CSPC 105

Automata Theory and Formal Languages

Introduction

Review on Relations and Graphs

L.P.Facun

Sets: collection of things

name = { ... , ... }

items : hat , pants , shirts , socks , and many more

fingers : pinky , ring , middle , index , thumb

items = { hat , pant , shirts , socks , ... } → infinite set

element

ellipsis

fingers = { pinky , ring , middle , index , thumb } → finite set

alphabet = { a , b , c , ... , x , y , z } → finite set

26

Sets: collection of things

integers = {1, 2, 3, 4, ...} → infinite set

1 is an element of integer

- $1 \in$ integer
- $2 \in$ integer
- $0 \notin$ integer

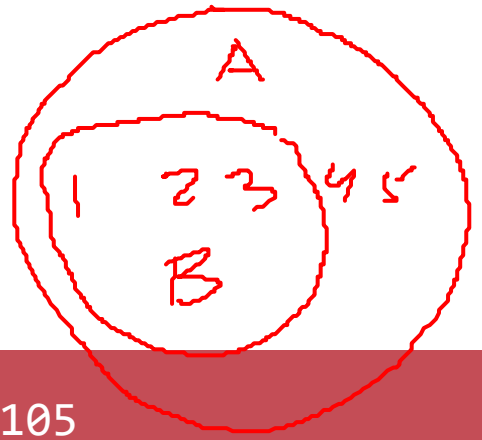
Sets: collection of things

subset = is a set that exist on another set

$A = \{1, 2, 3, 4, 5\}$

$B = \{1, 2, 3\}$

is B a subset of A? ✓



$C = \{6, 7\}$

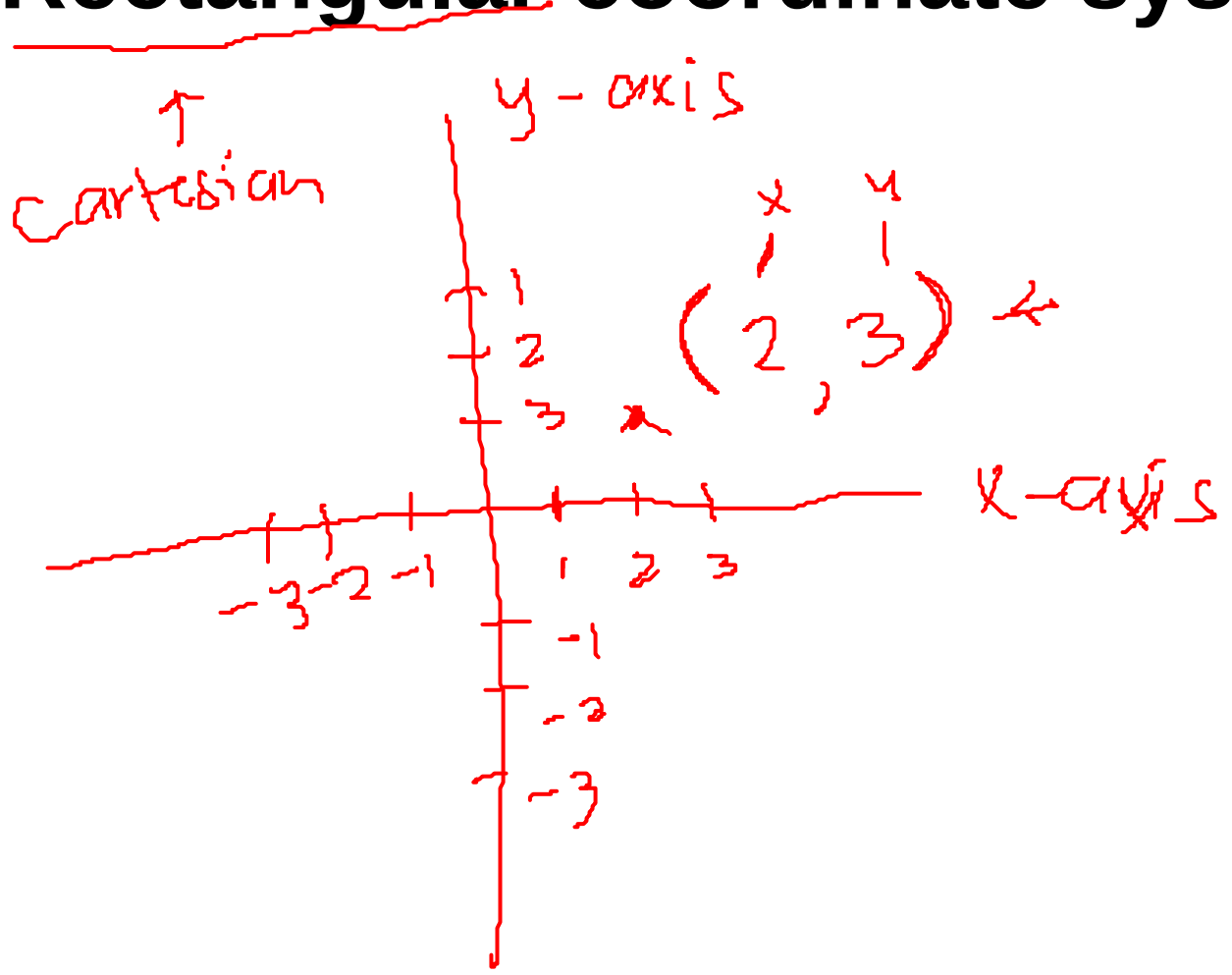
$D = \{1, 2, 3, 4, 5, 6\}$

is $C \subseteq A$? ✗

is $D \nsubseteq A$?

is $A \subseteq D$ ✓

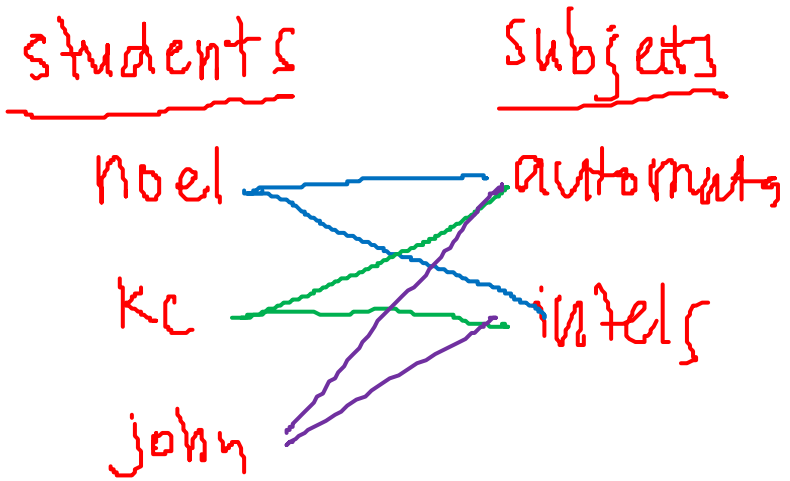
Rectangular coordinate system



Cartesian product of sets

students = {noel, kc, john}

subjects = {automata, intels}



(automata, noel)

cartesian product

↓

students x subjects = {

(noel, automata), (noel, intels)

(kc, automata), (kc, intel)

(john, automata), (john, intel)

