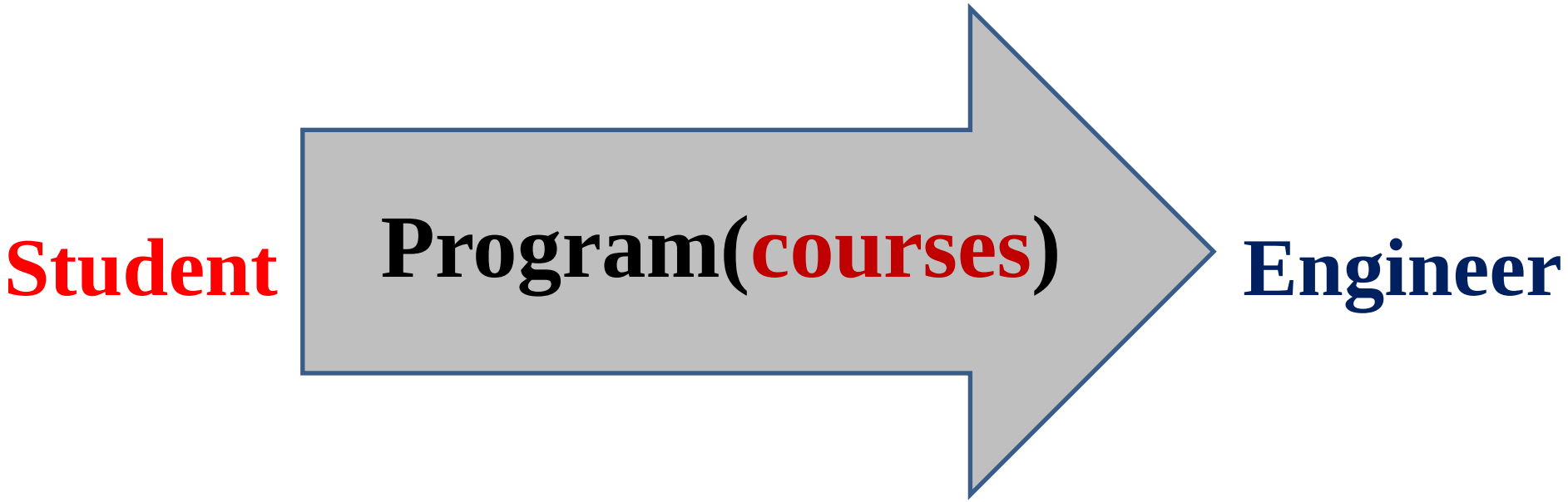
Dr. Mohamed Husien Eid

Mathematics Department

Faculty of Engineering – Shoubra

Benha University



Scientific Approach: المنهج العلمى

To create new يبدع

Invent	يخترع
Innovate	يبتكر
Discover	يكتشف
Clarify	يوضح
Specify	يصف
Refine	يهزب / ينقح
Develop	يطور

Intended Learning Outcomes (ILO's)

1. **Knowledge and Understanding**
2. **Intellectual Skills**
3. **Professional and Practical Skills**
4. **General Skills**

Course Aims

- To provide the students essential information and fundamentals of Calculus and Algebra and their applications in engineering.
- To apply mathematical techniques for modeling, solving and analyzing real problems.

Contents

- Functions of single variable
- Limits and continuity
- Derivative and applications
- Integrals
- Algebra of matrices
- Linear systems
- Complex numbers

