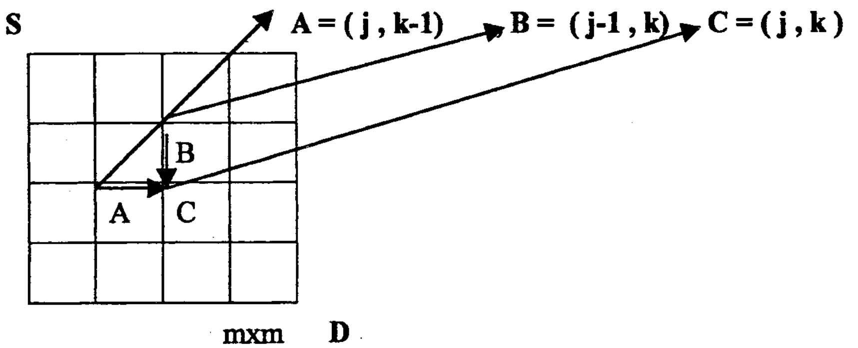
# SMARANDACHE ROUTE SEQUENCES

Amarnath Murthy, S.E.(E&T), WLS, Oil and Natural Gas Corporation Ltd., Sabarmati, Ahmedabad,- 380005 INDIA.

Consider a rectangular city with a mesh of tracks which are of equal length and which are either horizontal or vertical and meeting at nodes. If one row contains **m** tracks and one column contains **n** tracks then there are (m+1)(n+1) nodes. To begin with let the city be of a square shape i.e. m = n.

Consider the possible number of routes R which a person at one end of the city can take from a source **S ( starting point)** to reach the diagonally opposite end **D** the **destination**.




( m rows and m columns )

Refer **Figure -I**

For m = 1 Number of routes R = 1

For m = 2 , R = 2

For m = 3 , R = 12

We see that for the shortest routes one has to travel 2m units of track length. There are routes with 2m +2 units up to the longest route being 4m + 4.

We define **Smarandache Route Sequence (SRS)** as the number of all possible routes for a **'m'** square city. This includes routes with path lengths ranging from 2m to 4m +4 .

**Open problem(1): To derive a reduction formula/ general formula for SRS.**

Here we derive a reduction formula, thus a general formula for the number of **shortest routes.**

**Reduction formula for number of shortest routes:**

Refer **figure -II**

Let $R_{j,k}$ = number of routes to reach node ( j, k).

Node (j , k ). Can be reached only either from node (j-1, k) or from the node (j , k-1 ) . * {As only shortest routes are to be considered }.

It is clear that there is only one way of reaching node ( j, k) from node (j-1 , k). Similarly there is only one way of reaching node (j, k) from node (j , k-1). Hence the number of shortest routes to node (j , k ) is given by

$R_{j,k} = 1.\ R_{j-1,k} + 1.R_{j,k-1} =.\ R_{j-1,k} + R_{j,k-1}$

This gives the reduction formula for $R_{j,k}$.

Applying this reduction formula to fill the chart we observe that the total number of shortest routes to the destination ( the other end of the diagonal ) is ${}^{2n}C_n$ . This can be established by induction .

We can further categorize the routes by the number of **turning points** it is subjected to.

The chart for various number of turning points(**TPs**) for a city with 9 nodes is given below.

| | | | | |
|---|---|---|---|---|
| No of TPs | 1 | 2 | 3 | 4 |
| No of routes | 2 | 2 | 2 | 5 |

**Further Scope:**

**(1)** To explore for patterns among total number of routes , number of turning points and develop formulae for square as well as rectangular meshes (cities).

**(2)** To study as to how many routes pass through a given number/set of nodes? How many of them pass through all the nodes?

**Figure-I**