

# Advanced Algorithms

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## Lab 6 – Exercises on linear programming

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## Exercise 7.1 page 222 DPV

Consider the following linear problem

$$\max 5x+3y$$

$$5x - 2y \geq 0$$

$$x + y \leq 7$$

$$x \leq 5$$

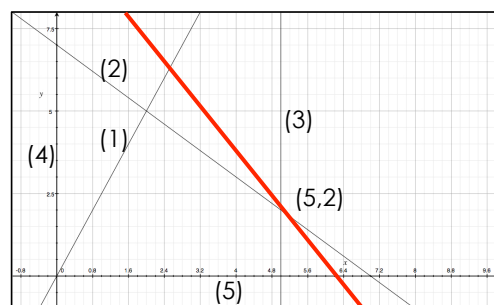
$$x \geq 0$$

$$y \geq 0$$

Plot the feasible region and identify the optimal solution

## Exercise 7.1 page 222 DPV

### Solution



$$\begin{aligned} \max & 5x+3y \\ (1) & 5x - 2y \geq 0 \\ (2) & x + y \leq 7 \\ (3) & x \leq 5 \\ (4) & x \geq 0 \\ (5) & y \geq 0 \end{aligned}$$

The optimal solution is achieved in the upper right corner of the convex feasible region, i.e. at the point (5, 2), and has value  $5 \cdot 5 + 3 \cdot 2 = 31$

## Exercise 7.4 page 223 DPV

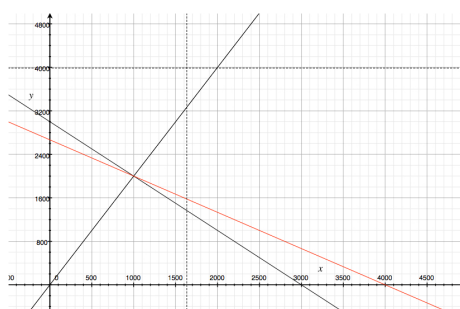
- Moe is deciding how much Regular Duff beer and how much Duff Strong beer to order each week
- Regular Duff costs Moe \$1 per pint and he sells it at \$2 per pint
- Duff Strong costs Moe \$1.50 per pint and he sells it at \$3 per pint
- However, as part of a complicated marketing scam, the Duff company will only sell a pint of Duff Strong for each two pints or more of Regular Duff that Moe buys
- Furthermore, due to past events that are better left untold, Duff will not sell Moe more than 3,000 pints per week
- Moe knows that he can sell however much beer he has

**Formulate a linear program for deciding how much Regular Duff and how much Duff Strong to buy, so as to maximize Moe's profit. Solve the program geometrically**

## Exercise 7.4 page 223 DPV

### Solution

- Let  $R$  the quantity of Regular Duff beer and  $S$  of Duff Strong beer that Moe is ordering per week
- The problem is modeled as
 
$$\begin{aligned} \max & R + 1.5*S \\ & R \leq 2*S \\ & R + S \leq 3000 \\ & R \geq 0 \\ & S \geq 0 \end{aligned}$$
- It is easily seen geometrically that the maximum is obtained at the vertex  $(R, S) = (1000, 2000)$  and optimum = 4000



## Assignment 05



### Exercise 7.5 page 223 DPV

- The Canine Products company offers two dog foods, Frisky Pup and Husky Hound, that are made from a blend of cereal and meat
- A package of Frisky Pup requires 1 pound of cereal and 1.5 pounds of meat, and sells for \$7
- A package of Husky Hound uses 2 pounds of cereal and 1 pound of meat, and sells for \$6
- Raw cereal costs \$1 per pound and raw meat costs \$2 per pound.
- It also costs \$1.40 to package the Frisky Pup and \$0.60 to package the Husky Hound
- A total of 240,000 pounds of cereal and 180,000 pounds of meat are available each month
- The only production bottleneck is that the factory can only package 110,000 bags of Frisky Pup per month

### Needless to say, management would like to maximize profit

1. Formulate the problem as a linear program in two variables.
2. Graph the feasible region, give the coordinates of every vertex, and circle the vertex maximizing profit. What is the maximum profit possible?

## Assignment 05 (cont.)



### Exercise

A nonferrous metals company makes four different alloys from two metals. The requirements are given below. Find the optimal product mix that maximizes gross revenue

| Metal       | proportion of metal in alloy |     |      |      | Availability |
|-------------|------------------------------|-----|------|------|--------------|
|             | 1                            | 2   | 3    | 4    |              |
| 1           | 0.5                          | 0.6 | 0.3  | 0.1  | 25           |
| 2           | 0.5                          | 0.4 | 0.7  | 0.9  | 40           |
| Alloy price | 750                          | 650 | 1200 | 2200 |              |

## Assignment 05 (cont.)

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### Exercise

1. Make an example of linear program has not feasible region (i.e., there are no solutions)
2. Make an example of linear problem for which the optimal solution is unbounded

(These questions anticipate some topic of the next lecture, so do your best. Wrong answers do not affects the evaluation of the assignment)