NEW OR REPLACE PROGRAM CODE

☐ **New Program Code** ☐ **Replace Program Code** Date: _____

REQUESTOR CONTACT INFORMATION

Name _____   Campus _____

Title _____   Email _____

Office/Dept _____   Phone _____

NEW PROGRAM CODE TO CREATE

Institution _____   Campus _____

Level _____   Effective Term _____

	Code (Max. Characters)	**Description**	**Check if requesting new code:**
College	(2) _____	_____	☐ See Banner form STVCOLL
Department	(4) _____	_____	☐ See Banner form STVDEPT
Degree/Certificate	(6) _____	_____	☐ See Banner form STVDEGC
Major	(4) _____	_____	☐ See Banner form STVMAJR
Concentration	(4) _____	_____	☐ See Banner form STVMAJR
Minor	(4) _____	_____	☐ See Banner form STVMAJR

If a similar major/concentration code exists in Banner, please list the code: _____

Justification to warrant a new major/concentration code similar to an existing major/concentration code:

_____

Is this major/concentration code being used the same way at the other UH campuses?	☐ Yes	☐ No
Should this program be available for applicants to select as their planned course of study on the online application? *If yes, student may select the code as their only program of study.*	☐ Yes	☐ No

RULES PERTAINING TO FINANCIAL AID AND 150% DIRECT SUBSIDIZED LOAN LIMIT LEGISLATION

Is 50% or greater of the classes in this program offered at a location other than the Home Campus?	☐ Yes	☐ No
Is this program/major/certificate financial aid eligible?	☐ Yes	☐ No
Does this certificate qualify as a Gainful Employment Program (Title IV-eligible certificate program)? *See http://www.ifap.ed.gov/GainfulEmploymentInfo/index.html*	☐ Yes	☐ No

Program Length
In academic years; decimals are acceptable. The length of the program should match what is published by the campus in any online and/or written publication.
_____

Special Program Designations   ☐ A ☐ B ☐ N ☐ P ☐ T ☐ U
See Special Program Designations Code Definitions on IRAO Program Code Request webpage

Required Terms of Enrollment: ☐ Fall ☐ Spring ☐ Summer ☐ Extended

Form modified: Oct 20208

EXISTING PROGRAM CODE TO REPLACE, IF APPLICABLE

Program Code	_____	Program Description	_____
Institution	_____	Campus	_____
College	_____	Department	_____
Level	_____		

Are current students "grandfathered" under the program code?　　　☐ Yes ☐ No

Should the old program code be available for use in Banner?　　　☐ Yes ☐ No

Effective [_____] **, old program code will no longer be available to admit or recruit students.**
Term (ie. Fall 2020)

This will turn off the online application, recruitment (effects Banner forms SRASUMI and SRAQUIK) and admissions (effects Banner forms SAADCRV, SAAADMS, SAASUMI, SAAQUIK, and SAAQUAN) Banner modules.

Effective [_____] **, old program code will no longer be available to award degree to students.**
Term (ie. Fall 2020)

This will turn off the general student (effects Banner form SGASTDN) and academic history (effects Banner form SHADEGR) Banner modules.

ATTACHMENTS

BOR Approved: Sole-credential Certificate, Associate, Bachelor and Graduate Degrees, and sole credential certificates

☐ BOR Meeting Minutes & Supporting Documents　　　☐ Curriculum

Chancellor Approved: Concentrations, Certificates and Associate in Technical Studies (ATS) Degree

☐ Memo from Chancellor to notify Vice President for Academic Planning and Policy regarding program action.

☐ Curriculum

CERTIFICATES ONLY: Please check one (1) statement. This certificate is a...

☐ BOR approved certificate. BOR Meeting/Approval Date: _____

☐ Chancellor approved within an authorized BOR program. BOR Program: _____

☐ Chancellor approved CO in accordance with UHCCP 5.203, Section IV.B.10.

VERIFICATIONS

By signing below, I verify that I have reviewed and confirm the above information that is pertinent to my position.

