



## **Integrated Computational and Data-enabled Science and Engineering: with focus on Bioinformatics and Big Data Analytics**

The Computational and Data-Enabled Science and Engineering (CDSE) program at Jackson State university was started with a mission and focus of integrating data science, Bioinformatics, and Big data analytics to train young scientists for future endeavors in data science. This program trains undergraduates and graduate students, in integrating data science skills to analyze big data to solve the grand challenges in the field of Bioinformatics and Data Science. This program brings together different disciplines and several departments at Jackson State University including, Computational Biology, Bioinformatics, Computer Science & Engineering, Chemistry, Physics, Public Health, and Mathematics & Statistical Science. We want to incorporate both graduate and undergraduate students at Jackson State University, and we are relatively a new program that has to face challenges in effectively communicating the mission with students and faculty, and also need to embrace institutional resources, faculty expertise to reflect our core mission of integrating data science and big data analytics.

### **Overview and History**

Computational Data Science at JSU is committed to foster academic and research interests of graduate and undergraduate students. CDSE now has graduate students working on various research projects with collaborations from various departments at JSU. Interdisciplinary research at CDSE started with few faculty members and few graduate students sharing the same research interests. Faculty members from Computer Science and Engineering contributed their research and academic skills to encourage students in CDSE. Although Data Science became an academic discipline, faculty and students interested in data science and its applications in their research has grown considerably in recent years. Most of the research in academic discipline and outside academic discipline is focused on analyzing different kinds of data to arrive at conclusions from the knowledge derived from data science and its analytics.

### **Education**

As the demand for data scientists continues to grow, CDSE is trying to figure out how to best contribute to the training of the workforce. Goal of CDSE is to create a research environment that collaborates different disciplines and different departments at JSU and that will improve career opportunities for graduate and undergraduate students. Computational thinking, critical thinking, problem solving skills, creativity, and innovativeness are not only crucial for our students to successfully complete their education but also important for their future career opportunities. Currently there are no faculty appointments directly to Data Science but we are interested in hiring faculty with joint appointments to enrich and complement the interdisciplinary departments across JSU. Students enrolled in CDSE are taking courses from different departments such as computer science, statistics, engineering, and Bioinformatics to understand the interdisciplinarity of the field. Major challenge to CDSE in developing a curriculum is to develop a course work that can complement the current existing coursework and not to overlook already established curriculum across the departments.

## **Research**

Data Science is not a discipline but rather an umbrella term used to describe a complex process involving not one data scientist possessing all the necessary expertise, but a team of data scientists with nonoverlapping complementary skills. Making students recognize the importance of data science and its applications for empowerment and workforce development is another challenge to CDSE. Encouraging students to be involved in interdisciplinary research in data science and collecting data across the disciplines at JSU and analyzing the data and providing solutions to their data can be challenging. Data from different departments need to be collected and analyzed by undergraduate and graduate students at CDSE. Project based learning approaches need to be incorporated into the curriculum for both undergraduate and graduate students at CDSE.

Bringing applications to the forefront: focusing on research skills and bringing application based learning rather than theoretical focus can help students at CDSE.

Real world experience: develop capstone based projects and learning from different software programming projects will help students gain real world experiences.

Practical programming skills: courses should require students to learn and use appropriate language for the expertise they are focusing on. For example, R for data analysis and Python, and TensorFlow for machine learning and low level language, such as c++ for building infrastructure need to be incorporated into CDSE to improve research skills.

## **Sustainability plan**

To pursue sustainability, we want to create and maintain an environment to support current and future graduate and undergraduate students in CDSE. Involving in research across departments at JSU and collaborating with other departments to encourage our students' participation in grants and research activities. Providing scholarships and research grants to our undergraduate and graduate students to explore and hone their data science skills is crucial in sustainability. We also encourage students to be involved in grants writing and funding opportunities across the departments. The ability to translate massive amounts of data into information to form a decision making process does not fit into any traditional academic discipline. Data Science requires a combination of computer science, statistics, mathematics departments and the help of faculty across the disciplines.

## **Societal Impact**

The power of data science for social good can be useful to mission driven organizations, when these organizations have the right talent, tools and resources data science can generate human impact by helping families in need, saving water during drought, and saving time in providing healthcare. We have already seen many data scientists across the globe have come forward to share the data across the globe to help people in need. Many corporate organizations involved in data science have come forward to share their resources to nonprofit organizations to serve people across the globe. Educating our undergraduate and graduate students in data science and involving them in data science projects and encouraging them to participate in community participation and serving the under-resourced communities will have a good societal impact. CDSE is committed to conduct programs using data analytics techniques to solve problems that affect communities and want to involve our students in volunteering social good projects.