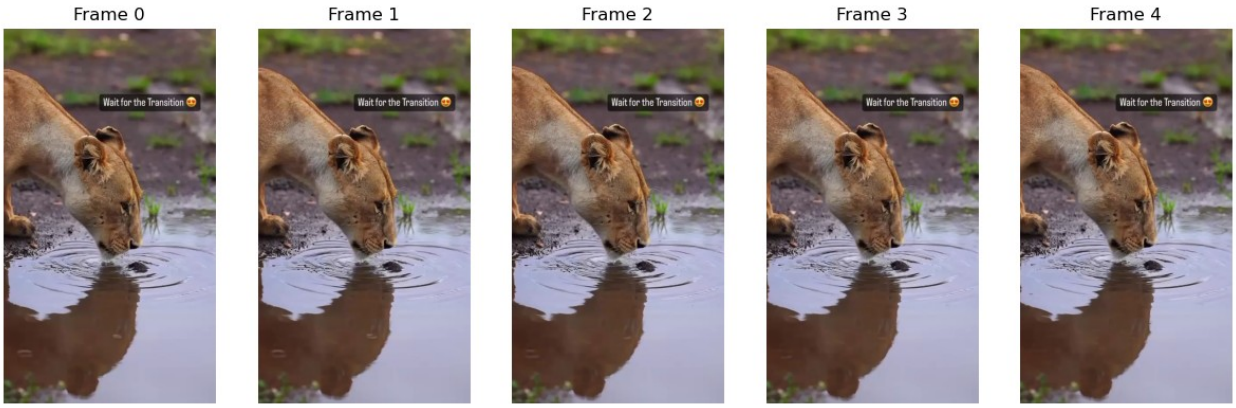
Step 1: Load Video and Extract Frames

We will extract frames from the video and save them into a folder, then display the first 5 frames.

```
import cv2
import os

# Path to your video file
video_path = "C:\\Users\\Narthana\\Downloads\\WhatsApp Video 2024-10-08 at 19.23.50_3400ea60.mp4"
output_folder = 'frames'

# Create a directory to save frames
if not os.path.exists(output_folder):
    os.makedirs(output_folder)

# Load the video
cap = cv2.VideoCapture(video_path)
frame_count = int(cap.get(cv2.CAP_PROP_FRAME_COUNT))
print(f"Total number of frames: {frame_count}")

frame_list = []

# Extract and save frames
for i in range(frame_count):
    ret, frame = cap.read()
    if ret:
        frame_filename = os.path.join(output_folder, f'frame_{i:04d}.png')
        cv2.imwrite(frame_filename, frame)
        frame_list.append(frame)
    else:
        break

cap.release()

# Plot the first 5 frames
plt.figure(figsize=(15, 5))
for i in range(5):
    plt.subplot(1, 5, i + 1)
    plt.imshow(cv2.cvtColor(frame_list[i], cv2.COLOR_BGR2RGB))
    plt.axis('off')
    plt.title(f'Frame {i}')
plt.show()
```

```
Total number of frames: 444
```



Step 2: Spatio-Temporal Segmentation (HSV Conversion and Segmentation)

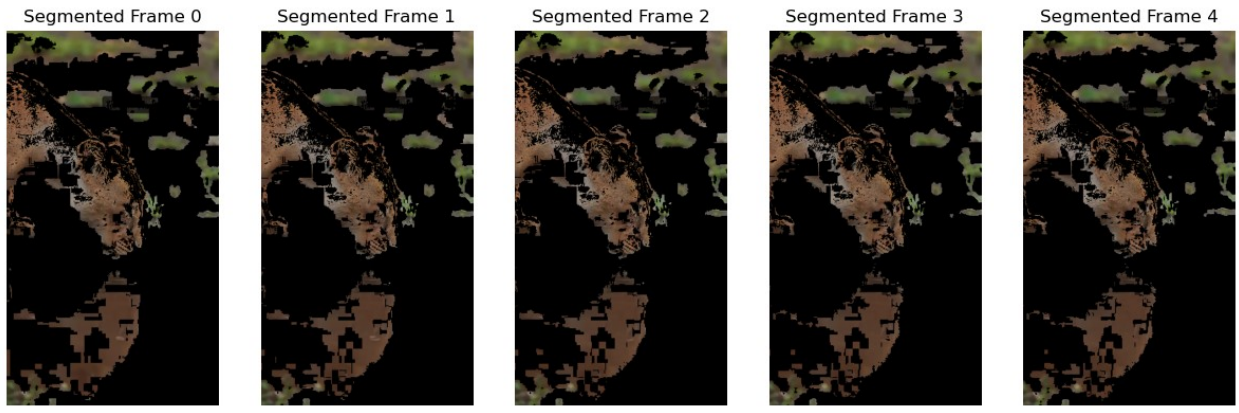
We will convert each frame to HSV format, perform simple color segmentation, and save them in a separate folder. We will also display the first 5 HSV frames.

```
import numpy as np

hsv_folder = 'hsv_frames'

# Create a directory to save HSV frames
if not os.path.exists(hsv_folder):
    os.makedirs(hsv_folder)

hsv_frames = []

# Convert each frame to HSV and save
for i, frame in enumerate(frame_list):
    hsv_frame = cv2.cvtColor(frame, cv2.COLOR_BGR2HSV)
    hsv_filename = os.path.join(hsv_folder, f'hsv_frame_{i:04d}.png')
    cv2.imwrite(hsv_filename, hsv_frame)
    hsv_frames.append(hsv_frame)

# Display the first 5 HSV frames
for i in range(5):
    cv2.imshow(f'HSV Frame {i}', hsv_frames[i])
    cv2.waitKey(0)
cv2.destroyAllWindows()
```

