SACRAMENTO CITY UNIFIED SCHOOL DISTRICT
BOARD OF EDUCATION

Agenda Item#__9.1h__

Meeting Date: July 18, 2013

Board of Education

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SECTION ONE — GENERAL INFORMATION

COURSE DESCRIPTION

This course provides a formal development of the algebraic skills and concepts using interactive computing, computer programming in C/C++, and hands-on robotics. This integrated math curriculum meets both

RoboPlay Competitions (http://c-stem.ucdavis.edu/roboplay):
UC Davis C-STEM Center organizes annual RoboPlay Competitions. RoboPlay Competitions are open-ended design challenges. The goal of the RoboPlay Competitions is to broaden student participation in computing, science, technology, engineering, and math (C-STEM) education with positive youth development for all students. The teamwork involved in the RoboPlay Competitions will engage all students including those who are inclined to pursue careers in the arts or humanities.

RoboPlay is designed for K-12 students to play with robots while having fun and exploring their creativity in writing, art, music, choreography, design, and film making and at the same time seamlessly learning C-STEM subjects. The necessary robot coordination to match the movement of multiple modules to music requires not only teamwork in designing a well-organized visual performance, but also the math and programming skills to produce the desired actions. The competitions enable students with different interests to explore the basic concepts of C-STEM in conjunction with their artistic and music talents.

There are two categories for RoboPlay Competitions: RoboPlay Video and RoboPlay Challenge. The RoboPlay Video Competition is completed within the classroom and submitted online. The RoboPlay Challenge Competition is held on UC Davis C-STEM Day. These robot competitions are open-ended design challenges that integrate math and computer programming with music, choreography, and design for practical real-world problem solving.

COURSE GOALS

Algebra is one of the most difficult topics for students to learn. This course is designed to support the students while they are taking algebra 1 or integrated mathematics 1. Algebra is a prerequisite for most courses in science, technology, engineering, and mathematics (STEM). It is considered as the gatekeeper for students to pursue a career in STEM. The primary goal of this class is to help students learn algebra. Through a sequence of well-designed hands-on math labs, students will learn basic concepts of algebra and their practical applications. At the same time, students will learn the fundamentals of computing, underlying working principles of computers, and computer programming for problem solving.

At the end of this course:
1. Students will be able to master the Algebra I concepts in the Common Core Math Standards.
2. Students will become stronger in the CCSS Standards for Mathematical Practice.
3. Students will be able to write computer programs in C/C++ language to solve algebraic problems and present the relations graphically using computer programs.
4. Students will be able to write computer programs in C/C++ language to control a single or multiple Mobots to accomplish specific tasks, including robotics dance.

5.

Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

CCSS.Math.Content.7.G.B.4 Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

CCSS.Math.Content.7.NS.A.2
Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.

CCSS.Math.Content.7.RP.A.3
Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

CCSS.Math.Content.8.EE.C.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

CCSS.Math.Content.8.F.B.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

CCSS.Math.Content.8.F.B.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS.Math.Content.HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context

CCSS.Math.Content.HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

CCSS.Math.Content.HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

CCSS.Math.Content.HSA-REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

CCSS.Math.Content.HSA-REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict

inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

CCSS.Math.Content.HSF-IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f(x)* denotes the output of f corresponding to the input *x*. The graph of *f* is the graph of the equation *y = f(x)*.

CCSS.Math.Content.HSF-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

CCSS.Math.Content.HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

CCSS.Math.Content.HSF-IF.C.7a Graph linear and quadratic functions and show intercepts, maxima, and minima.

INSTRUCTIONAL MATERIALS

(1) "LEARNING ALGEBRA USING C/C++ INTERPRETER CH", HARRY H. CHENG, UC DAVIS K-14 OUTREACH CENTER FOR COMPUTING AND STEM EDUCATION (C-STEM), UNIVERSITY OF CALIFORNIA, DAVIS, 2012.

(2) "LEARNING COMPUTER PROGRAMMING IN CH FOR THE ABSOLUTE BEGINNER", HARRY H. CHENG, UC DAVIS K-14 OUTREACH CENTER FOR COMPUTING AND STEM EDUCATION (C-STEM), UNIVERSITY OF CALIFORNIA, DAVIS

TEACHER RESOURCES

Teacher's solutions manual

RECOMMENDED STUDENT RESOURCES

Ch Student Edition 7.0

Suggested Activities

Go through all of the examples and have the students to the exercises in chapters 1 -12 of the book "LEARNING ALGEBRA USING C/C++ INTERPRETER CH.

Suggested Assessment

Have the students do the pre and post assessments for chapters 1 – 12 of the book "LEARNING ALGEBRA USING C/C++ INTERPRETER CH".

UNIT II: Equations and Graphing Lines

Students will use a utility program to practice solving linear equations. Students will also learn how to graph 2D lines and have deep understanding of domain, rang, intercepts and slope. Rational and Irrational numbers will also be addressed.

Standards Addressed

CCSS.Math.Practice.MP1
> Make sense of problems and persevere in solving them.

CCSS.Math.Practice.MP3
> Construct viable arguments and critique the reasoning of others.

CCSS.Math.Practice.MP4
> Model with mathematics.

