goto;

GOTO Copenhagen 2021

UNCLUSTER YOUR DATA SCIENCE USING VAEX

#GOTOcph

Who are we?

Maarten Breddels
Former astrophysicist
Freelancer / consultant / data scientist
Core Jupyter-Widgets developer
Founder of vaex.io
Principal author of vaex
maartenbreddels@gmail.com
www.maartenbreddels.com
@maartenbreddels
github.com/maartenbreddels

Jovan Veljanoski
Former astrophysicist
Sr. Data Scientist @ Tiqets
Co-founder of vaex.io
jovan.veljanoski@gmail.com
https://www.linkedin.com/in/jovanvel/

What people think we do

What we actually do

1 - 100

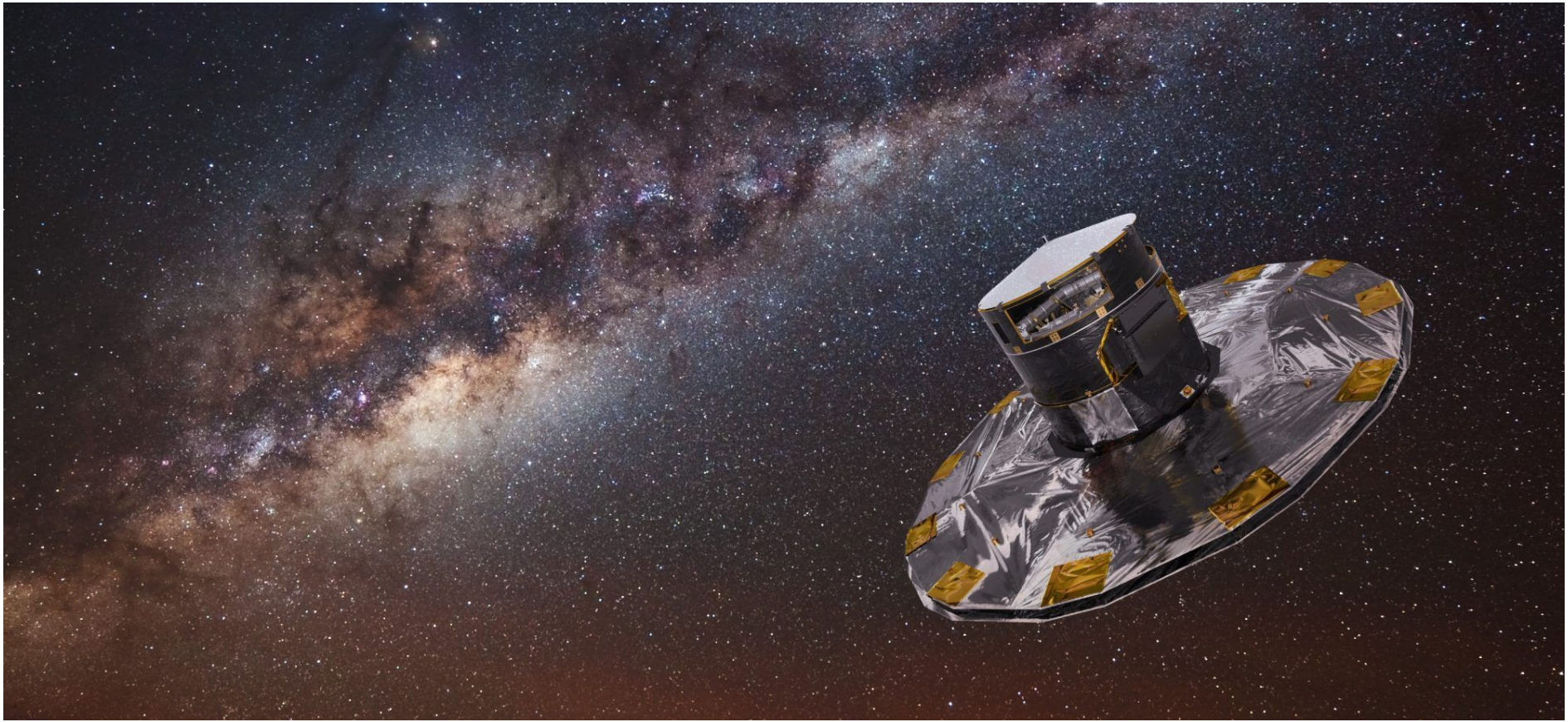
Number		Descriptor: epoch J1991.25				Position: epoch J1991.25			Par.	Proper Motion		Standard Errors					Astrometric Correlations (%)										Soln	
HIP		RA	Dec	V		α (ICRS)	δ		π	$\mu_{\alpha*}$	μ_δ	α*	δ	π	$\mu_{\alpha*}$	μ_δ	δ α*	π α*	π δ	$\mu_{\alpha*}$ α*	$\mu_{\alpha*}$ δ	$\mu_{\alpha*}$ π	μ_δ α*	μ_δ δ	μ_δ π	μ_δ $\mu_{\alpha*}$	F1	F2
		h m s	±° ′ ″	mag		deg	deg		mas	mas/yr		mas		mas	mas/yr												%	
1	2	3	4	5	6 7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1		00 00 00.22	+01 05 20.4	9.10	H	0.000 911 85	+01.089 013 32		3.54	−5.20	−1.88	1.32	0.74	1.39	1.36	0.81	+32	− 7	−11	−24	+ 9	− 1	+10	− 1	+ 1	+34	0	0.74
2		00 00 00.91	−19 29 55.8	9.27	G	0.003 797 37	−19.498 837 45	+	21.90	181.21	−0.93	1.28	0.70	3.10	1.74	0.92	+12	−14	−24	−29	+ 1	+21	− 2	−19	−28	+14	2	1.45
3		00 00 01.20	+38 51 33.4	6.61	G	0.005 007 95	+38.859 286 08		2.81	5.24	−2.91	0.53	0.40	0.63	0.57	0.47	+ 6	+ 9	+ 4	+43	− 1	− 6	+ 3	+24	+ 7	+21	0	−0.45
4		00 00 02.01	−51 53 36.8	8.06	H	0.008 381 70	−51.893 546 12		7.75	62.85	0.16	0.53	0.59	0.97	0.65	0.65	−22	− 9	− 3	+24	+20	+ 8	+18	+ 8	−31	−18	0	−1.46
5		00 00 02.39	−40 35 28.4	8.55	H	0.009 965 34	−40.591 224 40		2.87	2.53	9.07	0.64	0.61	1.11	0.67	0.74	+10	+24	+ 6	+26	−10	+20	−16	−30	−19	+ 6	0	−1.24
6		00 00 04.35	+03 56 47.4	12.31	G	0.018 141 44	+03.946 488 93		18.80	226.29	−12.84	4.03	2.18	4.99	6.15	3.20	+35	− 1	+ 3	−11	− 2	+47	− 2	+ 3	+31	+35	4	2.95
7		00 00 05.41	+20 02 11.8	9.64	G	0.022 548 91	+20.036 602 16		17.74	−208.12	−200.79	1.01	0.79	1.30	1.13	0.82	+32	+ 8	− 2	− 4	+12	+ 6	+11	+ 0	+16	+43	0	0.21
8		00 00 06.55	+25 53 11.3	9.05	3 H	0.027 291 60	+25.886 474 45		5.17	19.09	−5.66	1.70	0.93	1.95	1.54	0.88	+27	−66	−36	−38	−12	+36	−21	−24	+32	+18	0	0.98
9		00 00 08.48	+36 35 09.4	8.59	H	0.035 341 89	+36.585 937 77		4.81	−6.30	8.42	0.86	0.55	0.99	1.02	0.65	+ 3	+16	− 1	+ 0	+ 7	− 2	+ 8	+ 4	+10	+13	3	−1.26
10		00 00 08.70	−50 52 01.5	8.59	H	0.036 253 09	−50.867 073 60		10.76	42.23	40.02	0.77	0.73	1.10	0.98	0.82	−13	−24	+11	+ 1	− 7	+ 6	+ 0	−18	−22	−13	0	0.82
11		00 00 08.95	+46 56 24.0	7.34	H	0.037 296 95	+46.940 001 54		4.29	11.09	−2.02	0.52	0.51	0.84	0.53	0.54	+ 9	+20	+31	−30	+ 0	−11	+ 6	+21	+26	+ 5	0	−0.23
12		00 00 09.82	−35 57 36.8	8.43	H	0.040 917 56	−35.960 224 82		4.06	−5.99	−0.10	0.81	0.58	1.16	1.02	0.72	+13	− 9	−17	−36	+ 0	+16	− 1	−41	+29	+ 2	2	0.76
13		00 00 10.00	−22 35 40.9	8.80	H	0.041 679 70	−22.594 680 60		3.49	8.45	−10.07	1.21	0.67	1.48	1.44	0.59	+15	+23	+24	+ 9	+ 9	+24	− 5	−37	− 4	−10	0	−0.46
14		00 00 11.59	−00 21 37.5	7.25	G	0.048 271 89	−00.360 421 19		5.11	61.75	−11.67	0.88	0.54	0.99	1.12	0.59	+34	+ 1	−21	+23	− 3	+11	+ 1	−24	+27	+40	0	−0.31
