# Center for Computational Research

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# Mission

The mission of the proposed Center is **to support, promote and grow high-level interdisciplinary and multidisciplinary research involving computing**, and to offer the relevant URI students a supportive, broad, and deep interdisciplinary research computing environment. The Center for Research Computing will support, facilitate, and promote the activities of computational researchers, which is composed of at least 100 researchers from all across the university. The Center will support faculty research and work with other ITS teams to keep URI at the **forefront of high performance computing (HPC), machine learning (ML), artificial intelligence (AI), quantum computing (QC) and Data Science (DSC)** methods and technology.

More specifically, this means that the Center will provide URI researchers **access to cutting-edge computing equipment**; offer **hands-on training, support and consultancy** to enable computational research; lead and **assist with seeking grant funding**; and **facilitate access to a network of potential collaborators** and resources (at URI and in the region) **for interdisciplinary and multidisciplinary research.**

# Current Initial Phase – Core Operations (year 2-3)

- **Building the core support team**: We have added Dr. Michael Puerrer from Max Planck Institute to the team as a new member (he started last month) and added 4 graduate students to the team for additional College level "distributed" support and as liaisons. We have also done some internal reorganization of the tasks to better align with URI needs, individual interests and strengths.
- **Updating our core computational infrastructure:** This is being done through new interdisciplinary federal grants at URI and those in collaboration with regional universities. $2.2M is being invested in new computational hardware and storage (https://unity.uri.edu) that will be available to the URI research community shortly.
- **Building key relationships with other regional research centers:** We are establishing a "network" of collaborators – for example the Massachusetts Green HPC Center (MGHPCC) and the affiliated universities such as UMass, MIT, Harvard, BU and Northeastern.
- **Supporting the ~100 core research labs** that have immediate needs in the computational research area. More specifically, this means that labs approach us with their needs for certain types of computational hardware and support for their HPC/AI/Data/Quantum research and we get them access to those resources and offer them hands-on training, troubleshooting, etc. if they require it – at no cost, of course. If we do not have what they need, we leverage our regional "network" with the MGHPCC to get them those resources and associated support from another university (again, at no charge).

# Current Initial Phase – Core Operations (year 2-3)

- **Research, traineeship and internship opportunities for students** – we currently have 4 funded GAs on our team that offer support and consulting to various research labs all across the campus. These interactions with research labs offer them an internship-like opportunity wherein they learn about the wide variety of computational challenges that researchers face and how to address them. URI students also have internship opportunities at the MGHPCC and also in the larger eastern region via our NSF Cyberteam's grant program (https://its.uri.edu/research-computing/nsf-cyberteam-careers-project/)
- **Interdisciplinary grant writing and support** – we have been deeply engaged in large and small scale interdisciplinary grant writing with several different entities at URI and in the region. Examples include, an NSF AI Institute proposal, Build-Back-Better SmartBay proposal, DoD DEPSCoR, DURIP, NIUVT, NSF MRI, CC*, HDR etc. In some cases, we took a leading role, while in other cases we served minor supporting roles. We also provide researchers with content (for example, data management plans, facilities statements etc.) for their own submissions that are required by most agencies.

# Example #1: MGHPCC Collaboration



- **Massachusetts Green High-Performance Computing Center** is a collaboration between **BU, Harvard, MIT, NEU & UMass** on research computing infrastructure — URI has formally joined the MGHPCC
- **UMass - URI collaboration:** Building and operating a new and unique computational platform ("UNITY" cluster) for UMass & URI researchers through collaborative federal funding
- **MIT - URI collaboration:** Enabled access to MIT-LL's very large "SuperCloud" cluster for URI researchers
- **Open Storage Network** (OSN) active research data storage for collaboration and data sharing
- Disk and tape data storage via Harvard/BU's **North-East Storage Exchange** (NESE)— available soon
- **High speed access (**10 Gbps) to MGHPCC — available NOW!
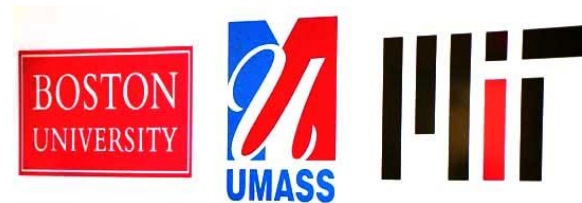
# Example #2: NSF Cyberteams

