

# Foundations

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# Signals

# Roadmap

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- Modules 1-2: The basics
  - Modules 3-5: Speech synthesis
  - Modules 6-9: Speech recognition
- Block 1 Week 2
    - Module 1: a brief look at speech production and perception
  - Block 1 Week 3
    - Foundations: signals
    - Module 2: speech signals and the source-filter model
  - Block 1 Week 4
    - Foundations: phonetics

# What you should already know

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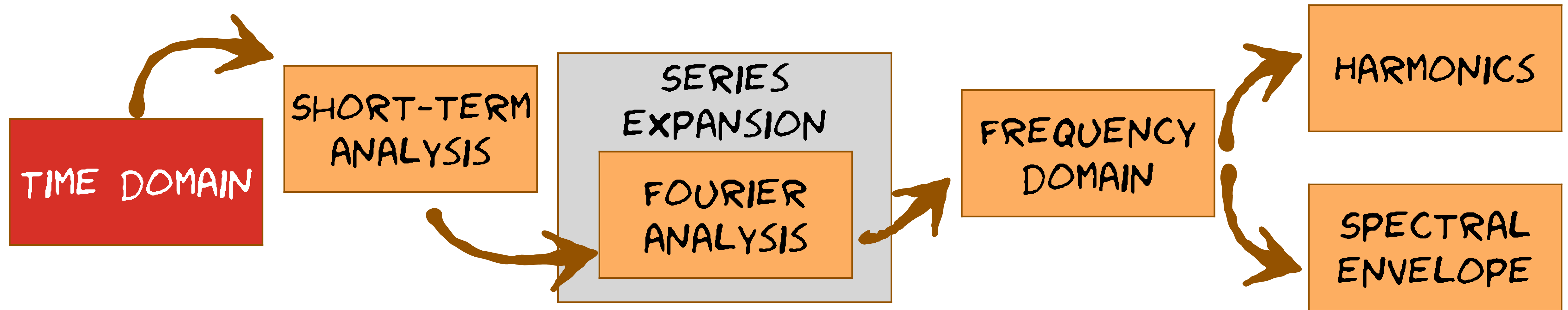
- From the videos
  - sampling and aliasing
  - quantisation and bit depth
  - short-term analysis

# Today's topics - Foundations: signals

	THEORY					APPLICATION					
	SPEECH			SIGNAL PROCESSING	PROBABILISTIC MODELLING	SPEECH SYNTHESIS		AUTOMATIC SPEECH RECOGNITION			
	SIGNALS	PRODUCTION	PERCEPTION			FRONT END	WAVEFORM GENERATION	FEATURE EXTRACTION	PATTERN MATCHING	HIDDEN MARKOV MODELS	CONNECTED SPEECH
CONCEPTS	TIME DOMAIN	SOUND SOURCE	PITCH	DIGITAL SIGNAL	DESCRIBING DATA	TOKENISATION & NORMALISATION	WAVEFORM CONCATENATION	SERIES EXPANSION	EXEMPLAR	GENERATIVE MODEL OF SEQUENCES	HIERARCHY
	PERIODIC SIGNAL	HARMONICS	COCHLEA	SHORT-TERM ANALYSIS	DISCRETE & CONTINUOUS VARIABLES	PRONUNCIATION	DIPHONE	FEATURES	DISTANCE		SUB-WORD UNIT
	FREQUENCY DOMAIN	VOCAL TRACT RESONANCE & FORMANTS	MEL SCALE	SPECTRAL ENVELOPE	JOINT, CONDITIONAL, BAYES' FORMULA	PROSODY		FEATURE ENGINEERING	SEQUENCE	HIDDEN STATE SEQUENCE	N-GRAMS
MODELS & DATA STRUCTURES	FILTER	RESONANT TUBE	FILTERBANK	IMPULSE TRAIN	GAUSSIAN	FINITE STATE TRANSDUCER		FEATURE VECTOR	SEQUENCE OF FEATURE VECTORS	HIDDEN MARKOV MODEL	
	IMPULSE RESPONSE	SOURCE-FILTER MODEL	PHONEME	PITCH PERIOD	GENERATIVE MODEL	DECISION TREE			GRID	LATTICE	GRAPH
ALGORITHMS & ANALYSIS				FOURIER ANALYSIS	FITTING A GAUSSIAN TO DATA	HANDWRITTEN RULES	OVERLAP-ADD	MFCCS	DYNAMIC PROGRAMMING (DTW)	DYNAMIC PROGRAMMING (VITERBI)	COMPOSITION ("COMPILING")
				CEPSTRAL ANALYSIS	CLASSIFICATION	LEARNING DECISION TREES	TD-PSOLA			BAUM WELCH	APPROXIMATION (PRUNING)

