

# Computer Vision - Sheet 5

Rhys Agombar  
Thiago Bell Felix de Oliveira

November 16, 2018

## 1

### 1.1

The Quadratic function is submodular if

$$c(\beta - \gamma)^2 + c(\alpha - \delta)^2 - c(\beta - \delta)^2 - c(\alpha - \gamma)^2 \geq 0 \quad (1)$$

Ignoring the constants and expanding the terms:

$$\beta^2 - 2\gamma\beta + \gamma^2 + \alpha^2 - 2\delta\alpha + \delta^2 - \beta^2 + 2\delta\beta - \delta^2 - \alpha^2 + 2\gamma\alpha - \gamma^2 = -2\gamma\beta + 2\delta\beta = 2\beta(\delta - \gamma) \quad (2)$$

Since  $\delta > \gamma$ , the expression is positive and the function submodular

### 1.2

Renaming the impulse function  $\delta$  as  $I$  we obtain:

$$1 - I(\beta - \gamma) + 1 - I(\alpha - \delta) - 1 + I(\beta - \delta) - 1 + I(\alpha - \gamma) \quad (3)$$

For inputs:  $\beta = \gamma = 1$  and  $\delta = \alpha = 2$  we obtain:

$$1 - I(0) + 1 - I(0) - 1 + I(-1) - 1 + I(1) = -2 \quad (4)$$

Therefore, the function is not submodular