15		00 00 12.07	+50 47 28.2	8.60	H	0.050 308 90	+50.791 173 84		2.45	13.88	5.47	0.66	0.70	1.16	0.78	0.70	−27	+ 8	+27	+22	+ 5	+ 9	+ 6	− 6	+14	−19	0	0.35
*16		00 00 12.34	−54 54 50.9	11.71	G	0.051 408 52	−54.914 128 19		0.53	257.39	−96.63	1.49	1.67	2.63	1.81	1.95	−27	− 7	−13	+ 2	+ 3	+ 4	+ 5	− 8	− 9	−22	0	0.76
*17		00 00 12.26	−40 11 32.4	8.15	H	0.051 099 57	−40.192 328 42		6.15	−34.46	−26.37	0.57	0.55	1.00	0.61	0.65	+18	+24	+13	+29	− 7	+11	−15	−35	−18	+11	0	−0.62
18		00 00 12.75	−04 03 13.5	11.03	G	0.053 139 23	−04.053 738 13		19.93	−127.22	23.78	2.18	1.20	2.36	2.69	1.15	+24	+19	+ 4	− 8	+ 3	+15	+ 3	−30	+26	+18	3	0.05
19		00 00 12.80	+38 18 14.7	6.53	H	0.053 316 96	+38.304 086 36		4.12	−2.50	−15.07	0.55	0.40	0.64	0.60	0.45	+ 9	− 5	+ 3	+53	− 8	−10	− 4	+21	+ 8	+23	0	−0.84
20		00 00 15.11	+23 31 45.4	8.51	G	0.062 950 50	+23.529 283 97		10.76	36.00	−22.98	0.88	0.59	1.06	0.92	0.59	+30	+39	+19	+10	+ 2	+ 8	+ 9	− 5	+20	+32	0	0.50
21		00 00 15.90	+08 00 26.0	7.55	H	0.066 235 69	+08.007 234 37		5.84	61.89	−0.22	0.84	0.51	0.95	0.84	0.56	+20	+13	− 9	−10	+ 1	+ 3	+ 6	−16	+30	+36	2	2.05
22		00 00 16.83	−49 21 08.2	8.69	H	0.070 135 93	−49.352 266 86		4.47	−7.90	0.46	0.63	0.79	1.15	0.71	0.93	− 6	− 1	−10	−16	−14	+ 8	−12	−26	− 6	+ 7	0	−0.40
23		00 00 17.86	+13 18 44.0	7.57	G	0.074 429 30	+13.312 210 83		12.21	54.15	9.65	0.90	0.52	0.95	0.91	0.55	+17	+10	+12	−23	+19	+ 9	+15	− 1	+10	+36	0	0.32
24		00 00 18.25	−23 27 09.9	9.05	H	0.076 049 79	−23.452 749 13		9.73	127.15	22.22	1.00	0.61	1.21	1.21	0.55	+ 3	−12	+21	−10	+12	+27	+ 1	−37	− 2	−13	1	0.24
25	H	00 00 19.05	−44 17 25.1	6.28	G	0.079 365 37	−44.290 297 41	A	13.74	58.36	−108.64	0.88	0.81	0.98	0.73	0.68	−32	+18	− 7	+ 2	−14	+ 2	−10	−25	+10	− 2	2	−0.52
26		00 00 20.24	−13 23 35.9	9.13	H	0.084 345 79	−13.393 296 86		9.19	−103.33	−33.35	1.00	0.83	1.34	1.42	0.75	+42	−13	−12	−12	−16	+33	−24	−55	+25	+31	0	−0.56
27		00 00 20.51	−41 17 51.1	9.32	H	0.085 469 76	−41.297 536 96		9.66	135.96	−113.67	0.82	0.73	1.38	0.95	0.94	− 2	− 6	+ 7	+19	− 3	+ 6	− 4	−34	−15	− 4	2	−0.07
28		00 00 20.94	−43 21 42.5	8.83	H	0.087 248 71	−43.361 799 62		5.64	−10.96	−8.69	0.71	0.60	1.05	0.83	0.78	+ 5	− 3	−11	+17	−15	+26	−14	−45	+ 8	+ 8	0	−0.76
29		00 00 22.11	−49 06 28.6	9.14	H	0.092 131 06	−49.107 955 05		2.85	26.86	4.05	0.75	0.92	1.40	0.79	1.09	− 9	−11	−18	−24	− 8	− 3	−11	−24	+ 8	+ 0	0	−0.23
30		00 00 23.07	+42 08 29.4	8.26	H	0.096 135 63	+42.141 498 82		3.79	−8.44	−10.14	0.53	0.53	0.88	0.72	0.54	+ 7	+11	+26	− 9	− 5	−14	+ 2	+14	+16	− 8	0	0.03
31		00 00 23.54	+02 40 31.7	7.63	H	0.098 093 90	+02.675 477 68		1.84	−4.88	−0.20	1.06	0.61	1.05	1.49	0.69	+19	+17	− 4	−33	+14	− 2	+22	+10	+ 7	− 7	0	−0.07
32		00 00 23.66	+51 56 22.2	9.09	H	0.098 583 75	+51.939 490 50		3.10	−0.39	−1.38	0.78	0.74	1.29	0.94	0.79	−18	+ 7	+18	+ 4	+ 8	+ 8	+ 8	+ 2	+19	−12	2	0.61
33		00 00 23.80	−10 27 44.8	8.10	H	0.099 180 83	−10.462 454 45		8.94	−3.62	28.71	0.90	0.48	1.09	1.39	0.47	+30	−31	− 6	−25	+ 2	+33	−14	−38	+30	+23	0	0.26
34		00 00 23.87	+26 55 05.7	6.43	H	0.099 469 73	+26.918 238 21		12.71	42.20	53.47	0.61	0.43	0.74	0.64	0.43	+15	+32	+13	+ 0	+ 4	+ 3	+ 7	+ 7	+15	+ 9	1	1.99

