The Nuts and Bolts of Creating a Two-Year Data Science Degree

Nuts and Bolts

This material is based upon work supported by the National Science Foundation under Grant No. 1902524.

How Did We Get Here?

- Start with the A.S. in Computer Information Technology (2018)
- "Lay of the land" – the A.S. in Computer Information Technology program as we started designing the new program:

The Program

The Computer Information Technology program prepares you for a respected career as a developer, programmer, programmer-analyst, database developer, or web developer. You'll study program and systems design, computer communications, database development, web development, customer support, and software development in specific languages. Our relationship with Microsoft's Developer Network Academic Alliance allows you to download a free, licensed copy of the Microsoft server and developer applications, operating systems and integrated development environments for programming languages taught in your classes. A 50-hour internship is included in the program to provide valuable work experience.

The Computer Information Technology degree program allows you to focus in one of three career tracks:

- **Software Development Track:** The Software Development Track allows for specialization in software development using modern languages. Students may select 6 credits from C language, C++, C#, Java, J2EE, or Visual Basic.NET, ASP.NET, CAPM, Special Topics or Introduction to IT.
- **Web Track:** The Web Track allows for specialization in web development using modern web technologies. Students may select 6 credits from web design, web management, Special Topics or Introduction to IT.
- **Database Track:** The Database Track allows for specialization in database development using modern database technologies. Students may select 6 credits from Oracle SQL and PL/SQL, database administration, M.S. Access database, Special Topics or Introduction to IT.

Timeline

2017 - 2018

- BILT "Informatics" Proposal
- NSF Grant Proposal
- Framework Design

2019

- NSF Grant Awarded
- Grant Year 1
- Frameworks Submitted
- Program Curriculum Submitted

2020

- Grant Year 2
- Online Shell Implementation Begins
- Online Marketing Campaign

2021

- Degree Rollout
- Online Shells Complete
- Grant Year 3

2022

- Student Recruitment
- First Completers
- Grant - No-cost extension

Timeline – 2017 - 2018 - Events

- Initial request from IT dean to explore the feasibility of an Informatics degree
- Formed departmental faculty committee
- BILT "Informatics" Proposal
  - Name change: "Data Science Technology"
  - Emphasize technician roles
- "Substantive Change" – avoided delay from SAC approval by creating courses as electives in existing A.S. Computer Information Technology degree program
  - Created Data Science track
- Attended State Framework Review Working Session
- Resources: Two-Year College Data Science Summit, Oceans of Data
- Job Outlook
- Framework Design (with future B.A.S. in mind)
  - A.S. Degree
  - Data Science Technician I, Data Science Technician II Technical Certificates
- NFS Grant Proposal
  - Modality: fully online

Timeline – 2018 – Curriculum - Existing

- Leverage existing IT courses specifically applicable to Data Science:
  - Python
    - Added Data Science-specific course modules and outcomes
  - Business Intelligence
    - (4000-level, subsetted/transformed to 2000-level "Data Warehousing")
- Leverage existing IT courses to provide foundational skills
  - Intro to IT
  - Intro to Programming
  - Networking
  - Web Development
  - Linux
  - Excel
  - Intro to Security
  - SQL Server (used in the Python course)
- GenEd: Intro to Statistics

Timeline – 2018 – Curriculum – New Courses

- New courses:
  - Java 1 (OCA Certification Prep)
    - Java is used in the Hadoop ecosystem
  - SAS
  - Statistical Programming with R
  - Introduction to Big Data Using Hadoop
  - Data Visualization
- Emphasis on free textbooks using college's O'Reilly subscription

Creating the Framework for a New Degree

2019 – 2020

Florida Department of Education
Curriculum Framework

Program Title: **Data Science Technology**
Career Cluster: **Information Technology**

AS	
CIP Number	1511010100
Program Type	College Credit
Standard Length	60 credit hours
CTSO	Business Professionals of America (BPA)
SOC Codes (all applicable)	15-1199 – Computer Occupations, All Others
CTE Program Resources	http://www.fldoe.org/academics/career-adult-edu/career-tech-edu/program-resources.stml

Purpose

This program offers a sequence of courses that provides coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in the Information Technology career cluster; provides technical skill proficiency, and includes competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of the Information Technology career cluster.

The content includes but is not limited to in-depth instruction on activities performed in the acquisition of data in structured and unstructured formats, cleaning, modeling, and analysis of acquired data, and extraction of knowledge or insights using statistical processes and systems. Additional content includes identification of data sources, retrieval issues and methodologies, data security, and the use of other informational tools.

Additional Information relevant to this Career and Technical Education (CTE) program is provided at the end of this document.

Creating the Framework for a New Degree

Standards

After successfully completing this program, the student will be able to perform the following:

01.0 Describe the data life cycle.
02.0 Describe basic statistical concepts and apply statistical methods used in data science problems.
03.0 Describe selection, preprocessing, and transformation processes used with data sources.
04.0 Describe modelling, analysis, and visualization techniques applied to acquired data.
05.0 Describe security best practices for each phase of acquisition, analysis, and retention of data.

Creating the Framework for a New Degree

Program Title: Data Science Technology
CIP Number: 1511010100
Program Length: 60 credit hours
SOC Code(s): 15-1199

The AS degree requires the inclusion of a minimum of 15 credits of general education coursework according to SACS, and it must be transferable according to Rule 6A-14.030 (2), F.A.C. At the completion of this program, the student will be able to:	
01.0	Describe the data life cycle. The student will be able to:
01.01	Describe ways in which data can be acquired:
01.01.1	Describe data sources and methods for acquiring data.
01.01.2	Describe how data is captured (i.e: from control systems devices or Internet of things devices, etc.).
01.01.3	Describe how acquired data is cleansed and enriched.
01.02	Describe techniques for analyzing data:
01.02.1	Describe data models.
01.02.2	Describe techniques used for data visualization.
01.02.3	Describe statistical methods which are applied to data to extract useful information.
01.03	Describe how data analysis results can be reported.
01.03.1	Describe dashboards and how they can be used to make business decisions.
01.03.2	Determine appropriate reporting formats.

