Potential Research Topics for Bachelor Thesis Supervision
Các Chủ Đề Nghiên Cứu Làm Khóa Luận Tốt Nghiệp Đại Học

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Preface

Các đề tài nghiên cứu tiềm năng cho Khóa Luận Tốt Nghiệp cho sinh viên Khoa Công Nghệ, UMT.

Mục lục

Chương 1

Preliminaries – Kiến Thức Chuẩn Bị

Contents

Keywords.

1. Machine Learning (ML).
   (a) Supervised Learning.
   (b) Unsupervised Learning.
   (c) Reinforcement Learning (RL).
2. Deep Learning (DL).

1.1 Mathematical Analysis & Numerical Analysis – Giải Tích Toán Học & Giải Tích Số

Resources – Tài nguyên.

1. NQBH. *Lecture Note: Mathematical Analysis & Numerical Analysis – Bài Giảng: Giải Tích Toán Học & Giải Tích Số.*
   PDF: URL: https://github.com/NQBH/advanced_STEM_beyond/blob/main/analysis/lecture/NQBH_mathematical_analysis_lecture.pdf.

1.2 Combinatorics & Graph Theory – Tổ Hợp & Lý Thuyết Đồ Thị

Resources – Tài nguyên.

1. NQBH. *Lecture Note: Combinatorics & Graph Theory – Bài Giảng: Tổ Hợp & Lý Thuyết Đồ Thị.*
   PDF: URL: https://github.com/NQBH/advanced_STEM_beyond/blob/main/combinatorics/lecture/NQBH_combinatorics_graph_theory_lecture.pdf.

1.3 Mathematical Optimization – Toán Tối Ưu

Resources – Tài nguyên.

1. NQBH. *Lecture Note: Mathematical Optimization – Bài Giảng: Toán Tối Ưu.*
   PDF: URL: https://github.com/NQBH/advanced_STEM_beyond/blob/main/optimization/lecture/NQBH_mathematical_optimization_lecture.pdf.

1.4 Artificial Intelligence (AI) – Trí Tuệ Nhân Tạo

Resources – Tài nguyên.

1. [Kut23]. *Gitta Kutyniok.The Mathematics of AI.*
2. [Kut24]. *Gitta Kutyniok.The Mathematics of Reliable AI.*
3. [NR21]. Peter Norvig, Stuart Russell. *Artificial Intelligence: A Modern Approach*. 4e.

1.5 Machine Learning – Học Máy

Resources – Tài nguyên.

1. [Cho25]. Kyunghyun Cho. *Machine Learning: a Lecture Note*. arXiv.
2. [DFO24]. *Mathematics for Machine Learning*. 1e.

1.5.1 Artificial Neural Networks (ANNs) – Mạng Nơron Nhân Tạo

Resources – Tài nguyên.

1. [Bac24]. Francis Bach. *Learning Theory from First Principles*. 1e.
2. [MC01]. Danilo P. Mandic, Jonathan A. Chambers. *Recurrent Neural Networks for Prediction: Learning Algorithms, Architectures and Stability*. 1e.

1.6 Deep Learning – Học Sâu

Resources – Tài nguyên.

1. [BB24]. Christopher M. Bishop, Hugh Bishop. *Deep Learning: Foundations & Concepts*.
2. [Cho21]. François Chollet. *Deep Learning with Python*. 2e.
3. [LBH15]. Yann LeCun, Yoshua Bengio, Geoffrey Hinton. *Deep Learning*. Nature.

Chương 2

Combinatorial Neural Networks & Optimization Problems in Graph Theory

1. *Keywords.* Combinatorial neural networks.

2. *Student.* Phan Vĩnh Tiến [PVT].

Resources – Tài nguyên.

1. Alessandro Benfenati, Emilie Chouzenoux, Laurent Duval, Jean-Christophe Pesquet, Aurélie Pirayre. *A review on graph optimization & algorithmic frameworks.* [Research Report] LIGM - Laboratoire d'Informatique Gaspard-Monge.