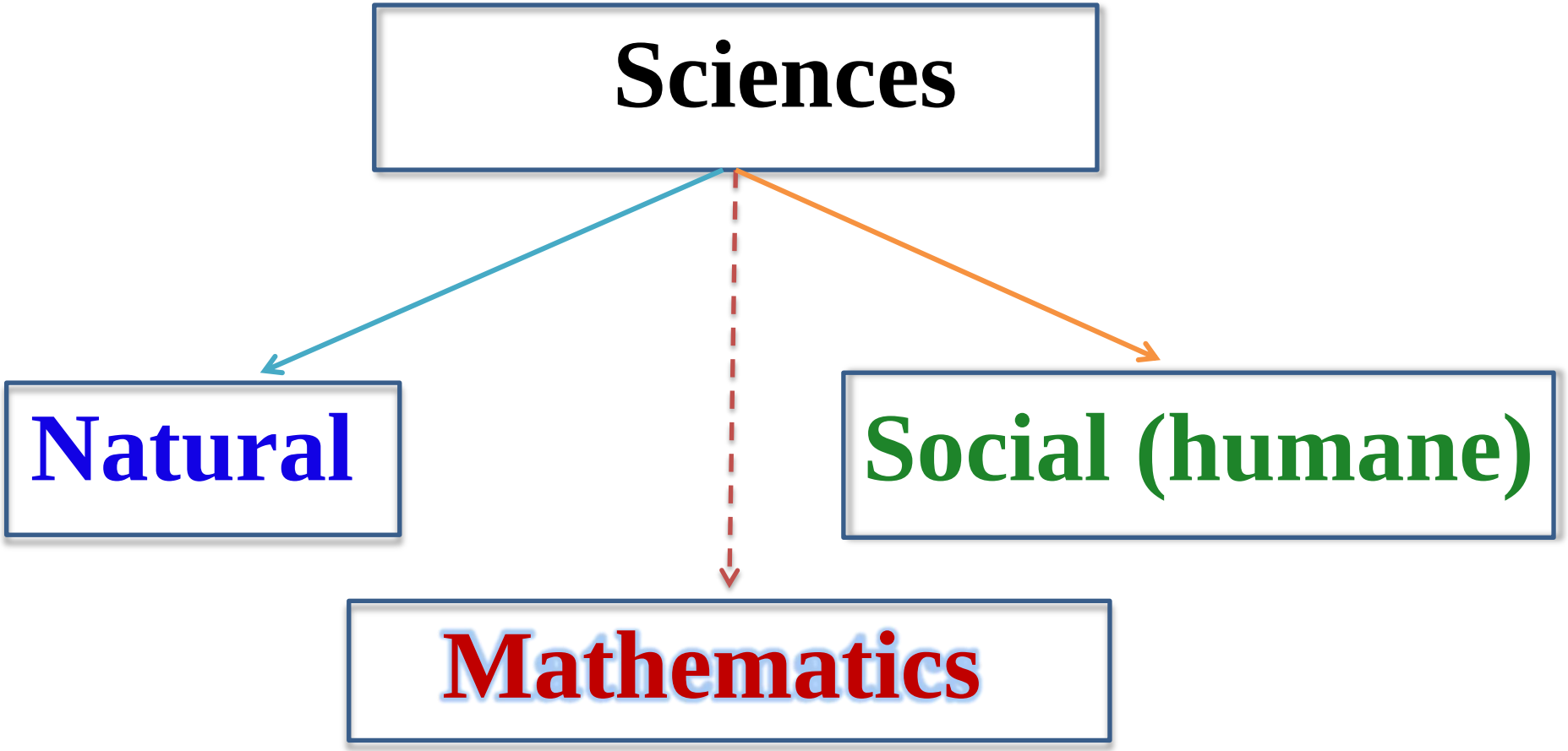
Weighting of assessments

- Final-semester examination 40 Marks
  (Minimum Pass Mark : 13)
- Mid-semester exam 30 Marks
- Mid-semester exam 20 Marks
- Class activities 10 Marks

