NoAI - Nauka sztucznych sieci

Sebastian Zając

Zakład Metod Statystycznych i Analiz Biznesowych
SGH w Warszawie

10.01.2022

https://sebastianzajac.pl

Edukacja

na początku było... "Ekono co?"

- 2002-2005 licencjat - Modelowanie szeregów czasowych za pomocą procesów ARMA i ARIMA w SAS (dr hab. J. Syska)
- 2005-2007 Magister - Topologiczne i geometryczne metody w klasycznej i kwantowej teorii pola (dr hab. J. Król)

chaos w NoStat

1. chaos $\rightarrow$ liniowość $\rightarrow$ statystyka $\rightarrow$ chaos deterministyczny
2. chaos liczbowy $\rightarrow$ t. mnogości $\rightarrow$ t. kategorii "$\rightarrow$" t. typów
3. determinizm $\rightarrow$ statystyka "$\rightarrow$" mechanika kwantowa $\rightarrow$ kwantowa teoria pola "$\rightarrow$" kwantowa grawitacja

$$P_{\psi}(\phi) = |\langle\phi|\psi\rangle|^2$$

Ciekawostki QM i statystyki

- A. Einstein, B. Podolsky, N. Rosen "Can Quantum-Mechanical Descirption of Physical Reality Be Considered Complete? " Physical Review 47 (1935) 777-780
- G. Birkhoff, J von Neumann "The logic of QM" J. Ann. of Math. 37 (1936)
- J. Bell "On the Einstein Podolsy Rosen Paradox" Physics 1.3 (1964)
- A. Aspect "Propsed experiment to test the nonseparability of QM" **Physical Review D**. 14 (8) 1944-1951 (1976)
- P. Billingsley "Probability and Measure" J Wiley & Sons Inc (1979)
- B. Feintezeig - Hidden Variables and Commutativity in QM (2013)

Jak stworzyć prawdziwy generator liczb losowych z wykorzystaniem komputera ?

"The method of the likelihood and the Fisher information in the construction of physical models."
E.W. Piotrowski, J. Sładkowski, J.Syska, S.Z

physica status solidi b basic solid state physics

Volume 246, Issue 5
May 2009
Pages 1033-1037

Original Paper

The method of the likelihood and the Fisher information in the construction of physical models

E.W. Piotrowski, J. Sładkowski, J. Syska, S. Zając

First published: 20 April 2009 | https://doi.org/10.1002/pssb.200881566 | Citations: 6

