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Minicurso: Introdução às Ferramentas de IA

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LM²C² - Laboratório de Moagem de Alta Energia, Materiais de Carbono e Compósitos

POLI USP

Main Research Projects:

- Recycling of industrial/mineral wastes
- Carbon development: graphene, GO, r-GO, CNT, etc
- Porous Carbon & Composites: Bone replacement
- Refractories: Post-mortem, & Metallurgical Processing and modelling
- Safety, Risk & Environmental analysis/modelling
- AI in Metallurgy and Refractories
- Cathedra Arcelor Mittal / Steel University

CICS Centro de Inovação em Construção Sustentável | USP

EMBRAPII

1) Introdução a IA, evolução conceitos, ferramentas e, visão de futuro.

2) Revisão e conceitos fundamentais: matemática, estatística, álgebra linear, tomada de decisão, etc.

3) Dados: extração de características, escalas, normalização, multicolinearidade, redução de dimensões.

4) Análise de dados exploratório: estatística descritiva, visualização de dados, identificação de padrões.

5) Avaliação de modelos: acurácia, precisão, tendências, análise de erro.

6) Modelos de machine learning: classificação, regressão, análise de cluster.

7) Redes neurais: conceitos: redes neurais artificiais, redes neurais recorrentes.

8) Introdução ao estudo de séries temporais.

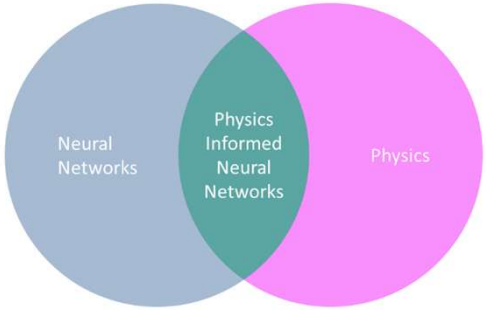
9) Softwares: Excel, visão geral de pacotes e plug-ins, ORANGE.

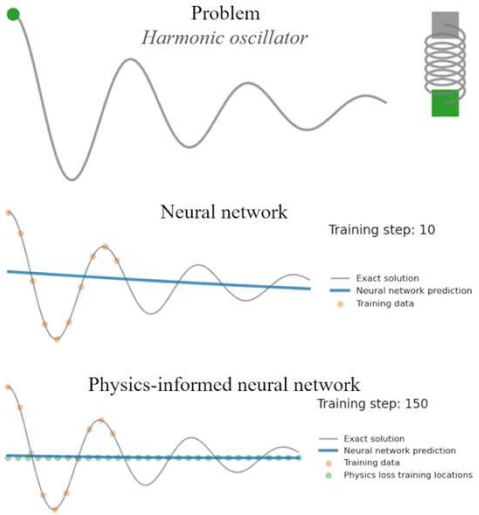
1ª Parte

Introdução

7ª Parte: ... O que vem por aí !

1) **Physics Informed Neural Networks (PINNs)**



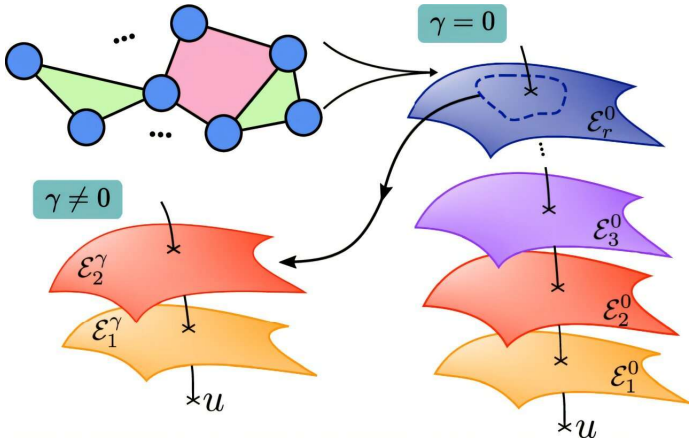


Physics Informed Neural Networks (PINNs): An Intuitive Guide | Towards Data Science