Registrar (Print Name)	**Financial Aid Officer** (Print Name)	**For Community Colleges, verification of consultation with OVPCC Academic Affairs:** Tammi Oyadomari-Chun
_____	_____	_____
Signature　　　　Date	Signature　　　　Date	Signature　　　　Date

ADDITIONAL COMMENTS

UNIVERSITY of HAWAI'I®
MĀNOA

October 5, 2020

MEMORANDUM

TO: David Lassner
               President

VIA: Michael Bruno   *Michael Bruno*
               Provost

VIA: Laura Lyons
               Interim Associate Vice Chancellor for Academic Affairs

FROM: Aloysius Helminck
               Dean, College of Natural Sciences

               Gwen Jacobs
               Co- Director, Hawaii Data Science Institute

               Jason Leigh
               Co- Director, Hawaii Data Science Institute

               Scott Robertson
               Chair, Department of Information & Computer Sciences

SUBJECT: APPROVAL OF THE NEW UNDERGRADUATE CERTIFICATE IN
               DATA SCIENCE

SPECIFIC ACTION REQUESTED:

It is requested that the new *Undergraduate Certificate in Data Science* be approved.

RECOMMENDED EFFECTIVE DATE:

It is recommended that the effective date be Fall 2021.

2565 McCarthy Mall, Keller Hall
Honolulu, Hawai'i 96822
Telephone: (808) 956-6451
Fax: (808) 956-9111
http://www.hawaii.edu/natsci/
An Equal Opportunity/Affirmative Action Institution

ADDITIONAL COST:

The College of Natural Sciences recently hired faculty with expertise in the area of Data Science in the Department of Information & Computer Sciences, Department of Mathematics, and the newly created School of Life Sciences.

No new resources will be required at the outset. The Department of Information & Computer Sciences (ICS) already offers the required courses as a part of their Bachelor of Science degree with the Data Science track. Reorganization of the teaching load for some ICS faculty will facilitate the increase in enrollment of the required courses expected in the first few years. However, if the program becomes very popular, there is an anticipated need for additional sections of these courses.

PURPOSE:

The University of Hawaii has recognized the demand for data science education and prioritized expanding educational programs with this concentration. The popularity of private "data science bootcamps" demonstrates the existence of the demand for this type of program.

The establishment of the *Undergraduate Certificate in Data Science* will address the demand for a training program outside of completion of a 4-year bachelor degree programs with Data Science tracks in the Department of Mathematics or the Department of Information & Computer Sciences. It will provide an academic certification completable in one year. The certificate is expected to serve current undergraduates from across the campus who wish to expand their background in data science techniques, as well as local post-baccalaureate professionals who wish to obtain additional training/certification from the University of Hawaii at Manoa.
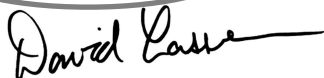
BACKGROUND:

The certificate will be granted by Department of Information & Computer Sciences in the College of Natural Sciences. ICS and the Hawaii Data Science Institute (HI-DSI) will collaborate on the design of the program over the first two years. The certificate will consist of four required courses (12 credits, all in ICS), which will be complemented by an additional six credits of elective courses that include options both across CNS (ICS, BIOL, PHYS, MATH) and in collaboration with other units (ATMO/CEE/SUST, ECON, MBBE)The program will be run by a *DS Program Committee* initially consisting of four faculty members in ICS who are also associated with HI-DSI and teaching the required courses.

ACTION RECOMMENDED:

It is recommended that the new *Undergraduate Certificate in Data Science* be approved.

APPROVED/DISAPPROVED:

_____   May 25, 2021
David Lassner   _____
President   Date

DATA SCIENCE CERTIFICATE PROPOSAL

Program Objectives

The Undergraduate Certificate in Data Science at UH Manoa will address the growing demand for data science education from both undergraduates and industry professionals who want to continue their education. It will provide skills in acquiring, archiving, and extracting knowledge from data, as well as problem solving and scientific communication. The certificate will be administered by the Information and Computer Science (ICS) department, in collaboration with the Hawaii Data Science Institute.