}

Cartesian product of sets

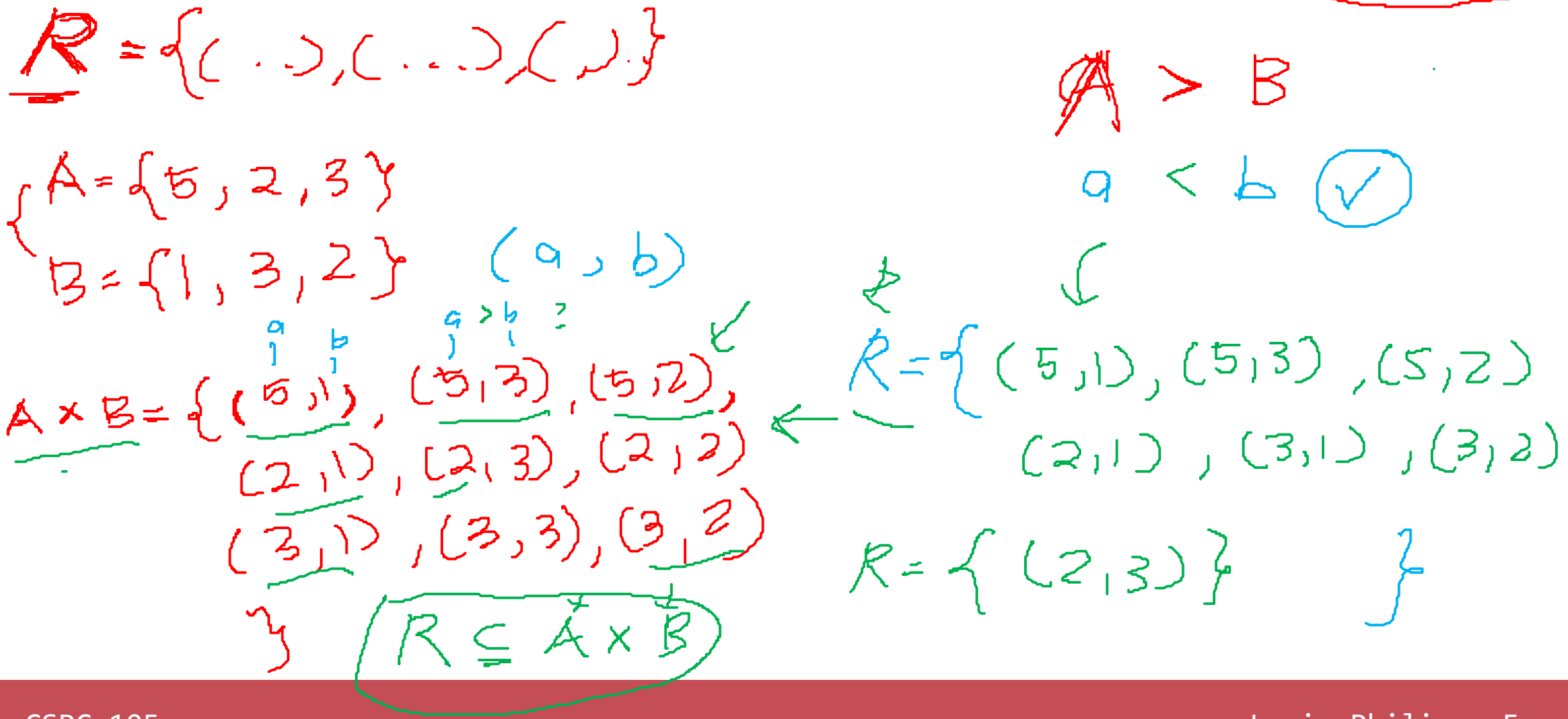
$A = \{2, 4, 6\}$

$B = \{10, 20, 30\}$

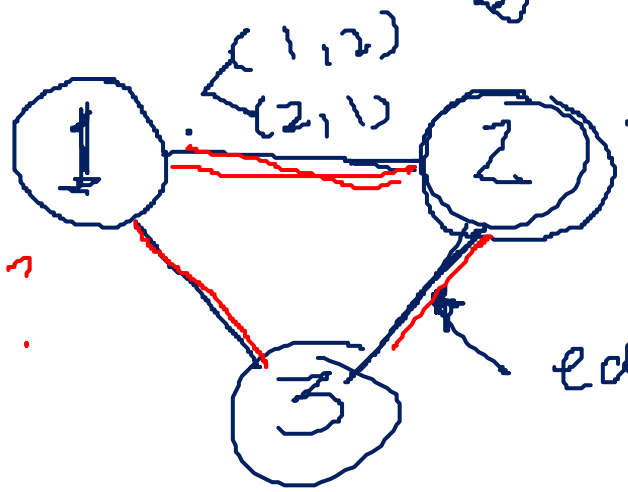
$A \times B = \{(2,10), (2,20), (2,30),$
$(4,10), (4,20), (4,30),$
$(6,10), (6,20), (6,30)\}$

