

2023 Technology Fee Full Proposal

Title: Arts & AI Virtual Workstation Studio

Proposer: Elizabeth Ross (elizross@ufl.edu), School of Art + Art History (SAAH), College of the Arts (COTA), 101 Fine Arts Building C, 1370 Inner Road, (352) 273-3047. Dr. Jack Stenner, Associate Professor in SAAH, who teaches courses that will use this equipment, has provided significant advice and support for the proposal.

Sponsoring Organization: College of the Arts

Purpose and Specific Objectives: This proposal creates a high-performance computer graphics studio that leverages UF's HiPerGator supercomputer and recent advances in virtualization technology to provide professional-level workstations for students in the College of the Arts. The setup developed and piloted with this proposal will provide a template for similar graphics-heavy workstation needs across the university. Students will be able to sit at a lower-end computer terminal and pull up a full-screen computer interface, allowing them to interact with professional software that typically requires much more expensive hardware. We will utilize HiPerGator resources combined with a local, real-time virtual workstation interface for the creation of visual effects, film production, and artificial intelligence applications. Such a system could eventually allow students across UF to access applications that will not run on their personal laptops now and to access them from many locations. This proposal will prototype that type of interactive connection following [models pioneered by top global visual effects studios](#).

Remote Desktop technologies and virtual computing have been around for a long time. They work well for common knowledge-worker tasks such as word processing, email, web browsing and basic graphics manipulation. When COVID hit, industries that involve heavy graphics use such as engineering, architecture, visual effects, film production and post-production, suddenly needed to provide employee access to their workstations/data-centers and recognized that most existing techniques were inadequate. These industries require large GPUs (graphics processing units), fast storage, color accuracy, and low latency interactivity to be useable for this kind of work. Technologies from Nvidia and Teradici (now, HP Anyware) were refined and developed to meet the needs of these heavy-graphics industries.

Instead of investing in expensive desktops, as we had to do in the past, we will purchase lower-end computers (clients) that will function as an interface to high-end virtual workstations hosted on HiPerGator. The combination of client and host computers we have specified will deliver students the capability to work with graphics intensive applications with real-time interactivity, accuracy, and color fidelity, on par with what they will find in industry. For UF, we will be piloting the technologies developed by industry during COVID, technologies that could benefit any field at UF that requires intensive manipulation of graphics, such as engineering and architecture.

This proposal will serve three additional purposes: (1) provide the visual arts infrastructure for the College of Arts' vision of a future shared collaborative teaching and research space for Artificial Intelligence (AI); (2) allow arts students to develop fluency with Linux PC systems (instead of Apple systems); and (3) support interdisciplinary curriculums, including the School of Art + Art History's new interdisciplinary curriculum.

(1) AI promises to be as disruptive to the visual arts as the invention of photography in the 19th century. As with AI, photography seemed (only seemed) to rob painting and drawing of their purpose by generating superior images of the natural world. The visual arts turned this threat into an opportunity over time, but the advent of photography had a powerful and long-lasting impact on the arts. Its invention launched a long process of considering how art and photography can work together to transform human experiences. This proposal will provide a space where students and researchers can grapple with the impact of AI on video, animation, and 3D modeling, while gaining mastery of skills in AI and audio/visual production in a professional-level studio environment.

The College of the Arts has developed a larger proposal for a collaborative AI and the Arts research space, to be housed in Computer Sciences/Engineering (CSE) when space becomes available. This grant would fund one component of that space: a computer lab with NVIDIA-equipped machines to support audio/visual production and research. In the larger vision, this computer cluster would connect to adjacent immersive audio and motion capture technology in a black box space enabled for audio, movement, and extended reality work. While waiting

for space in CSE, this computer cluster would be housed in Fine Arts C in an area dedicated to Art + Technology teaching and research with on-site staff dedicated to maintaining the facilities.

(2) Traditionally, machines running macOS have been the industry standard for visual arts applications, and facilities, and curriculums in SAAH (the visual arts arm of COTA) have been oriented almost exclusively toward Mac applications. However, Linux has come to dominate both the development of artificial intelligence as well as the development of the environments of the computer graphics, visual effects, and video game industries, among the largest potential employers of our students. Free-lance and independent artists are also using Linux because of the cost advantages of open-source software and because they believe in the social value of community-developed technology. This computer cluster will enable us to introduce Linux to our curriculums for the first time.

(3) The vision for a shared COTA AI research space would realize interdisciplinary research and teaching across the college in an unprecedented way, centered on AI. We have never had a shared maker space that connects the college's disciplines. The new Arts & AI undergraduate certificate, expected to begin next year, pending curricular approval, will bring students across the college together in classes for the first time. Even in the backup space in FAC, this computing facility would be the first in the Fine Arts complex designed in the wake of a fundamental redesign of our curriculums for Art and Graphic Design students. This means that all Art students will now be able to take courses in this new space that fill curricular requirements, and Graphic Design students will have increased flexibility to choose courses taught in this space to fulfill major requirements.

Impact/Benefit: This Arts & AI Virtual Workstation Studio will pilot a type of interactive connection technology, made possible by our HiPerGator capabilities, that is extensible across the university. This Linux-based studio will let artists and designers at UF work on the cutting edge of the computer graphics and AI fields with [the most recent tools and methods](#). It will also provide an opportunity to learn professional best practices for workflow with technology comparable to what they will find at industry employers. As part of a shared COTA research space, it would transform the currently siloed teaching and research practices in the college. 330 undergraduate and graduate students would be able to choose to take courses in this space that fulfill curricular requirements. That number should increase if the Arts & AI undergraduate certificate encourages cross-unit registration. In conjunction with a shared Arts & AI research space, this cluster could have a profound effect on COTA research practices (faculty and graduate student), as well as graduate student recruiting. Then the technology could be adopted elsewhere at UF.

