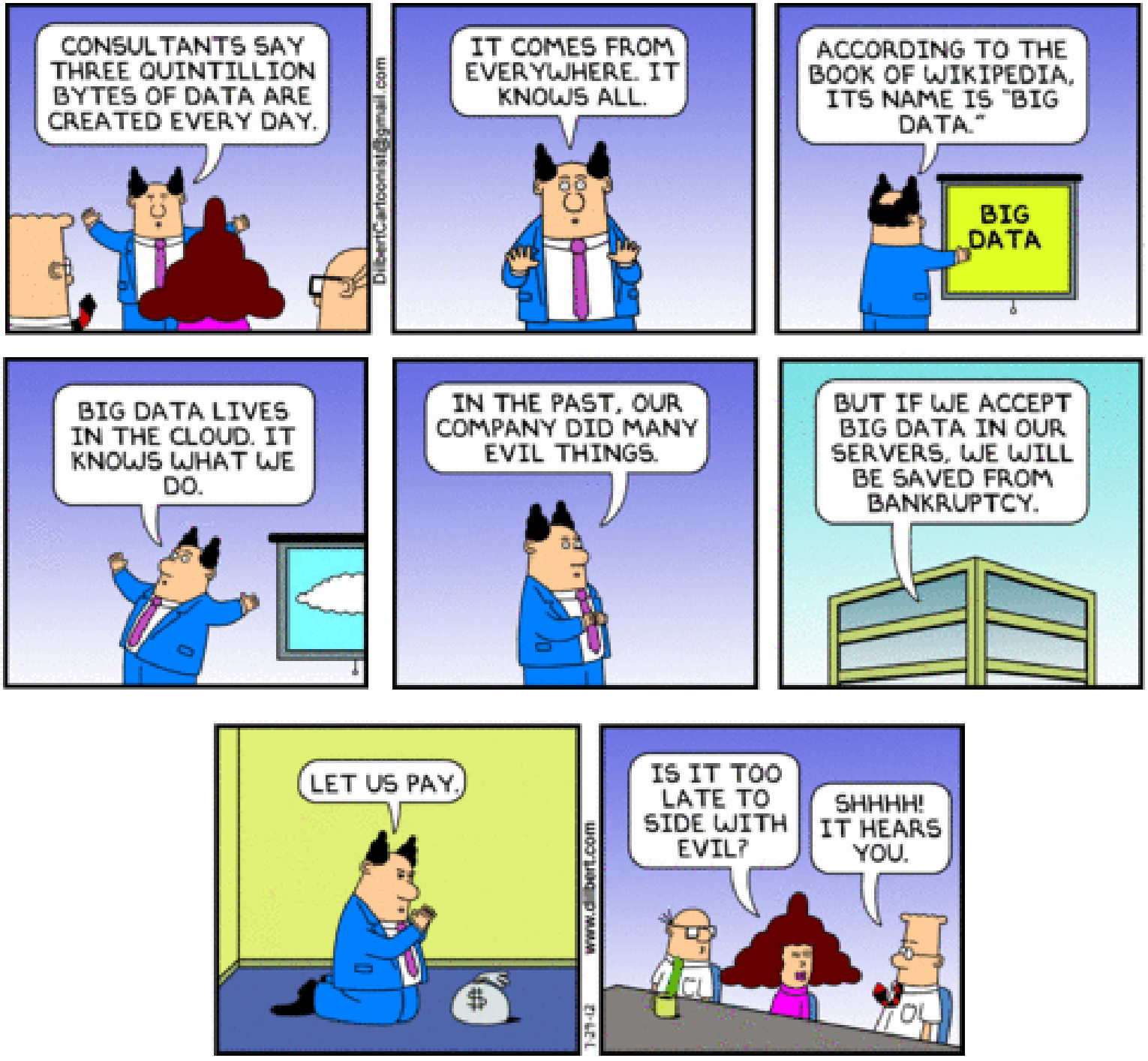
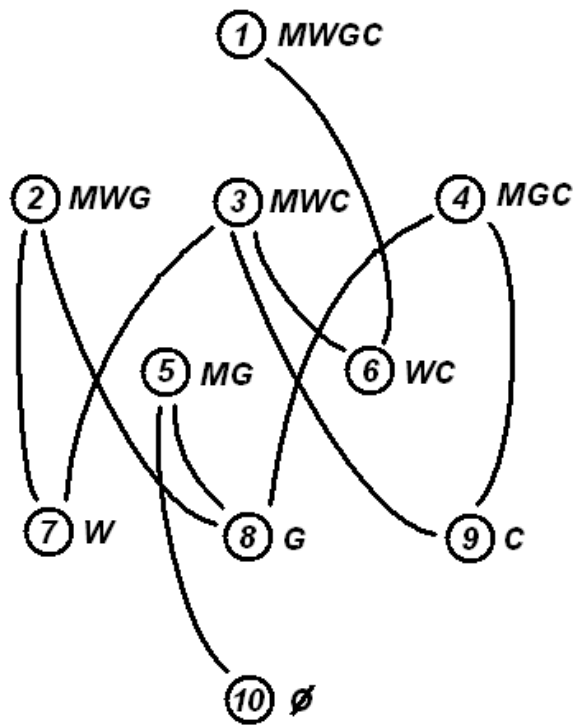