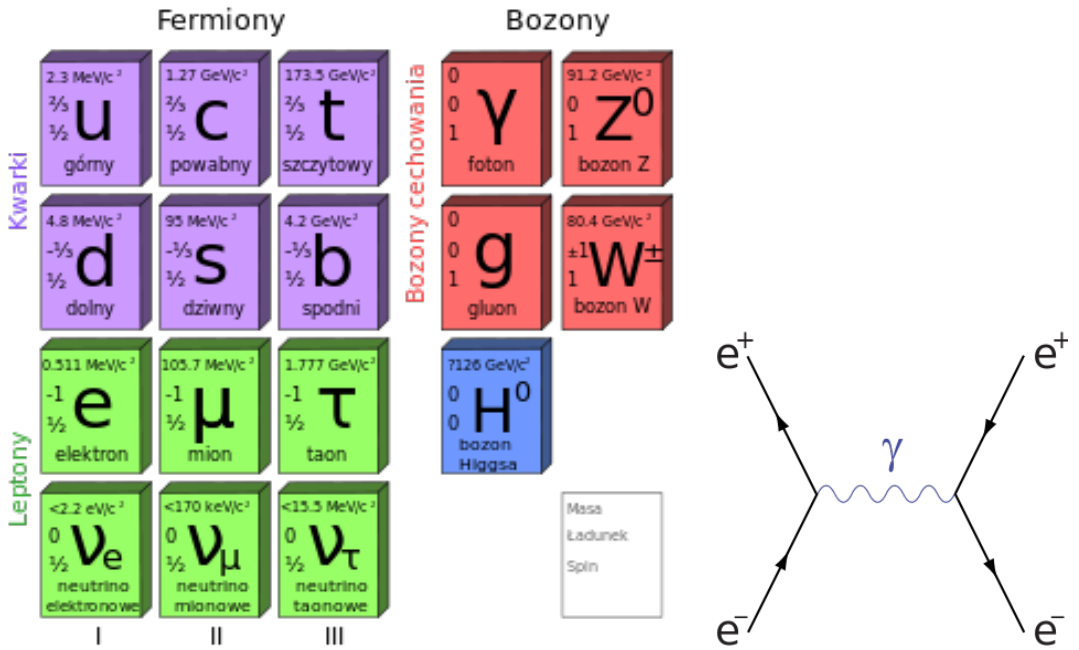
Abstract

The subjects of the paper are the likelihood method (LM) and the expected Fisher information (*FI*) considered from the point od view of the construction of the physical

Rozprawa doktorska - prof. dr hab. Marek Zrałek

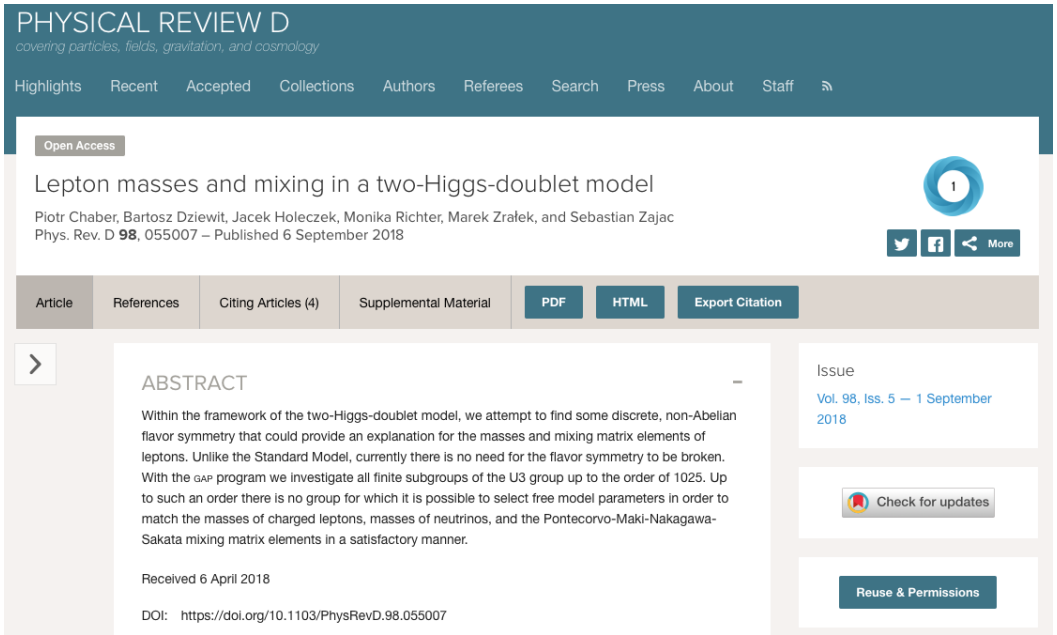
"Oscylacje akceleratorowych neutrin z uwzględnieniem ich niestandardowych oddziaływań"

We can't solve problem by using the same kind of thinking we used we create them (A. Einstein)

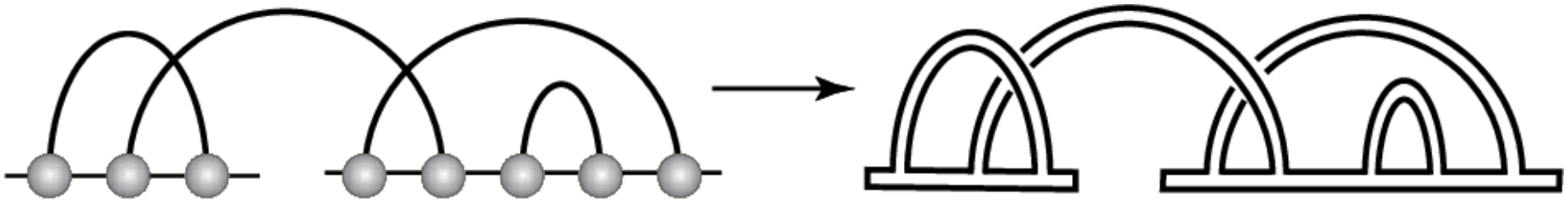


Fizyka neutrin do dziś...

