



## Dr. Ibrahim Aljarah, PhD

*Director of Open Educational Resources and Blended Learning Center  
Associate Professor of BIG Data Mining and Computational Intelligence  
The University of Jordan*

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## PERSONAL DETAILS

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*Birth* Oct 23, 1981

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*Google Scholar* <https://scholar.google.com/citations?user=moOTIYEAAAAJ&hl=en>

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## SUMMARY

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I am an associate professor of BIG Data Mining and Computational Intelligence at the University of Jordan -Department of Information Technology, Jordan. Currently, I am the Director of the Open Educational Resources and Blended Learning Center at The University of Jordan. I obtained the bachelor degree in Computer Science from Yarmouk University - Jordan, 2003. I also obtained my master degree in computer science and information systems from the Jordan University of Science and Technology - Jordan in 2006. I participated in many conferences in the field of data mining, machine learning, and Big data such as CEC, GECCO, NTIT, CSIT, IEEE NABIC, CASON, and BIGDATA Congress. Furthermore, I contributed in many projects in USA such as Vehicle Class Detection System (VCDS), Pavement Analysis Via Vehicle Electronic Telemetry (PAVVET), and Farm Cloud Storage System (CSS) projects. He has published more than 35 papers in refereed inter-national conferences and journals. My research focuses on data mining, Machine Learning, Big Data, MapReduce, Hadoop, Swarm intelligence, Evolutionary Computation, Social Network Analysis (SNA), and largescale distributed algorithms.

## EDUCATION

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### PhD in Computer Science

2010-2014

*North Dakota State University, Fargo, North Dakota, United States of America*

**Dissertation Title:** MapReduce-Enabled Scalable Nature-Inspired Approaches For Clustering

**Adviser:** Prof. Simone A. Ludwig

**GPA:** 3.9

### Master in Computer Science

2003-2007

*Jordan University of Science and Technology, Irbid, Jordan*

**Thesis Title:** An Automatic Course Scheduling Approach Using Instructors' Preferences

**Adviser:** Dr. Ayad Salhieh

**Cumulative Average:** 80.2

### Bachelor in Computer Science

1999-2003

*Yarmouk University, Irbid, Jordan*

**Cumulative Average:** 78.2

### Tawjihi (General Secondary Education Certificate)

1998-1999

*Al-Mazar Secondary Boys School, Irbid, Jordan*

**Average Score:** 81.2

## WORK EXPERIENCE

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### Administrative Experiences

#### Director of Open Educational Resources & Blended Learning Center

Aug. 2018 - Present

*International Affairs Unit*

*The University of Jordan, Amman, Jordan*

#### Assistant to Unit Director for Externally Funded Projects

Mar. 2018 - Aug. 2019

*International Affairs Unit*

*The University of Jordan, Amman, Jordan*

#### Acting Director

Sept. 2018 - Nov. 2018

*International Affairs Unit*

*The University of Jordan, Amman, Jordan*

#### Dean Assistant for Laboratory Affairs

Sep. 2017- Mar. 2018

*King Abdullah II School of Information Technology*

*The University of Jordan, Amman, Jordan*

#### Director of the University Website Content

Sep 2014- Sep. 2015

*The University of Jordan, Amman, Jordan*

#### Online Automated Exams Administrator and Developer

Nov. 2006 - Dec. 2009

*King Abdullah II for information and technology Faculty*

*The University of Jordan, Amman, Jordan*

**Duties include:**

- Analyzing online exams system logs and identifying potential issues with computer systems

- Introducing and integrating new automated exams technologies into existing data center environments
- Performing routine audits of online exam system and the other systems
- Performing grades analysis and maintaining system backups
- Applying operating system updates, patches, and configuration changes
- Installing and configuring new hardware and software.
- Adding, removing, or updating user account information
- Answering technical queries and dealing with often frustrated users
- Responsibility for security, and documenting the configuration of the online exam system
- Troubleshooting any reported problems discovered in the online exams system
- Ensuring that the network infrastructure is up and running

### Website Administrator

Nov. 2006 - Dec. 2007

*Language Center*

*The University of Jordan, Amman, Jordan*

**Duties include:** Server Upgrades and Maintenance, Security Audits, Content Maintenance, Site Design, Database Administration, and Backups

## Academic Experiences

### Associate Professor

May 2018 - Present

*Department of Information Technology*

*King Abdullah II School of Information Technology*

*The University of Jordan, Amman, Jordan*

### Assistant Professor

Sep. 2014- May 2018

*Department of Information Technology*

*King Abdullah II School of Information Technology*

*The University of Jordan, Amman, Jordan*

### Lecturer

May 2014- Sep. 2014

*Department of Information Technology*

*King Abdullah II School of Information Technology*

*The University of Jordan, Amman, Jordan*

### Teaching\Research Assistant

Jan. 2010 - May 2014

*Computer Science Department*

*North Dakota State University, Fargo, ND, USA*

**Duties include:**

- Tutoring, grading assignments, exams, and reports
- Assisting a professor with a large lecture class by teaching students in recitation, laboratory, or discussion sessions
- Conduct literature and database searches
- Continue to update knowledge and develop skills
- Contribute to the production of research reports and publications
- Present information on research progress and outcomes to bodies supervising research, e.g. steering groups, sponsors or members of research groups
- Prepare papers for steering groups and other bodies
- Analyze and interpret the results of own research and generate original ideas based on outcomes

### Part-time lecturer

Jan. 2007 - Dec. 2009

*Computer Information Systems*  
*King Abdullah II for information and technology Faculty*  
*The University of Jordan, Amman, Jordan*

**Duties include:** Teaching Advance Computer Skills (MS-Word, MS-Excel, MS-Front page), VB.NET, C++ Programming Course (Fundamentals Level), Object Oriented - C++ Course (Advance Level)

### Teacher

2004-2006

*Al-Mazar Secondary Boys School*  
*Ministry of Education, Jordan*

**Duties include:** Teaching computer programming courses.

## Industry Experiences

### Computer hardware and software technician

2003-2006

*NASA for computer technology center, Irbid, Jordan*

**Duties include:** Computer Maintenance, and software installations.

## AWARDS AND HONORS

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### PhD Scholarship

2010-2014

*The University of Jordan*

Granted by the University of Jordan to get the Ph.D degree in Computer Science from North Dakota State University, USA.

### Top highly Cited Researchers in Scopus

Jul 2018

*The University of Jordan*

Honored by The University of Jordan as one of the most publishing researchers in SCOPUS in the university Ranked 56 out 1600 (University level) in the last five years (2013-2018)

### Top highly Cited Researchers in Google Scholar

Sep 2018

*The University of Jordan*

Honored by The University of Jordan as one of the most publishing researchers in Google Scholar in the university.

Ranked 121 out of 1600 (University level) with more than 60 Google Scholar indexed publications

### Top Ten highly Cited Researchers in Scopus in 2018

March 2019

*The University of Jordan*

Honored by The University of Jordan as one of the Top Ten publishing researchers in SCOPUS in the university in 2018.

