extreme-scale ad-tech at MediaMath with Spark and Databricks

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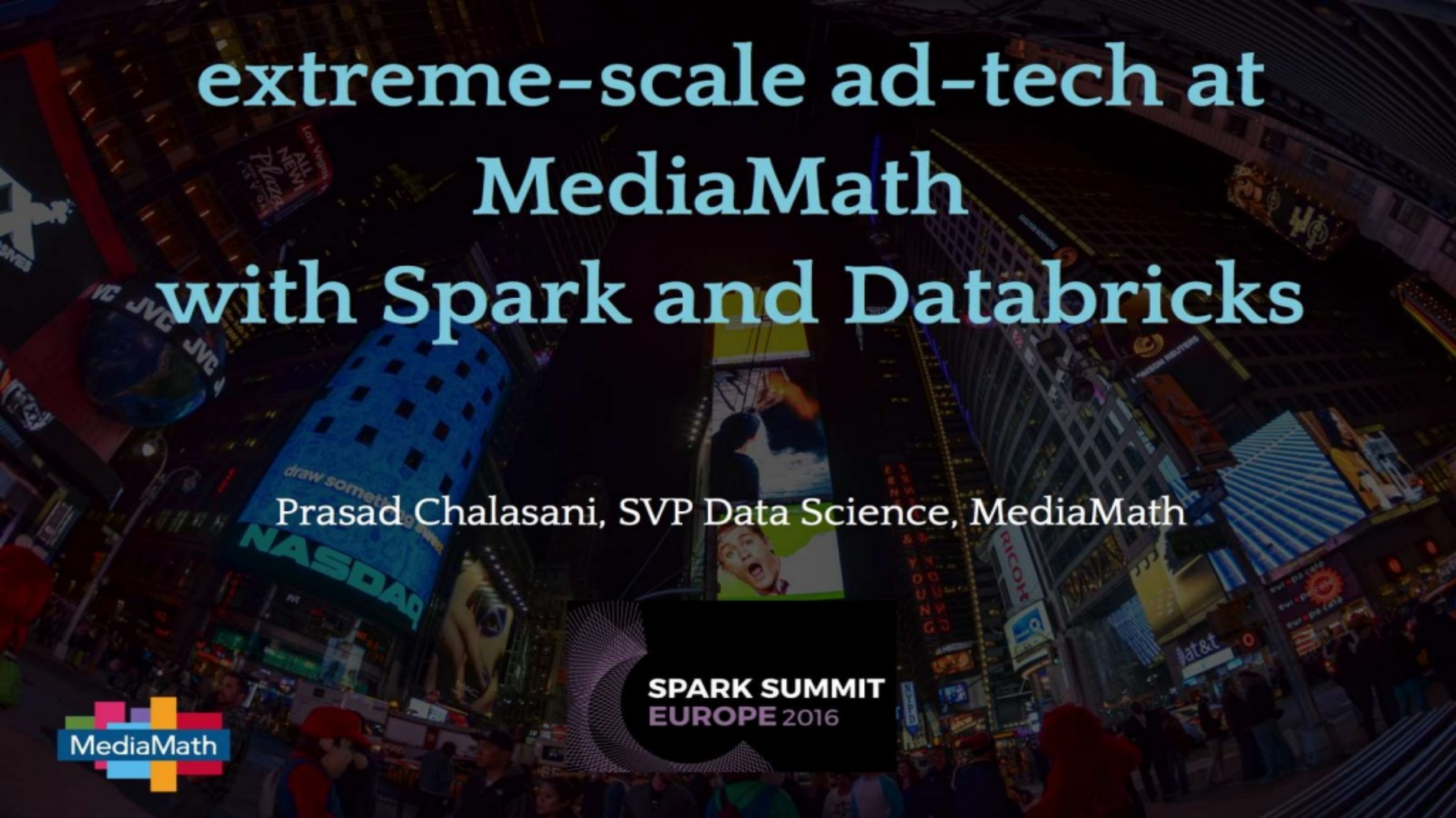
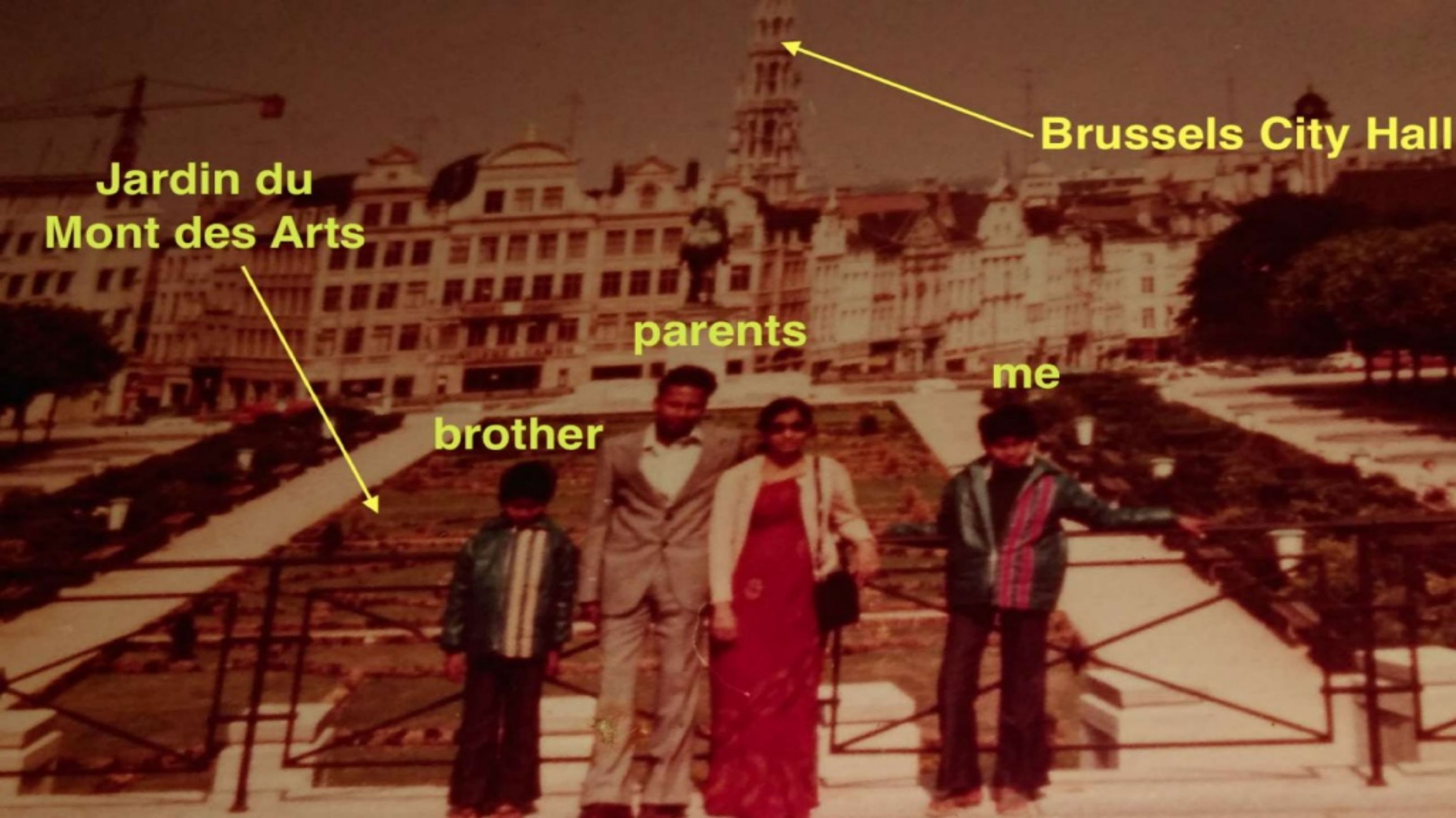