# Today's topics - Foundations: signals

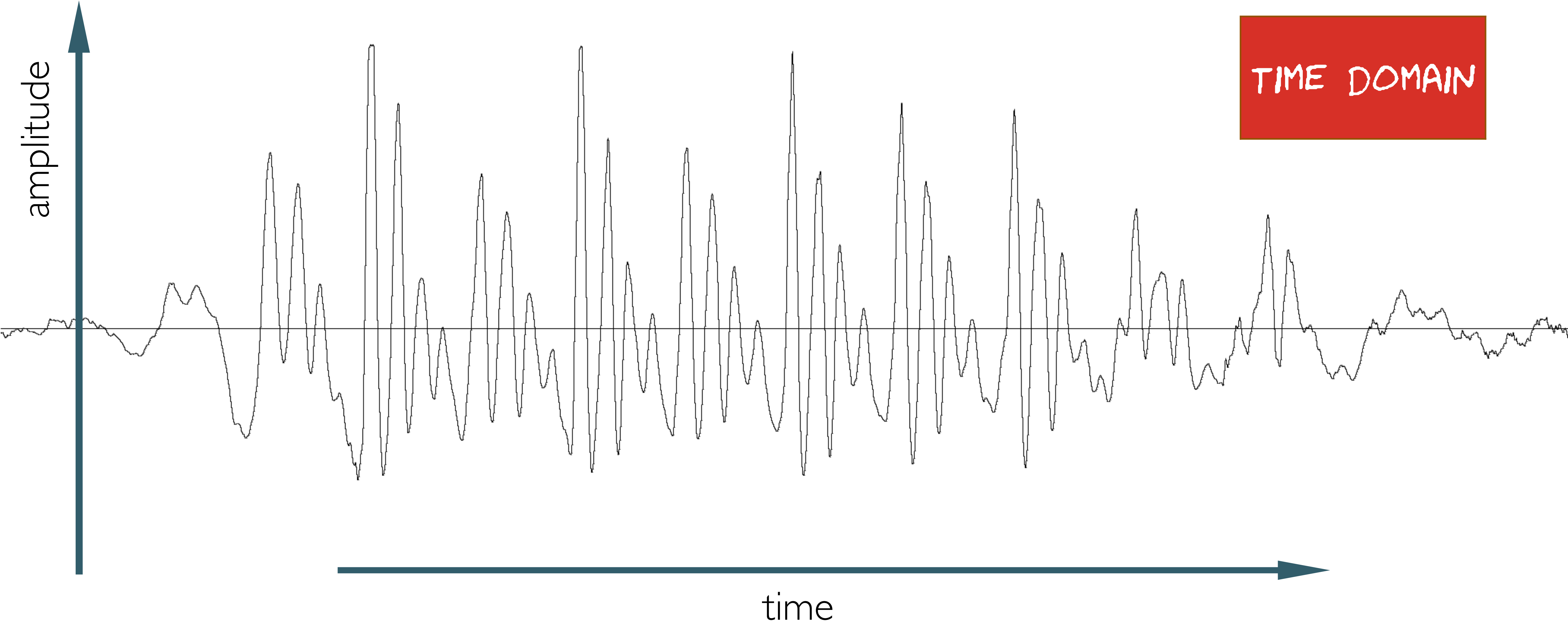
