Sectrics - Civil Engineering Software –Part D – HSC MAJOR PROJECT

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Contents

Logbook/Journal

Date & Time:	Difficulty:	Task Achieved:
Day/Month/Year	Difficulty (1-5)	Task Achieved – Challenge Encountered + Solution – Ideas & Thoughts – Reflection On Progress – Upcoming Tasks – (Bibliography)
09/25/2018	1	After drafting my first ideas for a major project I've decided to make a student study planner after looking at alternatives I've found that nothing integrates everything into an all in one bundle targeted towards HSC students by making an online based software students will be able to keep up to date with their work and not lose any progress if their computer or phone gets corrupted due to this idea I've decided to build a website, therefore, I've started to learn PHP, JS, MySQL as well as revising HTML & CSS
10/29/2018	2	Continued progress on learning PHP, JS & MySQL. After revision on HTML & CSS, I've decided to host a little static website to tinker on during my free time at shaancoding.com. Additionally, my HTML & CSS revision is finished.
10/30/2018	2	After getting semi-proficient in PHP I've decided to further work on the documentation of this project. Started with the initial prototyping phase of user interface designs as well as a storyboard and user story of how the application will work. In addition, I've started work on a data-flow diagram as well as a data dictionary.
10/31/2018	3	After further research and analysis when writing the scope of this project after completing the data flow diagram, I've decided that the scope of this project is too wide as well as the pre-requisites required are too many before, I can even attempt to begin this project. This in addition to the social & ethical issues that could potentially arise with an inadequately programmed piece of software, such as the leaking of user data, passwords & credit card information has ultimately made me decide to change projects to a Civil Engineering piece of software aimed towards students – Sectrics. So far initial research of truss analysis as well as the best way to solve linear algebra problems through computing. Additionally, the first implementation of the node.cs class file has been developed, taking in user inputs of node location, which node connects to which node (member variable), the forces applied as well as material properties have been implemented.
11/1/2018	1	Further research into the best way of solving this system. In addition, several key implementations of in the program have been added, in the main function, including; nodes, members as well as the start of the; support function, about function and exit application function.
11/3/2018	3	Continued programming of the civil engineering piece of software, after further research I've concluded that the best method of solving this system is utilizing the finite element method. Work on the solve function has begun with the creation of several math's functions including; DeltaX (which finds the difference between 2 points), as well as the implementation of a selection sort algorithm to hopefully find the maximum range and eventually length of a beam when implemented with a distance formula solver.
11/3/2018	4	Continued programming for the civil engineering software, however, I've gotten stuck with logic errors regarding solving the reaction forces, due to the restraint of me not wanting to utilize any additional libraries excluding the compulsory system library, I've gotten stuck determining a way to solve an equation.
11/4/2018	1	Began research on simultaneous equations to help solve the systems forces in each member, additionally found a method of solving simultaneous equations through matrices. This seems like the most efficient way and quickest way to solve a simultaneous equation. In addition, after discussing this with my math's teacher Mr Keagan he has, in addition, concluded that this would be the most efficient way. Due to this, I've begun watching Khan Academy videos on matrices and how to utilize these to solve simultaneous equations.
11/4/2018	1	After going out on Saturday I met a civil engineering and in the discussion, we began talking about my project. He recommended me to attempt to build a system similar to this in excel prior to programming it as it has several solve functions as well as the built-in implementation of matrices. Assisting me in modelling the structure prior to programming it. In addition, he also recommended me a video on how to solve simple truss questions with excel https://www.youtube.com/watch?v=CVSlVTvoMmA.

