The Ken Kennedy Institute 2021

Goals for the Upcoming Year

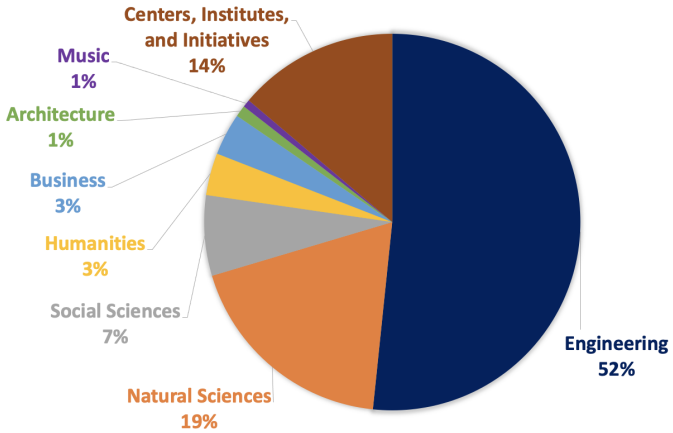
Our goals are multifaceted to impact research, support innovation, and build partnerships:

- Enable faculty to take their research to the next level
- Partner with universities, TMC, and industry on transformative efforts
- Help recruit top graduate students and postdocs
- Promote an ecosystem of innovation and entrepreneurship
- Elevate Rice's reputation and expand its reach

About The Ken Kennedy Institute

The Ken Kennedy Institute is a multidisciplinary group that works collaboratively on groundbreaking research in artificial intelligence, data, and computing. We foster a clear and strategic pathway to real-world impact.

The Ken Kennedy Institute is made up of 240 faculty members and senior researchers at Rice University spanning computer science, mathematics, statistics, engineering, natural sciences, humanities, social sciences, business, architecture, and music (increase by 17 over the last year). They collaborate in interdisciplinary teams to gather and interpret data and to develop solutions that address urgent problems facing our society. The Institute also has 63 associate members who are part of the greater campus population. In addition to these two communities, we have 334 subscribers to the mailing list of the Ken Kennedy Institute industry community, and we have 1,889 and 2,801 subscribers to the mailing lists of our Data Science community, and our HPC community respectively.



The Institute's members work in a variety of fields:

- AI, Robotics & Neuroengineering
- Analytics in Business, Humanities, & Social Sciences
- Bioinformatics and Data Science in Life & Health
- Computational Methods in Physics, Chemistry & Materials Science
- Computer Systems & Engineering
- Data and Modeling in Energy, Infrastructure, and Sustainability
- Machine Learning, Optimization & Statistics
- Programming & High Performance Computing

Primarily, the Institute is a catalyst for research collaborations across the conventional boundaries of laboratory, department, center, and university. Our increasingly complex world demands solutions that span disciplines. Today, most of our activities are in machine learning, AI, data science, and high performance computing and on how these can provide insight and enable convergent research in medicine, engineering, natural sciences, social sciences, humanities and the arts. To facilitate new collaborations, we have established research clusters that focus on key problems affecting the world. Research clusters are faculty-led collaborative efforts that are enabled by the institute.

We enable new conversations through our Member Luncheons and Distinguished Lecture Series. We promote interdisciplinary research in AI and data science through a number of events including our yearly Ken Kennedy Institute AI and Data Science Conference and Oil and Gas (now Energy) High Performance Computing Conference. We aid in workforce development through our Summer Machine Learning Boot Camp and High Performance Computing Boot Camp. We work closely with industry to bring promising ideas to market, and we develop academic, industry, and community partnerships in the computational sciences.

The Institute staff is comprised of Lydia E. Kavraki, Director; Angela Wilkins, Executive Director; Michelle Atkinson, Program Administer; Mackenzie Lee, Marketing & Events Specialist; and Anton Zhang, Data Scientist. To help identify new ideas and opportunities to elevate the Institute and Rice University, the Institute has formulated an External Advisory Board that expands a number of points of views across industries as well as a Faculty Advisory Committee consisting of Rice Faculty across multiple departments.

While 2021 has continued to be a challenging year for all of us requiring flexibility and perseverance due to the coronavirus (COVID-19) global pandemic, we can look back with a sense of accomplishment and success. Throughout the year, the Institute continued to develop collaborative efforts across Rice and the Houston computing, data science, and information technology community.

Impacting Research

- **Proposal Development in Research Clusters.** AI, Data, and Computing has become a dominant capability in all impactful technology. To advance the Ken Kennedy

Institute's mission, we build research clusters in critical topics. These clusters will build collaborative initiatives in the healthcare, environmental sciences, computational sciences, and social equity with the possibility of extending to new issues. The clusters comprise a diverse group of thought leaders from Rice to lead and support these new initiatives. Supporting these clusters is key to timely initiatives as funding agencies continually adjust strategic missions.

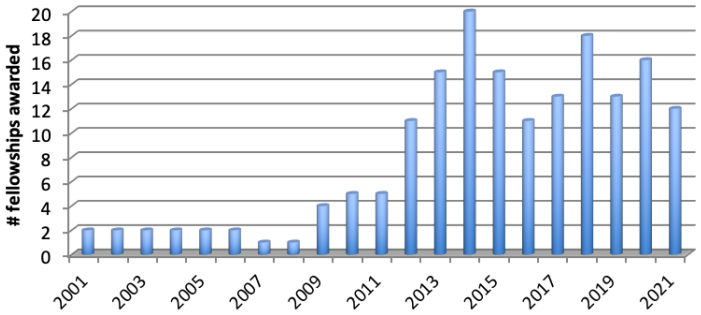
The expected outcomes are new grant opportunities and potential centers and initiatives. Today, the faculty is interested in core research in machine learning & AI, health, neuro-engineering, data visualization, spatial analysis, resilient infrastructures for cities, environmental studies, and computational sciences.

- **Seed Funding.** The Institute provides seed funding to encourage interdisciplinary research in data and computation projects. Two of our major efforts have been Enriching Rice through Information Technology and Collaborative Advances in Biomedical Computing. The Institute awarded new seed funding on Digital Humanities Research Development in 2021.

- **Graduate Fellowships.** With the support of industry, the Energy (previously Oil & Gas) High Performance Computing Conference, and nominating departments, the Ken Kennedy Institute has awarded nearly $1.5 million to 172 students since 2001.

  The Ken Kennedy Institute's annual graduate fellowship program awarded $65,000 to nine Rice University graduate students in five departments. The 2021-22 graduate fellowships are supported by BP, Schlumberger, Shell, the Energy High Performance Computing Conference, and the Andrew Ladd and Ken Kennedy-Cray endowments.

  The Institute continued to expand its recruiting fellowship program by offering four-year supplemental fellowships to three graduate students at Rice University totaling $45,000. The fellowships are funded by the Ken Kennedy Institute, through its annual Energy High Performance Computing Conference, and the nominating departments. The goal of the program is to attract outstanding graduate students to Rice in the fields of high performance computing, computational science and engineering, and data science, with special consideration given to students with research interests in the energy industry.



- **Shared Computing Infrastructure.** Since 2002, the Ken Kennedy Institute has successfully worked with faculty to fund and build Rice's shared cyberinfrastructure. Today, the Institute, in partnership with Rice's Office of Information Technology's (OIT) Center for Research Computing (CRC), supports the computational research needs of more than 190 faculty members and over 800 users. 250 of these users consume significant computing and storage resources in any given month. Financial support was channeled to the Institute for its contributions to Rice's shared cyberinfrastructure. This support has ended, and funding remains within CRC. We continue to meet and advise the CRC leadership on potential opportunities.

Building Partnerships

- **Building External Partnerships.** The Institute has begun collaboration with Methodist/Huntington Medical Research Institutes (HMRI). Collaborating with Rice ENRICH, we are initiating workshops in Spring 2022 with $50,000 to support potential collaborative projects (through ENRICH) on Robotics, Imaging, Operation/Logistics (Business School), and Digital Health-Related topics. In addition, we have already initiated several meetings across institution lines that will potentially lead to grant opportunities.

  The Institute is continuing collaboration with MD Anderson Cancer Center from 2020 as well.

