COMPLEX NUMBERS AND LINEAR ALGEBRA

1. complex numbers

1.1. **representation.** A complex number $z = a + ib$ has it's real part- a, and it's imaginary part- b. i is defined as the square root of -1. It is usually convenient to represent complex numbers using an exponential representation: $z = re^{i\theta}$, which should be interpreted as $z = r(\cos\theta + i\sin\theta)$, where r and θ are reals.

1.2. **additon, multiplication.** When adding together two complex numbers we get $z_1 + z_2 = r_1(\cos\theta_1 + i\sin\theta_1) + r_2(\cos\theta_2 + i\sin\theta_2) = r_1\cos\theta_1 + r_2\cos\theta_2 + i(r_1\sin\theta_1 + r_2\sin\theta_2)$. Multiplication of complex numbers results in $z_1 \times z_2 = r_1(\cos\theta_1 + i\sin\theta_1) \times r_2(\cos\theta_2 + i\sin\theta_2) = r_1r_2(\cos(\theta_1+\theta_2) + i\sin(\theta_1+\theta_2))$, or in exponential rapresentation: $r_1r_2e^{i(\theta_1+\theta_2)}$.

1.3. **complex conjugate, absolute value.** The complex conjugate of a number $z = re^{i\theta}$ is $z^* = re^{-i\theta}$, such that $zz^* = r^2$. The absolute value of $z = re^{i\theta}$ is $|z| = (zz^*)^{\frac{1}{2}} = |r|$.

2. linear algebra

For a review of the fundamental concepts of linear algebra that are relevant to our course, and also to get used to the Dirac notation, see the excellent book by Nielsen and Chuang - Quantum Computation and Quantum Information - pages 60-71. There are a few copies of that book at The Math library. There you can find information about vector spaces, bases and linear independence, matrices, eigenvalues and eigenvectors, inner products etc.