Brussels City Hall
Jardin du
Mont des Arts
parents
me
brother


digital display advertising
is a $25B/year business
MediaMath

a software platform for digital display advertising

we bid on the ad-exchanges
on behalf of ~10K campaigns
set up on our platform

40+ ad-exchanges send us 200B ad-opportunities daily (2-3 M/s)

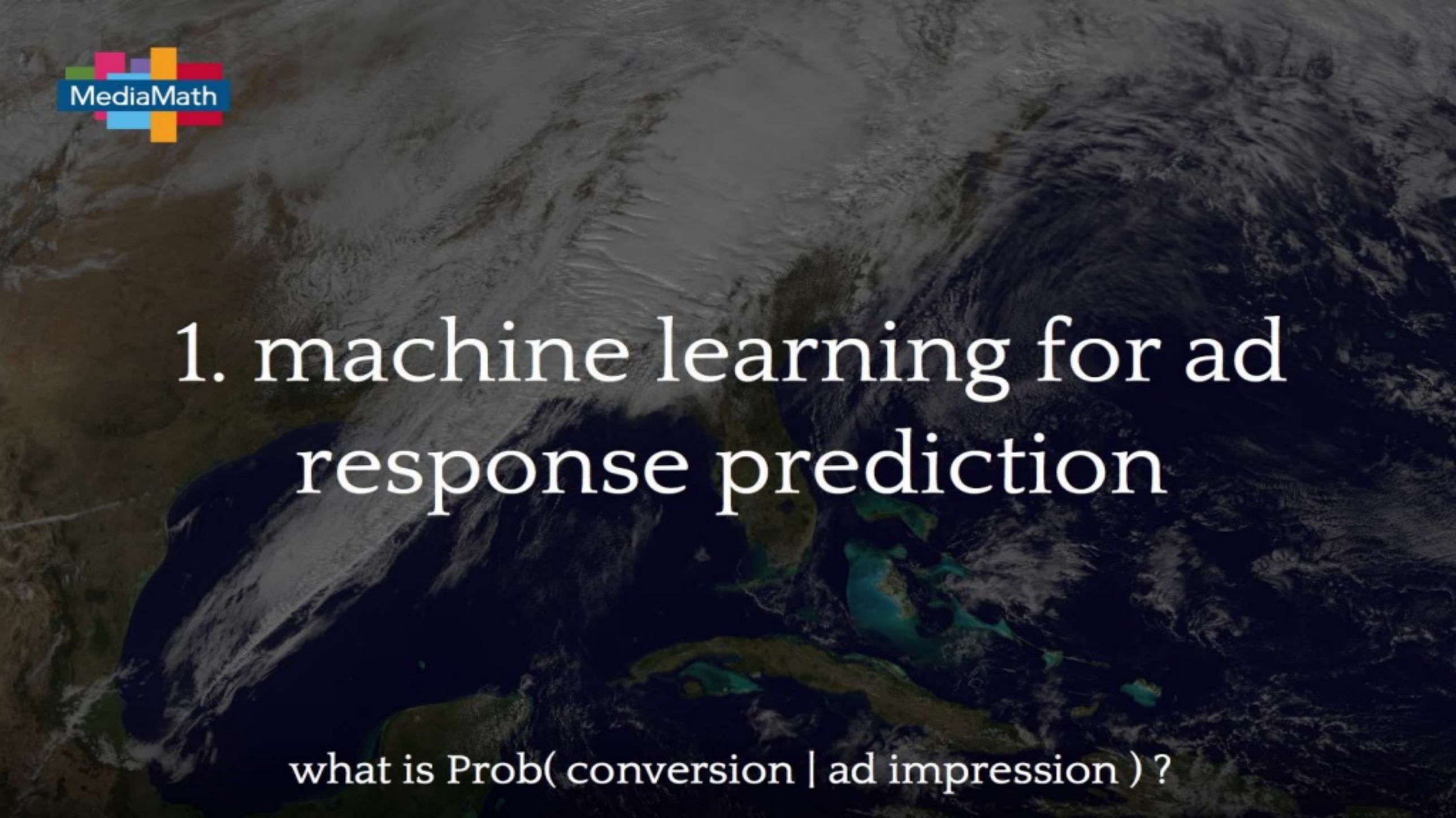
our bidders respond within 10 ms with:

- optimal campaign
- optimal bid price

powered by massive data

- 200 B daily ad-opportunities
- 1 B users (cookies)
- impressions, clicks, conversions, page-visits
- millions of sparse features
- terabytes of daily data

large-scale data applications with Spark @ MediaMath


MediaMath
1. machine learning for ad response prediction
what is Prob(conversion | ad impression) ?


