PROGRAMMING TIPS

1) for absolute beginners: start programming with Matlab/Octave M-scripts (high-level, ultra-easy-to-learn, scientific language) or Python

2) useful links for smartphone/PineA64+/OrangePi C++ users:

      -original C++ official site, and online compiler:

            http://www.cplusplus.com/

            http://www.cpp.sh/

      -tutorials with online compiler on multicore platform session:

            https://www.tutorialspoint.com/cplusplus/index.htm

            http://www.tutorialspoint.com/compile_cpp11_online.php

3) for data processing beginners (GB's of scalars and vectors data processing experience) in sequential C++, parallel CUDA C:

      -use **vector** container (read&process chunks of data – CPU memory bandwidth usage); for psuedorandom accesses use **map** container (unordered_set – faster, map – self sorting during creation via iterator); quite intuitive and good results are for vector< vector< float > > - vecD (vector in D-dimensions, allocated in one, continous virtual memory address – physicall memory continuity is platform dependend),

      -acceptable results are for bidirectional list< vector< float > >,

     -UNCOMPRESS to RAM:

            -tip from prof. Starzynski from Warsaw University: „faster for bigger data"

            -applicable from few MB's data size, can reduce used PCIe bandwidth in CPU-GPU transfers,

     -SORT = organise data:

            -easier and faster to processing

            -quite fast to obtain statistics (min, max, median, etc.)

     -NORMALIZE data:

            -one way to normalize is get median value from mean of sorted data and store it separately and as second step subtract it from data. If it does fit in float storage acceptable range get min element as 0 and divide each element by max element normalize to 1, (note that norm[0, 1] step is lossy if max element is much greater than median - use mean instead)

            -note median drawbacks – there are some other tricks like trimmed mean

            -one can use fastest datatypes which are commonly FLOAT (uint16_t are basicly for counters – use auto, or iterators), and store only an additional median value to on-air normalized data

            -FLOAT considerations:

                  -data storage precision: +-1000 variable value (better are +-100)

                  -accumulative computation accuracy max iteration = 100

                  -variable comparisions (err: 1.1==1.1!!!):

                      global float floatErr = 10e-5;

                      (1.1 – floatErr < 1.1)&&(1.1 + floatErr > 1.1)

                      pro: use CPU register described in 06_registerGlobal

                  -note that float pointer size is doubled than float datatype size on 64bit architecture:

                      sizeof(float*) = 8

                      sizeof(float) = 4

                      sizeof(uint16_t) = 2

                  -instead of float, the size of variable double representation size is:

                      doubled for 1D variable

                      quadratic for 2D variable

                      octal for 3D variable

                  -keep vectors normalized and store its median value as separate variable

-**FRAGMENT** data:
- -only small fragments of data with low programming instructions are fast
- -commonly only small fragments are trivially attainable
- -fragmented data are simpler to compute in parallel:

PARALLELIZE computations:
- -quite simple sequential parallelism on multicore CPU: GNU parallel scripts,
- -quite simple parallelism on GPU: accelerated libraries like Thrust (thrust::device_vector - omit expensive transfers for small data size),
- -computations of vectors with size bigger than 8000 elements are faster only on GPU

-**Time To Market cosiderations** – cost of computing Octave easto-to-write script few times during night or writing an OpenCL optimized application for week and obtain results in seconds (quite rare situation of often used programs)

-**Look up Tables –** usage of static vector containing prec-computed values highly reduces overall amount of computations. Check your program for multiple calculations of **2+2=4**!

4) C++ offline documentation could be accessible via cppman package:

```
#sudo apt-get install cppman
#cppman -c              #offline download / update
#cppman -m true         #set cppman instead of #man in #vim
```

- a) #cppman vector
- b) #cppman std::vector
- c) #man std::vector