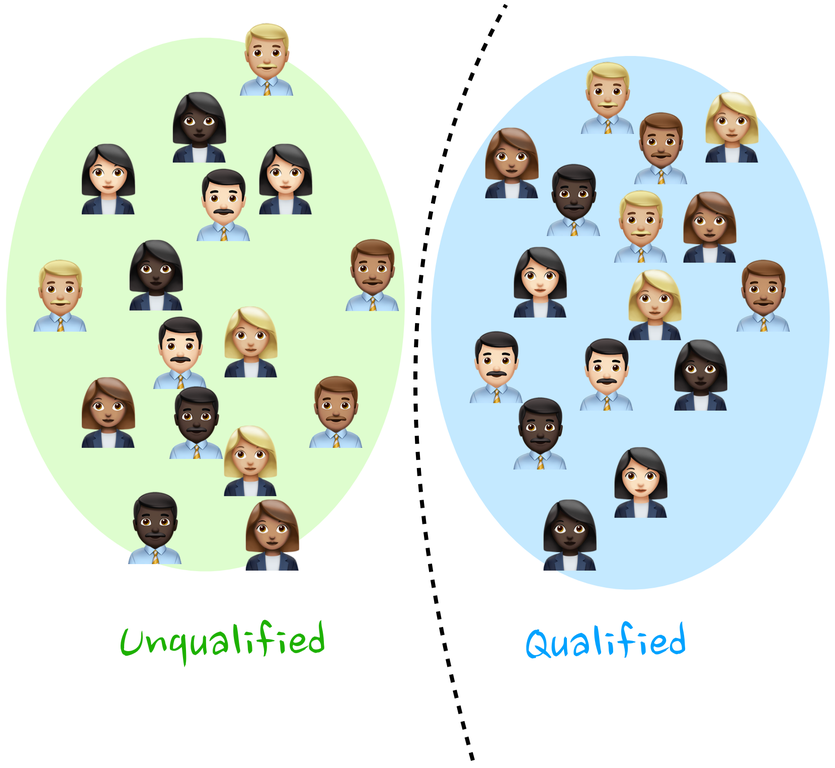
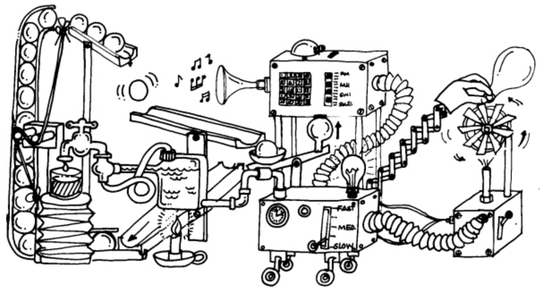
YEAR ONE



Unqualified

Qualified



Automated Decision-Making System

Accept

Reject

Gender	F	M	F	M	M	F	M	F
Test	75	80	85	74	77	84	83	90
Experience	0	1	1	0	1	0	0	1
	...	...	...	...	...	...	...	...
Height	170	190	165	188	178	168	177	162

Who are qualified ?

🤔

picture from “https://b2bstorytelling.files.wordpress.com/2015/03/complex_machine.jpg"

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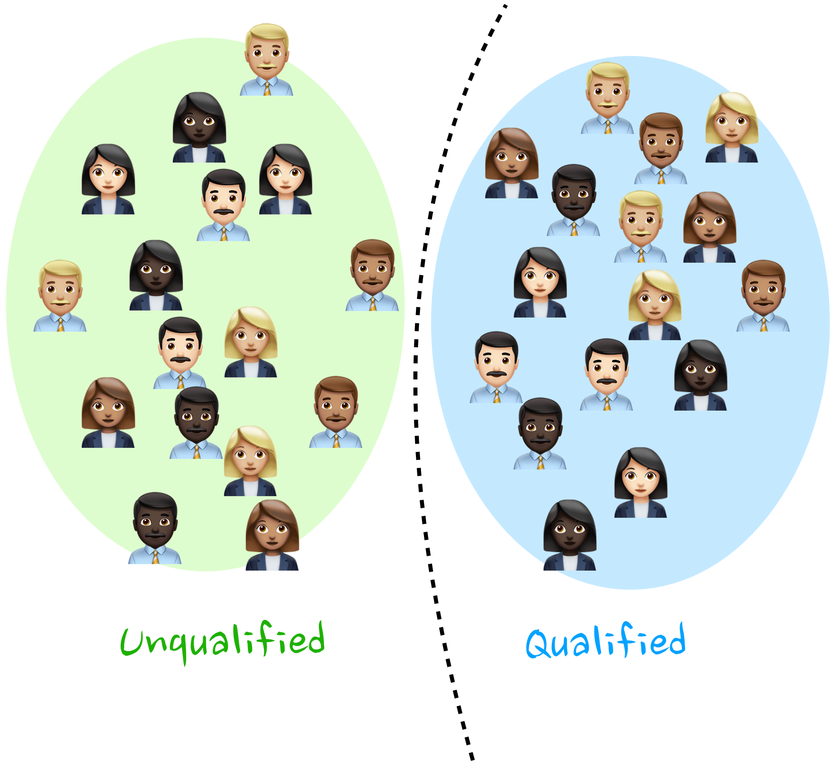