optimal bid price depends on
Prob(conversion | ad impression)
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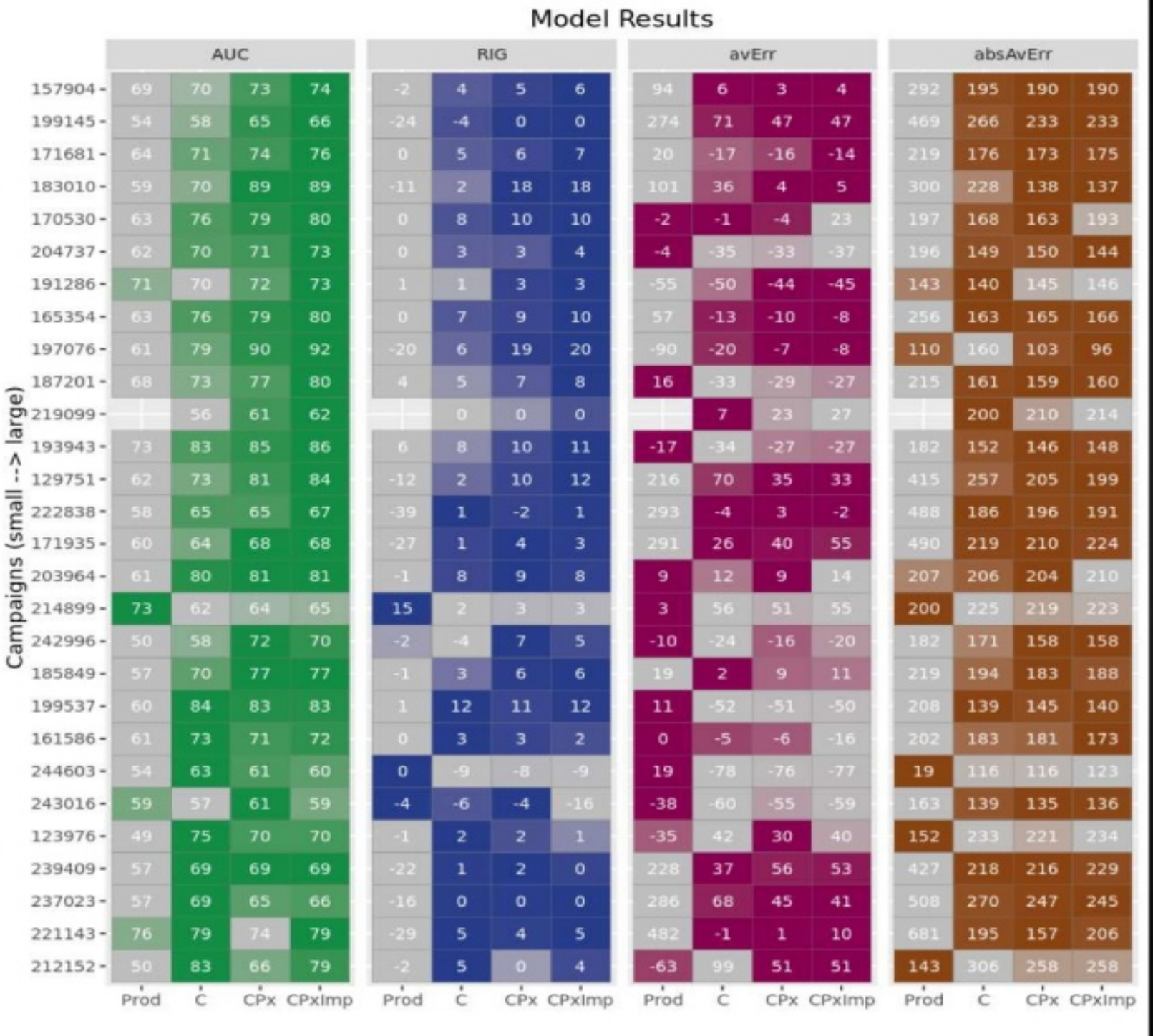
- model for each campaign
- logistic regression
- stochastic gradient descent
- online learning (incremental)
- implemented in Scala + Spark

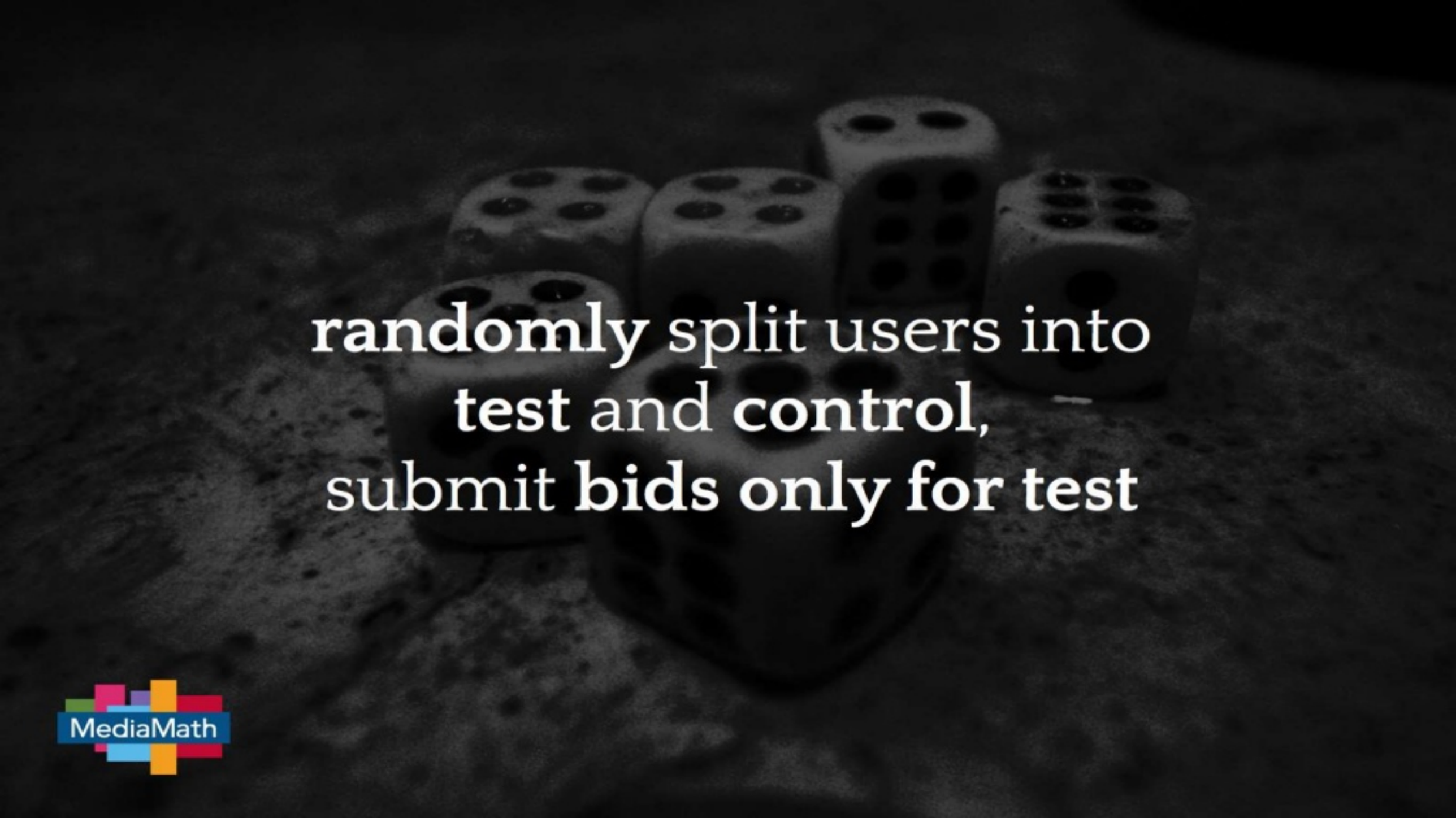
Databricks visualization:

- many campaigns
- model variations
- calibration methods
- ML metrics (AUC, LogLoss, ...)


