

CS - 3120 - Machine Learning

04. UG Course Modification (No Special Designation)

Due Dates and Resources

If you have questions or need assistance in filling out this proposal form, you may contact the [Office of Curriculum](#).

Deadlines for curriculum can be found:

[Curriculum SharePoint Curriculum Website Procedural Calendar](#)

On your Curriculog dashboard under 'My Upcoming Events'

In order to meet the deadline, this proposal must be on the *Nonsubstantive, Substantive Colleg/School, OR Substantive University Level Review* step on or before the listed due date. Which step will depend on the changes being made.

Resources for curriculum can be found:

[Originator How-To Guide Curriculum SharePoint](#)

This form **SHOULD** be used for the following:

Modification of a course **without** a special designation (General Studies, Service Learning, Multicultural, or Senior Experience).

This form **SHOULD NOT** be used for the following:

Modifying a course with a special designation (General Studies, Service Learning, Multicultural, or Senior Experience).

Creating a new course with or without a special designation (General Studies, Service Learning, Multicultural, or Senior Experience).

Creating or modifying a graduate course.

Directions for Form

General Instructions and Information

You may collapse individual sections of this form by clicking the arrow or "V" icon to the right of the section title.

All fields that are marked with an asterisk (*) are required.

Each section may have additional directions attached. Please follow instructions.

Note: Proposals that are incomplete or filled out incorrectly will be returned to the originator.

INSTRUCTIONS FOR MODIFYING AN EXISTING COURSE

Import the course you wish to modify.

Fill out Part I of the form.

Carefully follow the instructions on selecting the level of review your proposal requires.
Incorrect review selection will require a resubmission of the proposal.

LAUNCH the proposal.

Fill out Part II to indicate all the modifications you make to the course.

Modify any course fields in Part III as needed.

Modification Note: DO NOT MAKE CHANGES TO YOUR COURSE INFORMATION (PART III) UNTIL AFTER YOU LAUNCH THE PROPOSAL in order to track changes. Failure to use the track changes feature may cause a delay or denial of your proposal.

If you modify additional fields not already indicated in Part II, please make sure you add them to the modification list.

Approve the proposal.

Use the checkmark icon on the right of the screen to approve the proposal.

Part I: Department and Originator Information (Fill out BEFORE launching the proposal)

If you are changing course ownership, please list both departments and if applicable, both college/schools.

College/School:*

College of Aerospace, Computing, Engineering, and Design

Department:*

Name of Proposal Originator* Feng Jiang

Email of Proposal Originator* fjiang@msudenver.edu

Justification and Resource Implication for Curriculum Proposal:*

To make Machine Learning more accessible and available to students in their junior year, we would like to remove MTH3210 Probability and Statistics in the pre-requisite list. This change will help students to take Deep Learning course in their 3rd or senior year, which requires Machine Learning as a pre-requisite. Both Machine Learning and Deep Learning are required classes for the upcoming new Data Science and Machine Learning program. This change to make sure both these two courses are accessible to majority of our students. Probability and Statistics is still required for the degree. The Math expectation for the program is not lowered. No additional recourses needed to make this change. Course content is also adjusted to accommodate this change.

Related Curriculum Proposals:* N/A

Impact Report Results:*

Impact Report for CS 3120

Source: 2022-2023 Undergraduate Catalog	
Programs	Statistical Science Major, B.S.

Course Modification Level Review

The modification level review question will determine the workflow of this proposal, so it is important you select the correct one. Please consult [this document](#) carefully and select your choice. If you select a level of review that does not include the changes you make to the course, this proposal will be denied and you will have to resubmit a new proposal. If you are unsure which level of review you need to select, please contact the Curriculum Staff [here](#).

Course Modification Level Review Selection:* Nonsubstantive Substantive College/School Level Substantive University Level

According to the Undergraduate Curriculum Manual, it is the responsibility of both the originator as well as each level of review to consider potential overlap and curriculum conflict. Any potential overlap or conflict with existing curriculum should be reviewed, and the impacted department(s) should be requested to provide a letter of notification or support, depending on the circumstances. Attach documentation that supports affected Departments were notified and/or provided support of the proposed changes in the Proposal Toolbox by clicking on the paperclip icon on the right side of the form.

Please Confirm That:* I, the originator of this proposal, have completed the necessary due diligence to review this proposal for any potential overlap and/or conflict with existing curriculum. Any departments identified as having potential overlap and/or conflicts

have been contacted and a letter of notification and/or a letter of support has been obtained.

Part II: Course Modification Information

Reminder: This form CANNOT be used to change courses with special designations (Multicultural, Service Learning, Senior Experience, General Studies). If you submit a course with special designation(s) with this form, it will be denied and you will need to resubmit.