$23^h\ 59^m\ 43^s$ - $23^h\ 59^m\ 54^s$
118301 - 118322

Number	Descriptor: epoch J1991.25				Position: epoch J1991.25		Par.	Proper Motion		Standard Errors					Astrometric Correlations (%)										Soln	
HIP	RA	Dec	V		α (ICRS)	δ	π	$\mu_{\alpha*}$	μ_δ	α*	δ	π	$\mu_{\alpha*}$	μ_δ	δ α*	π α*	π δ	$\mu_{\alpha*}$ α*	$\mu_{\alpha*}$ δ	$\mu_{\alpha*}$ π	μ_δ α*	μ_δ δ	μ_δ π	μ_δ $\mu_{\alpha*}$	F1	F2
	h m s	±° ′ ″	mag		deg	deg	mas	mas/yr		mas		mas	mas/yr												%	
1 2	3	4	5	6 7	8	9 10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
118301	23 59 43.22	+21 17 21.1	7.67	H	359.930 069 20	+21.289 202 56	5.54	55.58	−63.96	0.74	0.60	1.01	0.80	0.57	+26	+22	+ 5	+ 5	− 4	+ 4	+ 2	−26	+30	+23	0	0.26
118302	23 59 43.78	−24 38 42.7	7.78	G	359.932 399 65	−24.645 198 26	2.35	−23.63	−12.42	0.93	0.50	1.08	1.24	0.47	+ 8	+14	+11	−12	+ 7	−18	+ 2	−38	+18	−22	0	1.36
118303	23 59 44.22	+62 59 30.1	7.94	2 H	359.934 255 93	+62.991 690 87	2.41	4.88	−5.53	0.63	0.60	0.83	0.81	0.65	−22	− 1	+15	+29	− 7	−14	− 5	− 7	+28	−27	0	1.10
118304	23 59 44.66	−32 12 38.3	8.27	H	359.936 089 71	−32.210 642 41	3.88	5.16	−32.64	0.83	0.49	1.10	0.89	0.57	+ 3	− 6	− 3	−54	+ 6	+ 4	+ 8	−35	+18	− 5	0	−0.69
118305	23 59 44.74	+08 41 21.0	11.94	G	359.936 425 83	+08.689 171 69	10.07	94.36	9.52	2.94	1.82	3.46	3.64	2.18	+30	+17	+ 3	+ 1	+ 5	+20	+ 9	− 3	+28	+37	4	1.69
118306	23 59 46.08	−50 59 56.9	7.28	H	359.942 016 91	−50.999 148 67	5.78	15.90	−43.70	0.57	0.56	0.84	0.64	0.59	−11	− 8	− 2	−12	− 1	+ 0	+ 1	−19	−18	− 8	0	0.50
118307	23 59 46.49	−00 16 48.2	6.83	2 H	359.943 727 64	−00.280 052 55	2.67	−5.14	−25.43	0.84	0.49	0.93	1.04	0.55	+29	+12	− 7	+19	− 1	+16	+ 5	−21	+26	+39	0	−1.14
118308	23 59 47.73	+50 06 45.0	9.93	H	359.948 880 04	+50.112 498 97	19.39	434.10	9.56	1.02	1.06	1.63	1.16	1.03	−20	+22	+15	+26	+ 9	− 1	+13	−18	+12	−16	0	3.65
118309	23 59 47.81	+11 16 24.3	6.74	H	359.949 220 17	+11.273 424 46	5.87	10.39	1.62	0.72	0.49	0.85	0.75	0.58	+31	+11	− 3	− 5	+ 6	+16	+10	− 5	+19	+50	0	0.06
118310	23 59 47.82	+06 39 52.4	8.85	H	359.949 256 71	+06.664 565 39	39.43	−60.87	−169.17	1.41	0.77	1.36	1.40	0.76	+ 6	−20	+11	−51	+11	+31	+ 1	−28	+11	+33	4	1.36
*118311	23 59 49.12	−38 15 09.4	11.85	G	359.954 685 46	−38.252 602 53	24.63	337.76	−112.81	2.46	1.60	2.96	2.78	2.05	+ 4	+ 6	− 1	−49	+ 4	+20	+ 7	−44	+ 1	− 5	1	−0.66
*118312	23 59 49.06	−02 06 45.2	8.35	H	359.954 433 74	−02.112 552 41	7.22	80.82	−21.41	0.98	0.63	1.11	1.15	0.64	+35	+ 2	−23	−29	−10	+13	− 9	−38	+28	+48	2	1.03
118313	23 59 49.40	+21 08 59.1	8.94	H	359.955 817 26	+21.149 739 73	2.32	0.28	−15.77	0.89	0.70	1.15	0.90	0.70	+28	+21	+ 3	+ 2	− 3	+ 6	+ 3	−25	+30	+27	0	1.21
118314	23 59 49.64	−37 51 28.6	9.27	H	359.956 824 20	−37.857 956 17	0.93	−6.60	−4.60	1.03	0.76	1.32	1.35	0.85	+11	−10	− 5	−21	− 3	+23	− 6	−38	+ 0	−13	0	0.26
118315	23 59 50.18	−18 30 26.2	8.47	H	359.959 080 83	−18.507 287 80	3.00	6.81	−1.29	1.00	0.64	1.13	1.72	0.61	+16	− 1	−14	− 1	+ 4	+18	− 5	−38	+10	−10	0	−1.69
118316	23 59 50.62	+32 32 13.0	9.51	H	359.960 898 63	+32.536 932 55	3.10	40.44	−1.43	1.01	0.69	1.14	1.14	0.71	+ 2	+11	− 9	+36	+ 1	−12	+ 4	+ 0	+17	+ 8	3	−0.45
118317	23 59 50.81	−36 25 10.1	10.01	H	359.961 700 60	−36.419 480 90	3.42	31.41	−5.41	1.20	0.74	1.55	1.51	0.95	− 1	+ 4	− 4	−33	+10	+14	+12	−30	+14	− 9	0	1.64
118318	23 59 51.30	+11 40 25.4	6.99	1 H	359.963 743 83	+11.673 708 66	1.92	−2.16	2.09	0.78	0.50	0.91	0.88	0.60	+33	− 2	− 9	−19	− 3	+21	− 2	−11	+27	+49	0	2.00
118319	23 59 53.74	−22 25 41.4	8.23	G	359.973 912 52	−22.428 180 30	10.63	148.74	27.53	0.97	0.58	1.17	1.10	0.52	+ 4	+17	+ 4	−11	+10	+17	+ 7	−31	+12	− 5	0	1.19
118320	23 59 54.25	+05 57 23.9	7.59	H	359.976 057 47	+05.956 637 86	5.00	20.92	−35.26	0.95	0.53	1.01	0.89	0.54	+21	+ 0	− 5	−18	+ 1	− 4	+ 1	−14	+22	+27	4	−1.12
118321	23 59 54.78	−64 22 21.3	9.20	G	359.978 238 91	−64.372 572 20	19.22	216.99	106.46	0.74	0.76	1.00	0.84	0.81	+ 1	− 7	−24	− 3	+15	− 4	+15	+ 1	−14	+12	0	0.05
118322	23 59 54.91	−65 34 37.5	4.49	H	359.978 791 95	−65.577 077 74	8.71	48.63	−22.33	0.44	0.42	0.57	0.48	0.47	+ 3	−12	−18	−17	+ 2	+17	+ 7	−12	− 8	+22	0	−1.72

Motivation

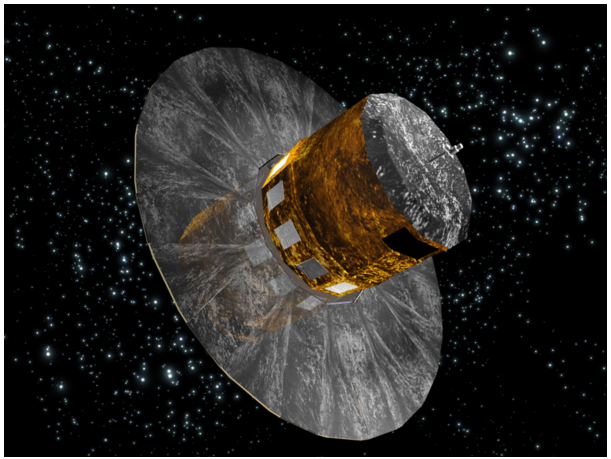
goto;

