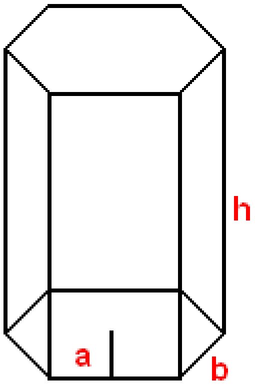
CS 218 – MIPS Assignment #3

Purpose: Become familiar with the MIPS stack and function calling convention.
Points: 100

Assignment:



Write a MIPS assembly language program to calculate the surface area for each three dimensional hexagonal prism[1] in a series of hexagonal prisms. Use the provided MIPS main program and develop the following functions:

- Write a void MIPS function, ***surfaceAreas()***, to calculate the surface areas for each three dimensional hexagonal prism in a series of hexagonal prisms. The formula for the hexagon surface area is as follows:

  $$areas[i] = 6 \times bases[i] \times (apothems[i] + heights[i])$$

  Note, the routine is must call the ***shellSort()*** function for the surface areas array before returning. All data is unsigned.

- Write a MIPS assembly language function, ***shellSort()***, to sort the volumes into ascending order (small to large). To sort the numbers, use the following Shell Sort[2] algorithm.

```
h = 1;
while ( (h*3+1) < length ) {
   h = 3 * h + 1;
}

while ( h>0 ) {
   for (i = h-1; i < length; i++) {
       tmp = lst[i];
       j = i;
       for ( j=i; (j >= h) &&
             (lst[j-h] > tmp); j = j-h) {
          lst[j] = lst[j-h];
       }
       lst[j] = tmp;
   }
   h = h / 3;
}
```

  You ***must*** use the above shell sort algorithm above (i.e., do **not** use a different sort). *Note*, the algorithm assumes array index's start at 0. As necessary, you can define additional variables. ***Submissions not based on this algorithm will not be scored***.

- Write a value returning MIPS function, ***findSum()***, to find the sum of a passed array.

[1] For more information, refer to: https://en.wikipedia.org/wiki/Hexagonal_prism
[2] For more information, refer to: http://en.wikipedia.org/wiki/Shell_sort

- Write a void MIPS function, ***surfaceAreasStats()***, that will find the minimum, maximum, median, and float average of the areas array.

- Write a value returning MIPS function, ***findAverage()***, to find the floating point (double) average of an array. The function must call the findSum() function and perform the required type conversions. Floating point functions return their results in $f0.

- Write a void MIPS function, ***displayStats()***, to print the diagonals array (six per line) and the statistical information (minimum, maximum, median, and float average) in the format shown in the example.

<u>Example Output:</u>

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
Hexagonal Prism Surface Areas Program


*******************************************************************
Hexagonal Prisms 1
Length: 15

Surface Areas - Values:
     108000     112530     112728     114576     116160     116604
     117000     118818     121158     121158     121500     122472
     125388     126162     127488

Surface Areas - Stats:
   min  = 108000
   max  = 127488
   med  = 118818
   ave = 118782.800000000003


*******************************************************************
Hexagonal Prisms 2
Length: 75

Surface Areas - Values:
     176016     177576     179664     180846     182106     183210
     183210     183918     184224     184800     185136     186048

      . . .   output truncated . . .
```

Submission:

- All source files must assemble and execute with QtSpim/SPIM MIPS simulator.
- Submit source file
    - ◦ Submit a copy of the program source file via the on-line submission
- Once you submit, the system will score the project and provide feedback.
    - ◦ If you do not get full score, you can (and should) correct and resubmit.
    - ◦ You can re-submit an unlimited number of times before the due date/time (at a maximum rate of 5 submissions per hour).
- Late submissions will be accepted for a period of 24 hours after the due date/time for any given assignment. Late submissions will be subject to a ~2% reduction in points per an hour late. If you submit 1 minute - 1 hour late -2%, 1-2 hours late -4%, … , 23-24 hours late -50%. This means after 24 hours late submissions will receive an automatic 0.

Program Header Block

All source files must include your name, section number, assignment, NSHE number, and program description. The required format is as follows:

```
#  Name: <your name>
#  NSHE ID: <your id>
#  Section: <section>
#  Assignment: <assignment number>
#  Description: <short description of program goes here>
```

Failure to include your name in this format will result in a reduction of points.

Scoring Rubric

Scoring will include functionality, code quality, and documentation. Below is a summary of the scoring rubric for this assignment.

Criteria	**Weight**	**Summary**
Assemble	-	Failure to assemble will result in a score of 0.
Program Header	3%	Must include header block in the required format (see above).
General Comments	7%	Must include an appropriate level of program documentation.
Program Functionality (and on-time)	90%	Program must meet the functional requirements as outlined in the assignment. Must be submitted on time for full score.