Step 3: Track Segmented Objects Across Frames

We'll track segmented regions based on HSV values and compare the movement and shape changes of the objects.

```
# Define color range for segmentation in HSV (modify according to your
need)
lower_bound = np.array([10, 20, 30])
upper_bound = np.array([80, 155, 155])

segmented_folder = 'segmented_frames'
if not os.path.exists(segmented_folder):
    os.makedirs(segmented_folder)

segmented_frames = []

for i, hsv_frame in enumerate(hsv_frames):
    # Threshold the HSV image to get only selected colors
    mask = cv2.inRange(hsv_frame, lower_bound, upper_bound)
    segmented_frame = cv2.bitwise_and(frame_list[i], frame_list[i],
mask=mask)
    segmented_filename = os.path.join(segmented_folder,
f'segmented_frame_{i:04d}.png')
    cv2.imwrite(segmented_filename, segmented_frame)
    segmented_frames.append(segmented_frame)

# Plot the first 5 segmented frames
plt.figure(figsize=(15, 5))
for i in range(5):
    plt.subplot(1, 5, i + 1)
    plt.imshow(cv2.cvtColor(segmented_frames[i], cv2.COLOR_BGR2RGB))
    plt.axis('off')
    plt.title(f'Segmented Frame {i}')
plt.show()
```



Step 4: Scene Cut Detection (Hard and Soft Cuts)

