

## Program Course Description Template

(Required information needed for course submission)

### **Program Information**

Program Name: UC Davis Center for Integrated Computing and STEM Education (C-STEM)

### **Contact Person**

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### **SECTION A. BASIC COURSE INFORMATION**

**Course Title: Integrated Mathematics I w/ Computing (C-STEM)**

**Transcript Abbreviation(s) / Course Code(s):** \_\_\_\_\_

**NOTE:** Schools are responsible for providing the above information.

#### **Length of Course:**

- Half Year (1 semester; 2 trimesters; 2 quarters)
- Full Year (2 semesters; 3 trimesters; 4 quarters)
- Two Years (4 semesters; 6 trimesters; 8 quarters)

#### **Subject Area / Discipline:**

**NOTE:** See attached [Appendix A] for all subject areas and disciplines.

Subject Area: Mathematics

Discipline: Mathematics I

#### **UC Honors Designation:**

Is this course being submitted for [UC honors](#) consideration?

**NOTE:** 9<sup>th</sup> grade courses are not eligible for UC Honors consideration.

- Yes    No

#### **Grade Level:**

**NOTE:** Grade level pertains to which grades the course has been designed.

- 9    10    11    12

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#### **Course Learning Environment:**

Is this course, or any separate section of this course, taught in an online learning environment?\*

- Yes    No

If “Yes,” has your institution conducted a self-assessment of the online course against the [iNACOL Standards for Quality Online Courses](#)?

- Yes    No

If “Yes,” does the course fulfill all 15 UC-identified power standards from the iNACOL Standards for Quality Online Courses?

Yes  No

If “Yes,” how many of the remaining 37 standards from the iNACOL Standards for Quality Online Courses the course satisfy? \_ \_\_\_\_\_

\*Please ensure to attach a copy of your completed [Online Course Self-Assessment Form](#).

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**Is this course an integrated course?**

**NOTE:** UC encourages the development of integrated courses that combine and skills of traditional academics with contextualized learning in [career technical education](#).

Yes  No

**If “Yes,” please indicate the Industry Sector and Career Pathway below:**

**NOTE:** See attached [Appendix B] for all industry sectors and career pathways.

Industry Sector: Information and Communication Technologies (ICT)

Career Pathway: Software and Systems Development

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**SECTION B: COURSE DESCRIPTION**

**Course Overview:**

Briefly (in a short paragraph) provide a brief summary/snapshot of the course’s content:

The course guides students through topics in Integrated Mathematics 1 in Common Core State Standards for Mathematics while simultaneously teaching students programming and computational thinking. Students use programming in C/C++ interpreter Ch to reinforce and extend their knowledge of mathematical concepts by analyzing real life situations, identifying given information, formulating steps that a computer program could calculate to find a solution, analyzing the results for accuracy, and revising/modifying the programming solutions as necessary. Topics covered include solving one-variable equations with multiple steps, solving and plotting absolute value equations and inequalities, linear equations, systems of linear equations and inequalities, exponential functions, statistical data analysis and visualization, arithmetic and geometric sequences, and geometric transformations, including translations, rotations, and reflections, and geometric constructions. Group computing projects allow students to collaborate on critical thinking activities based on mathematics topics while developing their teamwork and communication skills.

Pre-Requisites: \_\_\_\_\_ Required \_\_\_\_\_ Recommended \_\_\_\_\_

**NOTE:** Laboratory science and Advanced VPA courses require a pre-requisite. Some courses require appropriate pre-requisites. Please refer to the “A-G” Guide for more information.

Co-Requisites: \_\_\_\_\_ Required \_\_\_\_\_ Recommended \_\_\_\_\_

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## Course Content:

For each unit of the course, provide:

- 1) A brief description (5-10 sentences) of topics to be addressed that demonstrates the critical thinking, depth and progression of content covered.
- 2) A brief summary (2-4 sentences) of at least one assignment that explains what a student produces, how the student completes the assignment and what the student learns.