Student, Community, and State needs

The program will provide training in modern computational tools for analyzing data, including statistics, visualization, and artificial intelligence (AI). This has been identified as an important goal at the national, state, and university levels.

The certificate will address the demand for a training program in data science outside of a full 4-year degree in Math or Computer Science by providing a certificate that can be obtained in one year of courses by both undergraduates and post-bachelor professionals. We expect this to serve current undergraduates from across campus who wish to expand their background in data science techniques, as well as local professionals who wish to obtain additional training from UH by enrolling in a certificate program. The popularity of private "data science bootcamps" demonstrates the demand for this type of program.

Student Learning Objectives

The program will consist of 12 credits from a set of required courses, and 6 credits from a set of elective courses. This will enable students to complete the program in one year. The required courses will provide a foundation in data management, numerical programming, visualization, probability, statistics, and machine learning. The elective courses will provide experience applying these techniques to particular applications aligned with students' particular interests.

The certificate will address the following four student learning objectives (SLOs):

SLO1: Collect, manage, and visualize data.
Students will be able to:
1. Program in modern high-level programming languages (e.g. Python, R) to collect, manage, and manipulate data.
2. Understand fundamental principles of data management.
3. Visualize high-dimensional data.

SLO2: Select, apply, and evaluate models.

Students will be able to:
1. Identify common data science tasks and choose appropriate models for each task.
2. Fit statistical models to data.
4. Evaluate models on their ability to make predictions or uncover patterns.

SLO3: Interpret data science analysis outcomes.
Students will be able to:
1. Identify the assumptions made in common statistical models.
2. Assess the validity and reliability of a statistical model.
3. Identify potential sources of bias, unfairness, or ethical concerns in the use of statistical models.

SLO4: Communicate the results of an analysis.
Students will be able to:
1. Describe data, algorithms, and statistical models in written reports.
2. Contextualize the results and communicate the finding to technical or non-technical audiences.

Alignment with the Campus and UH system mission

The University of Hawaii has recognized the demand for data science education and has prioritized expanding educational programs and hiring new faculty in data science. Recent hires in ICS, Mathematics, and Life Sciences reflect this. This certificate will provide an important pathway for students to expand their skills in this area and take classes with these faculty.

Relationship to Other UH Programs

No undergraduate data science certificate exists at University of Hawaii at Manoa. Below we list the most closely-related programs and their relationship to the proposed certificate:

1. B.S. in Computer Science (Data Science Track) is a four-year degree program offered by the ICS, and is similar in content to a B.S. in Data Science at other universities. The certificate program will reuse required courses from this program, but will necessarily lack some of the depth and breadth offered by the 4-year degree.
2. B.S. in Mathematics (Data Science Track) is a four-year degree program offered by the Department of Mathematics. Similar to the DS track in Computer Science, the certificate program will necessarily lack some of the depth and breadth offered by this 4-year degree.
3. Hawaii Institute of Marine Biology (HIMB) is developing a graduate certificate in Data Science to be offered by the College of Natural Sciences or SOEST. This certificate will focus on graduate students in that program, and thus will specialize in specific tools used in the biological sciences.
4. The Undergraduate Data Science Certificate at UH Hilo is similar to the proposed program, but is unable to meet the needs of students and

professionals on Oahu. UH Hilo also offers a four-year B.S. in Data Science, which is similar to the UH Manoa B.S. in Computer Science (Data Science Track).
5. Kapiʻolani Community College is developing a 15-credit data science certificate program. The scope of that program is targeted at the "information technology worker who has little to no experience in utilizing databases." This program will target students with a stronger quantitative background.

Organization

Administration: The certificate will be granted by ICS in the College of Natural Sciences. ICS and HIDSI will collaborate on the design of the program over the first two years. The program will be run by a *DS Program Committee* initially consisting of four faculty members in ICS who are also associated with HIDSI and teaching the required courses, and determined by the ICS chair in each subsequent year.