- **Total** **100 Marks**

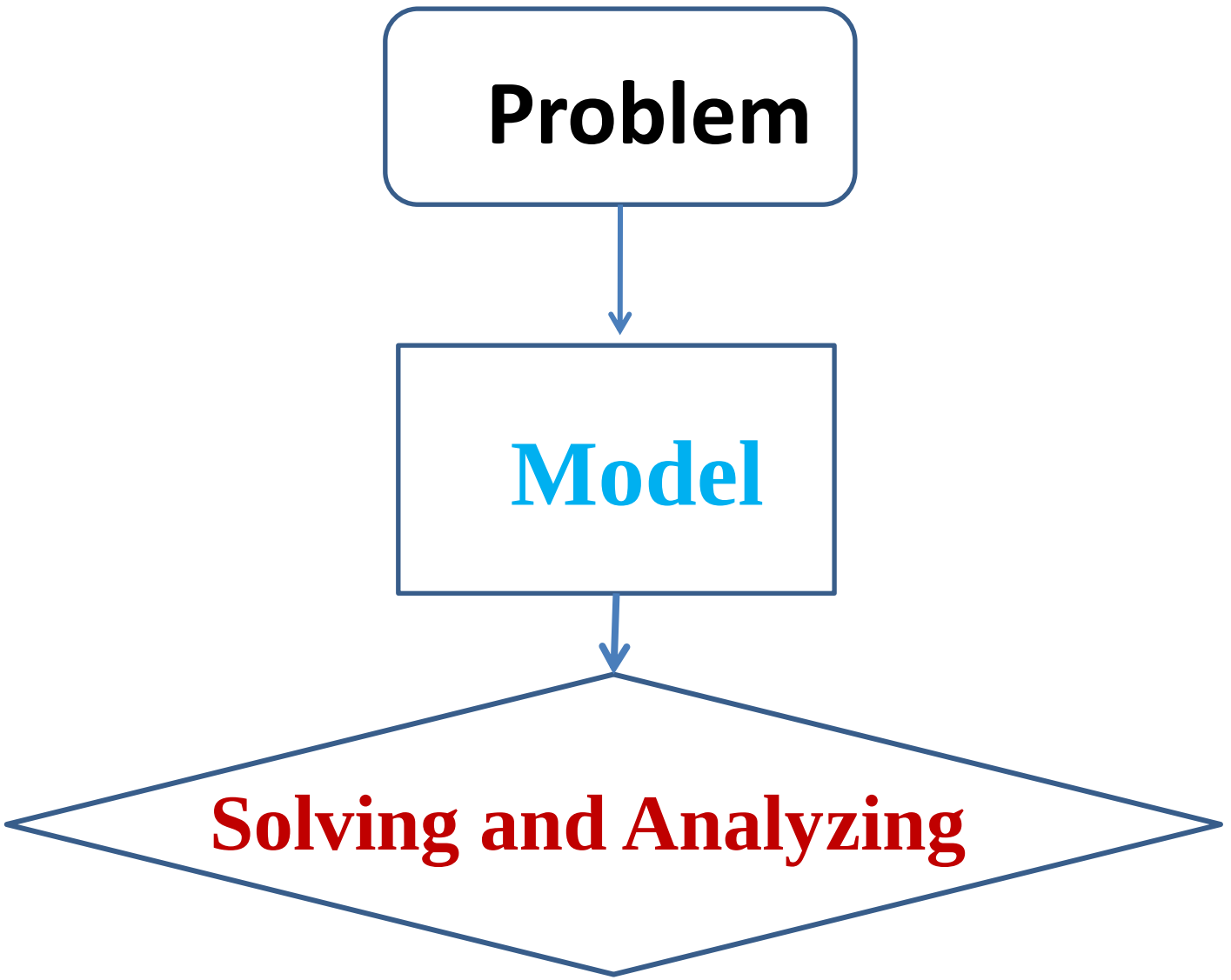
Text Books

- "Calculus", 6th Edition, James Stewart, Thomson Brooks / Cole, U.S.A, 2008.
- "The Theory of Matrices", 2nd Edition, P.Lancaster and M.Tismenetsky, Academic Press, London, New York, 1985.



Mathematics is the science of modeling and treatment problems and phenomena via explicit criteria

Mathematics



Rate of Change

Example: An amount of sugar (100 gm) in solution is decomposed in a chemical reaction into other substance through the presence of acids, and the rate at which the reaction takes place is proportional to the mass of sugar still unchanged.

Write the mathematical model.

Find the time at which all amount is decomposed

تتحلل كمية من السكر (100 جم) في محلول في تفاعل كيميائي إلى مادة أخرى من خلال وجود الأحماض،

و معدل التغير يتناسب مع كتلة السكر المتبقية.

The original amount of sugar is 100 gm.

Assume that **x** is the amount of sugar converted at time t.

