Here's a didactic canvas comparing a **Matrix** and a **Tensor** in the context of endurance training data:

---

# Matrix vs Tensor in Training Load Representation

## 1. Matrix (2D)

A matrix organizes data into **rows and columns**. It's perfect when you only want to track daily summaries.

**Example:** Training metrics stored as a matrix:

| Day | TSS | HRV | Sleep Hours | Resting HR |
|---|---|---|---|---|
| 1 | 85 | 62 | 7.5 | 48 |
| 2 | 90 | 58 | 6.0 | 50 |
| 3 | 40 | 72 | 8.0 | 46 |

- **Shape:** `[days × variables]`
- **Limitation:** No sense of order beyond rows. If an athlete does two sessions in one day, this structure cannot capture session order or intra-session dynamics.

---

## 2. Tensor (3D/4D+)

A tensor extends matrices into more dimensions, capturing **session-level**, **day-level**, and even **time-series level** information.

**Example:** Training load as a 3D tensor:

```
Tensor shape = [days × sessions × variables]
```

- **Day axis:** Each day in the training block.
- **Session axis:** Multiple sessions per day.
- **Variable axis:** Metrics such as TSS/TRIMP, energy per kg, HR quartiles, HRV pre/post, λHRV.

**Visualization:**

```
Day 1 → Session 1 → [TSS, TRIMP, HR quartiles, HRVpre, HRVpost...]
Day 1 → Session 2 → [TSS, TRIMP, HR quartiles, HRVpre, HRVpost...]
Day 2 → Session 1 → [ ... ]
```

You can even go further (4D/5D) by adding axes: - **Time samples within a session** (power, HR every second). - **Sport axis** (bike/run/swim). - **Context axis** (sleep, stress, body mass).

---

## Key Differences

- **Matrix = flat summary:** collapses complexity into daily averages.
- **Tensor = multidimensional structure:** preserves order, context, and interactions between variables.

---

## Takeaway

A matrix is like a training log in Excel: clear but limited. A tensor is like a 3D/4D training cube: it lets you rotate and analyze training from different perspectives — session order, physiological state, or multi-day patterns — without losing information.