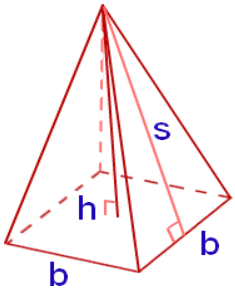
CS 218 – MIPS Assignment #3

Purpose:	Become familiar with the MIPS stack and MIPS standard calling convention.
Due:	Tuesday (4/23)
Points:	80

Assignment:

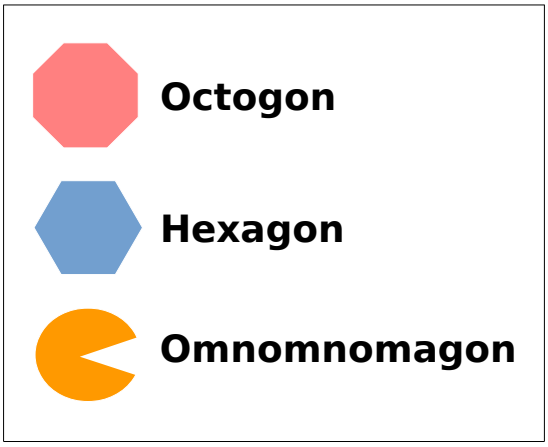
Write a MIPS assembly language program to calculate the total area of square pyramid[1] in a series of square pyramids. Use the provided MIPS main program and develop the following functions:



- Write a MIPS void function, ***calcTotalAreas()***, to calculate the total area for each square pyramid in a series of square pyramids. The formula for the total area is as follows:

$$totalAreas[i] = bases[i] \times \left(2 \times slants[i] + bases[i] \right)$$

- Write a MIPS void function, ***combSort()***, to sort the areas array in ascending order (small to large). To sort the numbers, use the following Comb Sort[2] algorithm which sorts in ascending order:




```
void function combSort(array, length)
    gap = length
    swapped = true

    outer loop while gap>1 OR
                    swapped = true
        // update gap for next sweep
        gap = (gap * 10) / 12
        if gap < 1
            gap = 1
        end if

        i = 0
        swapped = false

        inner loop until i + gap >= length     // single comb sweep
            if  array[i] > array[i+gap]
                swap(array[i], array[i+gap])
                swapped = true
            end if
            i = i + 1
        end inner loop
    end outer loop
end function
```

Note, the algorithm assumes array index's start at 0. Must initialize the count array to 0. As necessary, you can define additional variables. You must use the counting sort algorithm above (i.e., do not use other sorts). ***Submissions not based on this algorithm will not be scored***.

1 For more information, refer to: https://en.wikipedia.org/wiki/Square_pyramid
2 For more information, refer to: https://en.wikipedia.org/wiki/Comb_sort

- Write a MIPS void function, ***totalAreaStats()***, that will find the minimum, maximum, estimated median, statistical median, percentage difference[3], sum, and float average of the total areas array. The function must call the ***estMedian()***, and ***findMedian()*** functions. Additionally, the routine must call the ***combSort()*** function. The estimated median must be determine before the sort. The minimum, maximum, and statistical median must be determined after the sort. The percentage difference (between statistical median and estimated median) is calculated as follows:

$$pctDiff = \frac{estMedian - median}{median} \times 100.0$$

- Write a value returning MIPS function, ***estMedian()***, to find the estimated median of an array. If the list length is odd, the estimated median will be computed by summing the first, last, and the middle value and dividing by 3. If the list length is even, the estimated median will be computed by summing the first, last, and the two middle values and dividing by 4. The estimated median must be determined *before* the list is sorted.

- Write a value returning MIPS function, ***findMedian()***, to find the statistical median of an array. For an odd number of items, the median value is defined as the middle value. For an even number of values, it is the integer average of the two middle values. The statistical median must be determined *after* the list is sorted.

- Write a MIPS void function, ***printResults()***, to print the areas array (five space before each number, six per line) and the statistical information (minimum, maximum, estimated median, statistical median, percentage difference between the estimates median and statistical median, sum, and float average) in the format shown in the example.

Submission:

When complete, submit:

- A copy of the **source file** via the class web page before class time.

3 For more information, refer to: https://en.wikipedia.org/wiki/Relative_change_and_difference

Example Output:

The program must display the results to the console window. The output should look something like the following (with all of the correct answers displayed for all data sets):

```
MIPS Assignment #3
Square Pyramid Total Areas Program

*********************************************************************
Square Pyramid Data Set #1
Length: 30

Total Areas Values:
     700     869     912     979     1036     1079
     1155     1157     1335     1377     1377     1408
     1615     1653     1692     2000     2289     2332
     2496     2499     2599     2675     2737     2975
     2997     2997     3068     3335     3393     3472

Total Areas Stats:
   min      = 700
   max      = 3472
   med      = 1846
   est med  = 1936
   pct diff = %4.87540627
   sum      = 60208
   flt ave  = 2006.93334961
```

The numbers do not need to be aligned. You will need to print some space between each number (of they will all run together). *Note*, not all data sets not shown.