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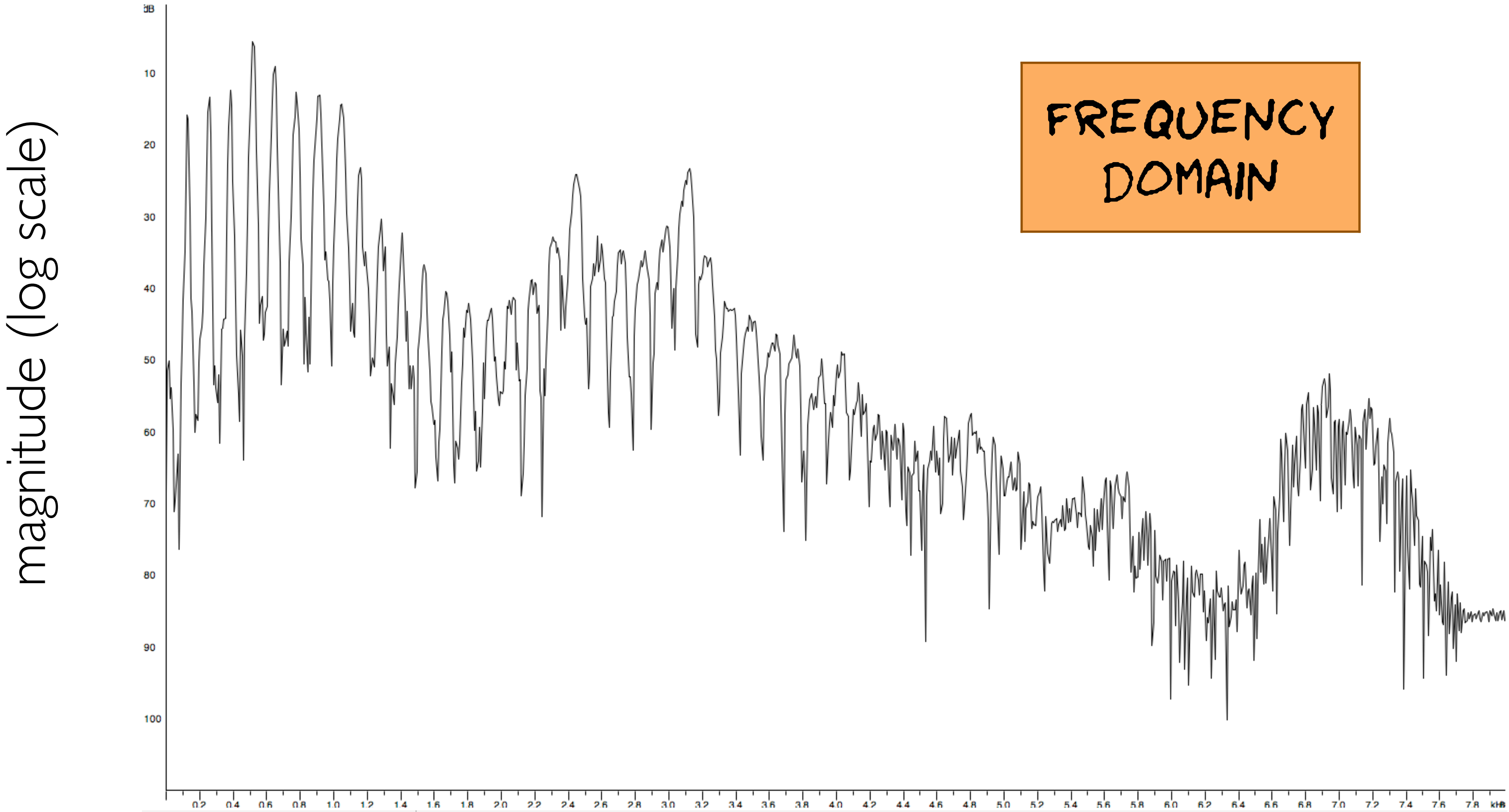
# How a microphone works