Sustainability: The SAAH employs Teaching Lab Specialists, the most experienced of whom dedicates 0.25 FTE to maintaining technology infrastructure. The initial site in FAC is located within an Art + Tech suite where the on-site equipment will be directly maintained by our personnel. The SAAH commits to paying for software application subscriptions beyond what is listed in the budget. They are estimated to total \$8538 annually, as well as other maintenance.

In the past, a one-time investment in hardware would have provided technology that lasted 5+ years, and we would have frugally continued to use it for as many years as possible, even as it began to obsolesce. Now that HiPerGator, software vendors, and many other industries have moved to a subscription model, we have to make a smaller initial investment, but then have ongoing annual expenditures. The budget below proposes resources to sustain the project for five years. Five years ago the technologies we are proposing to use did not exist, nor did the capabilities. Five years from now we expect that both will have continued to evolve. One benefit of the subscription model is that we will not be saddled with a more expensive investment in obsolescing hardware that we will feel obligated to continue using as long as possible. Instead, in five years, we will be able to reassess the state of the art and determine the new best technological model for our students.

Timeline: Equipment can be ordered as soon as funds are received. The technology infrastructure TLS can install it over the summer or during a semester break in concert with HiPerGator staff and key faculty. The COTA Arts & AI undergraduate certificate is expected to begin next year, pending curricular approval, when use of this equipment would also begin.

Budget: High-resolution video, animation, 3D modeling, and computer graphics require power-hungry applications, such as Maya, Unity3D, V-Ray, Nuke, Resolve, and Deadline. For this work, the computing needs are intense. Neither laptops nor UF computer labs meet these needs. HiPerGator will do the heavy lifting and represents the bulk of the budget. The budget requests 12 basic graphics workstations (client and monitor), enough for one workstation per student in a class. The basic workstations will connect to virtual machines running on HiPerGator.

As a part of this proposal, we will purchase a HiPerGator allocation consisting of 50 Terabytes of "Blue" storage. This type of work often involves working with large sets of data including AI imagery, massive sets of RAW video at 6K and above, and large collections of frames for animation work. A key component of working at this scale is the GPU. We will purchase an allocation that provides workstations with at least the capability of Nvidia's RTX 6000 professional graphics card. We will use Nvidia Virtual Workstation (vWS) software to deliver a workstation with the capabilities of the Nvidia RTX graphics card.

This work is also CPU intense. Each virtual workstation will provide the capability of a Dual Xeon Gold 6226R 2.9GHz processor workstation with 16 cores and 192 GB of RAM. Virtual workstations with these minimum specifications will communicate with client computers in FAC or CSE via a 10GbE network interface. The host virtual workstations will communicate with the clients using software designed for this purpose by Teradici (now, HP Anyware).

Students and faculty will interact directly with client machines in FAC or CSE. Client software designed for real-time interactivity (Teradici/HP Anyware) will communicate with the HiPerGator host workstation via a 10GbE network interface. Teradici/HP Anyware incorporates a protocol called PCoIP that can be tailored for specific use cases. Because our work is graphics intensive, we will require PCoIP "Ultra" in order to attain the capability to support YUV 4:4:4 or Uncompressed color space at 4K resolution as well as real-time interactivity using devices such as the Wacom tablet. To meet the minimum specifications to support PCoIP Ultra we require a computer that supports Intel's AVX2 instruction set, has at a minimum 6 cores, and includes an approved Nvidia GPU. To meet these specifications we have selected a Dell Precision 7820 tower with a single Xeon Bronze 1.9GHz CPU, 6 cores, 32GB RAM, and an Nvidia T1000 GPU.

HiPerGator will also host a 50-terabyte storage area network (SAN). The SAN supports collaborative work with high resolution and large data throughput video (6K), including distributed rendering. HiPerGator and the local machines will be connected using POoIP via existing 10GB network infrastructure feeding Fine Arts C or CSE.

HARDWARE	Price per unit	Number of units	Total	Notes
<u>Workstation</u> Dell Precision 7820 Tower - Workstation CPU: Intel Xeon Bronze 3204 32 GB Ram 1 TB ssd Hard Drive 10GB nic GPU: Single Nvidia T1000, 8GB	\$2,901	12	\$34,812	Most process intensive tasks will be handled by HiPerGator. 10GB nic or an interface capable of these speeds will be required for transfers.
<u>HiPerGator Allocation</u> 50 terabytes of storage space 12 virtual machines with equivalent of the following specs. CPU: Dual Xeon Gold 6226R 2.9GHz, 16 core, 22MB Cache, GPU: Single Nvidia RTX6000, 24GB, RAM: 192GB	\$57,000	1	\$57,000	This cost is a 5-year plan. We will need to ensure we have enough bandwidth for data transfer to HiPerGator.
Dell Ultrasharp 32 4K display	\$800	12	\$9600	
SOFTWARE				
<u>Teradici/HP Anyware</u>	\$240 per concurrent user	12	\$2016	With 30% education discount 50% discount with 3-year commitment
Teradici/HP Anyware	\$2000	1	\$2000	Optional initial setup and configuration
Nvidia vWS	\$50 per concurrent user	12	\$600	
TOTAL			\$106,028	