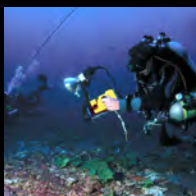


UNIVERSITY OF MIAMI
INSTITUTE for DATA SCIENCE
& COMPUTING



**SERVICES
+ RESOURCES**



Who Can Access IDSC?

IDSC services and resources are available to everyone: Students, faculty, researchers, the public and private sector, nonprofits, industry, and beyond.

Our collaborative approach brings together talented minds at the interface of disciplines to harness the University's AI-ready supercomputer and 5G+ edge computing environment.

As a member of the University of Miami's Frost Institutes of Science and Engineering, IDSC is focused on utilizing the extraordinary potential of data science to tackle society's greatest challenges.

From creative student projects to innovative industry-shaping ideas, IDSC services and resources can help you achieve your research, training, or business goals.



idsc.miami.edu





IDSC

SERVICES + RESOURCES.....

› Advanced Computing 1

Comprehensive resources ranging from hardware infrastructure to expertise in design and implementation of advanced computing solutions

› Data Analytics. 7

Methods for understanding large data sets, including data clustering and association rule mining, plus expertise in non-statistical data analysis

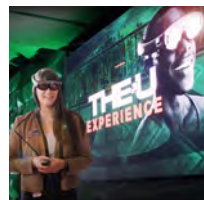
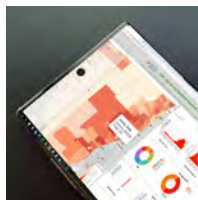
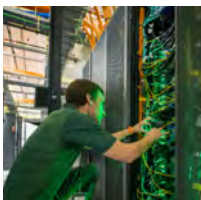
› Systems and Data Engineering 9

Geospatial data, image processing, photogrammetry, computer vision, search and multi-tier web-based applications, and systems development

› Visualization + Infographics 13

New technologies using multimodal media, from static infographics to interactive web presentations via augmented, mixed, and virtual reality

› Collaborative Projects 14





Triton Specs

IBM Power9/Nvidia Volta

IBM Declustered Storage

96 IBM Power 9 Servers

30TB RAM (256/node)

1.2 Pflop Double Precision

240 Tflop Deep Learning

64 bit Scalar

100 GB/sec Storage

150TB Shared Flash Storage

400TB Shared Home

2 @ 1.99TB SSD Local Storage

Advanced Computing

Through IDSC, the University of Miami maintains one of the largest centralized academic cyberinfrastructures in the country. Since 2007, the core has grown from zero advanced computing cyberinfrastructure to a regional high-performance computing (HPC) environment that currently supports 500+ users, 240 TFlops of computational power, and more than 3 Petabytes of disk storage.

The University's latest supercomputer acquisition, TRITON—rated one of the Top 5 US Academic Institution Supercomputers in the U.S. when launched—is UM's first GPU-accelerated HPC system, representing a completely new approach to computational and data science for all campuses. Built using IBM Power Systems AC922 servers, this system was designed to maximize data movement between the IBM POWER9 CPU and attached accelerators like GPUs.

AI + Data Science Capabilities

- **Advance System Services** Self-Serve to Concierge Services, Development to 24x7 Non-Stop Operations, On-Premises and Cloud
- **AI/Machine Learning** Platform/Algorithm Selection and Implementation
- **Artificial Neural Networks** Specialized for different purposes, such as: Convolutional Neural Networks (image recognition), Standard and Recurrent Neural Networks (pattern detection, classification, prediction), Graph Neural Networks (for network optimization and prediction)
- **Cybersecurity** End-to-End Solution Design, Implementation, Support
- **Data Engineering** Identifying, Integrating, Cleaning, ETL, Processing
- **Data Management** Pipeline Services from Ingest to Presentation and Preservation
- **Fuzzy Logic** Applying logic to problems where the concepts of true/false are defined in terms of degrees and not as complementary alternatives. Python libraries will be used.

AI + Data Science Capabilities (cont'd...)