Ranked 7 with 19 Scopus indexed publications in 2018

## FUNDED PROJECTS

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### Employing data mining methods to improve the quality of the performance of the educational process at the University of Jordan

April, 2019 - August, 2021

*The University of Jordan, Amman, Jordan*

Summary of the project:Over the last few years, the educational data mining techniques have received considerable attention, where these techniques concerned with developing methods for exploring the unique and hidden information that come from educational data. The hidden information that extracted from the educational data are used then to support the decision makers to enhance the education process. Many data mining and analysis techniques have been proposed to extract hidden information from educational data. The objective of this

project is to take advantage of data mining and data analytics to solve some of educational problems such as low student performance which is hinder the development of educational process. In this project, the data will be collected from the Admissions and Registration Unit at the University of Jordan. The data will be related to all aspects of the educational process such as student performance, the academic load of the instructors, the number of the registered courses, and other related data. Once the data collection phase has been completed, the data will be analyzed by applying intelligent methods by taking advantage of data mining techniques.

Funded By: Deanship of Academic Research, The University of Jordan

Budget: 8,000 JD (11,283 \$)

Duration: 2019 - 2021 (18 Months)

Lead Investigator: Hamad Alswalgah

Principal Investigators: Ibrahim Aljarah, Yazan Alshmailah, and Hossam Faris

## Intelligent Evolutionary Approach for Hate Speech Detection in Arabic Social Media

Feb, 2019 - Feb, 2021

*The University of Jordan, Amman, Jordan*

Summary of the project: Recently the social media has become an essential part of our daily life activities , people can post and share their opinion on current world's event . Although of its many useful uses, the hate speech is a common problem in social media. It means that using hate words against group or individuals based on people race , gender or religion with intention of bringing harm and raise violence toward them. It's important that social media should provide a tool to detect hate speech since it has a huge impact on its targets. Detecting hate speech in English has been widely studied and presented by a large number of researchers, however the topic of hate speech detection in Arabic language has attracted little attention .This due the limited resources and NLP (Natural Language Processing ) tools in Arabic, thus has drove our interest in proposing a tool for hate speech detection in Arabic social media . In this project, we use different machine learning and evolutionary algorithms to build efficient detectors/ models for hate speech contents.

Funded By: Deanship of Academic Research, The University of Jordan

Budget: 16,500 JD (23,000 \$)

Duration: 2019 - 2021(24 Months)

Lead Investigator: Ibrahim Aljarah

Principal Investigators: Bassam Hammo, Mohammed Abusharia, and Hossam Faris

## PUBLICATIONS

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### Journals

\*Corresponding Author

1. Hossam Faris, Ali Asghar Heidari, Al-Zoubi Ala'M, Majdi Mafarja, **Ibrahim Aljarah**, Mohammed Eshtay, and Seyedali Mirjalili. Time-varying hierarchical chains of salps with random weight networks for feature selection. *Expert Systems with Applications*, page 112898, 2019. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 4.292)
2. Rizik MH Al-Sayyed, Wadi'A Hijawi, Anwar M Bashiti, **Ibrahim Aljarah**, Nadim Obeid, and Omar Y Adwan. An investigation of microsoft azure and amazon web services from users' perspectives. *International Journal of Emerging Technologies in Learning*, 14(10), 2019. (**Publisher:** Kassel University Press GmbH, **Rank:** Q2, **IF:** N/A)
3. Hamouda Chantar, Majdi Mafarja, Hamad Alsawalqah, Ali Asghar Heidari, **Ibrahim Aljarah\***, and Hossam Faris. Feature selection using binary grey wolf optimizer with elite-based crossover for arabic text classification. *Neural Computing and Applications*, pages 1–20. (**Publisher:** Springer, **Rank:** Q1, **IF:** 4.664)
4. Amaal Al Shorman, Hossam Faris, and **Ibrahim Aljarah\***. Unsupervised intelligent system based on one class support vector machine and grey wolf optimization for iot botnet detection. *Journal of Ambient Intelligence and Humanized Computing*, pages 1–17, 2019. (**Publisher:** Springer, **Rank:** Q2, **IF:** 1.910)
5. Hossam Faris, Ruba Abukhurma, Waref Almanaseer, Mohammed Saadeh, Antonio M Mora, Pedro A Castillo, and **Ibrahim Aljarah\***. Improving financial bankruptcy prediction in a highly imbalanced

- class distribution using oversampling and ensemble learning: a case from the spanish market. *Progress in Artificial Intelligence*, pages 1–23, 2019. (**Publisher:** Springer, **Rank:** Q2, **IF:** N/A)
6. Mohammad Taradeh, Majdi Mafarja, Ali Asghar Heidari, Hossam Faris, **Ibrahim Aljarah**, Seyedali Mirjalili, and Hamido Fujita. An evolutionary gravitational search-based feature selection. *Information Sciences*, 2019. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 4.305)
  7. **Ibrahim Aljarah\***, Majdi Mafarja, Ali Asghar Heidari, Hossam Faris, and Seyedali Mirjalili. Clustering analysis using a novel locality-informed grey wolf-inspired clustering approach. *Knowledge and Information Systems*, pages 1–33, 2019. (**Publisher:** Springer, **Rank:** Q1, **IF:** 2.247)
  8. Mohammed Azmi Al-Betar, **Ibrahim Aljarah**, Mohammed A. Awadallah, Hossam Faris, and Seyedali Mirjalili. Adaptive  $\beta$ -hill climbing for optimization. *Soft Computing*, Mar 2019. (**Publisher:** Springer, **Rank:** Q2, **IF:** 2.367)
  9. Ali Asghar Heidari, Seyedali Mirjalili, Hossam Faris, **Ibrahim Aljarah**, Majdi Mafarja, and Huiling Chen. Harris hawks optimization: Algorithm and applications. *Future Generation Computer Systems*, 2019. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 4.639)
  10. **Ibrahim Aljarah\***, Hossam Faris, Seyedali Mirjalili, Nailah Al-Madi, Alaa Sheta, and Majdi Mafarja. Evolving neural networks using bird swarm algorithm for data classification and regression applications. *Cluster Computing*, pages 1–29, 2019. (**Publisher:** Springer, **Rank:** Q2, **IF:** 1.601)
  11. Ali Asghar Heidari, **Ibrahim Aljarah**, Hossam Faris, Huiling Chen, Jie Luo, and Seyedali Mirjalili. An enhanced associative learning-based exploratory whale optimizer for global optimization. *Neural Computing and Applications*, pages 1–27, 2019. (**Publisher:** Springer, **Rank:** Q1, **IF:** 4.213)
  12. Hossam Faris, Seyedali Mirjalili, and **Ibrahim Aljarah\***. Automatic selection of hidden neurons and weights in neural networks using grey wolf optimizer based on a hybrid encoding scheme. *International Journal of Machine Learning and Cybernetics*, pages 1–20, 2019. (**Publisher:** Springer, **Rank:** Q2, **IF:** 2.692)
  13. Majdi Mafarja, **Ibrahim Aljarah**, Hossam Faris, Abdelaziz I Hammouri, Al-Zoubi Ala’M, and Seyedali Mirjalili. Binary grasshopper optimisation algorithm approaches for feature selection problems. *Expert Systems with Applications*, 117:267–286, 2019. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 3.768)
  14. Hossam Faris, Al-Zoubi Ala’M, Ali Asghar Heidari, **Ibrahim Aljarah**, Majdi Mafarja, Mohammad A Hassonah, and Hamido Fujita. An intelligent system for spam detection and identification of the most relevant features based on evolutionary random weight networks. *Information Fusion*, 48:67–83, 2019. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 6.667)
  15. Mohammad Tubishat, Mohammad A. M. Abushariah, Norisma Idris, and **Ibrahim Aljarah**. Improved whale optimization algorithm for feature selection in arabic sentiment analysis. *Applied Intelligence*, 2018. (**Publisher:** Springer, **Rank:** Q2, **IF:** 1.983)
  16. Mo’ath Alrefai, Hossam Faris, and **Ibrahim Aljarah\***. Sentiment analysis for arabic language: A brief survey of approaches and techniques. *arXiv preprint arXiv:1809.02782*, 2018. (**Publisher:** arXiv, **Rank:** N/A, **IF:** N/A)
  17. Alaa F Sheta, Hossam Faris, and **Ibrahim Aljarah**. Estimating arma model parameters of an industrial process using meta-heuristic search algorithms. *International Journal of Engineering & Technology*, 7(3.10):187–194, 2018. (**Publisher:** SPC, **Rank:** Q4, **IF:** N/A)
  18. Majdi Mafarja, **Ibrahim Aljarah**, Ali Asghar Heidari, Hossam Faris, Philippe Fournier-Viger, Xiaodong Li, and Seyedali Mirjalili. Binary dragonfly optimization for feature selection using time-varying transfer functions. *Knowledge-Based Systems*, 161:185–204, 2018. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 4.396)