Then 100 – x is the amount still unchanged

Then $\frac{dx}{dt} = k(100 - x)$, K is constant, k =1

Then $\frac{dx}{x - 100} = -dt$

Then $\ln(x - 100) = -t + c$

Then $x - 100 = e^{-t+c} = C.e^{-t}$

The decomposition starts when t = x = 0

Then $0 - 100 = C.e^{0} = C$

Then $x = 100 - 100e^{-t} = 100(1 - e^{-t})$

is the mathematical relation.

(Increasing relation)

From $x(t) = 100(1 - e^{-t})$

t / minute	x / gm
1	63.2
2	86.5
4	98.2
5	99.99

All amount of sugar is converted when x = 100 gm, t approaches infinity

Example

Chemical A is being converted into chemical B at reaction rate – 0.5 per second. The initial concentration of A is 10 moles/liter.

Determine the concentration C(t) as a function of the time t.

Find the time at which the concentration C is 5 moles/liter.

The mathematical relation is $\frac{dC}{dt} = -\frac{1}{2}C$

Then $\ln C = -0.5t + k$

Then $C = e^{-0.5t+k} = m.e^{-0.5t}$

At $t = 0$, $C(0) = 10 = m.e^{0}$. Then $m = 10$

Then $C(t) = 10e^{-0.5t}$

is the mathematical relation.

(Decreasing relation)

From $C(t) = 10e^{-0.5t}$

t / second	C moles / liter
0	10
1	6.065
2	3.679

When C = 5, then $5 = 10e^{-0.5t}$

Then t = 1.4 seconds

Example: Mixing Solution

A tank contains 100 liters a brine solution containing 20 kg of salt. At time t = 0, fresh water is poured into the tank at rate 4 liters per minute while the well mixture leaves the tank at the same rate.

Determine the amount of salt in the tank at any time t.

خزان يحتوي على 100 لتر محلول ملحي يحتوي على 20 كجم من الملح. في الزمن t = 0، يتم سكب المياه العذبة في الخزان بمعدل 4 لتر في الدقيقة بينما الخليط المخفف يخرج بنفس المعدل.

If S is the amount of salt in kg at any time

The concentration in kg in liter is S/100

Then $\frac{dS}{dt} = -4\frac{S}{100} = -0.04\,S$

Then $S(t) = e^{-0.04t+k} = m.e^{-0.04t}$

At $t = 0$, $S(0) = 20 = m.e^{0}$. Then $m = 20$

Then $S(t) = 20e^{-0.04t}$

is the mathematical relation.

(Decreasing relation)

From $S(t) = 20e^{-0.04t}$

t / minute	S / Kg
0	20
1	19.22
2	18.46
10	13.4

The amount of salt in solution is 0 when t approaches infinity

Example

A metal bar at a temperature of 100^0 F is placed in a room at a constant temp. 0^0 F. After 20 minutes the temp. of the bar is 50^0

Find the time at which the temp. of the bar is 25^0

Find the temp. of the bar after 10 minutes.

Assume that u is the temp. of the bar at time t.

From Newton's law of cooling

$$\frac{du}{dt} = -k(\text{temp.of bar} - \text{temp.of its surrounding})$$

$$= -k(u - 0)$$

Then $\frac{du}{u} = -kdt$ Then $\ln u = -kt + c$

Then $u = e^{-kt+c} = e^{c}.e^{-kt} = C.e^{-kt}$

Since $u(0) = u(\text{time} = 0) = 100^{0}$

$u(20) = u(\text{time} = 20) = 50^{0}$

Then $100 = C.e^{0} = C$

$50 = 100e^{-20k}$, then $k = 0.035$

The mathematical relation is:

$$u(t) = 100e^{-0.035t}$$

When the temp. of the bar is 25^{0}

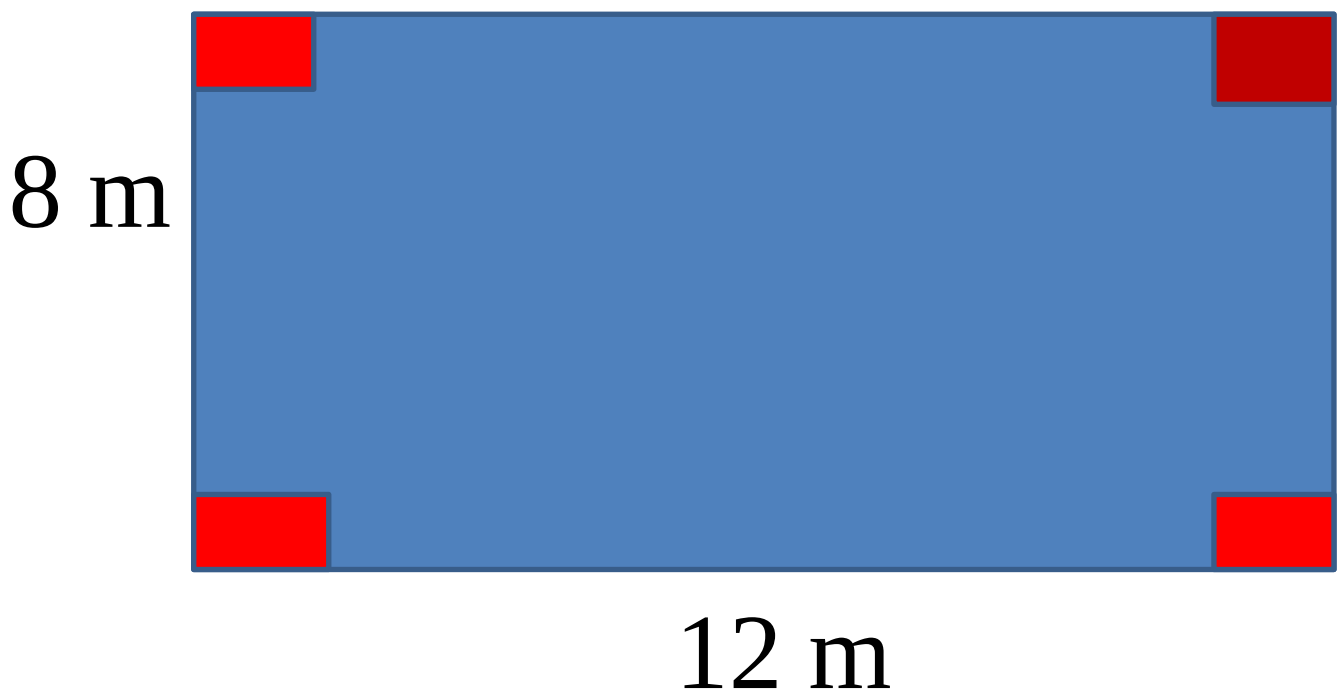
Then $25 = 100e^{-0.035t}$, then $t = 39.6$ min

After 10 minutes, the temp. of the bar is:

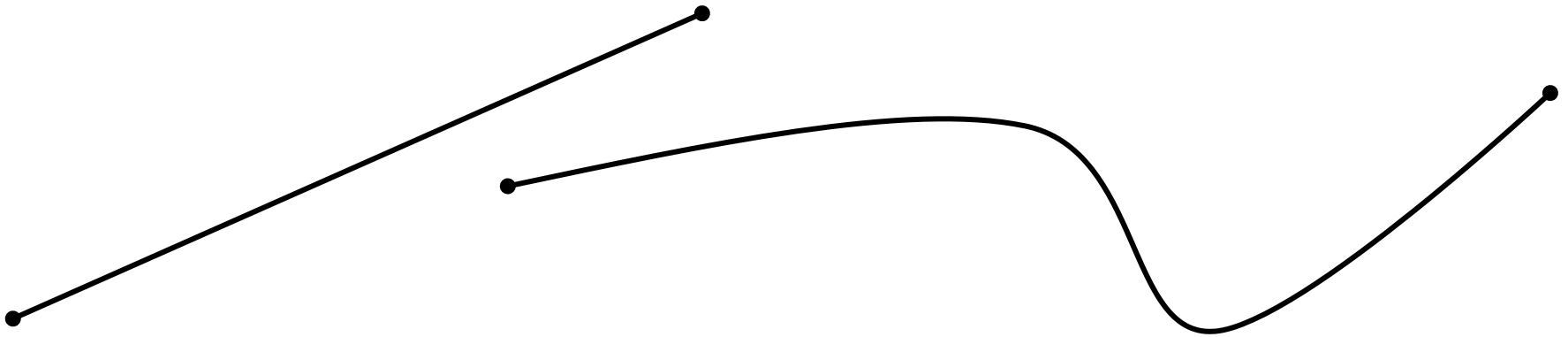
$$u(10) = 100e^{-0.035(10)} = 70.5^{0}\ F$$