We will use histogram differences to detect both hard and soft scene cuts. We will save the histograms in a separate folder and compare consecutive frames.

```
import os
import cv2

# Create directories for histograms, hard cuts, and soft cuts if they
don't exist
hist_folder = 'histograms'
hard_cut_folder = 'hard_cuts'
soft_cut_folder = 'soft_cuts'

for folder in [hist_folder, hard_cut_folder, soft_cut_folder]:
    if not os.path.exists(folder):
        os.makedirs(folder)

similarity_scores = []
threshold_hard_cut = 0.5  # Adjust this threshold for hard cuts
soft_cut_threshold = 0.8    # Adjust this for soft cuts

hard_cuts = []
soft_cuts = []

# Function to calculate histogram similarity
def calculate_histogram_similarity(frame1, frame2):
    # Calculate histograms
    hist1 = cv2.calcHist([frame1], [0], None, [256], [0, 256])
    hist2 = cv2.calcHist([frame2], [0], None, [256], [0, 256])

    # Normalize histograms
    hist1 = cv2.normalize(hist1, hist1).flatten()
    hist2 = cv2.normalize(hist2, hist2).flatten()

    # Calculate correlation similarity (0 to 1)
    score = cv2.compareHist(hist1, hist2, cv2.HISTCMP_CORREL)
    return score

# Compare consecutive frames for cuts
for i in range(1, len(frame_list)):
    similarity = calculate_histogram_similarity(frame_list[i-1],
frame_list[i])
    similarity_scores.append(similarity)

    # Save histograms
    hist_filename = os.path.join(hist_folder, f'hist_{i:04d}.png')
```

```
    hist_img = cv2.calcHist([frame_list[i]], [0], None, [256], [0,
256])
    hist_img = cv2.normalize(hist_img, hist_img).astype('uint8')
    cv2.imwrite(hist_filename, hist_img)

    # Hard Cut Detection
    if similarity < threshold_hard_cut:
        hard_cuts.append(i)
        hard_cut_filename = os.path.join(hard_cut_folder,
f'hard_cut_{i:04d}.png')
        cv2.imwrite(hard_cut_filename, frame_list[i])

    # Soft Cut Detection
    elif threshold_hard_cut <= similarity <= soft_cut_threshold:
        soft_cuts.append(i)
        soft_cut_filename = os.path.join(soft_cut_folder,
f'soft_cut_{i:04d}.png')
        cv2.imwrite(soft_cut_filename, frame_list[i])

# Display similarity scores for all frames
for i in range(len(similarity_scores)):
    print(f"Frame {i+1} vs Frame {i+2} Similarity Score:
{similarity_scores[i]:.4f}")

# Print total counts of cuts
print(f"Total Hard Cuts Detected: {len(hard_cuts)}")
print(f"Total Soft Cuts Detected: {len(soft_cuts)}")
```

```
Frame 1 vs Frame 2 Similarity Score: 0.9969
Frame 2 vs Frame 3 Similarity Score: 0.9991
Frame 3 vs Frame 4 Similarity Score: 0.9982
Frame 4 vs Frame 5 Similarity Score: 0.9982
Frame 5 vs Frame 6 Similarity Score: 0.9979
Frame 6 vs Frame 7 Similarity Score: 0.9983
Frame 7 vs Frame 8 Similarity Score: 0.9976
Frame 8 vs Frame 9 Similarity Score: 0.9974
Frame 9 vs Frame 10 Similarity Score: 0.9983
Frame 10 vs Frame 11 Similarity Score: 0.9980
Frame 11 vs Frame 12 Similarity Score: 0.9986
Frame 12 vs Frame 13 Similarity Score: 0.9961
Frame 13 vs Frame 14 Similarity Score: 0.9978
Frame 14 vs Frame 15 Similarity Score: 0.9976
Frame 15 vs Frame 16 Similarity Score: 0.9977
Frame 16 vs Frame 17 Similarity Score: 0.9973
Frame 17 vs Frame 18 Similarity Score: 0.9973
Frame 18 vs Frame 19 Similarity Score: 0.9983
Frame 19 vs Frame 20 Similarity Score: 0.9980
Frame 20 vs Frame 21 Similarity Score: 0.9986
Frame 21 vs Frame 22 Similarity Score: 0.9974
Frame 22 vs Frame 23 Similarity Score: 0.9980
```

```
Frame 23 vs Frame 24 Similarity Score: 0.9988
Frame 24 vs Frame 25 Similarity Score: 0.9971
Frame 25 vs Frame 26 Similarity Score: 0.9972
Frame 26 vs Frame 27 Similarity Score: 0.9982
Frame 27 vs Frame 28 Similarity Score: 0.9982
Frame 28 vs Frame 29 Similarity Score: 0.9954
Frame 29 vs Frame 30 Similarity Score: 0.9955
Frame 30 vs Frame 31 Similarity Score: 0.9766
Frame 31 vs Frame 32 Similarity Score: 0.9987
Frame 32 vs Frame 33 Similarity Score: 0.9986
Frame 33 vs Frame 34 Similarity Score: 0.9980
Frame 34 vs Frame 35 Similarity Score: 0.9988
Frame 35 vs Frame 36 Similarity Score: 0.9977
Frame 36 vs Frame 37 Similarity Score: 0.9954
Frame 37 vs Frame 38 Similarity Score: 0.9970
Frame 38 vs Frame 39 Similarity Score: 0.9982
Frame 39 vs Frame 40 Similarity Score: 0.9973
Frame 40 vs Frame 41 Similarity Score: 0.9976
Frame 41 vs Frame 42 Similarity Score: 0.9981
Frame 42 vs Frame 43 Similarity Score: 0.9975
Frame 43 vs Frame 44 Similarity Score: 0.9982
Frame 44 vs Frame 45 Similarity Score: 0.9959
Frame 45 vs Frame 46 Similarity Score: 0.9966
Frame 46 vs Frame 47 Similarity Score: 0.9980
Frame 47 vs Frame 48 Similarity Score: 0.9977
Frame 48 vs Frame 49 Similarity Score: 0.9978
Frame 49 vs Frame 50 Similarity Score: 0.9971
Frame 50 vs Frame 51 Similarity Score: 0.9982
