Enabling Parallel and Scalable Tools for Scientific Big Data Analytics

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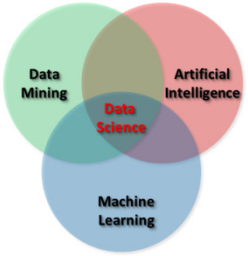
HELMHOLTZ ASSOCIATION

Federated Systems and Data Division

Research Group

High Productivity Data Processing



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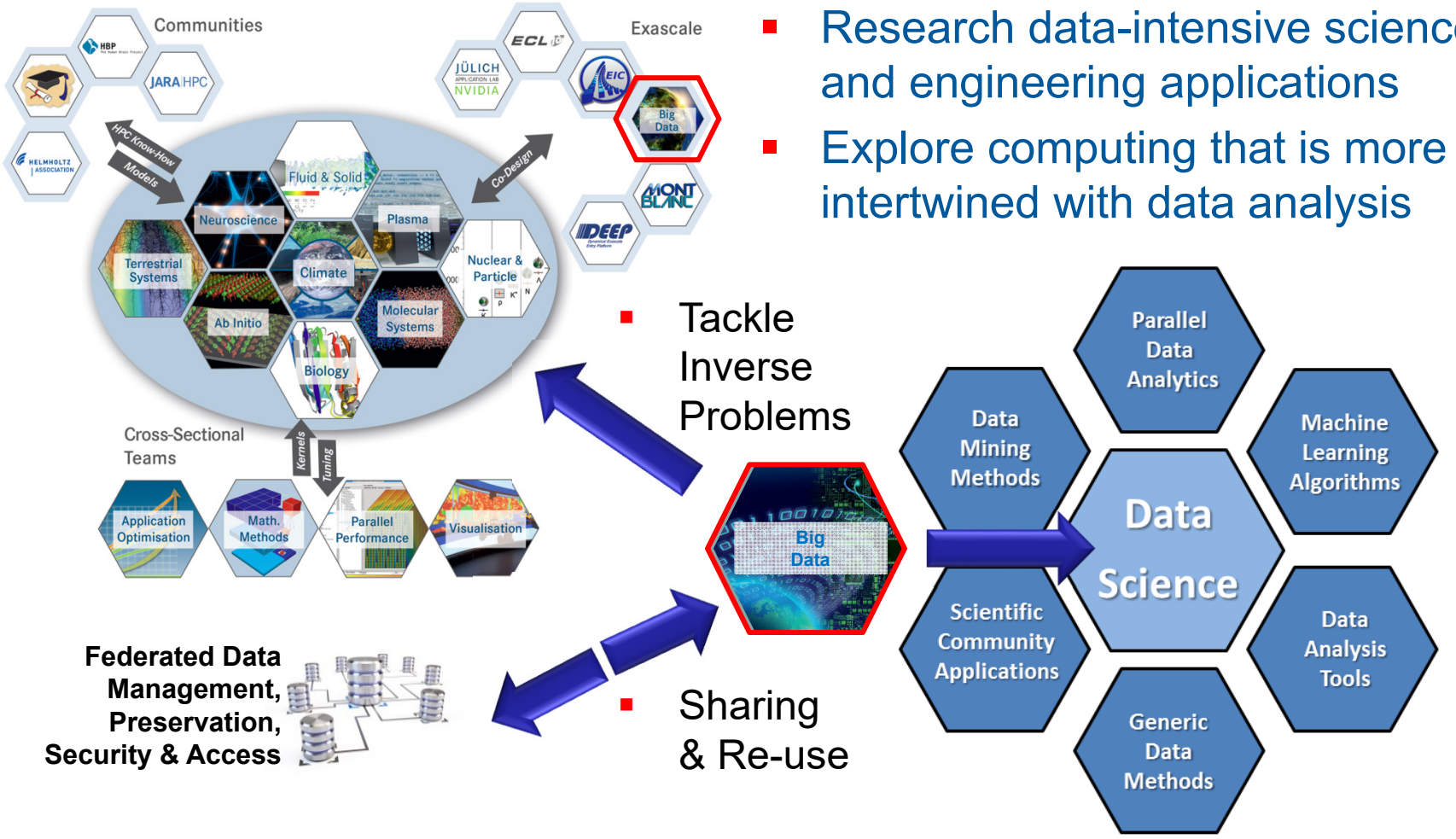
Scientific Big Data Analytics – Context JSC