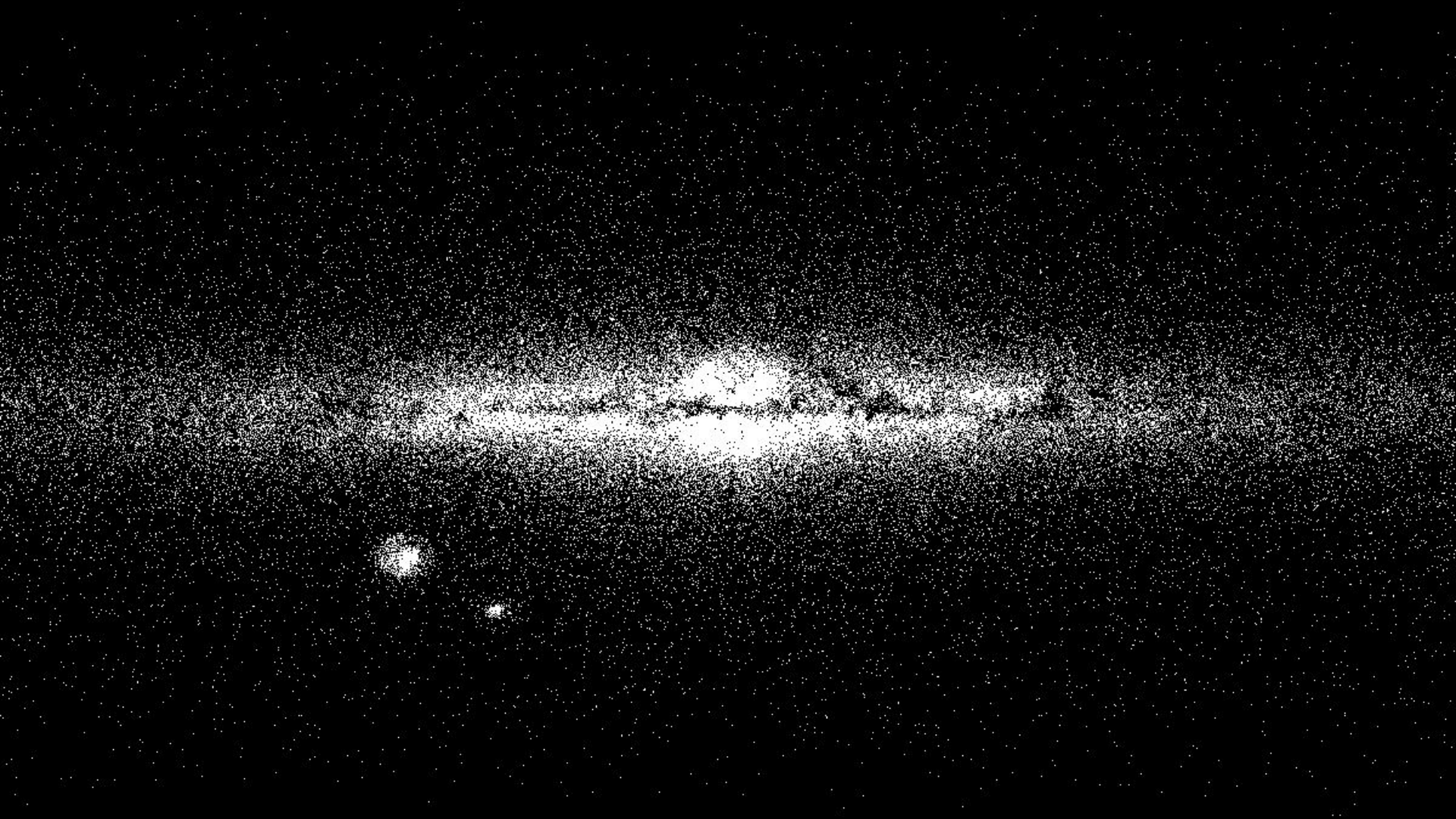


Motivation

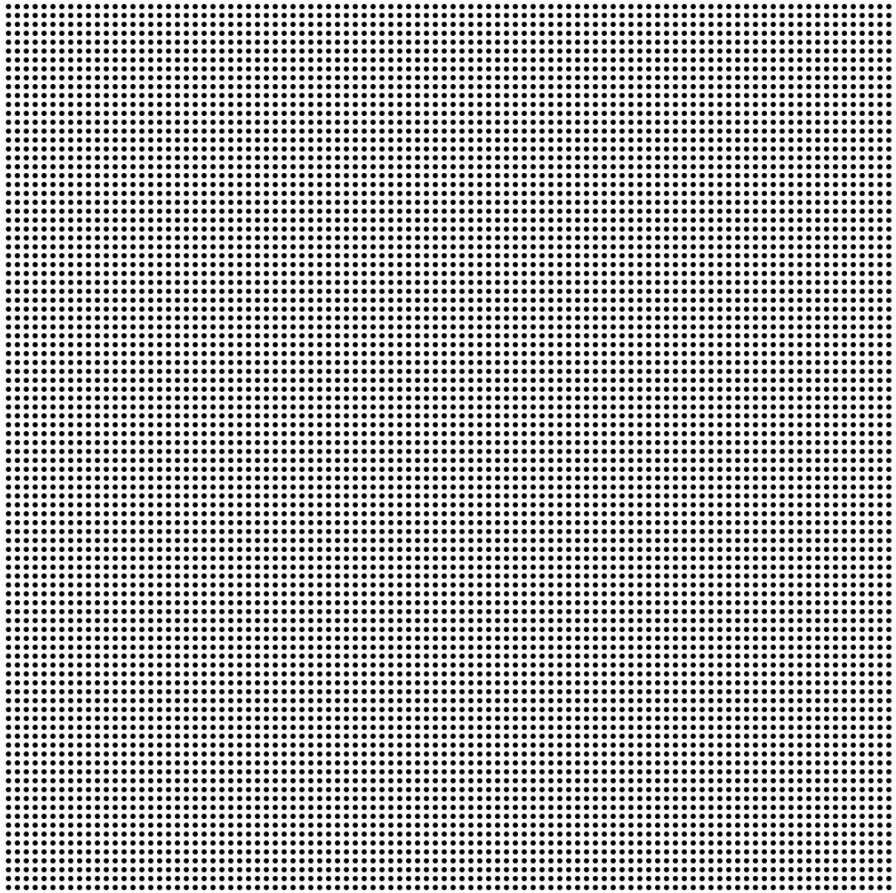
goto;

- The (original) problem: handling uncomfortably large data
  - Gaia Data: ~1.800.000.000 (billion!) of stars (rows), ~100 columns (features)
  - 10 000x increase in data
- What we need
  - Interactive exploration, visualisation, statistical analysis
- Requirements
  - Low barrier of entry, Accessible, Cheap
  - Easy setup
  - No cluster