Frame 51 vs Frame 52 Similarity Score: 0.9982
Frame 52 vs Frame 53 Similarity Score: 0.9981
Frame 53 vs Frame 54 Similarity Score: 0.9990
Frame 54 vs Frame 55 Similarity Score: 0.9983
Frame 55 vs Frame 56 Similarity Score: 0.9985
Frame 56 vs Frame 57 Similarity Score: 0.9938
Frame 57 vs Frame 58 Similarity Score: 0.9977
Frame 58 vs Frame 59 Similarity Score: 0.9977
Frame 59 vs Frame 60 Similarity Score: 0.9974
Frame 60 vs Frame 61 Similarity Score: 0.9799
Frame 61 vs Frame 62 Similarity Score: 0.9981
Frame 62 vs Frame 63 Similarity Score: 0.9926
Frame 63 vs Frame 64 Similarity Score: 0.9981
Frame 64 vs Frame 65 Similarity Score: 0.9973
Frame 65 vs Frame 66 Similarity Score: 0.9957
Frame 66 vs Frame 67 Similarity Score: 0.9891
Frame 67 vs Frame 68 Similarity Score: 0.9805
Frame 68 vs Frame 69 Similarity Score: 0.9357
Frame 69 vs Frame 70 Similarity Score: 0.9647
Frame 70 vs Frame 71 Similarity Score: 0.9638
Frame 71 vs Frame 72 Similarity Score: 0.9573
```

```
Frame 72 vs Frame 73 Similarity Score: 0.9697
Frame 73 vs Frame 74 Similarity Score: 0.9961
Frame 74 vs Frame 75 Similarity Score: 0.9988
Frame 75 vs Frame 76 Similarity Score: 0.9983
Frame 76 vs Frame 77 Similarity Score: 0.9979
Frame 77 vs Frame 78 Similarity Score: 0.9997
Frame 78 vs Frame 79 Similarity Score: 0.9991
Frame 79 vs Frame 80 Similarity Score: 0.9988
Frame 80 vs Frame 81 Similarity Score: 0.9998
Frame 81 vs Frame 82 Similarity Score: 0.9992
Frame 82 vs Frame 83 Similarity Score: 0.9976
Frame 83 vs Frame 84 Similarity Score: 0.9998
Frame 84 vs Frame 85 Similarity Score: 0.9998
Frame 85 vs Frame 86 Similarity Score: 0.9996
Frame 86 vs Frame 87 Similarity Score: 0.9981
Frame 87 vs Frame 88 Similarity Score: 0.9999
Frame 88 vs Frame 89 Similarity Score: 0.9998
Frame 89 vs Frame 90 Similarity Score: 0.9997
Frame 90 vs Frame 91 Similarity Score: 0.9964
Frame 91 vs Frame 92 Similarity Score: 0.9996
Frame 92 vs Frame 93 Similarity Score: 0.9998
Frame 93 vs Frame 94 Similarity Score: 0.9995
Frame 94 vs Frame 95 Similarity Score: 0.9995
Frame 95 vs Frame 96 Similarity Score: 0.9989
Frame 96 vs Frame 97 Similarity Score: 0.9995
Frame 97 vs Frame 98 Similarity Score: 0.9991
Frame 98 vs Frame 99 Similarity Score: 0.9994
Frame 99 vs Frame 100 Similarity Score: 0.9991
Frame 100 vs Frame 101 Similarity Score: 0.9995
Frame 101 vs Frame 102 Similarity Score: 0.9991
Frame 102 vs Frame 103 Similarity Score: 0.9991
Frame 103 vs Frame 104 Similarity Score: 0.9979
Frame 104 vs Frame 105 Similarity Score: 0.9981
Frame 105 vs Frame 106 Similarity Score: 0.9972
Frame 106 vs Frame 107 Similarity Score: 0.9968
Frame 107 vs Frame 108 Similarity Score: 0.9969
Frame 108 vs Frame 109 Similarity Score: 0.9975
Frame 109 vs Frame 110 Similarity Score: 0.9978
Frame 110 vs Frame 111 Similarity Score: 0.9987
Frame 111 vs Frame 112 Similarity Score: 0.9962
Frame 112 vs Frame 113 Similarity Score: 0.9973
Frame 113 vs Frame 114 Similarity Score: 0.9995
Frame 114 vs Frame 115 Similarity Score: 0.9993
Frame 115 vs Frame 116 Similarity Score: 0.9992
Frame 116 vs Frame 117 Similarity Score: 0.9994
Frame 117 vs Frame 118 Similarity Score: 0.9993
Frame 118 vs Frame 119 Similarity Score: 0.9995
Frame 119 vs Frame 120 Similarity Score: 0.9995
Frame 120 vs Frame 121 Similarity Score: 0.9963
```

```
Frame 121 vs Frame 122 Similarity Score: 0.9998
Frame 122 vs Frame 123 Similarity Score: 0.9997
Frame 123 vs Frame 124 Similarity Score: 0.9994
Frame 124 vs Frame 125 Similarity Score: 0.9994
Frame 125 vs Frame 126 Similarity Score: 0.9995
Frame 126 vs Frame 127 Similarity Score: 0.9998
Frame 127 vs Frame 128 Similarity Score: 0.9991
Frame 128 vs Frame 129 Similarity Score: 0.9997
Frame 129 vs Frame 130 Similarity Score: 0.9996
Frame 130 vs Frame 131 Similarity Score: 0.9997
Frame 131 vs Frame 132 Similarity Score: 0.9996
Frame 132 vs Frame 133 Similarity Score: 0.9991
Frame 133 vs Frame 134 Similarity Score: 0.9998
Frame 134 vs Frame 135 Similarity Score: 0.9996
Frame 135 vs Frame 136 Similarity Score: 0.9985
Frame 136 vs Frame 137 Similarity Score: 0.9996
Frame 137 vs Frame 138 Similarity Score: 0.9998
Frame 138 vs Frame 139 Similarity Score: 0.9996
Frame 139 vs Frame 140 Similarity Score: 0.9994
Frame 140 vs Frame 141 Similarity Score: 0.9997
Frame 141 vs Frame 142 Similarity Score: 0.9997
Frame 142 vs Frame 143 Similarity Score: 0.9997
Frame 143 vs Frame 144 Similarity Score: 0.9993
Frame 144 vs Frame 145 Similarity Score: 0.9996
Frame 145 vs Frame 146 Similarity Score: 0.9998
Frame 146 vs Frame 147 Similarity Score: 0.9997
Frame 147 vs Frame 148 Similarity Score: 0.9994
Frame 148 vs Frame 149 Similarity Score: 0.9996
Frame 149 vs Frame 150 Similarity Score: 0.9997
Frame 150 vs Frame 151 Similarity Score: 0.9963
