PRINCIPLES OF CONVOLUTIONAL DECODING

Key ideas to decode received sequence.

Maximum Likelihood Decoder

$\Rightarrow$ Minimum Distance

$d_H(\bar{r}, \bar{c})$

Hamming Distance.

Decoded codeword.

received sequence.

Decoding

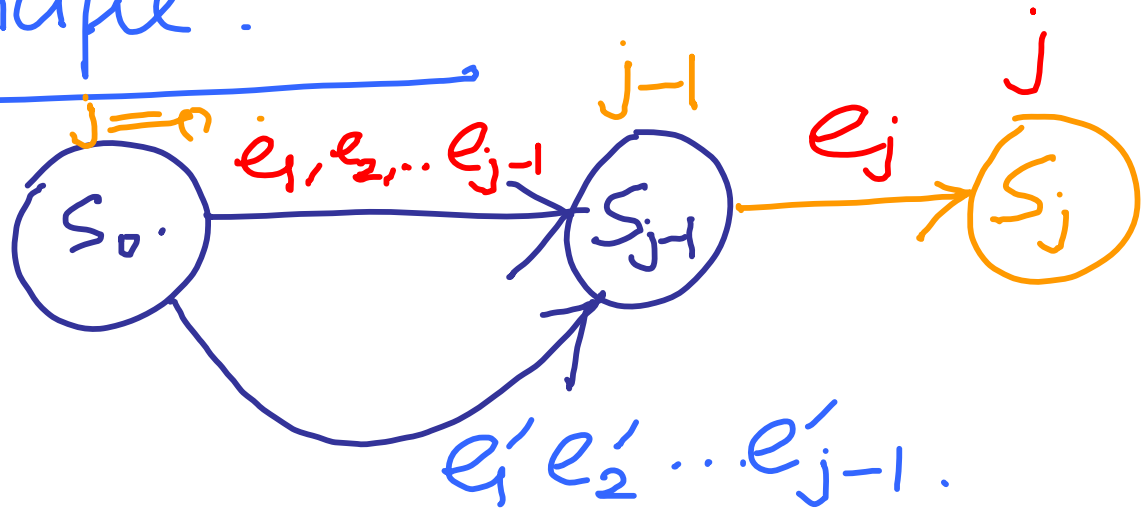
$\Downarrow$

Finding Path Through Trellis

$\Downarrow$

State Sequence.

1: Principle:



Let minimum distance from state s_0 to state s_j

min distance path $\equiv e_1 e_2 \ldots e_{j-1} e_j$

d_{min}

Then, $e_1 e_2 \ldots e_{j-1}$ is the minimum distance path from s_0 to s_{j-1}.

Proof: Proof by contradiction

If there exists an alternative path $e_1' e_2' \ldots e_{j-1}'$ which has min distance from s_0 to s_{j-1}