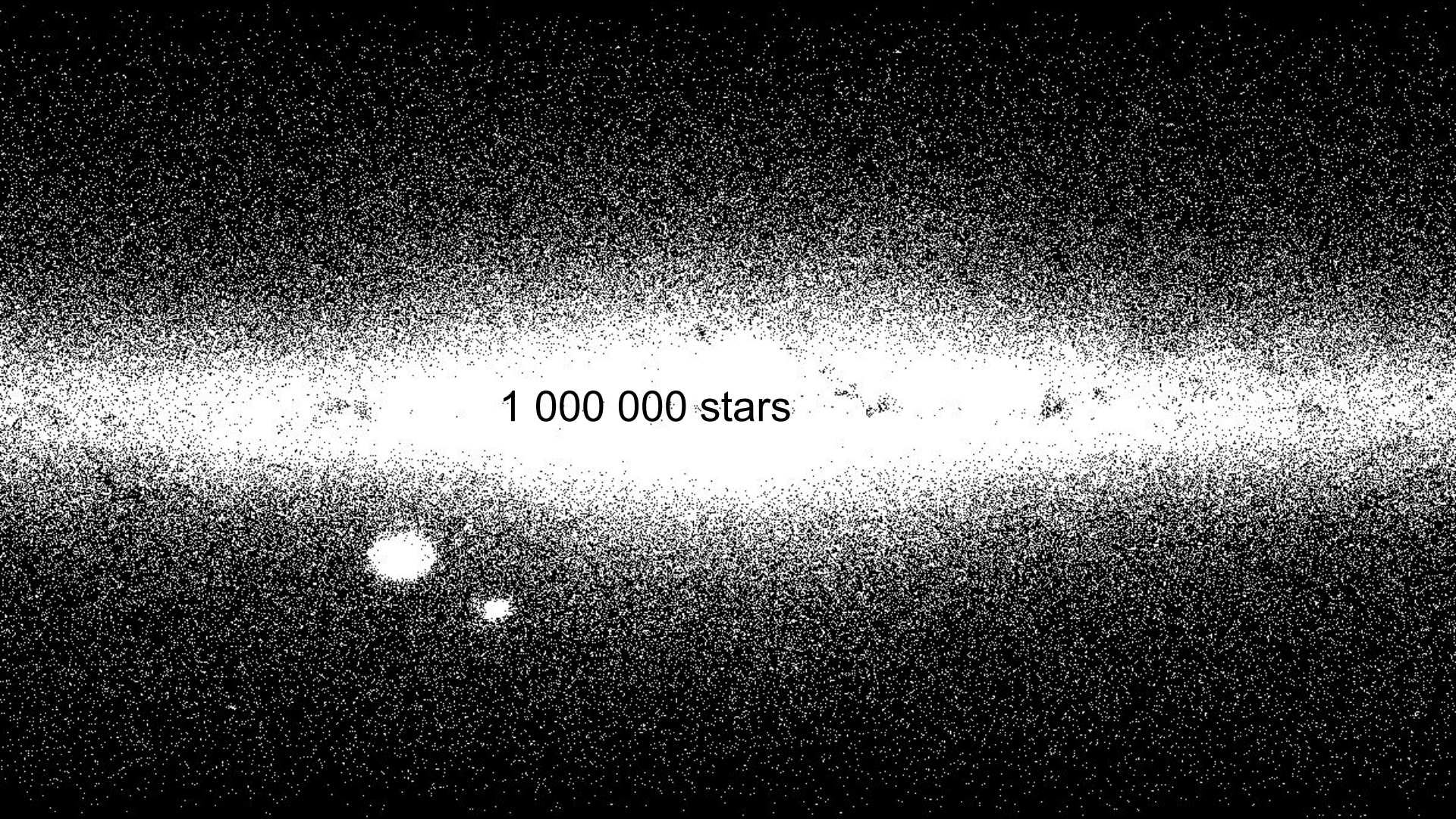




10,000 dots



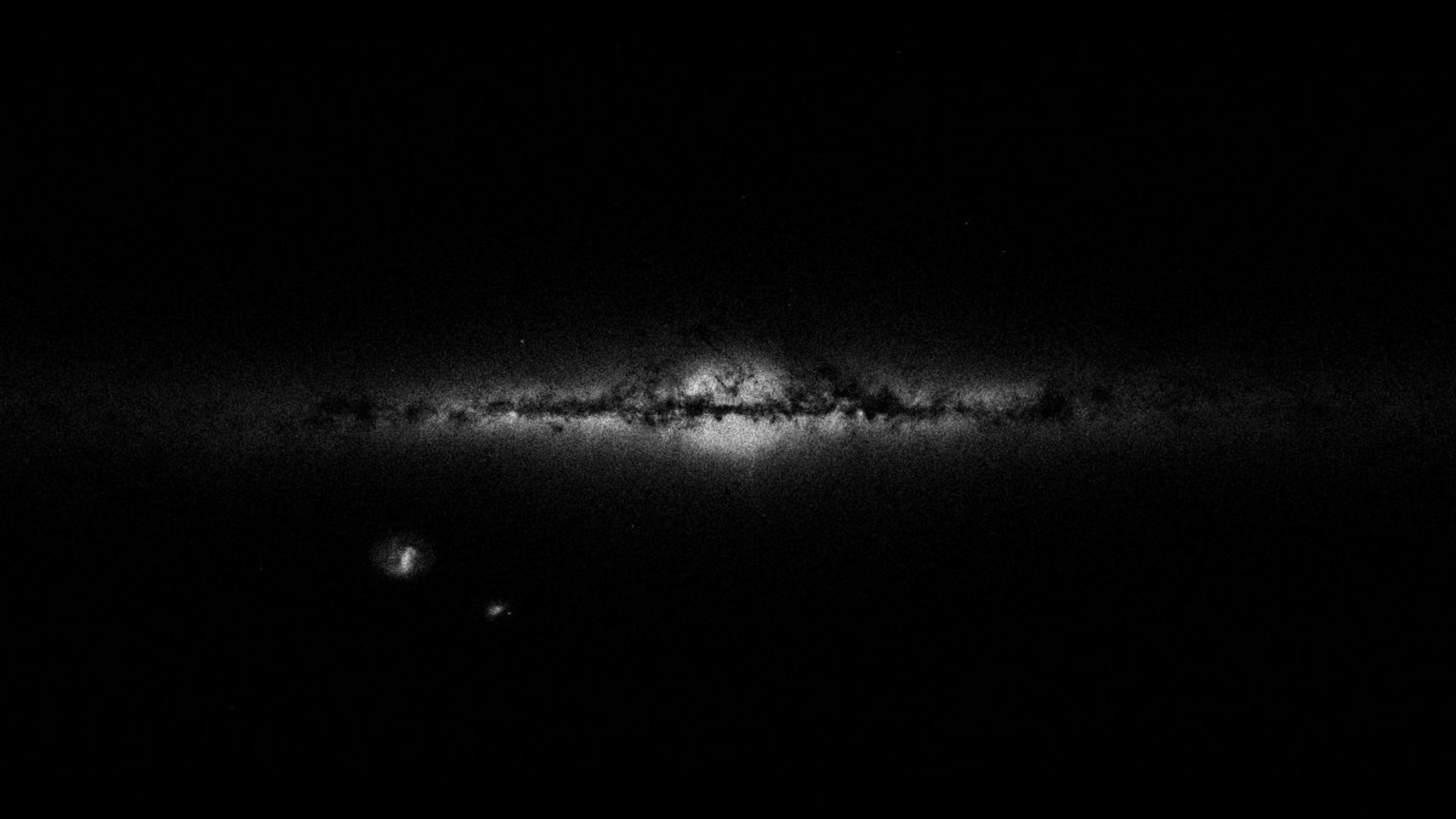
waitbutwhy.com

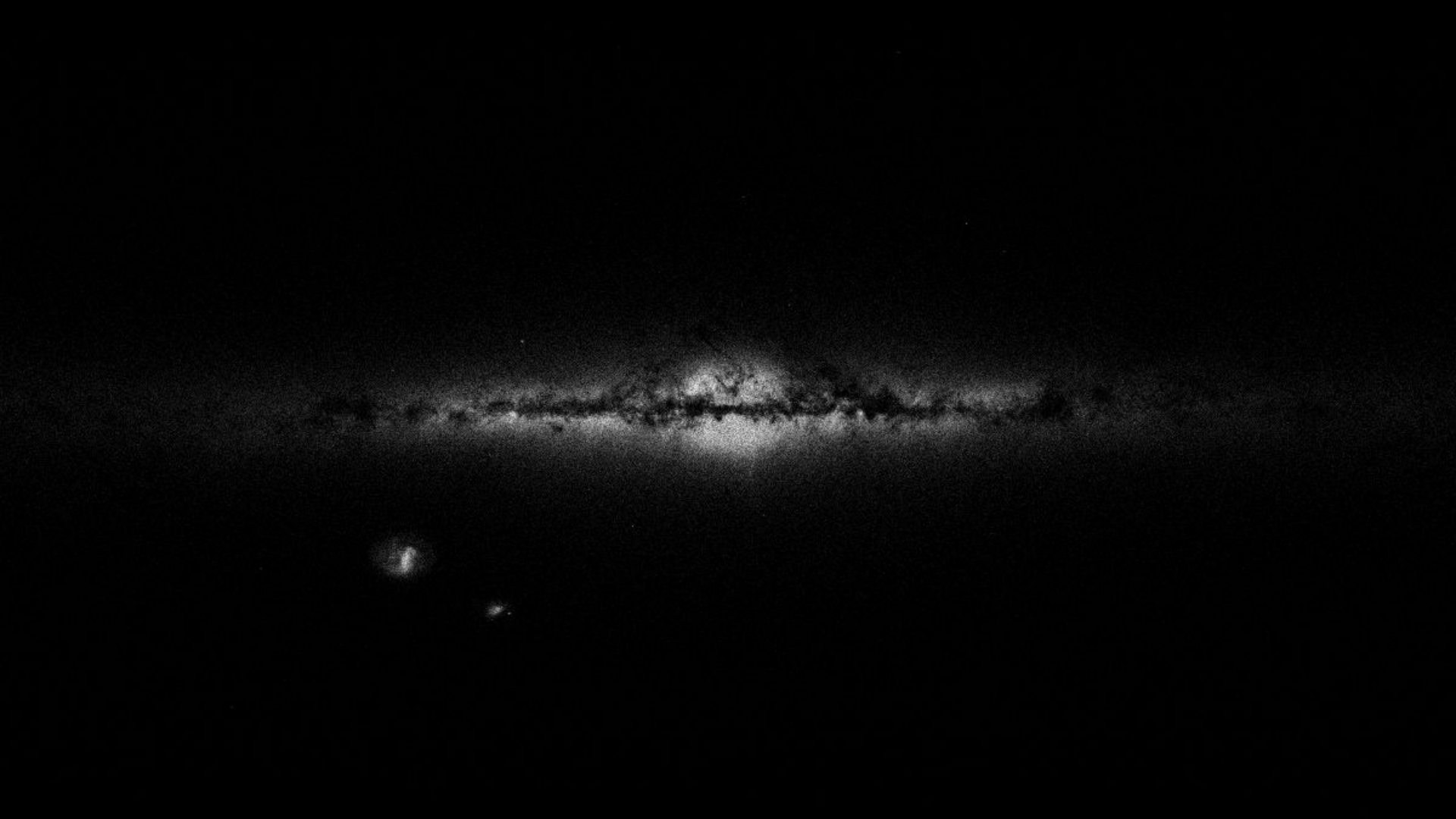

1 000 000 stars

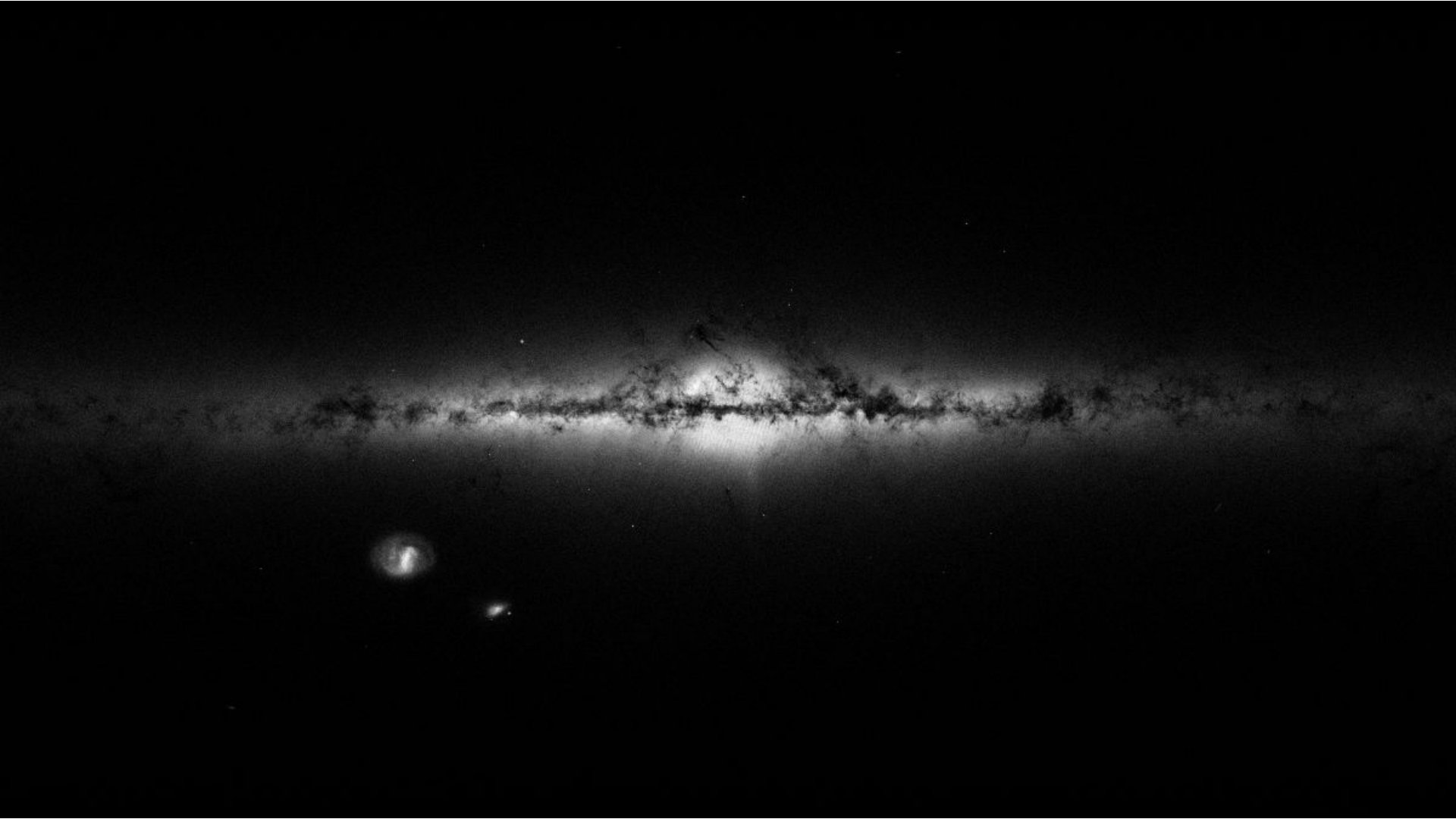
10 000 000 stars

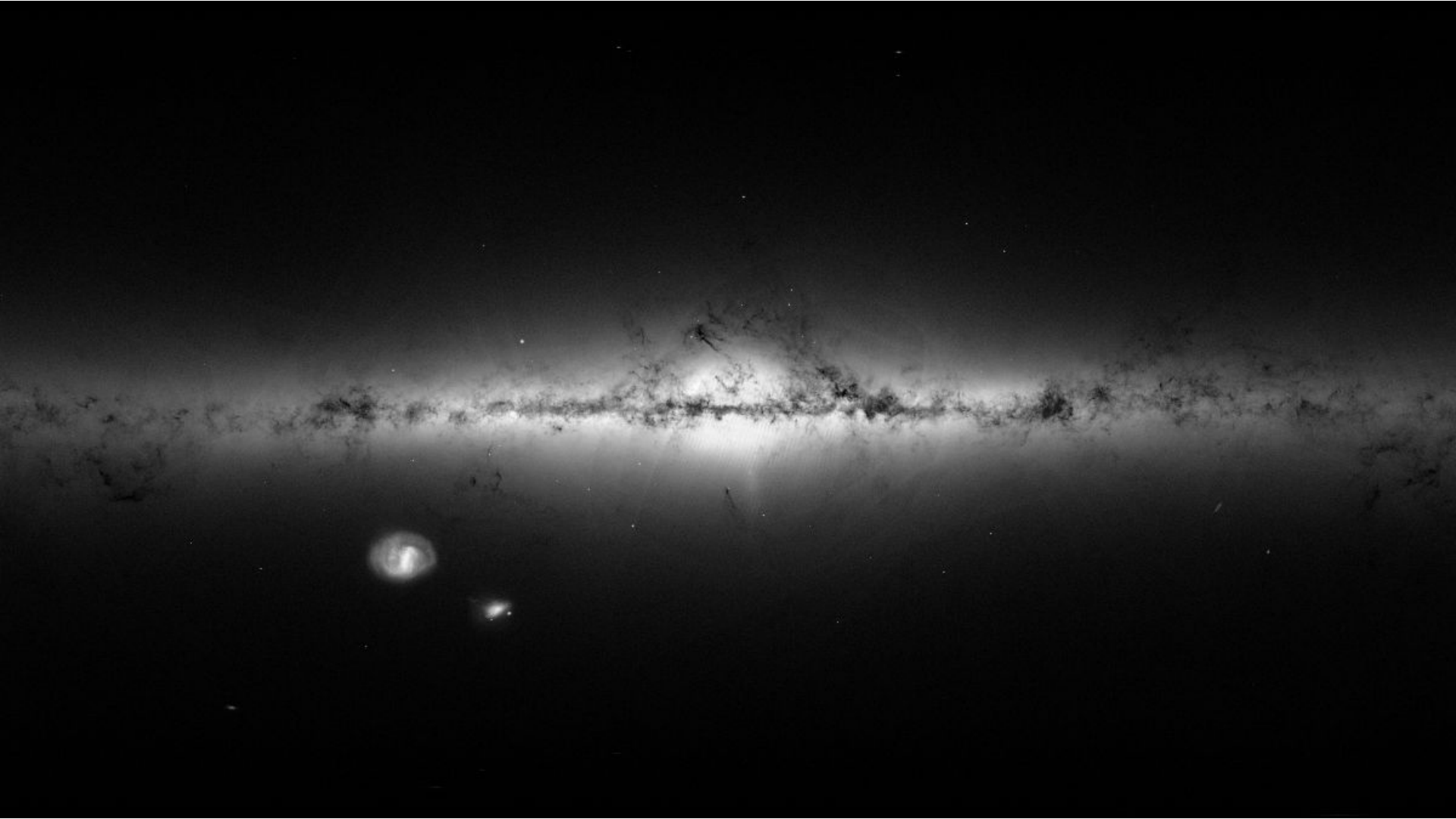
100 000 000 stars

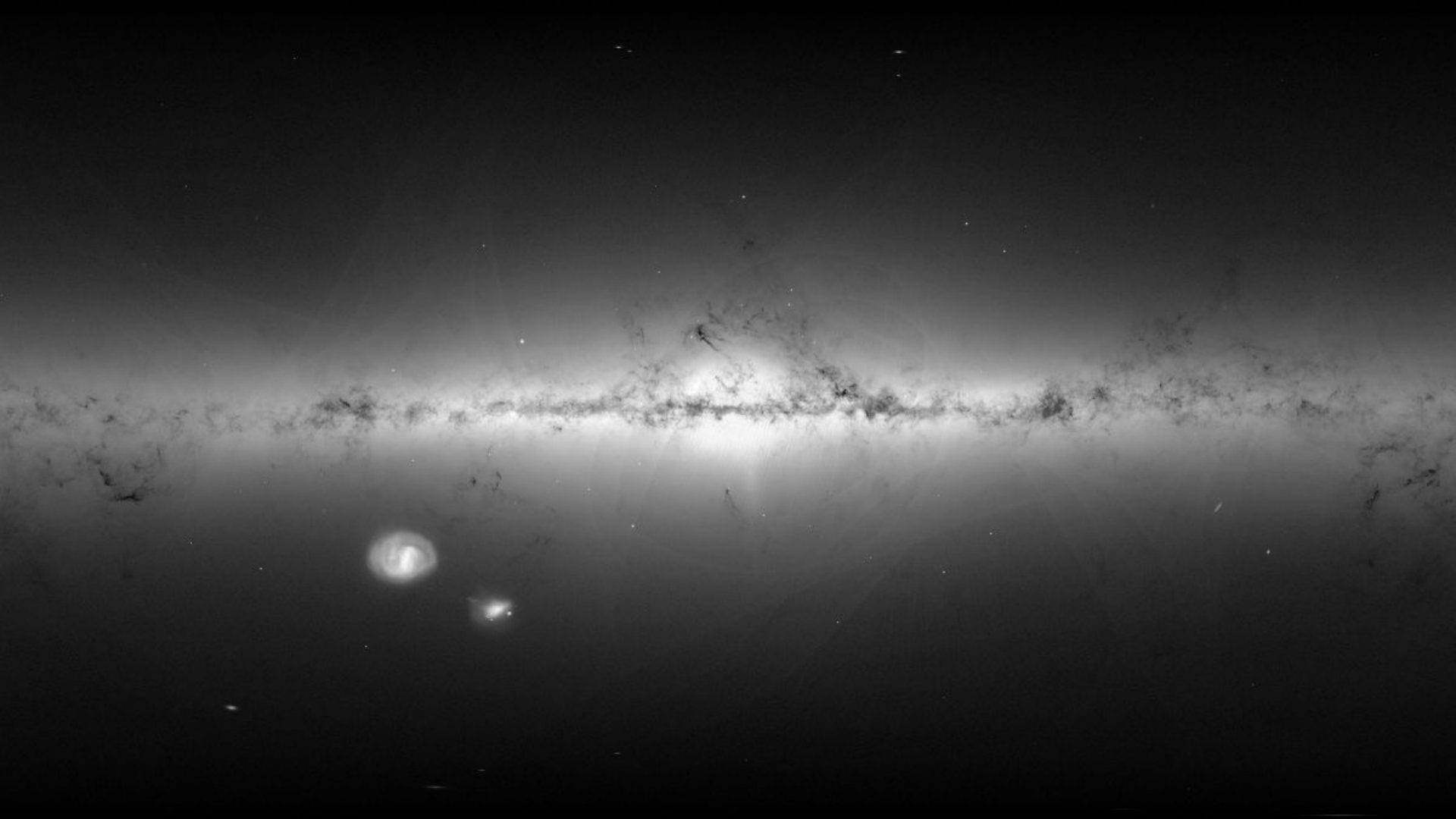
1 000 000 000 stars





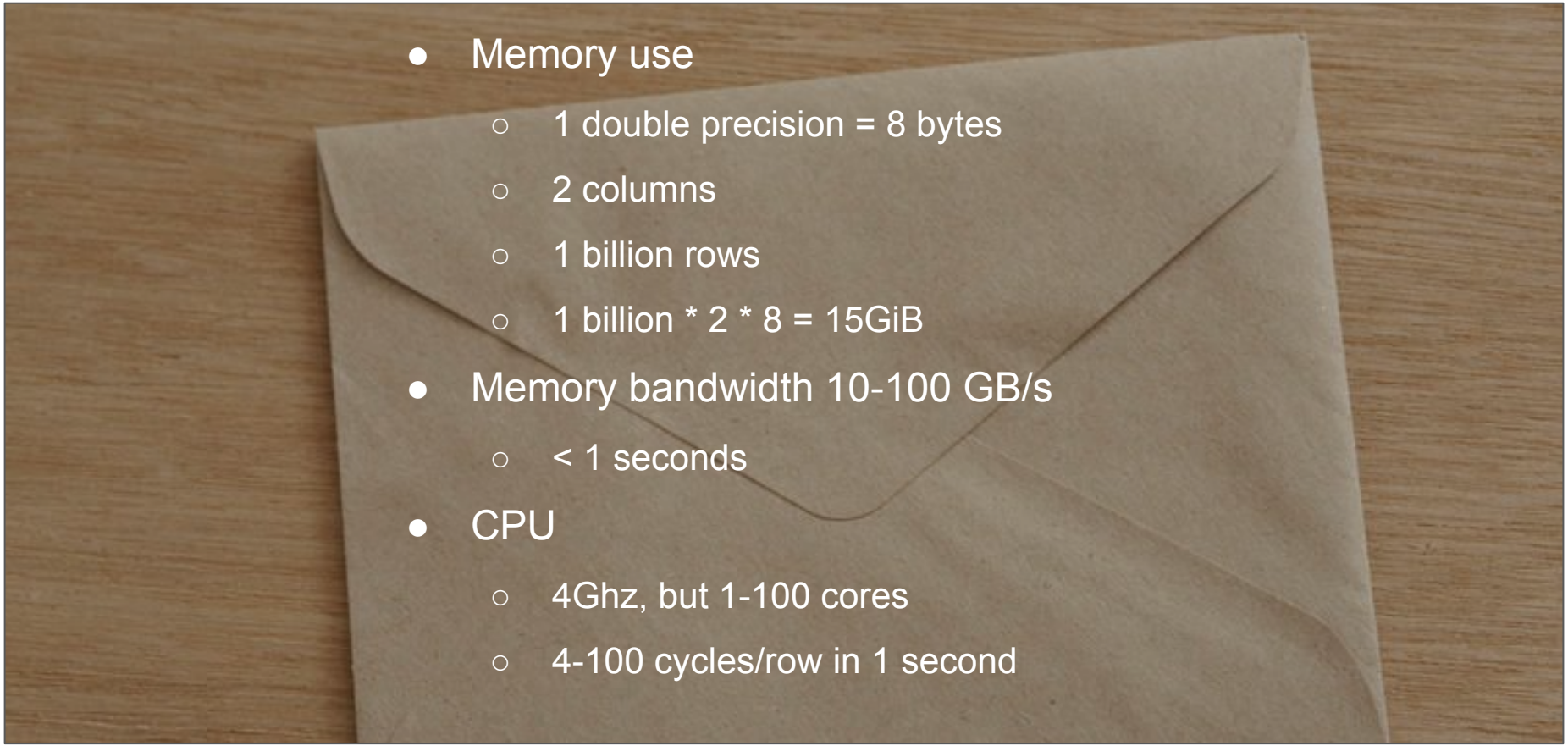






Motivation

goto;



- Memory use
  - 1 double precision = 8 bytes
  - 2 columns
  - 1 billion rows
  - 1 billion * 2 * 8 = 15GiB
- Memory bandwidth 10-100 GB/s
  - < 1 seconds
- CPU
  - 4Ghz, but 1-100 cores
  - 4-100 cycles/row in 1 second

Vaex

- High-performance, out-of-core DataFrame library
- Out-of-core algorithms ensure working with data larger than RAM
- Work with billions (10^9) of samples on a single machine / laptop interactively