### Unit One: Introduction to Computing/Operations with Real Numbers

This unit introduces the students to how a computer works and the importance of computing in the 21<sup>st</sup> century. Students learn the basics of programming and programming language syntax in C/C++ using the C/C++ interpreter Ch. Students evaluate expressions and practice order of operations in a Ch Command Shell. Students write proper programming language syntax to review and practice basic operations with real numbers, order of operations, and manipulating and evaluating variables in simple algebraic equations. To meet the challenges of this unit, students persevere in solving specific problems with attention to precision, construct variable arguments and critique the reasoning of others, and model with mathematics. Throughout this unit, students understand problems that arise in real life context of programming and find solutions of multi-step problems, choose and interpret the problems with formulas and conceptual understanding, and choose and interpret the scale of measurement. These skills are demonstrated in multi-tiered tasks throughout the unit and students apply their knowledge and understanding of basic programming syntax and number sense, expressions and equations to create mathematical models.

The purpose of tasks in this unit is two-fold: develop and enhance mathematical and programming concepts. For example, each student in pairs of two is given a set of 30 problems on order of operations. Students evaluate these problems by performing basic calculations using a Ch Command Shell. As another example, each pair of students creates a Tic-Tac-Toe grid and marks it only if he/she gets the correct answer. Both students keep evaluating until two Tic-Tac-Toe grids are filled and a winner emerges.

### Unit Two: Using Functions for Math Application

In Unit Two, students learn function notations and develop the concepts of domain and range in terms of a given context. Students explore four types of functions (arithmetic sequence, geometric sequence, linear, and exponential) and interpret them graphically, numerically, symbolically, and verbally. Comparing and contrasting all 4 types of functions, students interpret arithmetic sequences and geometric sequences as linear functions and exponential functions, respectively. Through real-world applications, students master the concept of function transformations and the effects of each transformation in terms of the context. Students work as a development project team to construct Ch programs, each defines a function, call the function using correct syntax, and debug it. Students construct graphs of functions using **plot.func2D()** and **plot.expr()**, and scatter plots using **plot.point()** and **plot.scatter()**. In addition, there are many opportunities for students to practice and improve their writing, reading, listening, and language skills.

Students learn the concept of various functions and the graphical representation of functions. In pairs, students write a Ch program that includes declaring several different types functions (linear, polynomial, and exponential) and then plotting these functions. Creating their own linear, polynomial, and exponential functions for this task, students diagram each function through a flowchart.

### Unit Three: **Linear Models and Solving Linear Equations and Inequalities**

In this unit, students work on multiple tasks integrating concepts of mathematics and software development. Students connect two-dimensional lines and systems of equations algebraically and graphically using programming. Animation is used to show students that the graph of a linear function is the set of all ordered solutions plotted on a plane. Students use a powerful graphing program to get a deeper understanding of the solution to a system of two linear equations. Students will explore real life problems that require them to solve a system of two linear equations. Certain tasks focus on systems of linear equations or systems of linear inequalities. Students will solve an introductory Linear Programming problem to summarize materials learned in this unit. This unit's tasks also focus on Standards of Mathematical Practice by providing multiple opportunities to have students make sense of problems and persevere in solving them, reason abstractly and quantitatively, and attend to precision.

One example of a student task is to generate a graph of height vs. face length of all students in the class in a scatter plot. This activity helps students understand the linear relationship between their height and their face length. First, each student in class accurately measures their height and face length working with a partner. All of this data must be displayed where each student can see it. Then, the students create a program to generate the desired graph.

### Unit Four: **Statistical Data Analysis**

In this unit students learn to reason abstractly and quantitatively to create plots with a title, labels, and specific points using member functions **plot.title()**, **plot.label()**, and **plot.point()**, respectively. Students make use of copying, pasting, and printing the displayed plot. Additionally, students informally fit a straight line to a scatter plot and find the trend line for the data. Using single variable statistical measures like mode, mean, median, and standard deviation, students summarize, represent and interpret data. Additionally, students use simple linear regression and residuals to analyze two-variable data. The data can also be interpreted using statistical models like scatter plots, dot plots, bar graphs, histograms, and Box-and-Whisker plots.

