

Usual Execution output:

```
Sent event: {'song_id': 404, 'timestamp': 1742131387.3013604, 'region': 'US', 'action': 'play'}
Sent event: {'song_id': 202, 'timestamp': 1742131388.0496716, 'region': 'APAC', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131390.0478222, 'region': 'US', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131390.9162977, 'region': 'APAC', 'action': 'play'}
Sent event: {'song_id': 505, 'timestamp': 1742131391.7911646, 'region': 'US', 'action': 'play'}
Sent event: {'song_id': 404, 'timestamp': 1742131393.416715, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131394.8853097, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131396.139115, 'region': 'US', 'action': 'play'}
Sent event: {'song_id': 202, 'timestamp': 1742131397.842831, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131399.0608277, 'region': 'APAC', 'action': 'play'}
Sent event: {'song_id': 303, 'timestamp': 1742131400.1084404, 'region': 'APAC', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131400.89847, 'region': 'APAC', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131401.9314969, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 202, 'timestamp': 1742131403.2241638, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 202, 'timestamp': 1742131404.0534666, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 202, 'timestamp': 1742131405.2157965, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 505, 'timestamp': 1742131406.5744696, 'region': 'APAC', 'action': 'play'}
Sent event: {'song_id': 303, 'timestamp': 1742131407.2401638, 'region': 'US', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131408.5920622, 'region': 'US', 'action': 'play'}
Sent event: {'song_id': 303, 'timestamp': 1742131409.9380484, 'region': 'APAC', 'action': 'play'}
Sent event: {'song_id': 505, 'timestamp': 1742131411.2391183, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 303, 'timestamp': 1742131412.3047688, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 303, 'timestamp': 1742131413.710239, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131415.1448805, 'region': 'US', 'action': 'play'}
Sent event: {'song_id': 202, 'timestamp': 1742131415.809675, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 303, 'timestamp': 1742131417.462571, 'region': 'APAC', 'action': 'play'}
Sent event: {'song_id': 202, 'timestamp': 1742131418.4222927, 'region': 'EU', 'action': 'play'}
Sent event: {'song_id': 101, 'timestamp': 1742131419.9028635, 'region': 'US', 'action': 'play'}
Sent event: {'song_id': 303, 'timestamp': 1742131421.6447933, 'region': 'US', 'action': 'play'}
```

=== Batch: 53 ===

window	region	song_id	count	rn
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	EU	101	4	1
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	EU	303	3	2
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	APAC	202	9	1
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	APAC	404	6	2
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	APAC	505	3	3

=== Batch: 54 ===

window	region	song_id	count	rn
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	US	404	3	1
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	EU	303	4	1
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	APAC	404	8	1
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	APAC	505	5	2
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	APAC	101	4	3

=== Batch: 55 ===

window	region	song_id	count	rn
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	US	404	5	1
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	US	303	4	2
{2025-03-16 18:20:00, 2025-03-16 18:25:00}	APAC	505	6	1

