Social Network Analysis: bipartite network

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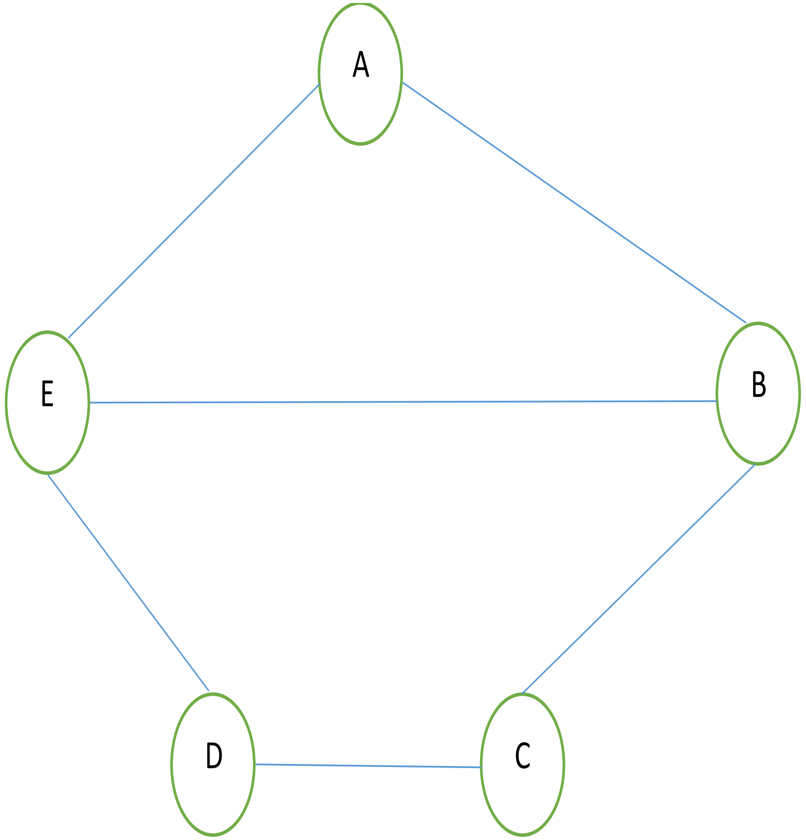
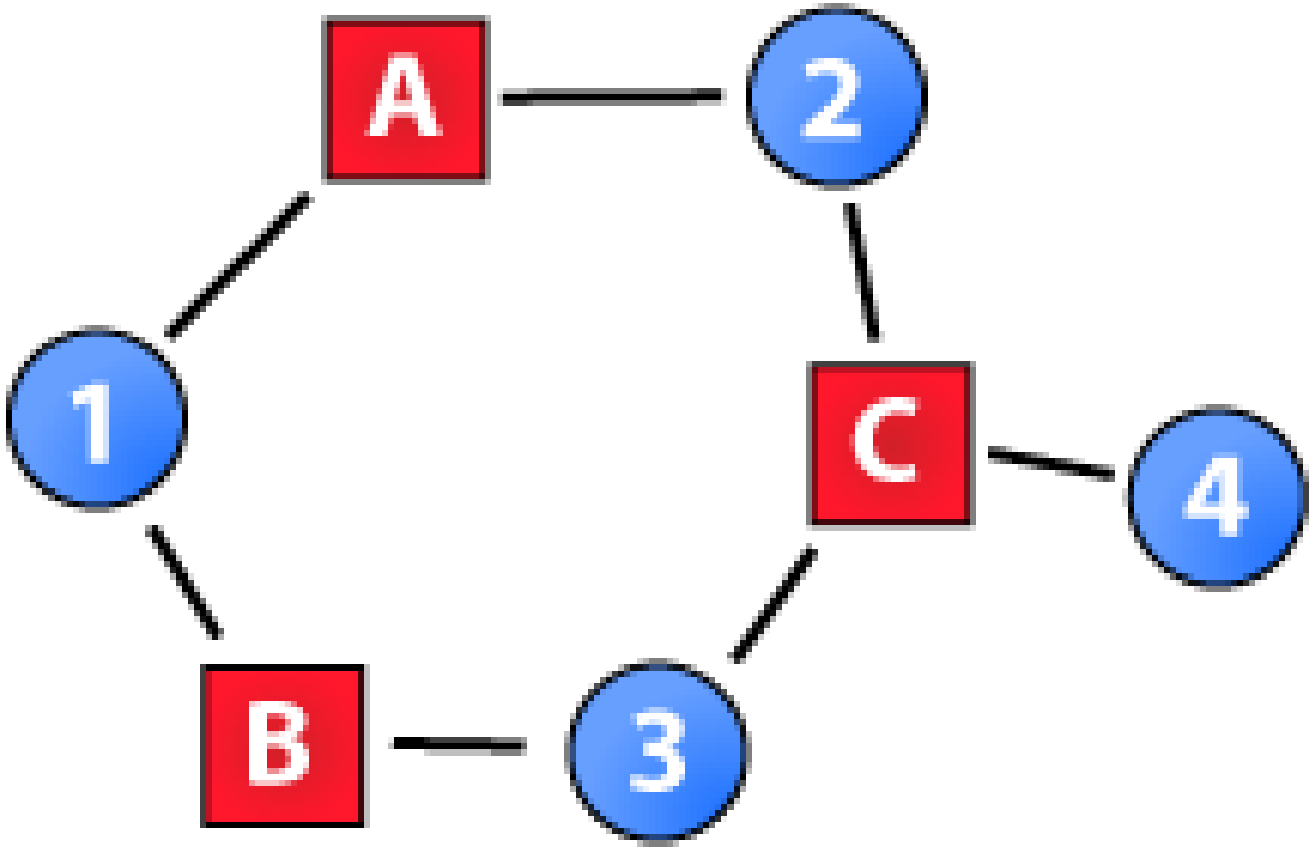
One-mode to bipartite network