- Like Pandas (similar API) but not built on Pandas
- Easy installation:
  - `pip install vaex`
- Legal: Free & Open Source, MIT License

Meet Vaex (the library)

- “Out-of-Core hybrid Apache Arrow/NumPy DataFrame for Python, ML, visualize and explore big tabular data at a billion rows per second”
- `pip install vaex` (ready to go)
- Open source (MIT License)
- DataFrame API
  - Pandas like
  - Part of “https://data-apis.org/”

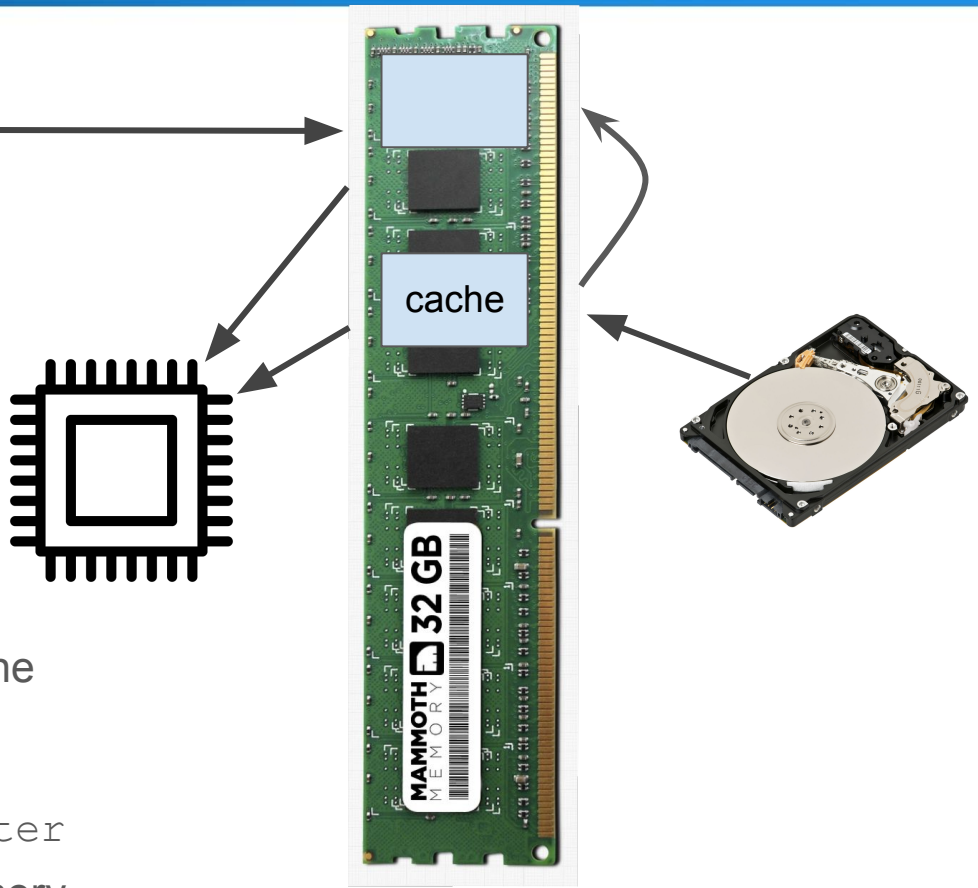
Vaex concepts

- Memory mapping
- Column based storage
- No memory copies
- Compute layer
- Expression system

Vaex concepts: memory mapping

goto;

- Normal disk reading
  - Allocate memory
  - Read from disk to memory
    - disk > cache > memory
  - Memory to CPU
  - Waste memory (thus cache)
- Memory mapping
  - Get a pointer to the same cache
  - No copy
  - Memory not taken, can be freed
  - Reading on accessing and not in cache
- Shared memory for all processes
  - e.g: `flask`, `gunicorn`, `dash`, `jupyter`
- Store on disk as you would keep it in memory



Column based storage

- Why?
  - Focus on accessing not all columns at a time
  - Sequential access is optimized for CPU and disk
  - Disk reading is block based
  - CPU cache friendly
- Hdf5
  - Non-standard: Container format, anything can be stored
  - Stored as a single contiguous array
  - Native storage
- Arrow
  - Standard: interoperatility
  - Specialized for tabular data
  - Chunks of column based
  - Native storage
- Parquet
  - Chunks of column based
  - Not-native, requires deserialization
- CSV
  - Non standard, row based, slow
  - `vaex.open("slow.csv", convert="fast.hdf5")`

Vaex concepts: column based storage

goto;

