

Cornell University



MAX PLANCK INSTITUTE
FOR SOFTWARE SYSTEMS

Improving Screening Processes via Calibrated Subset Selection

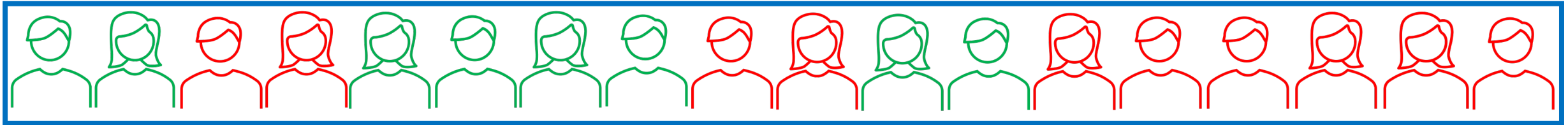
Luke Lequn Wang

Joint work with Thorsten Joachims and Manuel Gomez Rodriguez



Multi-Stage Selection Processes: Hiring Example

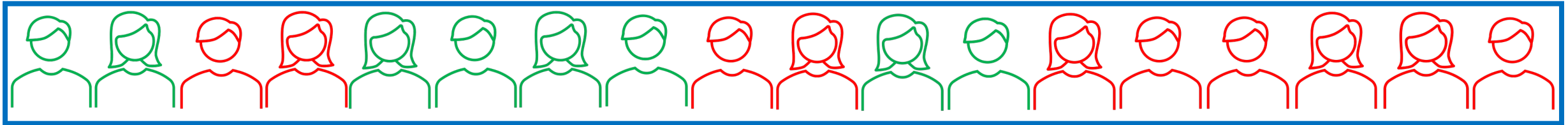
Green Qualified, Red Unqualified



↑
a pool of candidates

Multi-Stage Selection Processes: Hiring Example

Green Qualified, Red Unqualified

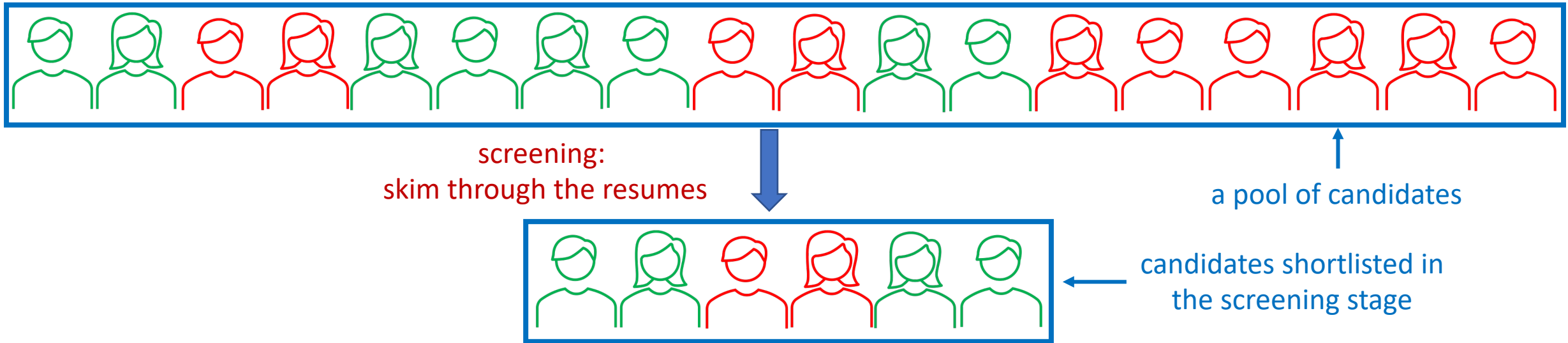


↑
a pool of candidates

For ease of presentation, we use an over-simplification of gender.

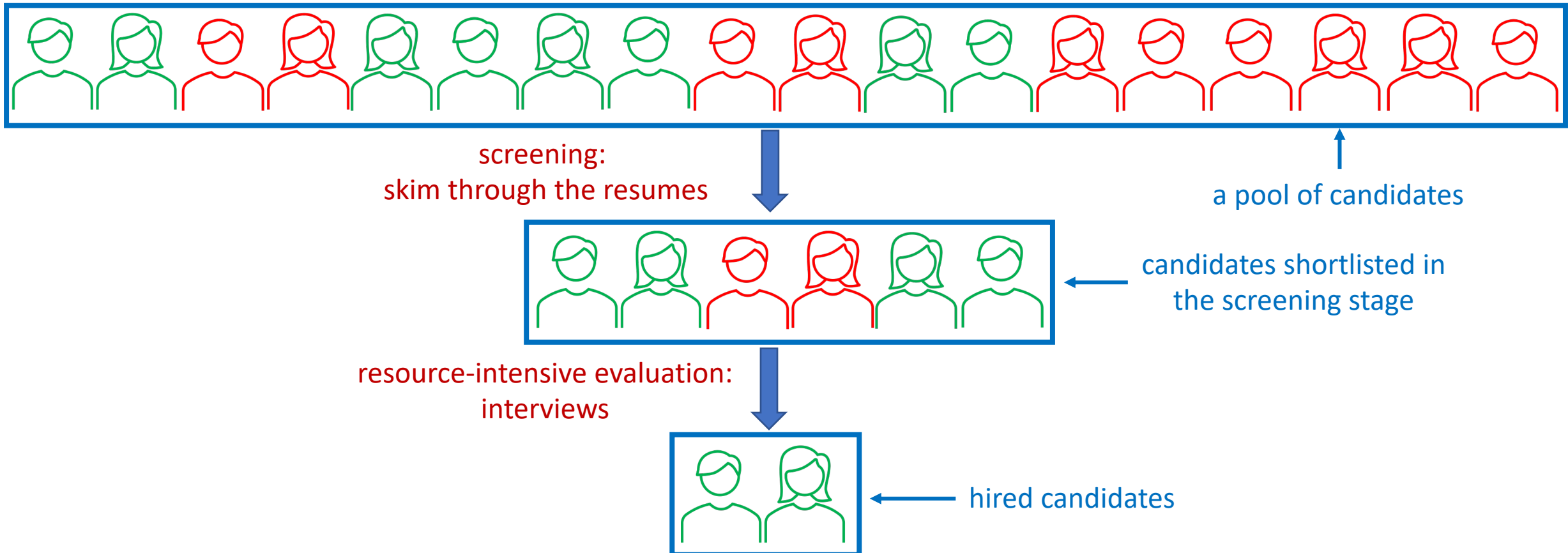
Multi-Stage Selection Processes: Hiring Example

