

2) (5 pts) ANL (Algorithm Analysis)

A program that runs an  $O(N\log(N))$  algorithm to sort an array of  $N$  polygons takes 10 seconds to sort 1,000,000 polygons. How long, **in milliseconds**, would it be expected for the program to take when sorting 1,000 polygons?

Let  $T(N) = cN\log(N)$  be the run time of the program for sorting  $N$  polygons. Using the given information, we have:

$$\begin{aligned}T(10^6) &= c(10^6)\log(10^6) = 10,000ms \\c(10^6) 6\log(10) &= 10,000ms \\c &= \frac{10^4ms}{6(10^6)\log(10)} = \frac{1ms}{600\log(10)}\end{aligned}$$

Now, let's solve for  $T(1000)$ :

$$\begin{aligned}T(10^3) &= \frac{1ms}{600\log(10)} \times 10^3 \times \log(10^3) \\&= \frac{1ms}{600\log(10)} \times 10^3 \times 3 \times \log(10) \\&= \frac{3000ms}{600} = 5ms\end{aligned}$$

**Grading:** 1 pt set up equation with constant  $c$   
2 pts solve for  $c$  (no simplification required)  
1 pt plug in  $N = 1000$   
1 pt arrive at the final answer

**Full credit if the ratio method is used properly, but if it isn't max 1 point.**