

SANKALP SINGH

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PROFILE

I build simulations and then test whether their results hold up. Most of my work sits between machine learning and mathematical modelling: tracking a drone without GPS, simulating robots on Mars, and asking when a neural network's answer can be trusted. I have written two research preprints, and one of them reports a negative result. I am applying for an M.Sc. in computational science or computer science, starting 2027.

EDUCATION

Guru Gobind Singh Indraprastha University (GGSIPU)

Sep 2022 – May 2026

B.Tech in Artificial Intelligence & Data Science. Degree awarded (provisional certificate)

Delhi, India

- First two years in core mathematics and physics. Dissertation: CompliSense (see Projects), supervised by Dr. Ashish Joshi.

RESEARCH (PREPRINTS)

A Lead Time Is Not a Detection: Auditing Grokking Predictor Signals

2026

S. Singh. Preprint

- Showed that reported “lead times” of early-warning signals for grokking (sudden late generalisation) depend partly on hand-chosen measurement thresholds, not only on the network.
- Under a strict pre-registered firing rule (5σ sustained over 3 checkpoints), the Fourier signal family led the test-accuracy jump in 8/8 seeds (median $\approx 2,600$ steps) and replicated on modular subtraction (5/5); weight norm fired 0/8 and effective embedding rank was a false positive, firing after grokking in 5/8.

Surrogate Trust Audit: When Can We Trust a Neural PDE Surrogate?

2026

S. Singh. Preprint. Code and full audit trail public

- Transplanted a frozen-feature reliability probe from ML interatomic potentials to neural PDE surrogates (FNO, PINN) and compared it with residual and ensemble-disagreement indicators across PDE families and distribution shifts.
- Headline negative result: a matched-capacity, input-only null model that never runs the surrogate matched or beat every indicator. Kept the null model as the pre-registered primary comparison even though it reversed the result.
- Validated every solver before trusting it: exact Cole–Hopf target for Burgers; traced a failing test to correct 2nd-order behaviour (residual falls $4.00\times$ per Δt halving, matching a derived closed-form law within 1%) instead of loosening the tolerance; fixed a float32 wavenumber bug (error $10^{-5} \rightarrow 3.3 \times 10^{-13}$). 178 pytest test functions. [\[code\]](#)

EXPERIENCE

Backend Developer

Sep 2025 – Jan 2026

Product Manager Accelerator

USA (Remote)

- Designed the full PostgreSQL schema (8+ SQLAlchemy models) for StylePilot AI, a fashion-styling platform; built FastAPI services for auth, wardrobe CRUD and pgvector similarity search.
- Integrated three ML services (CV pipeline with Gemini, SAM and CLIP; recommender; RAG chatbot) across frontend, database and model layers. Team placed 2nd at the programme showcase.

AI/ML Intern

Jul 2025 – Aug 2025

Prodigal AI

Delhi, India

- Built a Dockerised startup health-scoring app (Streamlit) and RAG + OCR pipelines that extract entities from unstructured market documents.
- Automated ML workflows with Apache Airflow for a 4-person team, replacing manual runs.

Student Research Intern, AI for Drug Discovery

May 2024 – Jun 2024

GGSIPU

Delhi, India

- Led the ML work in a team of 5: RDKit molecular fingerprints and Random Forest / ANN bioactivity classifiers for colon-cancer compounds (scikit-learn, TensorFlow).

SELECTED PROJECTS

SkyScout: Mars Aerial Scout and Rover | Python, Genesis, build123d, URDF/SDF, NumPy, SciPy, Blender (bpy)

[\[code\]](#)

- Autonomous Mars drone that maps hazards from above and hands safe routes to a rover. Authored both robots as CAD + URDF (rover 35 links / 34 joints, drone 21 / 20) and simulated them headless under Mars gravity.

- From-scratch error-state Kalman filter (ESKF) for GPS-denied flight: final position error 197.6 m uncorrected vs 0.38 m corrected over a 40 s flight with 39 fixes; filter consistency checked with ANEES and bias convergence.
- Drone builds its own hazard map from downward depth and GLCM texture with Bayesian log-odds fusion (F1 0.92, recall 0.97 vs ground truth, 99.95% coverage); rover plans A* over the *perceived* map with its own traversability model.
- Wrote permanent repo checkers after three faults passed the standard SDF validator; checking joints by overlap volume instead of distance exposed a hinge interpenetration hidden across nine design revisions.

