Due date: Monday, Sept. 23.

Reading: Finish Ch. 1


2. [4 points] A two-dimensional space is spanned by the orthonormal basis vectors $|1\rangle$ and $|2\rangle$. If operator $B$ has ket-bra representation $B = |1\rangle\langle 2| - |2\rangle\langle 1|$, find the corresponding explicit ket-bra representation of $\cosh(\frac{\pi}{3} B)$.
   (Hint: You may find it easier to work in matrix notation, and then convert back to ket-bra notation at the end.)

3. [6 points] For operator $\Omega$ depending on scalar $\lambda$, show that
   \[
   \frac{d}{d\lambda} (\Omega^{-1}) = -\Omega^{-1} \frac{d\Omega}{d\lambda} \Omega^{-1}.
   \]

4. [6 points] Referring to operators $X$ and $K$ in Shankar (1.10.41), show that $[X^2, K^2] = 2I + 4iXK$ two ways:
   (a) By applying $X^2K^2 - K^2X^2$ to an arbitrary $f(x)$ and seeing what happens.
   (b) By working solely with the operators and repeatedly applying commutator rules (1.5.10) and (1.5.11) with (1.10.41).

5. [8 points] Shankar Ex. 1.10.1-3, p. 63 (Dirac delta functions).