COMS21103: Data Structures and Algorithms

Problem Sheet - Week 7

1. **String Matching**

   (a) For the Knuth-Morris-Pratt algorithm, compute the prefix function π for the pattern ababbabbabbababbaba

   (b) Give a linear-time algorithm to determine whether a text **T** contains a cyclic rotation of another string **P**.
   For example:
   T = This is the arc de triumph
   P = car
   Finds the matched cyclic rotation "arc"

   (c) Construct the string-matching automaton for the pattern **P**=aabab and illustrate its operation on the text string **T**=aaababaabaabababaab

   (d) Construct the string-matching automaton for the pattern P=$[0..9]^+b^*a$ over the alphabet $\Sigma = \{0..9, a, b, c\}$

2. **Linear Programming**

   (a) From the slides (Slide 45), solve the linear program using $SIMPLEX$:

$$\begin{array}{ll} \text{maximise} & 18x_1 + 12.5x_2 \\ \text{subject to} & x_1 + x_2 \leq 20 \\ & x_1 \leq 12 \\ & x_2 \leq 16 \\ & x_1, x_2 \geq 0 \end{array}$$

   (b) On a 2D graph, show how your solution for the linear program in (a) corresponds to vertices of the convex hull of the space of feasible solutions,

      i. For each of the constraints, show the space of feasible solutions
      ii. Show the space of feasible solutions of the Linear Program
      iii. Is the linear program infeasible? Is it unbounded?
      iv. Trace the solution in (a) on the graph

   (c) Solve the following linear program using $SIMPLEX$:

$$\begin{array}{ll} \text{maximise} & x_1 + 3x_2 \\ \text{subject to} & -x_1 + x_2 \leq -1 \\ & -x_1 - x_2 \leq -3 \\ & -x_1 + 4x_2 \leq 2 \\ & x_1, x_2 \geq 0 \end{array}$$