Admission policy: Enrollment will be limited. Applicants must submit an application that will be reviewed by the DS Program Committee. Selection will be based on students' preparedness for curriculum. Specific requirements are:
1. Applicants must have completed a calculus course that covers limits, derivatives, partial derivatives, and integrals.
2. Applicants must have completed a programming course that covers basic data types, program control structure, and functions.
3. Applicants must have a minimum GPA of 3.0.

Program requirements: Students will be required to take 18 credits. Of these, 12 credits will be from a set of required courses. Another 6 credits of elective courses will enable students to focus on areas that interest them. A capstone project that demonstrates the student learning outcomes must be approved by the DS Program Committee; this project can be completed as part of the coursework.

Required courses (12 credits):
1. ICS 235 Machine Learning Methods
2. ICS 434 Data Science Fundamentals
3. *ICS 435 Machine Learning Fundamentals
4. *ICS 484 Data Visualization

Elective courses (6 credits):
1. *ATMO/CEE/SUST 449 Climate Modeling, Data Analysis & Applications
2. BIOL483/MBBE483 Bioinformatics
3. PHYS 305 Computational Physics
4. MATH 372 Elementary Probability and Statistics or MATH 472 Statistical Inference. (Due to overlap, cannot use both.)
5. ECON 425 Introduction to Econometrics

6. *ECON 427 Economic Forecasting
7. *ICS 438 Big Data Analytics
8. *ICS 422 Network Science Methodology

*Courses marked with asterisk have a significant project component that could be used to fulfill the capstone requirement.

Details:
1. Courses will not be allowed to be double counted with the requirements for other programs.
2. Students must pass each course within the certificate program with a grade of C or better.
3. As a residency requirement to earn the certificate, students must complete the 12 credits of required courses at UH Manoa. Exceptions can be made at the discretion of the DS Program Committee.
4. At the discretion of the DS Program Committee, students who demonstrate proficiency in the topics covered in the required courses may substitute those courses with elective courses.
5. Students who already have a B.S. in CS with the DS specialization or a B.S. in Math with the DS specialization are ineligible for the certificate. Students with a certificate in Data Science from UH Hilo are similarly ineligible.

Elective Courses: The list of elective courses will be determined by the DS Program Committee, and reviewed each year. Additional electives will be considered through a petitioning process, whose approval can be conducted in collaboration with the affected departments. Faculty and chairs of other departments have expressed interest in participating once the certificate has been launched. An up-to-date list of the elective courses will be maintained on the certificate website.

Advising and Counseling: All admitted students will be assigned a data science faculty advisor based on their interests. The data science faculty advisors will be chosen by the DS Program Committee. Initially, they will be those who teach either required or elective courses in the program.

Enrollment

We anticipate admitting 8-16 students to the program for Fall 2021.

A survey conducted by HIDSI among current UH students shows considerable demand for this program. Among 84 survey respondents across disciplines, 94% indicated their interest in such a program. A second survey of local employers also indicates high demand. Of 22 employers that participated, 16 indicated their intention to hire data scientists in the next 12 months.

In the 2019-2020 academic year, 9 students were awarded Data Science Certificates through UH Hilo's program. In Spring 2020, UH Manoa had 15 students enrolled in the Data Science track of the computer science degree program.

Resource Requirements

No new resources will be required at the outset. The required courses are already part of the ICS Data Science track, and will be taught every year. Reorganization of the teaching load for some ICS faculty will facilitate the increase in enrollment of the required courses expected in the first few years. However, if the program becomes very popular, we expect the need for additional sections of these courses. This could result in a need for lecturer, instructor and/or teaching-assistant positions. Once the program is running, we will also consider including Math 372 as a required course, which would require additional TA resources.

