

Solve the heat equation in a disk,

$$\nabla^2 u = \frac{\partial u}{\partial t} \quad \text{for } 0 < r < 1, \quad 0 \leq \theta < 2\pi, \quad 0 < t < \infty,$$

$$u(1, \theta, t) = 100, \quad u(r, \theta, 0) = f(r) \sin \theta.$$