Signal processing and machine learning

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SIGNAL

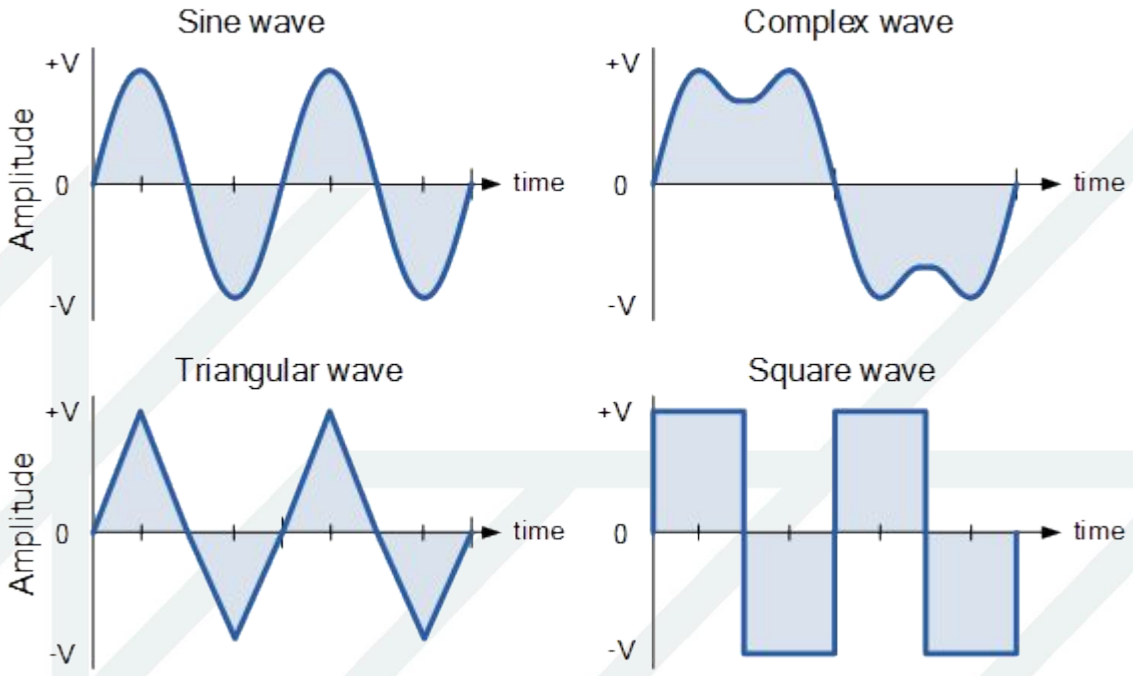
Definition:

A **signal** is a function of independent variables that carry some information.

But what does it mean!?