Model Results
AUC
RIG
avErr
absAvErr
Campaigns (small --> large)
157904 69 70 73 74 -2 4 5 6 94 6 3 4 292 195 190 190
199145 54 58 65 66 -24 -4 0 0 274 71 47 47 469 266 233 233
171681 64 71 74 76 0 5 6 7 20 -17 -16 -14 219 176 173 175
183010 59 70 89 89 -11 2 18 18 101 36 4 5 300 228 138 137
170530 63 76 79 80 0 8 10 10 -2 -1 -4 23 197 168 163 193
204737 62 70 71 73 0 3 3 4 -4 -35 -33 -37 196 149 150 144
191286 71 70 72 73 1 1 3 3 -55 -50 -44 -45 143 140 145 146
165354 63 76 79 80 0 7 9 10 57 -13 -10 -8 256 163 165 166
197076 61 79 90 92 -20 6 19 20 -90 -20 -7 -8 110 160 103 96
187201 68 73 77 80 4 5 7 8 16 -33 -29 -27 215 161 159 160
219099 56 61 62 0 0 0 7 23 27 200 210 214
193943 73 83 85 86 6 8 10 11 -17 -34 -27 -27 182 152 146 148
129751 62 73 81 84 -12 2 10 12 216 70 35 33 415 257 205 199
222838 58 65 65 67 -39 1 -2 1 293 -4 3 -2 488 186 196 191
171935 60 64 68 68 -27 1 4 3 291 26 40 55 490 219 210 224
203964 61 80 81 81 -1 8 9 8 9 12 9 14 207 206 204 210
214899 73 62 64 65 15 2 3 3 3 56 51 55 200 225 219 223
242996 50 58 72 70 -2 -4 7 5 -10 -24 -16 -20 182 171 158 158
185849 57 70 77 77 -1 3 6 6 19 2 9 11 219 194 183 188
199537 60 84 83 83 1 12 11 12 11 -52 -51 -50 208 139 145 140
161586 61 73 71 72 0 3 3 2 0 -5 -6 -16 202 183 181 173
244603 54 63 61 60 0 -9 -8 -9 19 -78 -76 -77 19 116 116 123
243016 59 57 61 59 -4 -6 -4 -16 -38 -60 -55 -59 163 139 135 136
123976 49 75 70 70 -1 2 2 1 -35 42 30 40 152 233 221 234
239409 57 69 69 69 -22 1 2 0 228 37 56 53 427 218 216 229
237023 57 69 65 66 -16 0 0 0 286 68 45 41 508 270 247 245
221143 76 79 74 79 -29 5 4 5 482 -1 1 10 681 195 157 206
212152 50 83 66 79 -2 5 0 4 -63 99 51 51 143 306 258 258
Prod C CPx CPxImp
Prod C CPx CPxImp
Prod C CPx CPxImp
Prod C CPx CPxImp

2. causal ad impact measurement

how much of response is driven by ad exposure?


randomly split users into
test and **control**,
submit **bids only for test**
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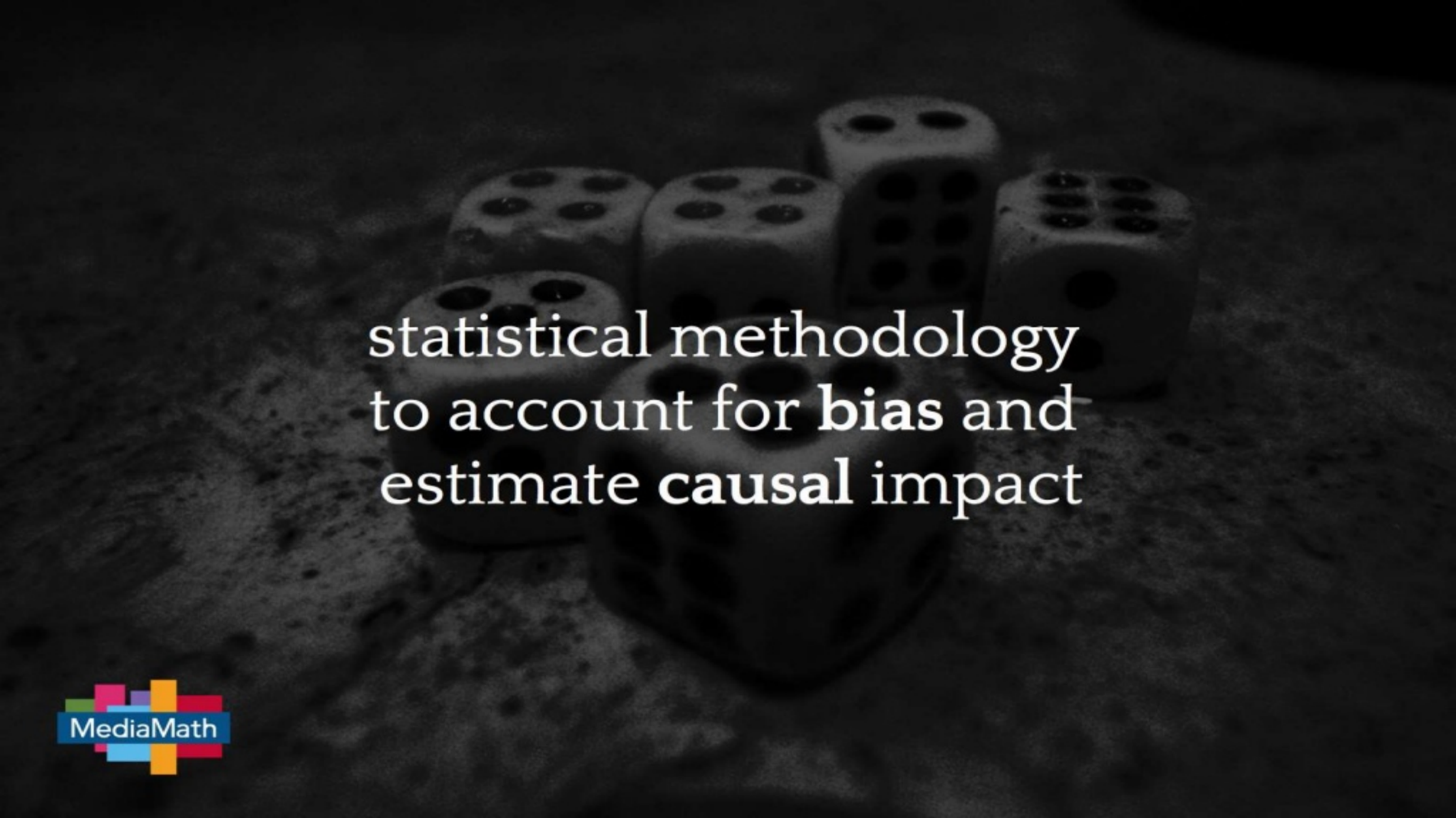
statistical methodology
to account for **bias** and
estimate **causal** impact
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Gibbs Sampling
for
confidence intervals
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runs daily in production
using Scala + Spark
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3. audience reach estimation
how many unique users satisfy targeting criteria?
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example targeting spec

- segment = **sports-enthusiast**
- country = **Belgium**
- dayOfWeek = **Sunday**
- deviceType = **iPad**
- channel = **Video**
- site = **economist.com**