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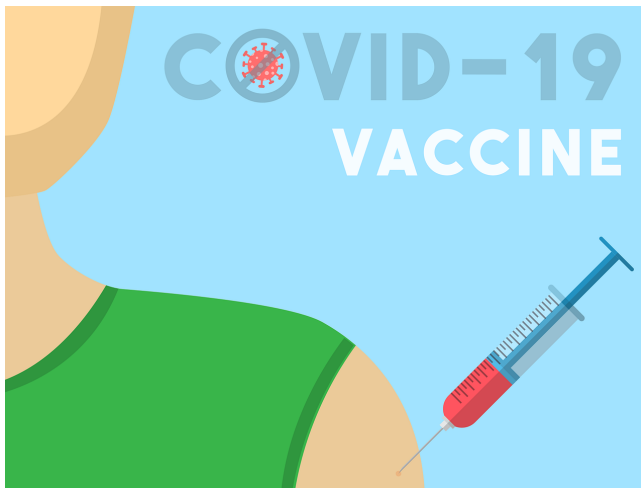


Multi-Stage Selection Processes: More Applications

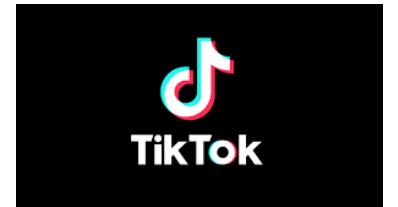
Medical Trials

Paper Reviews

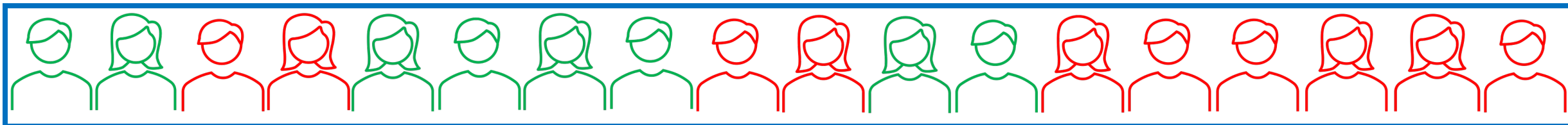
Recommender Systems



ICML | 2022



Two-Step Screening

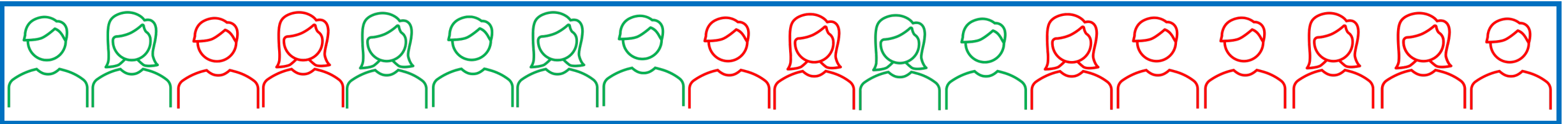


Two-Step Screening

1. Construct a classifier.

ranking by quality scores (left higher)

0.9 0.9 0.8 0.8 0.7 0.7 0.6 0.6 0.5 0.5 0.4 0.4 0.3 0.3 0.2 0.2 0.1 0.1

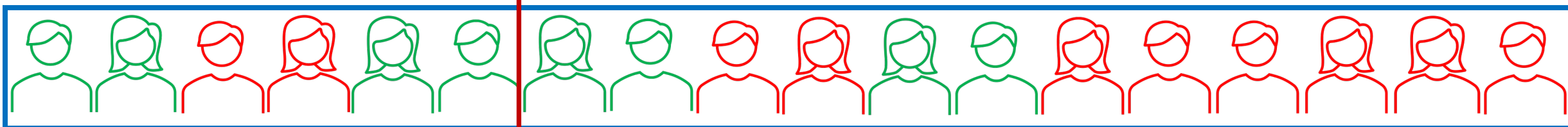


Two-Step Screening

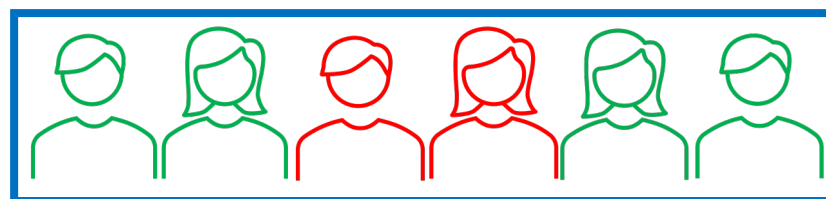
1. Construct a classifier.
2. Apply a threshold rule.