Adversarial Swarm Defence | PyTorch, WGAN-GP, TCN, Three.js, WebSocket

[code]

- 3D simulator of four swarm behaviours with TCN classifiers; a WGAN-GP generator learns to disguise attack trajectories as benign while the defence learns to catch them.
- Diagnosed training divergence: the critic separated real from fake by magnitude alone because a Tanh output covered under 40% of the real feature range; fixed by output rescaling.
- Measured that minibatch-std + DiffAugment delayed mode collapse only to epoch ≈ 55 vs ≈ 145 without them on a 560-sample dataset, and disabled them on that evidence.
- Extended into a real-time multi-sensor defence sim (radar, optical, acoustic, RF) with adaptive doctrine and an economic model where winning every engagement can still lose on cost-exchange ratio.

Inertial Ghost: GPS-Denied Drone Navigation | Python, ESKF, factor graphs, OpenCV, Godot 4

[code]

- Fuses IMU, visual odometry and UWB ranging with an ESKF, IMU pre-integration and factor-graph optimisation; A* planning through a 3D city, visualised live in Godot 4.
- Trajectory accuracy scored with ATE (TUM format); the evaluator was itself tested by injecting a trajectory with a known offset.

inkless: Zero-Dependency Markdown to PDF | Python standard library only

[code]

- Writes the PDF format byte by byte: hand-written Markdown parser, PDF object model, PNG chunk parser and font metrics, with an empty requirements file.
- Reproducible by construction: a syntax-tree test forbids time, random and uuid imports, and a clean rebuild is byte-identical by SHA-256. 151 tests.

CompliSense (dissertation) | BERT, XGBoost, SHAP, PostgreSQL + pgvector, Neo4j

code not public

- Co-developed with one classmate: BERT named-entity recognition at 84.8% macro F1, explainable risk scoring with SHAP, and a Neo4j knowledge graph; deployed at zero cost (Supabase, Render, Vercel, AuraDB).

HireScope: AI Resume Analyser | FastAPI, React, spaCy, sentence-transformers, FAISS, Redis

[code] [demo]

- Semantic resume and job matching with RAG-driven, role-specific feedback (87% ATS pass rate); OCR ingestion and deployment on Hugging Face Spaces.

Supernova Simulation | Three.js, GLSL, NumPy

[code]

- Interactive 3D stellar evolution with custom shaders, where the end state (nebula, pulsar, black hole) follows the chosen mass; an independent 10,000-particle NumPy prototype cross-checks the physics.

Also: regexray, solo hackathon regex engine and ReDoS analyser in pure stdlib Python (tokeniser, parser, backtracking matcher, Thompson NFA). **Global Weather Forecasting**, six models on 108,353 observations; showed a stacking ensemble gained only 0.003 R^2 over Random Forest, and plain linear regression matched Random Forest within 0.0004. **GLCM Texture Analysis**, texture features from scratch (NumPy, Pillow, Flask).

SKILLS

Languages	Python, SQL, JavaScript, Java, GLSL
ML / DL	PyTorch, TensorFlow, scikit-learn, XGBoost, LightGBM, SHAP, GANs (WGAN-GP), TCNs, Transformers (BERT), FNO, PINN
Scientific computing	NumPy, SciPy, Kalman filtering (ESKF), factor graphs, IMU pre-integration, spectral methods, Crank–Nicolson, A*
Robotics & simulation	URDF / SRDF / SDF, build123d CAD, Genesis, MuJoCo, Godot 4, Three.js, Blender (bpy)
LLM & data	RAG, FAISS, pgvector, sentence-transformers, spaCy, OCR (Tesseract)
Backend & infra	FastAPI, Flask, React, PostgreSQL, Neo4j, Redis, SQLAlchemy, Docker, Airflow, Azure, Git, pytest
Research practice	Pre-registration, null models, multi-seed studies, convergence tests, filter consistency (NEES)
Spoken	English (IELTS 8.0), Hindi (native), German (learning, A2 target)
Certification	Aeromodelling Certification