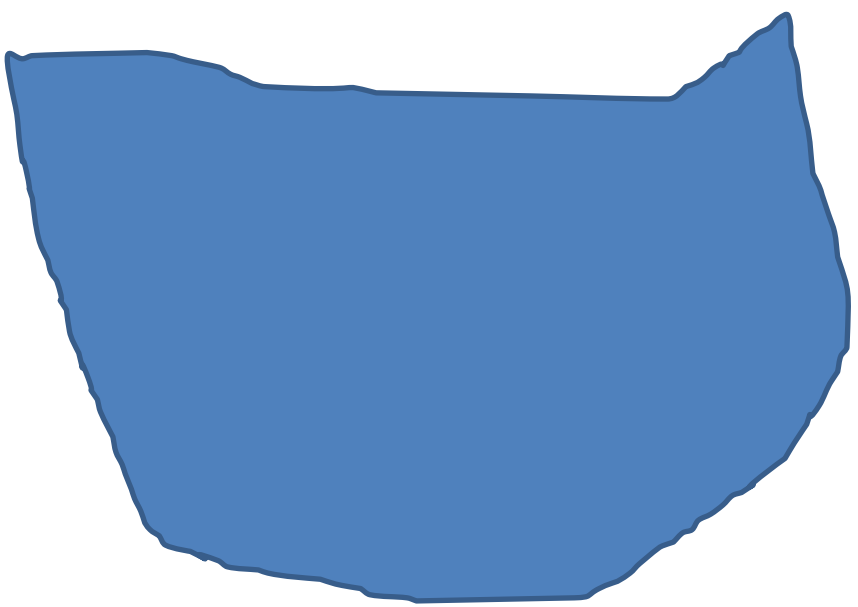
Optimization Problem

Design a Box



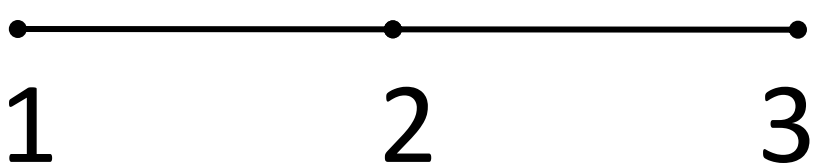
Application of Integral





Properties of Chemical Compounds

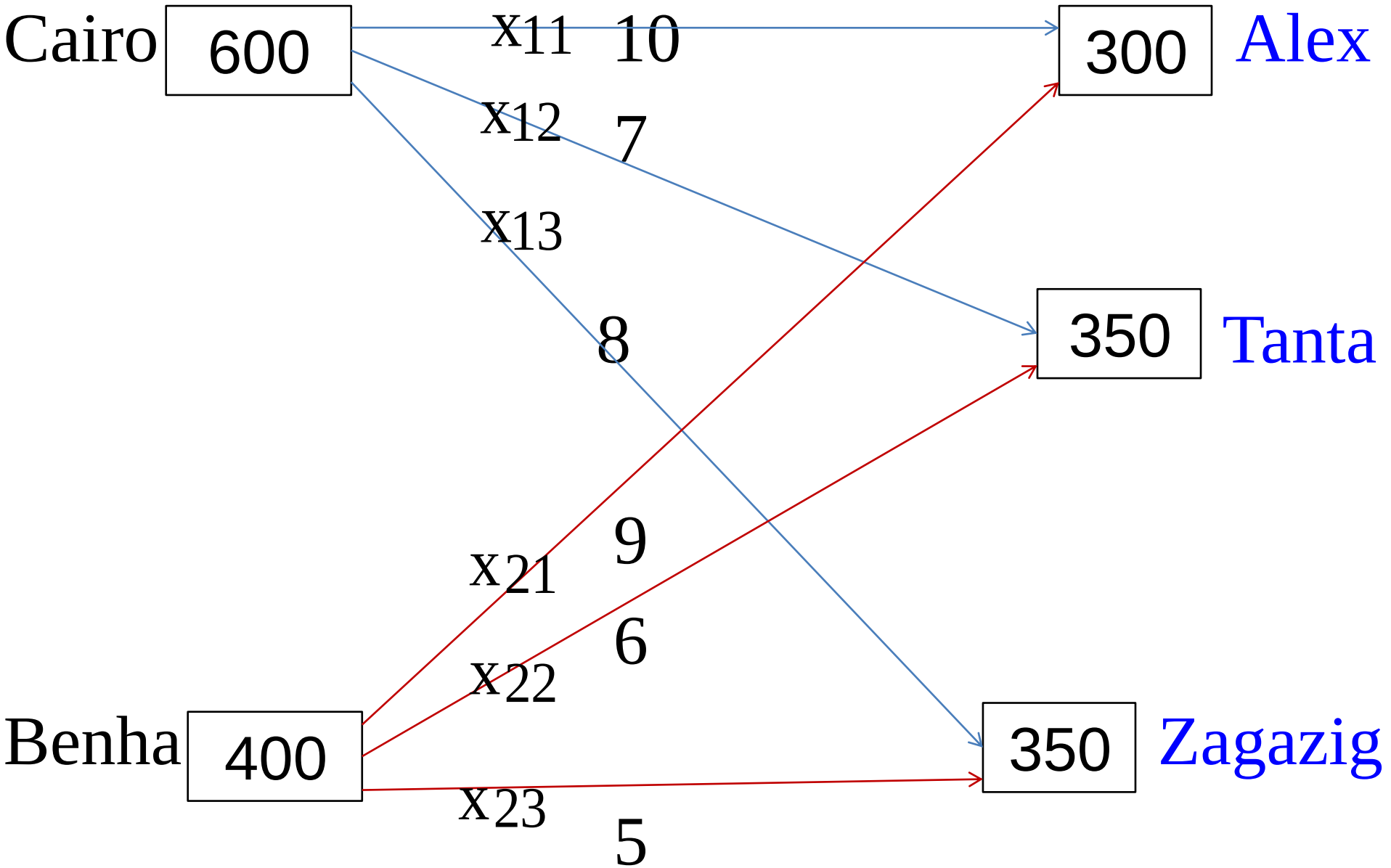
- The molecular graph:



- The matrix:

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

Optimization Problem



Mathematical Model

$$\text{Minimize } f = 10x_{11} + 7x_{12} + 8x_{13} + 9x_{21} + 6x_{22} + 5x_{23}$$

s.t

$$x_{11} + x_{12} + x_{13} = 600$$

$$x_{21} + x_{22} + x_{23} = 400$$

$$x_{11} + x_{21} = 300$$

$$x_{12} + x_{22} = 350$$

$$x_{13} + x_{23} = 350$$

$$x_{11},\ x_{12},\ x_{13},\ x_{21},\ x_{22},\ x_{23} \geq 0$$

Benha University

Home

My C.V.

About

Courses

Publications

Reports

Published books

Workshops / Conferences

Supervised PhD

Supervised MSc

Supervised Projects

Education

Language skills

Dr. Mohamed Husien Mohamed Eid

Academic Position: Lecturer

Current Administrative Position:

Ex-Administrative Position:

Faculty: Engineering, Shoubra

Department: Mathematical & Physical Engineering

Edu-Mail: mohamed.eed@feng.bu.edu.eg

Alternative Email: M_H_Eid2014@hotmail.com

Mobile:

Scientific Name: M.H.Eid

Publications [Titles(11) :: Papers(0) :: Abstracts(11) **]**

Inlinks(0) :: Courses Files(163) | **Total points :185**

News

To Publish your news click here

Thank You