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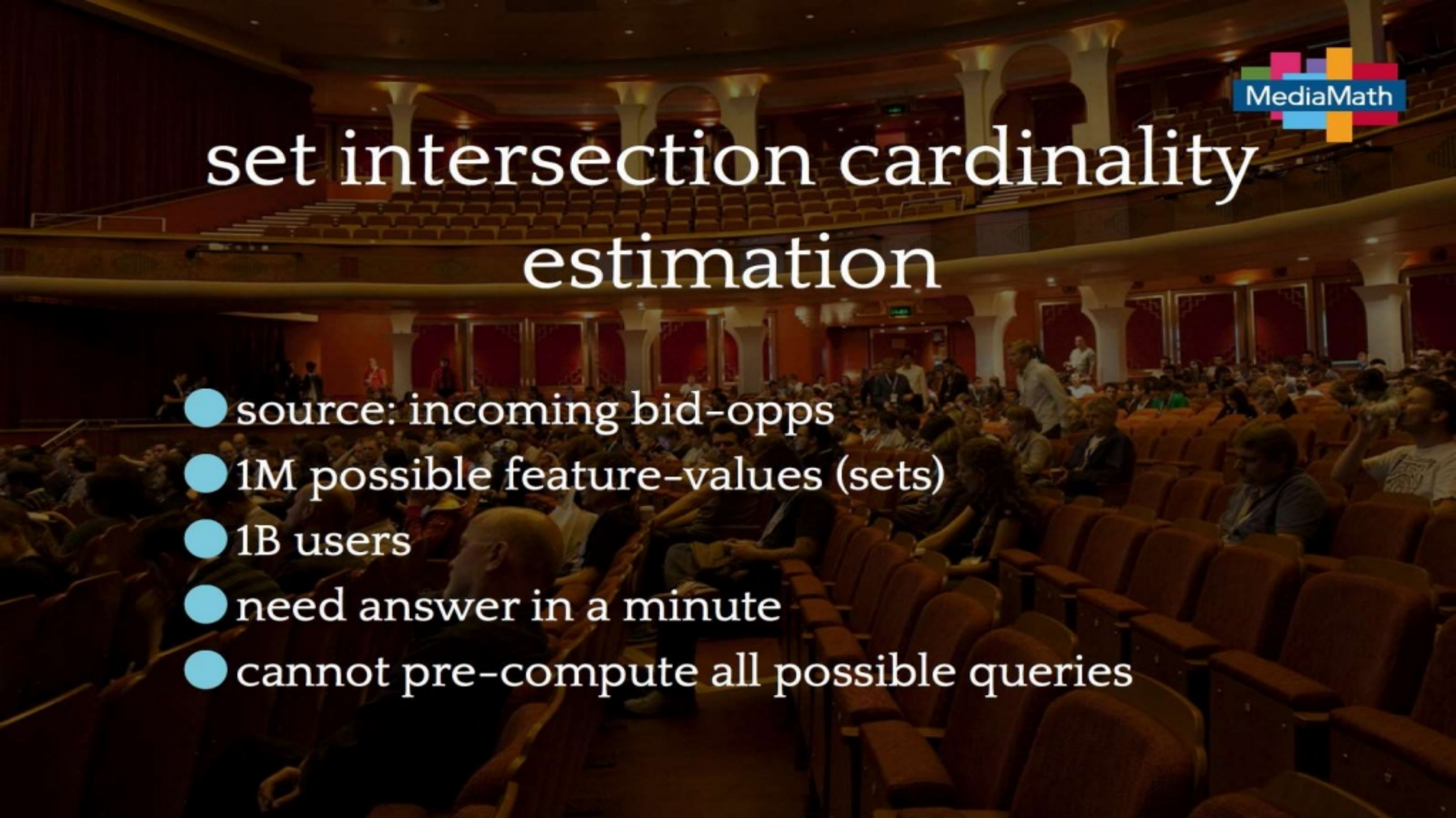

set intersection cardinality estimation

- source: incoming bid-opps
- 1M possible feature-values (sets)
- 1B users
- need answer in a minute
- cannot pre-compute all possible queries


offline:
k-minHash sketch in Redis/AWS for each set
Spark to update k-minHashes from bid-opps
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online (query-time):
retrieve k-minHash sketches for sets in query
compute intersection estimate fast
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other Spark applications at MediaMath

- attribution of response to ad-impressions
- predict win-rate as function of bid-price
- cross-device user identity

Databricks @ MediaMath

indispensable for productive data science

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quick ad-hoc analyses in scala, python, R, sql

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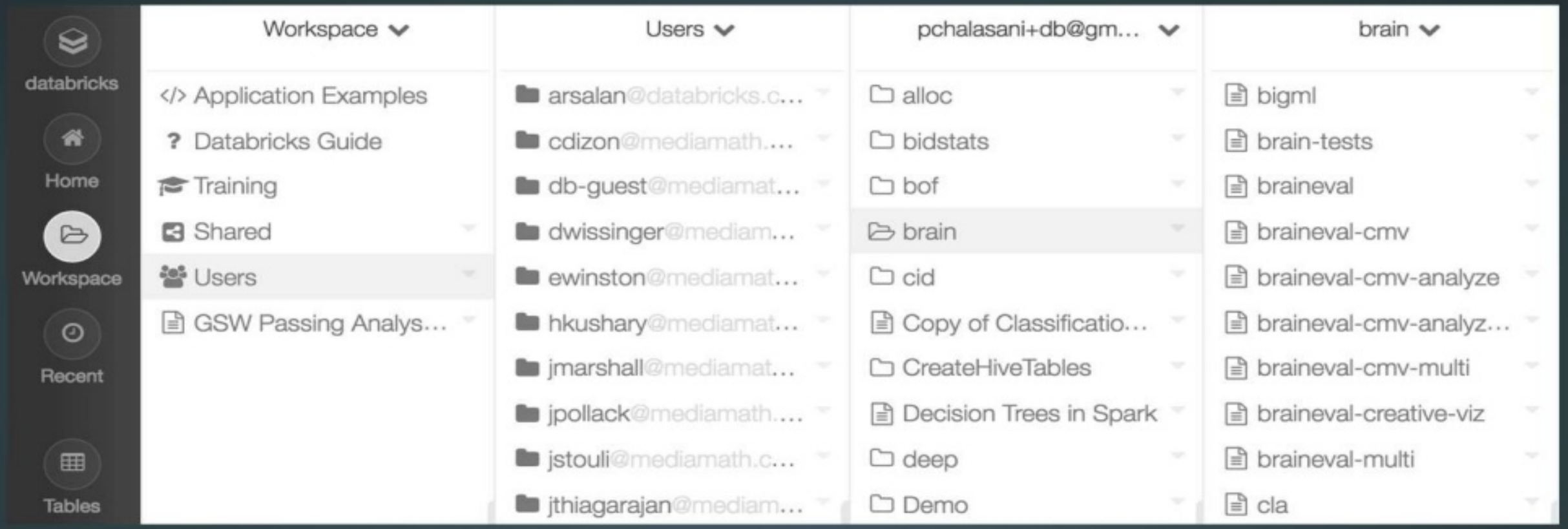