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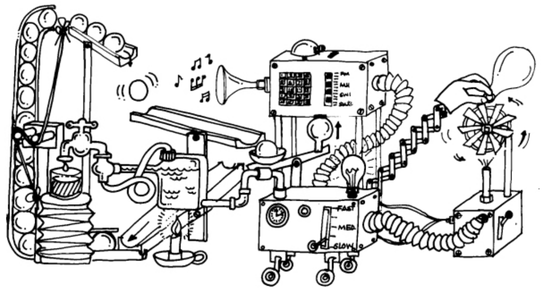
Qualified



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Gender	F	M	F	M	M	F	M	F
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	...	...	...	...	...	...	...	...
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Who are qualified ?

How to make fair decisions

🤔

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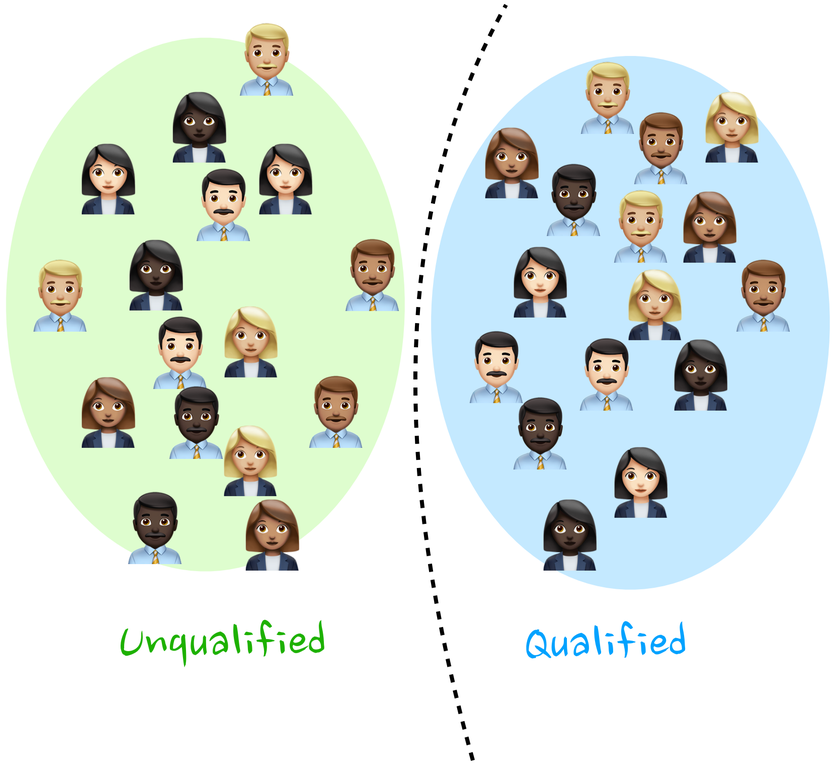
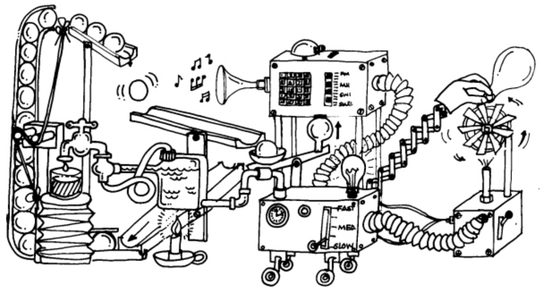
YEAR ONE



Unqualified

Qualified



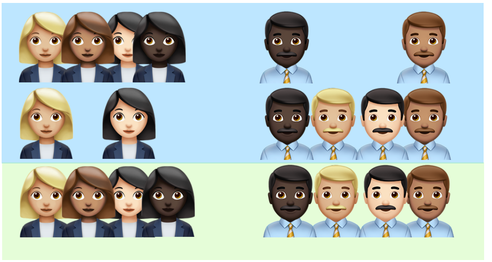
Automated Decision-Making System

Acceptance rates

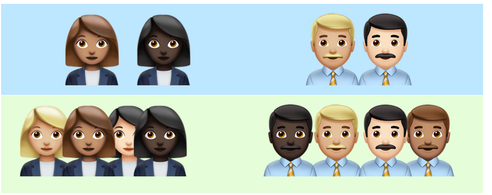
62.5%

62.5%

Accept



Reject



Gender	F	M	F	M	M	F	M	F
Test	75	80	85	74	77	84	83	90
Experience	0	1	1	0	1	0	0	1
...	...	...	...	...	...	...	...	...
Height	170	190	165	188	178	168	177	162

Who are qualified ?

