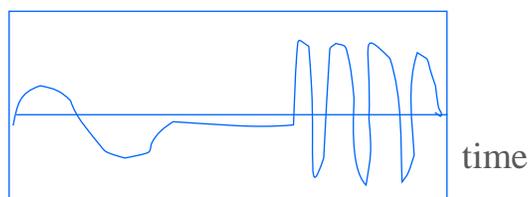


Wavelets - DWT

- DFT is great - but, how about compressing opera?
(baritone, silence, soprano?)
 - (General case: both smooth and /or locally bumpy functions)

value

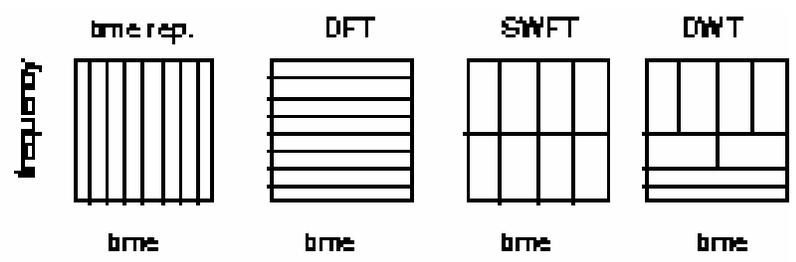


Wavelets - DWT

- Solution#1: Short window Fourier transform
- But: how short should be the window?

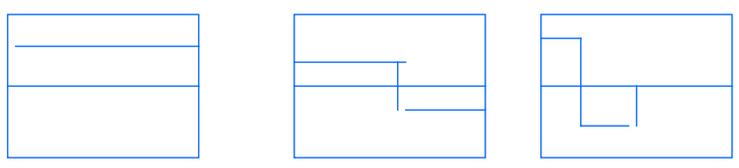
Wavelets - DWT

- Answer: **multiple** window sizes! -> DWT



Haar Wavelets

- subtract sum of left half from right half
- repeat recursively for quarters, eighths ...



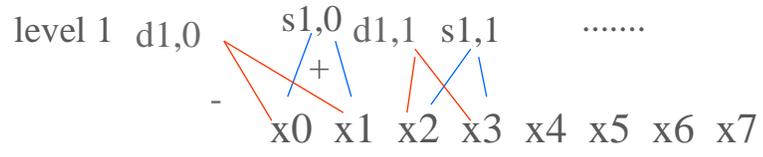


Wavelets - construction

$x_0 \ x_1 \ x_2 \ x_3 \ x_4 \ x_5 \ x_6 \ x_7$

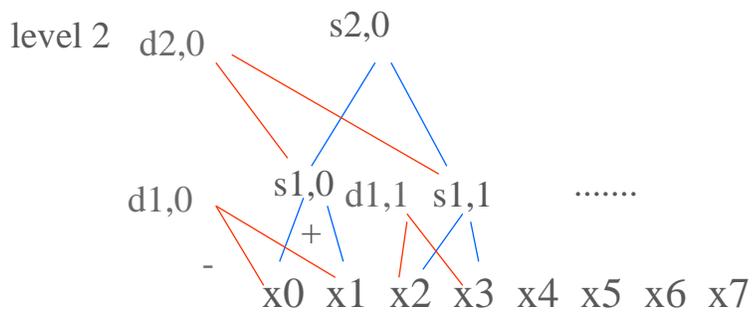


Wavelets - construction





Wavelets - construction



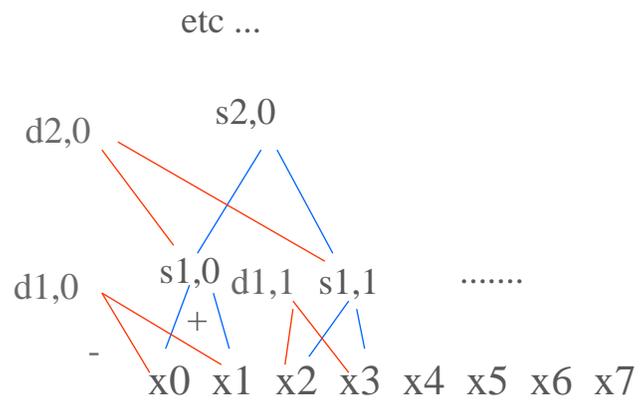
Multi DB and D.M.

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Wavelets - construction



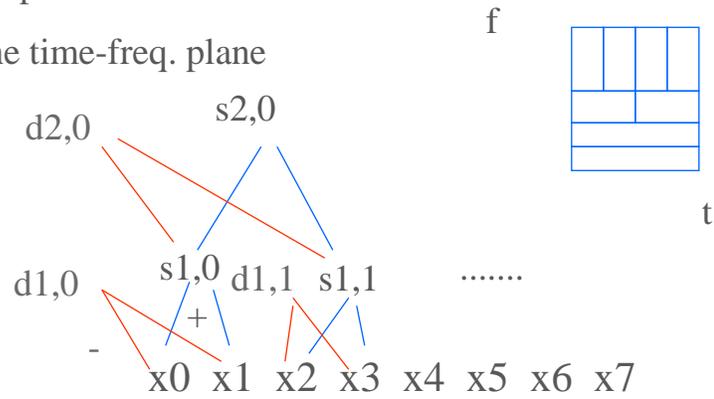
Multi DB and D.M.