Substantive Changes

- Substantive changes in Florida can result in extended time periods for approval of a new program

Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) Assessment				
In order to maintain the College's continued accreditation through the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC), all originators are required to complete this section to determine if reporting to SACSCOC is required. Please contact the Office of Institutional Effectiveness and Accreditation (OIEA) at oiea@fscj.edu at the beginning of the proposal process to discuss the specific requirements for your proposed change to minimize the possibility of implementation delay. ***If you answer YES to one or more of the questions below, complete the substantive change intake form found on the OIEA website. Timelines for the development and submission of reports to SACSCOC can also be found on the OIEA website.*** *Based on the information provided within the proposal, please identify if the proposal involves any of the following actions related to substantive change.*				
The development of a new degree or certificate program?	☐	Yes	☐	No
A contract, MOU, grant or consortium for the development of all or part of a new program or course?	☐	Yes	☐	No
The inactivation of a degree or certificate program?	☐	Yes	☐	No
An increase or decrease in the total degree or certificate program hours by ≥25%?	☐	Yes	☐	No
Adding or modifying coursework that requires new faculty, course content, equipment, facilities, library or other resources?	☐	Yes	☐	No
Changing the program from clock hours to credit hours or vice versa?	☐	Yes	☐	No
The instruction of courses delivered by College faculty/instructors and/or employees at an off-campus location?	☐	Yes	☐	No

Substantive Changes

- To avoid the "substantive change" categorization for our new program, we examined the department's curriculum landscape to see where we could lay the groundwork for a "non-substantive" design by integrating data science outcomes into existing courses and including them in a temporary track in an existing program.
- New learning outcomes were added to the following courses:
  - Introduction to Information Technology
  - Programming in Python
  - Computer Networks and Telecommunications

A.S. Computer Information Technology 2018

- Additional Learning Outcomes:
  - Introduction to Information Technology
    - "Use data science terminology to describe concepts, programming languages, and tools used for data acquisition and data analysis."
  - Programming in Python
    - "Describe the Data Life Cycle and how it is implemented in Python"
    - "Write Python applications which use Numpy and Pandas to manipulate and analyze data"
    - "Write Python applications which use Matplotlib to visualize data"
  - Computer Networks and Telecommunications
    - "Describe the concepts of network virtualization and cloud computing"

A.S. Computer Information Technology 2019/2020

- In 2019 the Data Science track was added to the CIT program to help the modified courses and impending program to get some traction

The Program

The Computer Information Technology program prepares you for a respected career as a developer, programmer, programmer-analyst, database developer, or web developer. You'll study program and systems design, computer communications, database development, web development, customer support, and software development in specific languages. Our relationship with Microsoft's Developer Network Academic Alliance allows you to download a free, licensed copy of the Microsoft server and developer applications, operating systems, and integrated development environments for programming languages taught in your classes. A 50-hour internship is included in the program to provide valuable work experience.

The Computer Information Technology degree program allows you to focus in one of four career tracks:

- Software Development Track: The Software Development Track allows for specialization in software development using modern languages. Students may select 9 credits from C language, C++, C#, Java, Java EE or Visual Basic.NET, ASP.NET, CAPM, Special Topics, or Introduction to IT.
  ***Note**: Students who select COP 2073C or CTS 2910C to satisfy elective coursework options are required to take STA 2023 as a prerequisite for enrollment into each course.*
- Web Track: The Web Track allows for specialization in web development using modern web technologies. Students may select 9 credits from web design, web management, Special Topics, or Introduction to IT.
- Database Track: The Database Track allows for specialization in database development using modern database technologies. Students may select 9 credits from Oracle SQL and PL/SQL, database administration, M.S. Access database, Special Topics, or Introduction to IT.
- Data Science Track: The Data Science Track allows for specialization in data science. Students may select 9 credits from programming in Python, SAS, R and data analytics, big data and data warehousing.

Data Science Track

- Added to the CIT program in 2018
- 9 Credit Hours, 3 Courses Minimum (prerequisites not listed)
  - **CIS 2349C - Introduction to Big Data Using Hadoop (New)**
  - **COP 2034C - Programming in Python**
  - **COP 2551C - Introduction to Object-Oriented Programming with Java**
  - **COP 2073C - Introduction to Statistical Programming with R (New)**
    - **Note: Students must complete STA 2023 prior to enrollment in this course.**
  - **CAP 2787C - Data Warehousing (derived from 4000-level BI course)**
  - **CTS 2456C - Introduction to SAS Programming (New)**

* In 2021 the track was removed since the A.S. in Data Science Technology program implementation was complete

NSF/ATE Grant

- DataTEC (Data Science Technician Education & Careers)

  "Meeting Industry Needs Through a Two-Year Data Science Technician Education Program"

  NSF grant #1902524

DataTEC Grant Timeline – Years 1 & 2

Year One: 2019-2020	
Fall 2019	• Host grant orientation meeting • Meet with BILT for curriculum design and certification skill needs • External Evaluator develops evaluation logic model, provides measurement process • Faculty work with industry experts on curriculum content/modifications and develop online and lab components for courses
Spring 2020	• Develop underrepresented student recruitment plan • Submit new program request form for credit program to FL Dept. of Ed
Summer 2020	• Host Data Science Working Connections for faculty • Curricular modifications reviewed/approved by FSCJ Curriculum Committee • Year One evaluation report is completed and submitted
Year Two: 2020-2021	
Fall 2020 to Summer 2021	• Once framework is approved by FL Dept. of Ed, create curriculum proposal for submission to FSCJ's Curriculum Committee for Provost approval • Work with SACSCOC for any implications with accreditation • Deploy recruitment plan for underrepresented students • Host Data Science Working Connections for faculty • Year Two evaluation report is completed and submitted