ranking by quality scores (left higher)

0.9 0.9 0.8 0.8 0.7 0.7 0.6 0.6 0.5 0.5 0.4 0.4 0.3 0.3 0.2 0.2 0.1 0.1



threshold



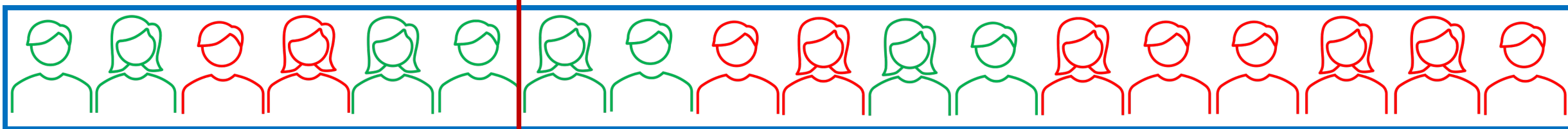
Two-Step Screening

1. Construct a classifier.
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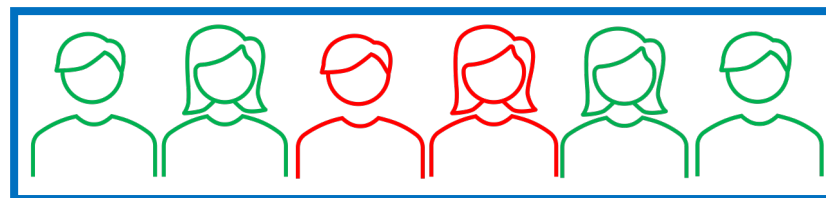
How to select the threshold?

ranking by quality scores (left higher)

