ojt-q3

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0.1 Q3. Singular Value Decomposition (SVD)

[1]:
```
import numpy as np
import sympy as sp

np.random.seed(29)
A = np.random.randint(0, 10, (5, 5))
sp.Matrix(A)
```

[1]:
$$\begin{bmatrix} 5 & 3 & 2 & 8 & 0 \\ 9 & 1 & 8 & 5 & 3 \\ 1 & 8 & 1 & 5 & 4 \\ 7 & 0 & 4 & 2 & 6 \\ 7 & 3 & 0 & 8 & 3 \end{bmatrix}$$

[2]:
```
U, Sigma, Vt = np.linalg.svd(A)
Sigma_matrix = np.diag(Sigma)
rank2approximation = U[:, :2] @ Sigma_matrix[:2, :2] @ Vt[:2, :]
rank3approximation = U[:, :3] @ Sigma_matrix[:3, :3] @ Vt[:3, :]
print("Rank 2 Approximation of Matrix A: ")
sp.Matrix(rank2approximation)
```

```
Rank 2 Approximation of Matrix A:
```

[2]:
$$\begin{bmatrix} 4.75844608008397 & 4.14867842373142 & 1.85652674575847 & 6.33101602180092 & 2.686382353820 99 \\ 9.56290601927815 & 0.241173076547636 & 6.31711686102891 & 5.04610640411638 & 4.22915790948535 \\ 2.08488927061375 & 6.09130730161141 & -0.55163544119072 & 6.82623904555762 & 1.79438290527134 \\ 7.10420046518837 & -0.415836311930769 & 4.88298641009617 & 3.18451118747595 & 3.05585158376462 \\ 5.73925633859545 & 4.52010350207778 & 2.3936966483179 & 7.17730594647575 & 3.17022428587274 \end{bmatrix}$$

[3]:
```
print("Rank 3 Approximation of Matrix A: ")
sp.Matrix(rank3approximation)
```

```
Rank 3 Approximation of Matrix A:
```

[3]:
$$\begin{bmatrix} 5.44257713813451 & 2.80099818321496 & 1.16756853645733 & 7.86648944654047 & 0.4133081886198 87 \\ 9.57328280785551 & 0.220731681933024 & 6.30666685500678 & 5.06939621519451 & 4.19468029038681 \\ 1.27317821435071 & 7.69030933296435 & 0.265802956338672 & 5.00442326802119 & 4.49135070097009 \\ 6.53643019313556 & 0.702623035578771 & 5.45476280487435 & 1.91019955692604 & 4.94230875010055 \\ 6.15241936139708 & 3.70620734082402 & 1.97761839402846 & 8.10461487965694 & 1.79746071653133 \end{bmatrix}$$