Predictive Coding

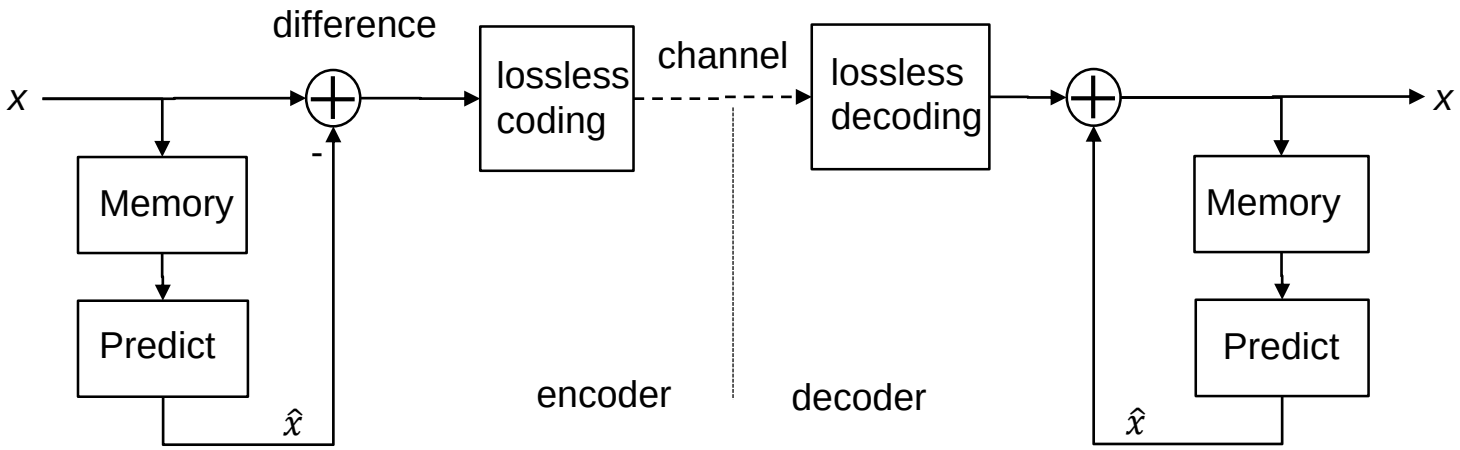
by Erol Seke

For the course "**Data Compression**"