0.9 0.9 0.8 0.8 0.7 0.7 0.6 0.6 0.5 0.5 0.4 0.4 0.3 0.3 0.2 0.2 0.1 0.1

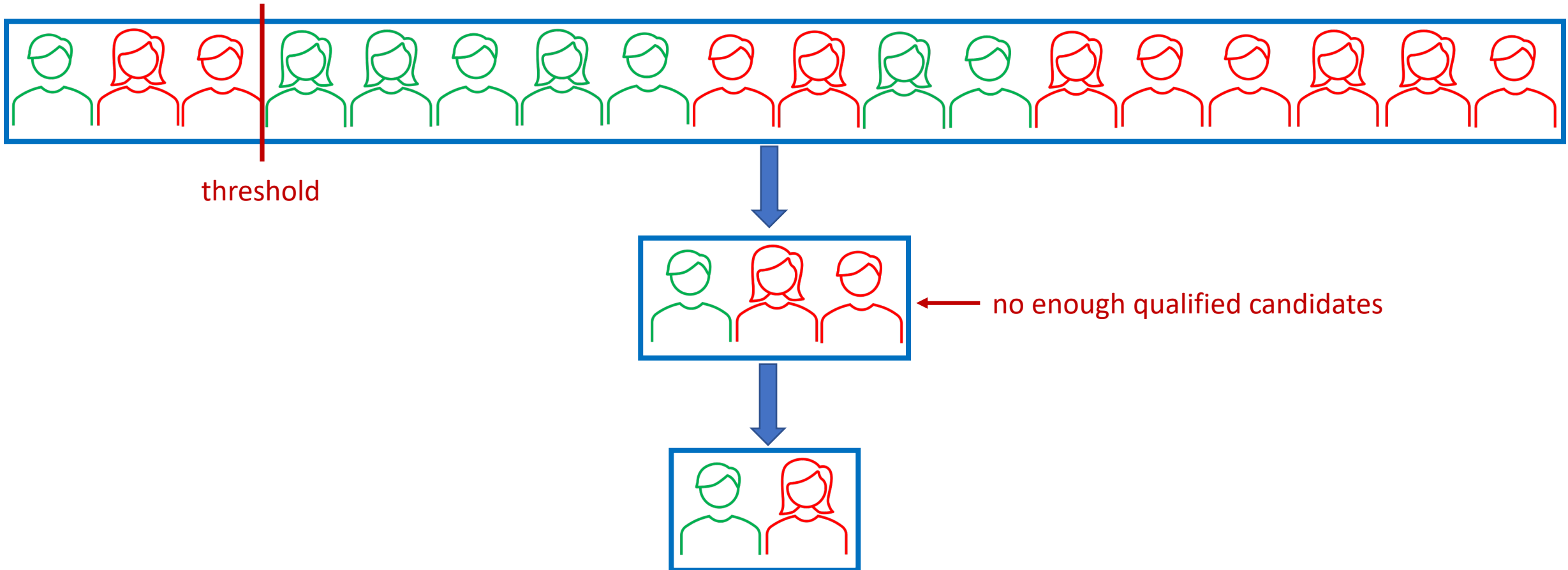


threshold



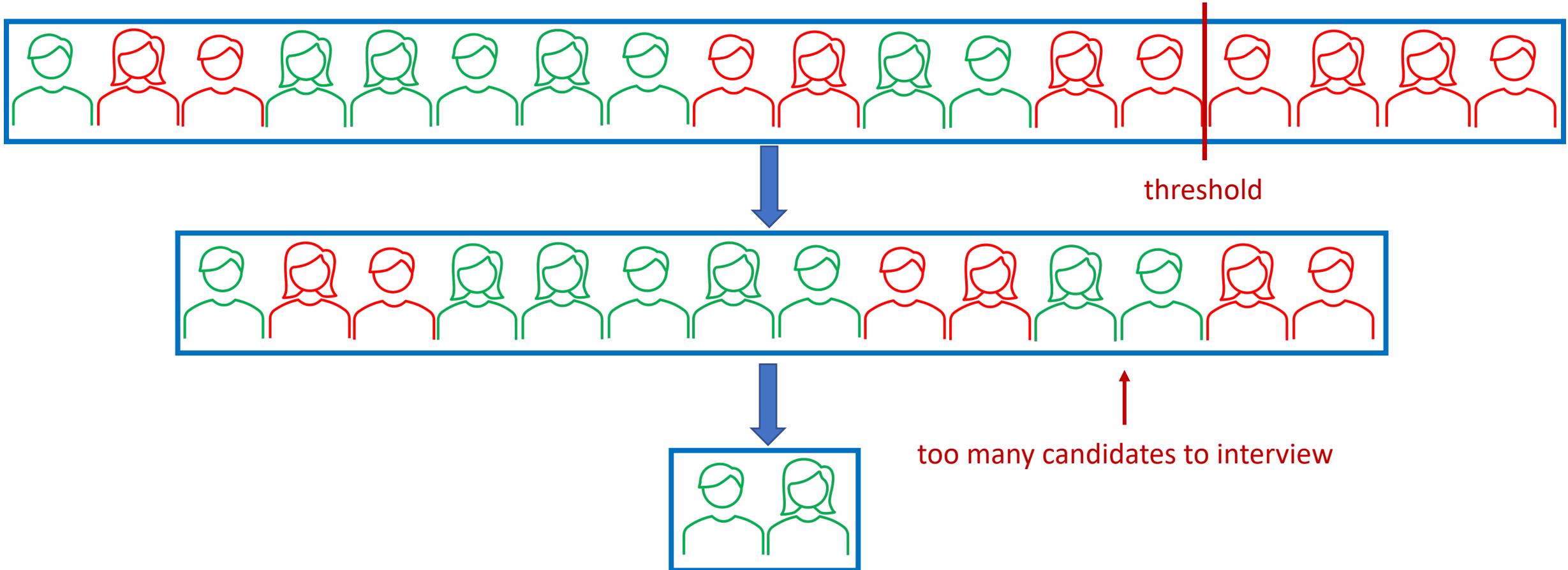
Objectives of Screening: Enough Qualified

ranking by quality scores (left higher)



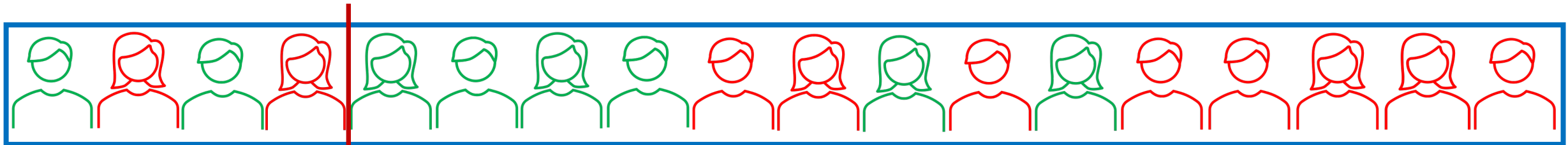
Objectives of Screening : Small Shortlists

ranking by quality scores (left higher)

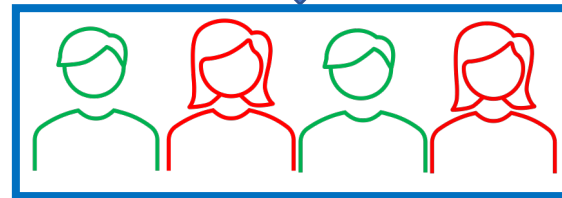


Objectives of Screening : Diversity

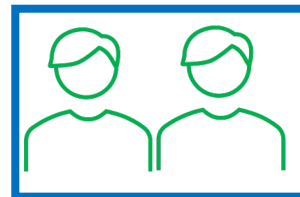
ranking by quality scores (left higher)



threshold

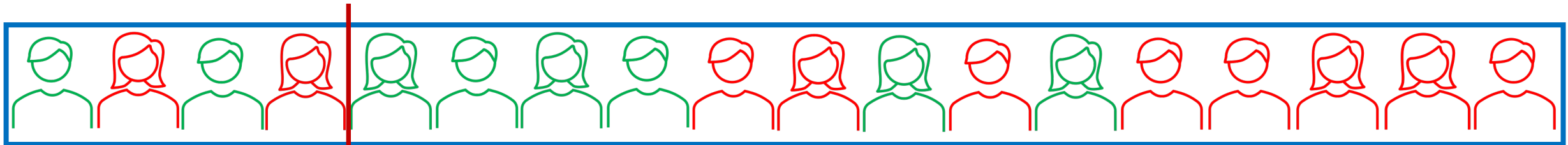


← unfair to female candidates



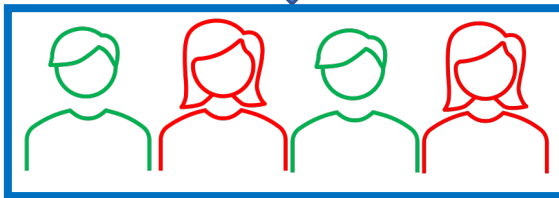
Objectives of Screening : Diversity

ranking by quality scores (left higher)

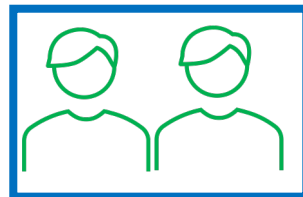


threshold

Possible reason: classifier is less accurate for female applicants.