SIGNAL EXAMPLES

Signals can be voltages that vary over time

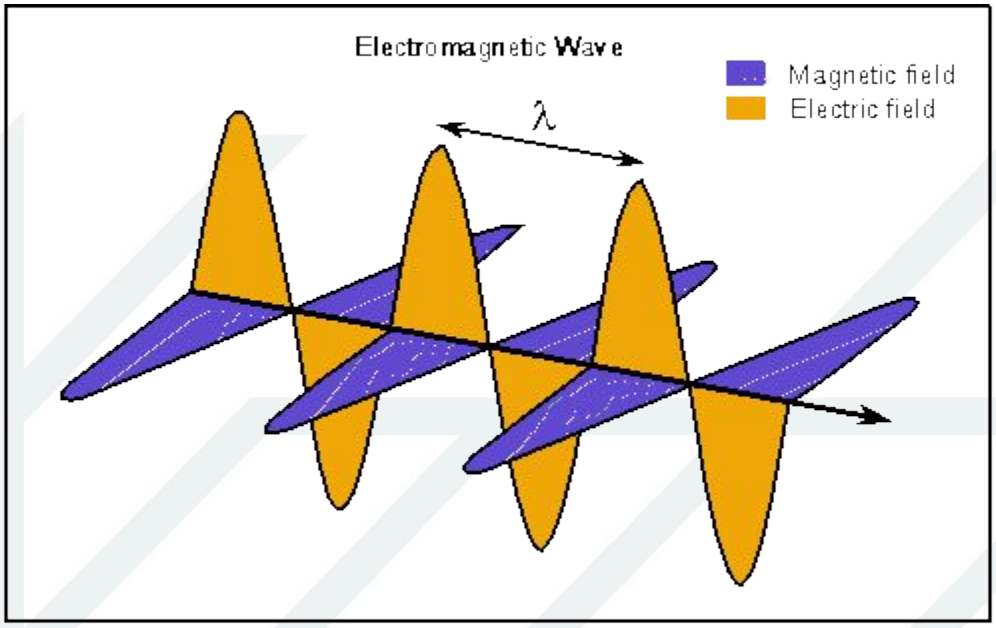


SIGNAL EXAMPLES

But signals also can be something that varies over space. Traffic signs might be considered a type of signal. They are frozen in time, but they vary from place to place.

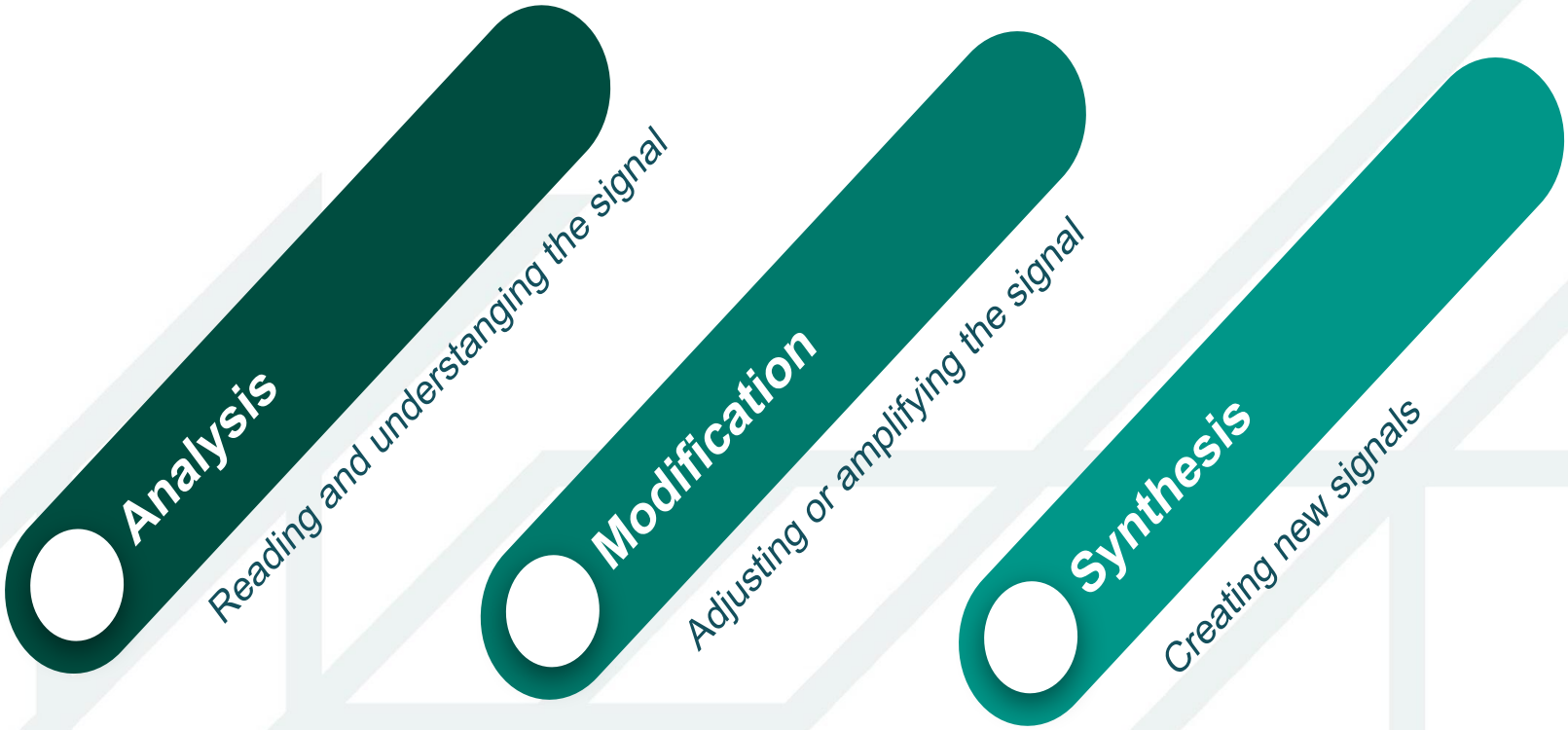
SIGNAL EXAMPLES

There are also signals in nature that vary both over time and space. Such are electromagnetic waves.



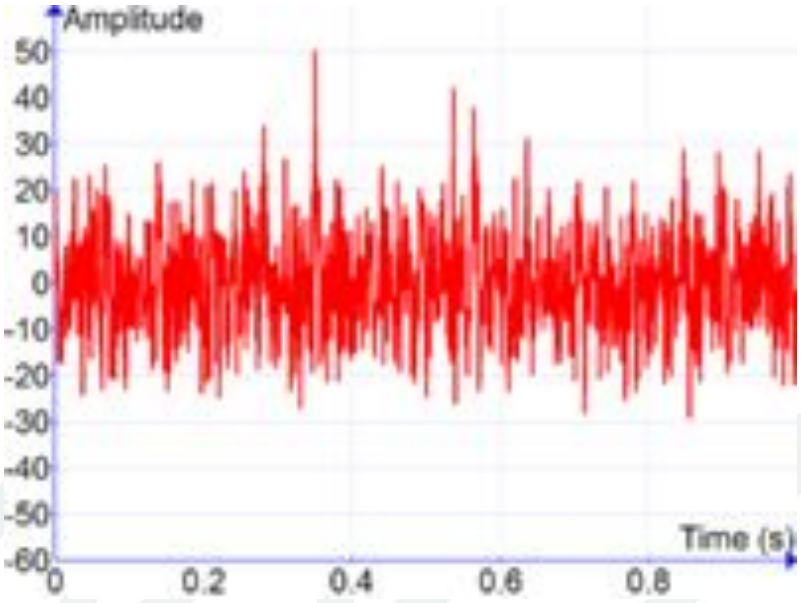
SIGNAL PROCESSING

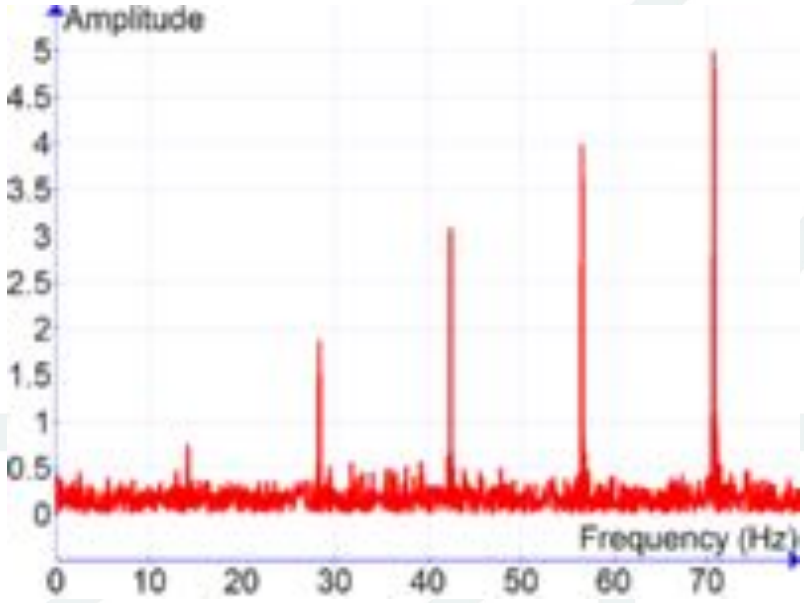
Signal processing is general practice of reading, modifying and creating new signals.



SIGNAL PROCESSING

AN EXAMPLE





MACHINE LEARNING

Traditional programming

Machine learning

MACHINE LEARNING

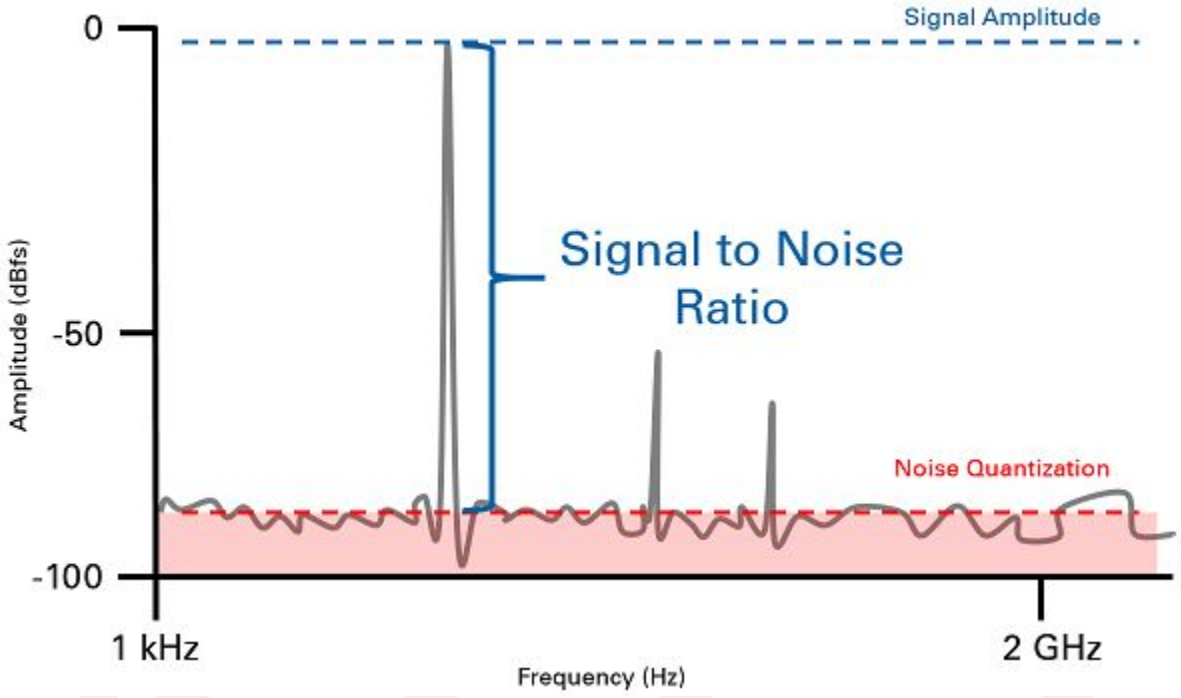
But why do we need machine learning in signal processing?

The real world signals are too complicated!

We rarely get clean distinct frequencies after Fourier transform. That's why there's work for statistics. And with statistics comes heavily associated field - **machine learning**.

MACHINE LEARNING

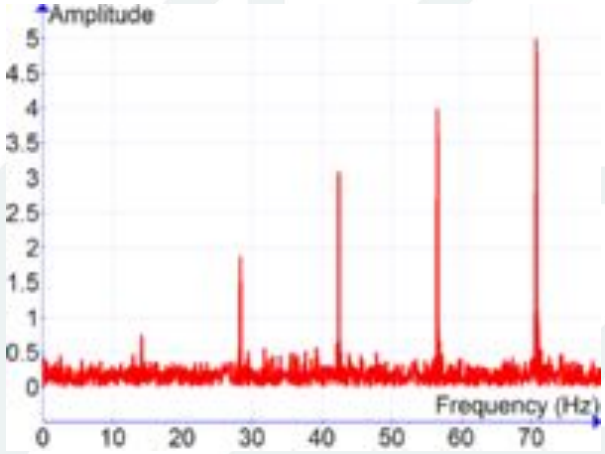
Normal signal would allow us to extract relevant frequencies out.