- What is one-mode network?



What is two-mode/bipartite network?



Data structure of bipartite network

	1	2	3	4	A	B	C
1					1	1	0
2					1	0	1
3					0	1	1
4					0	0	1
A	1	1	0	0			
B	1	0	1	0			
C	0	1	1	1			

Matrices multiplication

- If you multiple the green matrix (4 by 3) with the pink matrix (3 by 4), you would produce the following 4 by 4 matrix

	1	2	3	4
1	2	1	1	0
2	1	2	1	1
3	1	1	2	1
4	0	1	1	1

Matrix multiplication

$$\mathbf{A} = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \\ a_{31} & a_{32} \end{pmatrix}, \mathbf{B} = \begin{pmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \end{pmatrix}$$

$$\mathbf{AB} = \begin{pmatrix} a_{11}b_{11} + a_{12}b_{21} & a_{11}b_{12} + a_{12}b_{22} & a_{11}b_{13} + a_{12}b_{23} \\ a_{21}b_{11} + a_{22}b_{21} & a_{21}b_{12} + a_{22}b_{22} & a_{21}b_{13} + a_{22}b_{23} \\ a_{31}b_{11} + a_{32}b_{21} & a_{31}b_{12} + a_{32}b_{22} & a_{31}b_{13} + a_{32}b_{23} \end{pmatrix}$$

$$\mathbf{BA} = \begin{pmatrix} b_{11}a_{11} + b_{12}a_{21} + b_{13}a_{31} & b_{11}a_{12} + b_{12}a_{22} + b_{13}a_{32} \\ b_{21}a_{11} + b_{22}a_{21} + b_{23}a_{31} & b_{21}a_{12} + b_{22}a_{22} + b_{23}a_{32} \end{pmatrix}$$