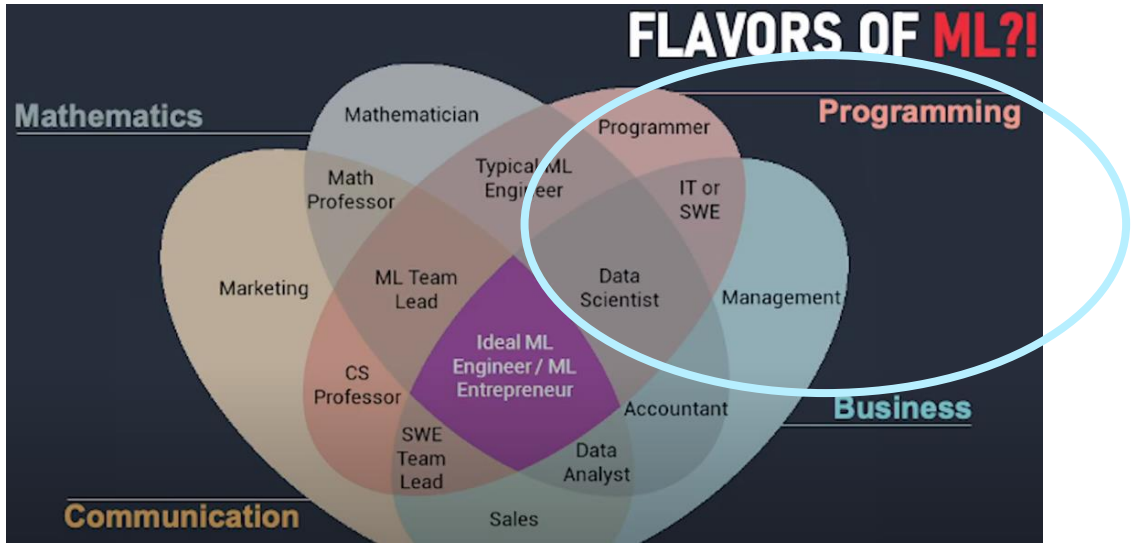
DataTEC Grant Timeline – Year 3 & Ongoing

Year Three: 2021-2022	
Fall 2021 to Summer 2022	• Full implementation of program, students enrolling in Data Science program; new/modified courses launched with cohorts • FSCJ continues offering courses, students entering and completing programs • Students provide feedback on curricula activities, lab activities, evaluation and assessment activities and on their overall experience in the courses • Host Data Science Working Connections for faculty • Year 3 and cumulative evaluation report submitted; Dissemination of best practices
Ongoing Project Sustaining Activities	
Quarterly BILT meetings; Recruitment of underrepresented students; Collect formative evaluation data (shared with PI 1x times a year); Evaluator site visits in Oct/March each year; Project personnel attend STEM and Data Science conferences for dissemination and professional development	

- Year 4 No-Cost Extension Approved Spring 2022

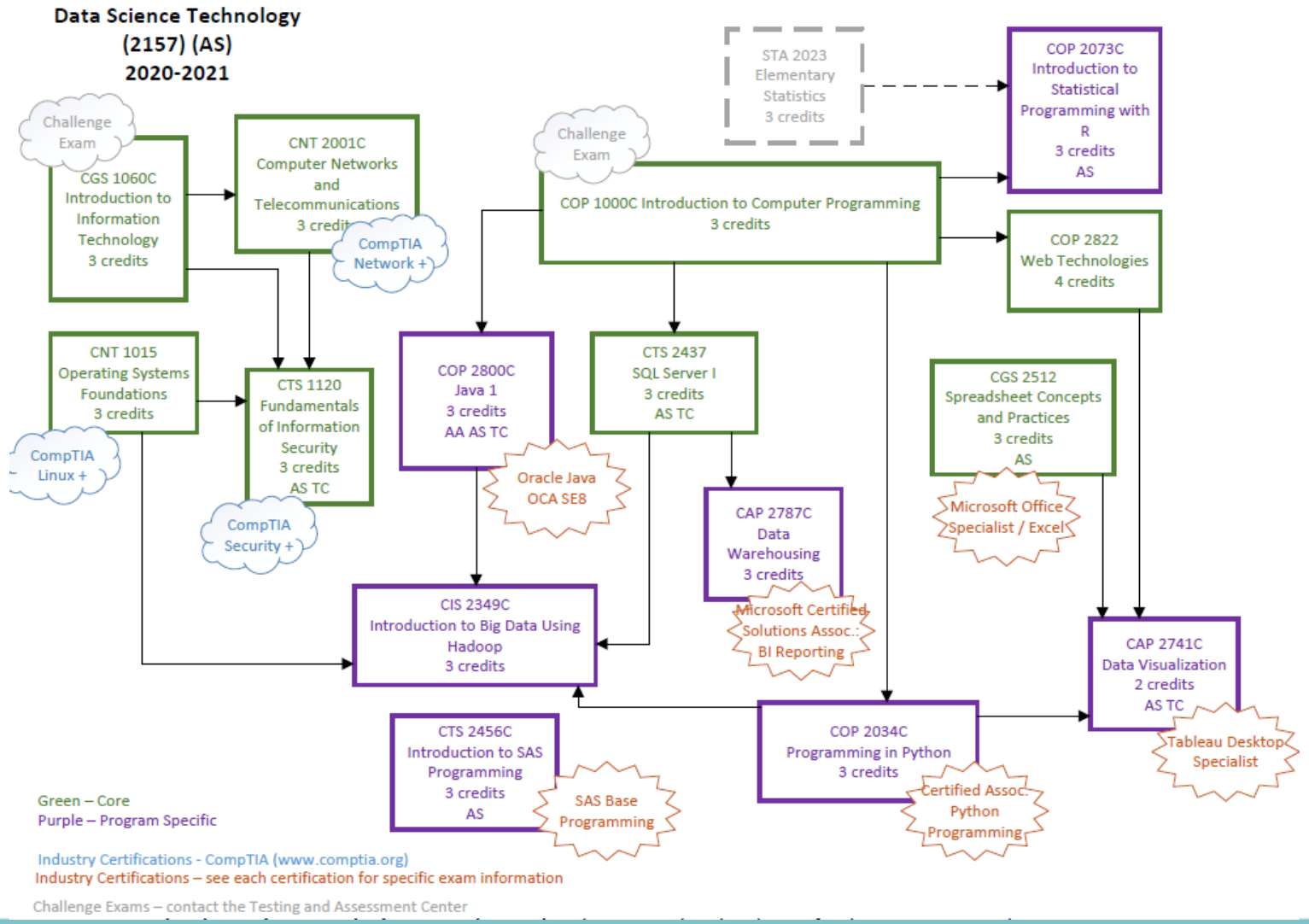
Timeline – 2019 – Curriculum – Industry Certifications