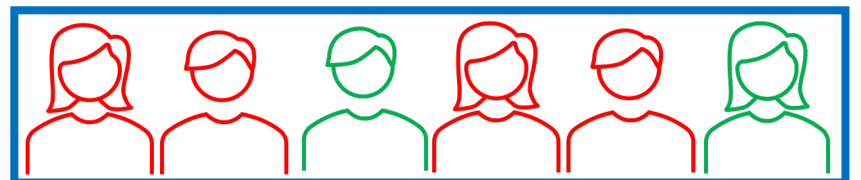
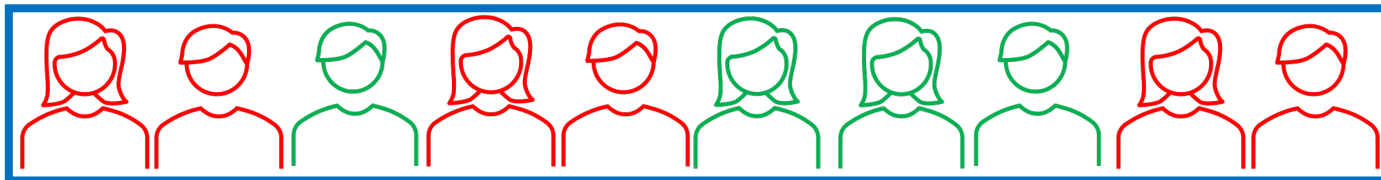
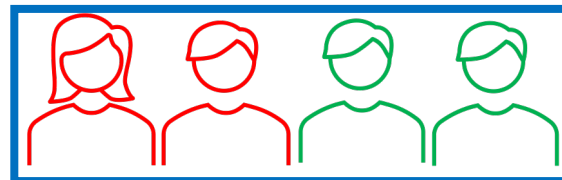
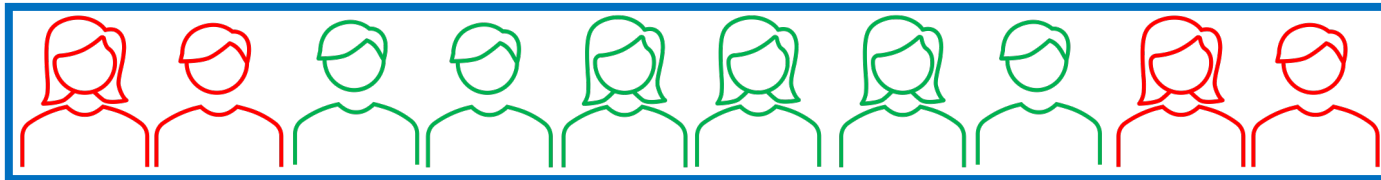
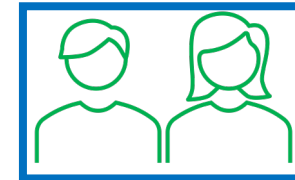
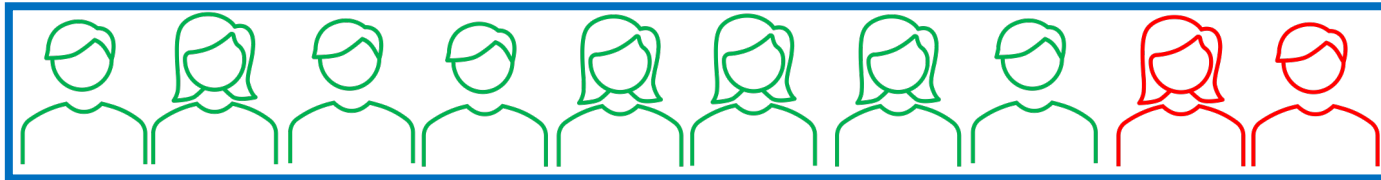


← unfair to female candidates



Individual Guarantee on “Enough Qualified” and “Small Shortlists”

