**Summary of NSF 1443054: CIF21 DIBBs: Middleware and High-Performance Analytics Libraries for Scalable Data Science project**

The NSF 1443054: CIF21 DIBBs: Middleware and High-Performance Analytics Libraries for Scalable Data Science project [[1,2]](https://paperpile.com/c/dKluSh/BW9J%2BA1Dc) led by Indiana University had two foundational concepts. The first was the big data Ogres work with Indiana University and the NIST Public Big Data Working Group that collected 51 use cases – each with 26 properties [3]. The Ogres were a set of 50 features that categorized applications and allowed one to identify common classes such as Global GML and Local LML Machine Learning. GML is highly suitable for HPC systems while the very common LML and MapReduce categories also perform well on more commodity systems. As another example, “Streaming” [4] was a feature seen in 80% of the applications. The second foundation was the High-Performance Computing enhanced Apache Big Data Stack HPC-ABDS [[5-7]](https://paperpile.com/c/dKluSh/z5bw%2B4KXT%2Bpwo5)) which built systems from the commodity open source Apache software enhanced by HPC high-performance computing as necessary as shown in Fig. 1. We have developed major HPC enhancements to ABDS software including Harp [[8, 9]](https://paperpile.com/c/dKluSh/elmU%2BoARK) based on Hadoop and Twister2 [[10]](https://paperpile.com/c/dKluSh/tpj3) based on Heron, Spark and Flink for both batch and streaming scenarios.

Figure 1: Proposed HPC-ABDS software stack compared to a classic HPC cluster approach. The levels 1-17 correspond to those introduced in [[7]](https://paperpile.com/c/dKluSh/4KXT%2Bpwo5). The software systems on the left are standard tools (mainly from Apache augmented by Harp [[8]](https://paperpile.com/c/dKluSh/luOp) and Twister2 [[10]](https://paperpile.com/c/dKluSh/tpj3) HPC enhancements.

The high-performance, scalable data analytics library SPIDAL has 4 components: a) core library approximating scope of Apache Mahout; b) parallel graph algorithms; c) analysis of biomolecular simulations (high-performance versions of existing libraries from Utah and Arizona State) and d) image processing. The table lists existing routines in the core area, and over next year we will be packaging and adding documentation and tutorials for all components.



Table: Current members of core SPIDAL High-Performance Library: DAAL implies integrated with Intel DAAL Optimized Data Analytics Library and so running well on KNL architecture. These use Map-Collective paradigm and collectives used are listed.

Note current target architectures are clusters with either Haswell or Knights Landing (KNL) nodes. We can also extend libraries to GPU’s.

**References**

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