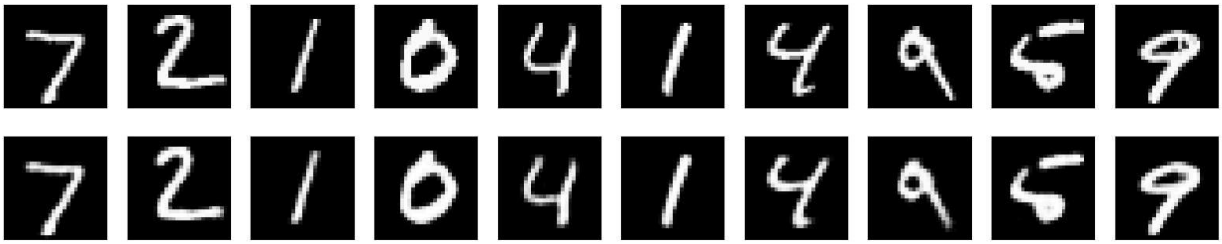
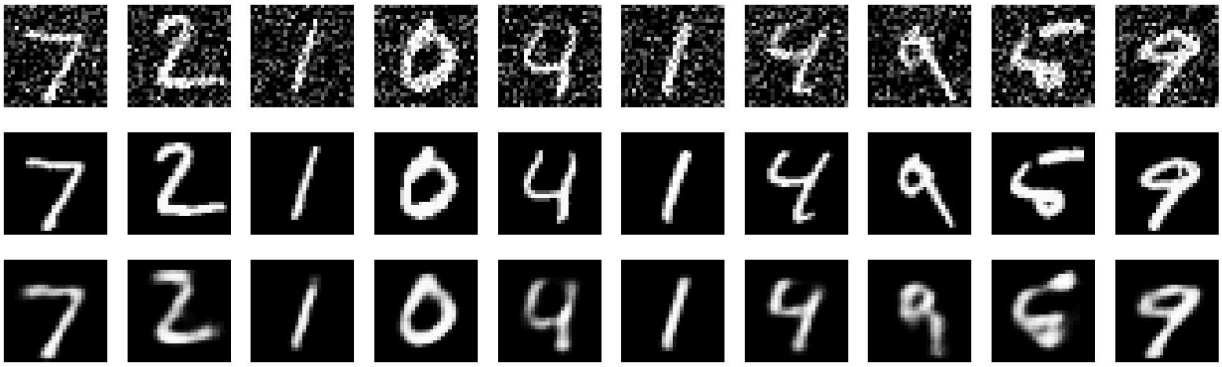
In [3]:
```
import tensorflow as tf
from tensorflow.keras import layers, models
from tensorflow.keras.datasets import mnist
import matplotlib.pyplot as plt
(x_train, _), (x_test, _) = mnist.load_data()
x_train = x_train.astype('float32') / 255.0
x_test = x_test.astype('float32') / 255.0
x_train = x_train.reshape(-1, 28*28)
x_test = x_test.reshape(-1, 28*28)
input_img = layers.Input(shape=(28 * 28,))
encoded = layers.Dense(128, activation='relu')(input_img)
decoded = layers.Dense(28 * 28, activation='sigmoid')(encoded)
autoencoder = models.Model(input_img, decoded)
autoencoder.compile(optimizer='adam', loss='binary_crossentropy')
autoencoder.fit(x_train, x_train, epochs=10, batch_size=256, validation_data=(x_t
reconstruction_loss = autoencoder.evaluate(x_test, x_test)
print(f"Reconstruction Loss: {reconstruction_loss}5")
decoded_imgs = autoencoder.predict(x_test)
n = 10
plt.figure(figsize=(20, 4))
for i in range(n):
    ax = plt.subplot(2, n, i + 1)
    plt.imshow(x_test[i].reshape(28, 28), cmap="gray")
    ax.get_xaxis().set_visible(False)
    ax.get_yaxis().set_visible(False)

    ax = plt.subplot(2, n, i + 1 + n)
    plt.imshow(decoded_imgs[i].reshape(28, 28), cmap="gray")
    ax.get_xaxis().set_visible(False)
    ax.get_yaxis().set_visible(False)
plt.show()
```

```
Epoch 1/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 2s 5ms/step - loss: 0.3137 - val_loss: 0.1347
Epoch 2/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.1259 - val_loss: 0.1028
Epoch 3/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0993 - val_loss: 0.0885
Epoch 4/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0875 - val_loss: 0.0812
Epoch 5/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0808 - val_loss: 0.0769
Epoch 6/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0770 - val_loss: 0.0741
Epoch 7/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0741 - val_loss: 0.0723
Epoch 8/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0724 - val_loss: 0.0710
Epoch 9/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0712 - val_loss: 0.0701
Epoch 10/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0703 - val_loss: 0.0694
313/313 ━━━━━━━━━━━━━━━━━━━━ 0s 865us/step - loss: 0.0691
Reconstruction Loss: 0.0693804919719696
313/313 ━━━━━━━━━━━━━━━━━━━━ 0s 536us/step
```



In [5]:
```
import numpy as np
import tensorflow as tf
from tensorflow.keras import layers, models
import matplotlib.pyplot as plt
(x_train, _), (x_test, _) = tf.keras.datasets.mnist.load_data()
