

NA_WorkSheet Introduction

The NA_WorkSheet is an aggregation of numerical algorithms collected into a single Java application/applet. The worksheet has been designed to allow a simple user interface for accessing and executing each numerical method. Each numerical analysis algorithm will normally require some type of input. The input will normally come in the form of an input equation/data and parameters for controlling the execution of the algorithm. Output from each algorithm approximation is directly available as either a solution or combination solution and intermediate data. The NA_Worksheet also provides the capability to graph an input equation with the ability to both translate and scale the resultant plot.

Upon running the NA_Worksheet application/applet the user will be presented with a standard 800x600 pixel frame that will conform to the host workstation's look and feel, theme. The frame can be resized to any desired dimension. The user's interface for the worksheet is divided into a quadripartite. In the upper left quadrant is the graph panel. Here plots can be viewed of the equation that is input for analysis. The upper right panel holds the main input, where various numerical methods can be selected and executed. The panel also provides a text box where the input equation for analysis can be entered. Two main buttons allow the user to either execute the selected approximation or graph the input equation. The lower left panel houses several tabbed panes that allows data output to be viewed, function evaluation, or controls for the graph panel to be accessed. The graph tab also includes the present grid scaling on the graph and coordinate information. The final panel in the lower right quadrant is particular to each selected numerical approximation. This panel provides the parameter selection and input for each chosen numerical method. A condensed list of the panels and there names follows:

- Graph Panel - Upper left quadrant
- Main Input Panel - Upper right quadrant
- Output/Graph Control Panel - Lower left quadrant
- Approximation Method Panel - Lower right quadrant

As an example to the general functionality of the NA_WorkSheet, input into the Main Input Panel Equation for Analysis text box, " $10*\sin(x/2) + 4$ ". Any equation input into this text box must reflect a valid numerical expression.

Multiplication and division being reflected with the characters "*", and "/" respectively. The valid variable assignment in this equation must be "x". A graph can now be generated of the Equation for Analysis by pressing the Graph Equation/Data button on the Main Input Panel. The Graph Panel will now display the resultant plot if there is not a problem with the input expression. If there is a problem the Output/Graph Control Panel Data pane tab will display the error. Various parameters associated with the generated plot in the Graph Panel can now be manipulated and displayed. Select the Graph tab in the Output/Graph Control Panel to view these options. The plot can be translated or zoomed in or out with the buttons in this panel. Also when the mouse pointer is within the Graph Panel the Present Coordinate position is displayed at the bottom of the Graph pane tab. At the bottom of this tab is also shown the present Grid Scale and the value of a Selected Coordinate position if the left mouse button is clicked on the graph somewhere. Another feature of the Graph Panel in the worksheet is the ability to control the colors used for the axis, background, grid, and plot. These are controlled through the Graph MenuBar selection at the top of the NA_WorkSheet.

Almost all approximations presently in the NA_WorkSheet will work with the Equation for Analysis. So its important to have a valid and correct expression. Lets now execute one of the approximations. In the Main Input Panel, select the Numerical Analysis Type "Polynomial Root", if it is not already selected, from the pull down menu. Select the "Bisection" approximation listed in the Main Input Panel. The approximation's input panel should now be displayed in the Approximation Method Panel, lower right quadrant. Several text boxes are listed, in the Approximation Method Panel, "Interval Endpoint A", "Interval Endpoint B", "Approximation Tolerance", and "Number of Iterations". There should also be a lone checkbox labeled "Intermediate Data". The Bisection Approximation is called a Polynomial Root finding numerical method. The approximation will try to determine the value of x in our equation, $f(x) = 10 \sin(x/2) + 4$, where $f(x) = 0$. In order for this particular approximation to achieve this it needs some hints. The hints are the two endpoints, Interval Endpoint A and Interval Endpoint B. Preferably there should be only one point between these values of x where f(x) will evaluate to zero. The graph can help us out here to select the two endpoints. With the mouse pointer over the graph left click to find two "Selected Coordinate" points on either side of where the sine function crosses $f(x) = y = 0$. Two such indeterminate points should be 5 and 10. Enter these two numebers for the "Interval Endpoint A" and "Interval Endpoint B". Now also enter "0.000001" for the "Approximation Tolerance", and "25" for the "Number of Iterations" in the Bisection Method Approximation's input panel. The execution of the approximation can now be accomplished by pressing the "Execute Approximation" button in the Main Input Panel. Results for each approximation will be displayed in the Output/Graph Control Panel Data pane tab text area. In this case "Root = 7.106218" should be displayed. Any errors associated with the execution of an approximation will also be displayed in this same text area.

The NA_WorkSheet provides a generic framework for executing various numerical analysis methods/approximations. Most of the approximations in the worksheet generally follow the sample process given in the previous paragraph. Some approximations do require some additional input or do not work with the Equation for Analysis. All the approximations if possible will provide additional data output besides the resulting solution if the "Intermediate Data" checkbox is selected in the approximation's Method Input Panel. Each approximation will also store resulting data so that comparisons can be made between similar numerical methods. In the Output/Graph Control Panel Data pane text area results can also be appended and output to the standard I/O. Future planned features also might include a more formal formatted resultant data, data file export, and generic printing of the particular setup/data of the worksheet's executing approximation.