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| Kaleidoscope of (Apache) Big Data Stack (ABDS) and HPC Technologies |
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| Cross-Cutting Functionalities |
| 1) Message and Data Protocols: Avro, Thrift, Protobuf |
| 2)Distributed Coordination: Zookeeper, Giraffe, JGroups |
| 3)Security & Privacy: InCommon, OpenStack Keystone, LDAP, Sentry |
| 4)Monitoring: Ambari, Ganglia, Nagios, Inca |

**17 layers****~200 Software Packages** |

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| **17)Workflow-Orchestration:** Oozie, ODE, ActiveBPEL, Airavata, OODT (Tools), Pegasus, Kepler, Swift, Taverna, Triana, Trident, BioKepler, Galaxy, IPython, Dryad, Naiad, Tez, Google FlumeJava, Crunch, Cascading, Scalding, e-Science Central, |
| **16)Application and Analytics:** Mahout , MLlib , MLbase, DataFu, mlpy, scikit-learn, CompLearn, Caffe, R, Bioconductor, ImageJ, pbdR, Scalapack, PetSc, Azure Machine Learning, Google Prediction API, Google Translation API |
| **15)High level Programming:** Kite, Hive, HCatalog, Tajo, Pig, Phoenix, Shark, MRQL, Impala, Presto, Sawzall, Drill, Google BigQuery (Dremel), Google Cloud DataFlow, Summingbird |
| **14A)Basic Programming model and runtime**, **SPMD, Streaming, MapReduce:** Hadoop, Spark, Twister, Stratosphere, Reef, Hama, Giraph, Pregel, Pegasus**14B)Streaming:** Storm, S4, Samza, Google MillWheel, Amazon Kinesis |
| **13)Inter process communication Collectives, point-to-point, publish-subscribe:** Harp, MPI, Netty, ZeroMQ, ActiveMQ, RabbitMQ, QPid, Kafka, Kestrel, JMS, AMQP, Stomp, MQTT**Public Cloud:** Amazon SNS, Google Pub Sub, Azure Queues |
| **12)In-memory databases/caches:** Gora (general object from NoSQL), Memcached, Redis (key value), Hazelcast, Ehcache |
| **12)Object-relational mapping:** Hibernate, OpenJPA, EclipseLink, DataNucleus and ODBC/JDBC  |
| **12)Extraction Tools:** UIMA, Tika |
| **11C)SQL:** Oracle, DB2, SQL Server, SQLite, MySQL, PostgreSQL, SciDB, Apache Derby, Google Cloud SQL, Azure SQL, Amazon RDS |
| **11B)NoSQL:** HBase, Accumulo, Cassandra, Solandra, MongoDB, CouchDB, Lucene, Solr, Berkeley DB, Riak, Voldemort. Neo4J, Yarcdata, Jena, Sesame, AllegroGraph, RYA, Espresso**Public Cloud:** Azure Table, Amazon Dynamo, Google DataStore |
| **11A)File management:** iRODS, NetCDF, CDF, HDF, OPeNDAP, FITS, RCFile, ORC, Parquet |
| **10)Data Transport:** BitTorrent, HTTP, FTP, SSH, Globus Online (GridFTP), Flume, Sqoop |
| **9)Cluster Resource Management**: Mesos, Yarn, Helix, Llama, Celery, HTCondor, SGE, OpenPBS, Moab, Slurm, Torque, Google Omega, Facebook Corona |
| **8)File systems:** HDFS, Swift, Cinder, Ceph, FUSE, Gluster, Lustre, GPFS, GFFS**Public Cloud:** Amazon S3, Azure Blob, Google Cloud Storage |
| **7)Interoperability:** Whirr, JClouds, OCCI, CDMI, Libcloud,, TOSCA, Libvirt |
| **6)DevOps:** Docker, Puppet, Chef, Ansible, Boto, Cobbler, Xcat, Razor, CloudMesh, Heat, Juju, Foreman, Rocks |
| **5)IaaS Management from HPC to hypervisors:** Xen, KVM, Hyper-V, VirtualBox, OpenVZ, LXC, Linux-Vserver, VMware ESXi, vSphere, OpenStack, OpenNebula, Eucalyptus, Nimbus, CloudStack, VMware vCloud, Amazon, Azure, Google and other public Clouds, **Networking:** Google Cloud DNS, Amazon Route 53 |

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