Matrices multiplication

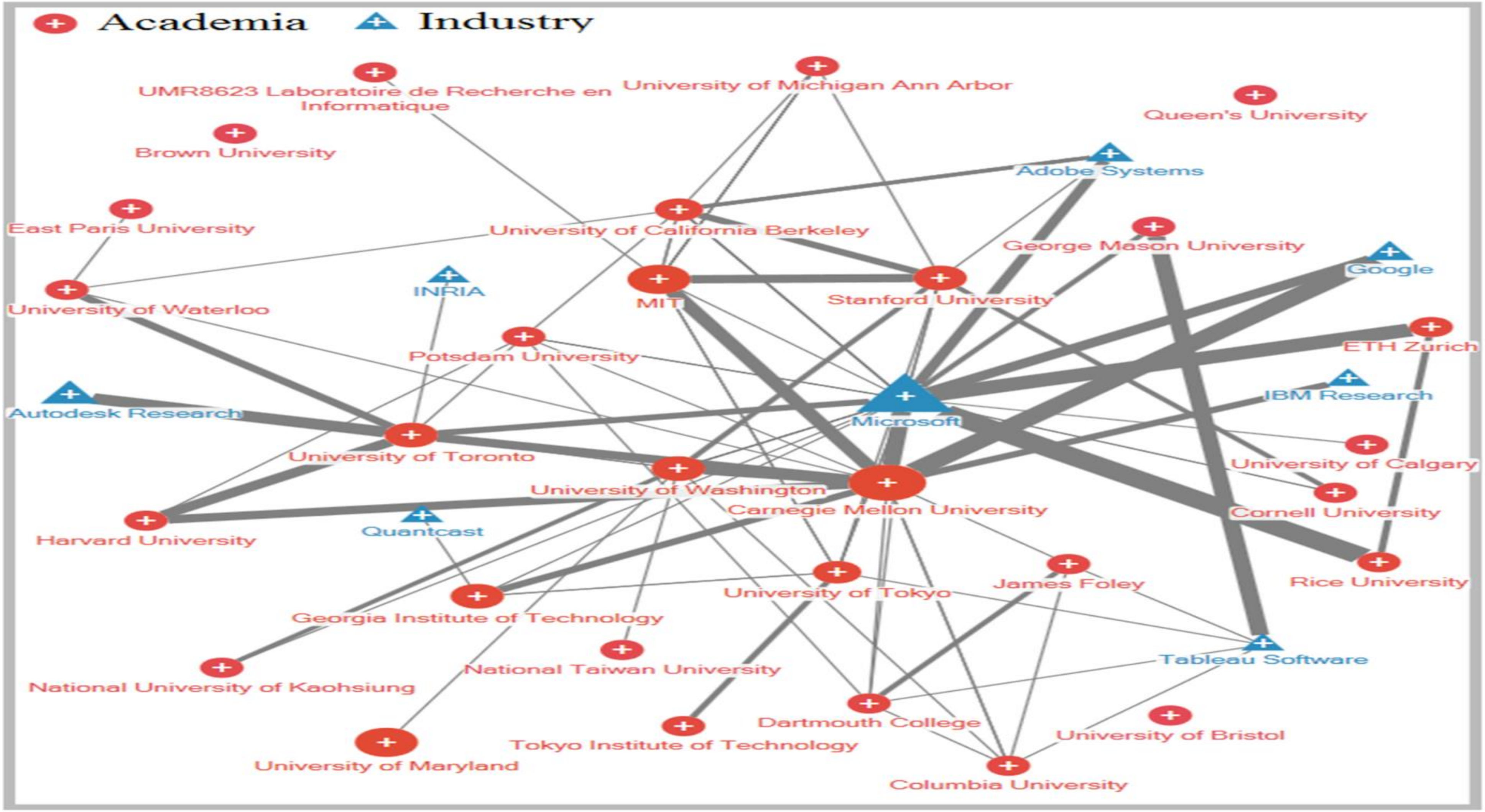
$$A_{3x2} \cdot B_{2x4} = C_{3x4} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix} \cdot \begin{pmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \end{pmatrix} =$$

$$= \begin{pmatrix} 1\cdot1+2\cdot5 & 1\cdot2+2\cdot6 & 1\cdot3+2\cdot7 & 1\cdot4+2\cdot8 \\ 3\cdot1+4\cdot5 & 3\cdot2+4\cdot6 & 3\cdot3+4\cdot7 & 3\cdot4+4\cdot8 \\ 5\cdot1+6\cdot5 & 5\cdot2+6\cdot6 & 5\cdot3+6\cdot7 & 5\cdot4+6\cdot8 \end{pmatrix} = \begin{pmatrix} 11 & 14 & 17 & 20 \\ 23 & 30 & 37 & 44 \\ 35 & 46 & 57 & 68 \end{pmatrix}$$