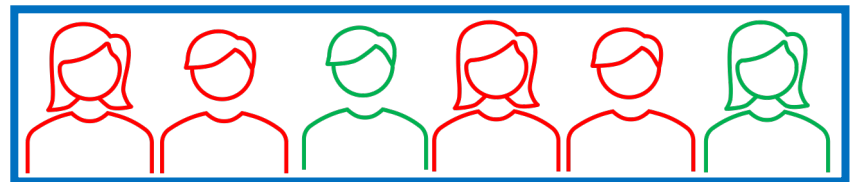
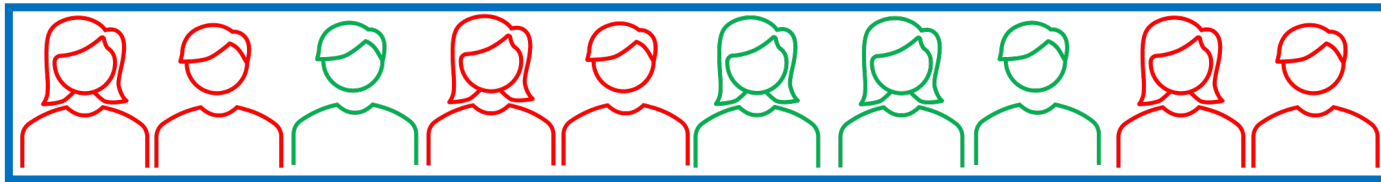
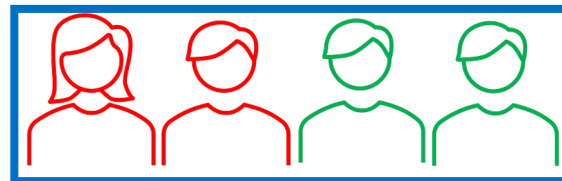
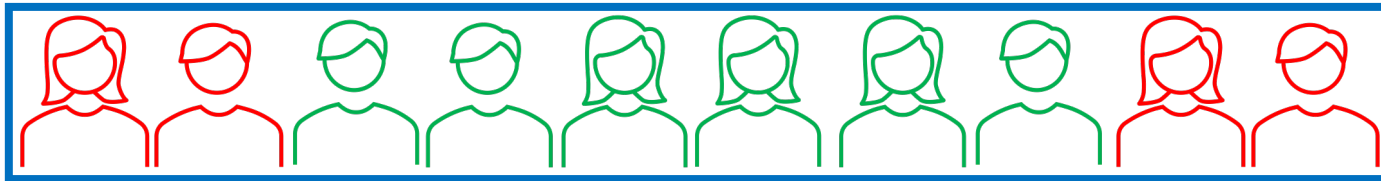
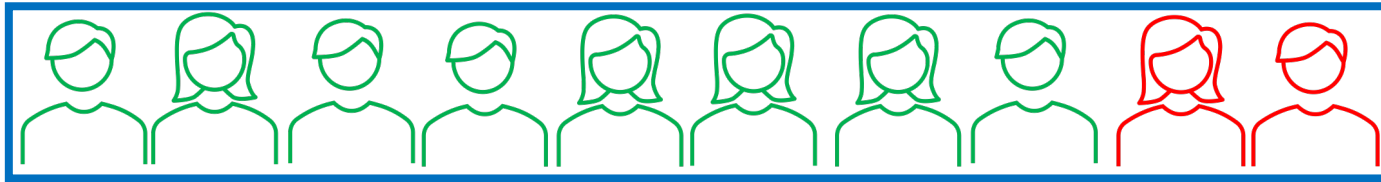
all possible pools of candidates



largest thresholds such that we select enough (2) qualified candidates for **each** pool

Individual Guarantee on “Enough Qualified” and “Small Shortlists”

all possible pools of candidates

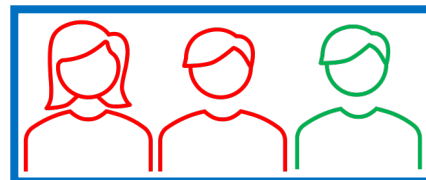
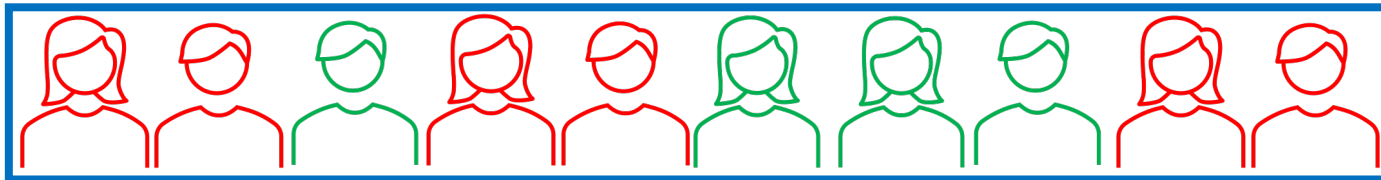
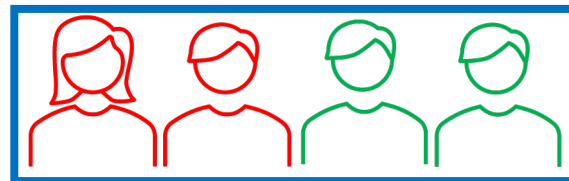
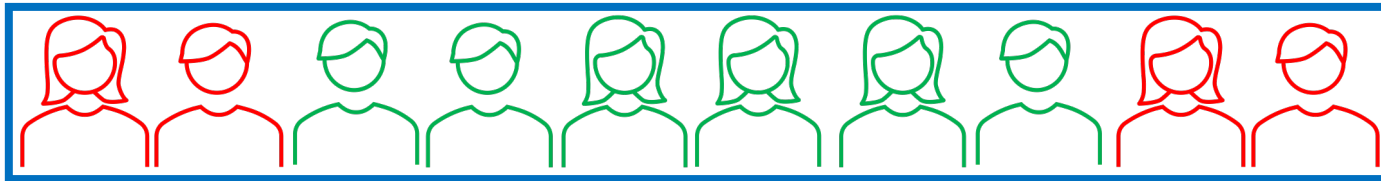
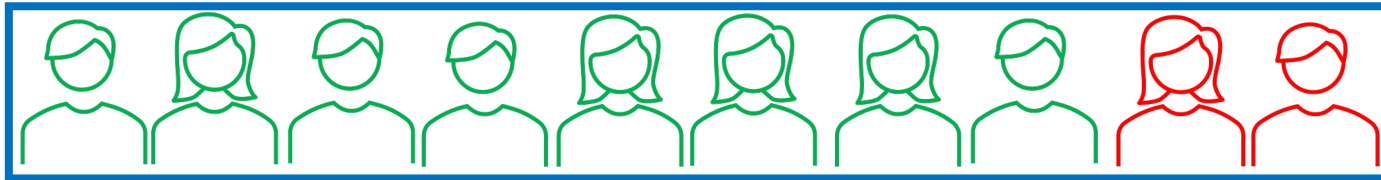