19. Ali Asghar Heidari, Hossam Faris, **Ibrahim Aljarah\***, and Seyedali Mirjalili. An efficient hybrid multilayer perceptron neural network with grasshopper optimization. *Soft Computing*, pages 1–18, 2018. (**Publisher:** Springer, **Rank:** Q1, **IF:** 2.367)
20. **Ibrahim Aljarah**, Majdi Mafarja, Ali Asghar Heidari, Hossam Faris, Yong Zhang, and Seyedali Mirjalili. Asynchronous accelerating multi-leader salp chains for feature selection. *Applied Soft Computing*, 71:964–979, 2018. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 3.907)
21. Mohammed Azmi Al-Betar, Mohammed A Awadallah, Hossam Faris, **Ibrahim Aljarah**, and Abdelaziz I Hammouri. Natural selection methods for grey wolf optimizer. *Expert Systems with Applications*, 113:481–498, 2018. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 3.768)
22. Hossam Faris, Majdi M Mafarja, Ali Asghar Heidari, **Ibrahim Aljarah\***, Al-Zoubi Ala’M, Seyedali Mirjalili, and Hamido Fujita. An efficient binary salp swarm algorithm with crossover scheme for feature selection problems. *Knowledge-Based Systems*, 154:43–67, 2018. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 4.396)
23. Sarah Shukri, Hossam Faris, **Ibrahim Aljarah\***, Seyedali Mirjalili, and Ajith Abraham. Evolutionary static and dynamic clustering algorithms based on multi-verse optimizer. *Engineering Applications of Artificial Intelligence*, 72:54–66, 2018. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 2.819)
24. **Ibrahim Aljarah\***, Al-Zoubi Ala’M, Hossam Faris, Mohammad A Hassonah, Seyedali Mirjalili, and Heba Saadeh. Simultaneous feature selection and support vector machine optimization using the grasshopper optimization algorithm. *Cognitive Computation*, pages 1–18, 2018. (**Publisher:** Springer, **Rank:** Q1, **IF:** 3.479)
25. Majdi Mafarja, **Ibrahim Aljarah\***, Ali Asghar Heidari, Abdelaziz I Hammouri, Hossam Faris, Al-Zoubi Ala’M, and Seyedali Mirjalili. Evolutionary population dynamics and grasshopper optimization approaches for feature selection problems. *Knowledge-Based Systems*, 145:25–45, 2018. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 4.396)
26. Hossam Faris, **Ibrahim Aljarah**, Mohammed Azmi Al-Betar, and Seyedali Mirjalili. Grey wolf optimizer: a review of recent variants and applications. *Neural computing and applications*, pages 1–23, 2018. (**Publisher:** Elsevier, **Rank:** Q1, **IF:** 4.213)
27. Wadi’ Hijawi, Hossam Faris, Ja’far Alqatawna, **Ibrahim Aljarah\***, Ala’M Al-Zoubi, and Maria Habib. Emfet: E-mail features extraction tool. *arXiv preprint arXiv:1711.08521*, 2017. (**Publisher:** arXiv, **Rank:** N/A, **IF:** N/A)
28. Seyedeh Zahra Mirjalili, Seyedali Mirjalili, Shahrzad Saremi, Hossam Faris, and **Ibrahim Aljarah**. Grasshopper optimization algorithm for multi-objective optimization problems. *Applied Intelligence*, 48(4):805–820, 2018. (**Publisher:** Springer, **Rank:** Q2, **IF:** 1.983)
29. Hossam Faris, **Ibrahim Aljarah\***, and Seyedali Mirjalili. Improved monarch butterfly optimization for unconstrained global search and neural network training. *Applied Intelligence*, 48(2):445–464, 2018. (**Publisher:** Springer, **Rank:** Q2, **IF:** 1.983)
30. Hossam Faris, Mohammad A Hassonah, Al-Zoubi Ala’M, Seyedali Mirjalili, and **Ibrahim Aljarah**. A multi-verse optimizer approach for feature selection and optimizing svm parameters based on a robust system architecture. *Neural Computing and Applications*, 30(8):2355–2369, 2018. (**Publisher:** Springer, **Rank:** Q1, **IF:** 4.213)
31. **Ibrahim Aljarah**, Hossam Faris, and Seyedali Mirjalili. Optimizing connection weights in neural networks using the whale optimization algorithm. *Soft Computing*, 22(1):1–15, 2018. (**Publisher:** Springer, **Rank:** Q2, **IF:** 2.367)