hundreds of notebooks: elegant, responsive, multi-language

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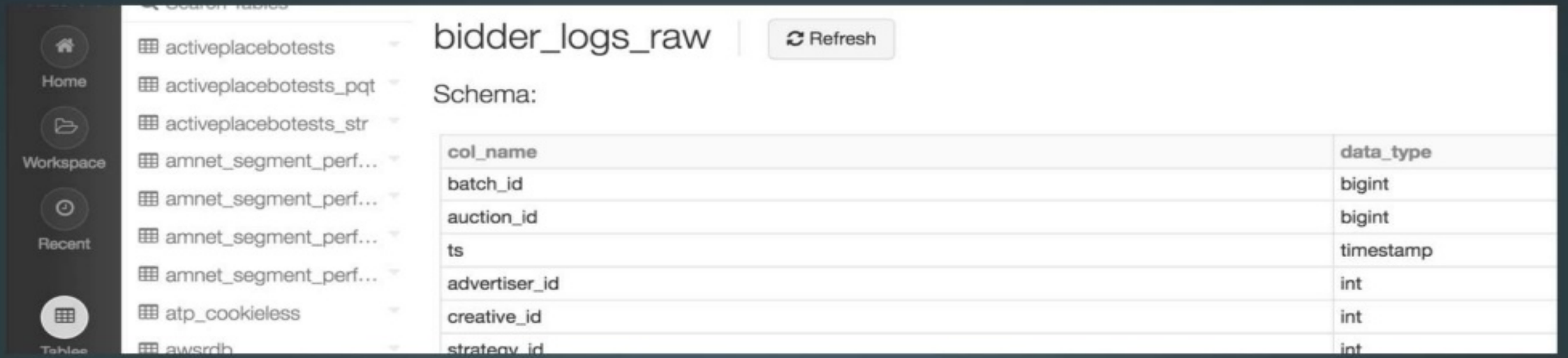

hundreds of tables

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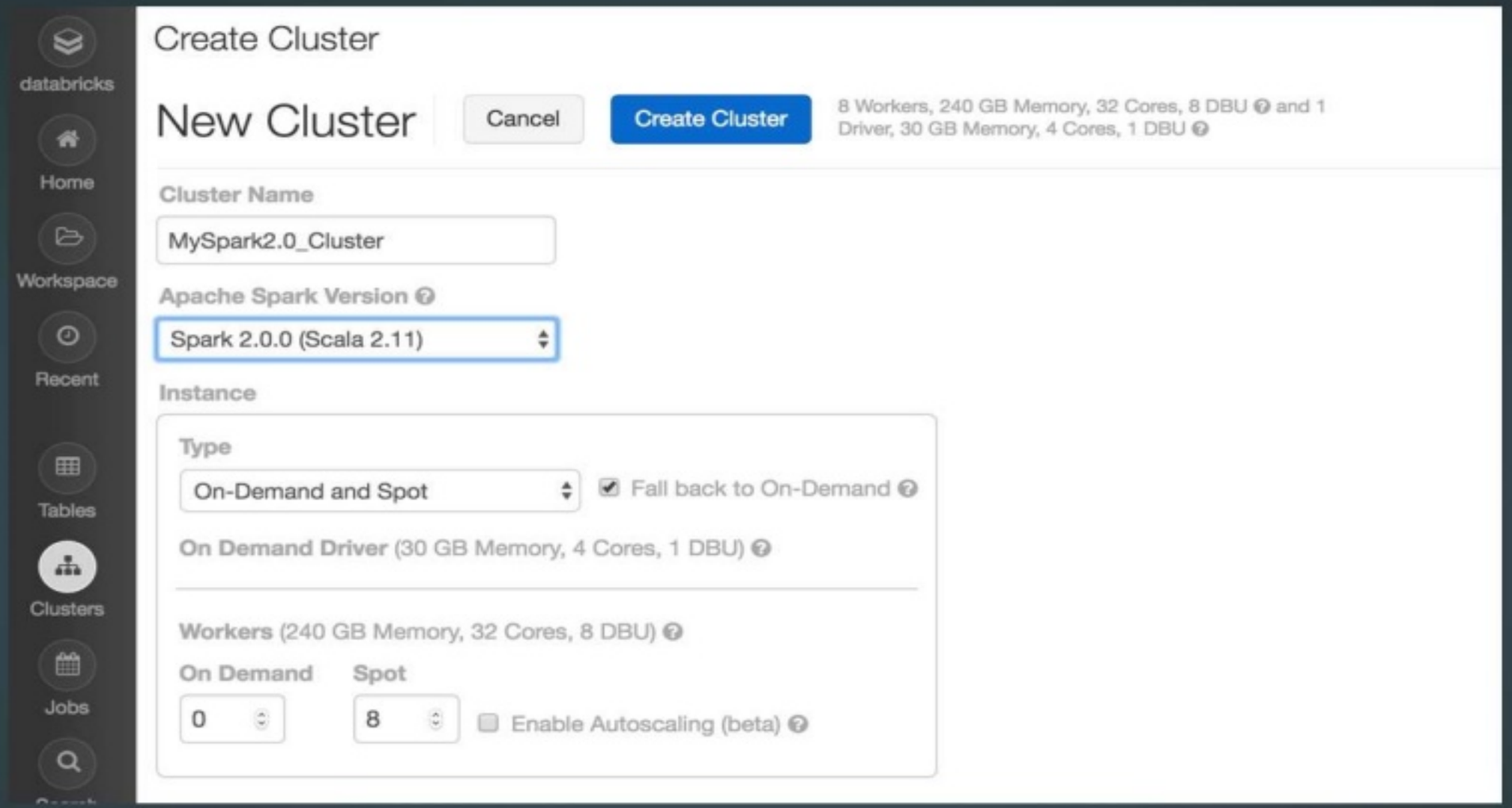

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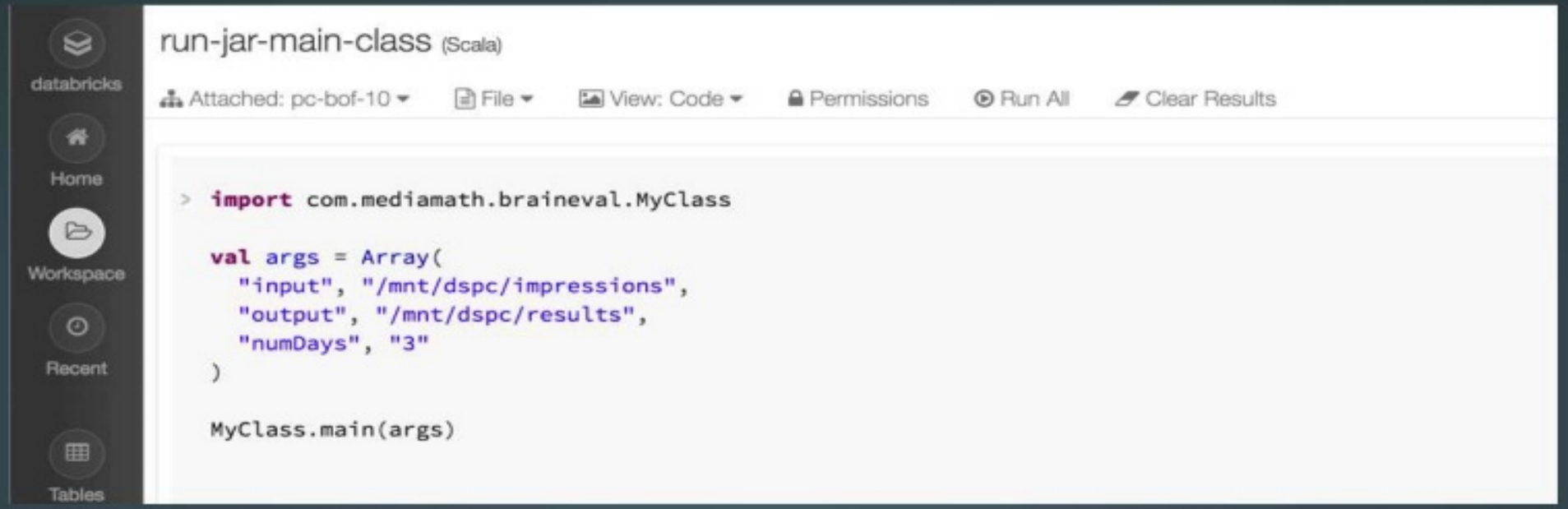
easily spin-up clusters