Changing processing window = 10 and action = skip:

```
Sent event: {'song_id': 202, 'timestamp': 1742132483.971048, 'region': 'APAC', 'action': 'skip'}
Sent event: {'song_id': 303, 'timestamp': 1742132485.3852394, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 202, 'timestamp': 1742132487.1861894, 'region': 'US', 'action': 'skip'}
Sent event: {'song_id': 303, 'timestamp': 1742132488.724495, 'region': 'US', 'action': 'skip'}
Sent event: {'song_id': 404, 'timestamp': 1742132489.2590125, 'region': 'APAC', 'action': 'skip'}
Sent event: {'song_id': 202, 'timestamp': 1742132489.817179, 'region': 'US', 'action': 'skip'}
Sent event: {'song_id': 303, 'timestamp': 1742132490.8205044, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 101, 'timestamp': 1742132491.550407, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 505, 'timestamp': 1742132492.4714904, 'region': 'US', 'action': 'skip'}
Sent event: {'song_id': 101, 'timestamp': 1742132493.760599, 'region': 'US', 'action': 'skip'}
Sent event: {'song_id': 404, 'timestamp': 1742132494.7340424, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 303, 'timestamp': 1742132495.7443326, 'region': 'US', 'action': 'skip'}
Sent event: {'song_id': 101, 'timestamp': 1742132496.2621634, 'region': 'US', 'action': 'skip'}
Sent event: {'song_id': 101, 'timestamp': 1742132497.2778294, 'region': 'APAC', 'action': 'skip'}
Sent event: {'song_id': 101, 'timestamp': 1742132498.5574765, 'region': 'APAC', 'action': 'skip'}
Sent event: {'song_id': 505, 'timestamp': 1742132499.2841802, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 505, 'timestamp': 1742132500.5503824, 'region': 'US', 'action': 'skip'}
Sent event: {'song_id': 303, 'timestamp': 1742132502.2499242, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 101, 'timestamp': 1742132503.1273937, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 202, 'timestamp': 1742132504.219621, 'region': 'APAC', 'action': 'skip'}
Sent event: {'song_id': 303, 'timestamp': 1742132505.3596017, 'region': 'APAC', 'action': 'skip'}
Sent event: {'song_id': 303, 'timestamp': 1742132506.2137785, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 505, 'timestamp': 1742132508.0419872, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 303, 'timestamp': 1742132508.741802, 'region': 'APAC', 'action': 'skip'}
Sent event: {'song_id': 303, 'timestamp': 1742132509.2430394, 'region': 'APAC', 'action': 'skip'}
Sent event: {'song_id': 505, 'timestamp': 1742132510.6334507, 'region': 'EU', 'action': 'skip'}
Sent event: {'song_id': 101, 'timestamp': 1742132512.5412135, 'region': 'APAC', 'action': 'skip'}
Sent event: {'song_id': 202, 'timestamp': 1742132513.621661, 'region': 'APAC', 'action': 'skip'}
```

=== Batch: 1 ===

window	region	song_id	count	rn
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	US	505	6	1
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	US	101	4	2
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	US	404	2	3
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	APAC	101	7	1
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	APAC	303	3	2
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	APAC	404	3	3
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	EU	404	6	1
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	EU	101	3	2
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	EU	303	2	3

=== Batch: 2 ===

window	region	song_id	count	rn
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	US	101	9	1
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	US	404	5	2
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	US	303	2	3
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	APAC	101	9	1
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	APAC	505	5	2
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	APAC	303	4	3
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	EU	101	4	1
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	EU	202	4	2
{2025-03-16 18:40:00, 2025-03-16 18:50:00}	EU	505	2	3

Changing processing window = 1 and action = like:


```
Sent event: {'song_id': 101, 'timestamp': 1742132738.8126311, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 101, 'timestamp': 1742132740.2767653, 'region': 'US', 'action': 'like'}
Sent event: {'song_id': 202, 'timestamp': 1742132741.9351904, 'region': 'APAC', 'action': 'like'}
Sent event: {'song_id': 505, 'timestamp': 1742132743.462937, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 505, 'timestamp': 1742132744.1922467, 'region': 'APAC', 'action': 'like'}
Sent event: {'song_id': 202, 'timestamp': 1742132745.1633065, 'region': 'US', 'action': 'like'}
Sent event: {'song_id': 303, 'timestamp': 1742132746.432662, 'region': 'US', 'action': 'like'}
Sent event: {'song_id': 101, 'timestamp': 1742132748.0489056, 'region': 'APAC', 'action': 'like'}
Sent event: {'song_id': 101, 'timestamp': 1742132749.6085374, 'region': 'APAC', 'action': 'like'}
Sent event: {'song_id': 505, 'timestamp': 1742132750.710833, 'region': 'US', 'action': 'like'}
Sent event: {'song_id': 404, 'timestamp': 1742132751.7915943, 'region': 'US', 'action': 'like'}
Sent event: {'song_id': 505, 'timestamp': 1742132753.743974, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 202, 'timestamp': 1742132755.6569626, 'region': 'US', 'action': 'like'}
Sent event: {'song_id': 202, 'timestamp': 1742132757.0935955, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 101, 'timestamp': 1742132758.7727637, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 303, 'timestamp': 1742132760.6961782, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 101, 'timestamp': 1742132762.5910914, 'region': 'APAC', 'action': 'like'}
Sent event: {'song_id': 101, 'timestamp': 1742132763.3999567, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 303, 'timestamp': 1742132764.2623227, 'region': 'APAC', 'action': 'like'}
Sent event: {'song_id': 303, 'timestamp': 1742132765.5649834, 'region': 'US', 'action': 'like'}
Sent event: {'song_id': 505, 'timestamp': 1742132767.2324839, 'region': 'APAC', 'action': 'like'}
Sent event: {'song_id': 505, 'timestamp': 1742132769.2123146, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 404, 'timestamp': 1742132770.2822337, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 101, 'timestamp': 1742132770.9191701, 'region': 'APAC', 'action': 'like'}
Sent event: {'song_id': 303, 'timestamp': 1742132771.8311658, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 505, 'timestamp': 1742132772.8065312, 'region': 'APAC', 'action': 'like'}
Sent event: {'song_id': 202, 'timestamp': 1742132774.2981706, 'region': 'EU', 'action': 'like'}
Sent event: {'song_id': 303, 'timestamp': 1742132775.5040827, 'region': 'EU', 'action': 'like'}
```