largest thresholds such that we select enough (2) qualified candidates for **each** pool

Impossible! (without unreasonable assumption)

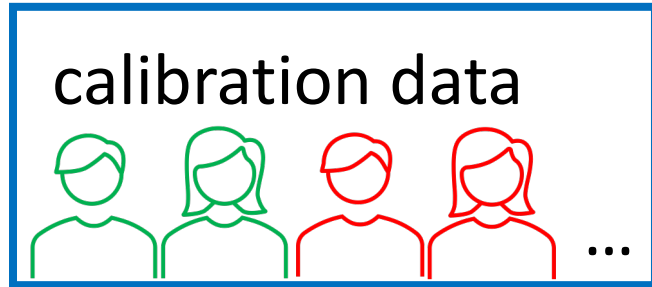
Marginal Guarantee on “Enough Qualified” and “Small Shortlists”

all possible pools of candidates

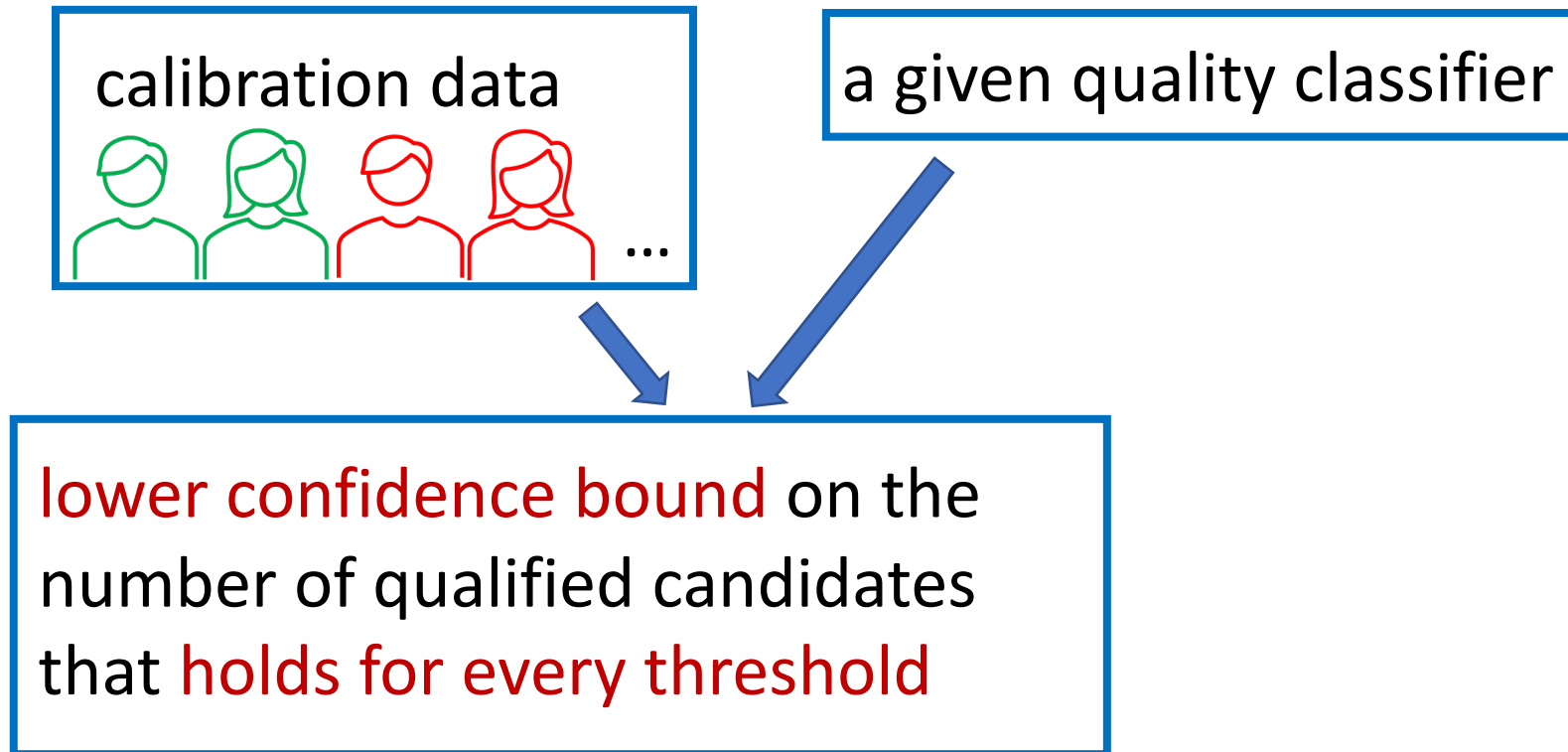


largest threshold such that we select enough (2) qualified candidates **in expectation** over the pools

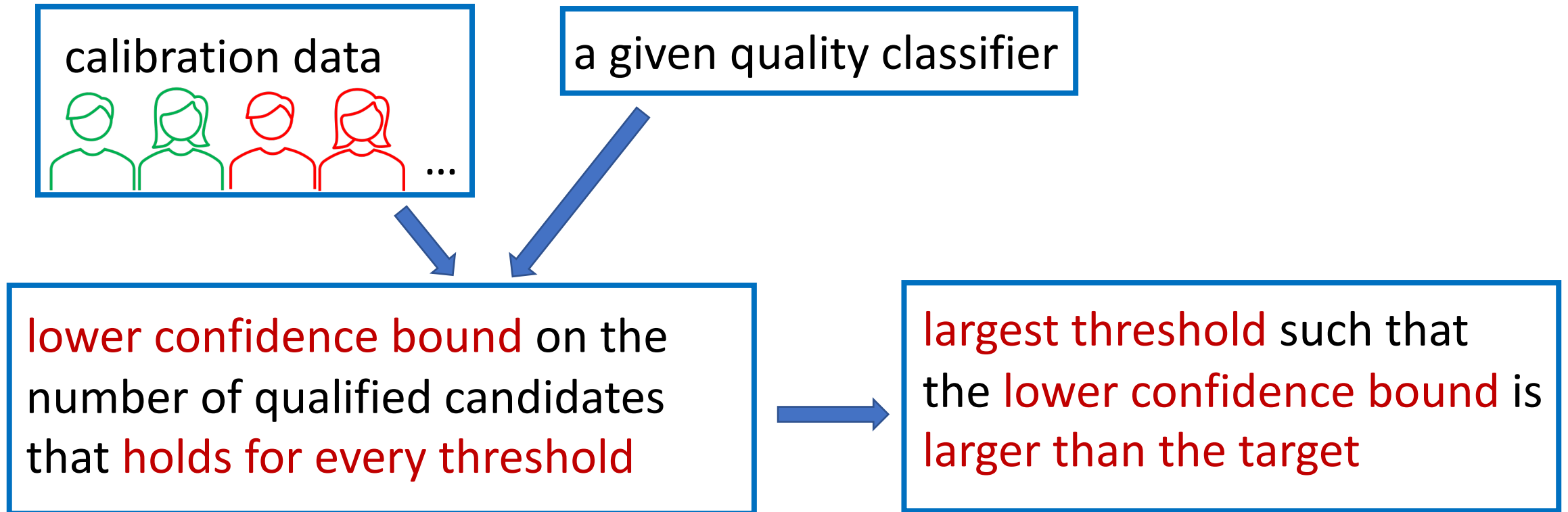
Near-Optimal Threshold: Calibrated Subset Selection (CSS) Algorithm



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Near-Optimal Threshold: Calibrated Subset Selection (CSS) Algorithm



Near-Optimality of CSS

Proposition (informal). *Under mild assumptions, for any $\alpha \in (0, 1)$, with probability at least $1 - \alpha$, CSS selects at most*

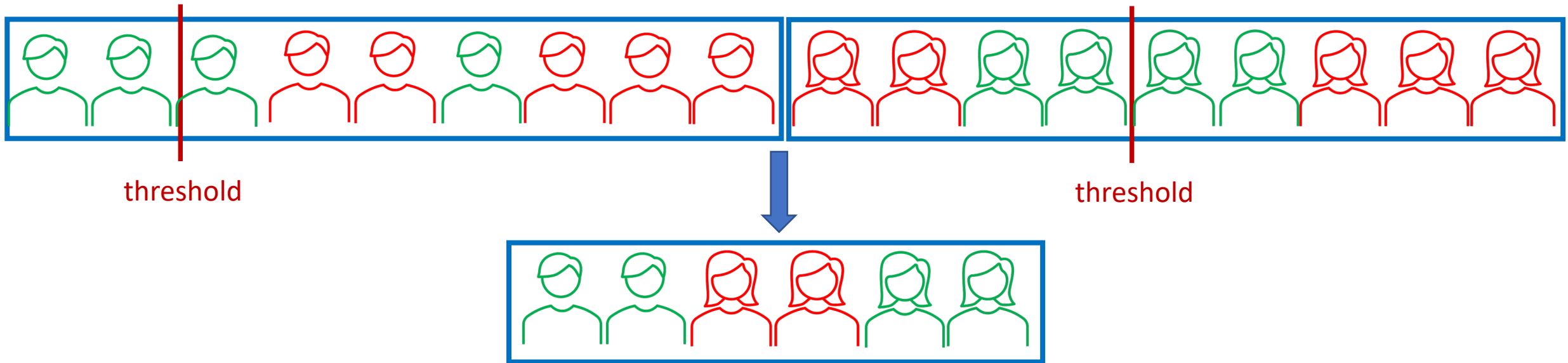
$$\frac{m}{n} + m\sqrt{2 \ln(2/\alpha)/n}$$

m : number of candidates
 n : calibration data size

more qualified candidates than the optimal threshold.

CSS Diversity Algorithm

Ranking: by quality scores (left higher)



For More Information Including Experiments

- Paper: <https://arxiv.org/abs/2202.01147>
- Code: <https://github.com/LequnWang/Improve-Screening-via-Calibrated-Subset-Selection>
- Come to Our Poster!

Thank you!