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# Waveform



# Spectrum



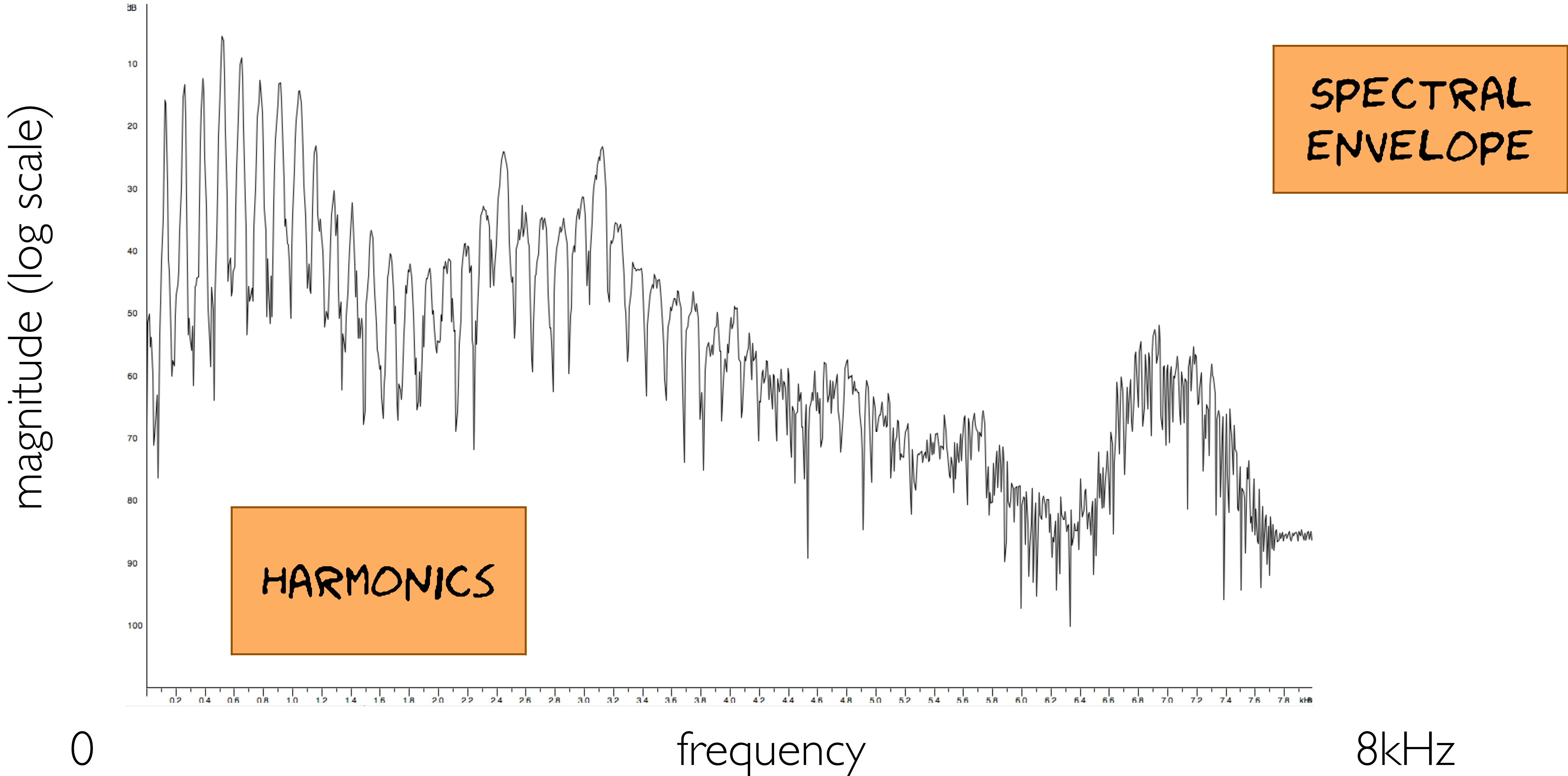
0

frequency

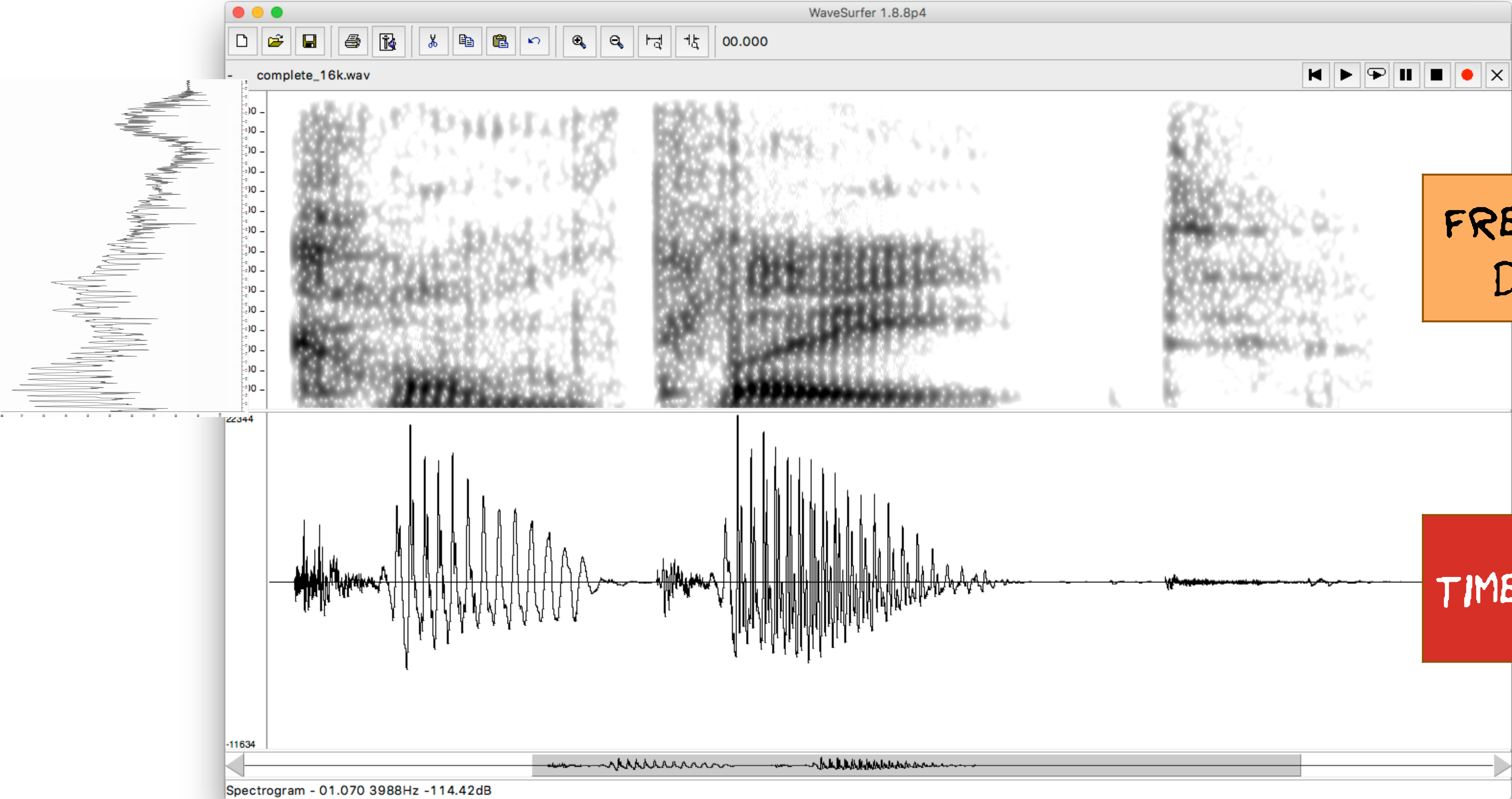
8kHz



