Space: an empty spot in the puzzle where word should be placed
Spot: a character within a space
Global Variables: the array of times, the puzzleList array (array of empty spaces the words fit into), and the list of all intersections of spaces

Main algorithm:

Input: a folder containing puzzle text files
Output: Completed puzzles are printed, ones that are impossible are not, times for each puzzle's computation are displayed as well

- Create an empty list of times (global)
- FOR each puzzle text file in puzzle folder
  - Start the timer and parse the file to find the length and width of the puzzle as well as the number of words
  - Parse the file a second time and copy the format of the puzzle to a 2D list (grid)
  - Use two double-for loops to first find horizontal spaces and then the vertical ones. These spaces are stored as lists of tuples, the tuples containing the X and Y coordinates on the puzzle board. Store these spaces in a list (puzzleList) (global).
  - Use a double for loop to compare every space stored in the puzzleList and create a list of common tuples (intersecting spots) (global)
  - Create an empty occupied spaces list
  - Call the Solving Algorithm with the grid, first space in the puzzleList, the list of intersecting spots, the list of words, and the empty occupied spaces list
  - SET a result variable, the grid, and a garbage variable to the return value of the above function
  - Stop the timer and add the time elapsed to the times list
  - IF the result was successful, print the puzzle number and finished grid
  - ELSE print that the puzzle was not possible with the puzzle number
- FOR each time stored in times
  - Print the puzzle number and the corresponding time elapsed

Solving Algorithm:

Input: 2D grid representing the game board, the current space being solved for, list of words, and spaces currently occupied on the board (initially empty)
Output: a tuple containing 1. The return value (tells the function whether to stop and try another word, continue, or finish because a solution has been found) 2. A grid and 3. A word list
Use: Call this function on any space in the puzzle and the completed puzzle will be sent back recursively as a grid

- Find the list of words which could fit in the space length and letter wise
- FOR each word in that word list
  - Make deep copies of both the occupied spaces list and the grid
  - Set the continue variable to 1 (0 means stop, 1 means go, 2 means done)
  - Attempt to place the word into the space provided (Place Word Algorithm)
  - IF unsuccessful, set the continue variable to 0 (which will send the program back to FOR)

```
		IF the continue variable is 1
			Add the input space to the cloned occupied spaces list
			Create a new word list containing all words but the newly added one
			FOR every space that intersects the current input space (Intersecting Spaces
			Algorithm)
				CALL this function with the cloned grid, current space in for loop, list of
				intersecting spots, the new word list, and cloned occupied spaces
				SET (continue variable, cloned grid, new word list) equal to the return
				value of the above function
				IF the continue variable is 0, break away from this for loop
				IF the continue variable is 2, return (2, cloned grid, new word list)
			IF continue variable is 1, return (1, cloned grid, new word list)
	Return (0, input grid, input word list) if the function made it out of the first FOR loop
```

Intersecting Spaces Algorithm:

Input: a space, list of occupied spaces
Output: a list containing the spaces that intersect the input space

```
	Create an empty return list
	FOR each space* in puzzleList
		IF the space* is not the input space and the space* is not in the occupied spaces list
			FOR each spot in the list of common spots
				IF the spot exists in the input space and in the space*
					Add the space* to the return list
	Return the return list
```

Place Word Algorithm:

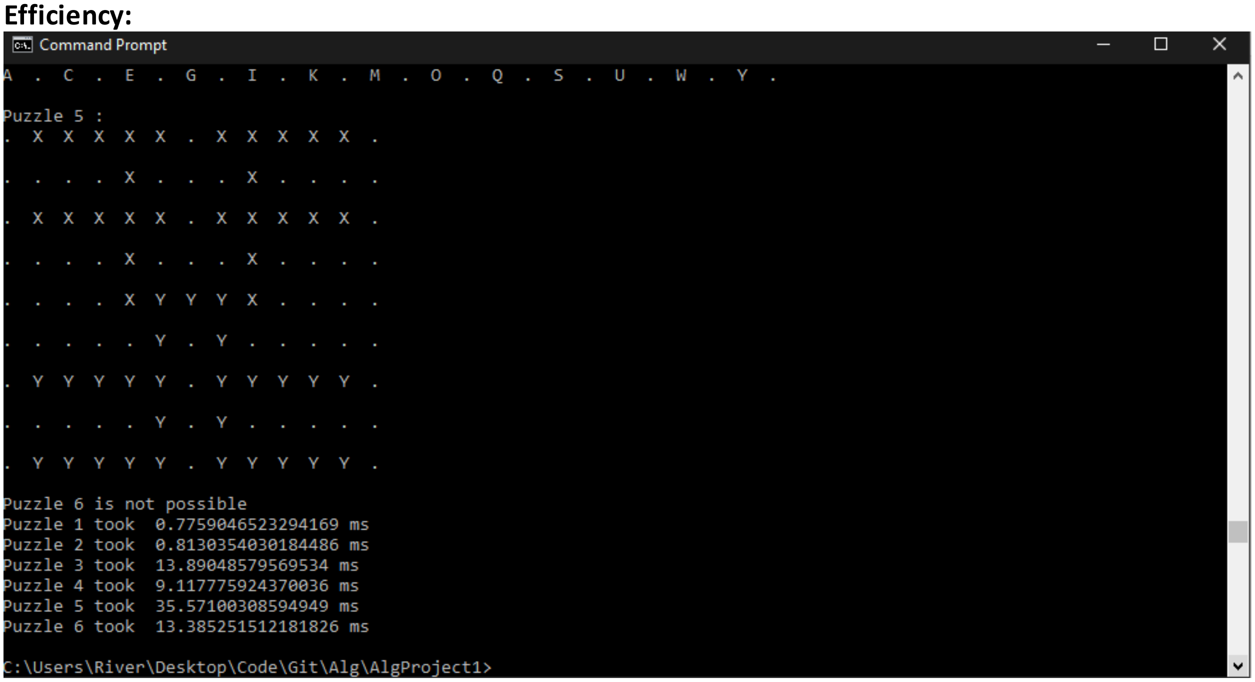
Input: a grid, a space, and a word
Output: a 0 or 1 (failure or success)

```
	FOR each character in input word
		IF the corresponding grid space contains a '*'
			Set the grid space to the character
		IF the corresponding grid space is not the character
			Return 0
	Return 1
```

Possible Words Algorithm:
Input: a grid, a space, and a wordlist
Output: a list of words that can fit in the space given its current state

FOR each spot in the space
    If the corresponding spot does not contain a "*"
        Add the letter to an array
        Add the index to an array
FOR each word in the input word list
    Initialize test bool to true
    IF the length of the word is the same as the length of the space
        FOR each letter in the letters array
            IF the word does not have the same letter at the same index
                Test bool is set to false
                Break
        IF the test bool is true
            Add the word to the return list
Return the return list

Efficiency:



Beating the better benchmark times almost universally except for puzzle 5 which takes around 15x longer than the better runtime. This is likely due to all the effort that goes into optimizing the input for my recursive solve, and in this case every single word is the same size and many of them are the same word, so this ends up eating a bunch of crunch time on the processor that is unneeded. It pays off in the other puzzles, however, so I'll take it.

The main solve algorithm iterates through a for loop N times, attempting to assign length of N characters to a grid, and calling itself again with N-1 for the input size. However, this doesn't necessarily mean the algorithm is any closer to being solved since it can still go back recursively and try something else. This behavior means that it can technically, if the perfect storm arises and none of the input optimization was used, the algorithm has an efficiency of a brute-force attempt of trying every single combination of words. This behavior gives it a theta(N!) time efficiency on its own. In a best case scenario, you can input N and every single word will work the first time you try it. In this case, the time efficiency would be closer to theta(N). Due to this behavior of the algorithm and the fact that most of its performance comes from optimizing the input that goes into the algorithm instead of the algorithm itself, I am unsure how to define its efficiency.