- Udział w **2 grantach** na UŚ (do 2018)
- Prezentacje na międzynarodowych konferencjach: Matter To The Deepest; Int. Conf. on neutrino physics and astrophysics - Heidelberg, Neutrino Oscillation Workshop - Otranto, DISCRETE - Wiedeń
- **8 publikacji** (2020) - oddziaływania i wykorzystanie grup symetrii do wyznaczenia mas i kątów mieszania leptonów.



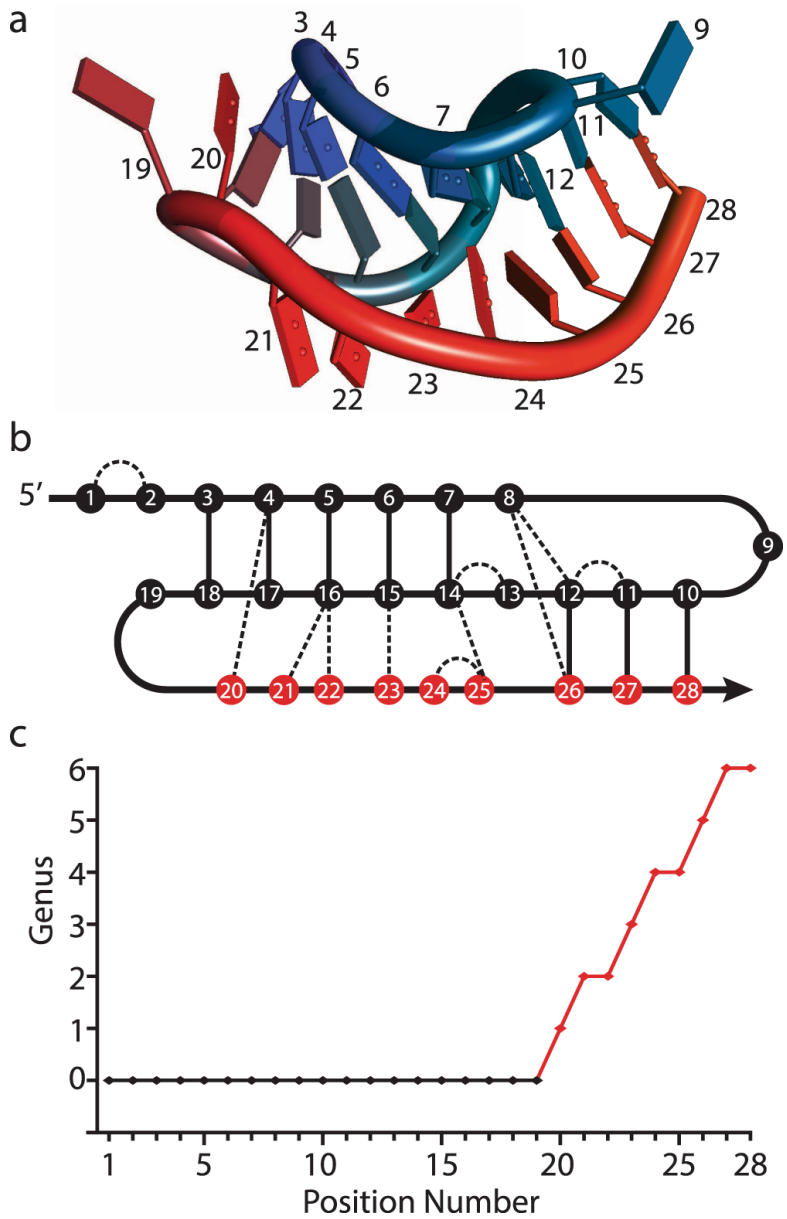
Poza Fizyką... ale z fizykami na UW



chord diagram C as fatgraph

skinny surface $\Sigma(C)$

Poza Fizyką...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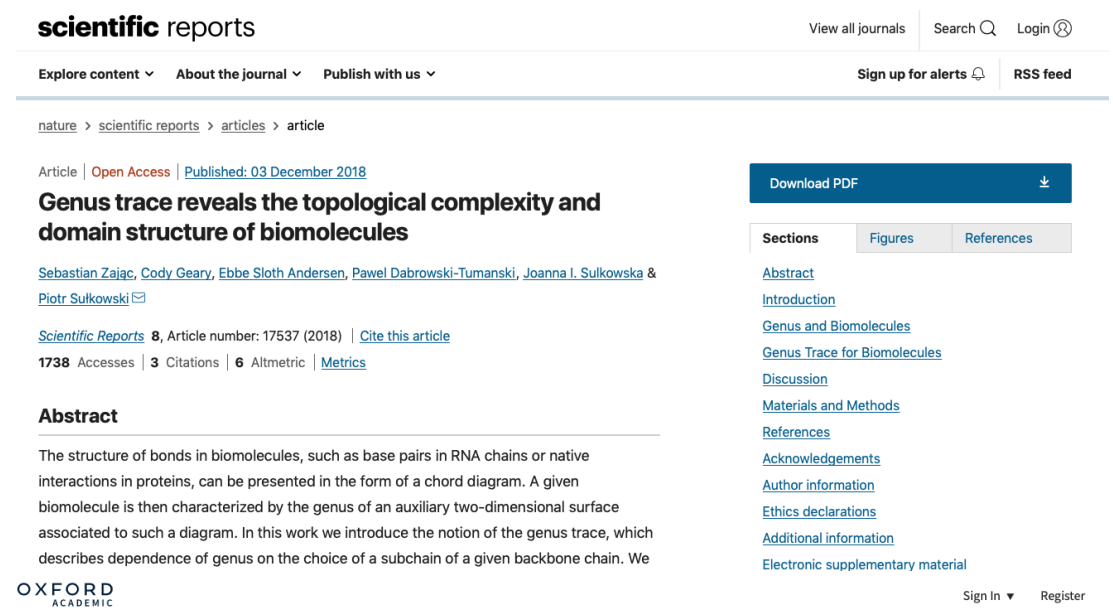
Poza Fizyką...



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Article | Open Access | Published: 03 December 2018

Genus trace reveals the topological complexity and domain structure of biomolecules

Sebastian Zając, Cody Geary, Ebbe Sloth Andersen, Pawel Dabrowski-Tumanski, Joanna I. Sulkowska & Piotr Sułkowski

Scientific Reports **8**, Article number: 17537 (2018) | Cite this article

1738 Accesses | **3** Citations | **6** Altmetric | Metrics

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Sections | Figures | References

Abstract
Introduction
Genus and Biomolecules
Genus Trace for Biomolecules
Discussion
Materials and Methods
References
Acknowledgements
Author information
Ethics declarations
Additional information
Electronic supplementary material

Abstract