- Research data-intensive science and engineering applications
- Explore computing that is more intertwined with data analysis

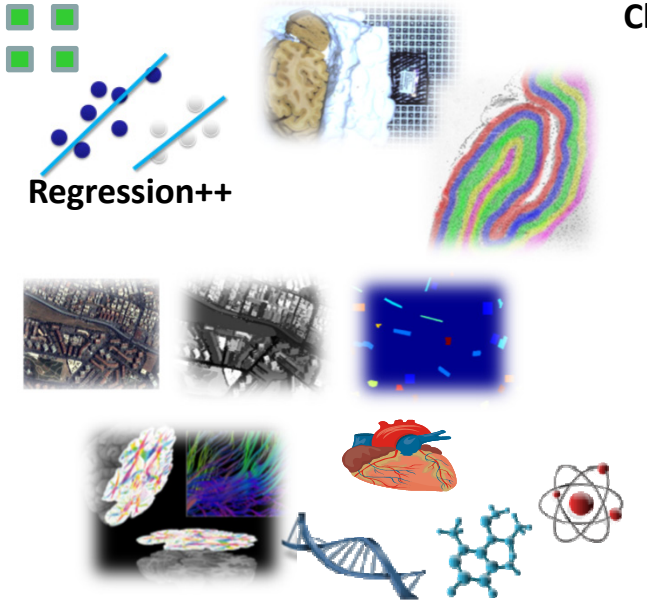
Th. Lippert, D. Mallmann, M. Riedel, *Scientific Big Data Analytics by HPC,* NIC Series 48, 417, ISBN 978-3-95806-109-5, pp. 1 - 10, 2016

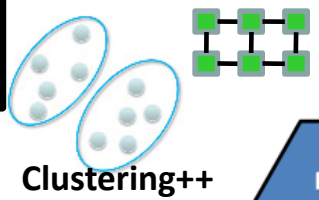
Data Analytics – Term Clarification

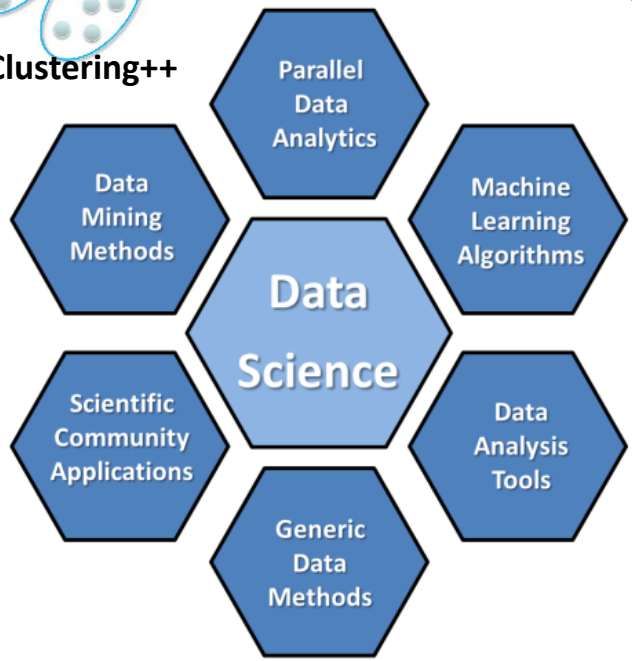
‘Data Analytics’ is an ‘interesting mix’ of different approaches

- Analytics: Whole methodology; Analysis: data investigation process itself
- ‘Big‘ requires scalable processing methods and underlying infrastructure