2) Curved neural networks enable AI memory recall through geometric design

by Kyoto University

A new international study has introduced Curved Neural Networks—a new type of AI memory architecture inspired by ideas from geometry. The study shows that bending the "space" in which AI "thinks" can create explosive memory recall



Miguel Aguilera et al, Explosive neural networks via higher-order interactions in curved statistical manifolds, *Nature Communications* (2025). DOI: 10.1038/s41467-025-61475-w

Quantum computing and AI

QC and AI can benefit from a symbiotic relationship to advance each other's capabilities and respective fields. This relationship contributes to realizing the most ambitious, long-term objective of artificial general intelligence (AGI). In this regard, it is important to distinguish between using QC for AI versus AI for QC.

Enabling the next frontier of quantum computing

AI for quantum computing

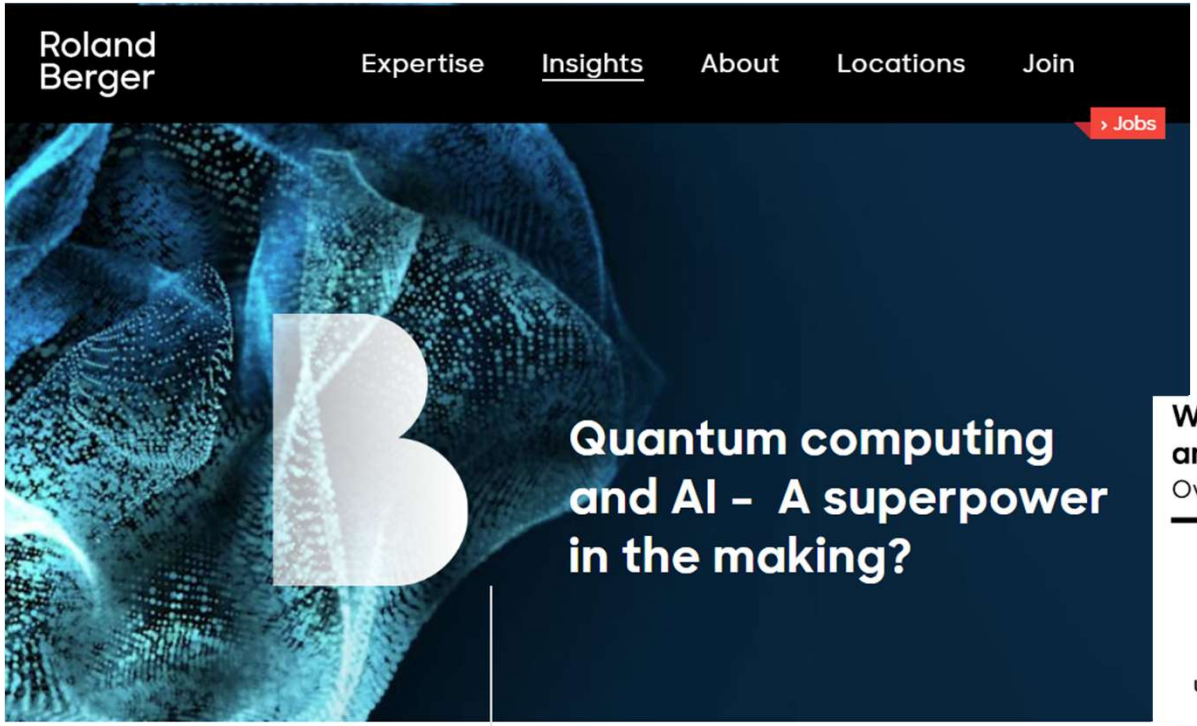
Conversely, AI can enhance the development, optimization, and practical applications of QC. Discussions with QC experts and industry leaders highlighted the following areas that could benefit from AI:

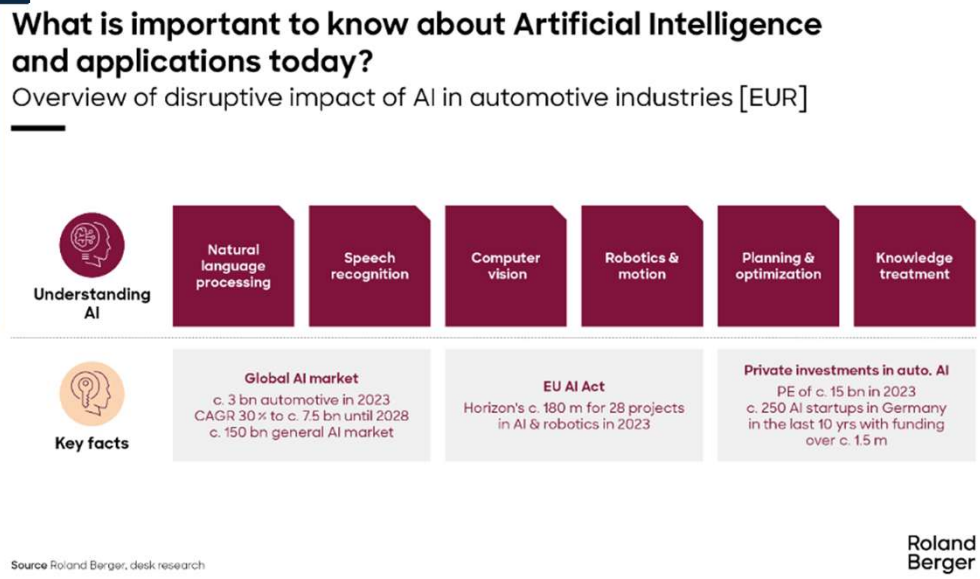
- *Error correction.* Machine learning predicts and corrects quantum computation errors, improving reliability.
- *Noise reduction.* AI analyzes noise patterns to develop noise-reduction strategies.
- *Quantum algorithm design and optimization.* Using AI-like reinforcement learning can efficiently discover new quantum algorithms and optimize circuits by minimizing gate operations and reducing errors.
- *Quantum hardware control.* AI can automate quantum device calibration for optimal performance and dynamically adjust control parameters to maintain system stability.
- *Resource management.* AI can be used to efficiently allocate qubits and optimize scheduling and compilation of quantum tasks.
- *Simulation and emulation.* AI can enhance quantum system simulations for algorithm and hardware testing and emulate quantum processes on classical hardware, aiding research.
- *Benchmarking and performance analysis.* AI can develop sophisticated benchmarking tools to evaluate and compare different quantum devices and algorithms.
- *Hybrid quantum–classical systems.* AI can optimize the distribution of tasks between quantum and classical processors, maximizing the efficiency of hybrid computation and facilitating the integration of the quantum–classical system.
- *QML.* AI techniques can improve the training of QML models, enhancing their performance and applicability.

Quantum computing for AI

QC for AI uses QC to rapidly process extensive data sets, thereby accelerating AI processes and training models. Scaling up through dedicated quantum algorithms that exploit quantum advantages can significantly contribute to achieving AGI in several ways, including the following:

- *Enhanced computational power.* Quantum algorithms solve complex problems faster than classical ones, speeding up data processing and computations essential for enabling AGI.
- *Efficient problem-solving.* Quantum algorithms handle optimization problems and simulations more efficiently, boosting AGI's advanced reasoning and decision-making tasks.
- *Improved learning capabilities.* Quantum machine learning (QML) accelerates AI learning processes, which is crucial for AGI's adaptability across diverse tasks and environments.
- *Parallel processing.* QC's parallelism speeds up AGI's training and inference stages, improving information analysis and synthesis.
- *Easier handling of complex data structures.* Quantum algorithms excel with complex, high-dimensional data, providing AGI with tools to process and understand intricate information.
- *Potential breakthroughs in AI research.* QC's unique properties can lead to new AI insights, fostering novel algorithms and architectures that are vital for AGI.





Quantum computing and AI – A superpower in the making? | Roland Berger

Sobre o futuro….

Só lembrando … Somente o aço líquido derrotou o exterminador !

https://youtu.be/oyJwQvbTWZM

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Thanks
Aloha
Merci
Gracias
谢谢
Danke
Grazie
Teşekkürler
Dziękuję
Obrigado

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