11/5/2018	3	Documentation has been lagging behind as I've continued to research methods of solving this problem. Today documentation again has been started. Work on the scope of this project has been started and due to a discussion with an engineering teacher an issue was highlighted to me regarding this project, regarding liability. There is rules & regulations regarding civil engineering software and if on the off chance an engineer uses my program and a bridge crashes due to the result of my software, I may be held liable. Therefore the scope has been changed to be specifically targeted towards students studying engineering studies in the HSC syllabus and not for real-life applications of structural analysis, in addition this has also changed the type of license this piece of software operates under, thus now falling under the **Mozilla Public License 2.0** stating that we are not liable for the misuse or use of this program.
11/5/2018	2	Further research and learning of matrices and how to solve simultaneous equations regarding matrices. So far have learnt how to multiply matrices and inverse matrices using the Gauss Jordon elimination method as well as the adjacent method. After careful consideration and the operations required to inverse the matrices, I've determined the easiest method to inverse the matrix would be the adjoint method.
11/10/2018	2	After further looking into the adjoint method and the coding of several functions, I've determined in turn to calculate the determinate using a matrix of minors, via the assistance of my math's teacher, the most efficient method most likely would be the utilization of a recursive function. Therefore, I've decided to research recursion and practice some recursive problems prior to the working on the determinant solver.
11/11/2018	3	Started the programming of the determinant function utilization recursive functions. The basic idea is to start from a big matrix and then split them up into smaller matrices and then split them up into smaller matrices until we get into the base form of a 1*1 matrix. Therefore, starting by a (n*n) then to a ((n-1) * (n-1)) going down to a (1*1).
11/11/2018	4	After a long 10-hour coding spree, finally finished the implementation of the determinant solver utilizing recursive functions. In addition, after further testing of the function have added catch functions allowing the process to only function if the matrix is square and in addition have solved a random issue regarding stack overflow error if the matrix is inputted with negative values.
12/11/2018	5	Further development of the math's functions, still focusing on programming a method to find the inverse of an n*n matrix. Full implementation of a function to remove rows & columns listed on a matrix and changing it to a ((n-1) * (n-1)) matrix has been developed. In addition, the creation of an (n*n) row column remover which takes a matrix of rows and columns has been developed, this function removes the related rows and columns listed simultaneously to avoid the changing of the global matrix's positions, thus changing the index removed.
13/11/2018	2	Completed the full implementation of the adjoint solver. The adjoint solver has been made by changing node locations and then using a matrix of cofactors on it.
20/11/2018	5	Finally finished all key matrix operations. Finished the full implementation of the matrix function, in addition, a key function completed was the inverse matrices solver, with catching if the matrix is not square or there is no determinant for example in the matrix {1,2,3}{4,5,6}{7,8,9} where the determinant, in this case, is 0.
21/11/2018	1	Continued work on additional matrix operations and additional functions. Created a matrix multiplication method between 2 matrices as well as a matrix multiplication method between a cofactor and a matrix. In addition, the creation of a matrix display function has been added, allowing quick ease of debugging as well as an aesthetically pleasing display format of matrix data.
21/11/2018	5	Started further work on the finite element method, specifically on modelling the structure to work with the finite element method. After careful consideration several key variables have been made including; Nodes, Members, Support, Load, Density, Young Modulus & Degrees of Freedom.
24/11/2018	5	Started further research on the finite element analysis method to solve simultaneous equations regarding the stiffness matrix. The first portion of it is understandable however I do not fully understand the global stiffness matrix. I've picked up a book regarding finite element method using this called Finite Element Procedures on the MIT website.
25/11/2018	5	Continued research on the finite element method, still encountering issues regarding the construction of the global stiffness matrix. Continued research on finite element analysis regarding alternative methods of constructing this matrix.

