Monster Sudoku Puzzle Solver Design Document

* Object List (Description of purpose, role, and intent)
  + Generator – Generates a random Monster Sudoku Puzzle based on parameters.
  + Reader/Writer – Reads input Sudoku or parameter files to generate puzzles and writes the puzzle to files.
  + Puzzle – A Sudoku puzzle, or an array of variables.
  + Variable – A variable, or cell of a Sudoku puzzle.
  + Solver – Solves a given Sudoku puzzle
  + Bookkeeper – Keeps record of level, variable assignment, and value deletion.
  + Logger – Logs information to log file
  + Alphabet – Holds the possible values for the variables
* Method/Member List
  + Generator (Done)
    - Char\*\* Generate Puzzle (int m, int n, int p, int q)
      * Takes as input m, the number of pre-solved cells, n, the size of the puzzle, p, the length of each block, q, the width of each block.
      * Returns a 2D char array.
  + Reader/Writer (Done)
    - Char\*\* Load Puzzle (char\* f)
      * Takes as input f, the input file name.
      * Returns the 2D char array of the puzzle
    - Void Save Puzzle (char\*\* p, char\* f)
      * Takes as input p, the char array, and f, the output file name
    - Char\*\* Create Puzzle (char\* f)
      * Takes as input f, the input file name
      * Returns the generated 2D char array
  + Puzzle
    - Members: 2D array of Variables, int m,n,p,q, alphabet
    - Bool Consistent (int x, int y)
    - Bool Complete ()
    - Set Puzzle
  + Variable
    - Members: int x, y (position), vector<char> domain
    - Add/Remove to Domain
  + Solver
    - Map<Flag,bool> Flags (for Heuristics), Book Keeper
    - Log Bundle Solve (Puzzle, timeout) – Solves the puzzle using a recursive backtracking search.
    - Log Bundle Back Track Search (Puzzle, level, timeout) – Recursively backtracking searches for a solution. Puzzle, and level are modified. When the time taken exceeds timeout, it will end and return a log bundle
    - Variable Select Next Variable (Puzzle) – Gets the next variable to search for a value, depending on heuristics and current puzzle state
    - Values Order Domain Values (Variable, Puzzle) – Returns a list of ordered values depending on heuristics and the puzzle state of the variable.
    - Bool Check Consistency (Variable Position, Puzzle, Value) – Checks if the value for the variable is consistent with the constraints
    - Bool Check Completeness (Puzzle) – Checks if the puzzle is complete
    - Book Keep (Level, Variable, Value, Puzzle) – Records the variable and values into the book keeper and removes them from the puzzle domains
    - Undo (level, Puzzle) – Undoes the specified level, i.e. adds back the values to the puzzle domains
    - Forward Check (Puzzle, Variable) – Checks the neighbors of the variables and removes the only value in that variable’s domain from the neighbors’ domains
    - Apply MRV (Puzzle, Unassigned Variables) – Assigns each unassigned variable with a number, and returns a list of variables with only the smallest number.
    - Apply DH (Puzzle, Unassigned Variables) – Assigns each unassigned variable with a number, and returns a list of variables with only the largest number.
    - Apply LCV (Puzzle, Variable) – Assigns each value in the variable’s domain with a number, and returns an ordered list of them from least to greatest.
    - Get Degree (Variable, Puzzle) – Gets the degree of the variable.
    - Get Remaining Values (Variable) – Gets the number of values in the domain.
    - Get Number of Constraints (Variable, Value, Puzzle) – Gets the number of constraints the value will have if assigned to the variable.
    - Apply AC (Puzzle) – Applies global arc consistency based on current state of the puzzle
    - Check All Dif (Variable Position, Puzzle, Value) – Checks if the value in the variable position satisfies the all dif constraint
    - Check Row (Variable Position, Puzzle, Value) – Checks the row to see if the value is repeated
    - Check Column (Variable Position, Puzzle, Value) – Checks the column to see if the value is repeated
    - Check Block (Variable Position, Puzzle, Value) – Checks the block to see if the value is repeated
    - Get Unassigned Variables (Puzzle) – Returns a list of all unassigned variables currently, starting with row 0 column 0
    - Find Minimum Remaining Value (MRV List) – Returns the smallest value in the list
    - Find Highest Degree (DH List) – Returns the highest value in the list
    - Find Lowest Constraining Value (LCV List) – Returns the smallest value in the list
    - Check Arc for Consistency (Puzzle, Variable, Variable) – Checks if these two variables are arc consistent.
  + Bookkeeper
    - Add Record (Variable, Values) – Adds the variable, values and level to list
    - Remove Record (index) – Removes the indexed record
    - Undo () – Removes and returns the last entry
  + Logger
    - Total start, Preprocessing start, Preprocessing done, Search start, Search Done, Solution time, Status, Solution, Count nodes, Count deadends
    - Log Files (file name) – Logs the values to file
  + Alphabet