How to make fair decisions

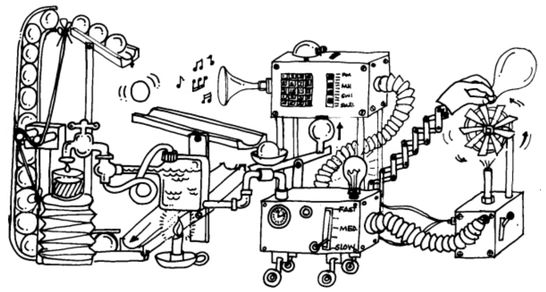
🤔

Any fairness criterion?

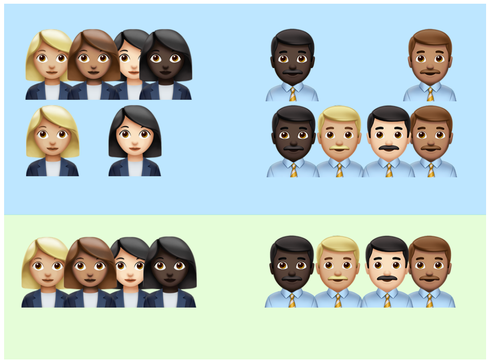
E.g., equalised acceptance rates?

picture from “https://b2bstorytelling.files.wordpress.com/2015/03/complex_machine.jpg"

AFTER GETTING DECISIONS



Accept



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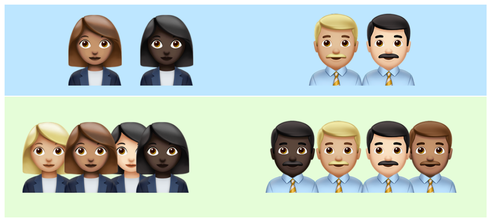
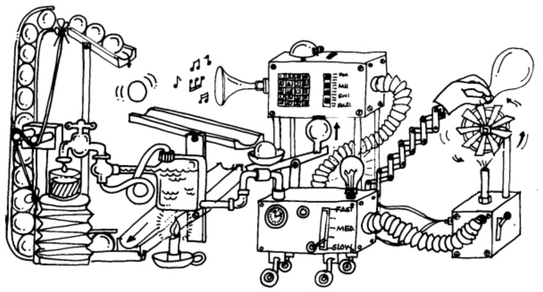
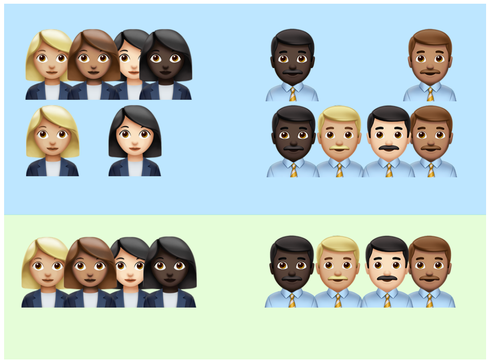


AFTER GETTING DECISIONS



Accept



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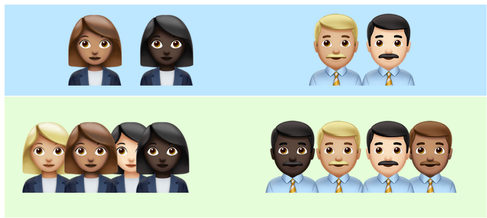


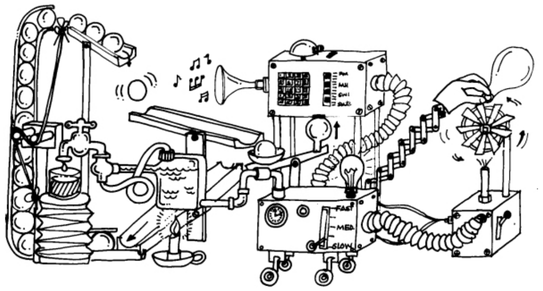
CULTURE

PHYSIOLOGICAL DIFFERENCE

SOCIAL PRESSURE

...