CCSS.Math.Practice.MP5

function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

CCSS.Math.Content.8.F.B.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS.Math.Content.HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

CCSS.Math.Content.HSA-REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Instructional Objectives

- o Students will be able to solve multi-step algebraic equations but still need additional practice.
- o Students will be able to make use of the macro **M_PI** for   as well as the square root function **sqrt()** in application problems involving perimeter, distance and midpoint as well as solving for particular values using the Pythagorean formula. *(MP4, MP5)*
- o Students will be able to create a plot with a title, labels and specific points using member functions **plot.title(), plot.label(),** and **plot.point()** of the plotting class CPlot, respectively. Students will be able to make use of copying, pasting and printing the displayed plot. *(MP5, MP7)*
- o Students will be able to calculate slope using the Ch command window, construct programs to graph lines using two points, calculate intercepts, and use them to graph a line. *(MP1, MP3, MP5, MP7)*
- o Students will be able to make use of the slope-intercept formula in a program to solve for values and plot linear equations. *(MP1, MP3, MP5, MP7)*
- o Students will be able to intercept and modify graphs created from a chide program. Modification will include: range of axis, size grid specifications, and axis size ratios. *(MP1, MP3, MP5, MP7)*

Suggested Activities

Go through all of the examples and have the students do the exercises in chapters 13 -18 of "LEARNING ALGEBRA USING C/C++ INTERPRETER CH."

Suggested Assessment

Have the students do the pre and post assessments for chapters 13 – 18 from "LEARNING ALGEBRA USING C/C++ INTERPRETER CH."

UNIT III: Functions and Graphing

Students will learn what a function is in the context of both mathematics and computer science. Students will used per defined function in the C programing language as well as

UNIT IV: Polynomials

Students will take what they learned from unit III and extend it to 2-D linear systems, and 2-D Inequalities.

Standards Addressed

CCSS.Math.Practice.MP1
> Make sense of problems and persevere in solving them.

CCSS.Math.Practice.MP3
> Construct viable arguments and critique the reasoning of others.

CCSS.Math.Practice.MP4
> Model with mathematics.

CCSS.Math.Practice.MP5
> Use appropriate tools strategically.

CCSS.Math.Practice.MP7
> Look for and make use of structure.

CCSS.Math.Content.HSA-APR.A.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

CCSS.Math.Content.HSA-APR.D.7 (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS.Math.Content.HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context

CCSS.Math.Content.HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R.

CCSS.Math.Content.HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

CCSS.Math.Content.HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

CCSS.Math.Content.HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.

CCSS.Math.Content.HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

CCSS.Math.Content.HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

CCSS.Math.Content.HSA-REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Instructional Objectives

o Students will be able to evaluate polynomials in the Ch command window to verify correct arithmetic or factoring operations. *(MP3, MP6)*

o Students will be able to plot functions using the plotting member functions plot.plotType() and plot.lineType(), to change the type, width, and color of the curve and its fill. *(MP1, MP3, MP4, MP5)*

o Students will be able to rewrite inequalities, isolating y, and plot them using the plotting member functions plot.plotType() and plot.lineType(), to change the type, width, and color of the curve. *(MP1, MP3, MP4, MP5)*

o Students will be able to use general formulas provided, substitution and combination, to write a program that solves any system of equations in two variables. Students will also be able to write a program which graphs a system of equations in two variables and then visually obtain the solution to the system. *(MP5)*

o Students will be able to check if a set of ordered pairs vary inversely using the Ch command window and to plot an inverse variation function, avoiding the points of discontinuity by calling the plot.func2D() function multiples times. *(MP5)*

o Students will be able to check arithmetic operations performed on rational expressions using the Ch command window as well as graph rational functions using the correct domain and graph their asymptotes. *(MP6)*

o Students will be able to analyze square root functions to determine their domain and range.

o Students will be able to use the Ch command window to verify arithmetic operations on radicals as well as solve radical equations graphically rather than algebraically. *(MP6)*

Suggested Activities

Go through all of the examples and have the students to the exercises in chapters 23 - 33 of "LEARNING ALGEBRA USING C/C++ INTERPRETER CH."

Suggested Assessment

Have the students do the pre and post assessments for chapters 23 - 33 from "LEARNING ALGEBRA USING C/C++ I

UNIT V: Introduction to Geometry and Statistics

This section provides students with a hands on approach to learning some of the key concepts in geometry and statistics. The graphical functions in the ChIDE will be used to teach the concepts in geometry and statistics. As an extention to this, the mobots can be used to cover some of the geometry concepts.

Standards Addressed

CCSS.Math.Practice.MP1
>Make sense of problems and persevere in solving them.

CCSS.Math.Practice.MP3
>Construct viable arguments and critique the reasoning of others.

CCSS.Math.Practice.MP4
>Model with mathematics.

CCSS.Math.Practice.MP5
>Use appropriate tools strategically.

CCSS.Math.Practice.MP6
>Attend to precision.

CCSS.Math.Content.HSG-CO.A.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

CCSS.Math.Content.HSG-CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

CCSS.Math.Content.HSG-CO.A.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

CCSS.Math.Content.HSG-MG.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

CCSS.Math.Content.HSG-MG.A.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

CCSS.Math.Content.6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.

Instructional Objectives

o   Student will gain a deeper understanding of how space, in the contexts of lines and angles, is quantified. *(MP1, MP4, MP5)*

- o Students will learn the concepts of rigid motion by using mobots and the angles of the mobot's joints. *(MP1, MP4, MP5, MP6)*
- o **Students will know how to solve a real life problem such as installing flooring, using both programming and mathematics.** *(MP1, MP4, MP5)*
- o Students will take a set of 2D data and create a scatter plot of the data in the ChIDE. *(MP4, MP5)*
- o Looking at a scatter plot, the students will be able to determine if the relationship is positive, negative, or none.
- o Given a set of data, students will be able to use the ChIDE to generate a bar graph or a line graph. *(MP4, MP5)*
- o Students will be able to read and understand bar graphs and line graphs.
- o Given a set of data, students will be able to use the ChIDE to generate a bar graph or a box and whisker plot. *(MP4, MP5)*
- o Students will be able to read and understand a box and whisker plot.

Suggested Activities

Use the activates found in the Wiki under teaching on the website http://c-stem.ucdavis.edu/

Suggested Assessment

None.