2. Quentin Cappart, Didier Chètelat, Elias B. Khalil, Andrea Lodi, Christopher Morris, Petar Veličković. *Combinatorial Optimization & Reasoning with Graph Neural Networks.*

3. Irwan Bello, Hieu Pham, Quoc V. Le, Mohammad Norouzi, Samy Bengio (Google Brain). *Neural Combinatorial Optimization with Reinforcement Learning.* ICLR2017.

4. Andoni I. Garmendia, Josu Ceberio, Alexander Mendiburu. *Neural Combinatorial Optimization: a New Player in the Field.*

5. [Gol18]. Boris Goldengorin. *Optimization Problems in Graph Theory.*

6. [NR21]. Peter Norvig, Stuart Russell. *Artificial Intelligence: A Modern Approach.* 4e.

Chương 3

Computer Music

Contents

1. *Keywords.* Automatic music transcription, music generation.
2. *Student.* Võ Ngọc Trâm Anh [VNTA].

Resources – Tài nguyên.

1. [BJP20]. Jean-Pierre Briot, Gaëtan Jadjeres, François-David Pachet Pachet. *Deep Learning Techniques for Music Generation.*
2. [DG24]. Shlomo Dubnov, Ross Greer. *Deep & Shallow: Machine Learning in Music & Audio.*
3. [HWR22]. Michael S. Horn, Melanie West, Cameron Roberts. *Introduction to Digital Music with Python Programming: Learning Music with Code.* 1e.

   Comment. Sách có hơi nhiều lỗi chính tả.
4. [Mül15; Mül21]. Meinard Müller. *Fundamentals of Music Processing – Using Python & Jupyter Notebooks.*

   Comment. Mathematically rigorous enough ⇒ Main reference.

Research community – Cộng đồng nghiên cứu.

1. Meinard Müller. Google Scholar.

3.1 Automatic Music Transcription (AMT)

Keywords.

3.2 Music Generation

Keywords. Stochastic, random Boltzmann machine (RBM).

Chương 4

Computer Vision

Contents

Resources – Tài nguyên.

1. Associate Prof. Lý Quốc Ngọc. *Lecture: Introduction to Image Processing & Applications – Bài Giảng: Nhập Môn Xử Lý Ảnh & Ứng Dụng.*

2. David Tschumperle, Christophe Tilman, Vincent Barra. *Digital Image Processing with C++: Implementing Reference Algorithms with the CImg Library.*

3. Mark S. Nixon, Alberto S. Aguado. *Feature Extraction & Image Processing for Computer Vision.* 4e.

4. Manas Kamal Bhuyan. *Computer Vision & Image Processing Fundamentals & Applications.*

5. Rafael C. Gonzalez, Richard E. Woods. *Digital Image Processing.* 4e.

6. Martin McBridge. *Image Processing in Python.*

4.1 Handwritten Digit Classification

Chương 5

Scheduling Problems

1. *Keywords.* Deterministic scheduling problem, stochastic scheduling problems.
2. *Student.* Nguyễn Ngọc Thạch [NNT].

Resources – Tài nguyên.

1. [Pin22]. Michael L. Pinedo. *Scheduling: Theory, Algorithms, & Systems.*

Chương 6

Miscellaneous

Contents

6.1 Linux

Resources – Tài nguyên.

1. [Sho19]. William Shotts. *The Linux Command Line: A Complete Introduction*. 2nd.

6.2 Contributors

1. Võ Ngọc Trâm Anh [VNTA].
2. Sơn Tân [ST].
3. Nguyễn Ngọc Thạch [NNT].
4. Phan Vĩnh Tiến [PVT].

Tài liệu tham khảo

[Bac24] Francis Bach. "Learning Theory from First Principles". In: Adaptive Computation and Machine Learning series (2024), p. 496.