AFTER GETTING DECISIONS



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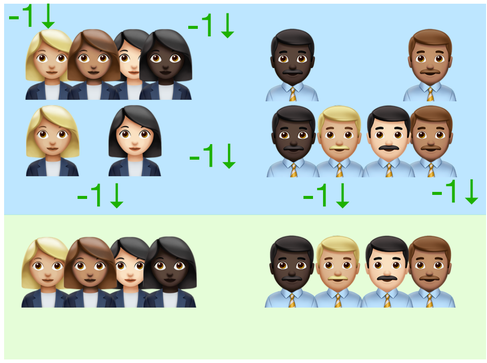

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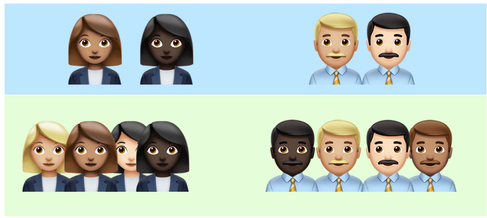

CULTURE

PHYSIOLOGICAL DIFFERENCE

SOCIAL PRESSURE

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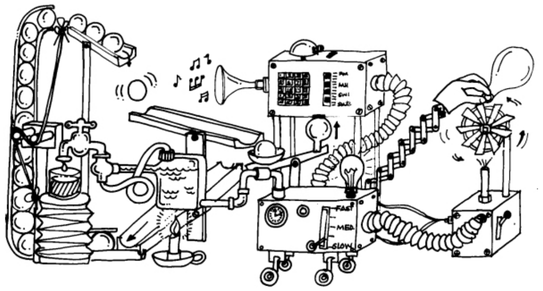
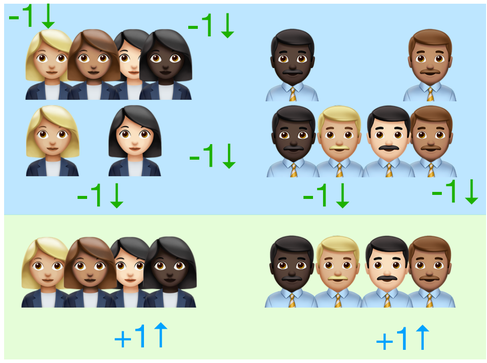
AFTER GETTING DECISIONS



Accept



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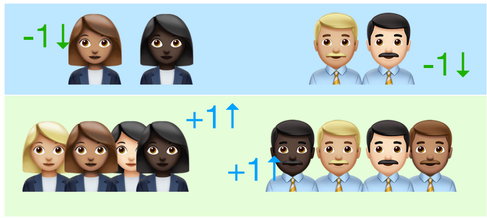


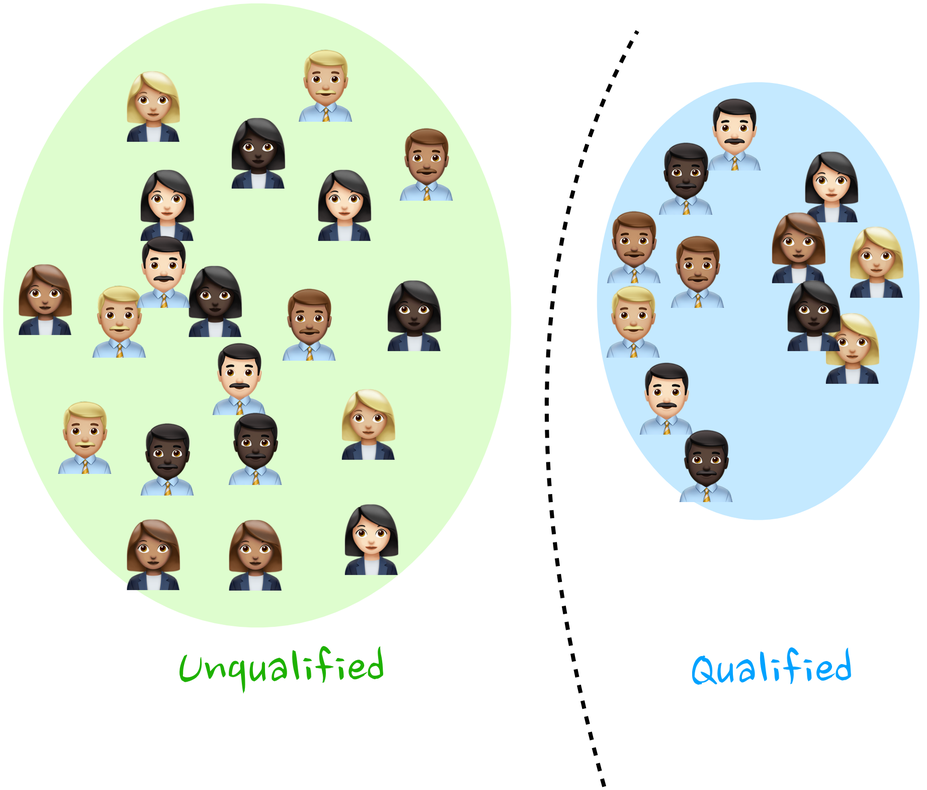
CULTURE

PHYSIOLOGICAL DIFFERENCE

SOCIAL PRESSURE

...

