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- Using tile notation, the estimated running time of my following programs are as follows:
  - o For Brute.java, the program has 4 nested loops, culminating in a function call at the end to determine whether four points (obtained through array accesses) are collinear. Not much else is going on in the program other than printing, so this nested loop is where the majority of the time will be consumed, thus the other parts can be disregarded. Since all the loops traverse from 0 to  $N-1$ , the cost model for time for these array accesses will be  $N^4$ , thus for tile notation, it'll be equivalent to  $\sim cN^4$  (since we use approximate models in this course).
  - o For Fast.java, the equivalent array accesses occur when determining the slopes of each point with respect to an 'origin'. This is done using one loop from 0 to  $N$ , and from the index of the previous to  $N$ , thus  $N(N-1)$ . Because of this, the tile notation for running time of Fast.java is  $\sim cN^2$  (since we use approximate models in this course).