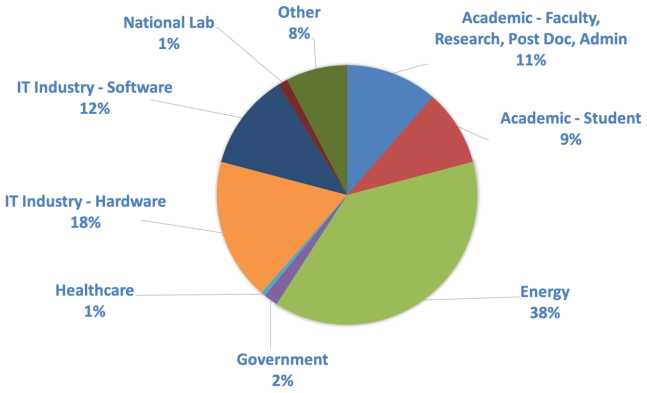
- **Data Scientist Hire.** The Institute hired its first in-house Data Scientist, Anton Zhang, supported by the Rice COVID-19 Research Fund. And as of now, we are working with MD Anderson to establish the data pipeline for our primary research projects. In the meantime, the Institute has also participated in alternative projects with other collaborators. Our data scientist, Anton Zhang, finished a project with Dr. Kamil Kanipov of UTMB. The project investigates the distress level of cancer patients and its potential correlations with demographic data such as age, gender, ethnicity, marital status, etc. Our study found that specific parameters, such as type of insurance, are strongly correlated with a patient's distress. Our findings are currently being written into a manuscript for submission.

Institute External Memberships. We continued membership with the Alliance of Artificial Intelligence in Healthcare and the Greater Houston Partnership. We expanded to be members of The Carpentries (a global non-profit organization that builds global capacity in essential data and computational skills for conducting efficient, open, and reproducible research by developing openly accessible lessons, training instructors to lead inclusive, interactive workshops, and helping to coordinate these workshops) and the LF AI & Data Foundation (connects members with innovative technical projects, companies, and developer communities that are transforming artificial intelligence, machine learning, and deep learning).

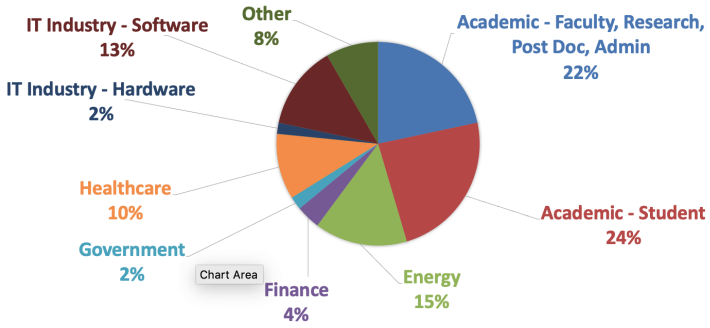
Supporting Innovation

Innovation Fellows. In collaboration with Lilie, IBB, SCI, and the Provost's Office, the Rice Innovation Fellow program launched in late 2021 to support graduate students to spend additional research time focusing on the practical aspects of applying their research to industry needs. The Rice Innovation Fellows program trains graduate students and supports their faculty to translate research into real-world impact. The Innovation Fellows program combines dedicated time and space at Lilie with personalized mentorship and equity-free funding to catalyze the next generation of world-changing, scientist-led companies. Drawing from her entrepreneurial experience, Angela Wilkins works weekly with fellows as an advisor and mentor. Additionally, the relationships formed by the Ken Kennedy Institute have helped identify potential advisors and board members.

Engagement. The 14th annual Oil and Gas (now Energy) High Performance Computing Conference on March 5, transitioned to virtual due to the COVID-19 global pandemic, and was extremely successful with over 1,100 registered leaders and experts from the energy industry to engage and network to help advance HPC, with a large number of sponsors. This conference is the premier meeting place for the energy industry to engage in conversations about challenges and opportunities in high performance computing, computational science and engineering, machine learning, and data science annually. Next year, the conference will be renamed the Energy High Performance Computing Conference to allow for inclusion of newer aspects of the energy industry.