ESKİŞEHİR OSMANGAZİ UNIVERSITY

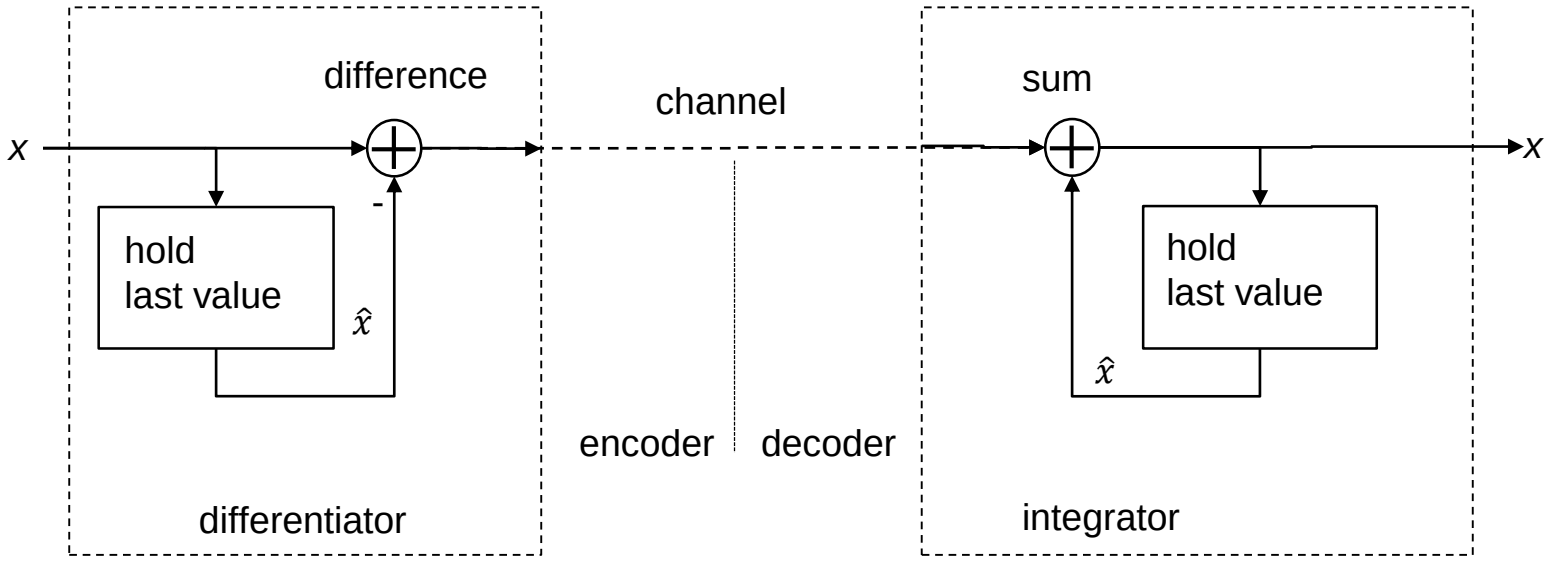
Differences over Predictions

Assumption is that the correlation between consecutive sample sets are high
(e.g. difference between consecutive samples are small),
so that the difference between new sample(s) and their estimates are small,
so that the difference(s) can be coded using fewer number of bits.



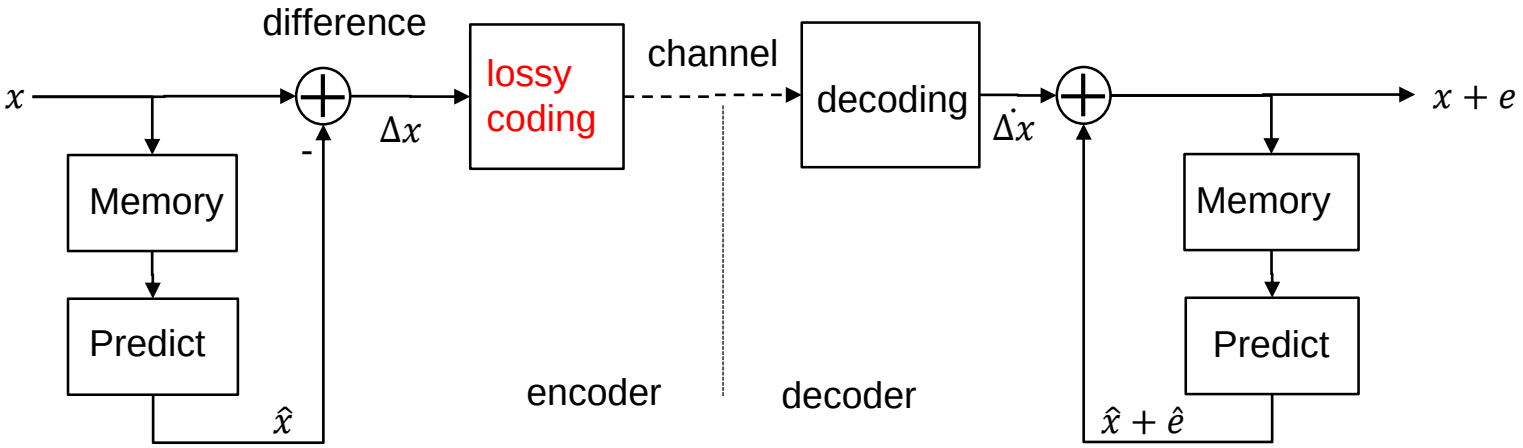
Principle of predictive coding

Simplest case



Differences over Prediction (not good)

Since the predictors do not use the same values, error builds up.
Predictions on erroneous values generates values with larger errors, eventually causing large error build-ups.