The structure of bonds in biomolecules, such as base pairs in RNA chains or native interactions in proteins, can be presented in the form of a chord diagram. A given biomolecule is then characterized by the genus of an auxiliary two-dimensional surface associated to such a diagram. In this work we introduce the notion of the genus trace, which describes dependence of genus on the choice of a subchain of a given backbone chain. We

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Volume 48, Issue D1
08 January 2020

Article Contents

Abstract
INTRODUCTION
DISCUSSION
FUNDING
REFERENCES

Comments (0)

< Previous Next >

Genus for biomolecules

Paweł Rubach, Sebastian Zajac, Borys Jastrzebski, Joanna I Sulkowska, Piotr Sułkowski

Nucleic Acids Research, Volume 48, Issue D1, 08 January 2020, Pages D1129–D1135, https://doi.org/10.1093/nar/gkz845

Published: 04 October 2019 **Article history**

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Abstract

The 'Genus for biomolecules' database (http://genus.fuw.edu.pl) collects information about topological structure and complexity of proteins and RNA chains, which is captured by the genus of a given chain and its subchains. For each biomolecule, this information is shown in the form of a genus trace plot, as well as a genus matrix diagram. We assemble such information for all and RNA structures deposited in the Protein Data Bank (PDB). This database presents also various statistics and extensive information about the biological function of the analyzed biomolecules. The database is regularly self-updating, once new structures are deposited in the PDB. Moreover, users can analyze their own structures.