Frame 151 vs Frame 152 Similarity Score: 0.9993
Frame 152 vs Frame 153 Similarity Score: 0.9998
Frame 153 vs Frame 154 Similarity Score: 0.9998
Frame 154 vs Frame 155 Similarity Score: 0.9996
Frame 155 vs Frame 156 Similarity Score: 0.9999
Frame 156 vs Frame 157 Similarity Score: 0.9999
Frame 157 vs Frame 158 Similarity Score: 1.0000
Frame 158 vs Frame 159 Similarity Score: 0.9999
Frame 159 vs Frame 160 Similarity Score: 1.0000
Frame 160 vs Frame 161 Similarity Score: 1.0000
Frame 161 vs Frame 162 Similarity Score: 1.0000
Frame 162 vs Frame 163 Similarity Score: 1.0000
Frame 163 vs Frame 164 Similarity Score: 0.9315
Frame 164 vs Frame 165 Similarity Score: 0.8143
Frame 165 vs Frame 166 Similarity Score: 0.7115
Frame 166 vs Frame 167 Similarity Score: 0.7188
Frame 167 vs Frame 168 Similarity Score: 0.7299
Frame 168 vs Frame 169 Similarity Score: 0.7244
Frame 169 vs Frame 170 Similarity Score: 0.7585
```

```
Frame 170 vs Frame 171 Similarity Score: 0.7587
Frame 171 vs Frame 172 Similarity Score: 0.6856
Frame 172 vs Frame 173 Similarity Score: 0.7414
Frame 173 vs Frame 174 Similarity Score: 0.9903
Frame 174 vs Frame 175 Similarity Score: 0.9942
Frame 175 vs Frame 176 Similarity Score: 0.9965
Frame 176 vs Frame 177 Similarity Score: 0.9963
Frame 177 vs Frame 178 Similarity Score: 0.9933
Frame 178 vs Frame 179 Similarity Score: 0.9965
Frame 179 vs Frame 180 Similarity Score: 0.9912
Frame 180 vs Frame 181 Similarity Score: 0.9500
Frame 181 vs Frame 182 Similarity Score: 0.9926
Frame 182 vs Frame 183 Similarity Score: 0.9978
Frame 183 vs Frame 184 Similarity Score: 0.9851
Frame 184 vs Frame 185 Similarity Score: 0.9941
Frame 185 vs Frame 186 Similarity Score: 0.9906
Frame 186 vs Frame 187 Similarity Score: 0.9990
Frame 187 vs Frame 188 Similarity Score: 0.9858
Frame 188 vs Frame 189 Similarity Score: 0.9981
Frame 189 vs Frame 190 Similarity Score: 0.9982
Frame 190 vs Frame 191 Similarity Score: 0.9994
Frame 191 vs Frame 192 Similarity Score: 0.9948
Frame 192 vs Frame 193 Similarity Score: 0.9995
Frame 193 vs Frame 194 Similarity Score: 0.9986
Frame 194 vs Frame 195 Similarity Score: 0.9996
Frame 195 vs Frame 196 Similarity Score: 0.2921
Frame 196 vs Frame 197 Similarity Score: 0.4730
Frame 197 vs Frame 198 Similarity Score: 0.6789
Frame 198 vs Frame 199 Similarity Score: 0.9993
Frame 199 vs Frame 200 Similarity Score: 0.9980
Frame 200 vs Frame 201 Similarity Score: 0.9983
Frame 201 vs Frame 202 Similarity Score: 0.9976
Frame 202 vs Frame 203 Similarity Score: 0.9973
Frame 203 vs Frame 204 Similarity Score: 0.9970
Frame 204 vs Frame 205 Similarity Score: 0.9912
Frame 205 vs Frame 206 Similarity Score: 0.9990
Frame 206 vs Frame 207 Similarity Score: 0.9987
Frame 207 vs Frame 208 Similarity Score: 0.9995
Frame 208 vs Frame 209 Similarity Score: 0.9985
Frame 209 vs Frame 210 Similarity Score: 0.9995
Frame 210 vs Frame 211 Similarity Score: 0.9648
Frame 211 vs Frame 212 Similarity Score: 0.9991
Frame 212 vs Frame 213 Similarity Score: 0.9988
Frame 213 vs Frame 214 Similarity Score: 0.9997
Frame 214 vs Frame 215 Similarity Score: 0.9994
Frame 215 vs Frame 216 Similarity Score: 0.9992
Frame 216 vs Frame 217 Similarity Score: 0.9986
Frame 217 vs Frame 218 Similarity Score: 0.9992
Frame 218 vs Frame 219 Similarity Score: 0.9994
```

```
Frame 219 vs Frame 220 Similarity Score: 0.9991
Frame 220 vs Frame 221 Similarity Score: 0.9992
Frame 221 vs Frame 222 Similarity Score: 0.9990
Frame 222 vs Frame 223 Similarity Score: 0.9991
Frame 223 vs Frame 224 Similarity Score: 0.9994
Frame 224 vs Frame 225 Similarity Score: 0.9990
Frame 225 vs Frame 226 Similarity Score: 0.9983
Frame 226 vs Frame 227 Similarity Score: 0.9986
Frame 227 vs Frame 228 Similarity Score: 0.9991
Frame 228 vs Frame 229 Similarity Score: 0.9985
Frame 229 vs Frame 230 Similarity Score: 0.9980
Frame 230 vs Frame 231 Similarity Score: 0.9980
Frame 231 vs Frame 232 Similarity Score: 0.9987
Frame 232 vs Frame 233 Similarity Score: 0.9974
Frame 233 vs Frame 234 Similarity Score: 0.9982
Frame 234 vs Frame 235 Similarity Score: 0.9978
Frame 235 vs Frame 236 Similarity Score: 0.9976
Frame 236 vs Frame 237 Similarity Score: 0.9982
Frame 237 vs Frame 238 Similarity Score: 0.9986
Frame 238 vs Frame 239 Similarity Score: 0.9972
Frame 239 vs Frame 240 Similarity Score: 0.9984
Frame 240 vs Frame 241 Similarity Score: 0.6579
Frame 241 vs Frame 242 Similarity Score: 0.9984
Frame 242 vs Frame 243 Similarity Score: 0.9977
Frame 243 vs Frame 244 Similarity Score: 0.9990
Frame 244 vs Frame 245 Similarity Score: 0.9984
Frame 245 vs Frame 246 Similarity Score: 0.9987
Frame 246 vs Frame 247 Similarity Score: 0.9993
Frame 247 vs Frame 248 Similarity Score: 0.9989
Frame 248 vs Frame 249 Similarity Score: 0.9981