- Why ?
  - Focus on analytical workloads
  - Sequential access is optimized for CPU and disk
  - Disk reading is block based
  - CPU cache friendly

Vaex concepts: column based storage

goto;

- HDF5
  - Non-standard: Container format, anything can be stored
  - Stored as a single contiguous array
  - Native storage

- Apache Arrow
  - Standard: interoperability
  - Specialized for tabular data
  - Chunks of column based
  - Native storage

- Apache Parquet
  - Industry standard
  - Not-native, compressed, requires deserialization

Vaex concepts: no memory copies

goto;

```
df = {
    'data': {
        'x': np.arange(4),
        'y': np.array([0, np.nan, 5, 1, 1e10])
    },
    'state': {}
}
```

```
df2 = df[df.y<10]
```

```
df2 = {
    'data': same_data,
    'state': {
        'filter': 'y < 10'
    }
}
```

```
df2['z'] = df.x + df.y*10
```

```
df2 = {
    'data': same_data
    'state': {
        'filter': 'y < 10'
        'virtual_columns': {
            'z': 'x + y*10'
        }
    }
}
```

Vaex concepts: compute & expression system

goto;

- Compute:
  - Streaming algorithms
  - Map reduce
  - C++ under the hood
- Expression system
  - Store the expression, not the result
  - Evaluate when needed
  - JIT via Numba, Pythran, Cuda

```
import numpy as np
x = np.arange(5)
y = x**2
x * y
```

```
array([ 0,  1,  8, 27, 64])
```

```
import vaex
df = vaex.from_arrays(x=x, y=y)
df.x * df.y
```

```
Expression = (x * y)
Length: 20 dtype: int64 (expression)
-----------------------------------
 0     0
 1     1
 2     8
 3    27
 4    64
  ...
15  3375
16  4096
17  4913
18  5832
19  6859
```

Vaex.io: from academic project to consultancy

goto;

- Solved a problem in astronomy
- Realized this solves a broader problem
- Moved towards industry grade features & applications
  - Fast string support
  - GroupBy
  - Join
  - ML integration
  - Automatic Pipeline & DataFrame State tracking
- Unclustering your data science

“Never do a live demo”

-Many people

Putting Vaex in production

- This is nice, but I need to put it in production:
  - Make a dashboard
  - Provide a data web API
  - Deploy an ML model
- Vaex is ideal
  - Memory mapping shares data
  - Integrated caching system can cache common queries
  - Well tested with dash, flask, fastapi
  - Subpackages for less dependencies (pick what you need)
    - `vaex-core`
    - `vaex-ml`
    - `vaex-viz`

Vaex in Production

goto;

- This is nice, but I need to put it in production:
  - Make a dashboard
  - Provide a data web API
  - Deploy an ML model
- Vaex is ideal
  - Memory mapping shares data
  - Integrated caching system can cache common queries/results
  - Well tested with Dash, Flask, FastAPI
  - Support cloud storage: s3, gcs (pyarrow, fsspec)
  - Subpackages for less dependencies (pick what you need)
    - `vaex-core`
    - `vaex-ml`
    - `vaex-viz`
    - more!

Vaex in the wild

BioSkryb GENOMICS

Field: Genomics
Use: Interactive exploration of genomics data (x240 performance increase)

STScI | SPACE TELESCOPE SCIENCE INSTITUTE

Field: Astronomy & Astrophysics
Use: Remote interactive exploration & visualisation and analysis of large datasets

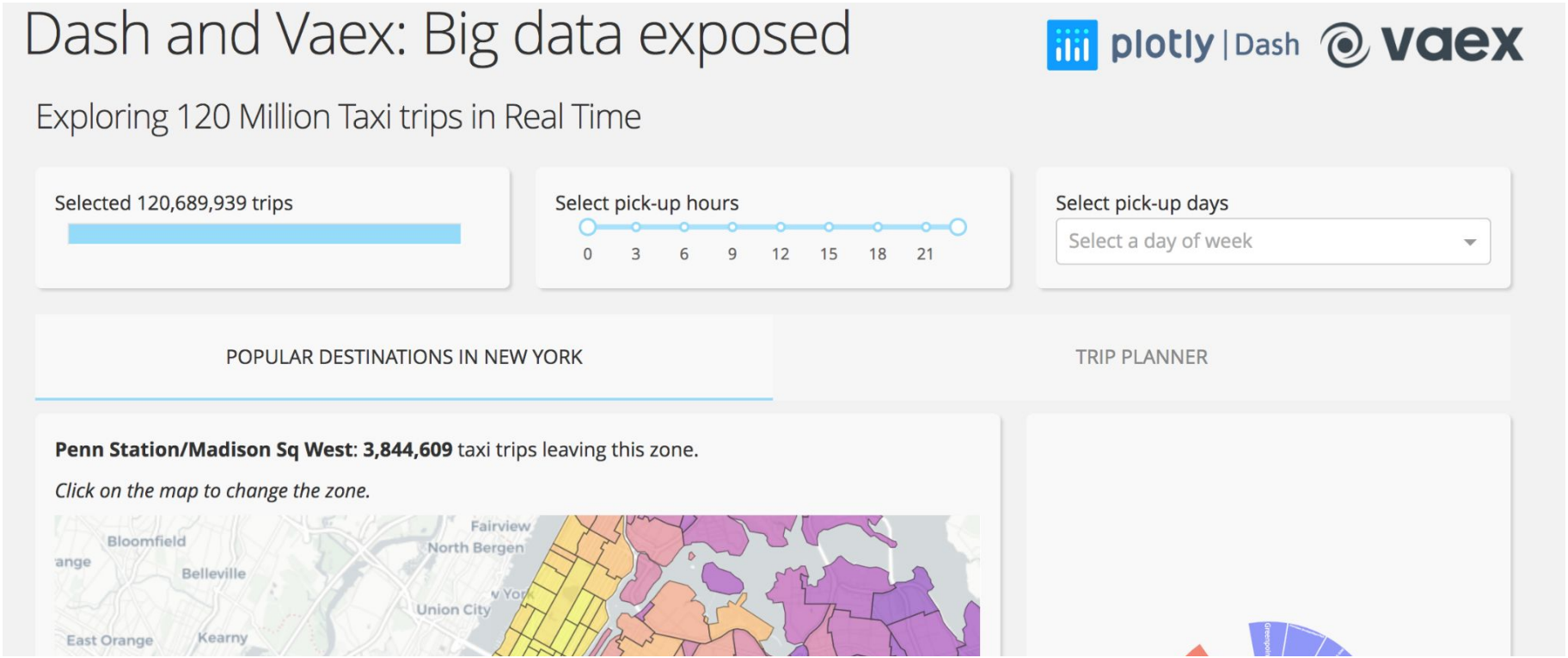
plotly

Field: Data visualisation & Dashboards
Use: The primary backend to the newly released Plotly Dashboard Engine;

Plotly Dash clients get access to big data with no setup.

Vaex in Production: Dash example

https://dash.vaex.io/



vaex-enterprise

goto;

- Non open source
- Non core dataframe features
- Caching of e.g. parquet to native storage
- Memory protection (to avoid queries taking too much memory)
- Distributed dataframe (dask or ray based)

Vaex.io: Consultancy

goto;

- Features development
- Support
- Retainers
- Performance
- Training

Flow back to open source development & maintenance

Summary

goto;

- Operating on 1 billion rows in 1 second is possible
- How we do this
  - Memory mapping
  - Column based storage
  - Multithreading and C++
  - Expression system
- Ideal for
  - Interactive exploration (EDA)
  - Backends (dashboard, Web APIs)
- No cluster needed

Get in touch!

goto;

- contact@vaex.io - support / consultancy training
-  https://github.com/vaexio/vaex
-  @vaex_io
- Documentation: https://vaex.io/docs/
- Examples: https://github.com/vaexio/vaex-examples/
- This talk and notebook:
  -  https://github.com/vaexio/vaex-talks

Content

- History of vaex?
  - Briefly gaia without mentioning gaia
  - -> 1 second
  - mmapping
  - Everybody can do it
  - Don’t need expensive hardware
- About Vaex / What / Why Vaex/DataFrame
  - Pandas defined the API
  - No SQL/DSL/SQLite / Python API
  - Simplicity, pip install, vaex.open or “SELECT * from …” dump to disk
  - Data in process, integrates well in the PyData stack (Viz,Stats,ML libraries)
  - Arrow ?
- Vaex as backend / cloud friendly / Who uses Vaex / Dashboard story
  - Vaex is fast!
  - Scaling up, multiple processes memory mapping
  - On node compute, no extra processes that can fail
  - Read from cloud storage, can cache locally (hdf5/parquet/arrow)
  - caching
- Demo
  - Basics
  - plots
  - Caching?
- Ending
  - Business model
    - Open source
    - Consultancy
  - How to contribute
    - Make a test or make it fail
- Other ideas
  - Leaky abstraction: some things which are not a good idea in pandas are a good idea in vaex, example

goto;

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