Then,

$$d_{min} = d(e_1, e_2, e_3 \ldots, e_j)$$

$$= \sum_{i=1}^{j} d(e_i)$$

$$= \sum_{i=1}^{j-1} d(e_i) + d(e_j)$$

$$\geq \sum_{i=1}^{j-1} d(e'_i) + d(e_j)$$

$$= d(e'_1 e'_2 \cdots e'_{j-1} e_j)$$

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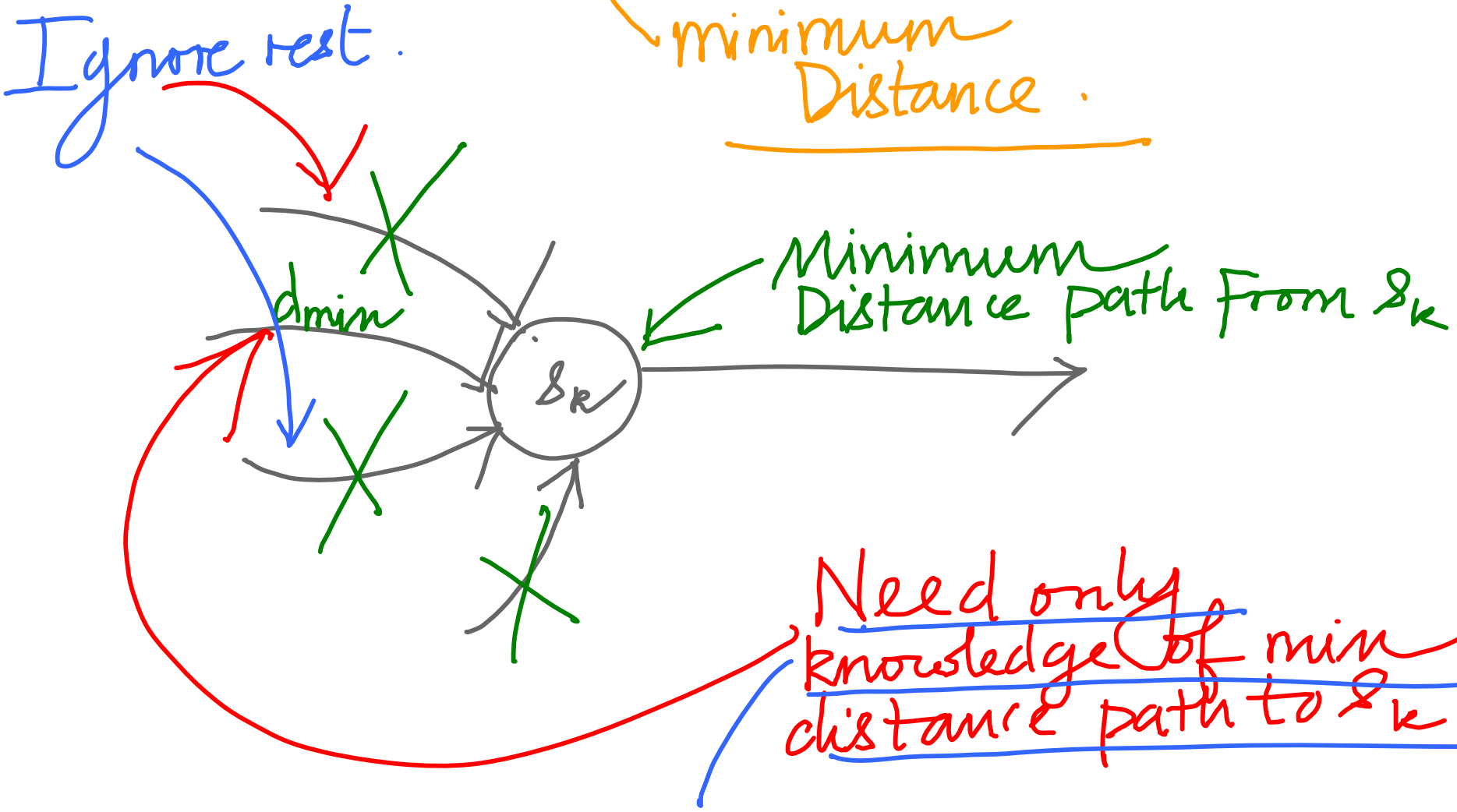
$d_{min} \geq d(e_1' e_2' \ldots e_{j-1}' e_j)$

Contradiction!