- URI collaborated with **Yale** on the $1.4M **CyberTeam CAREERS** NSF grant, alongside **RPI, Rutgers, PSU, UDEL & MGHPCC**
- The program **funds students for short-term projects** to help faculty researchers get computational projects off the ground
- Excellent opportunity for **faculty in Rhode Island** who need assistance with computational research. Excellent **"internship" like opportunity** for students
- CAREERS will find a faculty member a student, computational resources (for eg. UNITY) and even a regional expert as a resource
- Rhode Island schools including **Bryant, RIC, Salve Regina and CCRI** have already leveraged this opportunity

# Example #3: Quantum Computing

- URI / Physics Dept. launched a **Quantum Computing Initiative** in 2021 with a conference in Fall '21 on-campus
- **BS-MS, MS and Graduate Certificate** (Online) programs have been developed and are enrolling now!
- Lots of recent progress in applied areas of Quantum as well including **fluid simulations, signal processing, machine learning** etc. URI hopes to build expertise in these areas over the next few years
- **Two faculty hires** (Vanita Srinivasa and Wenchao Ge). Two more hires planned over the next few years
- New **partnership with IBM Quantum** on access to a quantum machine and supporting resources to jump start URI research and educational efforts.

# Intermediate Phase – Growth (year 3-4)

- **Scale up the core operations** as mentioned in the initial phase; we envision significant growth in computational research at URI over the next few years. We will make those core services mature and stable.
- **Grow the footprint of computational research** and expand into new areas at URI. This will be accomplished through outreach (college-wide capability presentations, demonstrations and training sessions) and detailed consulting activities. Some of this is already being done, although at a modest scale. Computational research is highly multi- and inter-disciplinary; we envision that the growth will largely be in that context.
- **Support graduate curricula** such as the interdisciplinary programs in Data Science and Quantum Computing. We would offer the appropriate training to the students for their research projects and even contribute towards (develop and teach) advanced courses. Some of this is being done already with the Data Science online Masters program.

# Intermediate Phase – Growth (year 3-4)

- **Hold regional events and workshops** that bring computational researchers in the region together to enable collaboration and awareness. An example of this is the long-running MGHPCC HPC Day: https://www.mghpcc.org/hpc-day/. URI computational researchers participated for the first time this year in September at this event at UMass Lowell. At a smaller scale, we have already begun holding online workshops and training sessions on basic computational tools like R, SAS, SPSS etc. and made them available asynchronously as well: https://its.uri.edu/research-computing-center/research-seminars/
- **Research collaboration "matchmaking"** i.e. help URI researchers find collaborators with similar interests leveraging our regional network. Some of this is already underway as well. For example, we have connected GSO researchers with labs at MIT that have common interests.
- **Meet-and-greet lunches and "lightning" talks** – the Center would hold lunches every semester or annually and organize 5 minute lightning talks by faculty members with the goal of facilitating collaboration within URI researchers in the broad area of computing.

# Advanced Phase – Maturity (year 4-5)

- **Strong core support for computational research** as detailed in the previous phases.
- **Full scale consultancy services –** the vision here is to be a "one-stop-shop" for full scale consultancy, training and support on HPC/AI/Data/Quantum at URI.
- **Develop new interdisciplinary graduate programs** – There is tremendous potential for developing exciting new interdisciplinary programs at URI – perhaps graduate certificate, MS and PhD programs in areas like Computational Science, HPC, AI, Data Science, Digital Humanities and Art. Naturally, these would be built in close collaboration with several academic Colleges and Departments. Dr. Khanna developed and directed an interdisciplinary PhD program in Computational Science in his previous position that quickly became the largest PhD program at that university.
- **Regional/National prominence** – with major progress on the type of activities and outcomes envisioned, the vision is to become a Center of prominence and excellence in the region or even nationally.