The 5th annual Ken Kennedy Institute AI and Data Science Conference on October 25-27, transitioned to virtual due to the COVID-19 global pandemic, and was able to host a stellar lineup of speakers from around the world and nearly 650 registered attendees. The conference ended with an in-person networking reception that was the highlight of the conference for attendees and sponsors.



The virtual Machine Learning Boot Camp, May 20-21, with 40 attendees focused on machine learning for executives. Our goal was to give a manager or a CEO in a field such as medicine, finance, manufacturing, or energy an introduction to the essential concepts behind Machine Learning. We also plan to extend these boot camps with topics such as machine learning for the biomedical area.

The Ken Kennedy Institute hosted several events and lecture series throughout the academic year that were given by well-known speakers. This year the Institute collaborated with fellow academic data science institutes across the country, the Rice Liu Idea Lab for Innovation and Entrepreneurship (Lilie) for the Technology Innovation Lecture Series, as well as the Baylor College of Medicine Human Genome Sequencing Center, Rice University, the COVID-19 International Research Team (COV-IRT), DNAnexus, and the BCM Alkek Center for Metagenomics and Microbiome Research.

The Institute organized the Unofficial NeurIPS

Workshop that allowed 17 Rice speakers (graduate students) to give short talks highlighting the latest research on ML and AI. We sponsored and provided support for large events such as the third COV-IRT Symposium and HackRice 11.

- **Data Science Coast to Coast (DS C2C) Seminar Series.** The Ken Kennedy Institute created the Data Science Coast to Coast (DS C2C) Seminar Series in coalition with six other academic data science institutes. The goal is to provide a unique opportunity to foster a broad-reaching data science community.

  Speakers throughout the spring of 2021 included faculty members and postdoctoral fellows at the seven host universities whose research spans the theory and methodology of data science, and their application in arts and humanities, engineering, biomedical, natural, physical and social sciences.

Rebranding

- **Rebranding and Increased Presence.** The Institute finalized its mission statement, re-branded weekly email templates to our member, industry, and conference subscribers, launched our Member of the Month highlights, increased total subscribers and social media presence, created a medium channel, customized our website more to our needs (phase 1 of 2) highlighting how the Institute impacts research, supports innovation, and builds partnerships, and updated branding with new slide decks and letterhead.
  - LinkedIn: 918 Followers (increase by 306)
  - YouTube: 688 Subscribers (increase by 165)
  - Twitter: 610 Followers (increase by 111)
  - Facebook: 344 Followers (increase by 47)
  - Medium: 22 Followers (Launched in July 2021)
- **Medium Channel.** The Institute launched our medium channel in July 2021. There have been 10 articles, receiving 1500+ views.

Looking to the Future

Providing Unique Advantages for Data Science. Faculty have limited resources to move research forward that does not fit into the typical academic funding process. This hinders innovation, leading to large inter-institution centers, industry collaborations, and new ventures. We believe there is a need to build a community of data scientists with exceptional data science, machine learning, and AI skills to work in partnership with its world-renowned faculty at Rice to start, enable, and translate data-driven research. The Rice Data Science Initiative brought new faculty to its campus, but these faculty are separated by distance in space and departments. This team could act as a conduit to bring together the many data science efforts at Rice.

Data science possesses special challenges that often involve theories, inputs, and implications across multiple academic fields as well as industry, and has considerable time-sensitivity regarding its impact. The Ken Kennedy Institute is uniquely positioned to tackle these challenges. The Institute can leverage the 300+ members across more than 10 departments at Rice University. Through events such as conferences, lectures, boot camps, and workshops, the Institute has built up a large base of connections and presence in industry, venture capital, and government. The institute can use these events to further its research agenda.

Expanding Partnerships. We will expand our efforts to develop partnerships with new institutions and industries. Ideally, these partnerships should enable the progress of the research clusters.

Expanding Fellowships. Historically, the industry fellowship program has been predominantly in the energy industry. We would like to expand the fellowship program to include new industries and new internship opportunities. We would also like to establish a network of postdoctoral researchers who will further facilitate the work of research clusters.