# Spectrum



# Spectrogram



FREQUENCY  
DOMAIN

TIME DOMAIN

SHORT-TERM  
ANALYSIS

Short term analysis, frame size, window function

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*see also Wavesurfer*

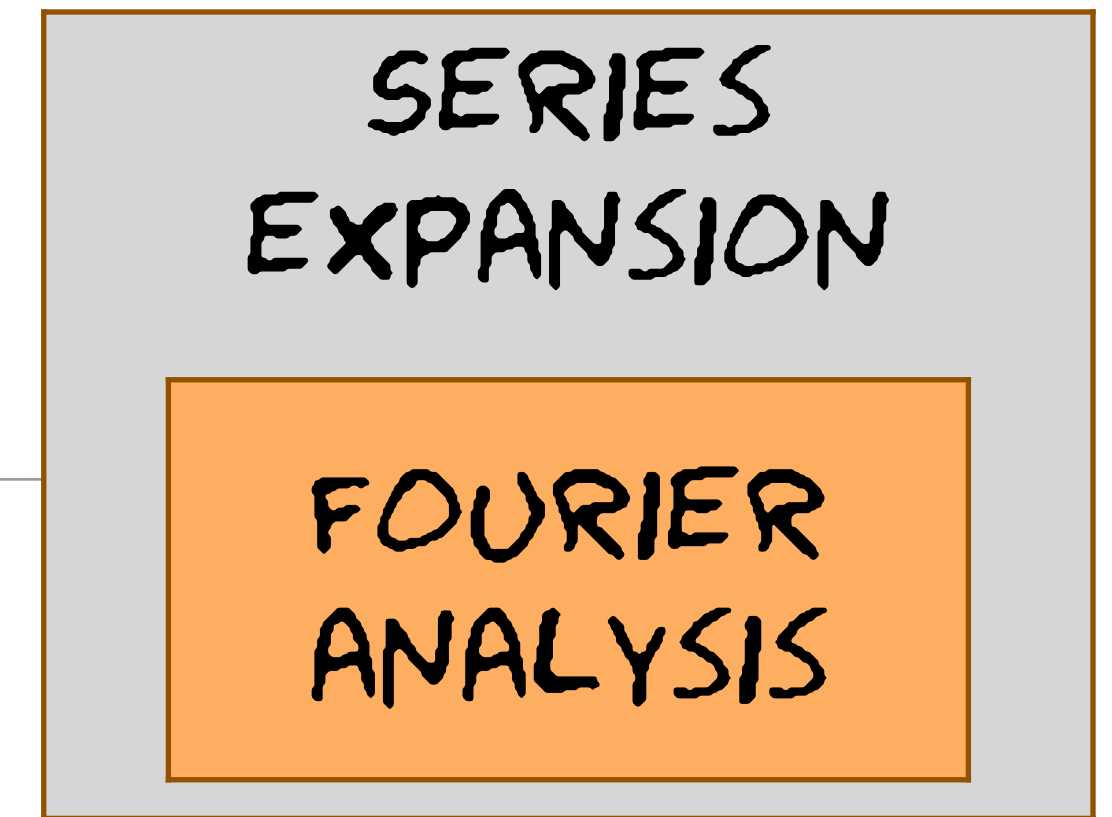
A very special signal: the sine wave

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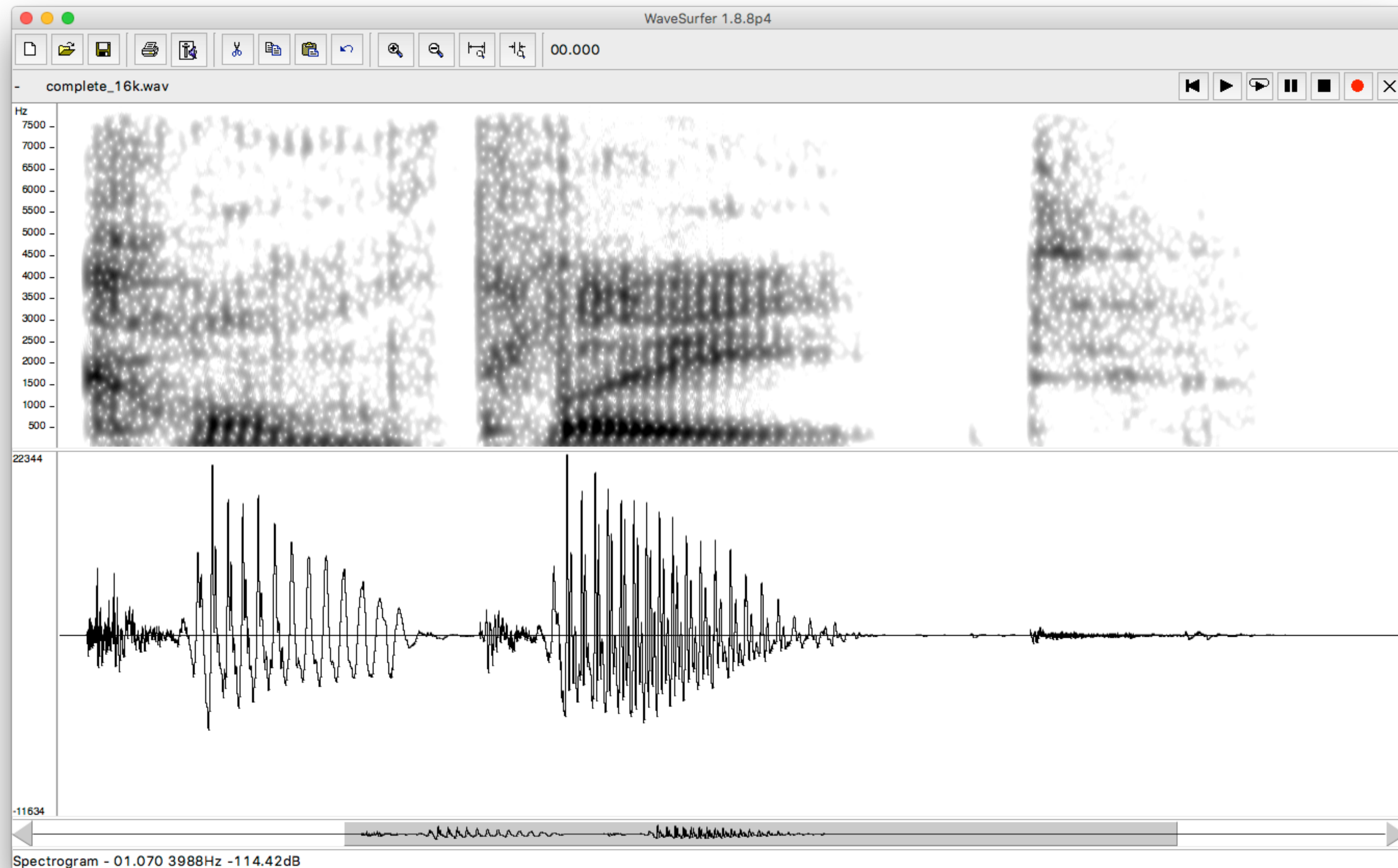