For the tasks in this unit, students integrate basic programming with the fundamentals of data modeling in order to analyze sample data. Building upon prior knowledge, students expand their knowledge and relate to real-world applications of using a scatter plot to find the most cost-effective Disneyland ticket package. Students print out their scatter plot and paste it on poster board to be presented to the class. Students continue to reinforce scatter plots and trend lines concepts in mathematics while informally analyzing residuals to assess the fit of a trend line.

## Unit Five: **Congruency and Geometric Transformation**

In Unit Five, students apply previously gained knowledge of software development to the mathematical concepts of congruence and the geometric transformation of translations, rotations, and reflections. In this way, students learn how geometric transformations are applied to the movement of objects in a plane through rules that define that movement. When writing their computer programs in Ch, students expand their computer programs with plotting that visually demonstrate and reinforce the different types of rigid motions and coordinate geometry. Students develop an understanding of congruency through the application of rigid motions as it applies to polygons. The tasks in this unit require the student to use best programming practices and apply mathematical concepts precisely. Students practice using appropriate tools strategically and attending to precision.

This unit allows students to experiment with translations. Students first translate geometric objects (e.g., triangles, quadrilaterals, etc.) by hand using graph paper and patty paper. Based on these explorations, students describe translation rules as a function of  $(x, y)$  and write specific translation rules for each problem they encounter. Then, students write a program, *translations.ch*, that graphs a geometric object's pre-image and image under a user-defined translation. Students must present their key data in a table format, and produce a one-page explanation of how they could improve upon their program design.

## Unit Six: **Coordinate Geometry and Geometric Construction**

Students build depth of knowledge upon their prior understanding of geometry with a Cartesian coordinate system to verify geometric relationships, including properties of special triangles, quadrilaterals, circles, and slopes of parallel and perpendicular lines, as well as areas and perimeters of polygons. Students also design computer programs for other geometric shapes including triangles and other polygons. Continually, building one task after another, students expand their programming capacity by adding a control and loop structure in programming. This extends into designing three additional computer programs for a triangle with reflection transformations under three circumstances. Eventually, students design additional computer programs for other geometric shapes. Expressing geometric properties with equations, students use coordinates to prove simple geometric theorems algebraically. Throughout this unit, students communicate their reasoning, demonstrate conceptual and procedural fluency, find examples of connecting Algebra and Geometry through coordinates in real life contexts by applying the elements of mathematical modeling, and become efficient problem solvers.

In one of the task, students prove polygons generated by plot functions in Ch such as **plot.triangle()**, **plot.rectangle()**, and **plot.quad()** are scalene triangles, isosceles triangles, equilateral triangles and rectangles by using algebraic formulas such as the slope formula and the distance formula. First, students generate 3 triangles and 1 rectangle on a coordinate plane using defined functions in Ch. Using the coordinates of the corners of each shape, students apply the slope formula and the distance formula to classify the shape. At the end, students turn in their picture that was generated by a program in ChIDE and the step-by-step calculation used to classify each shape.

In addition, students will use a compass, straightedge, and protractor to copy a line segment, copy an angle, bisect a segment, construct a perpendicular line, bisect an angle, construct a line parallel to a given line through a point, construct regular hexagon inscribed in a circle, construct an equilateral triangle, and construct a square.

**(Please feel free to add as many unit fields as necessary.)**

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## **SECTION C: COURSE MATERIALS**

Primary Textbook:

**NOTE:** Include list of primary and secondary course materials. Course materials help UC understand what materials are used to support student learning and the delivery of the course.

Title: Learning Common Core Mathematics with C/C++ Interpreter Ch for Integrated Mathematics 1

Edition:

Publication Date: June 2016

Publisher: UC Davis C-STEM Center

Author(s): Harry H. Cheng

URL Resource(s): <http://c-stem.ucdavis.edu>

Usage: x \_\_\_\_\_ Primary Text    x \_\_\_\_\_ Read in entirety or near entirety

Software: C-STEM Studio

Developer: UC Davis C-STEM Center

Website: <http://c-stem.ucdavis.edu/downloads/>

Software: Ch Professional Edition

Developer: SoftIntegration, Inc.