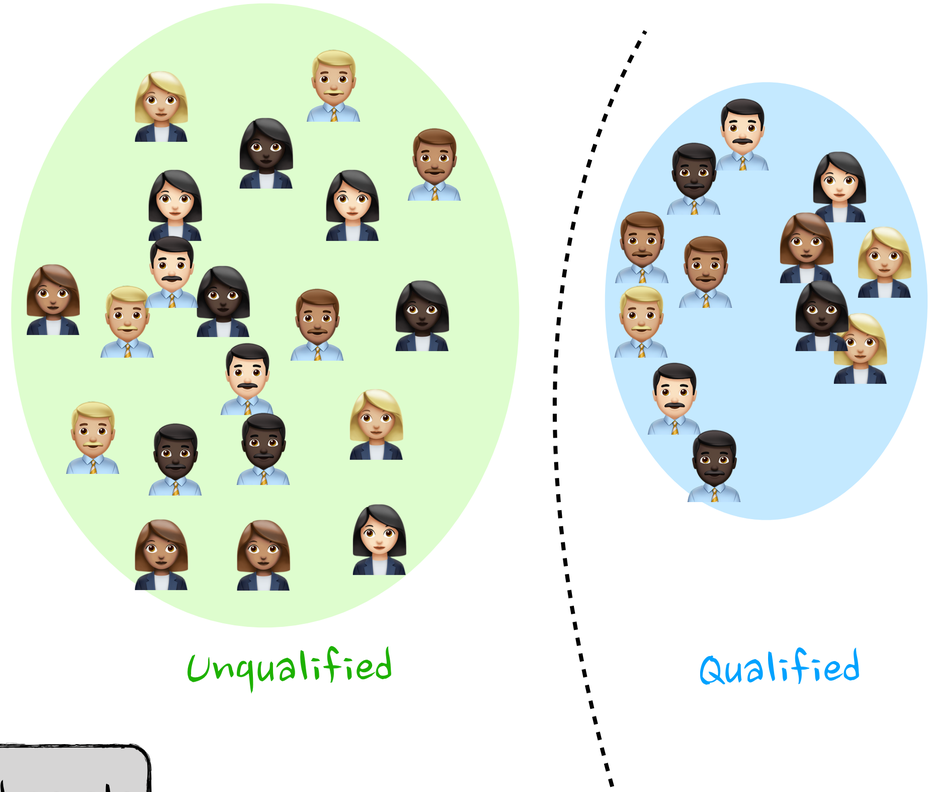
YEAR TWO



Unqualified

Qualified

YEAR TWO



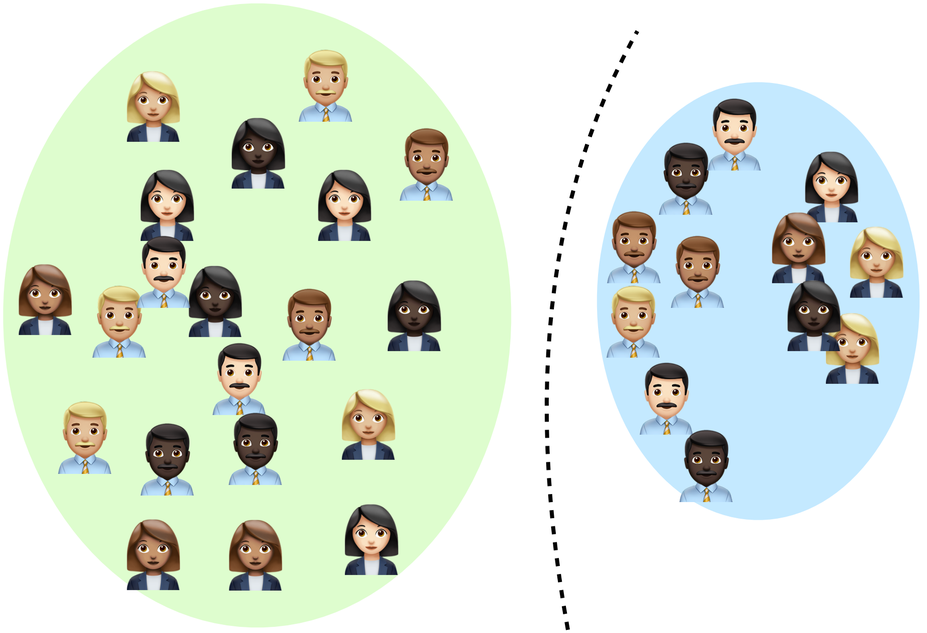
Unqualified

Qualified

LESS qualified people this year ??!!!

😰

YEAR TWO



Unqualified

Qualified

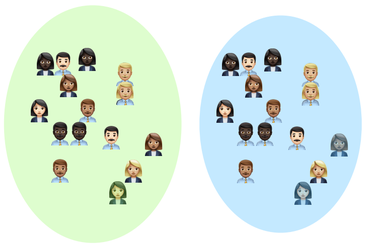
LESS qualified people this year ??!!!

