Javascript libraries such as Cubism, Rickshaw, Epoch, or Smoothie charts can stream realtime charts from independent data events

In any session where lap time data can be collected, we can generate charts showing the distribution of laptimes, potentially just displaying them for selected drivers. The laptime charts can be aligned with other charts detailing other historical data traces, such as weather information. Background banding may highlight rain etc. Laptime charts generated during practice sessions, particular the second practice session, can be used to generate models of tyre wear, or a more vague model of combined tyre wear/fuel corrected laptimes.

If charts like this are updated in real time, they give both a historical view, and the current view (the right hand leading edge). The historical view helps explain how the race got to its current state, and may indicate trends over the course of the race that might be extended, in the mind's eye at least, as projections. (Statistical modeling could be used to generate actual projections.)

Lap event data means we can generate other standard charts such as lap charts.
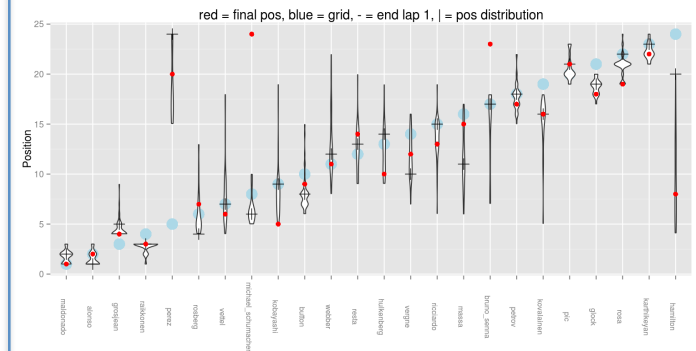

One way of reviewing the evolving state of a race is to consider it from the perspective of an individual driver. The race can be characterised using a *battlemap* that shows the distance between drivers on a lap by lap (or sector by sector) basis.

One problem with the battle map is that the identity of the cars placed in the race position behind and race position ahead are not displayed. Using two alternating symbols to denote different drivers, with a driver name or race number label by the symbol each time it (reflecting a change in the identity of the driver ahead or behind), might be one way of displaying this information whilst minimising clutter.
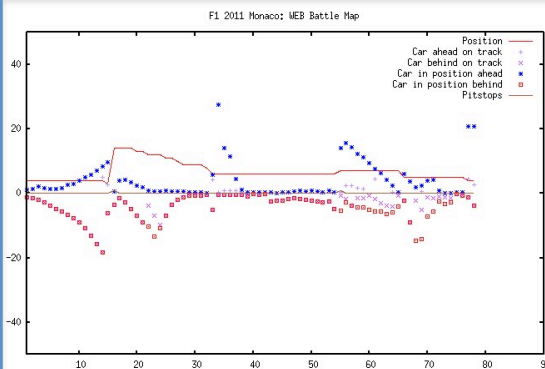
In the battle chart above, an indication is given of the distance between a particular driver and the cars immediately in front and behind in terms of both race position and track position. Another possible view is to display the distance between two particular, selected drivers, and plot their battle, thus helping fans make sense of how those two particular cars (that might have been said to be competing) are actually competing. (A third way of rendering battle maps is to pick a race position and show the battle for that. The battle map for third position, for example, would show the time to the car ahead in second and behind to the car in fourth. Such a map also needs an indication of which driver in placed in that position at any given time.)

Pit events are one area of the race where position changes are likely to result. A sense of anticipation can be built up if fans can be engaged in identifying when a good time to pit might be, e.g. in terms of identifying gaps that the driver might be able to emerge from the pit lane into, assuming a typical pit stop; tension arises from predicting that a driver might emerge into traffic. So how might we model these gaps from the the timing data?

A circular map with a circumference proportional to the laptime of the leader, or mean laptime of non-PITting or outlap cars and cars plotted the interval distance apart, can indicate track position. The inner circle shows a figurative display of where the cars are relative to each other in terms of interval, the outer banded region where they might emerge after a pit stop. We could also overlay numerical interval times on this chart, thought we would have to make it clear whether intervals related to the interval between consecutively placed cars in the race order, or whether it related to interval between cars next to each other in terms of track position. (We can estimate the time distance between cars on track either by calculation or by comparing time stamps from the timing data.)

```
{'interval': '0.4',
 'pos': 14,
 's2': '36.0',
 's3': '33.0',
 'laptime': '1:35.224',
 's1': '26.1',
 'gap': '12.4',
 'lap': 1,
 'timeofday': '14:41:46.378'},
```

```
raceObj.lapPurples.history[:3]
[{'classRank': 1,
  'lap': 1,
  'laptime': '1:32.010',
  'name': 'L. HAMILTON',
  'strtime': '14:41:34.205',
  'driverNum': '44'},
 {'classRank': 1,
  'lap': 3,
  'laptime': '1:31.913',
  'name': 'L. HAMILTON',
  'strtime': '14:44:38.478',
  'driverNum': '44'},
```

Example data objects parsed from timing data.

The *Race Summary Chart* is intended to provide an at glance summary of driver positions at notable parts of the race: on the grid, at the end of the first lap, at the current time or at the end of the race. The range and density of race positions held throughout the race is also shown using a statistical graphics technique known as a a violin plot.