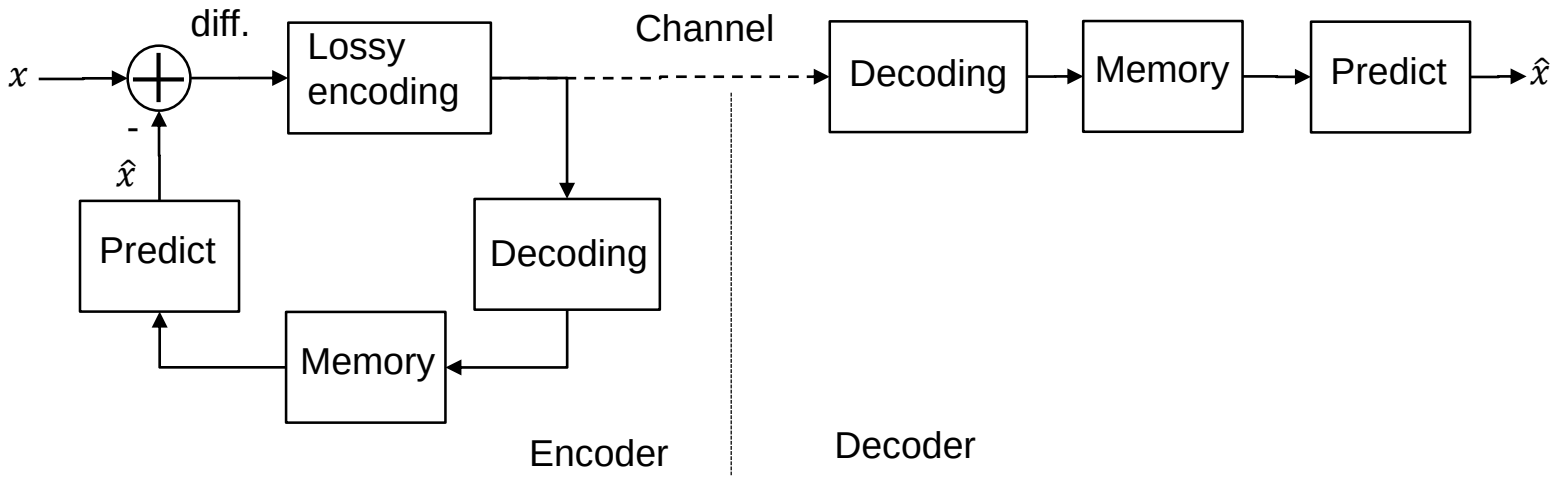


Therefore, this model **cannot** be used in practice.

Differences over Prediction (solution)

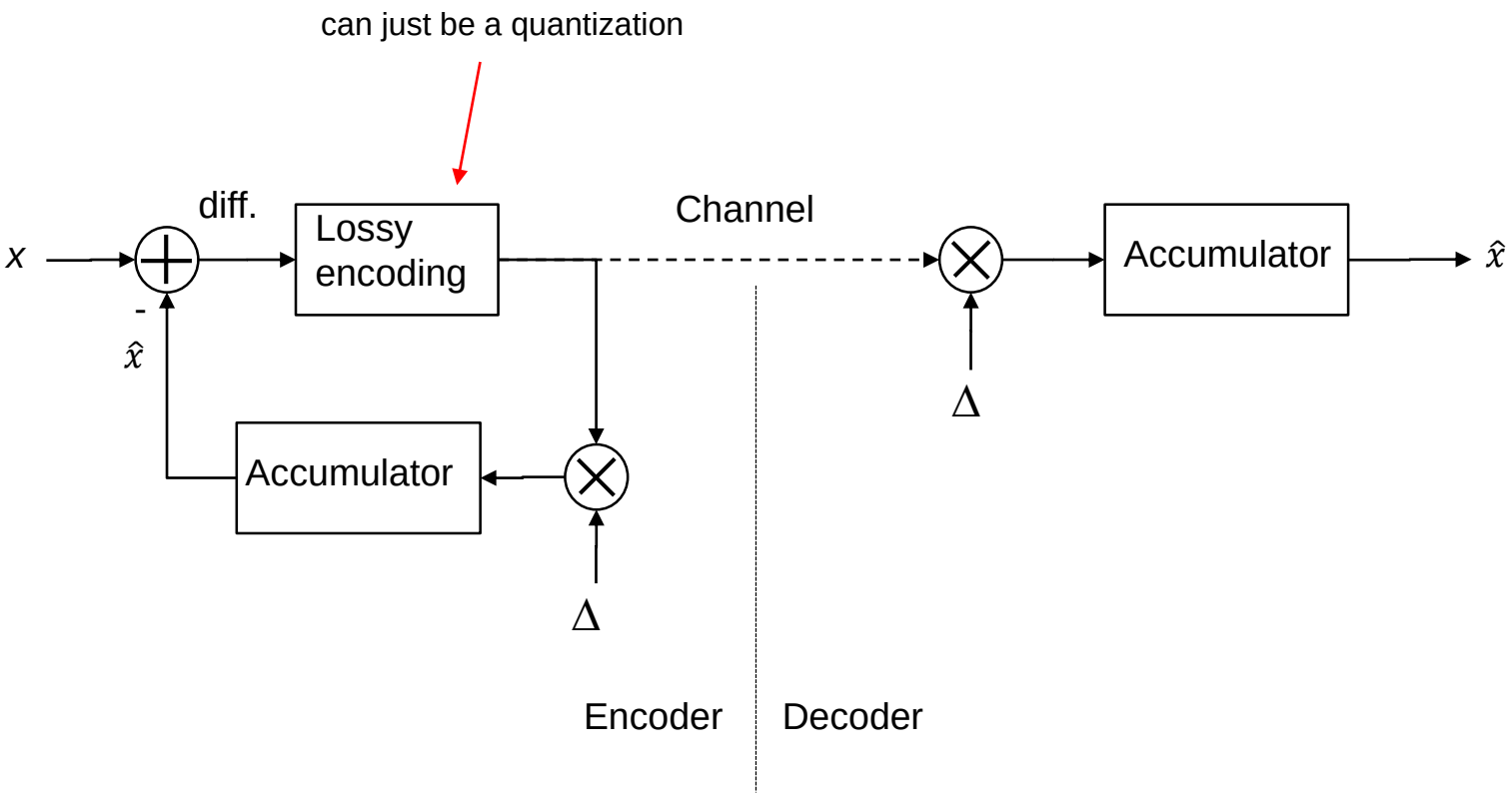
When the encoding is lossy, it is logical to perform prediction using possibly erroneous history so that no error build-up occurs.

