HW1

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Given $J(x(t), y)(t)) = \int_0^1 \frac{1}{2}(x(t)^2 + (y(t) - 1)^2)dt$, does a minimizer exist? What is it?

A minimizer, values that will bring the function to a minimum, does exist. **For this function the minimizer is: $x = 0$ & $y = 1$.** If x & y are constant at the specified values across the interval $[0, 1]$ the function evaluates to 0. Because we are integrating over the sum of the sqaures of two (assumed) real numbers, the lowest possible value is zero.

Given $J(x(t), y)(t)) = \int_0^1 \frac{1}{2}(x(t)^2 - (y(t) - 1)^2)dt$, does a minimizer exist? What is it?

A minimizer, values that will bring the function to a minimum, does exist. However, it is a function of y_{max} **For this function the minimizer is: $x = 0$ & $y = y_{max}$.** If x & y are constant at the specified values across the interval $[0, 1]$ the function evaluates to $-\frac{1}{2}(y_{max} - 1)^2$ which will be the minimum value.

Demonstrate a function which calculates the gradient of $f(x, y)$

[3]:
```python
import sympy as sym
```

[4]:
```python
x, y, z, c = sym.symbols('x y z a')
```

[5]:
```python
#input all state variables into conifguration vector
q = sym.Matrix([x, y])
```

[6]:
```python
q_2 = q.multiply_elementwise(q)
```

[7]:
```python
a = sym.Matrix([0, 0])
```

[8]:
```python
a_2 = sym.Matrix([1, c])
```

[9]:
```python
f = a_2.T * q_2 + a.T * q
```

[10]:
```python
print(f)
```

```
Matrix([[a*y**2 + x**2]])
```

[11]:
```python
f.jacobian(q)
```

[11]:

$$\begin{bmatrix} 2x & 2ay \end{bmatrix}$$

[ ]:
```python

```

[ ]:
```python

```