[BB24] Christopher M. Bishop and Hugh Bishop. *Deep Learning: Foundations & Concepts*. 2024 edition. Springer, 2024, p. 669.

[BJP20] Jean-Pierre Briot, Gaëtan Jadjeres, and François-David Pachet. *Deep Learning Techniques for Music Generation*. Computational Synthesis & Creative Systems. Springer, 2020, p. 284.

[Cho21] François Chollet. *Deep Learning with Python*. 2nd edition. Manning, 2021, p. 478.

[Cho25] Kyunghyun Cho. *Machine Learning: a Lecture Note*. 1st version. arXiv, 2025, p. 107.

[DFO24] Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. *Mathematics for Machine Learning*. 1st edition. Cambridge University Press, 2024, pp. iii+411.

[DG24] Shlomo Dubnov and Ross Greer. *Deep & Shallow: Machine Learning in Music & Audio*. 1st edition. Chapman & Hall/CRC Machine Learning & Pattern Recognition. CRC Press, 2024, p. 328.

[Gol18] Boris Goldengorin, ed. *Optimization problems in graph theory*. Vol. 139. Springer Optimization and Its Applications. In honor of Gregory Z. Gutin's 60th birthday. Springer, Cham, 2018, pp. xviii+331. ISBN: 978-3-319-94829-4; 978-3-319-94830-0. DOI: 10.1007/978-3-319-94830-0. URL: https://doi.org/10.1007/978-3-319-94830-0.

[HWR22] Michael S. Horn, Melanie West, and Cameron Roberts. *Introduction to Digital Music with Python Programming: Learning Music with Code*. 1st edition. Focal Press, 2022, p. 262.

[Kut23] Gitta Kutyniok. "The mathematics of artificial intelligence". In: *ICM—International Congress of Mathematicians. Vol. 7. Sections 15–20*. EMS Press, Berlin, [2023] ©2023, pp. 5118–5139.

[Kut24] Gitta Kutyniok. "The mathematics of reliable artificial intelligence". In: *SIAM News* 57.6 (2024), pp. 1, 4. ISSN: 1557-9573.

[LBH15] Yann LeCun, Yoshua Bengio, and Geoffrey Hinton. "Deep Learning". In: *Nature* 521 (2015), pp. 436–444. DOI: 10.1038/nature14539. URL: https://doi.org/10.1038/nature14539.

[MC01] Danilo P. Mandic and Jonathon A. Chambers. "Recurrent Neural Networks for Prediction: Learning Algorithms, Architectures and Stability". In: Wiley Series in Adaptive and Learning Systems for Signal Processing, Communications, and Control (2001), p. 304.

[Mül15] Meinard Müller. *Fundamentals of music processing*. Audio, analysis, algorithms, applications. Springer, Cham, 2015, pp. xxix+487. ISBN: 978-3-319-21944-8; 978-3-319-21945-5. DOI: 10.1007/978-3-319-21945-5. URL: https://doi.org/10.1007/978-3-319-21945-5.

[Mül21] Meinard Müller. *Fundamentals of music processing—using Python and Jupyter notebooks*. Second edition [of 3382223]. Springer, Cham, [2021] ©2021, pp. xxxi+495. ISBN: 978-3-030-69807-2; 978-3-030-69808-9. DOI: 10.1007/978-3-030-69808-9. URL: https://doi.org/10.1007/978-3-030-69808-9.

[NR21] Peter Norvig and Stuart Russell. *Artificial Intelligence: A Modern Approach*. 4th Edition, Global Edition. Pearson Series In Artificial Intelligence. Pearson, 2021, p. 1166.

[Pin22] Michael L. Pinedo. *Scheduling: Theory, Algorithms, and Systems*. 6th edition. Springer, 2022, pp. xvii+698.

[Sho19] William Shotts. "The Linux Command Line: A Complete Introduction". In: (2019), p. 640.