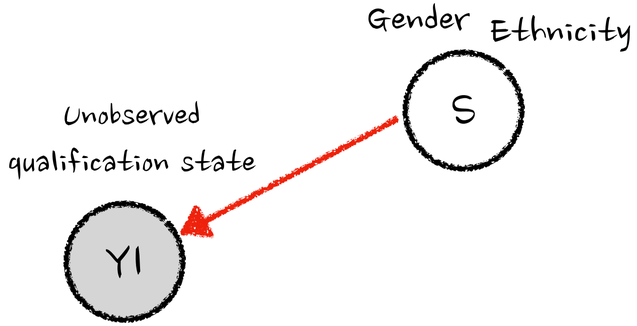
FAIR Decisions?

DECISION MAKING PROCESS

Year 1

Qualified

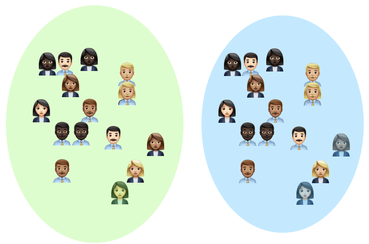




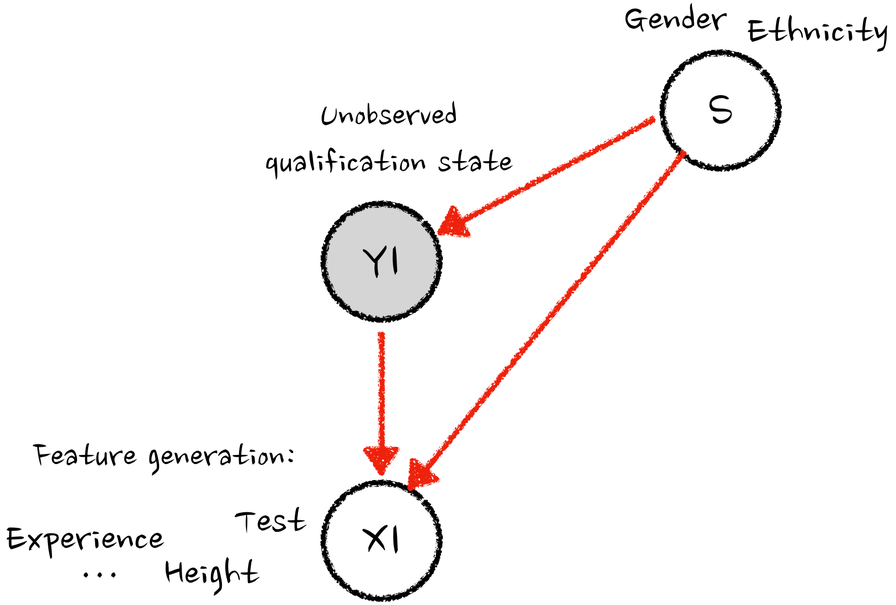
DECISION MAKING PROCESS

Year 1

Qualified



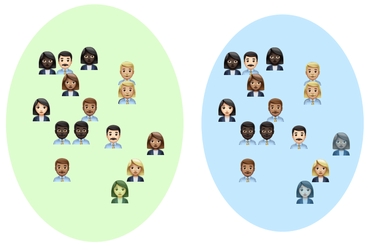
F	M	F	M	M	F	M	F
75	80	85	74	77	84	83	90
0	1	1	0	1	0	0	1
...	...	...	...	...	...	...	...
170	190	165	188	178	168	177	162