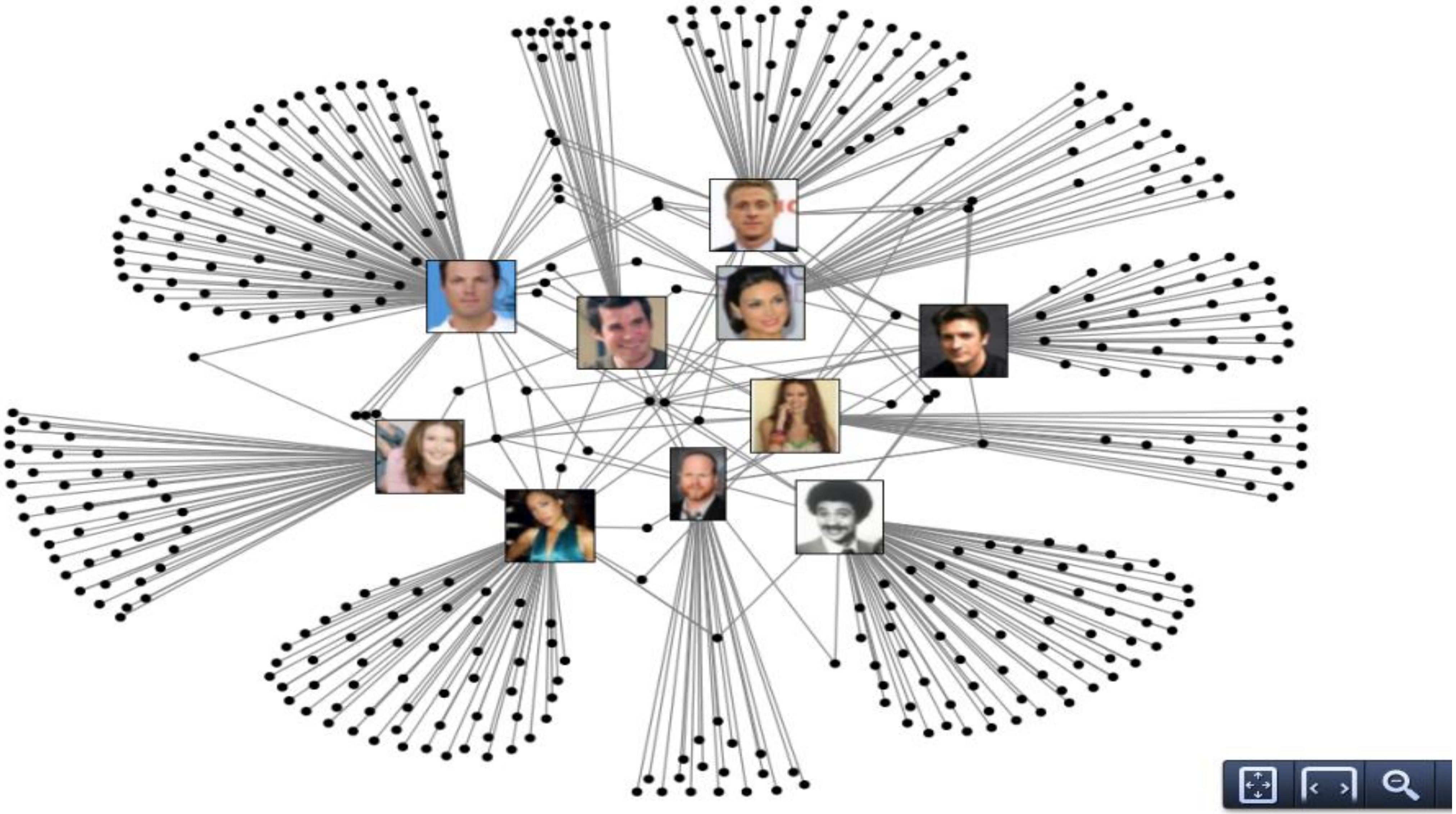
Could you produce the event by event matrix?