- Design for certification
  - CompTIA Linux+
  - CompTIA Network+
  - CompTIA Security+
  - Oracle Java OCA SE8
  - Python PCEP, PCAP
  - SAS Base Programming
  - Microsoft Office Specialist / Excel
  - Tableau Desktop Specialist
  - Microsoft Certified Solutions Associate: BI Reporting (now MCSE: Data Management and Analytics. What about CompTIA Data+ or ACAP?)



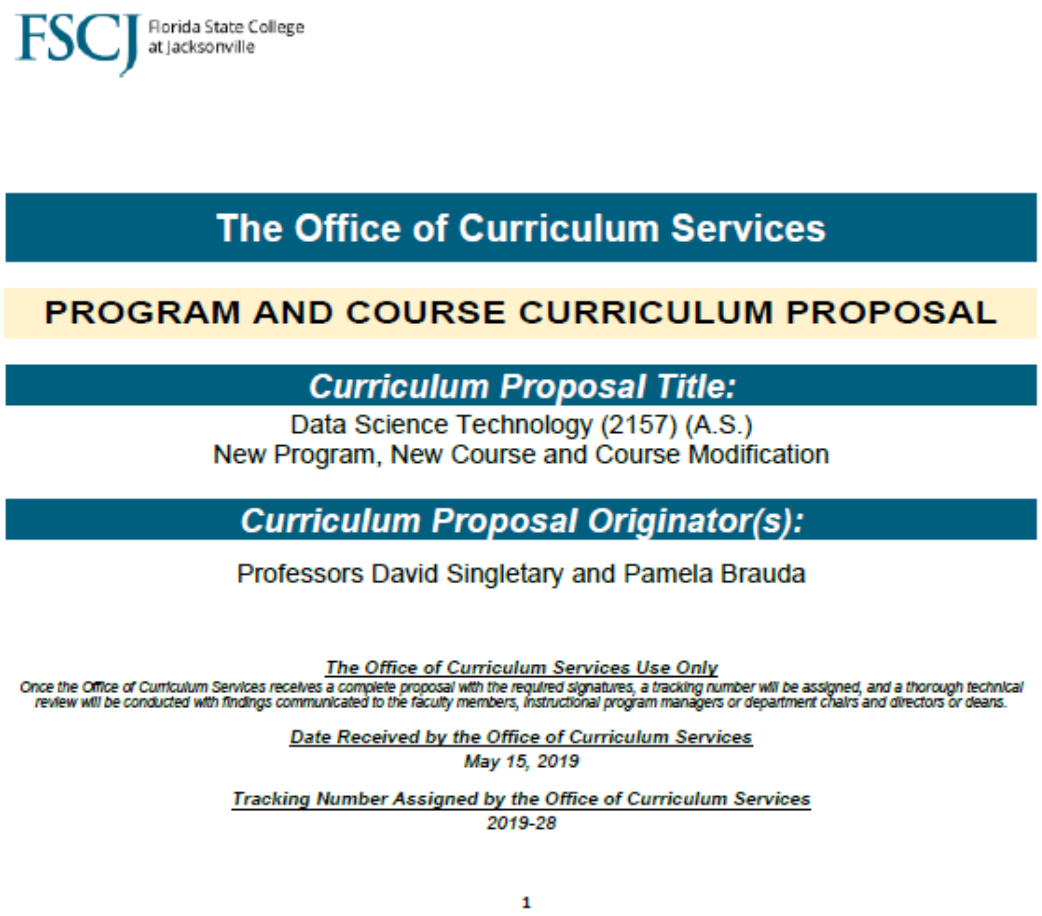
Blue Collar AI: Aaron Burciaga - (Feb 2021)/National CTC

Timeline – 2019 – Curriculum – Course Sequencing



Timeline – 2019 – Program Curriculum Proposal

- Curriculum Proposal Submitted to Office of Curriculum Services
- Dean, Associate Provost, Provost, Accreditation Liaison Sign-offs
- Subsequent approval by Board of Directors



FSCJ Florida State College at Jacksonville

The Office of Curriculum Services

PROGRAM AND COURSE CURRICULUM PROPOSAL

Curriculum Proposal Title:

Data Science Technology (2157) (A.S.)
New Program, New Course and Course Modification

Curriculum Proposal Originator(s):

Professors David Singletary and Pamela Brauda

The Office of Curriculum Services Use Only

Once the Office of Curriculum Services receives a complete proposal with the required signatures, a tracking number will be assigned, and a thorough technical review will be conducted with findings communicated to the faculty members, instructional program managers or department chairs and directors or deans.