Frame 249 vs Frame 250 Similarity Score: 0.9974
Frame 250 vs Frame 251 Similarity Score: 0.9986
Frame 251 vs Frame 252 Similarity Score: 0.9990
Frame 252 vs Frame 253 Similarity Score: 0.9976
Frame 253 vs Frame 254 Similarity Score: 0.9988
Frame 254 vs Frame 255 Similarity Score: 0.9983
Frame 255 vs Frame 256 Similarity Score: 0.9981
Frame 256 vs Frame 257 Similarity Score: 0.9990
Frame 257 vs Frame 258 Similarity Score: 0.9980
Frame 258 vs Frame 259 Similarity Score: 0.9985
Frame 259 vs Frame 260 Similarity Score: 0.9990
Frame 260 vs Frame 261 Similarity Score: 0.9976
Frame 261 vs Frame 262 Similarity Score: 0.9989
Frame 262 vs Frame 263 Similarity Score: 0.9990
Frame 263 vs Frame 264 Similarity Score: 0.9984
Frame 264 vs Frame 265 Similarity Score: 0.9971
Frame 265 vs Frame 266 Similarity Score: 0.9983
Frame 266 vs Frame 267 Similarity Score: 0.9983
Frame 267 vs Frame 268 Similarity Score: 0.9986
```

```
Frame 268 vs Frame 269 Similarity Score: 0.9987
Frame 269 vs Frame 270 Similarity Score: 0.9990
Frame 270 vs Frame 271 Similarity Score: 0.9972
Frame 271 vs Frame 272 Similarity Score: 0.9992
Frame 272 vs Frame 273 Similarity Score: 0.9992
Frame 273 vs Frame 274 Similarity Score: 0.9984
Frame 274 vs Frame 275 Similarity Score: 0.9992
Frame 275 vs Frame 276 Similarity Score: 0.9994
Frame 276 vs Frame 277 Similarity Score: 0.9966
Frame 277 vs Frame 278 Similarity Score: 0.9988
Frame 278 vs Frame 279 Similarity Score: 0.9987
Frame 279 vs Frame 280 Similarity Score: 0.9978
Frame 280 vs Frame 281 Similarity Score: 0.9976
Frame 281 vs Frame 282 Similarity Score: 0.9986
Frame 282 vs Frame 283 Similarity Score: 0.9938
Frame 283 vs Frame 284 Similarity Score: 0.9955
Frame 284 vs Frame 285 Similarity Score: 0.9913
Frame 285 vs Frame 286 Similarity Score: 0.9952
Frame 286 vs Frame 287 Similarity Score: 0.9946
Frame 287 vs Frame 288 Similarity Score: 0.9983
Frame 288 vs Frame 289 Similarity Score: 0.9985
Frame 289 vs Frame 290 Similarity Score: 0.6615
Frame 290 vs Frame 291 Similarity Score: 0.9995
Frame 291 vs Frame 292 Similarity Score: 0.9992
Frame 292 vs Frame 293 Similarity Score: 0.9993
Frame 293 vs Frame 294 Similarity Score: 0.9992
Frame 294 vs Frame 295 Similarity Score: 0.9995
Frame 295 vs Frame 296 Similarity Score: 0.9989
Frame 296 vs Frame 297 Similarity Score: 0.9995
Frame 297 vs Frame 298 Similarity Score: 0.9990
Frame 298 vs Frame 299 Similarity Score: 0.9995
Frame 299 vs Frame 300 Similarity Score: 0.9994
Frame 300 vs Frame 301 Similarity Score: 0.9957
Frame 301 vs Frame 302 Similarity Score: 0.9996
Frame 302 vs Frame 303 Similarity Score: 0.9995
Frame 303 vs Frame 304 Similarity Score: 0.9995
Frame 304 vs Frame 305 Similarity Score: 0.9992
Frame 305 vs Frame 306 Similarity Score: 0.9992
Frame 306 vs Frame 307 Similarity Score: 0.9995
Frame 307 vs Frame 308 Similarity Score: 0.9992
Frame 308 vs Frame 309 Similarity Score: 0.9985
Frame 309 vs Frame 310 Similarity Score: 0.9990
Frame 310 vs Frame 311 Similarity Score: 0.9994
Frame 311 vs Frame 312 Similarity Score: 0.9994
Frame 312 vs Frame 313 Similarity Score: 0.9985
Frame 313 vs Frame 314 Similarity Score: 0.9996
Frame 314 vs Frame 315 Similarity Score: 0.9994
Frame 315 vs Frame 316 Similarity Score: 0.9997
Frame 316 vs Frame 317 Similarity Score: 0.9992
```

```
Frame 317 vs Frame 318 Similarity Score: 0.9991
Frame 318 vs Frame 319 Similarity Score: 0.9992
Frame 319 vs Frame 320 Similarity Score: 0.9994
Frame 320 vs Frame 321 Similarity Score: 0.9987
Frame 321 vs Frame 322 Similarity Score: 0.9996
Frame 322 vs Frame 323 Similarity Score: 0.9997
Frame 323 vs Frame 324 Similarity Score: 0.9997
Frame 324 vs Frame 325 Similarity Score: 0.9989
Frame 325 vs Frame 326 Similarity Score: 0.9994
Frame 326 vs Frame 327 Similarity Score: 0.9997
Frame 327 vs Frame 328 Similarity Score: 0.9997
Frame 328 vs Frame 329 Similarity Score: 0.9994
Frame 329 vs Frame 330 Similarity Score: 0.9998
Frame 330 vs Frame 331 Similarity Score: 0.9945
Frame 331 vs Frame 332 Similarity Score: 0.9998
Frame 332 vs Frame 333 Similarity Score: 0.9998
Frame 333 vs Frame 334 Similarity Score: 0.9997
Frame 334 vs Frame 335 Similarity Score: 0.9998
Frame 335 vs Frame 336 Similarity Score: 0.9997
Frame 336 vs Frame 337 Similarity Score: 0.9992
Frame 337 vs Frame 338 Similarity Score: 0.9986
Frame 338 vs Frame 339 Similarity Score: 0.9994
Frame 339 vs Frame 340 Similarity Score: 0.9992
Frame 340 vs Frame 341 Similarity Score: 0.9984
Frame 341 vs Frame 342 Similarity Score: 0.9995
Frame 342 vs Frame 343 Similarity Score: 0.9996
Frame 343 vs Frame 344 Similarity Score: 0.9991
Frame 344 vs Frame 345 Similarity Score: 0.9991
Frame 345 vs Frame 346 Similarity Score: 0.9990
Frame 346 vs Frame 347 Similarity Score: 0.9996