Predictors are using the same input values.



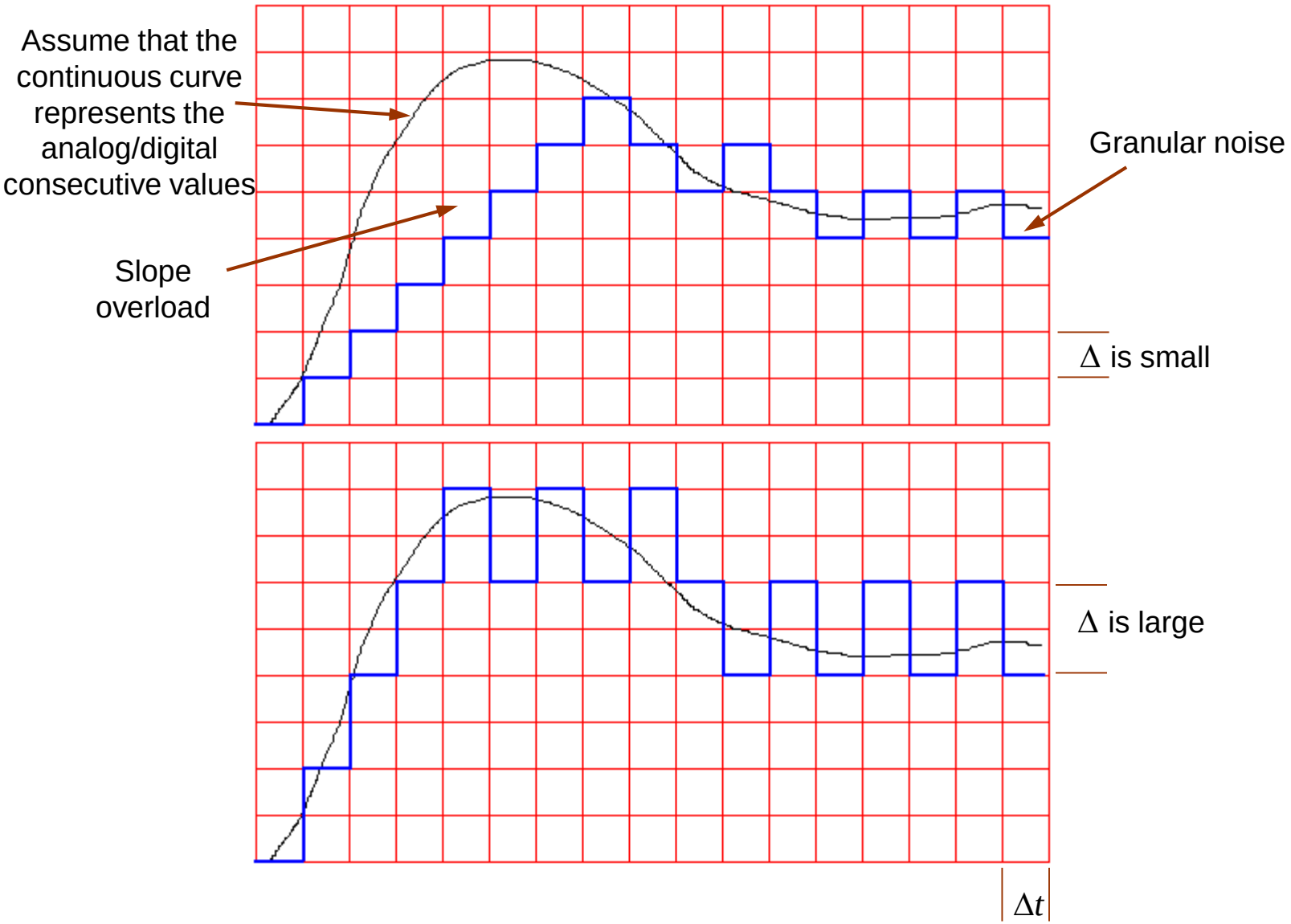
There will be errors resulting from lossy encoding, but there will be no error build-up.