Date Received by the Office of Curriculum Services

May 15, 2019

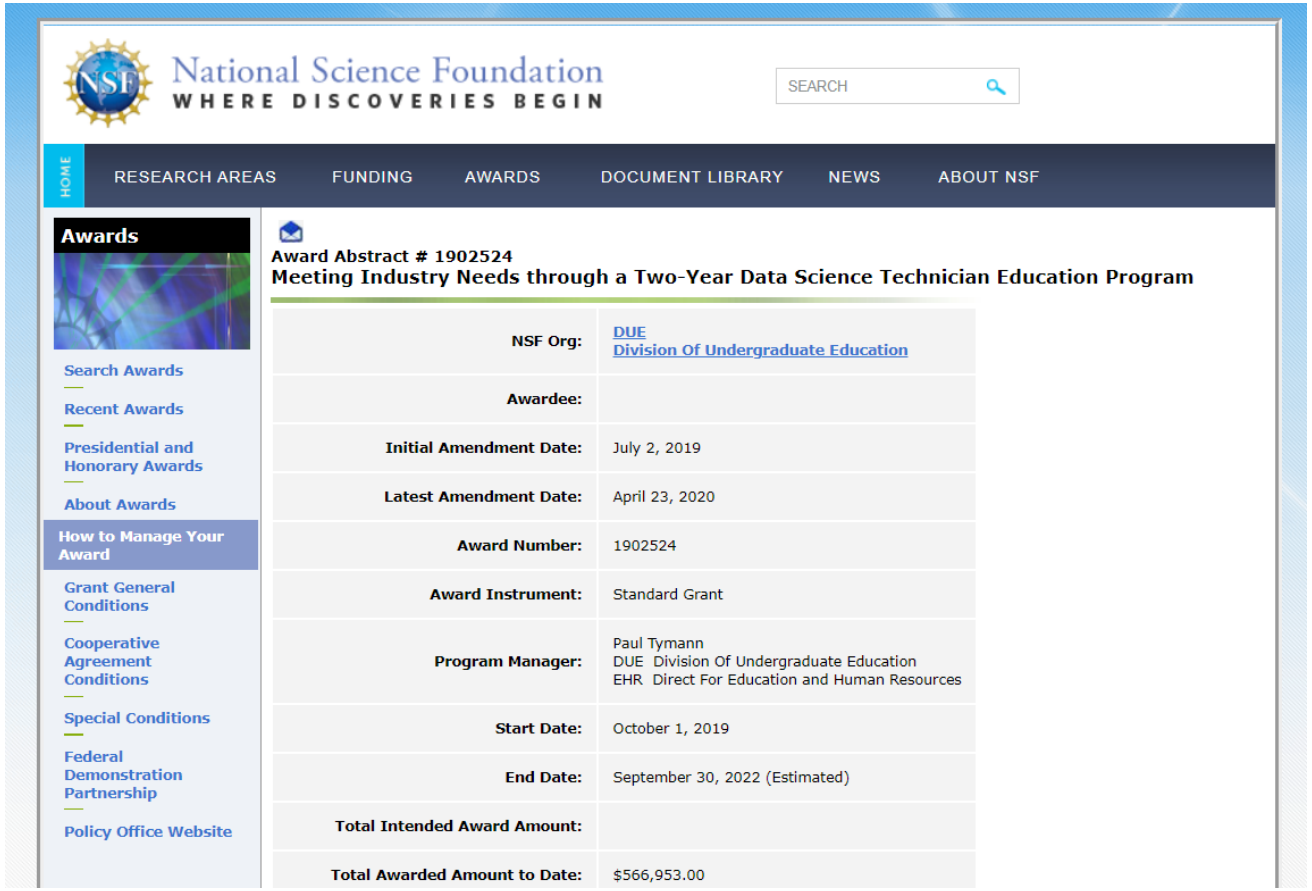
Tracking Number Assigned by the Office of Curriculum Services

2019-28

1

Timeline – 2019 – NSF/ATE Grant Awarded

- "Meeting Industry Needs through a Two-Year Data Science Technician Education Program"



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Award Abstract # 1902524
Meeting Industry Needs through a Two-Year Data Science Technician Education Program

NSF Org:	DUE Division Of Undergraduate Education
Awardee:	
Initial Amendment Date:	July 2, 2019
Latest Amendment Date:	April 23, 2020
Award Number:	1902524
Award Instrument:	Standard Grant
Program Manager:	Paul Tymann DUE Division Of Undergraduate Education EHR Direct For Education and Human Resources
Start Date:	October 1, 2019
End Date:	September 30, 2022 (Estimated)
Total Intended Award Amount:	
Total Awarded Amount to Date:	$566,953.00

Timeline – 2019 – First ATE PI Conference

Serving Northeast Florida with Online Data Science Curriculum

DataTEC's online offerings will help to eliminate transportation barriers for students

- Metro Jacksonville area spans several counties
- 1,504,980 residents, 874 square miles
  - largest city in land area in the contiguous U.S.
- The St. Johns River flows through the middle of Jacksonville, requiring seven bridges to connect the city

Just as these bridges are critical to the day-to-day operation of our city, bridges to educational access are also crucial for Jacksonville's lowest income residents and minority residents.

