Homework 2 - Due Wed. Feb. 20th
Introduction to Harmonic Analysis and its Applications

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Homework Policies

As in homework 1.

Exercises marked by (*) are not mandatory, but give you extra credit that will accumulate throughout the course and may affect your final grade.

Exercises

Exercise 1 (70pts). Exercise 4 from chapter 2 in Stein and Shakarchi's book: consider the 2π-period odd function defined on $[0, \pi]$ by $f(\theta) = \theta(\pi - \theta)$: (a) draw the graph of f, and (b) compute the Fourier coefficients of f, and show that

$$f(\theta) = \frac{8}{\pi} \sum_{k \text{ odd } \geq 1} \frac{\sin k\theta}{k^3} .$$

Is this function continuous on the circle? continuously differentiable on the circle? in L^2 of the circle?

Exercise 2 (30pts). Prove that if f is an even 2π-period function, i.e. $f(\theta) = f(-\theta)$ for all $\theta \in [-\pi, \pi]$, then the Fourier series can be written as a cosine series (i.e. if you expand the complex exponentials into cosine and sines, the sine terms vanish).