trivially run jars,
no need for shell scripts

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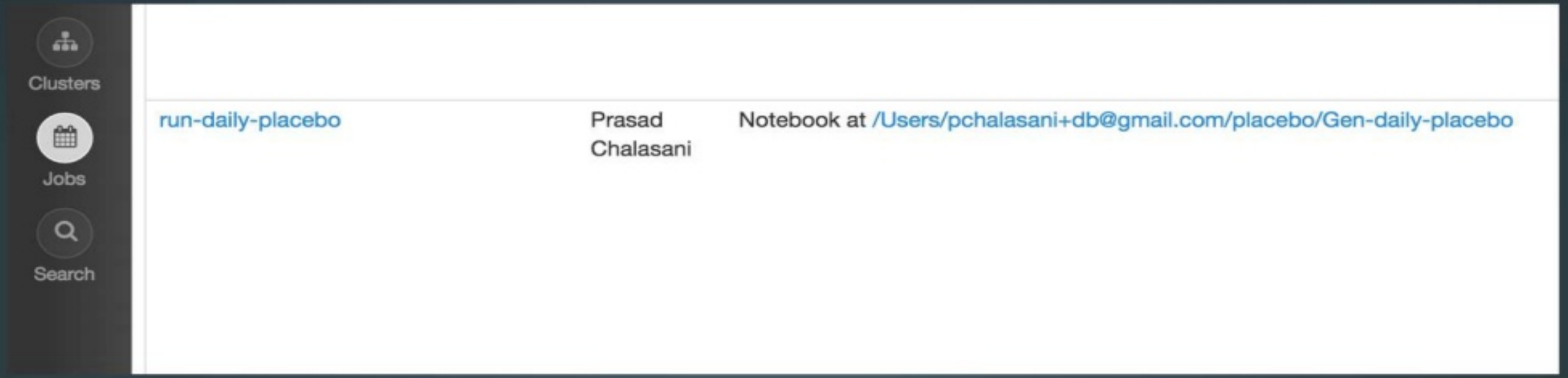