Please select from the below list all of the course modifications you are making. **Please do not make changes to fields you do not specify are being modified and make sure to list ALL fields that you modify.**

Specify ALL course modifications:

Banner Enforced prerequisites, corequisites, pre/corequisites

Outline

Prerequisites, corequisites, pre/corequisites

Required reading

Student Behavioral Learning Objectives (SBLOs)

If the course modification includes changing prefixes, is it a new prefix? Yes No N/A

Reminder: DO NOT MAKE CHANGES TO YOUR COURSE INFORMATION (PART III) UNTIL AFTER YOU LAUNCH THE PROPOSAL in order to track changes. Failure to use the track changes feature may cause a delay or denial of your proposal.

If you modify additional fields not already indicated, please make sure you add them to the modification list.

Part III: Course Information

Prefix:*

CS

Course Number:* 3120

Course Title:* Machine Learning

Transcript/Banner Course Title:* Machine Learning

Course Type:*

Computer Science

CIP Code: 11.0701

Part III: Course Information, continued

Please check all that apply from the selections below. You may select more than one option if applicable.

- Check All that Apply:* Required for Major
 Required for Minor
 Required for Concentration
 Required for Certificate
 Elective
 Specified Elective

To receive Title IV financial aid funds, all institutions of higher education must comply with the federal definition of a credit hour. The Higher Learning Commission requires institutions to maintain policies and procedures for verifying compliance with this definition.

Federal Credit Hour Definition: A credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally-established equivalency that reasonably approximates not less than:

(1) one hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or (2) at least an equivalent amount of work as required in paragraph (1) of this definition for other activities as established by an institution, including laboratory work, internships, practica, studio work, and other academic work leading toward to the award of credit hours. 34CFR 600.2 (11/1/2010)

Credits:* 4

Distribution of Credits:* (4 + 0)

Schedule Type(s):*

Lecture

Grade Mode(s):*

Letter

Face-to-Face or Equivalent Hours per course

Consult Appendix B and C of the [Curriculum Manual](#) to determine the hours for the course

Lecture: 60

Lab:

Internship:

Practicum:

Other Hours:

Additional Student Work Hours: 120

Please answer yes or no to the below questions. If you answer yes to any of the questions, please fill out the related field on the right.

A specified repeatable course is a course that allows a student to repeat the course either in its entirety or for a certain identified total number of credit hours. If you decide to make your course repeatable, please specify either how many times a student can repeat the course for credit, or for the total number of credits they can receive

how many times a student can repeat the course for credit, or for the total number of credits they can receive.

Is this course a specified repeatable course?* No Yes

If yes, indicate specified repeatable number of credits and/or repeats allowed:

Is this course a variable topics umbrella course?* No Yes

If yes, indicate variable topic number of credits and/or repeats available:

A crosslisting is when a course is made available under additional prefixes for students in other programs.

An equivalency is when two courses are coded in Banner to be equal to each other.

Generally equivalencies are used when an old, archived course is needed to be equal to a new course.

Crosslistings are used for all active courses. Supporting documentation should be included to demonstrate approval for crosslistings.

Are there course equivalencies?* No Yes

If yes, list all equivalent courses in alphabetical order:

Are there course crosslistings?* No Yes

If yes, list all crosslistings in alphabetical order:

Registration Restrictions

Program:

Major:

Level:

Class:

Student Attribute:

Part III: Course Information, continued

The following fields will allow you to attach prerequisites, corequisites, or prerequisites or corequisites to your course. Please specify if you want and of these prerequisites, corequisites, or prerequisites or corequisites Banner enforced.

Banner enforcement means that the requirement will be enforced when the student attempts to register for a course. If you do not Banner enforce the requirement, the system will not check the student's record for the requirement to be met.

Please also indicate the minimum passing grade.

Prerequisite(s): CS 2050 or MTH 2520, MTH 2140 or MTH 3130 or MTH 3140, each with C- or better, or permission of instructor.

Banner Enforced Prerequisite(s): CS 2050 or MTH 2520, MTH 2140 or MTH 3130 or MTH 3140

Minimum Passing Grade for Banner Enforced Prerequisite(s): C- or T

Corequisite(s):

Banner Enforced Corequisite(s):

Prerequisite(s) or Corequisite(s):

Banner Enforced Prerequisite(s) or Corequisite(s):

Minimum Passing Grade for Banner Enforced Prerequisite(s) or Corequisite(s):

Catalog Course Description:* Machine learning is the ability of computers to learn without explicitly programming an algorithm. Machine learning techniques learn about hyper-dimensional spaces with either explicit direction or implicit reinforcement. This course covers a variety of machine learning techniques and their application to actual data. Topics include the clustering of data and the retrieval of related data, the use of machine learning for recommender systems, and the creation of deep learning systems. This course includes both the underlying theory of machine learning and the creation of machine learning software for real-world problems.

The note field DOES show up in the course listing in the university catalog. A note should be made in specific instances where additional information about a course needs to be conveyed to students. The most common reasons for adding a note are:

The course is crosslisted Example: *(Note: Credit will be granted for only one prefix.)*

Variable credit courses Example: *(Note: Variable Credit)*

A course is repeatable Example: *(Note: This course may be repeated up to 3 times under different topics)* OR *(Note: This course is repeatable for a maximum of six semester hours)*

If a student cannot take two courses and earn credit for both Example: *(Note: Students cannot earn credit for XXX1234 and XXX2345)*

Note:

Lab Fees:

Field Trips:

The following section is the course content.