DECISION MAKING PROCESS

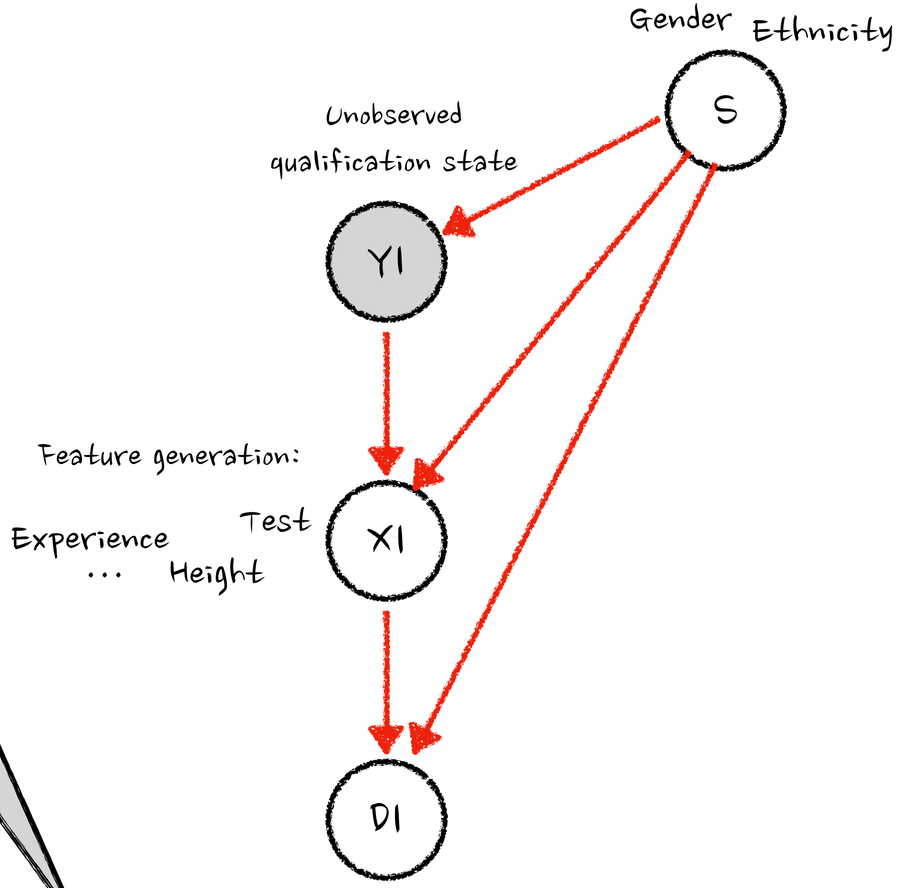
Year 1

Qualified



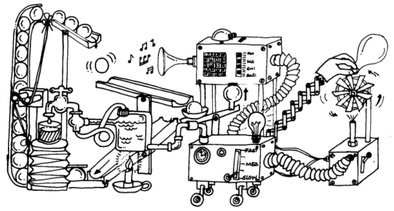
F	M	F	M	M	F	M	F
75	80	85	74	77	84	83	90
0	1	1	0	1	0	0	1
...	...	...	...	...	...	...	...
170	190	165	188	178	168	177	162

How to maximise my benefits?



Myopic Optimal Decision

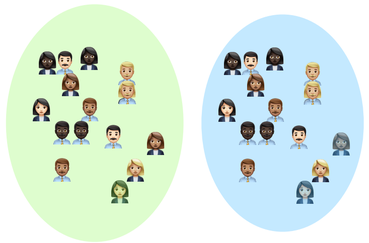
Under fairness constraints



DECISION MAKING PROCESS

Year 1

Qualified



F	M	F	M	M	F	M	F
75	80	85	74	77	84	83	90
0	1	1	0	1	0	0	1
...	...	...	...	...	...	...	...
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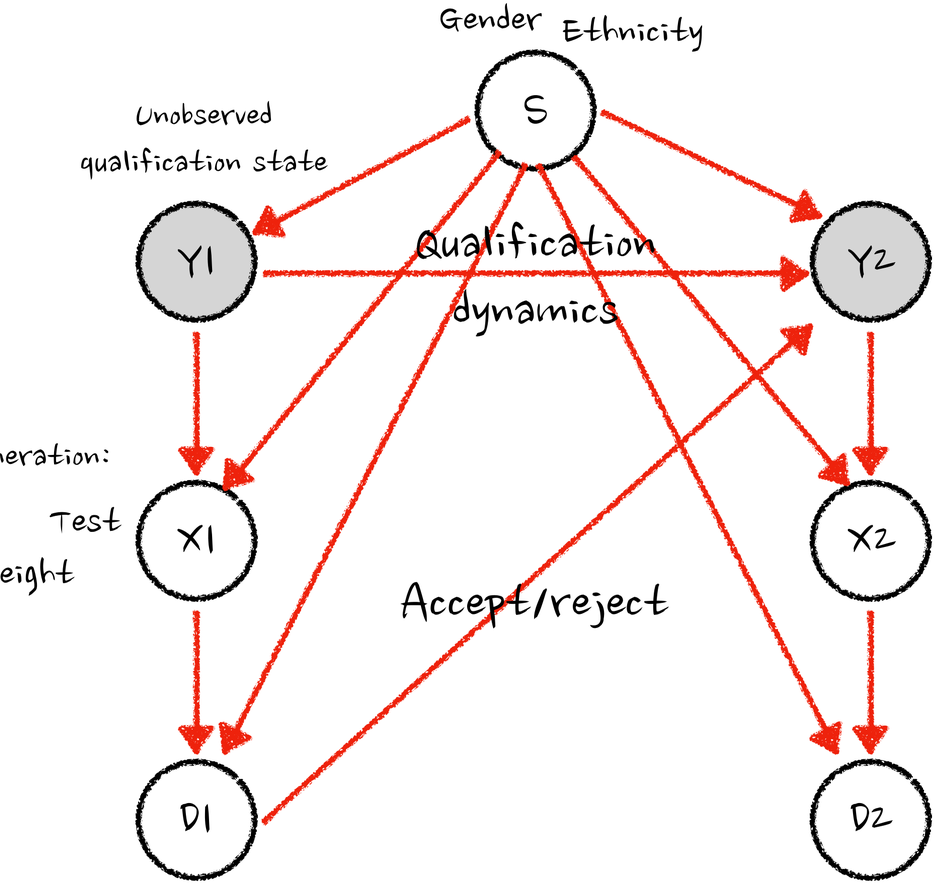