=== Batch: 2 ===

```
+-----+-----+-----+-----+
|window|region|song_id|count|rn |
+-----+-----+-----+-----+
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|APAC |404 |5 |1 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|APAC |101 |2 |2 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|APAC |303 |1 |3 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|EU |404 |2 |1 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|EU |101 |2 |2 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|EU |505 |1 |3 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|US |303 |3 |1 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|US |404 |2 |2 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|US |101 |2 |3 |
+-----+-----+-----+-----+
```

=== Batch: 3 ===

```
+-----+-----+-----+-----+
|window|region|song_id|count|rn |
+-----+-----+-----+-----+
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|APAC |303 |2 |1 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|APAC |202 |1 |2 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|EU |404 |3 |1 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|EU |202 |3 |2 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|EU |303 |1 |3 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|US |303 |4 |1 |
|{2025-03-16 18:47:00, 2025-03-16 18:48:00}|US |101 |4 |2 |
+-----+-----+-----+-----+
```


Performance comparison

CPU usage for 1 minute:

```
top - 12:09:07 up 13 min, 2 users, load average: 6.47, 3.38, 2.02
Tasks: 280 total, 2 running, 278 sleeping, 0 stopped, 0 zombie
%Cpu(s): 85.0 us, 13.3 sy, 0.0 ni, 1.3 id, 0.0 wa, 0.0 hi, 0.3 si, 0.0 st
MiB Mem : 7321.0 total, 156.6 free, 5170.2 used, 2928.4 buff/cache
MiB Swap: 3806.0 total, 3804.5 free, 1.5 used. 2150.7 avail Mem
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
7457	saad	20	0	5131680	826704	29872	S	97.0	11.0	2:53.53	java
15088	saad	20	0	85732	72704	5332	S	57.9	1.0	0:10.98	python3
24866	saad	20	0	83684	70876	5428	S	57.0	0.9	0:03.54	python3
16121	saad	20	0	85732	72700	5392	S	56.6	1.0	0:05.22	python3
25397	saad	20	0	71396	58296	5464	S	20.9	0.8	0:00.63	python3
4015	saad	20	0	11.1g	371204	202552	S	7.9	5.0	0:44.09	firefox
3329	saad	20	0	4577476	325248	150788	R	7.0	4.3	1:14.45	gnome-shell
9306	saad	20	0	1816900	149720	100436	S	6.0	2.0	0:03.27	gnome-system-mo
16	root	20	0	0	0	0	S	1.7	0.0	0:01.08	ksoftirqd/0
38	root	20	0	0	0	0	S	1.7	0.0	0:01.49	ksoftirqd/3
5361	saad	20	0	704496	60464	45056	S	1.7	0.8	0:12.02	gnome-terminal-
26	root	20	0	0	0	0	S	1.3	0.0	0:00.84	ksoftirqd/2
32	root	20	0	0	0	0	S	1.0	0.0	0:00.76	ksoftirqd/1
7156	saad	20	0	4785000	384192	21408	S	1.0	5.1	0:15.41	java
4706	saad	20	0	2396376	73232	60944	S	0.7	1.0	0:00.29	Web Content
4738	saad	20	0	2396384	73172	60756	S	0.7	1.0	0:00.28	Web Content
17	root	20	0	0	0	0	I	0.3	0.0	0:01.09	rcu_preempt
500	root	20	0	0	0	0	I	0.3	0.0	0:00.17	kworker/u16:26-events_unbound
708	root	20	0	0	0	0	I	0.3	0.0	0:00.83	kworker/1:3-events
2079	rtkit	21	1	20480	2732	2604	S	0.3	0.0	0:00.05	rtkit-daemon
5327	saad	20	0	41517	45264	14528	S	0.3	0.0	0:02.51	python3

CPU usage for 10 minute:

```
top - 12:13:07 up 17 min, 2 users, load average: 7.10, 5.20, 3.04
Tasks: 289 total, 2 running, 287 sleeping, 0 stopped, 0 zombie
%Cpu(s): 66.5 us, 32.1 sy, 0.0 ni, 0.6 id, 0.0 wa, 0.0 hi, 0.7 si, 0.0 st
MiB Mem : 7321.0 total, 345.0 free, 5577.9 used, 2440.1 buff/cache
MiB Swap: 3806.0 total, 3697.9 free, 108.1 used. 1743.0 avail Mem
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
34900	saad	20	0	5074468	851632	29740	S	213.2	11.4	3:11.57	java
3329	saad	20	0	4587212	242636	79688	S	28.5	3.2	1:33.60	gnome-shell
35499	saad	20	0	1136.2g	400300	142952	S	16.9	5.3	1:00.46	whatsapp-linux-
9306	saad	20	0	1819656	100040	47828	R	7.0	1.3	0:20.41	gnome-system-mo
35277	saad	20	0	32.6g	106496	70276	S	5.3	1.4	0:08.25	whatsapp-linux-
26	root	20	0	0	0	0	S	4.3	0.0	0:02.95	ksoftirqd/2
38	root	20	0	0	0	0	S	4.3	0.0	0:03.53	ksoftirqd/3
5361	saad	20	0	704912	55156	39236	S	4.0	0.7	0:15.86	gnome-terminal-
34974	saad	20	0	1132.3g	178280	126152	S	3.6	2.4	0:28.96	whatsapp-linux-
16	root	20	0	0	0	0	S	3.0	0.0	0:02.86	ksoftirqd/0
32	root	20	0	0	0	0	S	2.6	0.0	0:02.20	ksoftirqd/1
4015	saad	20	0	11.1g	311848	144312	S	2.0	4.2	0:44.93	firefox
5599	saad	20	0	417868	54412	15252	S	1.3	0.7	0:04.16	Xwayland
56735	saad	20	0	32.4g	58980	49636	S	1.3	0.8	0:00.45	whatsapp-linux-
3445	saad	20	0	388940	11596	6732	S	1.0	0.2	0:03.36	ibus-daemon
5630	saad	20	0	1243228	60648	34916	S	1.0	0.8	0:00.98	mutter-x11-fram
7156	saad	20	0	4785000	356204	16076	S	1.0	4.8	0:18.41	java
17	root	20	0	0	0	0	I	0.7	0.0	0:01.73	rcu_preempt
4706	saad	20	0	2396376	48912	36624	S	0.7	0.7	0:00.36	Web Content
34863	saad	20	0	111524	24184	11256	S	0.7	0.3	0:00.59	python3
37	root	rt	0	0	0	0	S	0.3	0.0	0:00.18	migration/3
1414	polkitd	20	0	308612	9276	6828	S	0.3	0.1	0:00.98	polkitd

Summarizing usage:

Based on the CPU usage reports:

1. **High CPU Usage:** In the second image, the `java` process is utilizing 97% of the CPU. This likely indicates that Kafka or a related service is consuming significant CPU resources due to the Kafka streaming job's processing workload.
2. **Overall System Load:** The system's load average is 6.47, 3.38, 2.02, which suggests a moderate to high load. The system is under stress with a high number of tasks and users, especially with CPU-intensive tasks like Kafka processing.
3. **Kafka and PySpark Jobs:** The gnome-shell and Kafka-related tasks are consuming substantial CPU, with streaming processing affecting overall performance. CPU spikes, as seen in the reports, are typical when handling high-frequency event data in real-time streaming applications like Kafka.