- **Genetic Algorithms** The iterative application of heuristic techniques to simulate solutions of complex optimization problems. The Python language will be used.
- **Neuro-Fuzzy Systems** Applying neural networks to classification problems where logic elements are fuzzy in nature. The Python language will be used.
- **Research and Predictive Analytics** Audio Research, IoT, Environmental Monitoring, Security Services
- **Rule Extraction Algorithms** The process of extracting a rule base from empirical observations as an alternative to predicting outcomes. Coding will be done in Python.
- **Scientific Programming** Code Porting, Optimization and Parallelization Support Vector Machines

Services + Resources

» Machine Learning + Deep Learning Services

- **Distributed Deep Learning** When deep learning problems are too large for a single graphics card and separating jobs into discrete parts would affect the math adversely, distributed deep learning spreads calculations over multiple GPU cards. This process is analogous to MPI on traditional CPUs.
- **IBM PowerAI Vision** Offering intuitive tools to label, train, and deploy deep learning models for computer vision without coding or deep learning expertise.
- **Large Model Support** Allows the successful training of deep learning models that would otherwise exhaust GPU memory.
- **Watson APIs** Focused in finance, governance, and healthcare, enabling access to the full power of Watson from a local installation.

» Machine Learning + Deep Learning Frameworks

- **BVLC/caffe+ IBM Caffe** for vision, speech, and multimedia projects (2.0 brings focus to mobile and low power compute). As its full name “Convolutional Architecture for Fast Feature Embedding” indicates, Caffe is fast and suitable for conventional CNN applications.
- **PyTorch** is one of the latest deep learning frameworks. It is famous for simplicity and flexibility with dynamic tensor computations while maintaining efficiency. Great for rapid prototyping and research.
- **SnapML** An efficient, scalable, machine learning library for training linear models in finance and governance, developed at IBM Research Zurich specifically to address scaling issues in commercial clouds.
- **TensorFlow** is designed to provide an end-to-end platform for production and scalability. IDSC’s optimized version includes visualization tool TensorBoard and the easy-to-use Keras API.
- **TensorFlow Keras** is a high-level API used for building and training deep learning models, and offers fast prototyping.
- **Time Series Analysis and Anomaly Detection** Time series data represents a collection of quantity that varies in time such as audio, video, financial indices, and metrics tracking data. The analysis of the internal structure of the time series data using techniques such as autocorrelation, autoregression, and recurrent neural networks could reveal the trend, provide the forecast and set alarm to the anomaly events.

» Data Engineering Services

- **Data Preparation and Cleaning** The process of reformatting, correcting and enriching data prior to analysis via Python libraries such as NumPy & Pandas, as well as Jupyter Notebooks.
- **Fully Secure Data Services** Blockchain attestation available.
 - IBM Mainframe hardware encryption exceeding US DoD standards
 - Extract, transform, and load data to the supercomputer graphically
 - Example Data Layers supported: Apache Drill, Storm, Spark, MQTT

Services + Resources (cont'd...)

• **Integrated Data Presentation/Persistence Services**

- Common Data Access Services Supported: HTTP(s), FTP, SSH, bbcp, Aspera etc.
- Common Web Platforms/Stacks Supported: LAMP, MEAN, Django, Node-JS, React, etc.
- Common Data Stores: PostgreSQL (commercial support available), MongoDB, Maria/MySQL, Redis
- **Interactive Analytics** Familiar tools at scale: Jupyter Hub, RStudio, Grafana

» Data Pipeline Systems

- Faster, Cheaper & More Reliable than Cloud Technologies
- Flexible and Secure System Architecture
- User Interfaces on 2 Rockhopper II Mainframes (Hardware Encryption)
- Data store on ESS Parallel Systems (De-clustered RAID)
- AI Training and Inference on Triton
- Centralized Data Design (Multiple System Same Data)
 - No tiering costs, No transaction/transfer cost
- Globally Accessible Network (100GB/sec I2, 10GB/sec internet)

» High Performance Storage

The 7PB WADE Storage Cloud offers SaaS and PaaS architecture.



305.243.4962 | hpc@ccs.miami.edu
idsc.miami.edu/platforms/advanced-computing





Data Analytics

Making discoveries in oceans of data is possible only with the use of efficient algorithms. As data grows in volume, velocity, variety, and veracity, so does the demand for efficiency in data science applications. IDSC explores audio, bioinformatic data, images, spatial data, text, time series data, and video, and can offer insight into all your data projects.

Classification

Large-scale data analysis in data mining, pattern discovery, machine learning, and other algorithmic development is available to on- and off-campus researchers. Classification models for labeled data organizes your data into categories for the most effective and efficient use. (Jupyter Notebooks / Jupyterlab available; Python and R environments, Julia, and Erlang; R-Studio; Matlab)

Clustering Analysis

IDSC mines your data to cluster groups sharing similar patterns. Common approaches include Self-organizing map (SOM) and k-means. Advanced techniques employed include:

- Concurrent Clustering of Data Points and Data Attributes
- Clustering with Constraints
- Subspace Clustering

Association Rule Mining

Association rules are if/then statements that help uncover relationships between seemingly unrelated data. IDSC uses techniques for discovering frequently occurring combinations of attributes to produce inferences based on the combinations thus discovered.

