CPSC 302 - Assignment 4

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1. Data Fitting

1.a

The equation $u(t)$ isn't linear, thus you can't find a perfect match using linear least squares.

1.b

We're trying to solve for $v(t) = x_1 + x_2 t$.

Normal equations:

$$X^T X b = X^T y$$

$$X = \begin{bmatrix} 1 & 0.0 \\ 1 & 1.0 \\ 1 & 2.0 \end{bmatrix}$$

$$y = \begin{bmatrix} 0.1 \\ 0.9 \\ 2 \end{bmatrix}$$

Solving the normal equations gives us

$$b = \begin{bmatrix} 0.05 \\ 0.95 \end{bmatrix}$$

$$v(t) = 0.05 + 0.95t$$

$$u(t) = e^{v(t)} = e^{0.05+0.95t}$$
$$u(t) = e^{v(t)} = e^{0.05} e^{0.95t}$$
$$u(t) = 1.0512711 e^{0.95t}$$

2. Classical Gram-Schmidt vs. Modified Gram-Schmidt

$$A = \begin{bmatrix} 1 & 1 & 1 \\ \epsilon & 0 & 0 \\ 0 & \epsilon & 0 \\ 0 & 0 & \epsilon \end{bmatrix}$$

Since we have a 4x3 matrix, we can decompose it into a 4x3 matrix and a 3x3 matrix.

$$A = \begin{bmatrix} \frac{1}{\sqrt{1+\epsilon^2}} & 0 & 1 \\ \frac{\epsilon}{\sqrt{1+\epsilon^2}} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & \epsilon \end{bmatrix} \begin{bmatrix} \sqrt{1+\epsilon^2} & \epsilon & \epsilon \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

3. **Comparison of Algorithms**

4. **Regularization**

5. **Compressing Image Information**