Required reading: Please list materials in preferred citation style (eg. MLA, APA, etc.).

List each material in this format. If there are multiple material please format them in a bullet or list style

Specific Measurable Student Behavioral Learning Objectives: Please list the SBLOs in your preferred numbering or bulleting style. Start section with: Upon completion of this course, the student should be able to:.

Detailed Outline of Course Content or Outline of Field Experience/Internship: Please list the course outline in your preferred numbering or bulleting style. It is recommended that you use a numbering format for this field.

Evaluation of Student Performance: Please list the evaluation of student performance in your preferred numbering or bulleting style.

You must use the numbering list feature within the toolbar above each field. Right click on a number in the list and select "Numbered List Properties" to change the numbering style. Please maintain consistency in the selected numbering or bulleting styles.

Reminder: DO NOT MAKE CHANGES TO YOUR COURSE INFORMATION (PART III) UNTIL AFTER YOU LAUNCH THE PROPOSAL in order to track changes. Failure to use the track changes feature may cause a delay or denial of your proposal.

If you modify additional fields not already indicated, please make sure you add them to the modification list.

Required reading and other materials will be equivalent to:*

Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition

Specific, Measurable Student Behavioral Learning Objectives:*

Upon completion of this course the student should be able to:

1. Evaluate and choose an appropriate machine learning technique for a given problem.
2. Analyze how a neural network model is represented and how it encodes non-linear features.
3. Select appropriate machine learning models for differing problems.
4. Compare supervised, unsupervised, and reinforcement learning.
5. Create and analyze models that reflect real-world data.

**Detailed Outline of
Course Content
(Major Topics and
Subtopics) or Outline
of Field
Experience/Internship ***

1. Introduction to Machine Learning
 1. Overview of machine learning
 2. Types of machine learning: supervised, unsupervised, reinforcement
 3. Applications and examples in real-world scenarios
2. Statistics Basics for Machine Learning
 1. Basic concepts: mean, median, mode, variance, standard deviation
 2. Probability distributions and their significance in ML
 3. Sampling methods and importance
3. Linear Regression
 1. Understanding linear regression and its mathematical basis
 2. Cost functions and gradient descent
 3. Overfitting and underfitting
4. Logistic Regression
 1. Introduction to classification problems
 2. Sigmoid function and log-odds
 3. Evaluation metrics for classification (accuracy, precision, recall, F1-score)
5. Decision Trees and Random Forests
 1. Basics of decision trees
 2. Entropy and information gain
 3. Ensemble methods: introduction to random forests
6. Support Vector Machines (SVMs)
 1. Linear SVM classification
 2. Non-linear SVMs using kernel trick
 3. SVM regression
7. Unsupervised Learning: Clustering
 1. K-means clustering
 2. Hierarchical and density-based clustering methods
 3. Evaluating clustering performance
8. Dimensionality Reduction Techniques
 1. Principal Component Analysis (PCA)
 2. t-Distributed Stochastic Neighbor Embedding (t-SNE)

3. Applications in feature reduction and visualization
9. Model Evaluation and Validation
 1. Train/test split, cross-validation
 2. Overfitting, underfitting, model complexity
 3. Model selection techniques
10. Neural Networks: Basics
 1. Perceptrons and multi-layer perceptrons
 2. Activation functions (ReLU, sigmoid, tanh)
 3. Backpropagation and training neural networks
11. Deep Learning: Convolutional Neural Networks (CNNs)
 1. Introduction to CNNs and their architecture
 2. Applications in image processing and computer vision
 3. Transfer learning and pre-trained models
12. Deep Learning: Recurrent Neural Networks (RNNs)
 1. Understanding RNNs and their applications
 2. Challenges in training RNNs (vanishing and exploding gradients)
 3. Long Short-Term Memory (LSTM) networks
13. Ethical Considerations in Machine Learning
 1. Bias and fairness in ML models
 2. Privacy concerns in data handling
 3. Ethical implications of automated decisions
14. Advanced Topics and Emerging Trends
 1. Overview of recent advancements in ML
 2. Introduction to reinforcement learning
 3. Discussion on generative adversarial networks (GANs)
15. Projects
 1. Final projects

**Evaluation of Student
Performance:***

1. Quizzes
2. Exams
3. Participation
4. Classwork
5. Homework
6. Papers
7. Projects

Academic Affairs and Registrar's Office Use Only

Notes Curriculum and Reporting Specialist added required reading and SBLOs to specify all course modifications field and corrected the outline format.

This course modification will be effective for the University 2024-2025 Undergraduate Catalog via the Summer 2024 Catalog Addendum and will be reflected in Banner beginning in Spring 2025.

Form updated July 2022