26/11/2018	5	Continued research on the finite element analysis method regarding the element stiffness matrix, after having another discussion with the Civil Engineer who previously recommended me with the matrix method, I've finally figured out a way to create the global stiffness matrix.
2/12/2018	2	Continued work on the feasibility study, focused heavily on the functional requirements of the program; full creation of the mandatory requirements, desirable requirements, optional requirements and possible future enhancements have been created.
3/12/2018	3	Started work on the generation of ideas and alternative solution phase including; idea generations, solution idea generations, possible alternative solutions, existing alternative solutions as well as possible alternative solutions.
5/12/2018	3	Continued work on the feasibility standard and finished the writing up of the convention/standard section as well as the Scope & Financial section. Issues, however, arise through the development in with the cost-benefit analysis.
6/12/2018	2	Continued work on; cost estimate, cost-benefit analysis in addition to operational, technical as well as project plan and Gantt chart.
8/12/2018	1	Finishing off on cost estimate, cost-benefit analysis, operational, technical and project plan and Gantt chart, additionally started and finished the section regarding social & ethical considerations.
10/12/2018	1	Starting work on the planning & designing phase; finished the user interface & screen design in addition to user storyboards and the input process output diagram.
12/12/2018	2	Started and finished the context diagram.
13/12/2018	2	Started and finished the decision trees as an optional requirement.
14/12/2018	2	Started and finished the Data Flow Diagram (DFD), Structure Chart, System Flowchart as well as Hardware & Software Requirements.
16/12/2018	N/A	Work delayed due to extreme rain conditions, many trees fell, and power was out in West Pennant Hills & Thornleigh, after driving to a friend's house started and finished the Data Dictionaries as well as Test Data.
16/12/2018	5	Finished Section 1 of the SDD major project, going to office work to print out project & get it bound.
4/01/2019	5	Initial commit of the Sectrics V1 Command Line Interface (CLI) program on GitHub. GitHub is used for better version control and to maintain a better logbook as well as easily revert changes if errors arise whilst still saving work.
5/01/2019	2	Start of Sectrics V2, a graphical user interface (GUI)
6/01/2019	1	Start of user manual as well as ReadMe.md
7/01/2019	1	Added a term of service & license for the operation of this program
3/03/2019	2	Fixed main menus on GUI program. Main menu for nodes was linking back to itself for all menus, fixed this by changing the path of the file it would open to a separate file instead of itself.
4/03/2019	3	Partial addition of the drawing function in the solve menu, this function draws what the bridge looks like with a zoomable & draggable feature. At the moment it however lacks the ability to display tension/compression in each beam as well as displaying images for supports on support nodes.
8/03/2019	3	Further implementation on the GUI interface, drawing the truss in a simple yet laggy form. In future addition of scrolling for zooming in and out as well as proper placement of supports with forces being displayed with magnitude and direction will be added.
9/03/2019	3	Further implementation of the GUI interface fixing styling inconsistencies as well as the implementation of a main menu thus making the tutorial optional instead of appearing every time the program is initialized.
10/03/2019	3	Further implementation of the GUI solve menu. Added the ability to view nodes supports.
12/04/2019	5	Further implementations on the GUI solve menu. Added the ability to view stresses / compression coefficients visually as well as displaying direction in red or blue for compression / tension.
26/04/2019	4	Added the ability to add or remove data for the nodes and members menu. Added the ability to add or remove data by the ability of viewing nodes & members data through a drop-down list. In the current version aesthetics and consistencies do not exist. In a future patch, additional menus for other forms will also include this menu as well as having the themes being more consistent throughout forms.

