Assignments Week 14 SF2705 Fourieranalysis.

These are the things that you are expected to do before the Lecture on the **13th of May**.

1 Reading: We will finish chapter 6.5, pages 198-207 in Stein-Shakarchi and hopefully also cover Chapter 7.1 pp. 218-226.

2 Discussion questions.

1. One way to understand a theory is to understand what it is good for. Fourier analysis on $[-L, L]$ helps us to solve difficult partial differential equations and the theory for the Radon transform helps us to interpret x-rays etc. Think for a while what finite Fourier analysis is good for.

   We are given a function $F(k)$ defined on $\mathbb{Z}(N)$ and the finite Fourier transform helps us write this function in a more complicated form:
   $$F(k) = \sum_{n=0}^{N-1} a_n e^{2\pi i n k/N} \qquad \text{where } a_n = \frac{1}{N}\sum_{k=0}^{N-1} F(k) e^{-2\pi i k n/N}.$$
   So what? Why is this important? Why would anyone want to do this?

2. Notice that the set $e_0, e_1, e_2, ..., e_{N-1}$ has more structure than the normal basis of a vector space. We can not only add the basis vectors, but also multiply them.

3 Problems to consider: Do **12, 13** and **14** in Stein-Shakarchi pp. 209-210.

4. Assignment for the 13th of May: Define the X-ray transform of $f \in \mathcal{S}(\mathbb{R}^2)$ as in Stein-Shakarchi p.200. Then define it's dual transform X^* in a way analogous to the dual $\mathcal{R}^*$. Then show that

$$X^*\left(X(f)\right)(x) = 2\int_{\mathbb{R}^2} \frac{f(y)}{|y-x|} dy = K * f(x), \qquad (1)$$

where $K(x) = \frac{2}{|x|}$.

HINT: *It is easier to do this calculation for $x = 0$ and then deduce (1) by a translation.*

5 Office hours: It does not seem to be any need for office hours. In case you have any pressing question please write me an email (johnan@kth.se) and we can book a time on Friday.