Website: <http://www.softintegration.com/download/>

Supplemental / Secondary Instructional Materials:

**NOTE:** Please list any other course materials here. These may include but are not limited to: literary texts, manuals, periodicals, articles, websites, primary documents, multimedia, etc.

### **[APPENDIX A] — SUBJECT AREAS / DISCIPLINES**

**NOTE:** For detailed information on all subject requirements, please visit the [A-G Guide](#).

\_\_\_\_\_ (“a”) – History / Social Science

\_\_\_\_\_ U.S. History

\_\_\_\_\_ American Government / Civics

\_\_\_\_\_ World History / Geography / Cultures

\_\_\_\_\_ (“b”) – English

\_\_\_\_\_ English

\_\_\_\_\_ English as a Second Language (ESL)/ English Language Development (ELD)

x \_\_\_\_\_ (“c”) – Mathematics

- \_\_\_\_\_ Algebra 1; Yr 1 of 2
- \_\_\_\_\_ Algebra 1; Yr 2 of 2
- \_\_\_\_\_ Algebra 1
- x \_\_\_\_\_ Mathematics I
- \_\_\_\_\_ Geometry; Yr 1 of 2
- \_\_\_\_\_ Geometry; Yr 2 of 2
- \_\_\_\_\_ Geometry
- \_\_\_\_\_ Mathematics II
- \_\_\_\_\_ Algebra 2; Yr 1 of 2
- \_\_\_\_\_ Algebra 2; Yr 2 of 2
- \_\_\_\_\_ Algebra 2
- \_\_\_\_\_ Mathematics 3
- \_\_\_\_\_ Algebra 2 / Trigonometry
- \_\_\_\_\_ Advanced Mathematics
- \_\_\_\_\_ Statistics
- \_\_\_\_\_ Computer Science

\_\_\_\_\_ (“d”) – Laboratory Science

- \_\_\_\_\_ Biology
- \_\_\_\_\_ Chemistry
- \_\_\_\_\_ Physics
- \_\_\_\_\_ Earth and/or Space
- \_\_\_\_\_ Integrated Science

**NOTE:** Students that enroll in an integrated-science program (ISP) are strongly advised to complete the entire three-year sequence. In most cases, the first year of an integrated-science sequence fulfills only the "g" elective requirement; the second and third years of the sequence then fulfill the two-year "d" laboratory science requirement. Accordingly, if only ISP I is successfully completed, then two courses from the categories of Biology, Chemistry, or Physics in the "d" subject area must be completed. If ISP I and only one of ISP II or ISP III are completed, then one additional course from the categories of Biology, Chemistry, or Physics from the "d" subject area must be taken to fulfill the "d" requirement.

\_\_\_\_\_ Interdisciplinary Science

**NOTE:** This category demonstrates that the course is cross-disciplinary and is often used for advanced science courses such as AP Environmental Science or Biochemistry.

\_\_\_\_\_ (“e”) – Language Other than English

- \_\_\_\_\_ LOTE Year 1
- \_\_\_\_\_ LOTE Year 2
- \_\_\_\_\_ LOTE Year 3
- \_\_\_\_\_ LOTE Year 4+

Language:

- \_\_\_\_\_ American Sign Language (ASL)
- \_\_\_\_\_ Arabic
- \_\_\_\_\_ Chinese

- French
- German
- Hebrew
- Italian
- Japanese
- Latin
- Other
- Russian
- Spanish

("F") – Visual & Performing Arts

- Dance
- Music
- Theater Arts
- Visual Arts
- Interdisciplinary Arts

("G") – College-Preparatory Elective

- History / Social Science
- English
- Mathematics / Computer Science
- Laboratory Science—Biology / Life Science
- Laboratory Science—Physical Science
- Laboratory Science—Earth / Space Science
- Laboratory Science—Interdisciplinary Science
- Laboratory Science—Integrated Science
- Language Other than English
- Visual & Performing Arts
- Interdisciplinary