run notebooks as jobs

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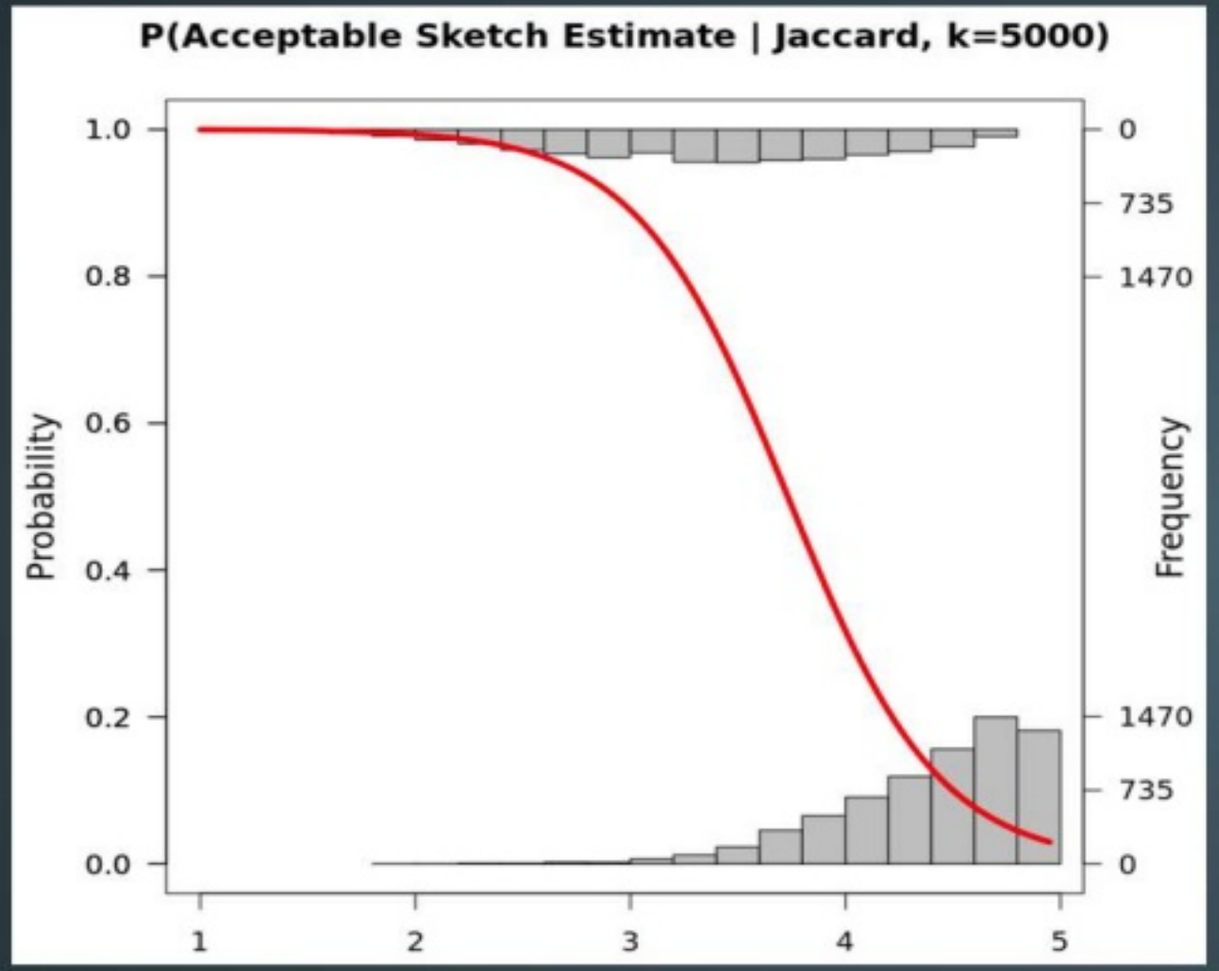
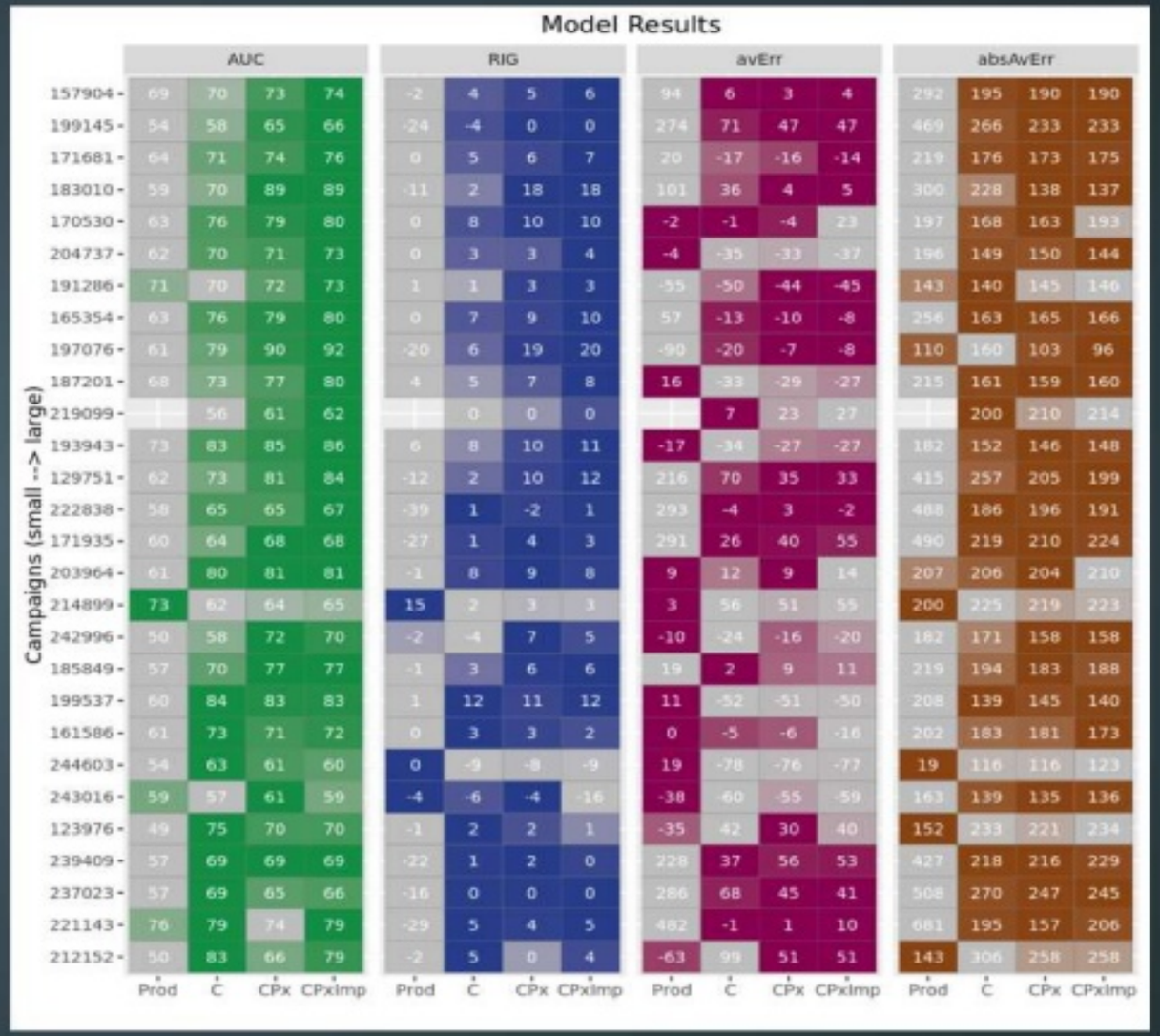
id	type	lm	incr	conf	lb	lbi	rtrcConf	ATT	gConf	glm5	glm50	glm95	rt	rc	rtw	w
796497	all	35	26	100	16	14	100	8	100	27	35	44	6	5	30	11
834256	all	411	80	100	17	15	100	3	100	238	408	935	3	3	4	13
857408	all	30	23	66	10	9	99	0	99	7	30	63	1	1	2	24
888637	all	26	20	100	20	17	100	517	100	25	26	26	2289	1911	2533	73
1041560	all	37	27	100	28	22	100	107	100	10	35	73	378	296	396	76
1056221	all	175	64	100	40	29	100	166	100	166	175	185	207	147	261	36

create, share dashboards





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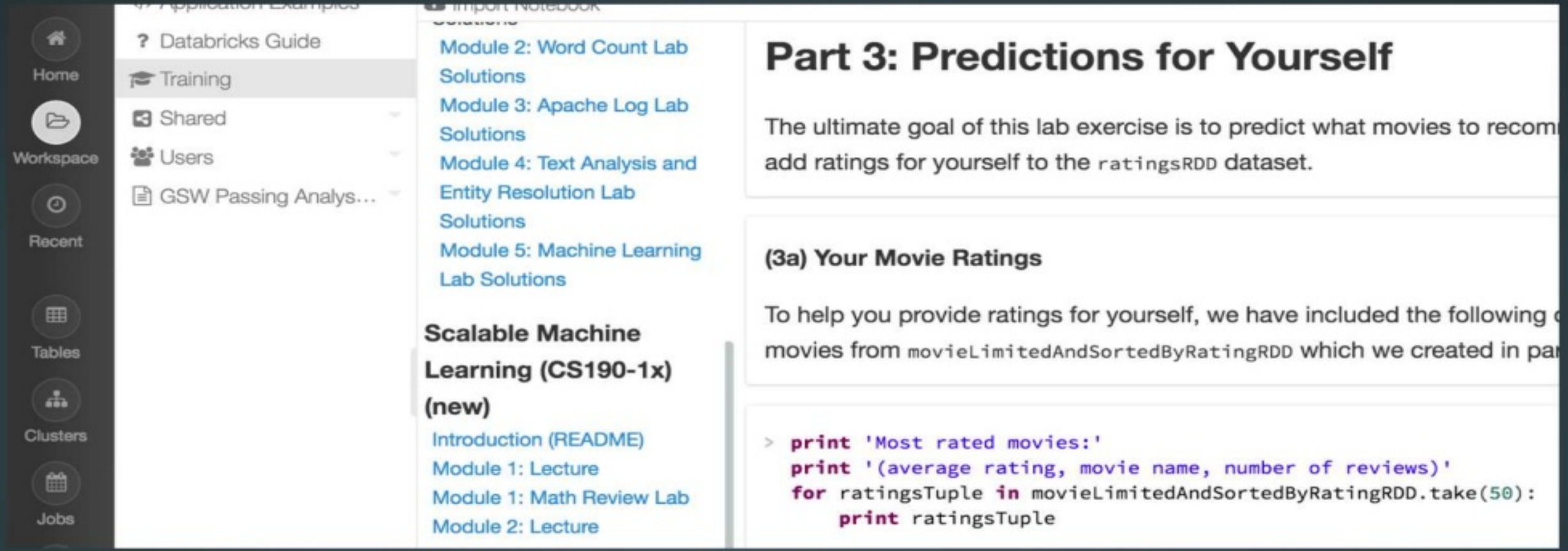
data visualizations



data science onboarding

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thank you!

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