

Heba Yousef Abdel-Nabi, PhD

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Artificial Intelligence & Deep Learning Researcher & Academic

SUMMARY

Passionate Computer Scientist with over 8 years of combined research and teaching experience, specializing in machine learning and deep learning. Holds a Ph.D. with a strong publication record, demonstrating a commitment to advancing the field through high-impact research. Proven expertise in developing innovative solutions to complex problems, lecturing, and fostering academic growth among students.

EDUCATION

Ph.D. in Computer Science 2017-2023

Princess Sumaya University for Technology (PSUT), Amman, Jordan

- Dissertation: "Automatic Whole Slide Image Segmentation using Deep Learning Techniques" [Dissertation overview provided at the end of the CV.]
- Supervisors: Prof. Arafat Awajan & Prof. Mostafa Ali
- Grade: 92.2% (Excellent)

Master in Electrical Engineering 2012-2015

Princess Sumaya University for Technology (PSUT), Amman, Jordan

- Thesis: "Providing Security to Transmitted Medical Images Using Cryptography and Reversible Watermarking"
- Advisor: Prof. Ali Al-Haj
- Grade: 90.5% (Excellent)

Bachelor in Computer Engineering 2006-2010

Princess Sumaya University for Technology (PSUT), Amman, Jordan

- Graduation Project: "Solar Billboard Lights System"
- Grade: 87.7% (Excellent)

EXPERIENCE

Assistant Professor 09/2024 - Present

School of Engineering, Princess Sumaya University for Technology (PSUT), Amman, Jordan

Teaching and Research Assistant 10/2017 - 6/2022

School of Computing Sciences, Princess Sumaya University for Technology (PSUT), Amman, Jordan

- Taught courses in Structured Programming, Object-Oriented Programming, and Computer Skills.
- Designed lecture materials, assignments, exams, and hands-on labs.
- Adapted teaching methods based on student evaluations and feedback.
- Contributed to research in the fields of optimization and artificial intelligence.

Teaching Assistant 10/2012 - 07/2015

School of Engineering, Princess Sumaya University for Technology (PSUT), Amman, Jordan

- Assisted in teaching courses in Circuits, Logic, Microprocessors, and Electronics.
- Conducted lab sessions, graded coursework, and provided individual tutoring to students.

RESEARCH INTERESTS

- Artificial Intelligence and Deep Learning
- Image Processing and Computer Vision
- Optimization using Evolutionary and Metaheuristic Algorithms

CERTIFICATIONS

- Data Science Professional Certificate, IBM (2024)
- Data Analyst Professional Certificate, IBM (2024)
- Cybersecurity Analyst Professional Certificate, IBM (2024)
- Microsoft Certified System Engineer (MCSE), Microsoft (2012)
- Cisco Certified Network Associate (CCNA), Cisco (2012)

TECHNICAL SKILLS

- Expertise in digital image processing, segmentation, watermarking, and reversible data hiding techniques.
- Proficient in machine learning and deep learning, including CNNs, RNNs, computer vision, and NLP models.
- Skilled in data mining algorithms, statistical analysis, data visualization, and pipeline engineering.
- Extensive experience with evolutionary and metaheuristic optimization algorithms.
- Knowledgeable in information security, cryptography, and digital watermarking techniques.
- Proficient in Python, MATLAB, C/C++, R, SQL; familiarity with embedded systems and electronics.

REFERENCES

- **Prof. Arafat Awajan**
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- **Prof. Ali Al-Haj**
Department of Computer Engineering, Princess Sumaya University for Technology, Jordan
Tel: +962 6 5359949 Ext. 330; Email: ali@psut.edu.jo
- **Prof. Mostafa Ali**
Department of Computer Information Systems, Jordan University of Science & Technology, Jordan
Tel: +962 2 7201000 Ext. 23917; Email: mzali@just.edu.jo

PUBLICATIONS

Journal Papers:

1. H. Abdel-Nabi, M. Z. Ali, and A. Awajan, "A multi-scale 3-stacked-layer coned U-net framework for tumor segmentation in whole slide images," *Biomedical Signal Processing and Control*, vol. 86, p. 105273, 2023, doi: <https://doi.org/10.1016/j.bspc.2023.105273>.
2. H. Abdel-Nabi, M. Z. Ali, and A. Awajan, "A Joint Multi-decoder Dual-attention U-Net Framework for Tumor Segmentation in Whole Slide Images," *Journal of King Saud University - Computer and Information Sciences*, p. 101835, 2023, doi: <https://doi.org/10.1016/j.jksuci.2023.101835>.