Frame 347 vs Frame 348 Similarity Score: 0.9996
Frame 348 vs Frame 349 Similarity Score: 0.9994
Frame 349 vs Frame 350 Similarity Score: 0.9995
Frame 350 vs Frame 351 Similarity Score: 0.9997
Frame 351 vs Frame 352 Similarity Score: 0.9997
Frame 352 vs Frame 353 Similarity Score: 0.9994
Frame 353 vs Frame 354 Similarity Score: 0.9992
Frame 354 vs Frame 355 Similarity Score: 0.9996
Frame 355 vs Frame 356 Similarity Score: 0.9992
Frame 356 vs Frame 357 Similarity Score: 0.5950
Frame 357 vs Frame 358 Similarity Score: 0.9902
Frame 358 vs Frame 359 Similarity Score: 0.9971
Frame 359 vs Frame 360 Similarity Score: 0.9979
Frame 360 vs Frame 361 Similarity Score: 0.9841
Frame 361 vs Frame 362 Similarity Score: 0.9980
Frame 362 vs Frame 363 Similarity Score: 0.9968
Frame 363 vs Frame 364 Similarity Score: 0.9963
Frame 364 vs Frame 365 Similarity Score: 0.9976
Frame 365 vs Frame 366 Similarity Score: 0.9976
```

```
Frame 366 vs Frame 367 Similarity Score: 0.9969
Frame 367 vs Frame 368 Similarity Score: 0.9977
Frame 368 vs Frame 369 Similarity Score: 0.9973
Frame 369 vs Frame 370 Similarity Score: 0.9976
Frame 370 vs Frame 371 Similarity Score: 0.9981
Frame 371 vs Frame 372 Similarity Score: 0.9983
Frame 372 vs Frame 373 Similarity Score: 0.9968
Frame 373 vs Frame 374 Similarity Score: 0.9959
Frame 374 vs Frame 375 Similarity Score: 0.9977
Frame 375 vs Frame 376 Similarity Score: 0.9985
Frame 376 vs Frame 377 Similarity Score: 0.9973
Frame 377 vs Frame 378 Similarity Score: 0.9971
Frame 378 vs Frame 379 Similarity Score: 0.9950
Frame 379 vs Frame 380 Similarity Score: 0.9982
Frame 380 vs Frame 381 Similarity Score: 0.9962
Frame 381 vs Frame 382 Similarity Score: 0.9984
Frame 382 vs Frame 383 Similarity Score: 0.9981
Frame 383 vs Frame 384 Similarity Score: 0.9974
Frame 384 vs Frame 385 Similarity Score: 0.9975
Frame 385 vs Frame 386 Similarity Score: 0.9959
Frame 386 vs Frame 387 Similarity Score: 0.9972
Frame 387 vs Frame 388 Similarity Score: 0.9973
Frame 388 vs Frame 389 Similarity Score: 0.9961
Frame 389 vs Frame 390 Similarity Score: 0.9983
Frame 390 vs Frame 391 Similarity Score: 0.9929
Frame 391 vs Frame 392 Similarity Score: 0.9985
Frame 392 vs Frame 393 Similarity Score: 0.9976
Frame 393 vs Frame 394 Similarity Score: 0.9971
Frame 394 vs Frame 395 Similarity Score: 0.9977
Frame 395 vs Frame 396 Similarity Score: 0.9973
Frame 396 vs Frame 397 Similarity Score: 0.9953
Frame 397 vs Frame 398 Similarity Score: 0.9985
Frame 398 vs Frame 399 Similarity Score: 0.9979
Frame 399 vs Frame 400 Similarity Score: 0.9979
Frame 400 vs Frame 401 Similarity Score: 0.9979
Frame 401 vs Frame 402 Similarity Score: 0.9978
Frame 402 vs Frame 403 Similarity Score: 0.9980
Frame 403 vs Frame 404 Similarity Score: 0.9985
Frame 404 vs Frame 405 Similarity Score: 0.9976
Frame 405 vs Frame 406 Similarity Score: 0.9970
Frame 406 vs Frame 407 Similarity Score: 0.9970
Frame 407 vs Frame 408 Similarity Score: 0.9973
Frame 408 vs Frame 409 Similarity Score: 0.9969
Frame 409 vs Frame 410 Similarity Score: 0.9987
Frame 410 vs Frame 411 Similarity Score: 0.9978
Frame 411 vs Frame 412 Similarity Score: 0.9987
Frame 412 vs Frame 413 Similarity Score: 0.9974
Frame 413 vs Frame 414 Similarity Score: 0.9975
Frame 414 vs Frame 415 Similarity Score: 0.9986
```

```
Frame 415 vs Frame 416 Similarity Score: 0.9983
Frame 416 vs Frame 417 Similarity Score: 0.9964
Frame 417 vs Frame 418 Similarity Score: 0.9957
Frame 418 vs Frame 419 Similarity Score: 0.9976
Frame 419 vs Frame 420 Similarity Score: 0.9978
Frame 420 vs Frame 421 Similarity Score: 0.9896
Frame 421 vs Frame 422 Similarity Score: 0.9887
Frame 422 vs Frame 423 Similarity Score: 0.9831
Frame 423 vs Frame 424 Similarity Score: 0.9779
Frame 424 vs Frame 425 Similarity Score: 0.9681
Frame 425 vs Frame 426 Similarity Score: 0.9680
Frame 426 vs Frame 427 Similarity Score: 0.9530
Frame 427 vs Frame 428 Similarity Score: 0.9738
Frame 428 vs Frame 429 Similarity Score: 0.9473
Frame 429 vs Frame 430 Similarity Score: 0.9612
Frame 430 vs Frame 431 Similarity Score: 0.9566
Frame 431 vs Frame 432 Similarity Score: 0.9737
Frame 432 vs Frame 433 Similarity Score: 0.9492
Frame 433 vs Frame 434 Similarity Score: 0.9401
Frame 434 vs Frame 435 Similarity Score: 0.9096
Frame 435 vs Frame 436 Similarity Score: 0.9067
Frame 436 vs Frame 437 Similarity Score: 0.8696
Frame 437 vs Frame 438 Similarity Score: 0.9366
Frame 438 vs Frame 439 Similarity Score: 0.8438
Frame 439 vs Frame 440 Similarity Score: 0.8822
Frame 440 vs Frame 441 Similarity Score: 0.7832
Frame 441 vs Frame 442 Similarity Score: 0.6441
Frame 442 vs Frame 443 Similarity Score: 0.5023
Frame 443 vs Frame 444 Similarity Score: 0.4348
Total Hard Cuts Detected: 3
Total Soft Cuts Detected: 15
```