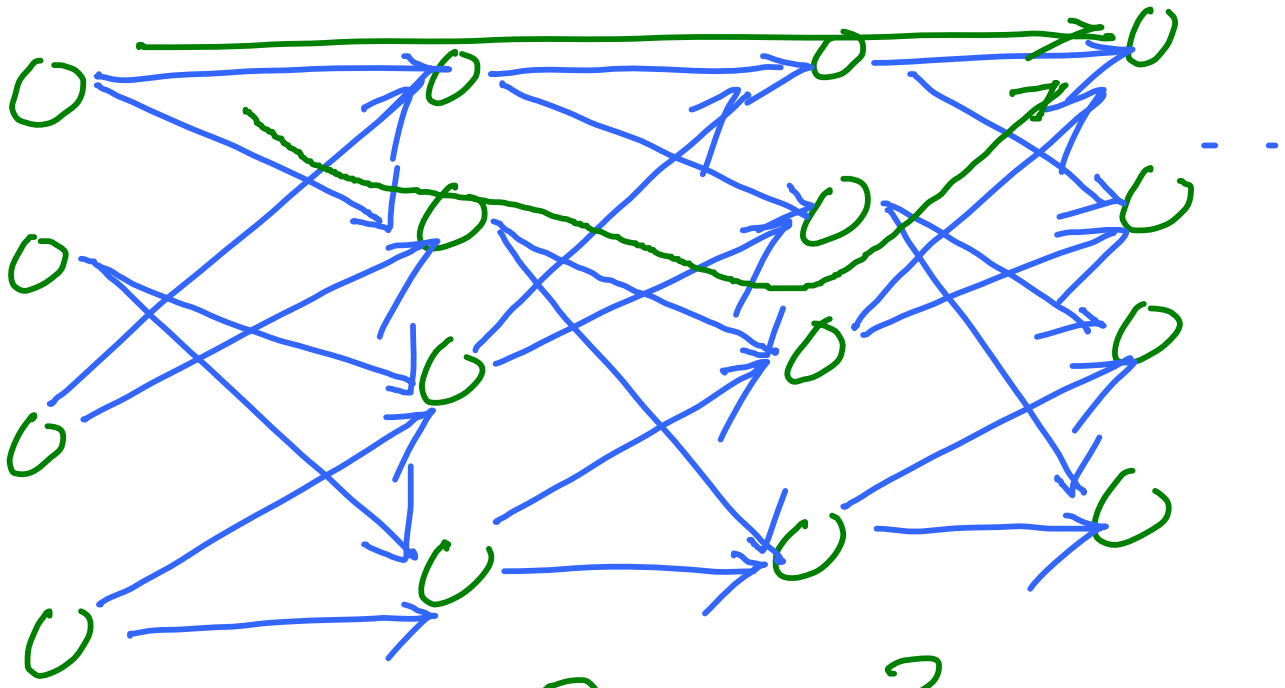
minimum Distance.

Ignore rest.



