Independent Study
Solving an Engineering Problem Using Google SketchUp and Ruby Programming Tools
Caroline Schiavo

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Advisor
Ralph Pantozzi, Ed. D.

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US Technology Coordinator
Judith Bianco

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Director of Technology
Kimberly Pearson

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Upper School Director
Elizabeth Woodall

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Course Description
This independent study extends learning in AP Computer Science A and emphasizes technology skills including the use of programming and Google SketchUp. The student will utilize the SketchUp SDK including the SketchUp C API , a coding interface for understanding and producing data in SketchUp models to interact with SketchUp files (.skp), which will modify old files and create new files. The student will also use Graphical User Interfaces (GUIs), a human-computer interface that uses icons and other computer tools through the use of a mouse with the assistance of code. The SketchUp Ruby API uses the Ruby programming language to extend the development of the GUIs and 'automate common tasks'. Ruby will be used as a scripting interface with SketchUp for the purpose of 3D modeling, and forming faces, objects, structures, and animations with the use of plugins to extend SketchUp's basic functions. SketchUp will teach the student how to manipulate 3D tools with precise measurement and create concrete engineering designs. With these processes, the student will gain knowledge of 3D modeling. The goal of the course is to design, develop, and generate a final project based on these specific concepts and using 'STREAM' to support the needs of the Kent Place community and its buildings including the in-progress Center for Innovation.

Independent Study Teacher
Ms. Judith Bianco, along with the assistance of the student's advisor, Dr. Ralph Pantozzi will be supervising the independent study. Ms. Bianco has been the student's teacher for AP Computer Science A and the trimester elective, Intro to Programming.

Skills
- Design 3D models including blueprints, layouts, and specific templates
- Use advance measuring techniques
- Utilize the SketchUp SDK (Software Development Kit)
    - Implementing specific data structures and functions
- Learn the Ruby programming language
- Understand Ruby programming in conjunction with the SketchUp Ruby API as a scripting interfaces for SketchUp
- Learn the basics of Graphical User Interfaces (GUI)
- Apply programming to engineering models
- Develop an understanding of the basic needs of civil and mechanical engineering
- Communication with Kent Place employees and students
- Gather survey information from Kent Place Community

Essential Questions
In the course, the student will answer these questions:
       What are the similarities and differences in all programming languages?
       How is programming, 3D prototypes and modeling related to real world applications?
       How to manipulate basic and advanced features of Google SketchUp?
       What is involved in the process of programming and engineering design?
       How is a structure created?

Course Readings and Resources
Some of the Primary texts are available for free online; if the texts are not free the student is willing to pay for them. The school would only have to pay for the SketchUp Pro 2014 Software, which Ms. Pearson has agreed to include in the 2014-2015 budget.
       Primary Texts:
              Introduction to Google SketchUp by Aidan Chopra $39.79
              Automatic SketchUp: Creating 3-D Models in Ruby by Matthew Scarpino $150
              Learn Ruby the Hard Way by Zed A. Shaw $28.06
       Primary Software:
              SketchUp Pro 2014 $49.00
       Free Online Sources:
              Code Academy Ruby: http://www.codecademy.com/tracks/ruby
              Udemy Ruby: https://www.udemy.com/courses/search/?q=ruby

       Secondary Texts:
              SketchUp Pro 2013 Step by Step by Joao Gaspar $28.95

Assignments and Due Dates
The independent study will take place over three trimesters of Senior Year with academic rigor.

Course readings and exercises will be specified in conjunction with the guidance of the Independent Study Teacher and to avoid any overlap of assignments.

       Trimester 1:
- Chapters 1-8 (Chopra)
  - Chapter 1: Meeting Google SketchUp
  - Chapter 2: Establishing the Modeling Mindset
  - Chapter 3: Building Simple Models
  - Chapter 4: Modeling Buildings
  - Chapter 5: Keeping your Model's Appearance
  - Chapter 6: Creating Everyday Objects
  - Chapter 7: Keeping Your Model Organized
  - Chapter 8: Modeling with Photographs
- Chapters 1-7 (Scarpino)
  - Chapter 1: Introduction to SketchUp Scripting
  - Chapter 2: Ruby Lesson #1: Data Structures

