1. List the members of your group below:

2. This question is based on Saxena's paper on dominance queries.[1]
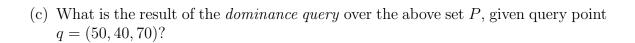
$$P = \bigcup_{i=0}^{9} \left\{ (c_{3i+1}, c_{3i+2}, c_{3i+3}) \mid c_j = \lfloor 10^{2j}(\pi - 3) \rfloor \bmod 100 \right\}$$

   (a) Provide a simple yet precise English description of the set P defined above.

   (b) List the elements of P explicitly. For your reference,

   $\pi = 3.141592\,653589\,793238\,462643\,383279\,502884\,197169\,399375\,105820\,974944\ldots$

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[1]Sanjeev Saxena, "Dominance made simple," *Information Processing Letters* 109/9 (2009).

(c) What is the result of the *dominance query* over the above set P, given query point $q = (50, 40, 70)$?

(d) What is the result of the *three-sided query* with the query triple $q = (30, 80, 50)$?

(e) Describe an $O(1)$ algorithm for answering *range maxima queries*, with no restriction on preprocessing time.

3. Depict the *red-black tree* resulting from the sequential insertion of

$$1, 2, 3, \ldots, 10, 20, 19, \ldots, 11$$

into an empty tree, using *bottom-up insertion*. All intermediate trees need not be depicted, but it is advisable to depict at least a few.

4. Repeat Question 3 with *top-down insertion.*