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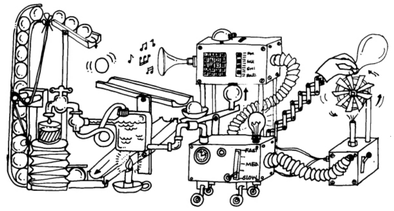
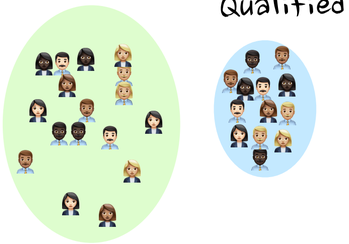


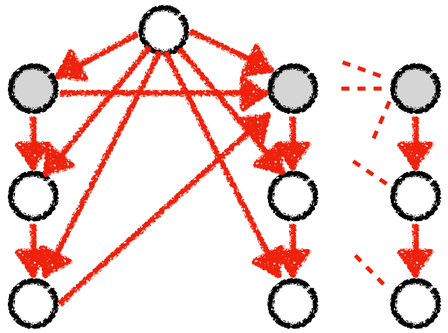
Year 2

Qualified



F	M	F	M	M	F	M	F
65	60	75	76	72	67	62	87
0	1	1	0	1	0	0	1
...	...	...	...	...	...	...	...
170	190	165	188	178	168	177	162

HOW DO FAIR DECISIONS FARE IN LONG-TERM QUALIFICATION?

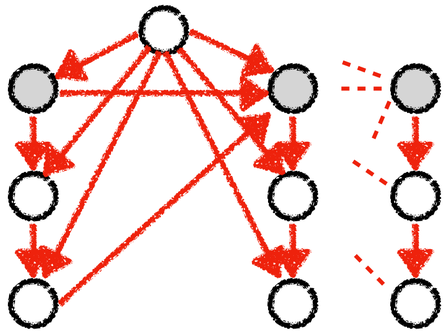


A class of static fairness constraints

Threshold policies are optimal…

Equilibrium: Existence and uniqueness

HOW DO FAIR DECISIONS FARE IN LONG-TERM QUALIFICATION?



A class of static fairness constraints

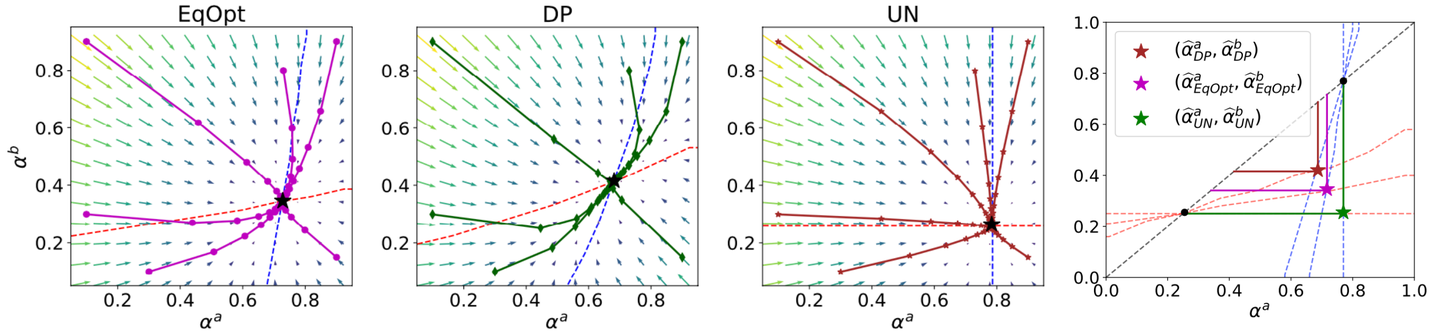
Threshold policies are optimal…

Equilibrium: Existence and uniqueness

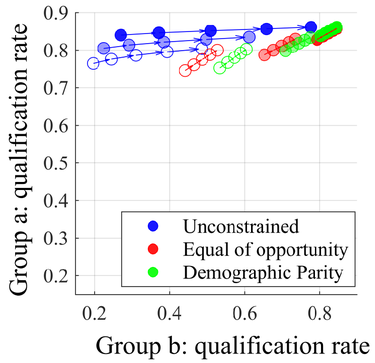
WITH A UNIQUE EQUILIBRIUM

Fairness constraints: impact on equilibrium states

Natural (in)equality



Effective interventions



Equilibrium and Oscillation