

- (1) Consider the Sturm-Louville eigenvalue problem

$$L | u \rangle + n^2 | u \rangle = 0$$

on  $-\pi \leq x \leq \pi$  with boundary conditions  $u(-\pi) = u(\pi) = 0$  and

$$L = \frac{d^2}{dx^2}$$

- (a) Is  $L$  self-adjoint? Explain.  
(b) Solve the eigenvalue problem, i.e. find the solutions  $u(x)$ .  
(c) Are the solutions orthogonal?  
(d) What are these functions normally called?
- (2) Let's generate Legendre polynomials! Write the generating function in terms of  $y = 2xh - h^2$  and write out the first three terms. If you expand  $y$  and collect the coefficients of  $h$ , then you can generate the first three  $P_\ell(x)$  polynomials.