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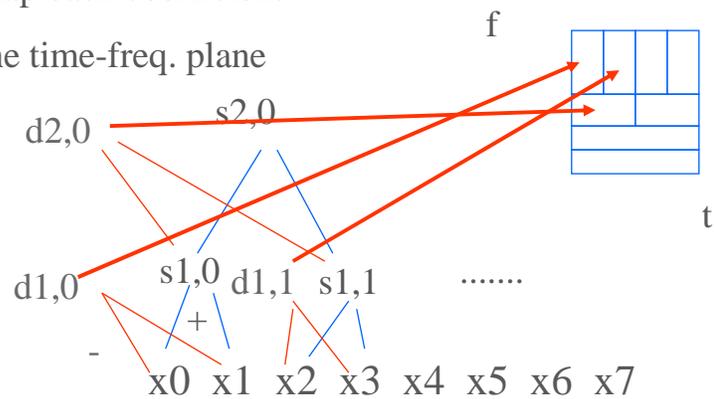
Wavelets - construction

Q: map each coefficient on the time-freq. plane



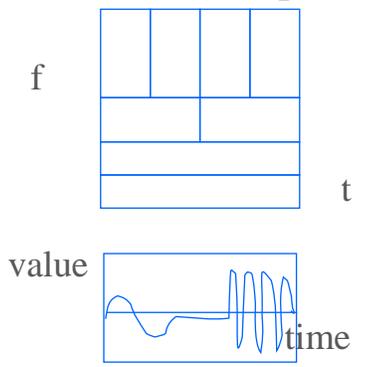
Wavelets - construction

Q: map each coefficient on the time-freq. plane



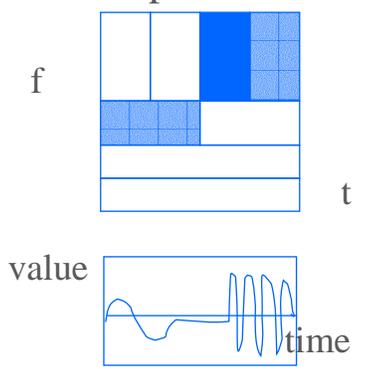
Wavelets - Drill:

- Q: baritone/silence/soprano - DWT?



Wavelets - Drill:

- Q: baritone/soprano - DWT?



Wavelets - construction

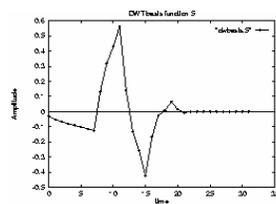
Observation 1:

- ‘+’ can be some weighted addition
- ‘-’ is the corresponding weighted difference
(‘Quadrature mirror filters’)

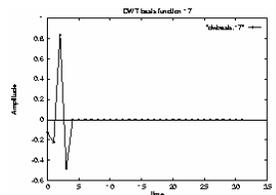
Observation 2: unlike DFT/DCT,

- there are *many* wavelet bases: Haar, Daubechies-4, Daubechies-6, ...

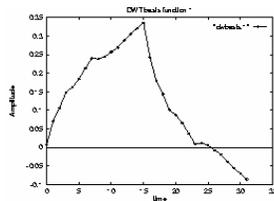
Wavelets - how do they look like?



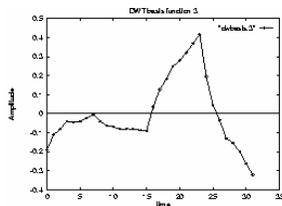
- E.g., Daubechies-4



Wavelets - how do they look like?



- Daubechies-4
- Weighted sum and difference, plus ...



Multi DB and D.M.

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Advantages of Wavelets

- Better compression (better RMSE with same number of coefficients)
- closely related to the processing of the mammalian eye and ear
- Good for progressive transmission
- handle spikes well
- usually, fast to compute ($O(n)$!)

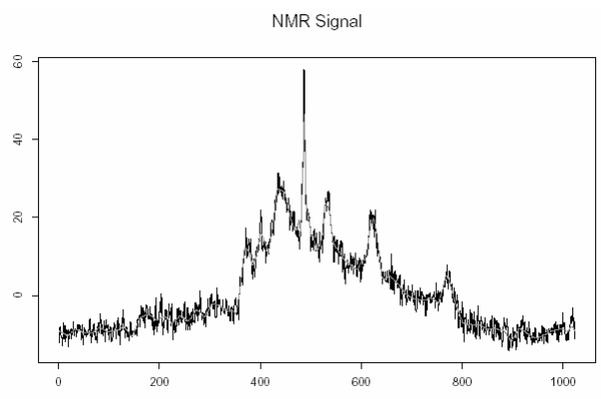
Multi DB and D.M.

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NMR Signal

- NMR



Wavelet Smoothing

- N

