T 21: Experimentelle Methoden 1 (Computing, Machine Learning, Statistik)

Zeit: Montag 16:45–19:00 Raum: JUR 253

T 21.1 Mo 16:45 JUR 253

Design and Execution of make-like Distributed Analyses — •Robert Fischer, Ralf Florian von Cube, Martin Erdmann, Benjamin Fischer, and Marcel Rieger — III. Physikalisches Institut A, RWTH Aachen

In particle physics, workflow management systems are primarily used as tailored solutions in dedicated areas such as Monte Carlo production. However, physicists performing data analyses are usually required to steer their individual workflows manually, which is time-consuming and often leads to undocumented relations between particular workloads. We present a generic analysis design pattern that copes with the sophisticated demands of end-to-end HEP analyses. The approach presents a paradigm shift from executing parts of the analysis to defining the analysis. Our tools allow to specify arbitrary workloads and dependencies between them in a lightweight and scalable structure. Further features are multi-user support, automated dependency resolution and error handling, central scheduling, and status visualization. The WLCG infrastructure is supported including CREAM-CE, DCAP, SRM and GSIFTP. Due to the open structure, additional computing resources, such as local computing clusters or Dropbox storage, can be easily added and supported. Computing jobs execute their payload, which may be any executable or script, in a dedicated software environment. Software packages are installed as required, and input data is retrieved on demand. We develop and test our system alongside ttbb and ttH cross section measurements. The clear interface and dependencies between individual workloads enables a make-like execution.

T 21.2 Mo 17:00 JUR 253

Aktuelle Entwicklungen des Meta-Monitoring Frameworks HappyFace — •Artur Il'Darovic Akhmetshin, Sebastian Brommer, Manuel Giffels, Georg Sieber und Günter Quast — Karlsruhe Institute of Technology, Karlsruhe, Germany

Um die Verfügbarkeit, Auslastung und Effizienz von Computing-Ressourcen zu überwachen, ist eine solide Monitoring Software heutzutage nicht wegzudenken. Solche Software muss einfach erweiterbar sein und die gewünschten Informationen zu den einzelnen Ressourcen anschaulich, aber vollständig darstellen können. Die Software sollte in der Lage sein diese Informationen anhand von festgelegten Kriterien zu bewerten und gegebenenfalls den Nutzer zu warnen, damit dieser auf Probleme rechtzeitig reagieren kann. Außerdem ist die effiziente Sammlung und Verarbeitung einer Vielzahl verschiedener Informationsquellen und die Kombination dieser Informationen ein wichtiges Merkmal. Im Rahmen dieses Vortrags werde ich die aktuellen Entwicklungen und Einsatzgebiete des HappyFace Meta-Monitoring Frameworks vorstellen, welches sich seit mehreren Jahren im produktiven Betrieb bewährt hat.

T 21.3 Mo 17:15 JUR 253

First steps towards an improved tuning method for Monte Carlo generators — •Fabian Klimpel[1,2], Stefan Kluth[1], and Andrea Knue[1] — [1]Max Planck Institut fuer Physik, Munich — [2]Technical University Munich

In high energy physics, Monte Carlo (MC) generators are used for the simulation of physics processes. In the simulation, parameters in the hard interaction and in the parton shower can be varied in a well defined range to achieve a better description of the data distributions (MC tuning). To do a full tuning, several parameters are varied and each parameter set leads to a simulated sample which is compared to the data. A binwise parametrization of the parameter variations is performed using the "Professor 2.4" framework. These functions are then optimized with respect to the measured data which are provided in the "Rivet" framework. This optimization should deliver the requested parameter values. In this talk an investigation of the stability of the fixed order polynomial interpolation performed by "Professor 2.4" is presented. This will be shown in comparison to a binwise adaptive fitting method. The optimization performed by "Professor 2.4" will be compared to a tuning performed using the Bayesian Analysis Toolkit (BAT).

T 21.4 Mo 17:30 JUR 253

Application of the VISPA web-platform for deep-learning based physics analyses — •Benjamin Fischer, Martin Erdmann, Robert Fischer, Erik Geiser, Christian Glaser, Gero Müller, Thorben Quast, Marcel Rieger, Martin Urban, Florian von Cube, David Walz, and Christoph Welling — Physics Institute III A, RWTH Aachen

VISPA (Visual Physics Analysis) is a web-platform allowing to conduct browser-based analyses including access to facilities for exploiting deep learning methods. Opportunistic resource allocation and modular extendability ensure the versatility to tackle a broad range of challenges.

VISPA's architectural concept and basic functions will be briefly outlined alongside the most recent developments. An overview on the available specialized tools for physics analyses will be given and explicitly illustrated in the scope of an in-progress analysis using deep learning. These include native-format data browsers for various file formats (e.g. ROOT) and methods for exploring highly ramified file-trees.

VISPA is used for high energy physics and astro particle physics as well as for university-level education.

