SAYANTAN DATTA
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Research Interests

My PhD research area intersects real-time graphics and machine learning.

Peer reviewed articles

Efficient Graphics Representation with Differentiable Indirection, Siggraph Asia, 2023 (Link)
Neural Shadow Mapping, Siggraph, 2022 (Link)
Adaptive Dynamic Global Illumination, High Performance Graphics Posters, 2022 (Link)
Subspace Neural Physics: Fast Data-Driven Interactive Simulation, Symposium of Computer Animation, 2019 (Link)

Work : Non-academic

- Oct, 2022 - May, 2023 - Research Scientist Intern - Meta Reality Labs Graphics (Redmond, WA, USA)
- Apr, 2022 - Jun, 2022 - Research Intern - Nvidia Research (Santa Clara, CA, USA)
- Aug, 2021 - Mar, 2022 - Sr. Researcher Intern - Huawei CG Labs (Vancouver Team, BC, Canada)
- Jan, 2021 - Jul, 2021 - Research Scientist Intern - Meta Reality Labs (Redmond, WA, USA)
- Jan, 2018 - Apr, 2018 - Animation Programmer Intern (Research) - Ubisoft LaForge (Montreal, QC, Canada)
- Sep, 2013 - Aug, 2016 - Power Plant Control Engineer - Damodar Valley Corporation (Somewhere India)
- Jul, 2013 - Sep, 2013 - Student contributor - Google summer of code (Kolkata, India)

Work : Academic

- McGill Teaching Assistantships (2016-2023) - ECSE 556 (Realistic Image Synthesis), COMP559 (Computer Animation), ECSE443 (Numerical Methods in Electrical Engineering), COMP250 (Intro to Computer Science), COMP202 (Intro to Programming), ECSE222 (Digital Logic), COMP310 (Operating Systems).

Project details

- Oct, 2022 - May, 2023: Low power shading and texturing, Meta Reality Labs Research - Graphics.
    - We explored neural architectures suitable for low power shading. Per-pixel/voxel neural shading often relies on MLP evaluations, however, MLPs are also the most computationally expensive part of a neural network. We show a technique that is more efficient compared to MLPs and other SOTA neural architectures while retaining or exceeding quality. Publication page.

- Apr, 2022 - Jun, 2022: Capturing dynamic content using *Instant-NGP,* Nvidia Research.
    - Neural Radiance Field (NeRF) based techniques are suitable for novel view synthesis of static 3D content. Armed with fast training times, we explored whether *Instant-NGP* is suitable for real-time view synthesis of a dynamic scene captured live from a few camera angles.

- Aug, 2021 - Feb, 2022: Scaling DDGI for large scenes and dynamic objects, Huawei Vancouver.
    - Probe based Global Illumination techniques such as DDGI are popular among real-time renderers due to their performance, temporal stability and simplicity. However, the probes are generally updated with

uniform sampling which causes them to converge slowly in scenes with large probe count. We introduce importance sampling for probes with an improved support for dynamic scene content. Our project is based on C++/D3D12/HLSL. Publication page.

- Jan, 2021 - July, 2021: Hard and soft shadows for low powered devices, Facebook Reality Labs.
  - Rendering hard and soft shadows without ray-tracing has been a longstanding problem. We train a convolutional network that works as a post-processing filter atop a standard shadow-mapping pass. Our model can generate high-fidelity hard shadows and plausible soft shadows in real time without ray-tracing. Our project is based on PyTorch, Nvidia Falcor, and CUDA. Publication page.

- 2018-2020:
  - Build and maintain a Vulkan based hybrid raytracing + rasterization engine for prototyping real-time raytracing projects and implement various technical papers on distribution effects, filtering and advanced MC sampling.
  - Prototyping ideas in a 2D Flatland raytracer.