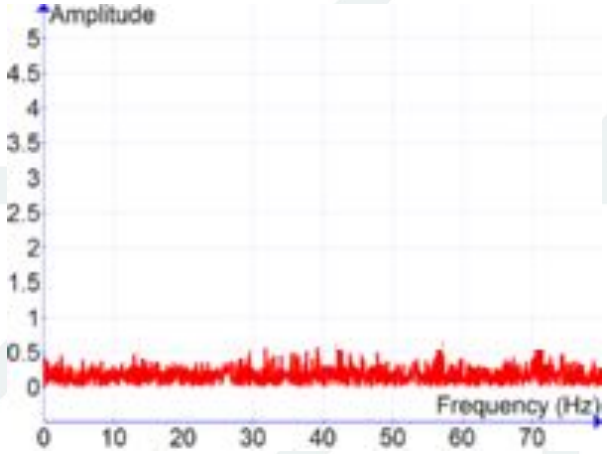
MACHINE LEARNING

But in real world signals might be too noisy. Still, they could have features in them which might allow us to get information out of them. But it can require a lot of tinkering. We couldn't do that automatically before, because our computers weren't powerful enough.

Distinct frequencies

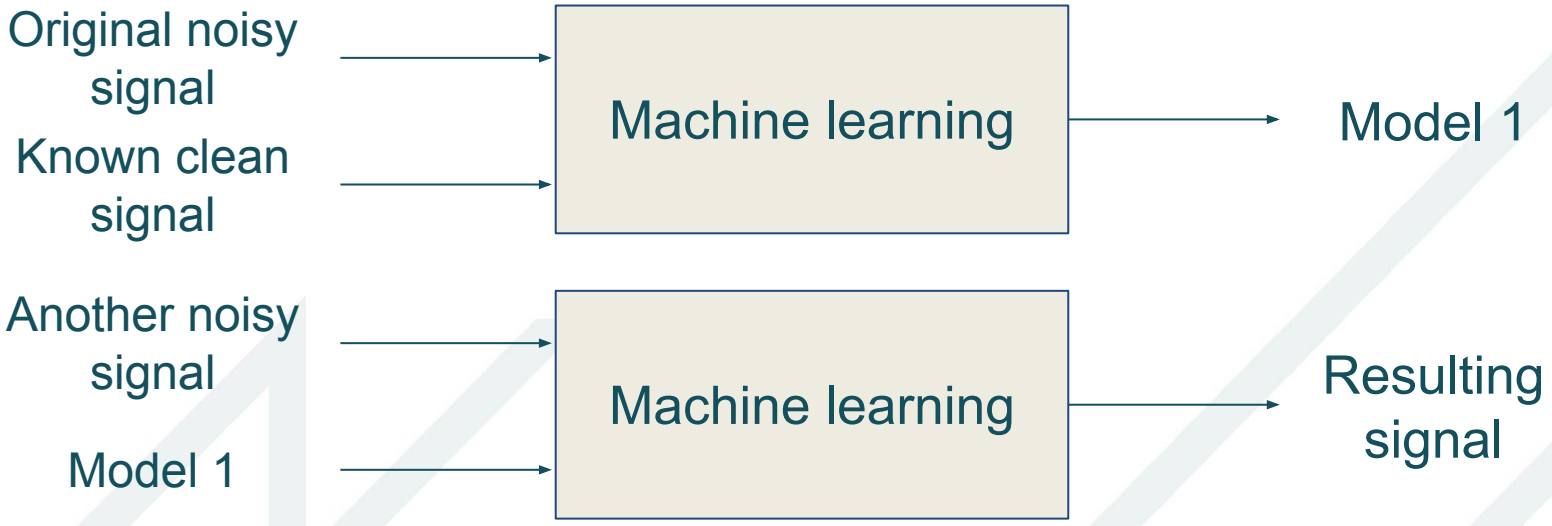


No distinct frequencies, but still might have some features



MACHINE LEARNING

How to extract those features?



Now we compare known clean signal to the resulting one.
If they differ too much we do the whole process again and again until we get satisfactory result.

CONCLUSION

Machine learning allows us to use faster more powerful computers we have now, to develop new ways to decypher noisy signals. And as we get better at it, we can send our signals through even noisier environments - we can send them:

- using less power
- further away.

Thank you!