The DataTEC team will align with FSCJ's Center for eLearning to incorporate best practices for recruitment and retention of minority students in online classes

Timeline – 2019 – First ATE PI Conference

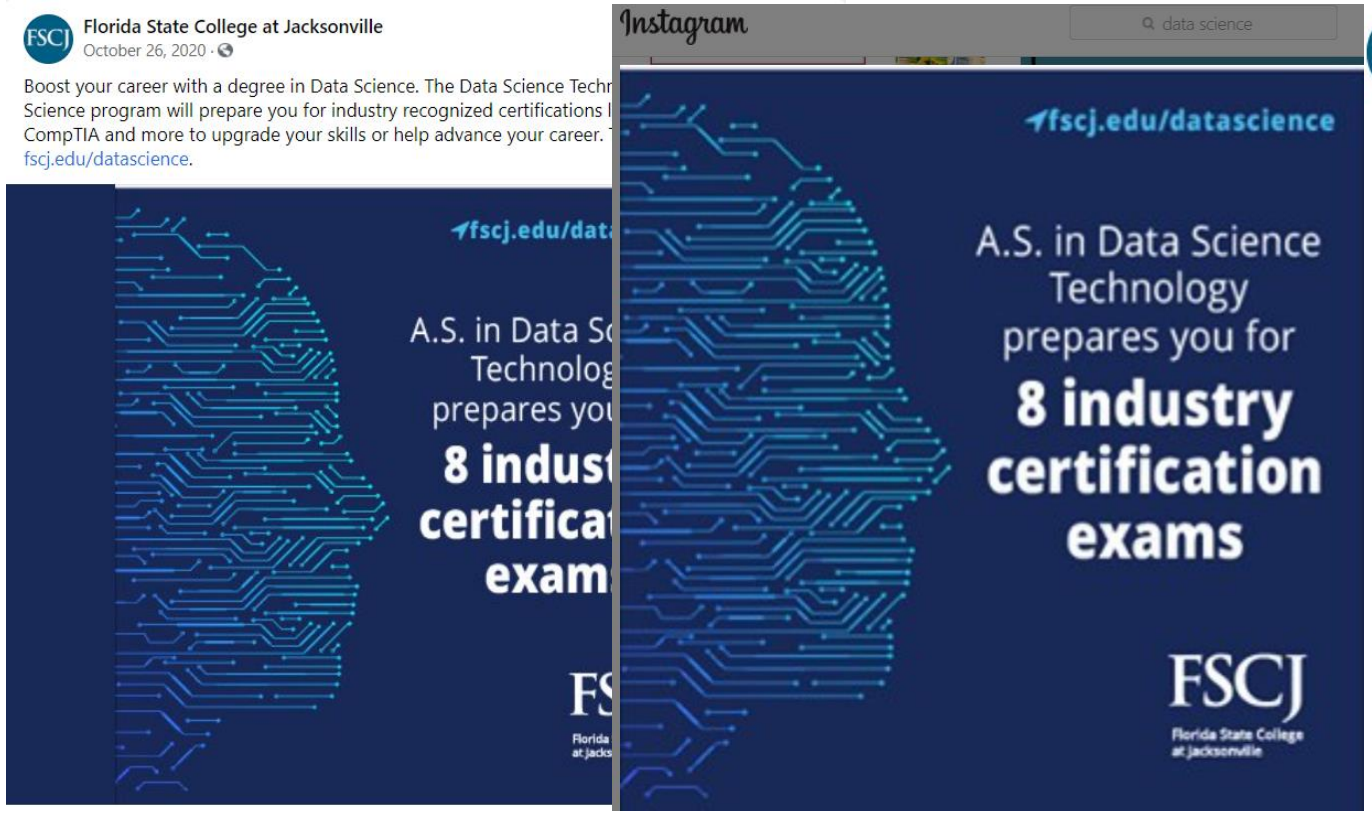
Community and Industry Partners

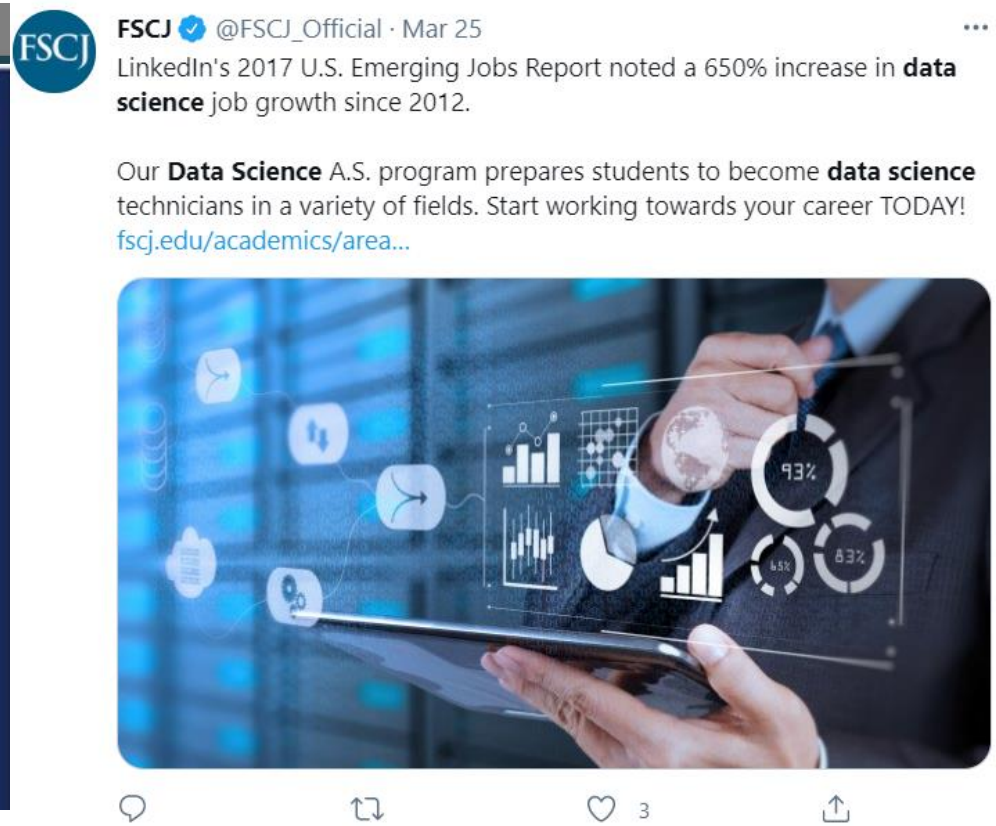
Timeline – 2020 – CeL Master Shell Design