x_train = x_train.astype('float32') / 255.0
x_test = x_test.astype('float32') / 255.0
x_train_flat = x_train.reshape((x_train.shape[0], 28 * 28))
x_test_flat = x_test.reshape((x_test.shape[0], 28 * 28))
def add_noise(images, noise_factor=0.3):
    noise = np.random.normal(loc=0.0, scale=1.0, size=images.shape)
    noisy_images = images + noise_factor * noise
    noisy_images = np.clip(noisy_images, 0.0, 1.0)  # Ensure values are in [0, 1]
    return noisy_images
x_train_noisy = add_noise(x_train_flat)
x_test_noisy = add_noise(x_test_flat)
encoder_input = layers.Input(shape=(784,))
encoded = layers.Dense(128, activation='relu')(encoder_input)
encoded = layers.Dense(64, activation='relu')(encoded)
encoded = layers.Dense(32, activation='relu')(encoded)
decoded = layers.Dense(64, activation='relu')(encoded)
decoded = layers.Dense(128, activation='relu')(decoded)
decoded = layers.Dense(784, activation='sigmoid')(decoded)
autoencoder = models.Model(encoder_input, decoded)
autoencoder.compile(optimizer='adam', loss='binary_crossentropy')
autoencoder.fit(x_train_noisy, x_train_flat, epochs=10, batch_size=256, validatic
decoded_imgs = autoencoder.predict(x_test_noisy)
decoded_imgs = decoded_imgs.reshape((x_test.shape[0], 28, 28))
n = 10
plt.figure(figsize=(20, 6))
for i in range(n):
    ax = plt.subplot(3, n, i + 1)
    plt.imshow(x_test_noisy[i].reshape(28, 28), cmap='gray')
    ax.axis('off')
    ax = plt.subplot(3, n, i + 1 + n)
    plt.imshow(x_test[i], cmap='gray')
    ax.axis('off')
    ax = plt.subplot(3, n, i + 1 + 2 * n)
    plt.imshow(decoded_imgs[i], cmap='gray')
    ax.axis('off')
```

```
Epoch 1/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 2s 6ms/step - loss: 0.3351 - val_loss: 0.1901
Epoch 2/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.1755 - val_loss: 0.1491
Epoch 3/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.1469 - val_loss: 0.1387
Epoch 4/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.1378 - val_loss: 0.1323
Epoch 5/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.1320 - val_loss: 0.1276
Epoch 6/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.1272 - val_loss: 0.1227
Epoch 7/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.1226 - val_loss: 0.1200
Epoch 8/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.1201 - val_loss: 0.1174
Epoch 9/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.1180 - val_loss: 0.1162
Epoch 10/10
235/235 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.1165 - val_loss: 0.1146
313/313 ━━━━━━━━━━━━━━━━━━━━ 0s 684us/step
```



In [ ]: