Popularity Bias in Recommendation

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WP2: User Modelling, Personalization and Engagement

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Research Centre for Responsible Media Technology & Innovation

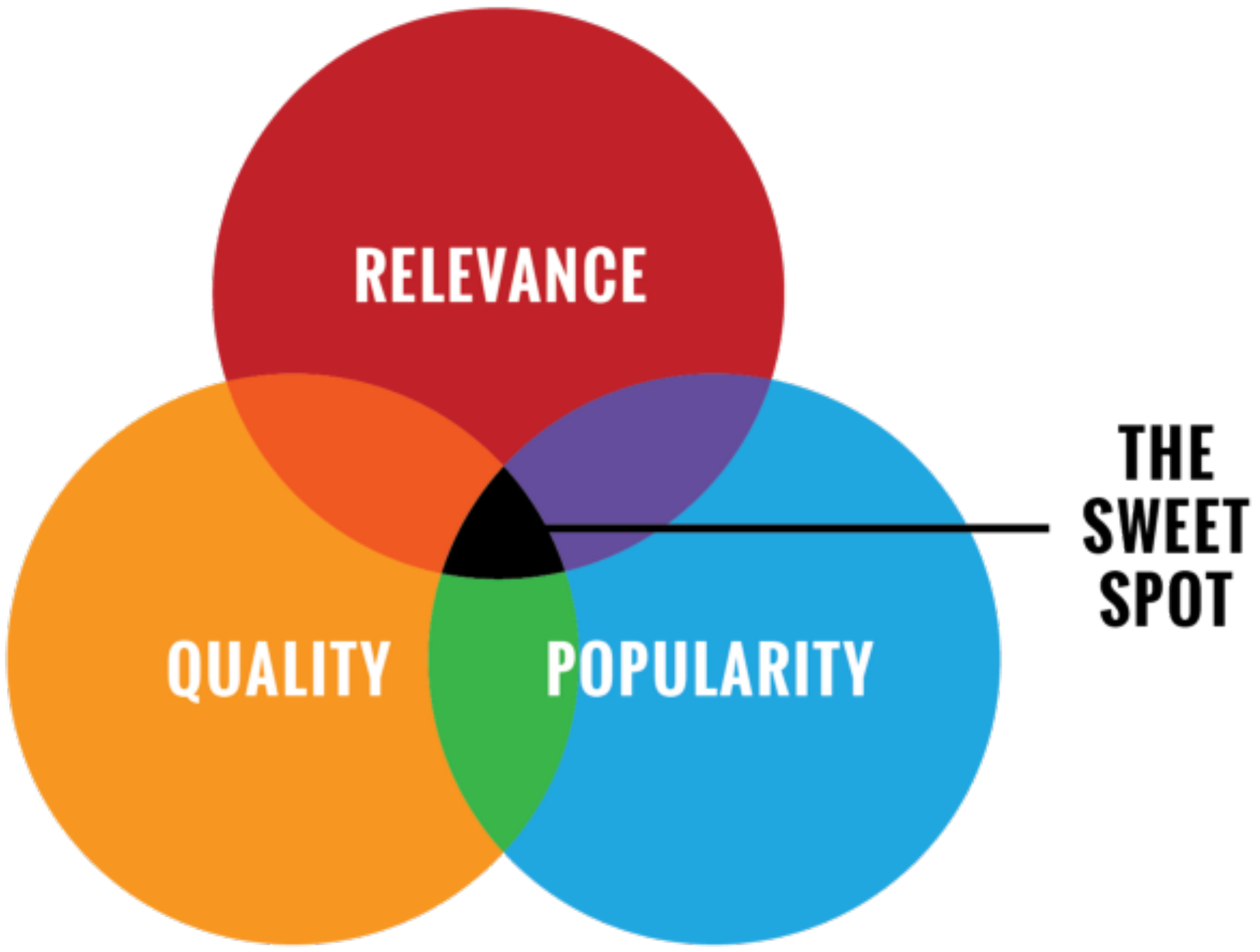
Project number 309339

Undesired Effects

- Echo chambers
- Filter bubbles
- Popularity bias
- Unfairness
- Discrimination
- Lack of diversity

Image source: https://medium.com/the-graph/popularity-vs-diversity-c5bc22c253ee, https://www.nbcnews.com/better/lifestyle/problem-social-media-reinforcement-bubbles-what-you-can-do-about-ncna1063896, https://theconversation.com/the-problem-of-living-inside-echo-chambers-110486

Can we recommend more diverse items in terms of popularity, which are still engaging, relevant and interesting to people?



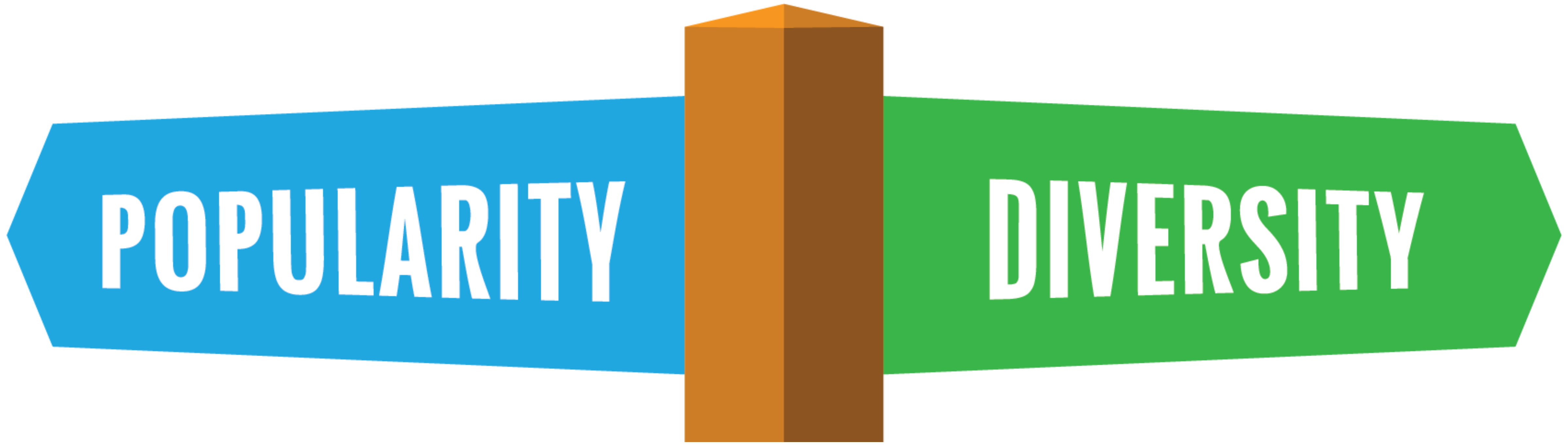


Image source: https://medium.com/the-graph/popularity-vs-diversity-c5bc22c253ee, https://medium.com/the-graph/popularity-vs-diversity-c5bc22c253ee

Research Track

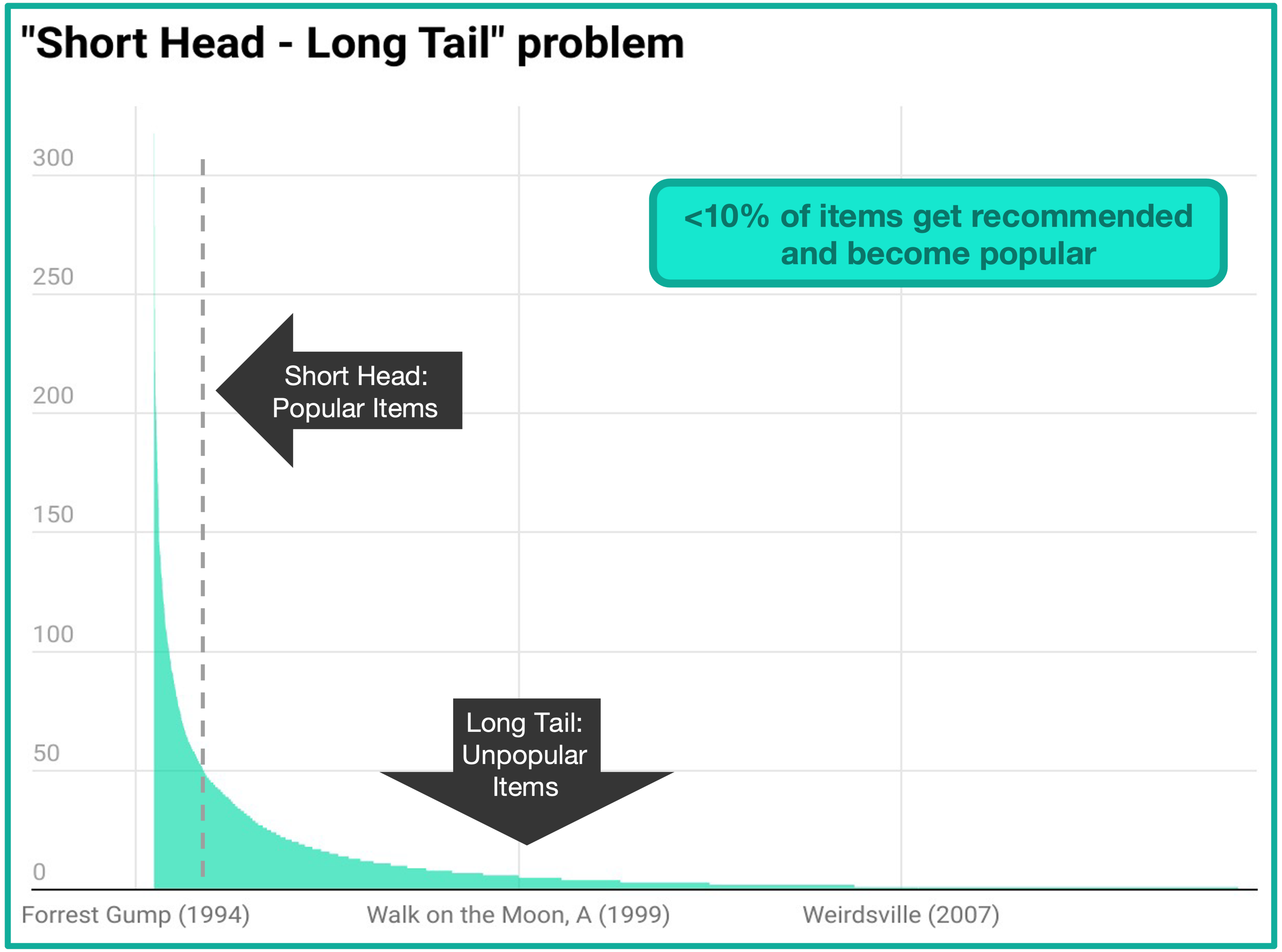
1. Identify the issue
2. Research state of the art
3. Pick / Upgrade a method
4. Offline testing and experiments
5. Deployment and online testing

Popularity Bias

- **“Matthew Effect”**
- **“Rich Getting Richer”**

Why is it bad?

- Decreases diversity of recommendation
- Can potentially lead to user dissatisfaction and lower engagement
- Can lead to provider withdrawal from the platform that makes the recommendation



Solutions

Pre-Processing

- Adjusting bias in training data
- Not many techniques existing

In-Processing

- Sophisticated algorithm tuning
- Need to replace the recommendation model

Post-Processing

- Easily implements on top of existing model
- Works with biased recommendation

Solutions

Pre-Processing

- 🟢 Adjusting bias in training data
- 🔴 Not many techniques existing

In-Processing

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- 🔴 Need to replace the recommendation model

Post-Processing

- 🟢 Easily implements on top of existing model
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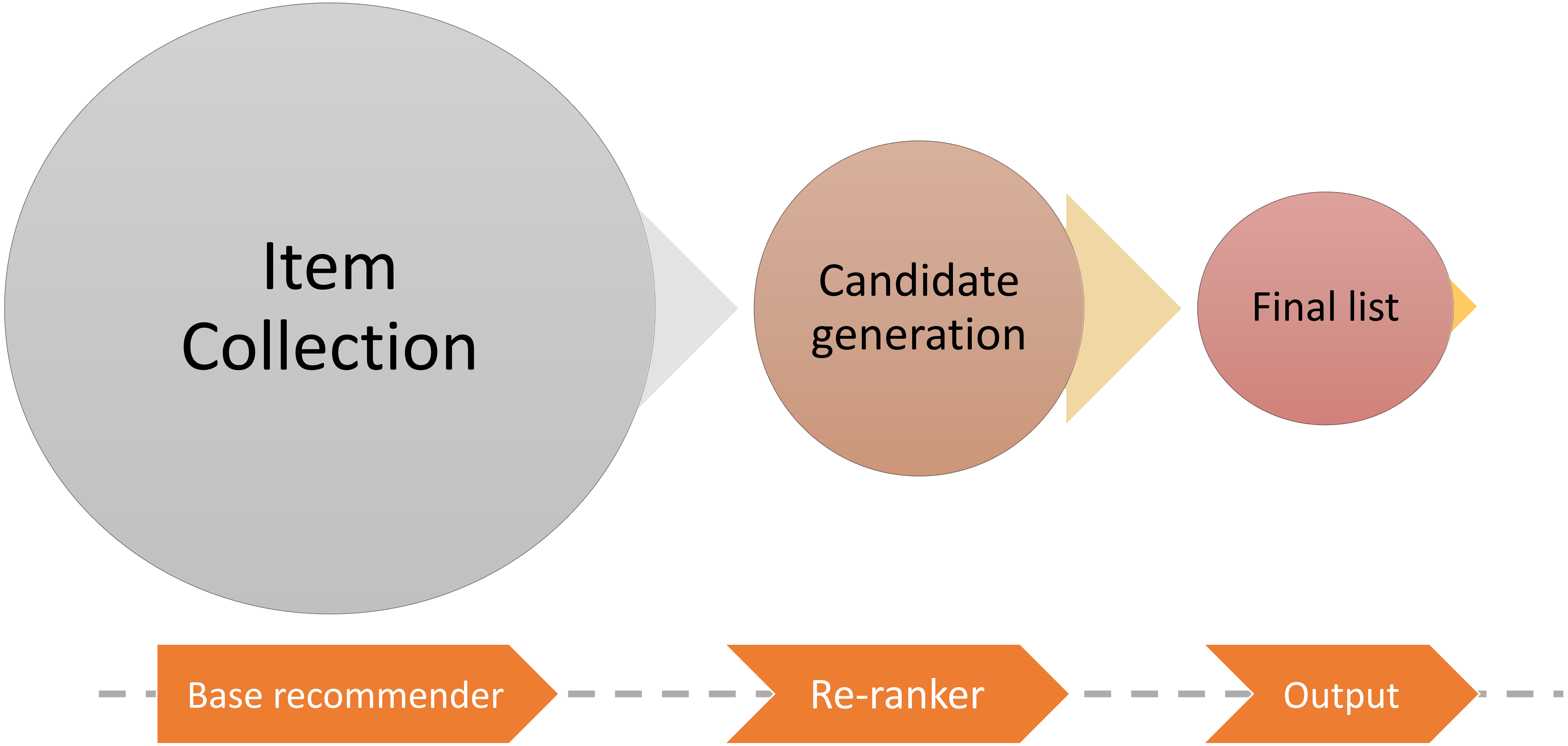
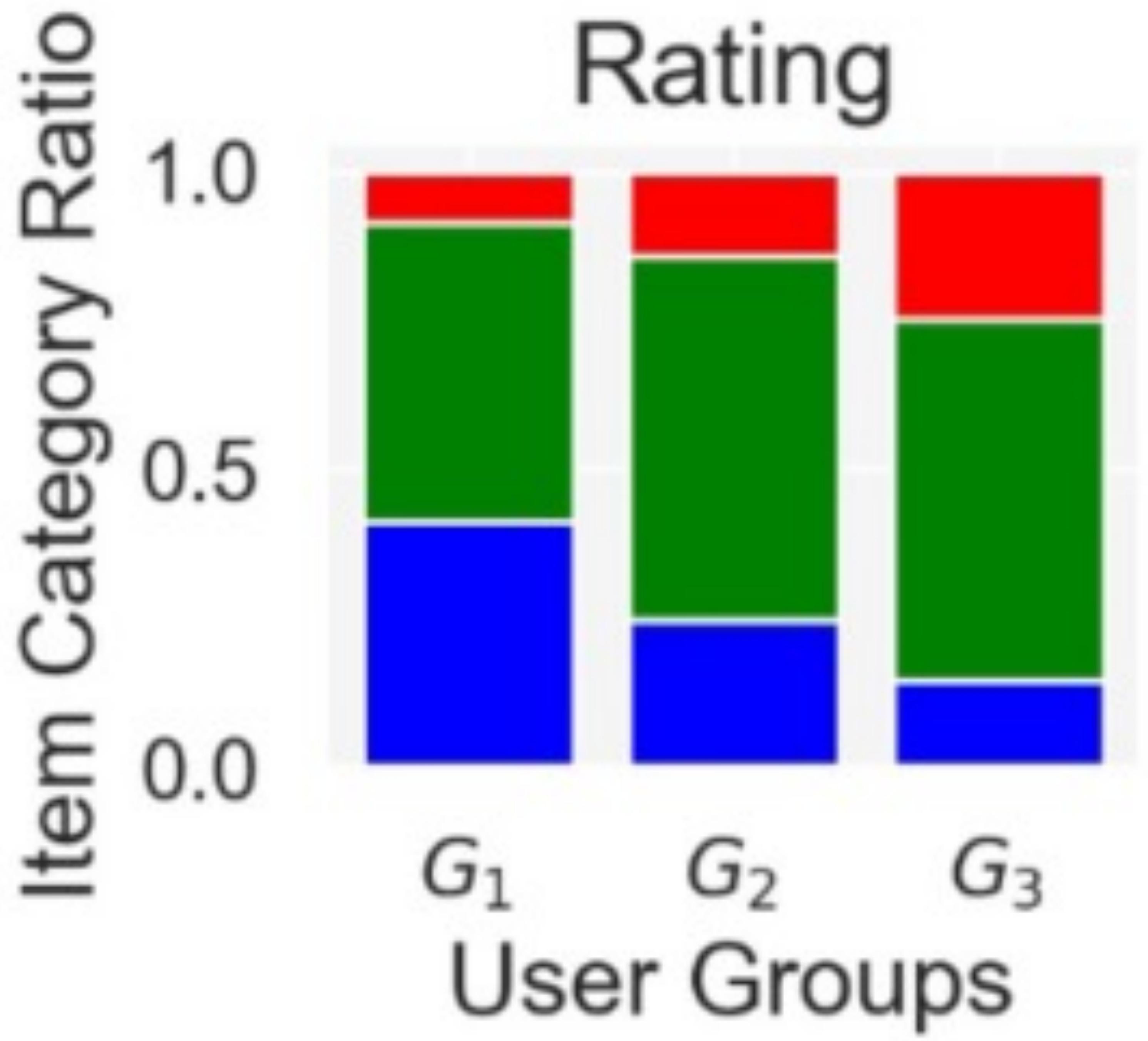
Post-Processing: Re-ranking



Calibrated Popularity

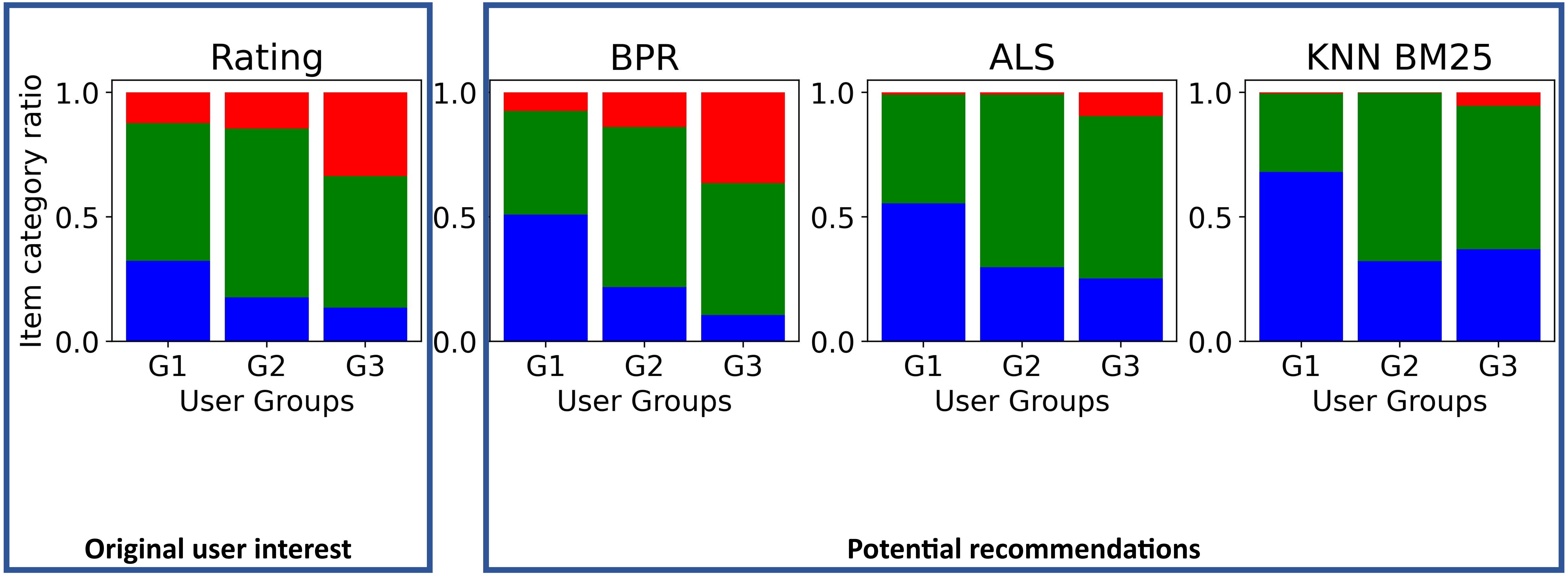
(**G1**) - “Mainstream” lovers
(**G2**) - Users with diverse preferences
(**G3**) - “Niche” lovers



- Very popular items
- Mid-popular tems
- Niche unpopular items

Preliminary Experiments

Very popular items
Mid-popular tems
Niche unpopular items



Offline Testing

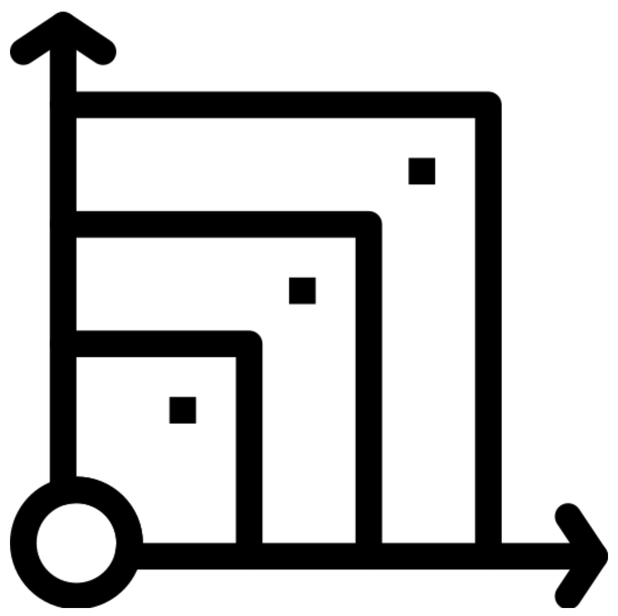
Dataset	Algorithm	Accuracy	Calibration	Long Tail Exposure			Equal Exposure	
		Prec ↑	*UPD* ↓	*ARP* ↓	*APLT* ↑	*ACLT* ↑	*Agg-Div* ↑	*Gini* ↓
TV 2	**Pop**	0.301	0.644	0.301	0.000	0.000	0.006	0.994
	Base (ALS)	**0.875**	0.286	0.143	0.639	0.292	0.321	0.874
	XQ	0.818	0.358	**0.100**	**0.956**	**0.364**	0.343	0.850
	FS	0.857	0.249	0.126	0.772	0.299	0.328	0.856
	CP	0.837	**0.123**	0.130	0.672	0.314	**0.392**	**0.844**
ML	**Pop**	0.381	0.629	0.381	0.000	0.000	0.007	0.993
	Base (ALS)	**0.738**	0.261	0.243	0.634	0.391	0.425	0.851
	XQ	0.656	0.378	**0.167**	**0.989**	**0.442**	0.412	0.848
	FS	0.697	0.237	0.202	0.839	0.397	0.432	0.835
	CP	0.720	**0.101**	0.223	0.676	0.408	**0.477**	**0.821**

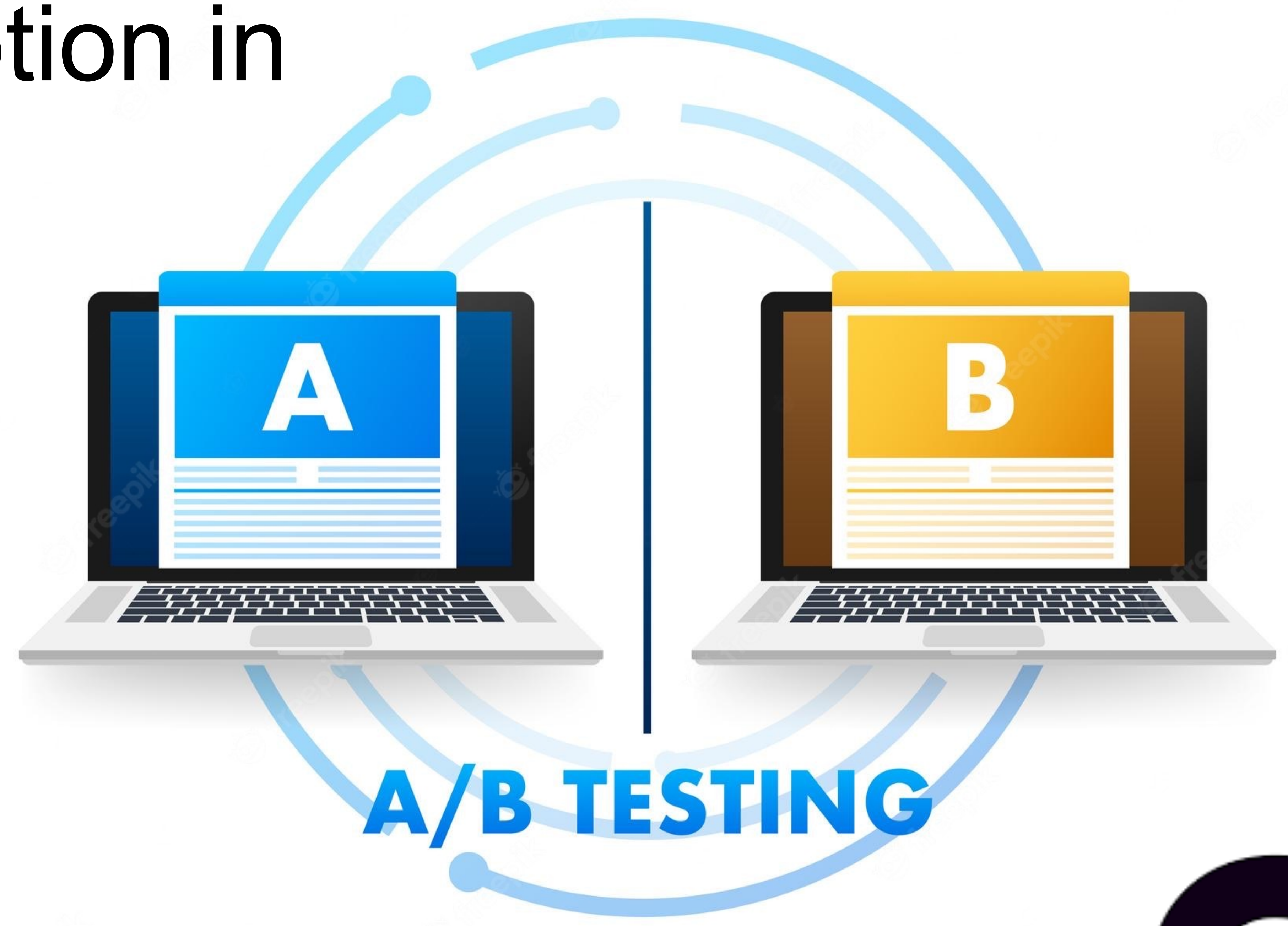
- Define set of metrics
- Get datasets
- Testing against other algorithms
- Make sure the chosen strategy works well enough for later live testing

Online A/B Testing

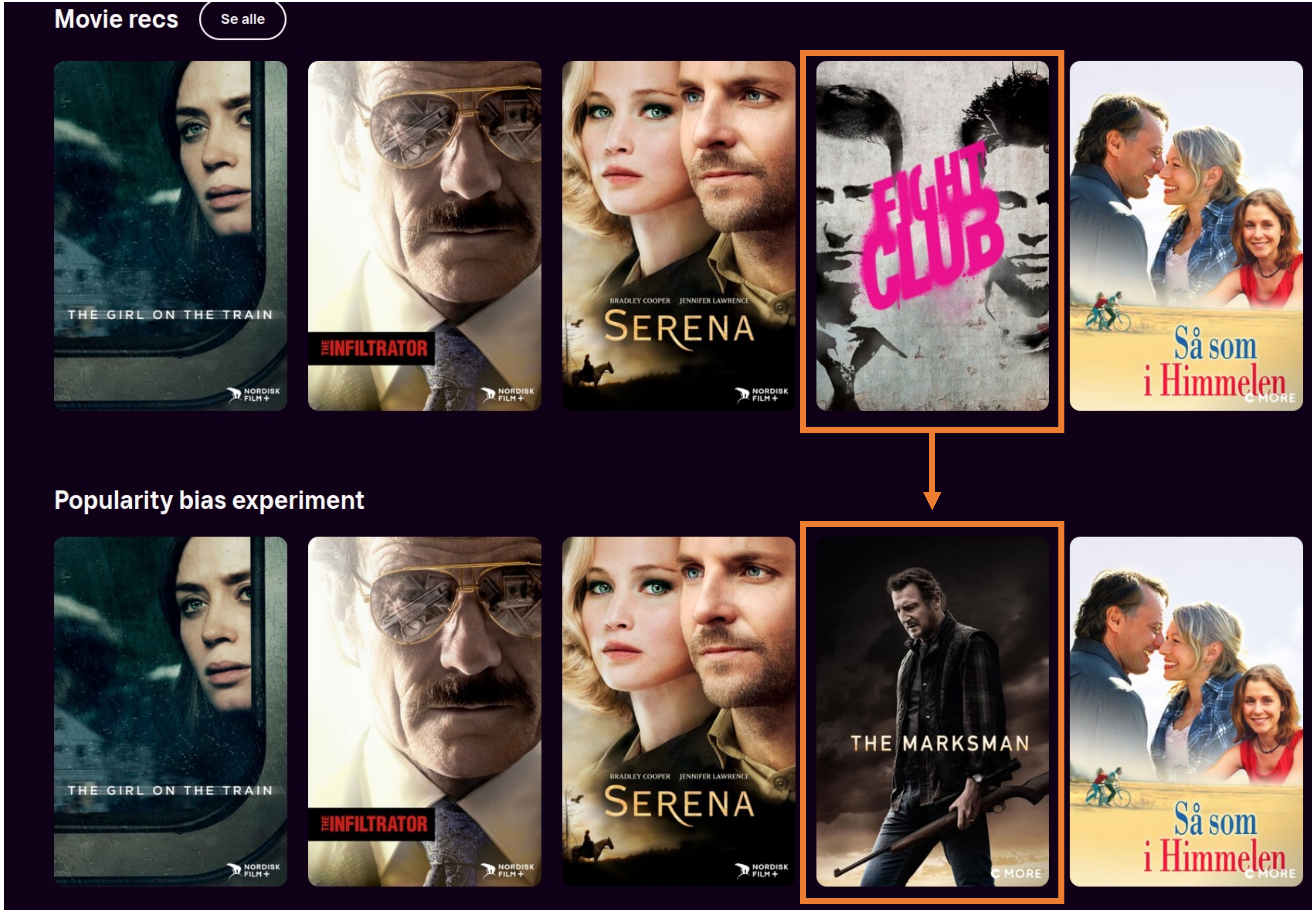
Assess user satisfaction and perception in real life scenario:

- Less biased setting
- Much greater user pool

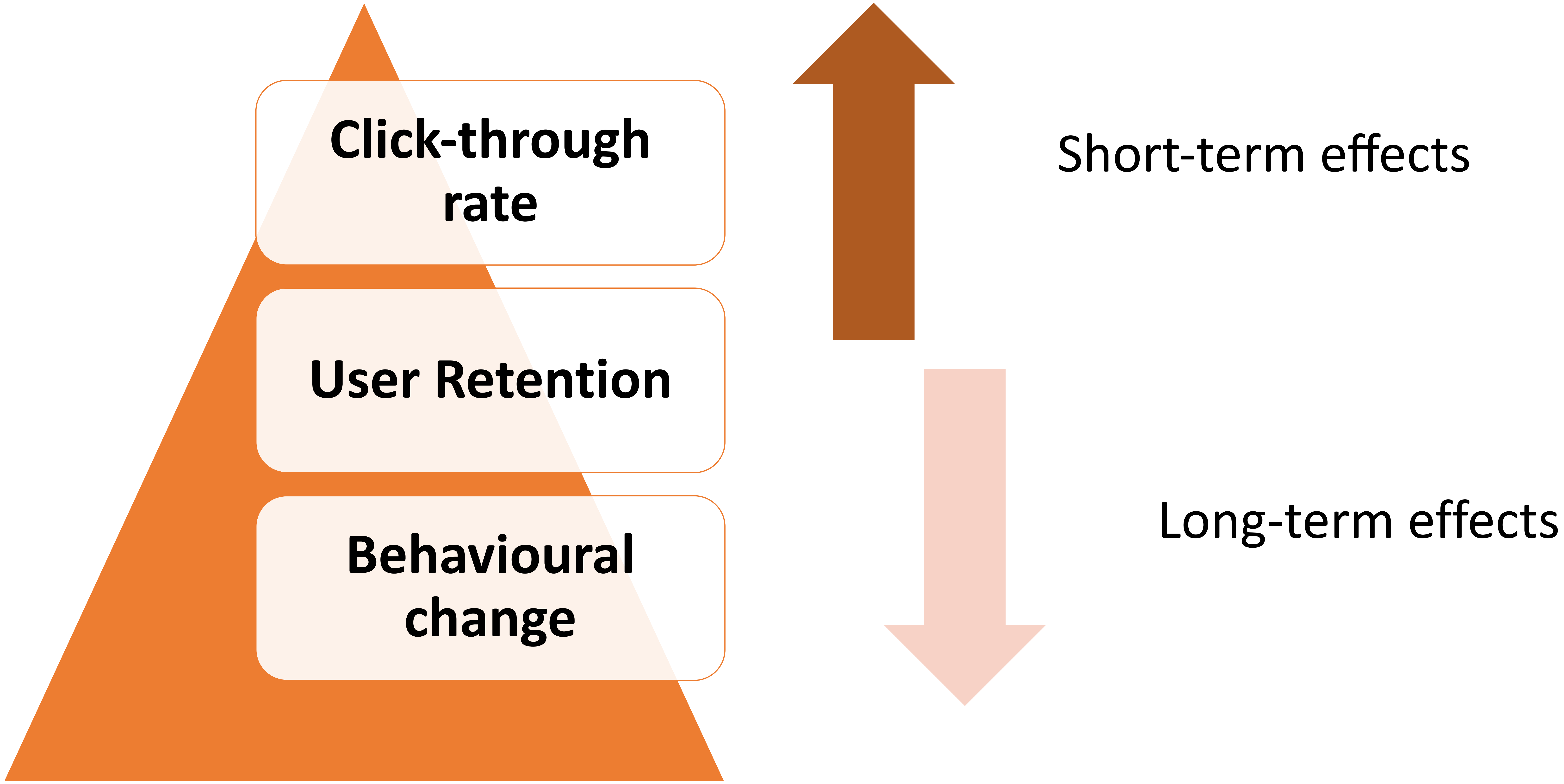




Academic ➡️ Industry: Scalability is important


Movie recs
Se alle
THE GIRL ON THE TRAIN
THE INFILTRATOR
BRADLEY COOPER JENNIFER LAWRENCE
SERENA
FIGHT CLUB
Så som i Himmelen
Popularity bias experiment
THE GIRL ON THE TRAIN
THE INFILTRATOR
BRADLEY COOPER JENNIFER LAWRENCE
SERENA
THE MARKSMAN
Så som i Himmelen

Online A/B Testing



Future Work

- More tests and experiments
- Qualitative analysis: user studies, questionnaires
- Algorithm modifications and improvements

Media Futures

Thank you!

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