# ASHKAN GHANAVATI

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## SUMMARY

Ph.D. Mechanical Engineering and Machine Learning Researcher with expertise in experimental mechanics of materials and advanced computational methods. Specialized in carbon nanotube characterization, mechanical testing, and Raman spectroscopy, with deep proficiency in machine learning for materials science applications. Skilled in Python, TensorFlow, and PyTorch for predictive modeling, feature engineering, and data-driven optimization. Experienced in supervised and unsupervised learning to uncover structure-property relationships, as well as generative modeling (VAEs, GANs, diffusion models) for physics-based engineering challenges. Passionate about bridging experimental materials research with machine learning and generative AI to accelerate innovation in materials discovery and engineering.

## EDUCATION

**Northeastern University**

**Ph.D.** Mechanics of Materials – Mechanical Engineering, GPA: 4.0 — Expected Jan 2026

**University of Tehran**

**M.Sc.** Energy Conversion – Mechanical Engineering, GPA: 3.97 — Feb 2017

**B.Sc.** Mechanical Engineering, GPA: 4.0 — Sep 2014

## SKILLS

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|---|---|
| **Programming** | Python, Bash, SQL, LaTeX |
| **Libraries** | NumPy, Pandas, scikit-learn, TensorFlow, PyTorch, Keras, XGBoost, Matplotlib, Seaborn |
| **Technologies** | Git, Docker, Linux, MLflow, Airflow, Flask , DVC, Google Cloud Services |
| **Characterization** | EM, Raman Spectroscopy, Mechanical Testing (Instron, DMA) |

## RESEARCH EXPERIENCE

**Northeastern University** — Sep 2020 – Present

*Graduate Research Assistant, Experimental Mechanics of Materials*

- Developed novel CNT assemblies with 200% mechanical property improvement through laser shock-wave compaction, electrical fusion, and ML-guided parameter optimization
- Built automated Python pipeline for end-to-end data collection, registry management, and parameter optimization across 500+ samples with robust filtering
- Implementing Bayesian optimization with GP surrogate models and acquisition functions (EI, UCB) for model-guided experimental design of remaining samples
- Applied supervised/unsupervised ML with LOOCV and data-efficient strategies to predict properties and uncover structure-property relationships
- Conducted comprehensive characterization: SEM imaging (50+ samples, ∼500 images), mechanical testing (quasi-static, DMA), and Raman spectroscopy
- Performed quantitative dimensional analysis from SEM data, integrating morphological measurements with processing parameters
- Implemented MLflow for experiment tracking, hyperparameter tuning, and feature importance analysis

## MACHINE LEARNING PROJECTS

**Fine-Tuning ProGen2 Protein Language Model** — April 2025

- Fine-tuned ProGen2 on three PFAM families (PF00257, PF00069, PF00072) using a GPU cluster (≈3 hr/epoch)
- Built both a single-family model (PF00257) and a multi-family model, achieving 20% and 25% average sequence identity, respectively
- Drove perplexity down from 1.72 to 1.30 on PF00257 through targeted hyperparameter tuning
- Applied attention-heatmap and HMMer analyses to validate dependencies and motif retention (93.9% single-family; 93% PF00072)

**Physics-Informed Neural Network for 2D Heat Equation** Jan 2025

- Built a PINN in PyTorch that embeds the transient 2D heat-equation PDE residual along with initial/boundary conditions into its loss function
- Validated the network's predictions against a finite-difference solver, achieving high accuracy across space and time

**End-to-End MLOps Implementation for Customer Segmentation** Sep 2023 – Dec 2023

- Created customer dataset using advanced feature extraction including RFM features
- Utilized K-means clustering for customer segmentation with product diversity and behavioral insights for detailed customer profiles
- Managed and modularized ML workflows using Airflow, and containerized the project with Docker for CI/CD
- Deployed Flask app on Google Cloud Platform for model serving and predictions

**MLOps Pipeline for Model Training and Deployment** Aug 2024 – Oct 2024

- Developed end-to-end MLOps pipeline using GitHub Actions and Google Cloud Platform
- Employed pytest with MagicMock for effective testing of GCP service interactions
- Integrated GCS for model versioning and storage, demonstrating cloud-based model management

**Developing Custom Machine Learning Classifiers for Genomic Data** Dec 2022 – April 2023

- Engineered multi-class Logistic Regression with cross-entropy, softmax function, and configurable optimization parameters
- Built custom SVM class using one-vs-rest approach with mini-batch SGD for multi-class classification
- Developed PCA class for dimensionality reduction on high-dimensional genomic data using eigen decomposition
- Designed Sequential Neural Network in PyTorch for genomic data classification tasks

## TEACHING EXPERIENCE

**Northeastern University** Boston, MA

- *Coordinator and Graduate Teaching Assistant, Thermodynamics and Fluid Mechanics:* Coordinated TA team, taught weekly lectures to +150 students, and mentored students during office hours
- *Graduate Teaching Assistant, MLOps:* Developed labs on GCP Composer, Airflow DAGs for ML pipelines, and GCP-GitHub Actions integration
- *Graduate Teaching Assistant, Mechanics of Materials Lab:* Instructed students on tension and torsion testing using Instron machines and experimental equipment

## PUBLICATIONS

- D You, AE Tatli, **A Ghanavati**, H Metghalchi, "Insight to recompression Bryton cycle," *Journal of Energy Resources Technology*, 2023
- D You, AE Tatli, **A Ghanavati**, H Metghalchi, "Design and Analysis of a Solar Energy Driven Tri-Generation Plant for Power, Heating, and Refrigeration," *Journal of Energy Resources Technology*, 2022
- Pedram Hanafizadeh, Amirhossein Shahani, **Ashkan Ghanavati**, M.A. Akhavan-Behabadi "Experimental investigation of air-water-oil three-phase flow patterns," *Experimental Thermal and Fluid Science*, 2017