

6	9	13	7
12		10	5
3	1	4	14
15	8	11	2

Mathematics for Computer Science
MIT 6.042J/18.062J

Directed Graphs (Digraphs)

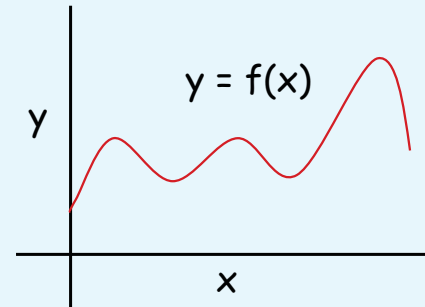


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digraphs.1

6	9	13	7
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3	1	4	14
15	8	11	2

Normal Person's Graph

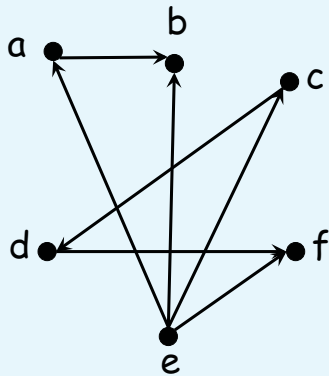


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digraphs.2

6	9	13	7
12		10	5
3	1	4	14
15	8	11	2

Computer Scientist's Graph



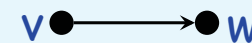
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digraphs.3

6	9	13	7
12		10	5
3	1	4	14
15	8	11	2

Digraphs

- a set, V , of vertices
 - a set, $E \subseteq V \times V$ of directed edges
- $(v,w) \in E$ notation: $v \rightarrow w$

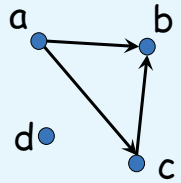


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digraphs.4

6	9	13	7
12		10	5
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Relations and Graphs



$$V = \{a, b, c, d\}$$

$$E = \{(a, b), (a, c), (c, b)\}$$

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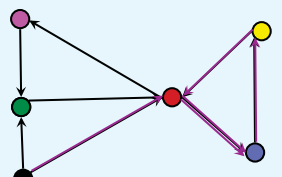
Digraphs

Formally, a digraph with vertices V is the same as a binary relation on V .

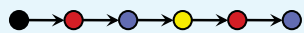
6	9	13	7
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Walks & Paths

Walk: follow successive edges



length: 5 edges

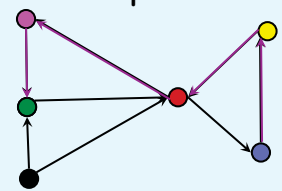


(not the 6 vertices)

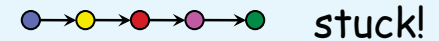
6	9	13	7
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Walks & Paths

Path: walk thru vertices without repeat vertex



length: 4 edges



6	9	13	7
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Matrix representation

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 $\left(\begin{array}{ccccccc} & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \end{array} \right)$

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6	9	13	7
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Matrix representation

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 $\left(\begin{array}{ccccccc} & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \end{array} \right)$

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6	9	13	7
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15	8	11	2

Matrix representation

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 $\left(\begin{array}{ccccccc} & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \end{array} \right)$

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6	9	13	7
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Adjacency Matrix

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 $\left(\begin{array}{ccccccc} & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \end{array} \right)$

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6	9	13	7
12		10	5
3	1	4	14
15	8	11	2

Adjacency Matrix

• • • • • •

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



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