Problem 1.

(a) Illustrate the operation of radix sort on the following list of English words: RUTS, TOPS, ROTS, SPOT, TONS, OPTS, TORS, SOTS, ROOT, ORTS, SUPS, PUTT

(b) Write one English sentence or two related sentences using the anagrams "ort", "rot", and "tor" (that indicates you understand the meanings of all three words).

Problem 2. Assume that we are sorting n elements with range $S \geq n$. Radix sort takes time $\Theta(d(n+r))$, where d is the number of digits and r is the radix. The minimum possible radix is 2, and the maximum reasonable radix is S.

(a) How fast is radix sort with radix 2 (in Theta notation)?

(b) How fast is radix sort with radix S (in Theta notation)?

(c) Assume that you can only use radix 2 or radix S. Justify your answers to the following (which you can derive just once).

(i) For what values of S do you prefer radix 2?

(ii) For what values of S do you prefer radix S?

(iii) For what values of S do you not care?

Problem 3. Assume we have an $n \times n$ grid of colors, where n is even. There are $n/2$ colors. In each row every color occurs exactly twice, and in each column every color occurs exactly twice. A monochromatic rectangle is a rectangle whose four corners are the same color, i.e., it is a set of four entries in the table with indices (r_1, c_1), (r_1, c_2), (r_2, c_1), and (r_2, c_2), where each entry has the same color. We use the integers $1, \ldots, n/2$ to represent the colors.

(a) Give an efficient algorithm to find all of the monochromatic rectangles in a grid.

(b) How fast is your algorithm (in Theta notation)?