CLOSEOUT

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WORKSHOP ON FAST REALTIME SYSTEMS AND REALTIME MACHINE LEARNING
Justus–Liebig–Universität Giessen
08.04.–11.04.2024

Realtime Workshop @ Giessen, April 8–11, 2024

- **A warm thank you to all speakers, all participants, and everyone who participated in the lively discussion.**
- A few things which caught my attention (in no particular sequence):
  - Triggerless DAQ systems is a modern trend (4 experiments reported at this workshop); for colliders easier than for fixed target experiments because event builder may utilize bunch crossing number
  - Sending data with Terabytes/s (CBM ~1 TB/s, ALICE >3 TB/s); pushing all data to CPU farm is tempting ("easier" than FPGA programming)
  - Neutrino experiments: never stop the run, you may miss the supernova (taking pedestals during ongoing run!) and the supernova has orders of magnitude more data than bandwidth on a normal weekday
  - TDCs on FPGAs and even ADCs on FPGAs (by time-over-threshold); who needs ASICs (but still needed in radiation-hard environment)
  - HLS, HLS, HLS and hls4ml, maybe code is still VDHL but it is generated by "transpilers" and not written by students anymore

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- System-on-a-chip (i.e. FPGA interfaced with ARM processors) changed the FPGA world, makes it much easier to get e.g. NN training data to the FPGA (compared to "pure" FPGAs); non-expensive boards available (ZYNQ) and AMD/Xilinx kept the approach for newer (and more expensive) platforms
- Change your VIVADO version, change your firmware! (although code is same)
- NN on L1 triggers "sneaked" in: tested, commissioned and running in experiments (Belle II, CMS); latency $<$100 ns (!) achieved; GNN for hit clean-up or finding tracks of any curvature (wide p_T range)
- Anomaly detection tempting to find new physics, but that's not "blind analysis"; requires a protocol what to do with the data
- Surprising ideas presented:
  - "half autoencoder" (CMS), score is taken from the bottleneck instead of loss function from behind the decoder
  - anomaly detection using decision trees instead of autoencoder;
  very tempting, does not need multiplications (DSP slices) but only "if statements"
- Versal is the new Porsche

BEFORE WE GO FOR LUNCH:

MANY THANKS FOR COMING.

HAVE A SAFE TRIP HOME.

LET'S KEEP IN TOUCH.