305.243.4962 | idsc@miami.edu
idsc.miami.edu/services





Systems + Data Engineering

The IDSC Systems and Data Engineering team are professional software engineers who actively seek collaborative partners for new and innovative software application and systems development projects. The team has developed applications and software systems to support work in clinical research, drug discovery, genomics, mapping and urban planning, observational biology/ecology, and the digital humanities.

Core Competencies

- Software Application Conceptualization, Design, Implementation, and Project Management
- AI, Machine Learning
- Computer Vision, Photogrammetry, and 3D Reconstruction
- Drones and Aerial Survey with a Focus on Urban Spaces
- Extended Reality (XR) (augmented AR, Virtual, Mixed MR)
- GIS and Geospatial Application Development
- Participatory Mapping and Community-Centered GIS Development
- Search/Complex Data
- Semantic Web
- Spatial Surveying and Architectural Documentation

IDSC Systems and Data Engineering offers expertise for collaborators who need to include novel software systems as part of their projects, including expert personnel for inclusion in grant proposals and the development of prototypes or initial analysis in preparation for proposal submission.

Our experts can help you select the right technologies, languages, libraries, and toolsets to ensure your project's success.



●●●●●●●●●● Systems + Data Engineering Services:

3D Reconstruction

3D reconstruction is the creation of three-dimensional models (often scaled) of objects, places, and scenes in the real world. IDSC has expertise in both computer vision methods, such as Structure from Motion (SfM) and direct measurement measurement methods (LiDAR) used to create these models. For 3D reconstruction projects, IDSC:

- Uses drones to capture aerial photos, and create models and scaled imagery for large areas
- Uses LiDAR to create 3D models of interior spaces, sculptures, etc.

The output data from these projects can be used to:

- Create GIS databases
- 3D printing projects
- Support the production of architectural drawings and maps
- Provide assets for extended reality (XR) and other computer graphics applications

XR Application Development and Consulting

IDSC provides consulting services and development expertise to extended reality (XR), augmented (AR), and virtual (VR) applications. Platforms include MagicLeap, MS HoloLens, and Unity.

AI/ML Consulting

IDSC provides expertise and consulting services to collaborators who want to apply new and emerging methods to their research projects.



305.243.4962 | idsc@miami.edu

idsc.miami.edu/platforms/systems-and-data-engineering



pointcloud of La Nuestra Señora de la Merced Chapel, Allapattah neighborhood, Miami, Florida



Visualization + Infographics.....

Data Visualization augments cognition to enable the exploration of complex data sets and illuminate scientific findings. IDSC's Human Centered Design and Computing program encompassing Visualization and Creative Technologies regularly collaborates with scientists in communicating their results to stakeholders and to the general public using multimodal media—from static infographics to interactive web presentations, and other products that take advantage of technologies like augmented, mixed, and virtual reality.

IDSC Visualization and Infographics Consulting offers guidance on visual design, user experience, and which tools or tutorials are best to bring your design to life. Visit: idsc.miami.edu/vizconsult.

Visualization Laboratory

The Viz Lab is a resource available by appointment to the UM community. Capable of accommodating 14 guests, the space offers an impressive venue to host a class or your next executive meeting. Located in the Arthur A. Ungar building Room 330-D, with a direct connection to all UM computing resources, the Viz Lab features a Mechdyne 3D-Display and a Cyviz 2D-Wall. IDSC regularly offers demonstrations and orientation sessions for new users.

To book a tour, or for more information, email vizlab@miami.edu.

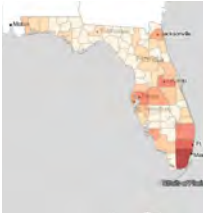
305.243.4962 | idsc@miami.edu
idsc.miami.edu/research/hcdc





IDSC

Collaborative Projects

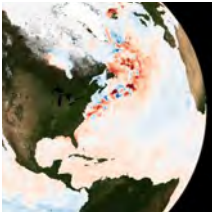


XSAT Covid-19/Outbreak Dashboard

xsat.idsc.miami.edu

IDSC researchers developed the xSAT eXperimental Situational Awareness tool, a first-of-its-kind early-detection platform that enables local residents to interact with infectious disease outbreak data and identify hot spots.

