How to get good cuts when you can not store the full sample?

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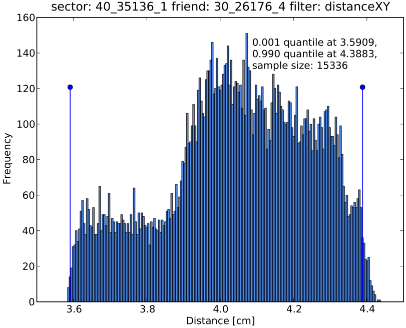
February 20, 2015

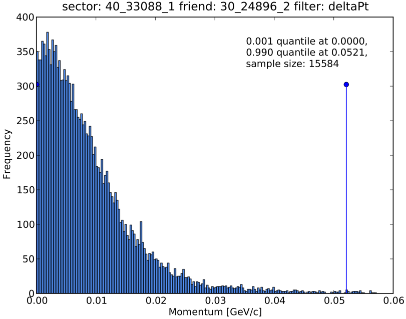
why RAM is the bottleneck for secMapCreation

The Problem:

- getting good cuts for the secMap is crucial
- reliable cuts need big sample sizes which need to be stored
- rough estimation: nTracks * charges * phiRange * thetaRange * momentumRange = nTracks * 2 *360*140*3500 = nTracks * 350 Mio
- easy solution: iterative algorithms to determine cuts
- for gaussian-like distributions: estimate expectation value and standard deviation → you can easily estimate any quantile you like
- unfortunately we can not assume gaussian-like distributions
- requests:
    - determine exact quantile of sample, if possible
    - shall work independently from shape of distribution
    - allow merging of different samples of the same sector-combination


sector: 40_35136_1 friend: 30_26176_4 filter: distanceXY

0.001 quantile at 3.5909,
0.990 quantile at 4.3883,
sample size: 15336


sector: 40_33088_1 friend: 30_24896_2 filter: deltaPt

0.001 quantile at 0.0000,
0.990 quantile at 0.0521,
sample size: 15584

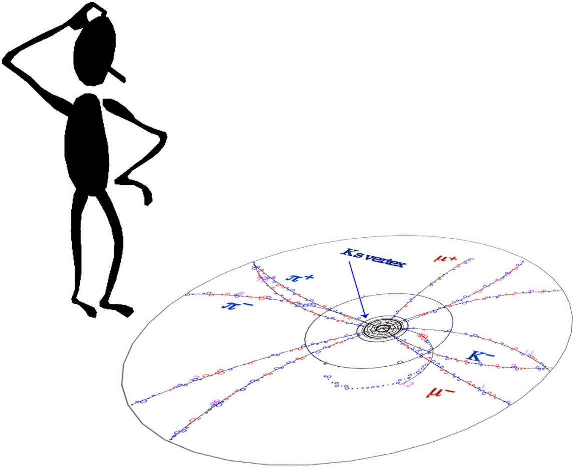
how to get quantiles

- so far:
  - collect full sample
  - sort it
  - retrieve quantiles (min & max cutoff)
- proposal:
  - instead of storing full sample, two sortable containers (one for lower and one for upper cutoff) are used.
  - the fact that the quantiles are near the min and max quantile can be used for reducing the footprint

Example: case 1% and 99% percentile

- start with 2 small sortable containers one for lower (filled with datatype::max), one for upper (filled with datatype::min) cutoff.
- new measurements are sorted into these containers, if they are bigger than the smallest entry (for upper cuts), or smaller than the biggest entry (for lower cuts)
- if measurement was accepted e.g. from upper cut container, lowest value for upper cut is discarded
- if measurement was not accepted by the containers, measurement is discarded and sample-size-counter increased
- size of container grows with the sample size, for 1% percentile → store smallest 2% of measurements.
- if two samples shall be merged, the lower and the upper containers of both samples are fully merged and their counters added.
- with the upper safety margin, for given quantiles and big sample sizes memory consumption is decreased by a factor of 25.
- does practically never lose relevant data and works with samples of any shape

that's all, folks!



Any suggestions, ideas or requests?
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