SASHWAT BILVESH DESAI

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EDUCATION

Master of Science in Applied Mathematics, Northeastern University   Expected 2026
Relevant Coursework: Probability, Mathematical Modeling, Applied Statistics, Machine Learning, Analysis I.

Bachelor of Technology in Electronics Engineering   2019 - 2023
Dwarkadas Jivanlal Sanghvi College of Engineering, Mumbai, India

SKILLS

Programming Languages	Python, MATLAB, R, C++, SQL
Mathematical Skills	Differential Equation, Fourier Analysis, Linear Algebra, Calculus, Probability, Matrix Algebra, Vector Calculus, Statistical Inference, Numerical Methods, Stochastic Processes, Time Series Analysis, Multivariate Analysis, Graph Theory, Complex Analysis
Data Analysis Skills	Panda, Matplotlib, PySpark, Plotly Dash, Data Assimilation Techniques, SciPy Ecosystem, SymPy, Autograd, Statistical Hypothesis Testing, Markov Chain Methods, Hierarchical Bayesian Models, Functional Data Analysis, Tableau, Causal Inference, Big Data Technologies
Machine Learning Skills	Deep Learning, Regression, Classification, Optimization Techniques, Clustering, PyTorch, TensorFlow, OpenCV, Keras, Reinforcement Learning, Neural Networks, Natural Language Processing, Computer Vision, Generalized Additive Models, Transfer Learning
Soft Skills	Jupyter Notebooks, LaTeX, VS Code, GitHub, Mentoring, Grading, Design Patterns in Scientific Computing, Reproducible Research Practices, Test-Driven Development, Experimental Design, High-Performance Computing, Object-Oriented Design, Documentation Tools, Research Paper Writing, Parallel Programming, Grant Proposal Preparation, Academic Assistance

EXPERIENCE

Graduate Teaching Assistant   Sep 2025 - Present
Northeastern University College of Science   *Boston, MA*

- Conducted office hours twice weekly to provide personalized guidance on statistical software (R) implementation and interpretation of biological data analysis results for MATH 7340: Statistics for Bioinformatics assisting Dr. Valerie Hower.
- Facilitated student understanding of key topics including Probability, Distributions, Statistical Inference, Multiple Hypothesis Testing Methods, ANOVA, and Regression Analysis through targeted problem-solving sessions and conceptual explanations.

Bridge To Calculus Summer Mentor   Jun 2025 - Aug 2025
Northeastern University   *Boston, MA*

- Mentored students in Calculus and Statistics while facilitating R programming laboratory sessions, guiding hands-on data analysis and statistical computing to prepare students for advanced mathematics coursework.
- Collaborated with lead instructors to enhance student learning outcomes through individualized academic support, problem-solving strategies, and course management tasks including grading and attendance tracking.

Data Analyst and Machine Learning Research Assistant Mar 2024 - Aug 2024
Dwarkadas J. Sanghvi College of Engineering *Mumbai, India*

- Collaborated with Professor Shruti Dodani at Dwarkadas J. Sanghvi College of Engineering to develop an automated Diabetic Retinopathy detection system using Deep Learning by implementing and comparing CNN, DenseNet, and ResNet architectures
- Expanded the dataset from 102 to 703 fundus images through augmentation techniques like flipping, rotation and brightness adjustment for enhanced model training.
- Achieved 97.17% testing accuracy with DenseNet 169 by implementing systematic overfitting prevention through dropout and batch normalization, conducting comprehensive performance analysis across multiple architectures, and advancing medical image analysis for improved healthcare accessibility in densely populated areas.

PROJECTS

Shakespearean Text Generator Using Recurrent Neural Networks Nov 2025

- Implemented word-level LSTM architecture with 512-unit recurrent layer to model Shakespearean language patterns, processing 5.7MB corpus of complete works through comprehensive text normalization pipeline removing 50+ special characters and handling UTF-8 encoding.
- Developed sliding window sequence generation with 20-word context windows and one-hot encoding for vocabulary representation, creating training dataset from processed corpus with configurable minimum word frequency thresholds for optimal vocabulary size.
- Engineered temperature-based sampling algorithm using multinomial distribution for controllable text generation, implementing softmax probability scaling to balance between conservative predictions and creative variations in generated Elizabethan prose.
- Achieved coherent generation of 600+ word passages maintaining Shakespearean style including archaic vocabulary, poetic phrasing, and dramatic dialogue patterns, with model checkpoint system saving best weights across 100 training epochs using categorical crossentropy loss optimization.

Bach Chorale Generator Using Recurrent Neural Networks Nov 2025

- Implemented LSTM-based sequence-to-sequence architecture with 64-unit recurrent layer to model four-part harmony in Bach chorales, utilizing TensorFlow/Keras for neural network approximation of musical patterns and voice leading rules.
- Developed sliding window data pipeline with 16-timestep sequences to process JSB Chorales dataset, featuring min-max normalization and automated train/validation/test splitting across 382 Bach compositions for robust generalization.
- Engineered autoregressive generation algorithm with temperature-controlled sampling to produce 100-timestep chorales from seed sequences, incorporating clipping mechanisms and denormalization.
- Achieved audio synthesis capability through custom sine wave generation mapping MIDI notes to frequencies at 22050 Hz sampling rate, enabling real-time playback of generated four-part harmonies with documented test loss of 0.0089 MSE and 0.0677 MAE.