32. Hossam Faris, **Ibrahim Aljarah**, Nailah Al-Madi, and Seyedali Mirjalili. Optimizing the learning process of feedforward neural networks using lightning search algorithm. *International Journal on Artificial Intelligence Tools*, 25(06):1650033, 2016. (**Publisher:** World Scientific, **Rank:** Q4, **IF:** 0.565)
33. **Ibrahim Aljarah\***, Hossam Faris, Seyedali Mirjalili, and Nailah Al-Madi. Training radial basis function networks using biogeography-based optimizer. *Neural Computing and Applications*, 29(7):529–553, 2018. (**Publisher:** Springer, **Rank:** Q1, **IF:** 4.213)
34. Elaf Abu Amrieh, Thair Hamtini, and **Ibrahim Aljarah**. Mining educational data to predict student’s academic performance using ensemble methods. *International Journal of Database Theory and Application*, 9(8):119–136, 2016. (**Publisher:** SERSC, **Rank:** Q4, **IF:** N/A)
35. Bashar Awad Al-Shboul, Heba Hakh, Hossam Faris, **Ibrahim Aljarah**, and Hamad Alsawalqah. Voting-based classification for e-mail spam detection. *Journal of ICT Research and Applications*, 10(1):29–42, 2016. (**Publisher:** ITB, **Rank:** Q3, **IF:** N/A)
36. Hossam Faris, **Ibrahim Aljarah**, and Seyedali Mirjalili. Training feedforward neural networks using multi-verse optimizer for binary classification problems. *Applied Intelligence*, 45(2):322–332, 2016. (**Publisher:** Springer, **Rank:** Q2, **IF:** 1.983)
37. Loai M Alnemer, Lama Rajab, and **Ibrahim Aljarah**. Conformal prediction technique to predict breast cancer survivability. *International Journal of Advanced Science and Technology*, 96:1–10, 2016. (**Publisher:** Springer, **Rank:** N/A, **IF:** N/A)
38. **Ibrahim Aljarah\*** and Simone A Ludwig. A scalable mapreduce-enabled glowworm swarm optimization approach for high dimensional multimodal functions. *International Journal of Swarm Intelligence Research (IJSIR)*, 7(1):32–54, 2016. (**Publisher:** IGI Global, **Rank:** N/A, **IF:** N/A)
39. Nazeeh Ghatasheh, Hossam Faris, **Ibrahim Aljarah**, and Rizik MH Al-Sayyed. Optimizing software effort estimation models using firefly algorithm. *Journal of Software Engineering and Applications*, 8(03):133, 2015. (**Publisher:** Scientific Research Publishing, **Rank:** Q4, **IF:** N/A)
40. **Ibrahim Aljarah**, Ayiad Salhieh, and Hossam Faris. An automatic course scheduling approach using instructors’ preferences. *International Journal of Emerging Technologies in Learning (iJET)*, 7(1), 2012. (**Publisher:** IAOE, **Rank:** Q3, **IF:** N/A)
41. Saeed Salem, Rami Alroobi, Shadi Banitaan, Loqmane Seridi, **Ibrahim Aljarah**, and James Brewer. Improving functional modules discovery by enriching interaction networks with gene profiles. *Current Bioinformatics*, 7(4), 2012. (**Publisher:** IAOE, **Rank:** Q3, **IF:** 0.54)

## Conferences

1. Reham. Barham and **Ibrahim Aljarah\***. Link prediction based on whale optimization algorithm. In *2017 International Conference on New Trends in Computing Sciences (ICTCS)*, pages 55–60, Oct. 2018
2. Heba Hakh, **Ibrahim Aljarah\***, and Bashar Al-Shboul. Online social media-based sentiment analysis for us airline companies. In *Proceedings of the New Trends in Information Technology (NTIT-2017)*, Amman, Jordan, April 2017
3. Hamad Alsawalqah, Bashar Al-Shboul, Yazan Alshamaileh, Hossam Faris, **Ibrahim Aljarah**, and Ahmad Abadleh. A proposed index for evaluating component commonality for software product family. In *Proceedings of the New Trends in Information Technology (NTIT-2017)*, Amman, Jordan, April 2017



4. Ghadeer AL-Sukkar, **Ibrahim Aljarah\***, and Hamad Alsawalqah. Enhancing the arabic sentiment analysis using different preprocessing operators. In *Proceedings of the New Trends in Information Technology (NTIT-2017), Amman, Jordan*, April 2017
5. Hossam Faris, **Ibrahim Aljarah**, Sayedali Mirjalili, Pedro Castillo, and J.J Merelo. Evolopy: An open-source nature-inspired optimization framework in python. In *In Proceedings of the 8th International Joint Conference on Computational Intelligence ECTA, Portugal*, volume 3, pages 171–177, April 2016
6. Laila. M. Qaisi and **Ibrahim Aljarah\***. A twitter sentiment analysis for cloud providers: A case study of azure vs. aws. In *2016 7th International Conference on Computer Science and Information Technology (CSIT)*, pages 1–6, July 2016
7. Hossam Faris, **Ibrahim Aljarah\***, and Ja'far Alqatawna. Optimizing feedforward neural networks using krill herd algorithm for e-mail spam detection. In *2015 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT)*, pages 1–5, Nov 2015
8. Sarah. E. Shukri, Rawan. I. Yaghi, **Ibrahim Aljarah\***, and Hamad Alsawalqah. Twitter sentiment analysis: A case study in the automotive industry. In *2015 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT)*, pages 1–5, Nov 2015
9. Elaf A. Amrieh, Thair Hamtini, and **Ibrahim Aljarah**. Preprocessing and analyzing educational data set using x-api for improving student's performance. In *2015 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT)*, pages 1–5, Nov 2015
10. Nailah. Al-Madi, **Ibrahim Aljarah**, and Simone A. Ludwig. Parallel glowworm swarm optimization clustering algorithm based on mapreduce. In *2014 IEEE Symposium on Swarm Intelligence*, pages 1–8, Dec 2014
11. **Ibrahim Aljarah\*** and Simone A. Ludwig. A new clustering approach based on glowworm swarm optimization. In *2013 IEEE Congress on Evolutionary Computation*, pages 2642–2649, June 2013. Cancun, Mexico
12. **Ibrahim Aljarah\*** and Simone A. Ludwig. Mapreduce intrusion detection system based on a particle swarm optimization clustering algorithm. In *2013 IEEE Congress on Evolutionary Computation*, pages 955–962, June 2013. Cancun, Mexico
13. **Ibrahim Aljarah\*** and Simone A. Ludwig. Towards a scalable intrusion detection system based on parallel pso clustering using mapreduce. In *Proceedings of the 15th Annual Conference Companion on Genetic and Evolutionary Computation, GECCO '13 Companion*, pages 169–170, New York, NY, USA, 2013. ACM
14. **Ibrahim Aljarah\*** and Simone A. Ludwig. A mapreduce based glowworm swarm optimization approach for multimodal functions. In *2013 IEEE Symposium on Swarm Intelligence (SIS)*, pages 22–31, April 2013
15. **Ibrahim Aljarah\*** and Simone A. Ludwig. Parallel particle swarm optimization clustering algorithm based on mapreduce methodology. In *2012 Fourth World Congress on Nature and Biologically Inspired Computing (NaBIC)*, pages 104–111, Nov 2012
16. Saeed Salem, Shadi Banitaan, **Ibrahim Aljarah**, and Rami Alroobi. Mining maximal-homogeneous subnetworks using protein interaction networks and gene profiles. In *in proceeding of the 4th international conference on Bioinformatics and Computational Biology (BICoB)*, pages 203–210, Las Vegas, Nevada, USA, Oct 2012

