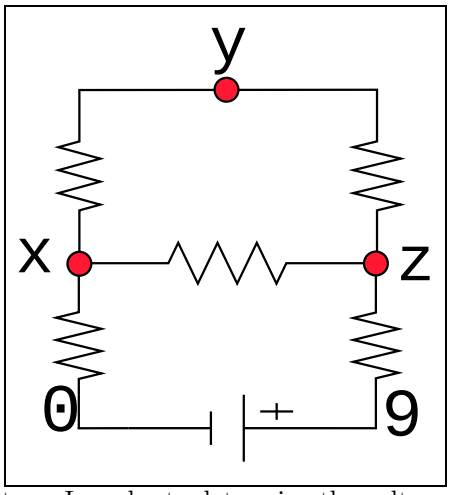
In class exercice 2/5/2002 **Math 21b, Oliver Knill**



We consider an electric circuit which contains a power supply of 9 volts and is made of 5 resistors. In order to determine the voltage at each point, we need to know 2 laws:

- **Ohms law** $U = RI$ relates the resistance R, the current I and the voltage difference U near a resistor.
- **Kirkhoffs law:** tells that the sum of the currents passing to a point is zero.

In our circuit all resistors have resistance 1. Consequently, by Ohm's law the current through a resistor is the voltage difference. From Kirkhoff's law we get the equations:

$$\left| \begin{array}{rl} x - 0 + x - y + x - z & = 0 \\ y - x + y - z & = 0 \\ z - x + z - 9 + z - y & = 0 \end{array} \right|$$

The voltages x, y, z at the corresponding points of the circuit satisfy the linear equations:

$$\left| \begin{array}{rl} 3x - y - z & = 0 \\ -x + 2y - z & = 0 \\ -x - y + 3z & = 9 \end{array} \right|$$

Can you solve these equations?

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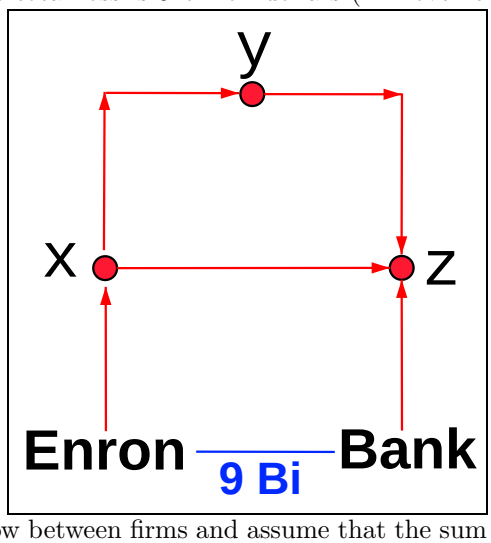
Federal investigators in the collapse of Enron have found a network of firms or partners affiliated with Enron. Let us assume that the total loss is 9 billion dollars (in November, there were talks to sell Enron for 8 Billion to Dynegy).



The firms are trading among each other. If I is the cash flow between firms and assume that the sum of the money currents passing through any firm is zero. If the firm network is as described in the picture, we obtain from money conservation the equations:

$$\left| \begin{array}{rl} x-0+x-y+x-z & =0 \\ y-x+y-z & =0 \\ z-x+z-9+z-y & =0 \end{array} \right|$$

The money losses x, y, z at the corresponding firms satisfy the linear equations:

$$\left| \begin{array}{rl} 3x-y-z & =0 \\ -x+2y-z & =0 \\ -x-y+3z & =9 \end{array} \right|$$

Can you solve these equations to determine the loss of each of the firms?