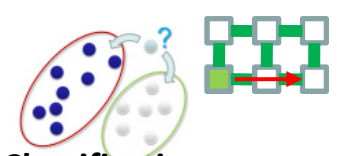
- **Concrete ‘big data‘: large medical data**

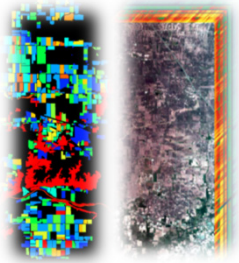




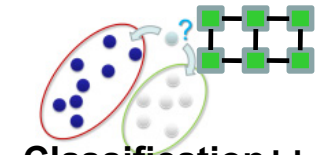


- **Concrete ‘big data‘: large earth science data**



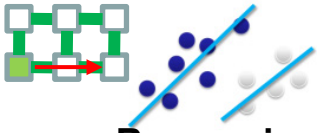


Data Analytics – Research Key Focus

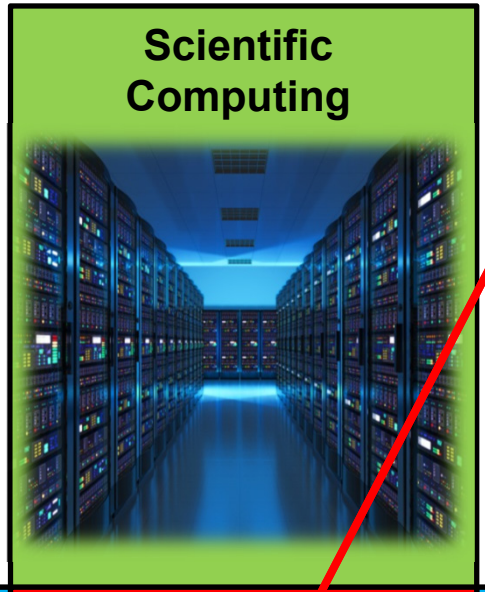


Classification++

Clustering++



Regression++



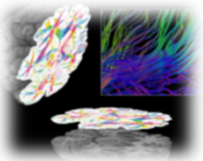
Scientific Computing

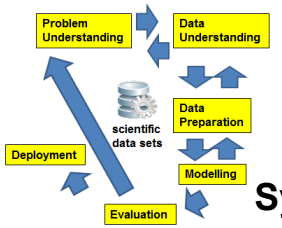
Scientific Applications using ‘Big Data’
Traditional Scientific Computing Methods
HPC and HTC Paradigms & Parallelization
Emerging Data Analytics Approaches
Optimized Data Access & Management
Statistical Data Mining & Machine Learning
Inverse Problems & their Research Questions

‘Big Data’ Methods

Scientific Applications

‘(Big) Data from various data science applications‘





Systematic & Automated Analytics guided by CRISP – DM

Data Analytics – Selected Research Expertise

Key expertise making algorithms parallel & scalable for 'big data'

- Driven by scientific and engineering cases, e.g. understanding the human brain, remote sensing applications, marine measurements analysis, …
- Example: Clustering, e.g. Density-based Spatial Clustering of Applications with Noise (DBSCAN)
- Example: Classification, e.g. Support Vector Machines (SVMs)

Parallel & Scalable DBSCAN clustering tool

Problem: Automatic outlier detection for data quality

- ✓ Tailor solution for community
- ✓ Scalability towards Big Data
- ✓ Design and improve automatic data analytics approaches

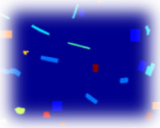


Parallel & Scalable SVM classification tool

Problem: Classification of buildings from multi-spectral images

- ✓ Enable smooth transition from 'manual Matlab SVM scripts'
- ✓ Research on parallel SVM methods (map-reduce, HPC)



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G. Cavallaro, M. Riedel, et al., *On Understanding Big Data Impacts in Remotely Sensed Image Classification Using Support Vector Machine Methods,* IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, Issue 99, pp. 1-13, 2015

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Talk available online:

www.morrisriedel.de/talks