17. **Ibrahim Aljarah\***, Shadi Banitaan, Sameer Abufardeh, Wei Jin, and Saeed Salem. Selecting discriminating terms for bug assignment: A formal analysis. In *Proceedings of the 7th International Conference on Predictive Models in Software Engineering*, Promise '11, pages 12:1–12:7, New York, NY, USA, 2011. ACM
18. Saeed Salem, Shadi Banitaan, **Ibrahim Aljarah**, James Brewer, and Rami Alroobi. Discovering communities in social networks using topology and attributes. In *2011 10th International Conference on Machine Learning and Applications and Workshops*, volume 1, pages 40–43, Dec 2011
19. Saeed Salem, Rami Alroobi, Shadi Banitaan, Loqmane Seridi, James Brewer, and **Ibrahim Aljarah**. Clarm: An integrative approach for functional modules discovery. In *Proceedings of the 2Nd ACM Conference on Bioinformatics, Computational Biology and Biomedicine*, BCB '11, pages 646–650, New York, NY, USA, 2011. ACM
20. Shadi Banitaan, Saeed Salem, Wei Jin, and **Ibrahim Aljarah**. A formal study of classification techniques on entity discovery and their application to opinion mining. In *Proceedings of the 2Nd International Workshop on Search and Mining User-generated Contents*, SMUC '10, pages 29–36, New York, NY, USA, 2010. ACM

## Book Chapters

1. **Ibrahim Aljarah**, Majdi Mafarja, Ali Asghar Heidari, Hossam Faris, and Seyedali Mirjalili. Multi-verse optimizer: Theory, literature review, and application in a data clustering. In *Nature-Inspired Optimizers: Theories, Literature Reviews and Applications*, pages 123–141. Springer International Publishing, Cham, 2020
2. Hossam Faris, Seyedali Mirjalili, **Ibrahim Aljarah**, Majdi Mafarja, and Ali Asghar Heidari. Salp swarm algorithm: Theory, literature review, and application in extreme learning machines. In *Nature-Inspired Optimizers: Theories, Literature Reviews and Applications*, pages 185–199. Springer International Publishing, Cham, 2020
3. Majdi Mafarja, Ali Asghar Heidari, Hossam Faris, Seyedali Mirjalili, and **Ibrahim Aljarah**. Dragonfly algorithm: Theory, literature review, and application in feature selection. In *Nature-Inspired Optimizers: Theories, Literature Reviews and Applications*, pages 47–67. Springer International Publishing, Cham, 2020
4. Ali Asghar Heidari, Hossam Faris, Seyedali Mirjalili, **Ibrahim Aljarah**, and Majdi Mafarja. Ant lion optimizer: Theory, literature review, and application in multi-layer perceptron neural networks. In *Nature-Inspired Optimizers: Theories, Literature Reviews and Applications*, pages 23–46. Springer International Publishing, Cham, 2020
5. Seyedali Mirjalili, **Ibrahim Aljarah**, Majdi Mafarja, Ali Asghar Heidari, and Hossam Faris. Grey wolf optimizer: Theory, literature review, and application in computational fluid dynamics problems. In *Nature-Inspired Optimizers: Theories, Literature Reviews and Applications*, pages 87–105. Springer International Publishing, Cham, 2020
6. Hossam Faris, **Ibrahim Aljarah**, and Seyedali Mirjalili. Chapter 28 - evolving radial basis function networks using moth–flame optimizer. In Pijush Samui, Sanjiban Sekhar, and Valentina E. Balas, editors, *Handbook of Neural Computation*, pages 537 – 550. Academic Press, Elsevier, 2017
7. Hossam Faris, **Ibrahim Aljarah\***, and Bashar Al-Shboul. A hybrid approach based on particle swarm optimization and random forests for e-mail spam filtering. In Lecture Notes in Computer Science, editor, *Computational Collective Intelligence*, pages 498–508, Cham, 2016. Springer International Publishing

- Hamad Alsawalqah, Hossam Faris, **Ibrahim Aljarah\***, Loai Alnemer, and Nouh Alhindawi. Hybrid smote-ensemble approach for software defect prediction. In Radek Silhavy, Petr Silhavy, Zdenka Prokopova, Roman Senkerik, and Zuzana Kominkova Oplatkova, editors, *Software Engineering Trends and Techniques in Intelligent Systems*, pages 355–366, Cham, 2017. Springer International Publishing

## PROJECTS

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### Vehicle Class Detection System

Dec. 2013–April. 2014

North Dakota State University, USA.

**Project Description:** This project is developed for Upper Great Plains Transportation Institute (UGPTI), which is a research and education center at North Dakota State University. This project aims to design a traffic monitoring system by extracting vehicle images from video acquisition using OpenCV library (pattern recognition functions). Then, we used a rule-based system to classify the vehicles according to their axle's properties.

**Technologies** used in this project: C++ language and OpenCV library.

### Farm Cloud Storage System

Sept. 2013–Dec. 2013

North Dakota State University, USA.

**Project Description:** This project was developed for John Deere/RDO Equipment companies and was supported by NDSU Computer Science Industry/University Consortium Program which was dedicated to strengthening ties between NDSU and regional industry. The aim of this project was to automate the collection of data from farmers and the storage of this data in a cloud-based file system. The stored data was used for analysis in order to contribute towards specialized software tools for farm support.

Technologies used in this project: Cloud Operating System (OpenStack), FTP, ASP.NET, C#, IIS7, and MYSQL 5.0

### PAVVET App– Pavement Analysis Via Vehicle Electronic Telemetry

Jan. 2013–Sep. 2013

North Dakota State University, USA.

**Project Description:** This project was developed for the Upper Great Plains Transportation Institute (UGPTI), which was a research and education center at North Dakota State University. This project aims to design a smart phone app under iPhone platform to collect information to monitor the road conditions using the iPhone embedded sensors (Motion sensor/accelerometer, Gyroscope and GPS).

Technologies used in this project: iOS operating system and Objective-C.

### Automated Exams System

Jan. 2007–Dec. 2009

University Of Jordan, Jordan.

