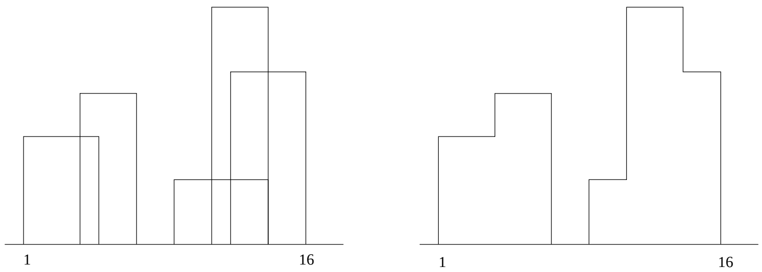
Midterm Exam
CIS 675 — Spring 1998
Wednesday, March 4

Problem 1. [This problem carries 5 points.] Where did I go wrong in the following?

$$(\sum_j a_j)(\sum_j \frac{1}{a_j}) = \sum_j \sum_j \frac{a_j}{a_j} = n^2.$$

Problem 2. [This problem carries 15 points.] Solve $T_0 = 5$, $2T_n = nT_{n-1} + 3n!$ for all $n > 0$. Is it true that $T_n = O(2^n)$? [Hint: Transform T_n to S_n via $S_n = \frac{2^n}{n!}T_n$.]

Problem 3. [This problem carries 30 points.] The skyline problem: Given the exact locations and heights of several rectangular buildings in a city, draw the skyline of these buildings by eliminating all hidden lines. Note that all buildings are on a straight line and the entire picture is 2-dimensional. The following example illustrates the problem.



Example: In the attached figure, on the left hand side are five rectangular buildings representing the inputs. The buildings are represented as (3,**7**,6), (10,**9**,14), (8,**3**,14), (1,**5**,4), and (11,**6**,16), where in each ordered triplet the first real number represents the beginning of the building, the second (boldface) real number is the height of the building, and the third is the point of termination, respectively. On the right hand side of the figure is the desired output; the associated skyline where hidden lines are no longer seen. The desired output for the above data is:

(1,**5**,3,**7**,6,**0**,8,**3**,10,**9**,14,**6**,16).

Problem For $i = 1, \ldots, n$ let $B_i = (x_i, \boldsymbol{h}_i, y_i)$ denote the ith building, where x_i denotes the staring point, y_i denotes the terminal point, and $\boldsymbol{h}_i$ denotes

its height.
(A) Solve the skyline problem using the incremental method and provide its analysis. [Explain the method in a few simple English sentences; **don't** give the associated computer program.]
(B) Use the divide-and-conquer method to solve the problem and analyze it. Is there any advantage in using the divide-and-conquer method? Explain.