3. H. Abdel-Nabi, M. Z. Ali, A. Awajan, R. Alazrai, M. I. Daoud, and P. N. Suganthan, "An iterative cyclic tri-strategy hybrid stochastic fractal with adaptive differential algorithm for global numerical optimization," *Information Sciences*, vol. 628, pp. 92-133, 2023, doi: <https://doi.org/10.1016/j.ins.2023.01.065>.
4. M. Z. Ali, H. Abdel-Nabi, R. Alazrai, B. AlHijawi, M. G. AlWadi, A. F. Al-Badarneh, P. N. Suganthan, M. I. Daoud, and R. G. Reynolds, "A cultural evolution with a modified selection function and adaptive α -cognition procedure for numerical optimization," *Applied Soft Computing*, p. 110483, 2023, doi: <https://doi.org/10.1016/j.asoc.2023.110483>.
5. H. Abdel-Nabi, M. Ali, A. Awajan, M. Daoud, R. Alazrai, P. N. Suganthan, and T. Ali, "A comprehensive review of the deep learning-based tumor analysis approaches in histopathological images: segmentation, classification and multi-learning tasks," *Cluster Computing*, pp. 1-41, 2023, doi: <https://doi.org/10.1007/s10586-022-03951-2>.
6. H. Abdel-Nabi, G. Al-Naymat, M. Ali, and A. Awajan, "HcLSH: A Novel Non-Linear Monotonic Activation Function for Deep Learning Methods," *IEEE Access*, 2023, doi: <https://doi.org/10.1109/ACCESS.2023.3276298>.
7. H. Abdel-Nabi, A. Awajan, and M. Z. Ali, "Deep learning-based question answering: a survey," *Knowledge and Information Systems*, pp. 1-87, 2022, doi: <https://doi.org/10.1007/s10115-022-01783-5>.
8. R. S. Al-Gharaibeh, M. Z. Ali, M. I. Daoud, R. Alazrai, H. Abdel-Nabi, S. Hriez, and P. N. Suganthan, "Real-parameter constrained optimization using enhanced quality-based cultural algorithm with novel influence and selection schemes," *Information Sciences*, vol. 576, pp. 242-273, 2021, doi: <https://doi.org/10.1016/j.ins.2021.06.057>.
9. A. Al-Haj and H. Abdel-Nabi, "An efficient watermarking algorithm for medical images," *Multimedia Tools and Applications*, vol. 80, no. 17, pp. 26021-26047, 2021, doi: <https://doi.org/10.1007/s11042-021-10801-7>.
10. H. Abdel-Nabi and A. Al-Haj, "Reversible data hiding in adjacent zeros," *Multimedia Systems*, vol. 27, no. 2, pp. 229-245, 2021, doi: <https://doi.org/10.1007/s00530-020-00732-y>.
11. S. Al-Saqqa, S. Sawalha, and H. AbdelNabi, "Agile Software Development: Methodologies and Trends," *International Journal of Interactive Mobile Technologies*, vol. 14, no. 11, 2020, doi: <https://doi.org/10.3991/ijim.v14i11.13269>.

Conference Papers:

1. H. Abdel-Nabi, M. Ali, and A. Awajan, "Multi-scale Dual-Attention based U-Net for breast cancer segmentation in ultrasound images," presented at the 2023 6th International Conference on Signal Processing and Information Communications, February 2023. (Accepted, to be published in Springer book series Signals and Communication Technology).
2. H. Abdel-Nabi, M. Z. Ali, A. Awajan, R. Alazrai, M. I. Daoud, P. N. Suganthan, and R. Reynolds, "3-sCHSL: Three-Stage Cyclic Hybrid SFS and L-SHADE Algorithm for Single Objective Optimization," in Proc. of the 2023 IEEE Congress on Evolutionary Computation (CEC), pp. 1-8, July 2023, doi: <https://doi.org/10.1109/CEC53210.2023.10254143>.
3. H. Abdel-Nabi, M. Ali, M. Daoud, R. Alazrai, A. Awajan, R. Reynolds, and P. N. Suganthan, "An Enhanced Multi-Phase Stochastic Differential Evolution Framework for Numerical Optimization," in Proc. of the 2022 IEEE Congress on Evolutionary Computation (CEC), pp. 1-8, July 2022, doi: <https://doi.org/10.1109/CEC55065.2022.9870438>.
4. H. Abdel-Nabi, A. Awajan, and M. Ali, "A novel ensemble strategy with enhanced cross attention encoder-decoder framework for tumor segmentation in whole slide images," in Proc. of the