**[APPENDIX B] — INDUSTRY SECTORS / CAREER PATHWAYS**

**NOTE:** This applies to integrated courses only.

Agriculture and Natural Resources

- Agricultural Business
- Agricultural Mechanics
- Agriscience
- Animal Science
- Forestry and Natural Resources
- Ornamental Horticulture
- Plant and Soil Science

Arts, Media, and Entertainment

- \_\_\_\_\_ Media and Design Arts
- \_\_\_\_\_ Performing Arts
- \_\_\_\_\_ Production and Managerial Arts

\_\_\_\_\_ **Building and Construction**

- \_\_\_\_\_ Cabinetmaking and Wood Products
- \_\_\_\_\_ Engineering and Heavy Construction
- \_\_\_\_\_ Mechanical Construction
- \_\_\_\_\_ Residential and Commercial Construction

\_\_\_\_\_ **Education, Child Development and Family Services**

- \_\_\_\_\_ Child Development
- \_\_\_\_\_ Consumer Services
- \_\_\_\_\_ Education
- \_\_\_\_\_ Family and Human Services

\_\_\_\_\_ **Energy and Utilities**

- \_\_\_\_\_ Electromechanical Installation and Maintenance
- \_\_\_\_\_ Energy and Environmental Technology
- \_\_\_\_\_ Public Utilities
- \_\_\_\_\_ Residential and Commercial Energy and Utilities

\_\_\_\_\_ **Engineering and Design**

- \_\_\_\_\_ Architectural and Structural Engineering
- \_\_\_\_\_ Computer Hardware, Electrical, and Networking Engineering
- \_\_\_\_\_ Engineering Design
- \_\_\_\_\_ Engineering Technology
- \_\_\_\_\_ Environment and Natural Science Engineering

\_\_\_\_\_ **Fashion and Interior Design**

- \_\_\_\_\_ Fashion Design, Manufacturing, and Merchandising
- \_\_\_\_\_ Interior Design, Furnishings, and Maintenance

\_\_\_\_\_ **Finance and Business**

- \_\_\_\_\_ Accounting Services
- \_\_\_\_\_ Banking and Related Services
- \_\_\_\_\_ Business Financial Management

\_\_\_\_\_ **Health Science and Medical Technology**

- \_\_\_\_\_ Biotechnology Research and Development
- \_\_\_\_\_ Diagnostic Services
- \_\_\_\_\_ Health Information
- \_\_\_\_\_ Support Services
- \_\_\_\_\_ Therapeutic Services

\_\_\_\_\_ Hospitality, Tourism, and Recreation

\_\_\_\_\_ Food Service and Hospitality

\_\_\_\_\_ Food, Science, Dietetics, and Nutrition

\_\_\_\_\_ Hospitality, Tourism, and Recreation

x \_\_\_\_\_ Information Technology

\_\_\_\_\_ Information Support and Services

\_\_\_\_\_ Media Support and Services

\_\_\_\_\_ Network Communications

x \_\_\_\_\_ Programming and Systems Development

\_\_\_\_\_ Manufacturing and Product Development

\_\_\_\_\_ Graphic Arts Technology

\_\_\_\_\_ Integrated Graphics Technology

\_\_\_\_\_ Machine and Forming Technology

\_\_\_\_\_ Welding Technology

\_\_\_\_\_ Marketing, Sales, and Service

\_\_\_\_\_ E-Commerce

\_\_\_\_\_ Entrepreneurship

\_\_\_\_\_ International Trade

\_\_\_\_\_ Professional Sales and Marketing

\_\_\_\_\_ Public Services

\_\_\_\_\_ Human Services

\_\_\_\_\_ Legal and Government Services

\_\_\_\_\_ Protective Services

\_\_\_\_\_ Transportation

\_\_\_\_\_ Aviation and Aerospace Transportation Services

\_\_\_\_\_ Collision Repair and Refinishing

\_\_\_\_\_ Vehicle Maintenance, Service, and Repair