**Project Description:** This system was designed using Microsoft Visual Basic and MySQL 2007 Database.

## PRESENTATIONS AND TALKS

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- “Optimizing Feedforward Neural Networks Using Krill Herd Algorithm for E-mail Spam Detection”, IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT), Amman, Jordan, November 2015.
- A New Clustering Approach based on Glowworm Swarm Optimization, In Proceedings of 2013 IEEE Congress on Evolutionary Computation Conference (IEEE CEC'13), Cancun, Mexico, June 2013.
- MapReduce Intrusion Detection System based on a Particle Swarm Optimization Clustering Algorithm, In Proceedings of 2013 IEEE Congress on Evolutionary Computation Conference (IEEE CEC'13), Cancun, Mexico, June 2013.
- Parallel Particle Swarm Optimization Clustering Algorithm based on MapReduce Methodology, Fourth World Congress on Nature and Biologically Inspired Computing (IEEE NaBIC'12), Mexico City, Mexico, November 2012.
- Selecting Discriminating Terms for Bug Assignment: A Formal Analysis, 7th International Conference on Predictive Models in Software Engineering (ACM Promise'11), Banff, Alberta, Canada, September 2011.

# INVOLVEMENT IN: CONFERENCES, WORKSHOPS, AND EVENTS

## Conferences

2017

- *Phi's Research and Innovation Summit (PRIS17)*, Amman, Jordan, August.
- *New Trends in Information Technology (NTIT-2017) conference*, Amman, Jordan, April.

2015

- *The third 2015 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT)*, 3-5 November, Amman, Jordan.

2013

- *The 2013 IEEE International Conference on Big Data (BigData'13)*, October 6-9, Silicon Valley – Santa Clara, California, USA.
- *The Fifth 2013 IEEE World Congress on Nature and Biologically Inspired Computing (NaBIC2013)*, August 12-14, Fargo, North Dakota, USA.
- *The 2013 IEEE Congress on Evolutionary Computation Conference (IEEE CEC'13)*, June 20-23, Cancun, Mexico.

2012

- *The Forth 2012 IEEE World Congress on Nature and Biologically Inspired Computing (NaBIC2012)*, November 5-9, Mexico City, Mexico.

2011

- *The Seventh ACM International Conference on Predictive Models in Software Engineering (Promise'11)*, Banff, Canada, September 20-21 (Co-located with ESEM'11).

## Workshops

2018

- *Training workshop of HEAL+” about Data science, Machine Learning, and Curriculum Development of a master program in Health informatics, which is funded by Erasmus+ program of the European Union. Sweden, Stockholm, April 7-April 17, 2018.*
- *”Open Knowledge Night” workshop with Katherine Maher - Executive Director of Wikimedia Foundation By Jordan Open Source Association. Zain Innovation Campus (ZINC), King Hussein Business Park, Amman, Jordan. October 2018.*

2016

- *Learn what Cloud Computing can do for you and your business” workshop by Oracle, PST, and Techaccess companies, Sheraton Amman Hotel, Amman, Jordan. December 2016.*
- *How technology helps forecast the weather workshop by Arabia Weather and Jordan Open Source Association”. Zain Innovation Campus (ZINC), King Hussein Business Park Amman, Jordan. March 2016.*

2015

- *”Machine Learning” workshop by Jordan Open Source Association. Zain Innovation Campus (ZINC), King Hussein Business Park, Amman, Jordan. August 2015.*

- *International Staff Training Week IV: Re-Thinking Internationalization at Middle East Technical University (METU). Turkey, Ankara. June 17-21, 2019. The staff week includes the following themes: Institutional Structures for Internationalization, Challenges and Crises in Internationalization and Mobility Programs, and Internationalization at Home.*

## **PROFESSIONAL ACTIVITIES**

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### **Committees**

- Organizing Committee: New Trends in Information Technology (NTIT-2017) conference, Amman, Jordan, April, 2017
- Technical Committee: International Conference on New Trends in Computing Sciences, Amman, Jordan, October 2017
- Technical Committee: The International Conference on Computer Science and Information Technology (CSIT 2016), Amman, Jordan
- Organizing Committee: Fifth World Congress on Nature and Biologically Inspired Computing (IEEE NaBIC'13), USA
- Organizing Committee: Fifth International Conference on Computational Aspects of Social Networks (CASoN 2013), USA.

### **Journals/Conferences Reviewer:**

- Applied Soft Computing. Elsevier.
- Neurocomputing, Elsevier.
- Journal of Computer and System Sciences, Elsevier.
- Neural Computing and Applications, Springer.
- Journal of the American Society for Information Science and Technology
- Modern Physics Letters B (MPLB)
- Kuwait Journal of Science (KJS)
- IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT)

## **PROFESSIONAL AFFILIATIONS AND CERTIFICATES**

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### **Affiliations**

- Institute of Electrical and Electronics Engineers (IEEE) Society
- Extreme Science and Engineering Discovery Environment (XSEDE)
- Jordan Computer Society (JCS)

### **Certificates**

- Title: Big Data 101. Certification authority: IBM Cognitive Class. License: BD0101EN. Jun 2017.
- Title: Hadoop 101. Certification authority: IBM Cognitive Class. License: BD0111EN. Jun 2017.
- Title: International Computer Driving Licence. Certification authority: Ministry of Education, Amman, Jordan. 2004.

# STUDENT ADVISING AND COMMITTEES

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## Advising

### Current students

- Neveen Hijazi, "Ensemble Feature Selection based on Parallel Evolutionary Algorithms: Homogeneous and Heterogeneous approaches", PhD Dissertation. The University of Jordan. (**In progress**). Expected: July 2020.
- Enas Faisal, "Coevolutionary Framework for Feature Selection and Optimization of Neural Networks", PhD Dissertation. The University of Jordan. (**In progress**). Expected: July 2020.
- Raneem Qaddoura, "A Design and Implementation of a Clustering Algorithm based on the Nearest Point", PhD Dissertation. The University of Jordan. (**In progress**). Expected: July 2019.
- Maria Habib, "Multi-objective Intelligent Computational Algorithms: An Approach toward Intrusion Detection in Internet of Things Era", M.Sc. Thesis. The University of Jordan. Expected: June 2019 (**In progress**).

### Alumni students

- Haifa Ghanem, "Detecting Android Malware Using Multi Dynamic Analysis Method", M.Sc. Thesis. The University of Jordan. July 2018
- Moath Alrefai, "Building a Hybrid Sentiment Analysis System for Arabic Language", M.Sc. Thesis. The University of Jordan. Dec 2017
- Rawan Yaghi, "Link Prediction Using Evolutionary Learning Models", M.Sc. Thesis. The University of Jordan. May 2017.
- Sarah Shukri, "Web Log Clustering Based on Evolutionary Optimization Algorithm", M.Sc. Thesis. The University of Jordan. Dec 2016.
- Elaf Abu Amrieh, "A Recommender System for Predicting and Improving Student's Performance Using Educational Data Mining", M.Sc. Thesis. The University of Jordan. May 2016

## Examination Committees

- Osama Al-Qasem, "Software Fault Prediction Using Deep Learning Algorithms", M.Sc. Thesis. Yarmouk University. December 2018.
- Feras Namous, "Continuous Smartphone Authentication Based on user Behaviour", M.Sc. Thesis. The University of Jordan. December 2018.
- Wedyan Alswiti, "Age prediction for online web filtering using data mining techniques", M.Sc. Thesis. The University of Jordan. July 2018.
- Mohammad Eshtay, "Metaheuristic design for extreme learning machine", PhD Dissertation. The University of Jordan. June 2018.
- Nazek Hassouneh, "Deep learning for predicting survivability for leukemia patients on seer data", M.Sc. Thesis. The University of Jordan. April 2018.
- Hebah Aldomi, "Query Expansion Using Bat-Inspired Algorithm For Arabic Information Retrieval", M.Sc. Thesis. Yarmouk University. April 2018.
- Mohammad Hassonah, "Sentiment analysis using hybrid machine learning method", M.Sc. Thesis. The University of Jordan. July 2017.
- AlMonther Al-Khalafat, "Violence detection over online social networks: an arabic sentiment analysis approach", M.Sc. Thesis. The University of Jordan. March 2017.
- Bara'a Alhammad, "Pattern recognition tracking of gene functionalities in plants natural evolution", M.Sc. Thesis. The University of Jordan. July 2015.

## TEACHING EXPERIENCE

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- **Undergraduate Level's Courses:** Computer Skills, Visual Basic Programming, C++ Programming, Object Oriented Programming, Decision Support Systems, Operations Researches, Web Application Development, Computer Fundamentals, Social Media, Advance topics (Data Science, Python).
- **Graduate Level's Courses:** Social Network Analysis

## RELATIVE COMPUTER SKILLS

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- Operating Systems: Linux (Ubuntu), Windows 10, 7, and Vista
- Programming Languages: Oracle 8i/9i, C++, Visual basic, Pascal, HTML 5L, CSS 3, Java, JavaScript, C#, Python, Perl, and Others
- Software Packages: Matlab 2018, LATEX R, MS-Office 2013
- Machines: IBM PC's and Compatibles.
- Knowledge In: Big Data Analytics, Hadoop/MpReduce , Hive, Pig, Spark, Mahout Framework, Software Engineering life cycle, Database Management Systems, Relational Databases, Assembly Programming, Hardware and Software Maintenance, and Windows 8 Security, and familiar with NTFS file system, Networks Management With Windows 2013 Server, and Windows7.

## LANGUAGES

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<i>Languages</i>	Arabic (mother tongue) English (Medium)
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## REFERENCES

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- Prof. Bassam Hamoo, The University of Jordan, Jordan, Amman. Email: b.hammo@ju.edu.jo.
- Prof. Simone Ludwig, North Dakota State University, USA. Email: simone.ludwig@ndsu.edu
- Dr. Hossam Faris , The University of Jordan, Jordan. Email: hossam.faris@ju.edu.jo

\*References available upon request

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# Research Statement

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**Ibrahim Aljarah, PhD**

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My research interests are in supervised and unsupervised machine learning and data mining algorithms and their combination with several dimensionality reduction, and feature selection methods based on nature-inspired based optimization. In addition, I am very interested in Big Data Era, MapReduce, Hadoop, Swarm intelligence, Evolutionary Computation, Social Network Analysis (SNA), and large scale distributed algorithms.

## Previous Research

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In my Master's thesis I proposed a solution model to tackle the timetabling problems using data mining and optimization methodologies. The solution proposed was a new representation of the timetabling problem by mining instructor preferences from previous schedules to avoid undesirable time slots for instructors. This work is published in International Journal of Emerging Technologies in Learning (iJET), Vol 7(1), pp. 24-32, (2012). My PhD research was concentrated on developing parallel scalable nature-inspired data mining algorithms. PhD research was aimed to benefit from the MapReduce methodology, which is a parallelization platform to reformulate the data mining algorithms in order to become more efficient and scalable for big data. Most state-of-the-art nature-inspired algorithms do not work well when applied on large datasets. Some of the algorithms need restructuring and rebuilding to become computationally efficient to deal with growing data. I proposed three related methods to tackle the large scale data set problems. Firstly, we introduced Parallel Particle Swarm Optimization Clustering Algorithm based on MapReduce Methodology, which allows us to adapt the MapReduce framework to prove that MapReduce is successful as a parallelization methodology for data clustering. This work was published in Proceedings of the Fourth World Congress on Nature and Biologically Inspired Computing (IEEE NaBIC'12), November 2012, Mexico City, Mexico. Secondly, we extended this work by developing a large scale intrusion detection system to deal with the large-scale network traffic. This work was accepted in Proceedings of the Genetic Evolutionary Computation Conference (GECCO'13), July 2013, Amsterdam, Netherlands. Thirdly, we proposed a MapReduce Glowworm Swam Optimization (GSO) algorithm to solve the multimodal functions. We demonstrated that MapReduce GSO is appropriate for optimizing difficult evaluation functions, and we showed that high function peak capture rates were achieved. This work was accepted in the IEEE Symposium Series on Computational Intelligence - SSCI 2013, April 2013, Singapore. As part of separate projects through my graduate study, I have also worked on Bug Assignment (Bug Triage) project, which is considered one of the challenging problems in software development. In this project, the bug assignment problem was formulated as a classification task, and then examines the impact of several term selection approaches on the classification effectiveness. This work was published in the Proceedings of the 7th International Conference on Predictive Models in Software Engineering (Promise'11 -ACM), September 2011, Banff, Canada.

## Current Research

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My recent research work covers three distinct areas of machine learning, data mining, and optimization: neural network optimization, feature selection, and sentiment analysis. Since May 2014, I have co-authored in more than 25 articles in top journals in machine learning, and data mining: Expert Systems with Applications (Elsevier) (2 articles), Information Fusion, (Elsevier) (one article), Knowledge-Based Systems, (Elsevier) (3 articles), Soft Computing, (Springer) (2 articles), Applied Soft Computing, (Elsevier) (one article), Engineering Applications of Artificial Intelligence, (Elsevier) (one article), Cognitive Computation, (Springer) (one article), Neural Computing and Applications, (Springer) (3 articles), Applied Intelligence, (Springer) (4 articles), and many more. More details about my current research are given in the following paragraphs:



## Spam Identification and Detection

With the incremental use of emails as an essential and popular communication mean over the Internet, there comes a serious threat that impacts the Internet and the society. This problem is known as spam. By receiving spam messages, Internet users are exposed to security issues, and minors are exposed to inappropriate contents. Moreover, spam messages waste resources in terms of storage, bandwidth, and productivity. What makes the problem worse is that spammers keep inventing new techniques to dodge spam filters. On the other side, the massive data flow of hundreds of millions of individuals, and the large number of attributes make the problem more cumbersome and complex. Therefore, proposing evolutionary and adaptable spam detection models becomes a necessity. In this paper, an intelligent detection system that is based on Genetic Algorithm (GA) and Random Weight Network (RWN) is proposed to deal with email spam detection tasks. In addition, an automatic identification capability is also embedded in the proposed system to detect the most relevant features during the detection process. The proposed system is intensively evaluated through a series of extensive experiments based on three email corpora. The experimental results confirm that the proposed system can achieve remarkable results in terms of accuracy, precision, and recall. Furthermore, the proposed detection system can automatically identify the most relevant features of the spam emails.

## Evolutionary Clustering Algorithms

Clustering based on nature-inspired algorithms is considered as one of the fast growing areas that aims to benefit from such algorithms to formulate a clustering problem as an optimization problem. In this work, the search capabilities of a recent nature-inspired algorithm called Multi-verse Optimizer (MVO) is utilized to optimize clustering problems in two different approaches. The first one is a static clustering approach that works on a predefined number of clusters. The main objective of this approach is to maximize the distances between different clusters and to minimize the distances between the members in each cluster. In an attempt to overcome one of the major drawbacks of the traditional clustering algorithms, the second proposed approach is a dynamic clustering algorithm, in which the number of clusters is automatically detected without any prior information. The proposed approaches are tested using 12 real and artificial datasets and compared with several traditional and nature-inspired based clustering algorithms. The results show that static and dynamic MVO algorithms outperform the other clustering techniques on the majority of datasets

## Feature selection and dimensionality reduction

Feature selection is an imperative preprocessing step that can positively affect the performance of machine learning techniques. Searching for the optimal feature subset amongst an unabridged dataset is a challenging problem, especially for large-scale datasets. In this research, nature-inspired algorithms such as Salp Swarm Algorithm, Grasshopper Optimization Algorithm are formulated and modified to be search strategies to design a wrapper-based feature selection methods. The proposed algorithms are tested and validated on well-known datasets. The results and comparisons verify that utilizing nature-inspired based algorithms as feature selection methods improve the performance in terms of accuracy metric.

## Sentiment analysis

To help individuals or companies make a systematic and more accurate decisions, sentiment analysis (SA) is used to evaluate the polarity of reviews. In SA, feature selection phase is an important phase for machine learning classifiers specifically when the datasets used in training is huge. Whale Optimization Algorithm (WOA) is one of the recent metaheuristic optimization algorithm that mimics the whale hunting mechanism. However, WOA suffers from the same problem faced by many other optimization algorithms and tend to fall in local optima. To overcome these problems, two improvements for WOA algorithm are proposed in this research work. The first improvement includes using Elite Opposition-Based Learning (EOBL) at initialization phase of WOA. The second improvement involves the incorporation of evolutionary operators from Differential Evolution algorithm at the end of each WOA iteration including mutation, crossover, and selection operators. In addition, we also used Information Gain (IG) as a filter features selection technique with WOA using Support Vector Machine (SVM) classifier to reduce the search space explored by WOA. To verify our proposed approach, four Arabic benchmark datasets for sentiment analysis are used since there are only a few studies in sentiment analysis conducted for Arabic language as compared to English. The proposed algorithm is compared with six well-known optimization

algorithms and two deep learning algorithms. The comprehensive experiments results show that the proposed algorithm outperforms all other algorithms in terms of sentiment analysis classification accuracy through finding the best solutions, while its also minimizes the number of selected features.

## **Vision for the Future**

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For future research, I am open to all problems related to machine learning and optimization. I am particularly interested in working on distributed and parallel future selection methods to handle the big data, and large dimensional datasets. Another future interest, is to use the multi-objective optimization to solve some challenging.

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# Teaching Statement

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## Ibrahim Aljarah, PhD

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One of the important merits and valuable experiences of an academic life is the opportunity to work with young and bright students with clear minds. It gives me a chance to be a part of their initial stages of learning journey. This experience is not only reflected on the students to learn new things, but also reflected on me for improving my own skills to invent new teaching methods. I believe that knowledge if not passed from generation to generation will die, we must be very careful to transfer this knowledge in easy and smooth ways to preserve it. Teaching is one of the most effective ways to pass on our knowledge, thus ensuring that our field grows and prospers.

### Teaching Experience

My primary teaching experience comes from four semesters as a teaching assistant (TA), of Computer Science at the introductory, upper-division undergraduate, and graduate levels. My first exposure to teaching came as a first year, graduate student, when I served as a TA for introductory Computer Science course, running a weekly discussion, assisting students during office hours, and grading assignments and exams. Helping a group of students with largely no prior experience in our field achieve basic proficiency and the ability to use Java programming. More recently, I have served as a TA/RA for, respectively, NDSU's undergraduate and graduate data mining and bioinformatics courses. In the former, I ran two weekly discussion sections, prepared and graded exams, and designed some R-language-based hands-on labs. Furthermore, as a senior graduate student at North Dakota State University, USA, I had the opportunity to advise some younger graduate students. Having experienced myself many of the difficulties of a graduate student, for example, the switching from a problem solving to a problem understanding mind set, the pursuit of individual research, and the articulation of results for my dissertation, I've helped many graduate students in overcoming these difficulties. One of the results of my tutoring of younger students was the work on Davei's thesis. In this project, I helped her in framing her research to understand the global optimization problem and in designing a parallel algorithms to further evaluate her master thesis work.

As a faculty member, I would be qualified and excited to teach courses in web development, decision support systems, operation research, computer fundamentals, data analytics, and social network analysis at both the graduate and undergraduate level. I would also be happy to teach courses in data science, data mining, cloud computing, and programming languages. I would enjoy giving seminars on large scale "Big Data" systems, MapReduce (HADOOP Frameworks), distributed computing in theory and in practice, and emerging topics in internet of things and Cybersecurity.

A big part of my current research is done in cooperation with graduate students. Currently, I am advising 2 M.Sc. students, and two PhD students. I find that the most important skill an advisor has to develop is the ability to strike the right balance between helping students to make optimal choices in their work and at the same time providing them with enough freedom and encouragement to conduct research on their own. I try to promote active research dialog and open interaction with the students. To achieve this I have regular meetings with students and maintain an open door policy. I enjoy the stimulation team research provides and expect to have a strong group of research students in the future. I also believe in the benefits of cooperation with other faculty members. I think co-advising students widens the research scope of each individual researcher and is beneficial to faculty as well as students. Finally, I believe that the best way to learn about research is to do high-quality, novel research and participate meaningfully as a collaborator. I believe to give students meaningful projects that engage their curiosity and work with them as valued contributors.

### Teaching Philosophy

I aim to keep courses attractive through my passion for teaching and by covering the material in an engaging manner. In many areas, computer science is a practical subject—and, as a result, some of those courses are seen as less interesting—but with the proper instruction, all aspects of our field can be

engaging and inspiring. Lectures should be grounded in realistic case examples and students should be given opportunities to apply the lessons through in-class active learning activities. Students should work in groups to develop an understanding of the human aspects of software development and to encourage collaborative learning.

### **Teaching Methods**

I am interested in teaching a variety of courses at the graduate and undergraduate levels using new teaching methods, such as blended learning, learning by projects, and virtual learning