Concept: **series expansion**

describing a complex signal as a sum of simple signals

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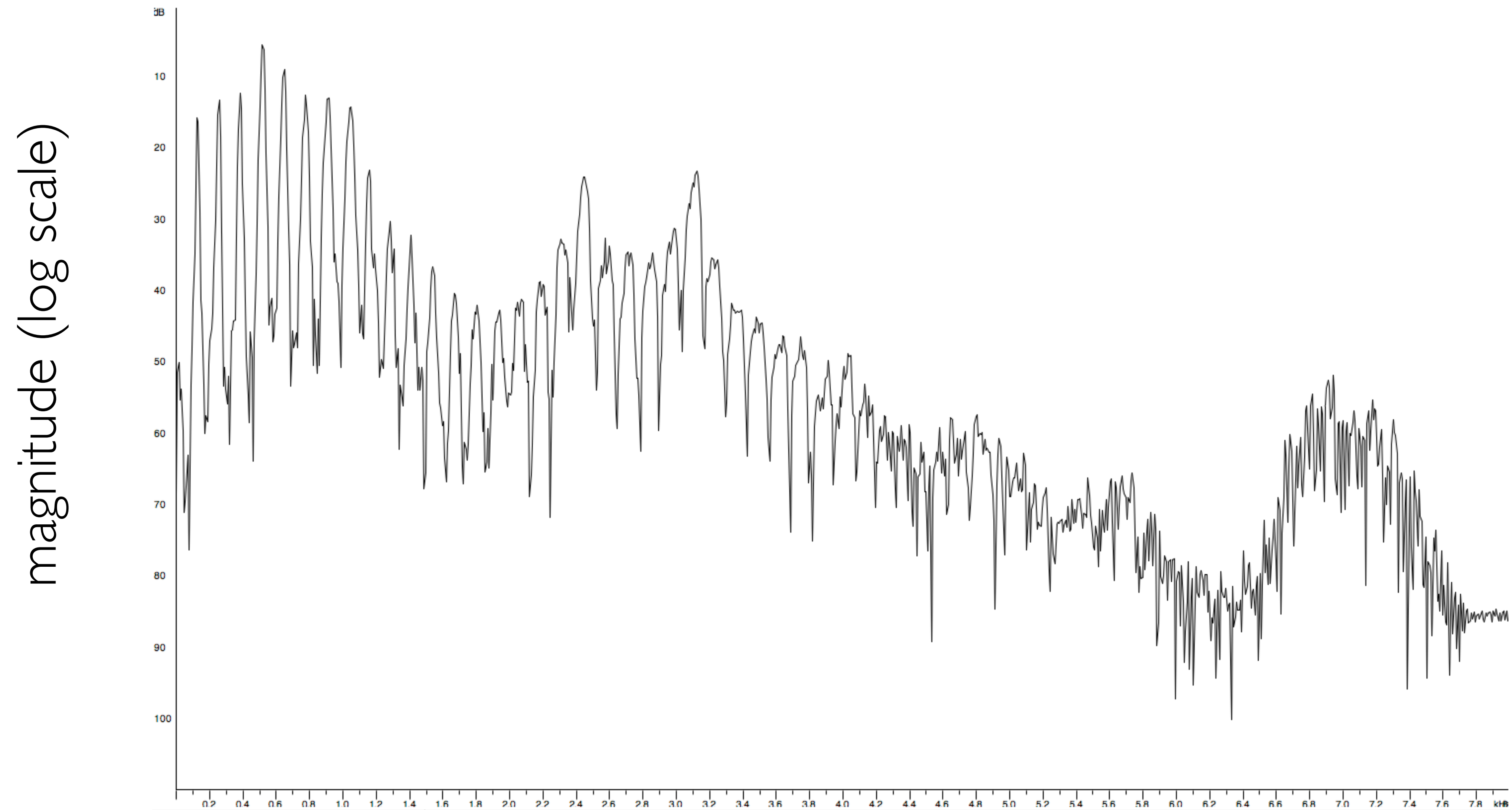