- FSCJ Center for eLearning
  - https://www.fscj.edu/academics/schools-of-learning/online-learning/center-for-elearning
- Grant deliverable calls for full online modality to increase access
  - Deliverable included 6 online courses
  - Recorded Lectures
  - Horizon Virtual System Access

Timeline – 2020 – Marketing the Program

- Periodic program focus ads from college marketing



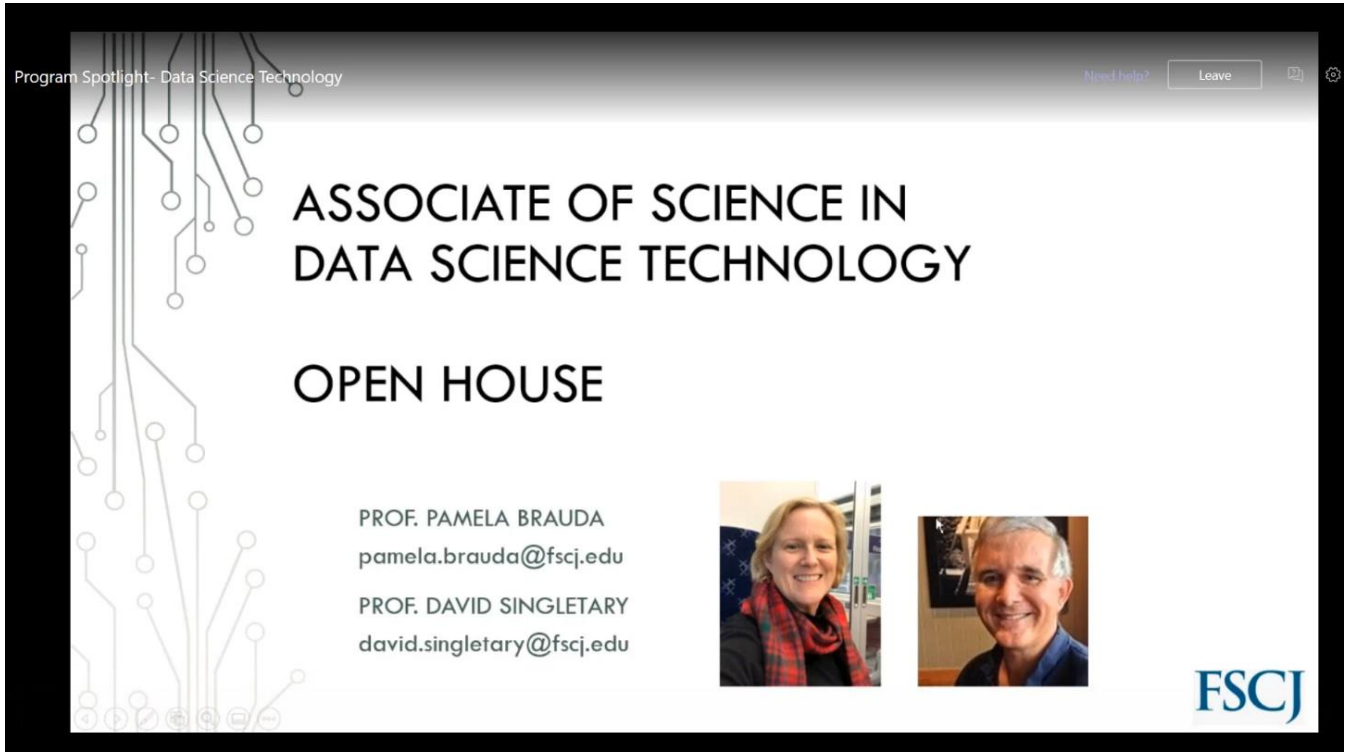


FSCJ Florida State College at Jacksonville

Timeline – 2020 – Marketing the Program

- Virtual Open House – Program Spotlight

VIRTUAL OPEN HOUSE



Timeline – 2020 – Marketing the Program

- iHeart Media Campaign($5K)

Campaign Info

Campaign ID:	16531
Campaign Date:	10/16/2020
Campaign Name:	DATA TEC

Deployment Info

Broadcast Date:	10/19/2020
Subject Line:	Start your journey to a career in data science
From Line:	net@fscj.edu

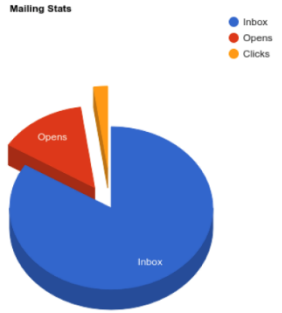
Campaign Stats

Total Quantity:	27,500
Total Opens:	4,442
Open %:	16.15%
Total Clicks	610
Clicks %:	2.22%
HTML CTR:	13.73%