Tic-Tac-Toe Using Reinforcement Learning May 2025

- Implemented Deep Q-Network (DQN) architecture with experience replay buffer to train an autonomous Tic-Tac-Toe agent using PyTorch, featuring neural network approximation of Q-functions for state-action value estimation.
- Developed epsilon-greedy exploration strategy with dynamic decay scheduling to balance exploration and exploitation during training, enabling the agent to discover optimal strategies through self-play.
- Engineered complete Tic-Tac-Toe environment with support for agent vs. agent and human vs. agent gameplay, including state representation, reward structure, and action validation mechanisms.

- Achieved robust performance evaluation framework testing against multiple opponent strategies including random players and minimax algorithms, with documented win rates, draw frequencies, and average moves to victory.

Impact of the COVID-19 Pandemic on Students' Behavior and Well-being   Feb 2025 - Apr 2025

- Analyzed comprehensive survey data from 1,182 students during COVID-19 lockdown examining time allocation patterns, digital behaviors, health outcomes, and online learning experiences across multiple demographic segments.
- Employed multiple statistical methodologies including chi-square tests, ANOVA, logistic regression, and correlation analysis to identify significant relationships between student wellness indicators and behavioral patterns.
- Established significant negative correlation ($r = -0.16, p < 0.001$) between self-study time and social media usage, revealing competition for student attention during remote learning periods.
- Identified critical protective factors for student health including physical activity time and sleep duration through regression modeling, with findings showing healthier students reported more effective time utilization patterns.

Studying the Interconnections Between the Economic Growth of Two Regions Based on Capital and Labor Flow   Oct 2024 - Dec 2024

- Developed a mathematical framework integrating Solow Growth Model with Malthusian Population Model to analyze economic dynamics between interconnected regions.
- Constructed a system of four differential equations capturing interplay between capital accumulation, labor force growth, and inter-regional mobility.
- Established existence of unique equilibrium points and analyzed stability properties through mathematical proof and numerical simulations.
- Identified critical threshold phenomenon in capital-induced labor movement affecting regional convergence and economic inequality.

Detection of Diabetic Retinopathy Using Deep Learning   Mar 2024 - Aug 2024

- Developed and deployed deep learning models for automated diabetic retinopathy detection using CNN, DenseNet (121, 169), and ResNet 50 architectures, processing 703 augmented fundus images to enable early disease identification and reduce manual screening workload for ophthalmologists.
- Achieved 97.17% testing accuracy with DenseNet 169 model on augmented dataset and 93.75% on raw dataset, implementing data augmentation techniques (horizontal/vertical flipping, rotation, brightness adjustment, shearing) to enhance model performance from initial 102-image clinical dataset.
- Engineered custom CNN architectures with optimized hyperparameters and integrated batch normalization/dropout techniques to prevent overfitting, comparing performance across 5 different models using TensorFlow/Keras frameworks for binary classification of retinal pathology.
- Collaborated with medical professionals at Malpani Eye Hospital to acquire and validate high-quality fundus imaging dataset, ensuring accurate clinical labeling by senior ophthalmologist for training models that assist in preventing vision loss in diabetic patients.

Cost Optimization Solutions for E-commerce Vendors   Apr 2022 - May 2023

- Developed a comprehensive cost optimization model for e-commerce supply chain management, integrating material, production, transportation, and inventory costs into a unified objective function to minimize total expenditure for perishable goods distribution in the dairy industry.
- Implemented Differential Evolution algorithm using Python with NumPy libraries to solve the multi-variable optimization problem, testing with Rosenbrock function for validation and achieving convergence to optimal solution ($f = 0.03$) within 50 iterations.

- Analyzed real-world supply chain data from dairy industry operations including inbound/outbound delivery costs across 3-100km distances, incorporating tanker transport rates and refrigerated warehouse inventory costs to model practical business constraints.
- Designed a 4-layer network model connecting vendors, facilities, warehouses, and customers to optimize product flow, addressing the challenge of newer e-commerce vendors competing with established companies while maintaining profit margins in a market where online sales increased from 34.5% to 53.9% (2017-2021).

PUBLICATIONS

- S. Desai and S. Dodani, "Detection of Diabetic Retinopathy Using Deep Learning Techniques," 2024 IEEE 3rd World Conference on Applied Intelligence and Computing (AIC), Gwalior, India, 2024, pp. 898-904.

- Sashwat Desai, "Cost Optimization Solutions for E-Commerce Vendors," International Journal of Innovative Science and Research Technology (IJISRT), Volume 8 Issue 9, September 2023, pp. 1317-1337

- Desai Sashwat Bilvesh, "Image Processing Techniques: A Review," International Journal of Innovative Science and Research Technology (IJISRT), Volume 8 Issue 2, February 2023, pp. 1302-1308