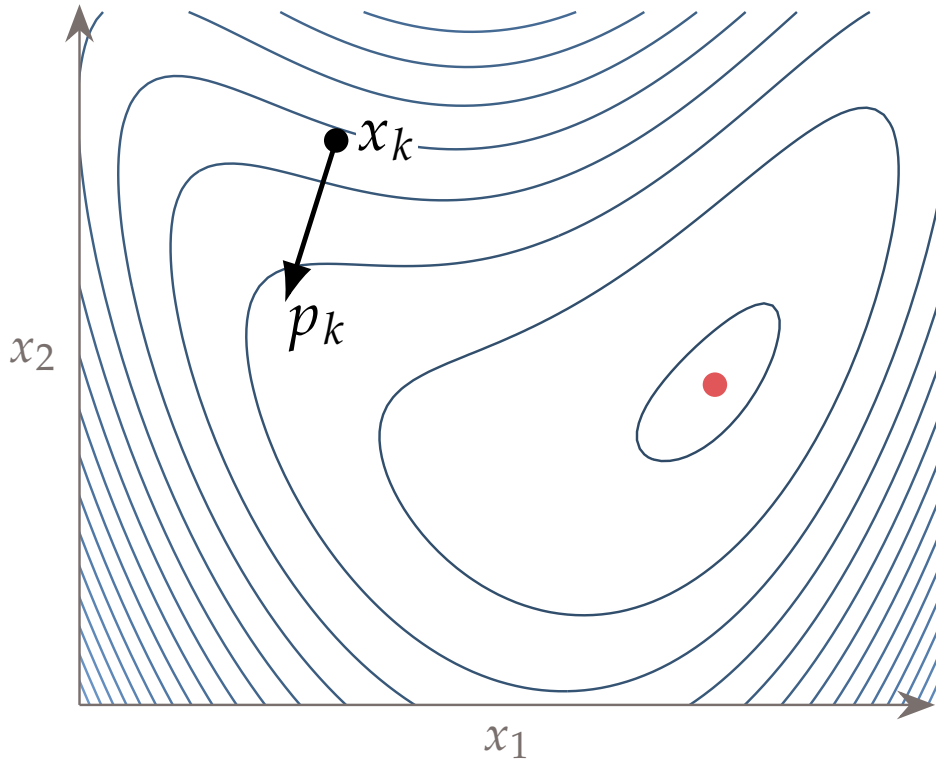
ODE Examples and Boundary Value Problems

ME EN 275
Andrew Ning
aning@byu.edu



Higher Order ODEs

1. solve for highest order derivative

2. $z_0 = y$

   $z_1 = y'$

   ⋮

   stop before highest derivative

3. write equation for derivative of each z

   $z_0' = z_1$

   $z_1' = z_2$

   $z_2' =$

Bungee jump

$$my'' + cy' + ky = mg$$

1) $y'' = g - \frac{1}{m}(cy' + ky)$

2) $z_0 = y$

$z_1 = y'$

3) $z_0' = z_1$

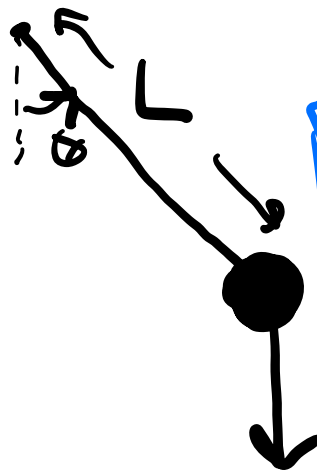
$z_1' = g - \frac{1}{m}(cz_1 + kz_0)$

3) $z = [y, y']$

$\frac{dy}{dt} = y'$

$\frac{dy'}{dt} = g - \frac{1}{m}(cy' + ky)$

Nonlinear Pendulum



$$\tau = I\alpha$$

$$-L \cdot mg \sin\theta = mL^2 \frac{d^2\theta}{dt^2}$$

1) $\frac{d^2\theta}{dt^2} = -\frac{g}{L}\sin\theta$

2) $z_0 = \theta$
$z_1 = \dot{\theta}$

$y = [\theta, \dot{\theta}]$

3) $\dot{z}_0 = z_1$
$\dot{z}_1 = -\frac{g}{L}\sin z_0$

$\frac{d\theta}{dt} = \dot{\theta}$
$\frac{d\dot{\theta}}{dt} = -\frac{g}{L}\sin\theta$

Boundary Value Problems