- o Chapter 3: Fundamentals of SketchUp Scripting
- o Chapter 4: Transformations and Additional Geometry
- o Chapter 5: Ruby Lesson #2: Control Structures and Files
- o Chapter 6: Colors, Textures, and Materials
- o Chapter 7: Managing Geometry: Layers, Groups, and Components
- Exercises 0-26 (Shaw)
  - o Exercise 0: The Setup
  - o Exercise 1: A Good First Program
  - o Exercise 2: Comments and Pound Characters
  - o Exercise 3: Numbers and Math
  - o Exercise 4: Variables and Names
  - o Exercise 5: More Variables and Printing
  - o Exercise 6: Strings and Text
  - o Exercise 7: More Printing
  - o Exercise 8: Printing, Printing
  - o Exercise 9: Printing, Printing, Printing
  - o Exercise 10: What Was That?
  - o Exercise 11: Asking Questions
  - o Exercise 12: Libraries
  - o Exercise 13: Parameters, Unpacking, Variables
  - o Exercise 14: Prompting and Passing
  - o Exercise 15: Reading Files
  - o Exercise 16: Reading and Writing Files
  - o Exercise 17: More Files
  - o Exercise 18: Names, Variables, Code, Functions
  - o Exercise 19: Functions and Variables
  - o Exercise 20: Functions and Files
  - o Exercise 21: Functions Can Return Something
  - o Exercise 22: What Do You Know So Far?
  - o Exercise 23: Read Some Code
  - o Exercise 24: More Practice
  - o Exercise 25: Even More Practice
  - o Exercise 26: Congratulations, Take A Test!

Trimester 2:
- Chapters 9-16 (Chopra)
  - o Chapter 9: Changing your Model's Appearance
  - o Chapter 10: Presenting your Model inside SketchUp
  - o Chapter 11: Working with Google Earth and the 3D Warehouse
  - o Chapter 12: Printing your Work
  - o Chapter 13: Exporting Images and Animations
  - o Chapter 14: Exporting to CAD, Illustration, and Other Modeling Software
  - o Chapter 15: Creating Presentation Documents with Layout
  - o Chapter 16: Troubleshooting and Using Additional Resources
- Chapters 8-13 (Scarpino)

- o Chapter 8: Ruby Lesson #3: Classes and Modules
- o Chapter 9: Attributes, Options, and Observers
- o Chapter 10: The SketchUp Interface: Dialogs, Menus, Commands, and Plugins
- o Chapter 11: The SketchUp Interface: Views, Cameras, Pages, and Tools
- o Chapter 12: Actions & Animation
- o Chapter 13: WebDialogs
- Exercises 27-49 (Shaw)
  - o Exercise 27: Memorizing Logic
  - o Exercise 28: Boolean Practice
  - o Exercise 29: What If
  - o Exercise 30: Else and If
  - o Exercise 31: Making Decisions
  - o Exercise 32: Loops and Arrays
  - o Exercise 33: While Loops
  - o Exercise 34: Accessing Elements of Arrays
  - o Exercise 35: Branches and Functions
  - o Exercise 36: Designing and Debugging
  - o Exercise 37: Symbol Review
  - o Exercise 38: Doing Things To Lists
  - o Exercise 39: Hashes, Oh Lovely Hashes
  - o Exercise 40: Modules, Classes, And Objects
  - o Exercise 41: Learning To Speak Object Oriented
  - o Exercise 42: Is-A, Has-A, Objects, and Classes
  - o Exercise 43: Gothons From Planet Percal #25
  - o Exercise 44: Inheritance Vs. Composition
  - o Exercise 45: You Make A Game
  - o Exercise 46: A Project Skeleton
  - o Exercise 47: Automated Testing
  - o Exercise 48: Advanced User Input
  - o Exercise 49: Making Sentences
- Survey for students and teachers to design and formalize a concept for the Culminating Assignment
  - o Examples:
    - ▪ How should the courtyard be designed for best functionality?
    - ▪ What elements would one want in the new library?

Trimester 3:
- Solidifying concepts from Trimester 1 and 2
- Working with the Phase III architectural and engineering firms
- Completing Culminating Assignment, specified below

Culminating Assignment could consist of:

- Working with the Phase III architectural and engineering companies to create virtual 3D Models
- Creating a new engineering design with the SketchUp SDK and Ruby API for:
  - Courtyard
    - Create a concept suitable for all types of weather and easily moveable without damage
  - Library
    - Develop a design that will help the library transition into to online learning, as it eliminates more print sources
  - Student lounge
    - To enhance the layout and efficiency of its daily space and square foot usage
  - Teacher stations
    - Ease the effort of teacher technology accessibility to enhance/increase classroom technology use
- Using Graphical User Interfaces (GUI) through Ruby to enhance my Google SketchUp Designs
- Utilize Ruby to create new SketchUp tools, objects, and web dialogs