ΔΣ or ΣΔ

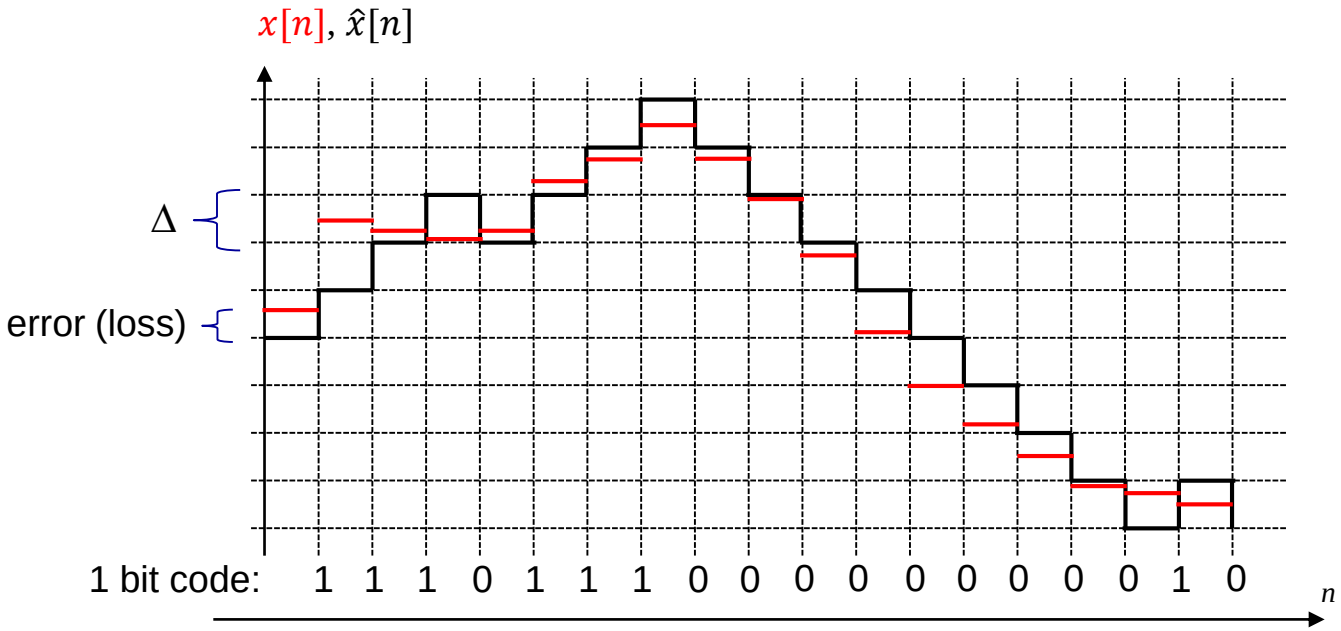


Quantization can be as simple as single bit representing + or - differences

$\Delta\Sigma$ with single bit quantization

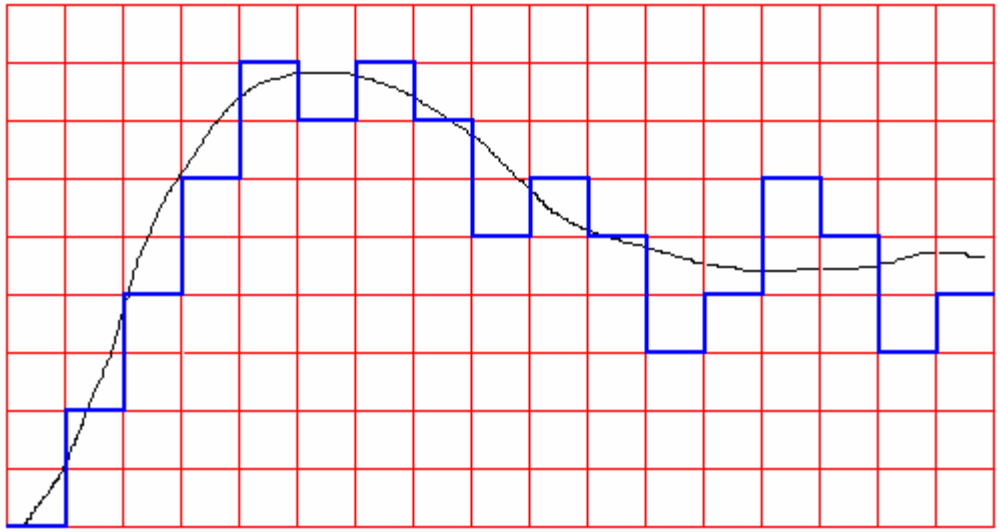


Example with digital input sequence



Adaptive $\Delta\Sigma$

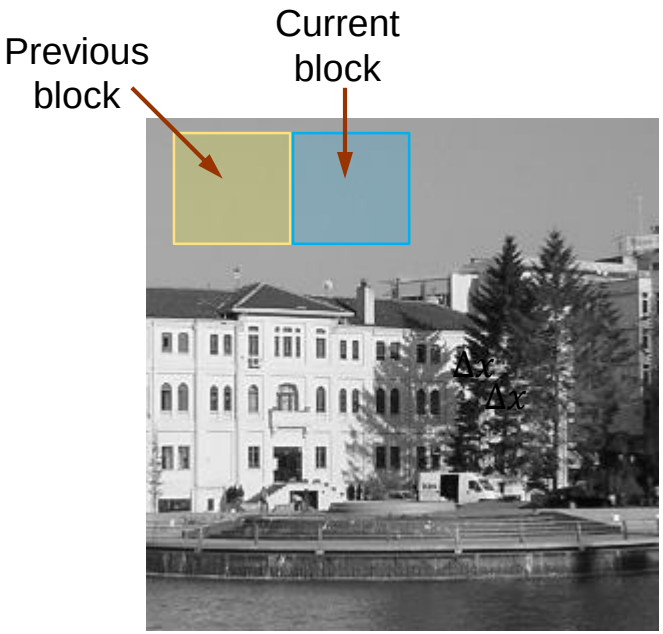
Increase the step size if last two outputs have the same sign
Decrease the step size if last two outputs have the opposite sign

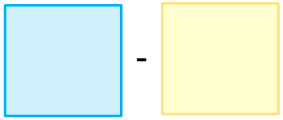


The rule to determine the step size is simply $\Delta_n = \Delta_{n-1} K^{\varepsilon_n \times \varepsilon_{n-1}}$

Note: to keep the figure simple, only 2 values of step size are used here

2D



Δx = 

basic approach : encode the difference
another approach : in order to have small numbers in Δx, find the best matching block within previous blocks and encode both position and difference.
yet another approach : do the encoding on a linear transformation of the difference.

END