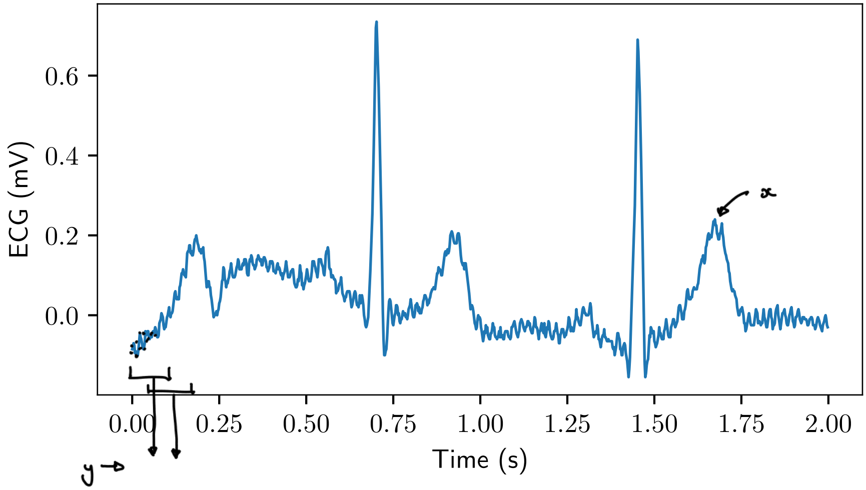
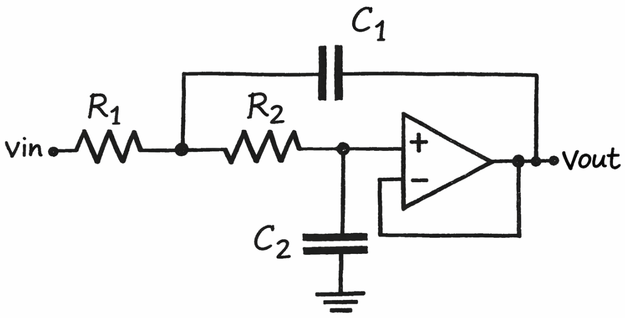
Introduction to digital signal processing

Herman Kamper

How would you smooth this signal?

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Lectures, practicals and tutorials

Schedule:

- Lecture: Wednesday 09:00 (E2005)
- Lecture: Thursday 09:00 (E2005)
- Lecture: Friday 12:00 (E2005)
- Practical or tutorial: Friday 14:00 (M2002 or E1029)

I am really bad with emails

Practical 1 is already out for this week (headphones will be useful)

Assessments

- Assessment weights: $w_{\mathsf{AF}} = 20\%$, $w_{\mathsf{A1}} = 30\%$, $w_{\mathsf{A2}} = 50\%$
- Assessment further (AF): Practicals, tutorials and class tests
- Practicals wil be handed in on SUNLearn every week (0, 1, 2)
- Late hand in or missed test: 0 (but will give you one chance)
- Please read the module framework

Course notes and textbook

Systems and Signals 414
Stelsels en Seine 414

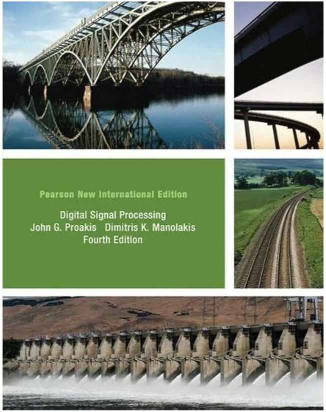
Presented by Herman Kamper
Handouts by Thomas Niesler

trn@sun.ac.za
kamperh@sun.ac.za

Prescribed book:
Digital Signal Processing, Proakis + Manolakis, 4th. ed., Prentice Hall

Handout 1: Signals and signal analysis

Stellenbosch University
SS414: Digital Signal Processing, Thomas Niesler and Herman Kamper   Slide 1.I



Other resources: Summary sheet and website

Summary: Digital signal processing

Herman Kamper

Identities

$$\sum_{n=0}^{N-1} r^n = \frac{1 - r^N}{1 - r} \quad \text{for all } r$$

$$\sum_{n=0}^{\infty} r^n = \frac{1}{1 - r} \quad \text{for } |r| < 1$$

$$\sum_{n=N}^{\infty} r^n = \frac{r^N}{1 - r} \quad \text{for } |r| < 1$$

$$\sum_{n=0}^{\infty} n r^n = \frac{r}{(1 - r)^2} \quad \text{for } |r| < 1$$

Continuous signals

Sinusoidals:

$$e^{j\theta} = \cos(\theta) + j\sin(\theta)$$

$$\cos(\theta) = \frac{1}{2}e^{j\theta} + \frac{1}{2}e^{-j\theta}$$

$$\sin(\theta) = \frac{1}{2j}e^{j\theta} - \frac{1}{2j}e^{-j\theta}$$

Even and odd functions:

$$x(t) = x_e(t) + x_o(t) = \frac{x(t) + x(-t)}{2} + \frac{x(t) - x(-t)}{2}$$

Continuous convolution:

$$h(t) * x(t) = \int_{-\infty}^{\infty} h(\tau)x(t - \tau)\,\mathrm{d}\tau$$

Written-out notes and partial videos:

https://www.kamperh.com/ss414/

(do not ask for more)

What I want you to get from this course

- For the Fourier transform to finally click in
- To appreciate the wonder of the discrete Fourier transform (DFT):
  That we can computationally get the spectrum of a signal
- The math behind the z-transform is real, and you can do something useful with it (filters)
- **Signals are real:** They are also more than sinusoids and pulses
- **In life, we often don't have a "correct answer"**