

Robot arm

1) Implement 3-segment robot arm.

I've implemented a dynamic N-segment robot arm by slightly prettyfying initial code.

$$\frac{L_{MSE}}{\delta y'} = \frac{(y - y')^2}{\delta y'} = \frac{(y - y')^2}{\delta(y - y')} \cdot \frac{(y - y')}{\delta y'} = -2 \cdot (y - y') \cdot \frac{y'}{\delta y'}$$

```
def rotation(theta: float):
```

```
    """
```

```
    :param theta: in radians
```

```
    :return:
```

```
    """
```

```
    c = np.cos(theta)
```

```
    s = np.sin(theta)
```

```
    return np.array((
```

```
        (c, -s),
```

```
        (s, c),
```

```
    ))
```

```
def d_rotation(theta: float):
```

```
    """
```

```
    :param theta: in radians
```

```
    :return:
```

```
    """
```

```
    c = np.cos(theta)
```

```
    s = np.sin(theta)
```

```
    return np.array((
```

```
        (-s, -c),
```

```
        (c, -s),
```

```
    ))
```

```
prev_r = None
```

```
for segment_idx in range(SEGMENT_COUNT):
```

```
    # getting rotation value
```

```
    theta = thetas[segment_idx]
```

```
    # getting rotation matrix
```

```
    r = rotation(theta)
```

```
    dr_theta_1 = d_rotation(theta)
```

```
    # calculating current segment vector by adding rotated segment template to the tip of the previous segment
```

```
    np_joints[segment_idx+1] = np.dot(r, segment) + np_joints[segment_idx]
```

```
    # STILL BLACK MAGIC FOR ME
```

```
    x = dr_theta_1 @ segment
```

```
    if segment_idx:
```

```
        x = prev_r @ x
```

```

# is this somehow related to derivative of the loss function?
d_theta_1 = np.sum(x * -2 * (TARGET_POINT - np_joints[-1]))
# END OF BLACK MAGIC

# updating and storing new rotation value for the current segment
thetas[segment_idx] -= d_theta_1 * LEARNING_RATE

prev_r = r

loss = np.sum((TARGET_POINT - np_joints[-1]) ** 2)
plt.title(f'loss: {loss:.4f} thetas: {tuple(round(np.rad2deg(theta)) for theta in thetas)}')

```

2) Loss of MSE from tip of robot arm (last vector) to target point:

```

loss = np.sum((TARGET_POINT - np_joints[-1]) ** 2)

```