

# SFWR ENG 3O03 & 4O03 / COMP SCI 4O03 (6O03)

## Linear Optimization

### Problem Set 1 – 10 points

Posted: September 10, 2018 / Due date: October 2, 2018

**\*\* JUSTIFY YOUR ANSWERS \*\***

1. Consider the problem of finding a plane  $\alpha^T x = \beta$  (i.e.  $a_1 x_1 + a_2 x_2 + a_3 x_3 = \beta$  with  $\alpha \neq (0, 0, 0)$ ) that separates the following two sets of points (some points from  $S_1$  and  $S_2$  might lie on the plane  $\alpha^T x = \beta$ ):

$$S_1 = \{(1, 2, 3), (3, 1, 2), (2, 3, 1)\} \quad \text{and} \quad S_2 = \{(0, 2, 0), (4, 2, 4), (\pi, \log \pi, \sqrt{2})\}$$

**1.1.** Formulate the problem as a Linear Program (LP). **2p**

**1.2.** Find a *feasible solution*  $(\alpha, \beta)$  if it exists, or show that *no feasible solution* exists. **2p**

2. A furniture manufacturer has 4000 units of Walnut, 5000 units of Maple, and 6000 units of Oak in stock. It can create 3 products using these raw materials, with input requirements as given below. A table must always be sold with 4 chairs and a desk must be sold with a chair. Chairs can be sold individually. You are asked to find the product mix (i.e. how many tables, desks and chairs to produce respectively) that maximizes the revenue.

	Wood needed	(unit/item)		Profit
	Walnut	Maple	Oak	Revenue/item
Table	25	50	90	\$100
Desk	15	30	50	\$50
Chair	10	10	25	\$10

**2.1.** Formulate the problem as an Linear Program (LP). **2p**

**2.2.** Solve the linear program to find the maximum revenue (and how many of each to sell)?  
(A software tool may be used but a screenshot of the result must be provided) **1p**

3. Santa Trees Inc. is selling Christmas trees in the 4 weeks leading up to Christmas. They must satisfy the demand of exactly 70 trees for week 1, exactly 80 trees for week 2, exactly 90 trees for week 3, and exactly 100 trees for week 4. Santa Trees can acquire at most 90 trees per week. The trees cost \$100 in weeks 1 and 2, and \$150 in weeks 3 and 4. Their supplier has agreed to provide them with at most 20 extra trees per week in weeks 3 and 4, but at an increased price of \$200 per tree. Santa Trees also pays a storage fee for any unsold trees at the end of the week at a rate of \$3 per tree. What is the minimum cost to acquire sufficient trees to meet the demand?

**3.1.** Formulate the problem as a Linear Program (LP) **3p.**

- Your solution must reach your instructor or the TA by or before the due date.
- You, or your reliable friend must give your work to the TA hand-to-hand or deliver at class to your instructor.
- You have to sign your assignment; your signature certifies that the assignment is **your** work.
- If you use some software to reach a solution, explain how.