27/04/2019	4	Added the ability to add or remove data for material properties & support properties.
28/04/2019	5	Slight bug fix on the load menu. Bug fix on the loads menu not working and displaying the first support as "Null" when clearing data.
1/05/2019	2	Added draggable bridge. Added the ability for the bridge to be draggable on all forms, allowing the user to better view sections of the bridge in close detail, useful for complicated trusses.
5/05/2019	1	Added saving of bridges. Added the ability to save bridges in a .CSV format created by Sectrics.
6/05/2019	3	Fixed the saving of bridges in a more useful data format removing unneeded data and adding support types to the .CSV to display pictures for supports.
8/05/2019	3	Added the ability to take pictures of the bridge. Added the ability to save pictures of the drawn bridge as a png or jpg file.
10/05/2019	3	Fixed fatal crash. Removed the ability to crash the program by adding identical members, in addition added a try, catch statement to the drawing of the bridge to prevent the software crashing if information is entered incorrectly.
11/05/2019	3	Fixed fatal crash. Removed the ability to add nodes with the same coordinate leading to delta length in the solve menu having a length of zero leading to divide by zero errors.
12/05/2019	3	Further bug fixes. Removed a list of misc. bugs
13/05/2019	4	Update on the drawing menu. Added the ability to drag around the drawn bridge more fluidly and having the ability for the bridge to show on all menus whilst maintaining the same location.
13/05/2019	3	Finished the ability to save & load files. Finished the ability to load files in the "Nodes Menu" for a shortcut in testing as well as to allow the user to save & load files. This feature in future will be formatted and moved to all forms in a consistent theme in the next update.
14/05/2019	4	Added the ability to resize the menus. Added the ability to resize all menus whilst keeping the same dimensions for all.
15/05/2019	3	Added the ability to calculate reaction forces. Added a simple method of determining reaction forces in each support node and then breaking the resultant.
21/05/2019	4	After valid criticisms from Tian, Jason as well as others, the GUI has been updated. The GUI has been updated to look less like a flash game from the early 2000s but a simpler dark theme UI for a piece of engineering software. This allows the scaling of the program to look better aesthetically as well as to simplify the user experience.
23/05/2019	3	Further work on the GUI. Further work on the user interface, simplified and optimized the interface to add additional remove decluttering the program allowing the user to see and view more data in a more efficient, better looking manner.
23/05/2019	4	Finalized some code for previous feature, adding "back" button to all applications leading to a main menu. In addition, added the ability to view the bridge during construction instead of solely in the solve menu.
24/05/2019	4	Bug patch. When removing a member linking to a node that doesn't exist anymore members are not deleted, this leads to a fatal crash of both the drawing section of the program in addition to the solve menu.
25/05/2019	4	Added the memberTable form, replacing the table that would show up on the main member form to a separate form decluttering the menu
25/05/2019	4	Added the materialTable form, replacing the table that would show up on the material properties form to a separate form decluttering the menu
25/05/2019	4	Added the supportsTable form, replacing the table that would show up on the main supports form to a separate form decluttering the menu
25/05/2019	4	Added the loadsTable form, replacing the table that would show up on the main loads form to a separate form decluttering the menu
25/05/2019	1	Deleted legacy assets. Deleted legacy assets, including background & depreciated buttons which are no longer used in the program.
26/05/2019	4	Added the ability to reset the bridge. Added the ability to reset the bridge removing all nodes, members, material properties etc. to allow the user to build a new bridge from scratch without reopening the program.

27/05/2019	4	Slightly tweaked UI. Slightly tweaked the UI by changing positions on buttons as well as other items to be more consistent with the major theme of the program.
28/05/2019	4	Changed logos & themes. Further updated the theme to be a more modern, professionally looking software going to a more commercial software aesthetic. This includes the changing of the logos.
28/05/2019	4	Adjusted UI. Adjusted the UI for further consistency between UI's additionally.
28/05/2019	4	Added confirmation for new bridge. Added a confirmation screen for the ability to create new bridges. This prevents users from accidently wiping out all their data by misclicking or by accident.
29/05/2019	4	Updated the loadBridge function. Updated the loadBridge function fixing it so that not all data is wiped then erased prior to the user confirming. This prevents users from cancelling the form and having all their data wiped out regardless.
2/06/2019	5	After fatal error in creation of element-stiffness matrix, due to low time restraints I've decided to utilize my python code to calculate reaction forces.
2/06/2019	5	Added the ability to load python as well as transfer & receive information from python file by using arguments during initialization.
2/06/2019	5	Added additional connections & bug fixed datatypes changing integers to doubles.
3/06/2019	5	Fixed the output of the python file to a readable format in C#.

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