- 2017 - 2018 : Numerical Study of Frictional Contact, Master's Thesis Project.
  - We developed a high quality soft body contact simulator taking into account surface roughness and material elasticity to obtain accurate synthetic data that we then use to train a much simpler neural model. We used finite element modeling, elasticity theory and modal analysis, and collision detection to build the training simulator and also leverage multithreading with explicit CPU SIMD intrinsics to accelerate the training data generation.

- 2017 - 2018 : Accelerating cloth simulation using latent space dynamics, Ubisoft Montreal.
  - Explored strategies for reduced space dynamics with collision detection and resolution (in reduced space) using deep neural networks. We tested different neural architectures, evaluated their runtime performance in C++/HLSL, and worked on integrating inference with the Ubisoft production physics engine. We also used DCC tools like 3DS Max, Maxscript to generate training data. Publication page.

- 2013 - 2016 : Power plant control engineer (No longer interested in this track).
  - Worked on various aspects of power plant control systems - installation, maintenance, repair of sensors, and control logic programming.

- 2012 - 2016 : Accelerating cryptographic hashes using GPU in John-The-Ripper password security auditing tool.
  - Implemented the now popular "Mask mode" for password generation on GPU.
  - Implemented Perfect Hash Table for detecting hash collisions on GPU.
  - Write and maintain GPU kernels for cryptographic hash functions such as MsCash2, MD5, BCrypt etc.

Education

McGill University	PhD, Elec. and Computer Engg.	Sept 2018 - Fall, 2023	N/A
McGill University	MSc, Computer Science-Thesis	Sept 2016 - Aug 2018	GPA : 4.0/ 4.0
NIT, Durgapur, India	B.Tech, Electronics and Comm.	July 2009 - July 2013	GPA : 8.91/10

Scholarships

- Year 2020-2024, Fonds de Recherche du Québec – Nature et technologies, worth CAD 84000.
- Year 2017-2018, Pierre Arbour Foundation Scholarship, worth CAD 20000.
- Year 2018-2021, Base McGill Engineering Fellowship, worth CAD 96000.

Skills

Languages: *C, C++, Python, Java, Javascript.*
APIs: *Vulkan, D3D12, OpenCL, CUDA, PyTorch*

Class projects and short projects

- Reinforced ray-tracing : McGill RL - Implemented a ray-tracer in Nori where the direction of next ray is learnt online using RL. Used C++, Intel TBB for multithreaded updates to the Q-function.
- Real time rigid body simulation using GPUs : McGill Comp Animation - Implemented Projected Gauss Seidel (CPU) and Projected Jacobi (GPU) solvers for rigid body contacts. Used Ogre3d, Bullet SDK and OpenCL.
- Ray-tracing engine: McGill Image Synthesis : Implementing BVH, various importance sampling schemes, environment maps, light sources, Brdfs, implementation of paper “Linearly Transformed Cosines”.

Volunteer Experience:

- Member of student and postdoctoral advisory committee in CS-CAN in 2018-2019.
- Selected as a student volunteer at Siggraph Los Angeles 2017.
- Selected as a Micro Observer to facilitate the General Assembly Election on 21st April 2016 in India.
- Selected as a TA for Coursera Heterogeneous Parallel Programming course, January 2014.
- Open-source developer for John-The-Ripper password security auditing tool for 3 years.

Extra coursework (MOOCs):

- Programming/HPC : Coursera: Heterogeneous Parallel Programming, 2013 and 2014, Coursera: Algorithm Design and Analysis, Coursera: Compilers, Coursera: Hardware Software Interface.
- Math/ML : Coursera : Bayesian method for ML, Udacity : Reinforcement Learning, Youtube : Stephen Boyd Convex Optimization, Coursera: Machine Learning, edX : Intro to Probability and Statistics, MIT 18.02 (Multivariate calculus), MIT 18.06 (Linear Algebra), Youtube : Pavel Grinfeld Tensor Calculus.
- edX: Foundations of Computer Graphics, UC Berkeley.

Other Achievements:

- 97.25% Aggregate in Sciences + Mathematics in Senior School Exam, 2009.
- Rank 5th in Indian Junior Mathematics Olympiad 2006.