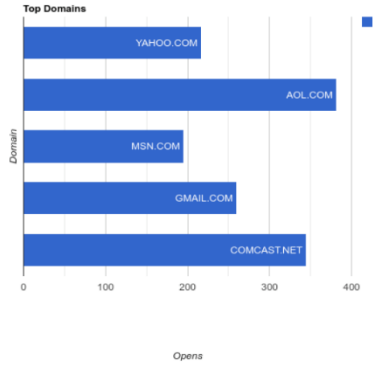
Top Domain Breakdown

YAHOO.COM:	217
AOL.COM:	382
MSN.COM:	195
GMAIL.COM:	260
COMCAST.NET:	345
OTHER:	3043

Stats Chart



Domain Chart



FSCJ Florida State College at Jacksonville

Navigating the Bureaucracy

- Bureaucracy: a system of organization characterized by specialization of functions, adherence to fixed rules, and a hierarchy of authority.
  - Bureaucracy is inevitable
- Find your champions
  - Senior faculty, dean, program manager, provost, curriculum experts, industry partners
- Identify roadblocks
  - Administrative – forms, existing processes
  - Academic – other faculty, committees
  - External – accreditation, "sister" institutions with right of refusal
  - Industry - no such job?
  - Government – black hole
- Learn the rules
- Learn the players
- Be persistent with your needs, even tenacious, but always be polite

https://allen-faulton.medium.com/the-fine-art-of-navigating-bureaucracy-a91236a29e58

Distilling Essential Statistics in Technical Curriculum

Motivation

- Effective in the fall semester of 2023, the Associate in Science in Data Science Technology program will include coursework which meets two specific FLDOE-directed legislative changes:

  1. Civic Literacy Competency (Senate Bill 1108), which requires students initially entering an FCS institution in 2022-23 and thereafter to complete a course and pass an assessment to demonstrate competency in civic literacy.

  2. Associate in Science General Education (HB 1507), which requires that students entering an A.S. or A.A.S. degree program in the 2022-2023 academic year, and thereafter, must complete at least one identified state core course in each subject area as part of the general education course requirements before a degree is awarded.

- For the A.S. program one course, Introduction to Statistical Programming with R (COP 2073C), will no longer include Elementary Statistics (STA 2023) as a prerequisite. Instead, a statement will be added “Students are strongly recommended to take STA 2023 prior to enrollment in this course.

R Course Statistical Learning Outcomes

- Describe the common mathematical and statistical functions used in R and implement programs which use those functions, including functions related to probability, correlation, linear regression, and confidence intervals.
  - These outcomes are also present to a lesser degree in our Excel and SAS courses.
- Describe the process of hypothesis testing using R and implement a program which demonstrates hypothesis testing.

Teaching Statistics to Non-Statisticians

- On Teaching Statistics to Non-Statisticians (JSM 2013)
- Scott Evans, Ph.D., M.S. Harvard University
  - "Don’t be afraid to deviate from the norm or how the class was taught to you. If you learned it in a math or stat department then it may not best for a non-stat audience."
  - Discuss limitations of p-values and need for confidence intervals
  - Younger generations learn differently than we do: surfers / scanners vs. sit and think

- https://higherlogicdownload.s3.amazonaws.com/AMSTAT/985e96d2-45e9-4950-969e-1bb1b02ac30d/UploadedImages/JSM/JSM2013%20teaching%20biostats.pdf

Teaching Statistics to Non-Statisticians

- On Teaching Statistics to Non-Statisticians (JSM 2013)
- Vincent Lo Re, MD, MSCE UPenn
  - Statistical tests are viewed as “tools”
  - Students learn to use right tools to answer specific questions

  - https://higherlogicdownload.s3.amazonaws.com/AMSTAT/985e96d2-45e9-4950-969e-1bb1b02ac30d/UploadedImages/JSM/JSM2013%20teaching%20biostats.pdf

Teaching Statistics to Non-Statisticians

- On Teaching Statistics to Non-Statisticians (JSM 2013)
- Megan Mocko, Master Lecturer. University of Florida
- Guidelines for Assessment and Instruction in Statistics
    - Emphasize statistical literacy and develop statistical thinking
    - Use real data
    - Stress conceptual understanding, rather than mere knowledge of procedures.
    - Use technology for developing understanding and analyzing data

- https://higherlogicdownload.s3.amazonaws.com/AMSTAT/985e96d2-45e9-4950-969e-1bb1b02ac30d/UploadedImages/JSM/JSM2013%20teaching%20biostats.pdf

Leveraging the Program

Northeast Florida FinTech Initiative

- https://www.fscj.edu/academics/workforce-education/grant-programs/fintech-grant
- The Northeast Florida FinTech Initiative represents a partnership between Florida State College at Jacksonville and St. Johns River State College, regional schools, nonprofits and numerous financial services companies to provide new financial technology, or “FinTech” training and certification opportunities in topics such as blockchain, mobile applications, machine learning and cloud-based data management.
- This innovative collaboration to provide new FinTech-related training and certifications will help equip Floridians with skills in demand by Northeast Florida’s growing FinTech industry.
- The FinTech Initiative will also include the creation of a new externship program and working connections program. These programs will provide leaders of nearby K-12 schools with valuable skills and information needed to introduce students to the FinTech industry and will offer real-world industry experiences to College faculty.

Northeast Florida FinTech Initiative

- Banking Specialist - FinTech Technical Certificate – An introductory-level certificate designed to get students on a FinTech career pathway. Available Online
- FinTech Advanced Technical Certificate –For those who already hold a degree and is designed to upskill IT-based FinTech skills, particularly in software applications and development
- FinTech Support Technician Boot Camp Academy - a fast-track program that provides a non-credit pathway for individuals to acquire skills desirable to regional FinTech companies
  - Security+ Boot Camp Academy
  - MOS Excel 2019
  - Python

FinTech Technician Technical Certificate

- Associate Level
- Leverages Data Science Technology Courses

BAS in Data Science

- Letter of Intent submitted
- Supported by enrollment data from A.S. degree program and regional job posting data (Kimble group)

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