- 2022 13th International Conference on Information and Communication Systems (ICICS), pp. 262-269, June 2022, doi: <https://doi.org/10.1109/ICICS55353.2022.9811163>.
5. H. Abdel-Nabi, G. Al-Naymat, and A. Awajan, "Content based image retrieval approach using deep learning," in Proc. of the 2019 2nd International Conference on new Trends in Computing Sciences (ICTCS), pp. 1-8, October 2019, doi: <https://doi.org/10.1109/ICTCS.2019.8923042>.
 6. H. Abdel-Nabi, A. Awajan, and N. Obeid, "A Novel Histogram Shifting Reversible Data Hiding Scheme for Color Images," in Proc. of the 2018 8th International Conference on Computer Science and Information Technology (CSIT), pp. 173-179, July 2018, doi: <https://doi.org/10.1109/CSIT.2018.8486203>.
 7. S. Al-Saqqa, H. Abdel-Nabi, and A. Awajan, "A survey of textual emotion detection," in Proc. of the 2018 8th International Conference on Computer Science and Information Technology (CSIT), pp. 136-142, July 2018, doi: <https://doi.org/10.1109/CSIT.2018.8486405>.
 8. H. Abdel-Nabi and A. Al-Haj, "Medical imaging security using partial encryption and histogram shifting watermarking," in Proc. of the 2017 8th International Conference on Information Technology (ICIT), pp. 802-807, May 2017, doi: <https://doi.org/10.1109/ICITECH.2017.8079950>.
 9. A. Al-Haj and H. Abdel-Nabi, "Digital image security based on data hiding and cryptography," in Proc. of the 2017 3rd International Conference on Information Management (ICIM), pp. 437-440, April 2017, doi: <https://doi.org/10.1109/INFOMAN.2017.7950423>.
 10. H. Abdel-Nabi and A. Al-Haj, "Efficient joint encryption and data hiding algorithm for medical images security," in Proc. of the 2017 8th International Conference on Information and Communication Systems (ICICS), pp. 147-152, April 2017, doi: <https://doi.org/10.1109/IACS.2017.7921962>.

Book Chapter:

H. Abdel-Nabi and A. Al-Haj, "Frequency domain based data hiding for encrypted medical images," in *Intelligent Data Security Solutions for e-Health Applications*, Academic Press, pp. 21-56, 2020, doi: <https://doi.org/10.1016/B978-0-12-819511-6.00002-9>.

PH.D. DISSERTATION OVERVIEW

My Ph.D. research was dedicated to pioneering deep learning-based frameworks for automated tumor segmentation in Whole Slide Images (WSIs), addressing critical challenges in digital pathology.

Key Challenges Tackled:

- WSIs, with dimensions up to 50,000 x 50,000 pixels, surpass standard computational capabilities.
- Differences in tissue preparation, staining, and scanning introduce significant color variability.
- WSIs offer varied contextual details across multiple levels of magnification, complicating analysis.
- Traditional deep learning models are not designed to handle the large input sizes of WSIs.

Innovative Contributions and Achievements:

- Developed a **cluster-based random patch sampling strategy** to efficiently extract and analyze informative regions from WSIs.
- Implemented **encoder-decoder networks** utilizing a U-Net architecture with a pre-trained backbone, enhancing feature extraction capabilities.
- Integrated **attention mechanisms, dilation fusion blocks, and edge enhancement** techniques to adeptly capture multi-scale contextual information.
- Applied **deep supervision and morphological post-processing** to significantly refine segmentation accuracy.
- Introduced **novel ensemble techniques** that synergize color spaces, magnifications, and leverage a hybrid evolutionary optimization approach for superior performance.
- Formulated a **new activation function**, demonstrably improving model performance across various tests.

Impact:

My dissertation's methodologies have established new state-of-the-art benchmarks for tumor segmentation in Whole Slide Images (WSIs), significantly outperforming previous models across several public datasets. By introducing innovative deep learning frameworks, my research has markedly enhanced segmentation accuracy, representing a major advancement in the field of digital histopathology.

These breakthroughs not only improve the accuracy of cancer diagnoses but also offer a robust and scalable solution for analyzing digitized histopathology images. The development of these methods marks a pivotal stride in leveraging artificial intelligence for medical imaging, potentially transforming diagnostic processes and patient outcomes in oncology.