Each year, the DS Program Committee will ensure the certificate students are able to enroll in the required courses by reserving seats for them in these courses. This will be done by cross-listing required courses using the DATA code, reserving *N* seats for the DATA section in each course, and restricting enrollment to the DATA section to "by instructor permission only." Thus, only certificate students will be allowed to enroll in the DATA section for the required courses.

Elective Courses

A survey of the UH Manoa curriculum shows that there are many courses that can be used as electives in the Data Science Certificate. Many of these are taught by the 8+ data science-related faculty hired in recent years, and in the NSF EPSCoR Track 1 proposal submitted July 2020, funding was requested to further expand data science capacity through additional data science faculty hires. This diversity in courses will allow us to design custom experiences that match with student career prospects. HIDSI will be responsible for coordinating among colleges to minimize duplication of classes by, among other activities, cross-listing courses under the DATA subject code to strategically mitigate cross-department course requirements conflicts while minimizing the duplication of course or programs.

Computing

HIDSI successfully received funding to build Mana, a computing cluster which includes modern Graphics Processing Units (GPUs) to support research and data science education. These resources are now available to students through the High-Performance Computing center run by ITS.

Efficiency

The required courses are already being taught every year to support the ICS undergraduate degree in Computer Science, in particular the Data Science track. For the elective courses, this program will make use of the data science-related elective courses already being taught in multiple departments. We can potentially increase efficiency further by cross-listing courses using the DATA subject code to allow data science faculty from multiple departments to teach them.

Evaluation of Effectiveness

At the end of each year, the DS Program Committee will review the Key Performance Indicators (KPIs) listed below and assess the health of the program. These metrics will also be refined as the program evolves. Data collection will consist of a combination of tracking student class enrollment records and online surveys. Proposed KPIs include:

1. Number of new applicants each year.
2. Number of certificate students enrolled in the courses.
3. Number of applicants remaining in the program each year.
4. Number of graduates each year.
5. Job placements and career plans of graduates via an **Exit Survey**.
6. **Course evaluations** of all required and elective courses will be annually reviewed by the program administrators. Courses with poor evaluations may be removed from the program.
7. Assessment of learning outcomes via a **capstone project** reviewed by the DS Program Committee. This will typically be done as part of an elective course. Together with the students' grades, this will be used to evaluate student learning outcomes.

Presented to the Mānoa Faculty Senate by the Committee on Academic Planning & Policy (CAPP) for a vote of the full senate on May 12, 2021, a resolution supporting the proposal for an undergraduate certificate in data science.

RESOLUTION SUPPORTING THE PROPOSAL FOR AN UNDERGRADUATE CERTIFICATE IN DATA SCIENCE

WHEREAS, the Department of Information & Computer Sciences, in partnership with Hawai'i Data Science Institute, has proposed an 18-credit Undergraduate Certificate in Data Science; and

WHEREAS, the University of Hawai'i has recognized the demand for data science education and prioritized expanding educational programs with this concentration; and

WHEREAS, the College of Natural Sciences recently hired faculty with expertise in the area of Data Science in the Department of Information & Computer Sciences, Department of Mathematics, and the newly created School of Life Sciences; and

WHEREAS, the Undergraduate Certificate in Data Science at UH Manoa will address the growing demand for data science education from both undergraduates and industry professionals who want to continue their education, and will provide skills in acquiring, archiving, and extracting knowledge from data, as well as problem solving and scientific communication; and

WHEREAS, proposers have consulted with relevant units and the proposed certificate does not duplicate or replace existing UH Mānoa programs, **or** programs at other UH campuses; and

WHEREAS, the required courses are already part of the ICS Data Science track, and there are many existing courses that can be used as electives; and

WHEREAS, the proposed certificate does not require new resources; therefore,

BE IT RESOLVED, that the Mānoa Faculty Senate recommends approval of the proposal to establish an Undergraduate Certificate in Data Science in the Department of Information & Computer Sciences at the University of Hawai'i at Mānoa.

Supporting Document:
Proposal for Undergraduate Certificate in Data Science