$A \times B = \{ \ldots \}$

Relation: set of ordered pairs that satisfy a relationship



Graph



undirected graph

(1,2)
(2,1)

vertex / node

edge

$V = \{1, 2, 3\}$

$E = \{(1,2), (1,3), (2,3)\}$

$G = (\{1,2,3\}, \{(1,2),(1,3),(2,3)\})$

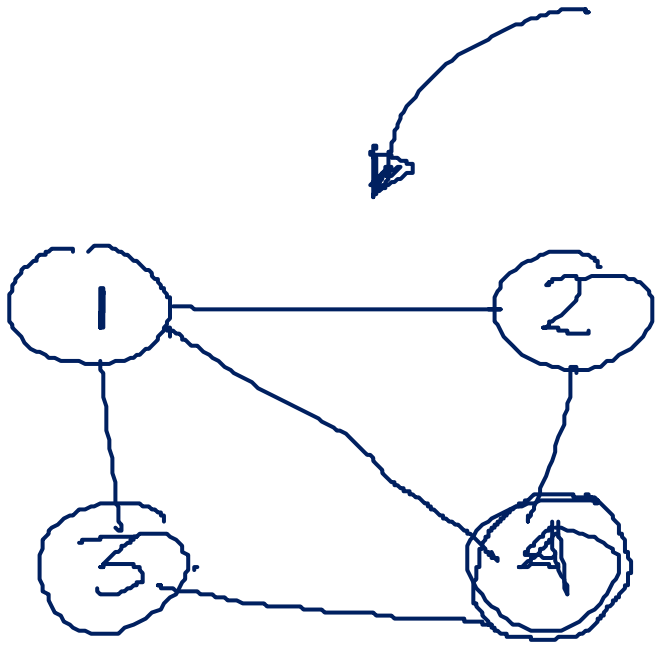
$G = (V, E)$

V: set of vertices

E: set of edges

vertex	degree
1	2
2	2
3	2

Graph



$G = (\{1, 2, 3, 4\},$

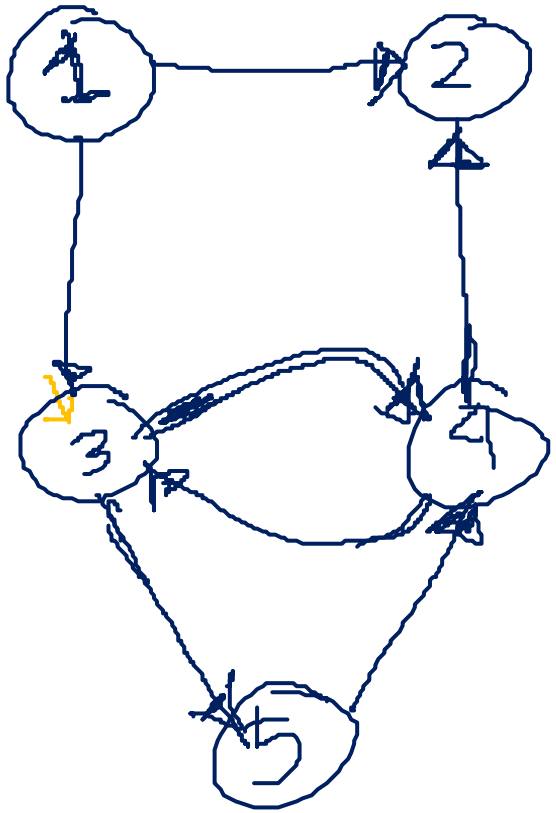
$\{(1,2), (1,4), (1,3), (2,4)$

$(3,4)\})$

Vertex		degree
1	?	3
2		2
3		2
4		3

Graph

directed graph → digraph, $G = (V, E)$



$G = (\{1, 2, 3, 4, 5\},$

$\{(1, 3), (1, 2), (4, 2), (3, 5), (3, 4), (4, 3), (5, 4)\})$

vertex	indegree	outdegree
1	0	2
2	2	0
3	2	2
4	2	2
5	1	1

list

$Q = \{on, off\}$

$q_0 \in Q$

~~Activity!~~ Summarize

$\{\ldots\}$ - sets

$(\ldots,\ldots)$ - pair

$\in$ - element of

$\subseteq$ - subset

$A \times B$ - cartesian product

R - relation

G - graph