CONSULTANTS SAY THREE QUINTILLION BYTES OF DATA ARE CREATED EVERY DAY.
DilbertCartoonist@gmail.com
IT COMES FROM EVERYWHERE. IT KNOWS ALL.
ACCORDING TO THE BOOK OF WIKIPEDIA, ITS NAME IS "BIG DATA."
BIG DATA
BIG DATA LIVES IN THE CLOUD. IT KNOWS WHAT WE DO.
IN THE PAST, OUR COMPANY DID MANY EVIL THINGS.
BUT IF WE ACCEPT BIG DATA IN OUR SERVERS, WE WILL BE SAVED FROM BANKRUPTCY.
LET US PAY.
$
www.dilbert.com
IS IT TOO LATE TO SIDE WITH EVIL?
SHHHH! IT HEARS YOU.

Adjacency matrices

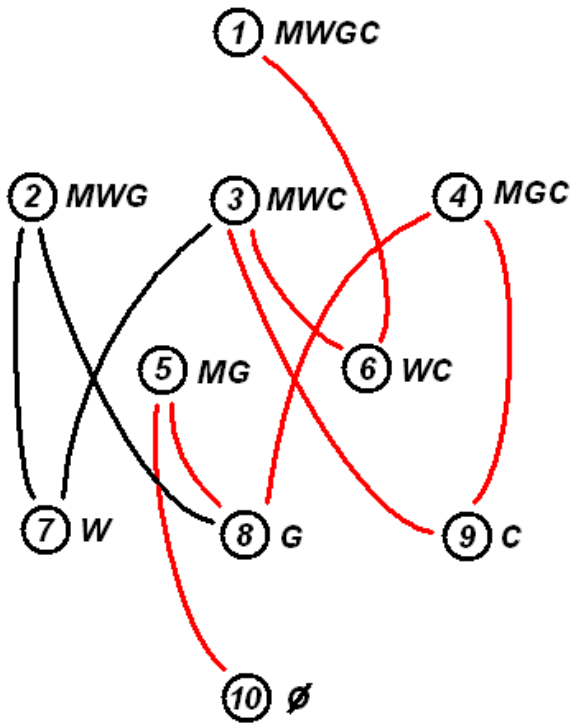
The *Adjacency matrix* of a "(di)(multi)graph (with loops)" is the $n \times n$ matrix A, where n is the number of "vertices", for which $a_{i,j}$ = the number of edges from vertex i to vertex j.

Example:

A man wants to take his pet wolf, a goat and his immense prize cabbage to market. He cannot leave the goat alone with the cabbage, or the wolf alone with the goat. He comes to a river, with a boat only large enough to accommodate him and one of his wares/companions. Can he cross without something being eaten?



Seeing the graph, it's not hard to come up with a solution. But is a shorter one possible?



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

According to R,

$$A^7 = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 22 & 23 & 16 & 23 & 2 \\ 0 & 0 & 0 & 0 & 0 & 39 & 63 & 84 & 62 & 23 \\ 0 & 0 & 0 & 0 & 0 & 68 & 84 & 80 & 84 & 16 \\ 0 & 0 & 0 & 0 & 0 & 39 & 62 & 84 & 63 & 23 \\ 0 & 0 & 0 & 0 & 0 & 18 & 39 & 68 & 39 & 22 \\ 22 & 39 & 68 & 39 & 18 & 0 & 0 & 0 & 0 & 0 \\ 23 & 63 & 84 & 62 & 39 & 0 & 0 & 0 & 0 & 0 \\ 16 & 84 & 80 & 84 & 68 & 0 & 0 & 0 & 0 & 0 \\ 23 & 62 & 84 & 63 & 39 & 0 & 0 & 0 & 0 & 0 \\ 2 & 23 & 16 & 23 & 22 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

but no smaller power of A has $(1, 10)$-th entry nonzero, so we have the two shortest solutions.