PUBLIC HEALTH APPLICATION | Advanced Computing, Software Engineering



High-Resolution Global Climate Modeling

idsc.miami.edu/wp-content/uploads/2019/10/hr_historical.mp4

A Rosenstiel research team employs a hierarchy of models with differing resolutions (from 100 to 50km in the atmosphere, and 1 to .1 degree in the ocean) to improve both the modeling and understanding of important fine-scale processes.

EARTH SYSTEMS MODELING | Rosenstiel School, CIMAS



Santa Cruz del Islote, Colombia

Documenting the world's most crowded island was one stop in the "Mapping of informal Settlements in Latin America" project. Traveling with a group from the School of Architecture, IDSC engineers experimented with advanced image analysis and mapping using hand-held mobile devices and drones.

DRONE MAPPING INFORMAL CITIES | School of Architecture, Cure and Penabad



Nuestra Señora de la Merced Chapel Tour

Located on the campus of Corpus Christi Catholic Church in Allapattah, La Merced Chapel recreates the spirit of an old Peruvian church. IDSC worked with a team of art history students to create an immersive Magic Leap AR experience offering detailed information on the Chapel's interior, exterior architecture, and five of its Spanish Colonial paintings.

AUGMENTED REALITY | School of Art & Art History, College of Arts and Sciences

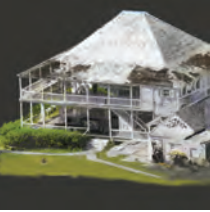


The U Experience, Magic Leap Tour

uexperience.wixsite.com/uexperience

Adding a digital dimension to real-world video, this Magic Leap campus tour combined real and virtual environments in an interactive XR application that complements freshman orientation. This capstone project was part of an MFA in Interactive Media.

EXTENDED REALITY (XR) | Office of Student Affairs, School of Communication



The Residency, Harbour Island, Bahamas

A group of UM students, faculty, and researchers evaluated the historical significance, potential restoration, and future preservation of the historic Harbour Island Governor's residence in Dunmore Town. The team took aerial photos with drone mapping, and created a point cloud, graphs, and drawings.

HISTORIC PRESERVATION | School of Architecture, Antiquities Monuments Museum Corp.



MAP The Miami Affordability Project

map.idsc.miami.edu

As part of the University's "Focus on Affordable Housing" initiative, the interactive MAP tool (a multi-tier web-based application) was designed to explore Miami's housing landscape, address needs, and promotes informed decisions on housing policy.

SEARCHABLE MAPS | Office of Civic and Community Engagement (OCCE)



URIDE

IDSC helped develop the University Research Informatics Data Environment (URIDE), a web-based platform that aggregates and visualizes de-identified patient data from the UHealth/UChart system, enabling the exploration of demographics, diagnoses, procedures, vitals, medications, labs, notes, allergies, comorbidities, locations, physicians, and more.

FREE TEXT SEARCHING | UHealth, Miami CTSI Biomedical Informatics



Mikvé Israel-Emanuel Synagogue, Curaçao

Located in the capital city of Willemstad on the island of Curaçao, Lesser Antilles, Mikvé Israel-Emanuel (the oldest continuously operating synagogue in the Western Hemisphere) was documented as part of a project to create an architectural record of the Caribbean's Jewish synagogues and temples.

COMPUTER VISION | School of Architecture, Institute for Advanced Study of the Americas, Miller Center for Contemporary Judaic Studies, College of Arts and Sciences

NEW DEGREE.....

Master of Science in Data Science

This degree provides interdisciplinary connections and experiential learning opportunities across all aspects of data science and computing, from machine learning to marine science, city planning, or communications.

Students from any academic discipline are invited to explore advancing their careers with foundational knowledge on the applications and implications of data in a variety of fields.

For more information, please contact the Office of Interdisciplinary and Professional Studies at 305.284.8783.

Data Scientist

"The sexiest job of the 21st century."

-HARVARD BUSINESS REVIEW

UNIVERSITY
OF MIAMI



msdatascience.miami.edu

UNIVERSITY OF MIAMI

INSTITUTE for DATA SCIENCE
& COMPUTING



1320 S Dixie Hwy, Suite 600
Coral Gables, FL 33146-2930

305.243.4962 | idsco@miami.edu