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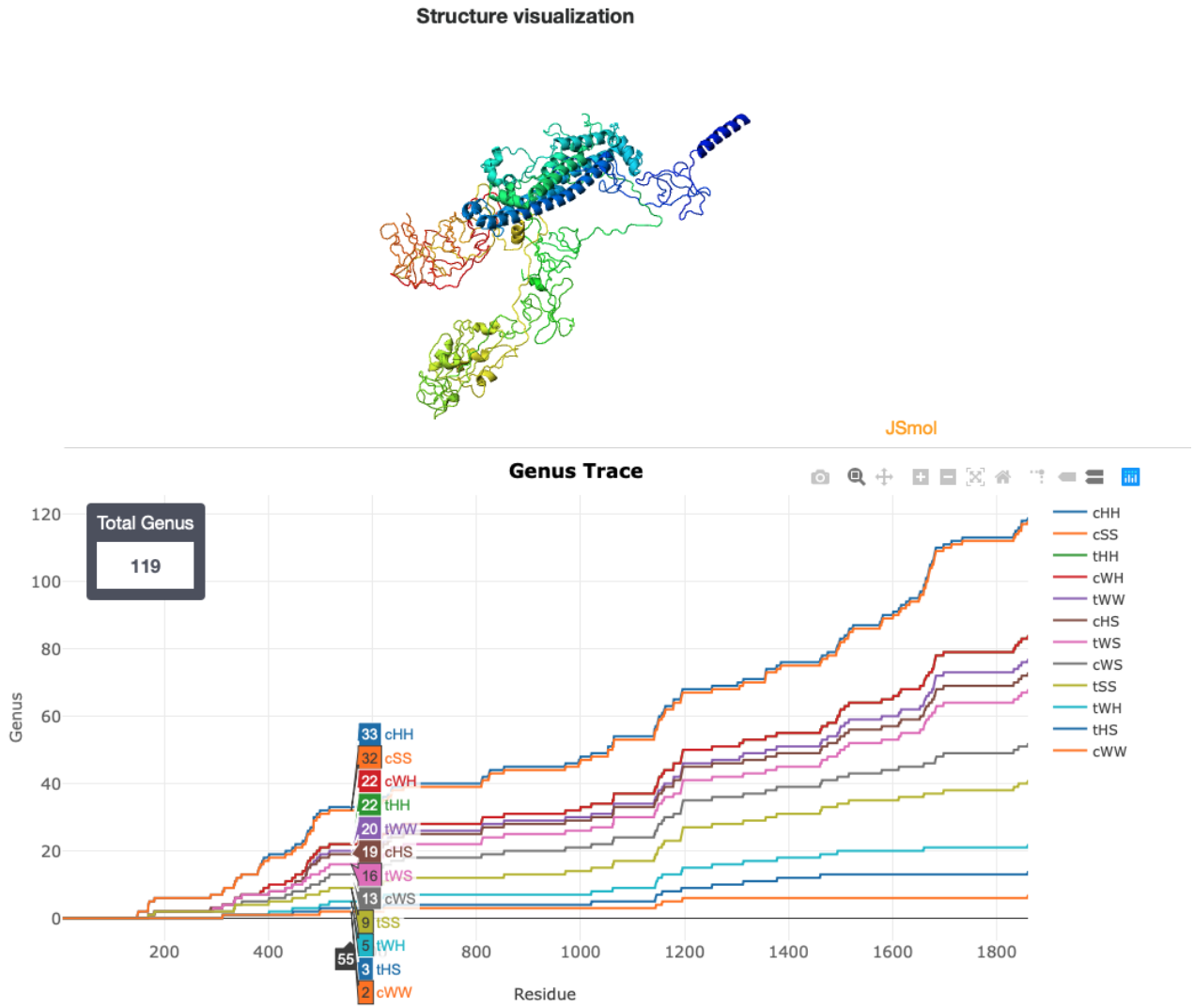
ONQUADRO: a database of experimentally determined quadruplex structures

PDBe-KB: collaboratively defining the biological

Poza Fizyką ... https://genus.fuw.edu.pl

309851 proteins, 1575 RNA Structures.

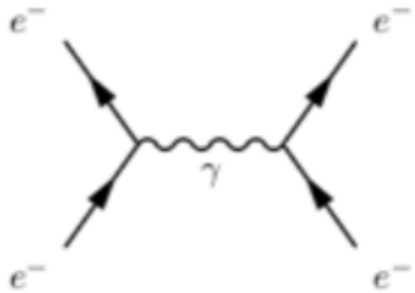


Gdzie jeszcze znajdziesz diagramy ?

Fizyka

"Physics is like sex: sure, it may give some practical results, but that's not why we do it."

– Richard Feynman



„Category Theory is like sex: it may give some practical results, but that's not why we do it. „ - Sebastian Zając

The category of chord diagrams

We fix three positive integers k, ℓ, and m and a multifunction

$$\varphi\colon \ell \times \ell \to m$$

The objects of $\mathfrak{C}_{k,\varphi}$ are structures of the form

$$\mathbb{S} = \langle S, <^S, \{B_i^S\}_{i<k}, \{N_i^S\}_{i<\ell}, \{E_i\}_{i<m}\rangle,$$

where:

(D1) $\langle S, <^S\rangle$ is a finite linearly ordered set.

(D2) $\{B_i^S\}_{i<k}$ and $\{N_i^S\}_{i<\ell}$ are partitions of S.

(D3) $B_{i_0} < B_{i_1}$ whenever $i_0 < i_1 < k$.

(D4) $\langle S, E_i\rangle$ is a graph for every $i < m$.

(D5) $E_{i_0} \cap E_{i_1} = \emptyset$ whenever $i_0 \neq i_1$.

(D6) If $x \in N_{i_0}$, $y \in N_{i_1}$ and $\langle x, y\rangle \in E_j$, then $j \in \varphi(i_0, i_1)$.

The sets B_i are called *backbones*, while the sets N_i are *types of nodes* and E_i are *types of edges*.

A $\mathfrak{C}_{k,\varphi}$-morphism from $\mathbb{S}$ to $\mathbb{T} = \langle T, <^T, \{B_i^T\}_{i<k}, \{N_i^T\}_{i<\ell}, \{E_i\}_{i<m}\rangle$ is a mapping $f : S \to T$ that preserves the linear orderings (that is, $x <^S y \implies f(x) <^T f(y)$) and satisfies for every $x, y \in S$:

(M1) $f(x) \in B_i^T \iff x \in B_i^S$

(M2) $f(x) \in N_i^T \iff x \in N_i^S$

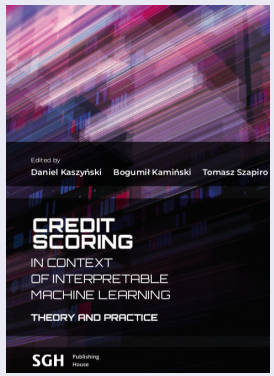
(M3) $\langle f(x), f(y)\rangle \in E_i^T \iff \langle x, y\rangle \in E_i^S$.

Informally, a $\mathfrak{C}_{k,\varphi}$-arrow is a mapping that preserves the structure of $\mathbb{S}$, "adding" new vertices and new edges of various types.
In the language of model theory, $\mathfrak{C}_{k,\varphi}$-arrows are called *embeddings*.

It is clear that $\mathfrak{C}_{k,\varphi}$ forms a category.

Praca naukowa - tematyka

- Metody selekcji zmiennych, Modele z wykorzystaniem karty scoringowej i wspomagane AI, wyjaśnianie modeli ML, Metody detekcji anomalii w czasie rzeczywistym.



Zajęcia

- Analiza danych w czasie rzeczywistym (dla ekonomistów !)
- Wstęp do kwantowego uczenia maszynowego (dla biznesu !)

Konferencje

Business Analytics and **SAS Institute** - Modelowanie dla Biznesu; Open International Didactic Seminar on Business Intelligence and Data Science; Modern Methods and Practices in Credit Risk; **Data Science Summit ML edition**; 22nd International Conference on Quantitative Methods in economics

mój Excel

- PKO BP - MLOps - pipeline (python), DAG (Airflow), Models (MLFlow), Spark, RealTime
- Algomine AI - Data Science Engineer - Towarowanie sklepów, Dane BIK etc w SAS, Python, R
- AMA Institute - Data Analysis Expert - Dynamiczna analiza plików JPK, Darmowa (i nie tylko) biblioteka Advanced Scorecard Builder.
- Oracle - Junior Front End Developer - testy A/B on web
- GoWork - Szkolenia PHP, JS, HTML5, CSS3
- Wasko Gliwice - tester SI WCPR (112)

QPoland (part of QWorld) i inne

`https://qworld.net/qpoland/`

- Organizacja warsztatów, seminariów, hackatonów
- Pierwszy Polski QChallange ze współpracą z IBM oraz Paribas.
- Washington DC Quantum Computing Meetup - moderowanie
- Discord - Współczesne Metody Analizy i Przetwarzania Danych - Seminarium `https://discord.gg/uvMdgkTq`
- Seminarium 17.01.2022 18.00 - Justyna Zawalska - "Hybrid quantum-classical machine learning with TensorFlow Quantum".

Za krótkie wprowadzenie do QML

Czy komputery kwantowe istnieją ?

Aktualnie mamy do dyspozycji koprocesory (Quantum Processing Unit) - 8 (Xandu), 32 (Rigetti), 53 (IBM) qubitów. Wciąż za mało qubitów i za dużo szumów. Qubit = "Quantum Bit"

$$|\psi\rangle = \alpha\,|0\rangle + \beta\,|1\rangle = \alpha\begin{pmatrix}1\\0\end{pmatrix} + \beta\begin{pmatrix}0\\1\end{pmatrix} = \begin{pmatrix}\alpha\\\beta\end{pmatrix}$$

Fizyka

Superpozycja stanów, splątanie kwantowe, Odwracalne i Unitarne bramki, pomiar. Uogólnienie teorii statystyki ale nie statystyka !

$$|\psi\phi\rangle = |\psi\rangle \otimes |\phi\rangle$$

$$|\psi\rangle = \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)$$

Zastosowania

Faktoryzacja (Shor algo), Przeszukiwanie (Grover), QML (QSVM, QPCA, QNLP...), Złożone symulacje (materiały, chemia, biologia), Problemy optymalizacyjne, Quantum Neural Networks. W ogólności znaczne przyśpieszenie obliczeń ! wykonywanych na standardowych komputerach.

Quantum Circuits: Quatnum Gates np. Macierze Pauliego, Hadamard Gate

$$H = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$$

$$H|0\rangle = \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$$

Kod Qiskit - losowy bajt

```
import numpy as np
from qiskit import  QuantumRegister, ClassicalRegister,
                    QuantumCircuit, execute, Aer

q = QuantumRegister(8,'q')
c = ClassicalRegister(8,'c')

circuit = QuantumCircuit(q,c)
circuit.h(q)
circuit.measure(q,c)

simulator = Aer.get_backend('qasm_simulator')
job = execute(circuit, simulator, shots=2)
result = job.result()
counts = result.get_counts(circuit)
print(counts)
```

```
{'01000000': 1, '11111011': 1}
```

Poza Światem

Polskie Radio | JAZZ.PL

Koncerty

ostatnia aktualizacja:
24.12.2021 19:00

POWRÓT

Nika Lubowicz i wigilijny koncert kolęd [ZOBACZ WIDEO]

DWÓJKA

W wigilijny wieczór w cyklu "Jazz.PL" zaprosiliśmy na wspólne kolędowanie z Niką Lubowicz, wokalistką i pianistką. Na scenie Studia S-3 towarzyszyli jej: mąż Sebastian Zając, bracia Dawid Lubowicz na skrzypcach, Jakub Lubowicz na fortepianie, a także Maciej Matysiak na kontrabasie oraz Patryk Dobosz na perkusji.