# Hydro-Turbine Optimization

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## Introduction

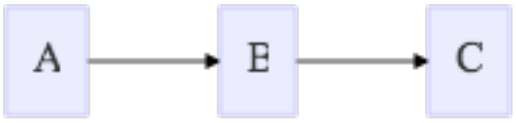
This is a panda

Figure 1: The Victim

### Intro

Settled by Thomas Fowler in 1829, Maine became a hub the Through an analysis of the changing state of hydro-electric power in the of Millinocket, Maine.

$f(x) = sin(x) + 12$




## Problem 1 $f(Q_1, Q_2, Q_3) = KW_T = KW_1 + KW_2 + KW_3$

$g(Q_1, Q_2, Q_3) = Q_T = Q_1 + Q_2 + Q_3$

$\Lambda \nabla g = \nabla < 1, 1, 1 >=< \Lambda, \Lambda, \Lambda >$

$K_{TQ_1} = \Lambda \; K_{TQ_2} = \Lambda \; K_{TQ_3} = \Lambda$

$\therefore K_{TQ_1} = K_{TQ_2} = K_{TQ_3}$

Now

$KW_T = ((-18.89 + .1277Q_1 - 4.08 \cdot 10^{-5}Q_1^2) + (-24.51 + .1358Q_2 - 4.69 \cdot 10^{-5}Q_2^2) + (-27.02 + .1380Q_3 - 3.84 \cdot 10^{-5}Q_3^2))(170 - 1.6 \cdot 10^{-6}Q_T^2)$

$KW_{TQ_1} = ((-70.42 + .1277Q_1 - 4.08 \cdot 10^{-5}Q_1^2 + .1358Q_2 - 4.69 \cdot 10^{-5}Q_2^2 + .1380Q_3 - 3.84 \cdot 10^{-5}Q_3^2) + (1.6 \cdot 10^{-6} \cdot 2(Q_1 + Q_2 + Q_3)) + (.1277 - 8.16 \cdot 10^{-5}Q_1)(170 - 1.6 \cdot 10^{-6}(Q_1^2 + Q_2^2 + Q_3^2 + 2Q_1Q_2 + 2Q_2Q_3 2Q_1Q_3))$

**For TQ_2** $KW_{TQ_2} = ((-70.42 + .1277Q_1 - 4.08 \cdot 10^{-5}Q_1^2 + .1358Q_2 - 4.69 \cdot 10^{-5}Q_2^2 + .1380Q_3 - 3.84 \cdot 10^{-5}Q_3^2) + (1.6 \cdot 10^{-6} \cdot 2(Q_1 + Q_2 + Q_3)) + (.1358 - 9.38 \cdot 10^{-5}Q_2)(170 - 1.6 \cdot 10^{-6}(Q_1^2 + Q_2^2 + Q_3^2 + 2Q_1Q_2 + 2Q_2Q_3 2Q_1Q_3))$

**For TQ_3** $KW_{TQ_3} = ((-70.42 + .1277Q_1 - 4.08 \cdot 10^{-5}Q_1^2 + .1358Q_2 - 4.69 \cdot 10^{-5}Q_2^2 + .1380Q_3 - 3.84 \cdot 10^{-5}Q_3^2) + (1.6 \cdot 10^{-6} \cdot 2(Q_1 + Q_2 + Q_3)) + (.1380 - 7.68 \cdot 10^{-5}Q_3)(170 - 1.6 \cdot 10^{-6}(Q_1^2 + Q_2^2 + Q_3^2 + 2Q_1Q_2 + 2Q_2Q_3 2Q_1Q_3))$

Let $170 - 1.6 \cdot 10^{-6}Q_T^2 = a$

$\therefore (.1277 - 8.16 \cdot 10^{-5}Q_1)(a) = (.1358 - 9.38 \cdot 10^{-5}Q_2)(a) = (.1380 - .768 \cdot 10^{-5}Q_3)(a) = a(-.0081 - 8.16 \cdot 10^{-5}Q_1 + 9.38 \cdot 10^{-5}Q_2) = 0$