The spectrogram is a picture that tells us how the signal can be created from a sum of sine waves



The spectrum is a diagram that tells us how **one frame** of the signal can be created from a sum of sine waves

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0

frequency

8kHz

# The Fourier transform

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<http://www.falstad.com/fourier/Fourier.html>

<http://www.jezzamon.com/fourier/>

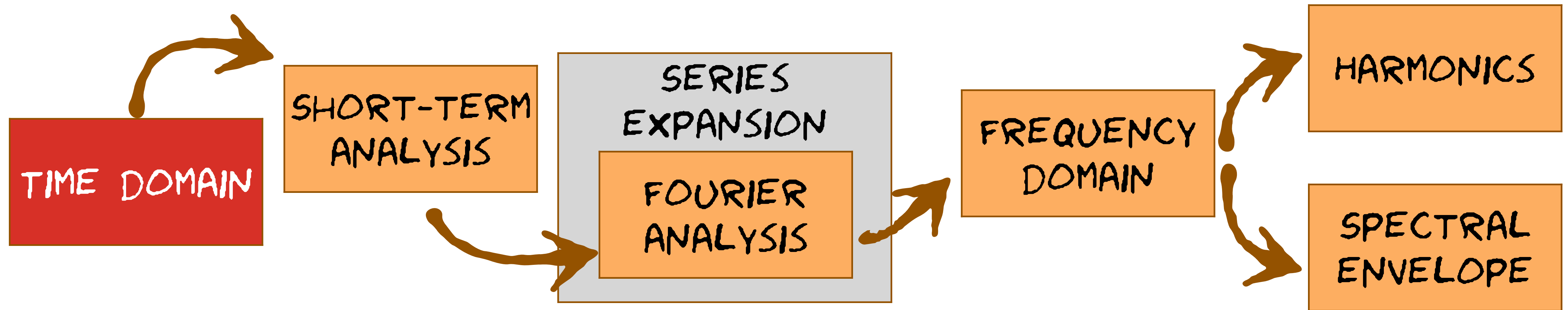


# Magnitude and phase

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# Today's topics - what we covered

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# What next?

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- The source-filter model
  - resonant tube
  - vocal tract resonance & formants
  - filter, impulse response
  - harmonics
  - spectral envelope
- Optional foundation material
  - a crash course in phonetics

In Module 2 today

In next week's foundation class