Need only knowledge of min distance & path to s_k

No need to store any other information



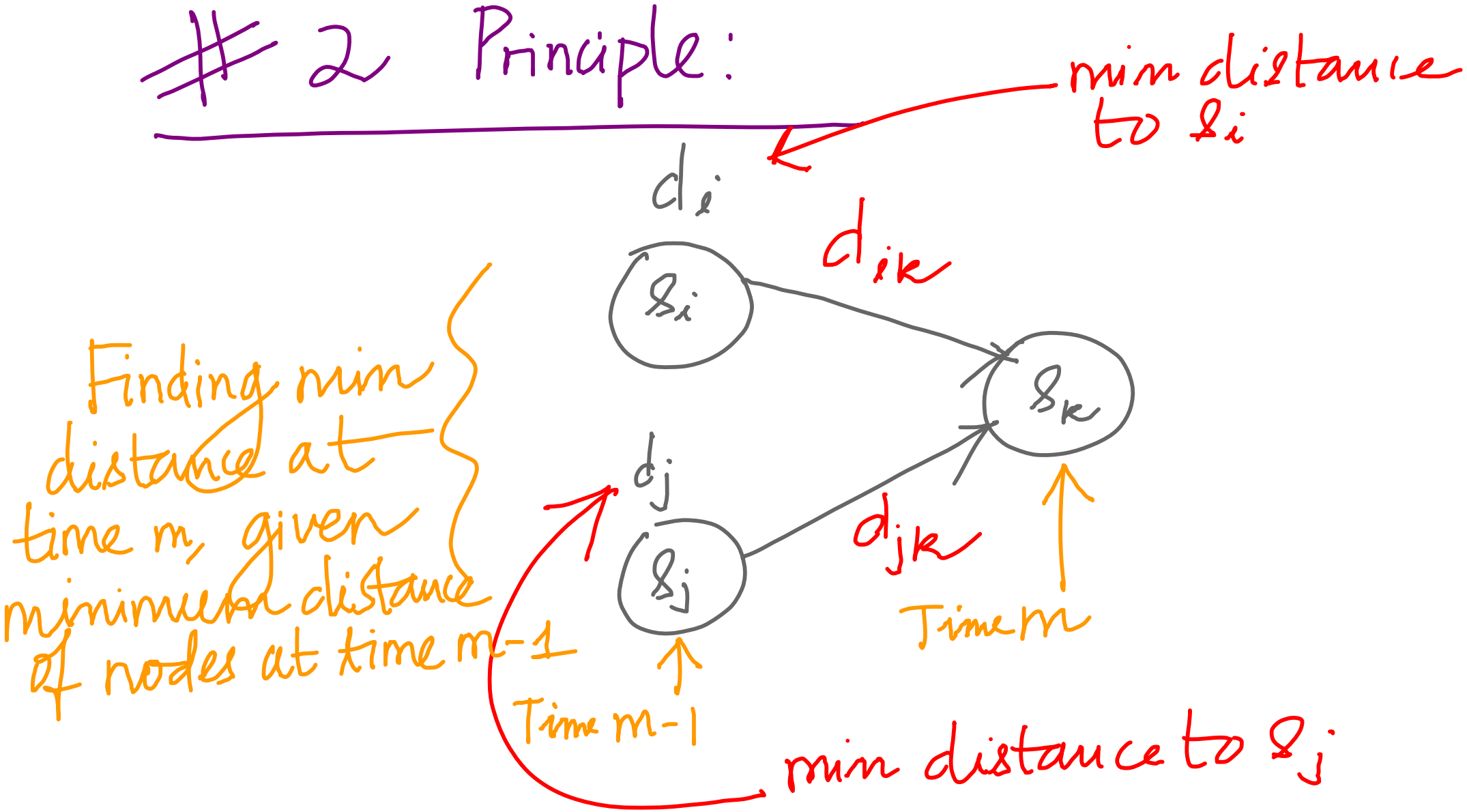
2 2 2

Total # paths becomes exponential!

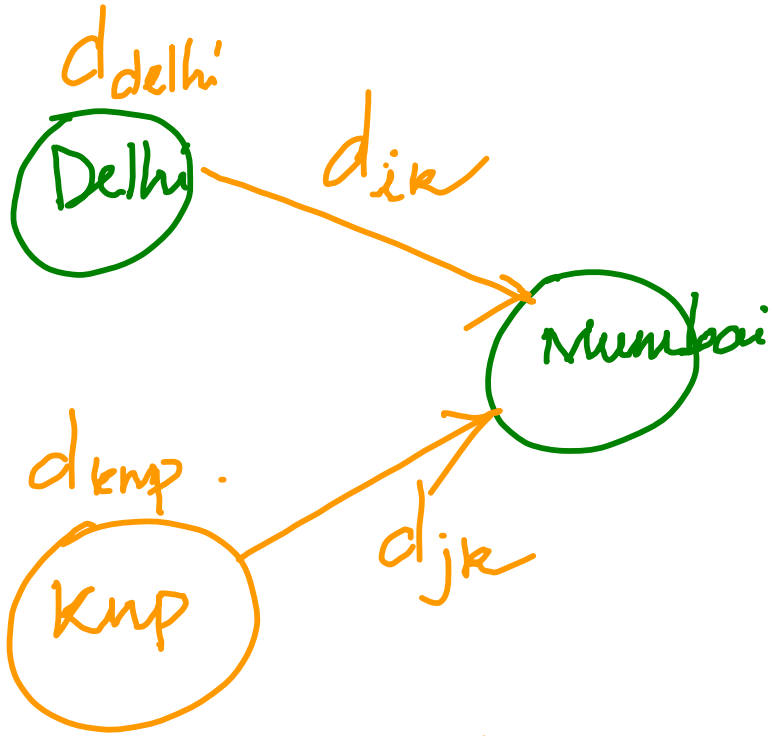
Very difficult (impossible) to compute

This principle greatly simplifies computation.

#2 Principle:



min distance to s_k
$= \min\{d_i + d_{ik}, d_j + d_{jk}\}$



$$d_{mum} = \min\{d_{delhi} + d_{ik}, d_{knp} + d_{jk}\}$$