T 21.5 Mo 17:45 JUR 253

Development of morphing algorithms for `Histfactory` using information geometry — •Anjishnu Bandyopadhyay[1], Ian Brock[1], and Kyle Cranmer[2] — [1]University of Bonn — [2]New York University

Many statistical analyses are based on likelihood fits. In any likelihood fit we try to incorporate all uncertainties, both systematic and statistical. We generally have distributions for the nominal and $\pm 1\sigma$ variations of a given uncertainty. Using that information, `Histfactory` morphs the distributions for any arbitrary value of the given uncertainties. In this talk, a new morphing algorithm will be presented, which is based on information geometry. The algorithm uses the information about the difference between various probability distributions. Subsequently, we map this information onto geometrical structures and develop the algorithm on the basis of different geometrical properties. Apart from varying all nuisance parameters together, this algorithm can also probe both small ($< 1\sigma$) and large ($> 2\sigma$) variations. In this talk, it will be also shown how this algorithm can be used for performing interpolation on Monte Carlo distributions of physical variables.

T 21.6 Mo 18:00 JUR 253

Multivariate Regression on the Example of Missing Transverse Energy Estimation — •Nicola Zäh, Raphael Friese, Günther Quast, and Roger Wolf — Institut f\"ur Experimentelle Kernphysik, Karlsruhe, Germany

Boosted decision trees are commonly used for classification in the field of particle physics. A similar technique, gradient boosted regression trees, can be applied to regression tasks. The resolution of missing transverse energy is an important quantity in particle physics and can be improved by using multivariate analysing techniques.

In this talk the performance of gradient boosted regression trees will be compared with other methods to calculate this quantity.

T 21.7 Mo 18:15 JUR 253

Konfidenzintervalle und Ausschlussgrenzen am Beispiel der Analyse des Verzweigungsverhältnisses von $B_s^0 \to \mu\mu\mu\mu$ — Johannes Albrecht[1], •Titus Mombächer[1], Stefanie Reichert[1] und Konstantin Schubert[2] für die LHCb-Kollaboration — [1]TU Dortmund — [2]ehemals TU Dortmund

Auf der Suche nach Widersprüchen zwischen experimentellen Befunden und Standardmodellvorhersagen sind korrekte statistische Methoden essenziell, um die Präzision von Vorhersagen und Messungen von Parametern zu quantifizieren. Dazu werden Konfidenzintervalle und Ausschlussgrenzen definiert, die mit einer festgelegten Häufigkeit den wahren Parameterwert enthalten.
Bei der Konstruktion der Konfidenzintervalle haben unterschiedliche Herangehensweisen unterschiedliche Vor- und Nachteile.

In diesem Vortrag werden verschiedene Methoden zur Bestimmung von Konfidenzintervallen und Ausschlussgrenzen erläutert und anhand der Messung der oberen Ausschlussgrenze auf das Verzweigungsverhältnis des Zerfalls $B_s^0 \to \mu\mu\mu\mu$ mit dem LHCb Experiment diskutiert.

T 21.8 Mo 18:30 JUR 253

Kontinuumsunterdrückung mit Deep Learning Techniken für

das Belle II-Experiment — •Dennis Weyland, Michael Feindt, Jochen Gemmler, Pablo Goldenzweig, Thomas Hauth, Martin Heck und Thomas Keck — IEKP, KIT, Karlsruhe

Das sich im Bau befindliche Belle II-Experiment wird den Großteil seiner Datennahme auf der Energie der $\Upsilon(4S)$ Resonanz durchführen, jedoch entsteht dabei nicht immer ein $B\bar{B}$-Mesonenpaar. Der Zerfall $e^+e^- \to q\bar{q}$ ist der dominante Untergrund und wird Kontinuum genannt. Um in Analysen $B\bar{B}$-Mesonenpaare von Kontinuum zu unterscheiden, besitzt das Belle II-Software Framework bereits einen multivariaten Klassifizierungs-Algorithmus. Deep Learning Techniken, die das Trainieren von Neuronalen Netzen in deutlich größeren Dimensionen ermöglichen, finden in letzter Zeit immer häufiger Einzug in physikalische Klassifizierungs-Aufgaben. Aus diesem Grund wird untersucht, wie man Deep Learning in der Kontinuumsunterdrückung einbringen kann, um bessere Resultate als die etablierte Technik zu erzielen.

Dieser Vortrag wird eine Übersicht beider Techniken geben und erste Resultate präsentieren.

T 21.9 Mo 18:45 JUR 253

Modern Machine Learning Methods in HEP — Raphael Friese, Günter Quast, Roger Wolf, and •Stefan Wunsch — Institut für Experimentelle Kernphysik, Karlsruhe, Germany

Modern machine learning methods such as deep neural networks are an active field of research in many scientific disciplines. Also the HEP community puts increasing effort in this emerging technology.

In particle physics, commonly used machine learning methods are boosted decision trees and shallow neural networks, which have proven their superior classification power over conventional cut based event selection in the last decade. Currently, deep learning shows again first signs of a significantly improved performance compared to these algorithms, which the HEP community aspires to exploit for its analyses.

This talk puts emphasis on the state-of-the-art usage of these modern machine learning methods and the application on event classification in particle physics.