香港科技大学（广州）
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

数据科学与分析学域
DATA SCIENCE AND ANALYTICS THRUST
信息枢纽
INFORMATION HUB

DSA Research Experiences for Undergraduates

Research Project

Section1: Faculty Information

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Section2: Research Project Proposal

Project Title	Efficient and Controllable AIGC with Diffusion Models
Project Description (max 800 words)	1. Summary 1.1. This project focuses on advancing AI-generated content (AIGC) using diffusion models, addressing challenges in computational efficiency and user control. 1.2. Students will optimize diffusion models (e.g., Stable Diffusion) for faster training/inference and develop methods for precise output customization (e.g., adjusting image styles or text coherence). 1.3. Applications include creative industries, education, and human-AI collaboration. 2. Objectives 2.1. Improve Computational Efficiency 2.1.1. Investigate methods to reduce training/inference costs (time, memory) without quality loss. 2.1.2. Explore lightweight architectures (e.g., latent-space diffusion) and adaptive sampling strategies. 2.1.3. Benchmark performance against baseline models (e.g., Stable Diffusion v1.5) on datasets like COCO. 2.2. Enhance Controllability 2.2.1. Develop mechanisms for granular control (e.g., semantic prompts, spatial conditioning). 2.2.2. Design intuitive interfaces (e.g., sliders, text feedback) for iterative user refinement. 2.2.3. Experiment with hybrid models (e.g., diffusion + reinforcement learning) for intent alignment. 2.3. Validate Practical Utility 2.3.1. Apply models to case studies in art/design, education, or scientific visualization. 2.3.2. Conduct user studies to evaluate usability, creativity, and ethical concerns (e.g., bias mitigation). 2.4. Foster Undergraduate Skill Development

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2.4.1. Train students in AI frameworks (PyTorch, Hugging Face Diffusers) and collaborative coding (Git).

2.4.2. Encourage critical analysis of AI ethics, including environmental impact and responsible deployment.

3. Expected Outcomes

3.1. Technical Contributions

3.1.1. Novel algorithms for efficient diffusion models (e.g., 30–50% faster inference).

3.1.2. Open-source code repositories for controllable generation techniques (e.g., cross-modal guidance).

3.2. User-Centric Tools

3.2.1. Prototype interfaces (web/desktop apps) for lay users to guide AIGC outputs.

3.2.2. Tutorials for domain-specific tasks (e.g., medical imaging, game asset creation).

3.3. Case Studies and Dissemination

3.3.1. Demonstrations in applied contexts (e.g., educational diagrams, marketing content).

3.3.2. A public workshop to share tools and findings.

3.3.3. A final report and potential conference submissions.

4. Impact

4.1. Bridges theoretical AI research and practical usability, democratizing AIGC through efficiency and control.

4.2. Prepares students for AI careers via hands-on experience in full-stack development and ethical AI design.

Proposed Research Duration	Start Date: __2025_____ / ___4_____ / ____01____ End Date: ___2025_____ / ____9____ / ___30_____
Student/Researcher Duties	1. Implement and test diffusion model optimizations (e.g., lightweight architectures, adaptive sampling). 2. Benchmark model performance on efficiency (speed, memory) and output quality. 3. Conduct case studies and user evaluations to assess practical utility and ethical concerns. 4. Document code, maintain repositories, and contribute to reports/publications.
Technical Skills Required	☐ √ Python ☐ Machine Learning ☐ Big Data ☐ R ☐ √ Deep Learning ☐ SQL ☐ C/C++ ☐ Other: _____
Preferred Student/Researcher Background	1. Programming (Python, PyTorch), 2. Deep Learning basics, 3. Linear Algebra/Statistics, 4. Strong interest and basic knowledge in generative AI (e.g., diffusion models).

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Maximum Number of Students/Researchers	☐ 1	☐ √ 2

Section3: Pre-Application Research Exposure Meeting

Faculty members are encouraged to schedule a Research Exposure Meeting to introduce students to their projects.

Preferred Date	-
Preferred Time	-
Meeting Mode	☐ In-Person ☐ Online
Venue (if in-person)	-
Meeting Link (if online)	-

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