	A	B	C
A			
B			
C			

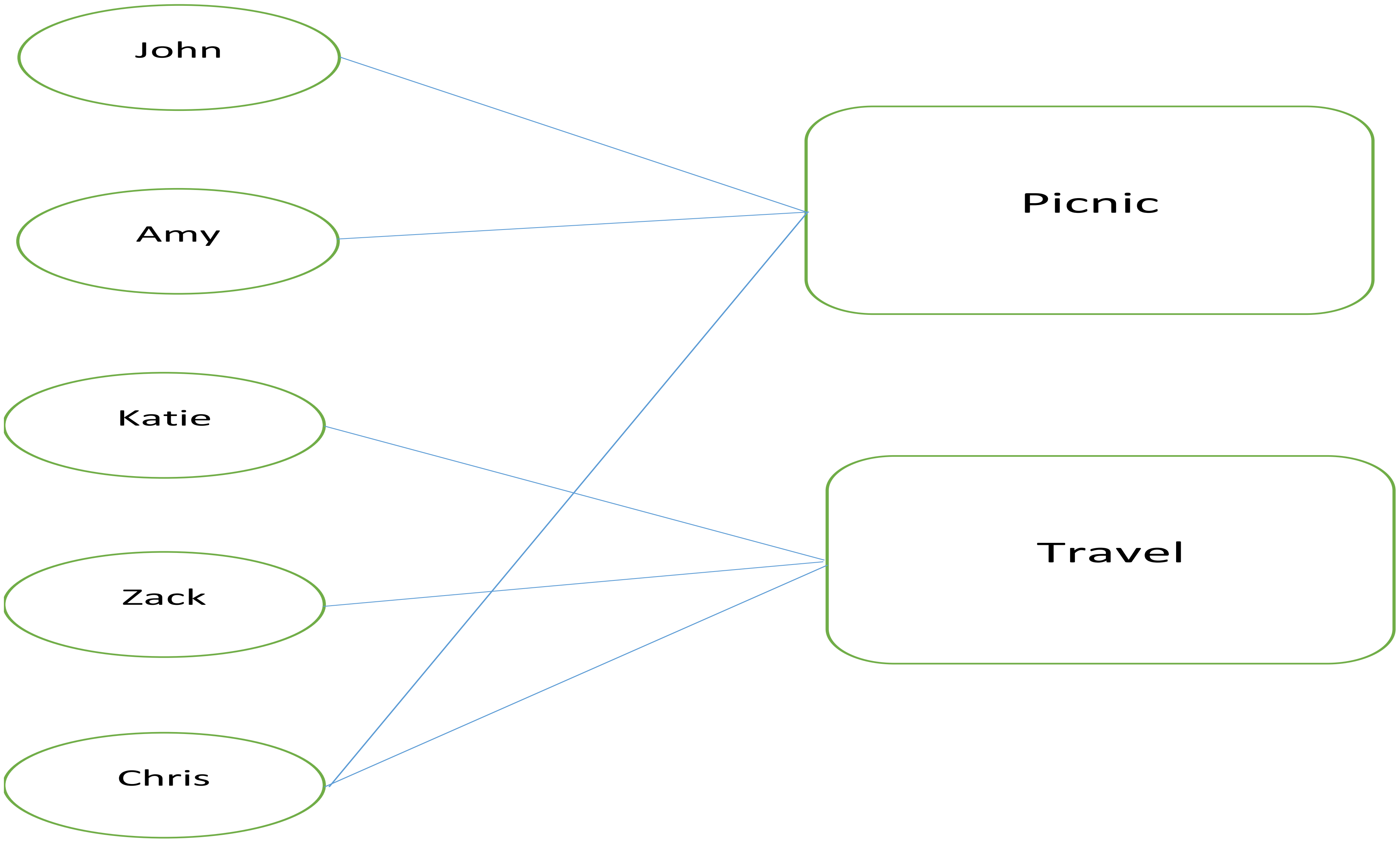
Application of bipartite network: Between Universities and Companies in R & D



Between actors and movies



The following artificial dataset



Converting bipartite to one-mode network

$$\begin{pmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 1 & 1 \end{pmatrix} \times \begin{pmatrix} 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 1 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 2 \end{pmatrix}$$

Actor by event matrix multiplies with event by actor matrix = actor by actor matrix.

Event by actor multiply by actor by event

Event by actor matrix multiplies with actor by event matrix = event by event matrix

$$\begin{pmatrix} 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 \end{pmatrix} \times \begin{pmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 1 & 1 \end{pmatrix} = \begin{pmatrix} 3 & 1 \\ 1 & 3 \end{pmatrix}$$

The result

	John	Amy	Katie	Zach	Chris	Picnic	Travel
John	**1**	**1**	**0**	**0**	**1**	1	0
Amy	**1**	**1**	**0**	**0**	**1**	1	0
Katie	**0**	**0**	**1**	**1**	**1**	0	1
Zach	**0**	**0**	**1**	**1**	**1**	0	1
Chris	**1**	**1**	**1**	**1**	**2**	1	1
Picnic	1	1	0	0	1	**3**	**1**
Travel	0	0	1	1	1	**1**	**3**

Bipartite network

studies are particularly useful for studying situations in which respondents cannot be interviewed or would be unlikely to report truthfully. In some cultures, respondents may feel compelled to report, e.g., friendship with everybody else in the same class or the same workplaces. In such a situation, observing actual behavior and co-attendance of events can help reveal the social structure of a group of classmates or co-workers.