Step 5: Scene Cut Summary and Result Visualization

We will mark the scene cuts and display the frames where the cuts were detected.

Cut Detection Logic:

The calculate_histogram_similarity function calculates the histogram similarity between two frames.

The main loop iterates through the frames, calculating similarity scores for consecutive frames.

If the similarity score is below threshold_hard_cut, it's classified as a hard cut, and the frame is saved to the hard_cuts folder.

If the score falls between the hard and soft cut thresholds, it's classified as a soft cut and saved to the soft_cuts folder.

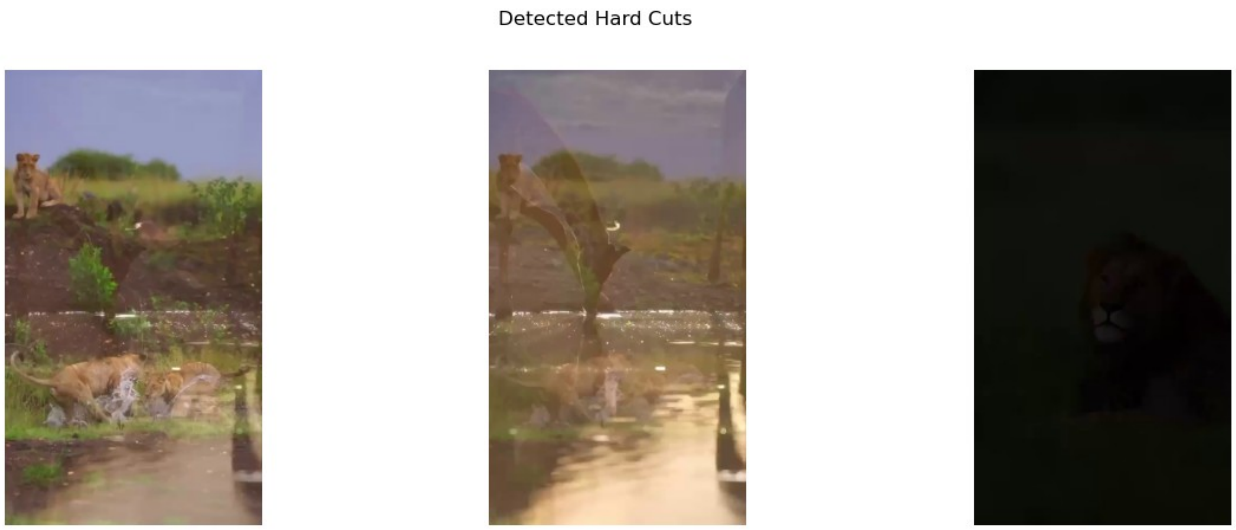
Histogram Comparison Method:

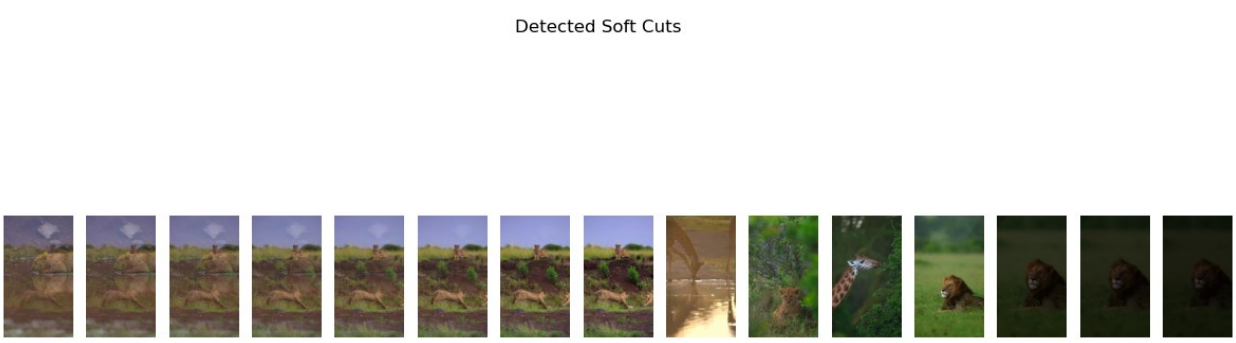
The method cv2.HISTCMP_CORREL is used instead of cv2.HISTCMP_INTERSECT. The correlation method returns a value between 0 and 1:

0 indicates no similarity.

1 indicates identical histograms.

```
import os
import cv2
import matplotlib.pyplot as plt

# Result Visualization
# Function to display frames
def display_frames(frames, title):
    plt.figure(figsize=(15, 5))
    for i, frame in enumerate(frames):
        plt.subplot(1, len(frames), i + 1)
        plt.imshow(cv2.cvtColor(frame, cv2.COLOR_BGR2RGB))
        plt.axis('off')
    plt.suptitle(title)
    plt.show()

# Display detected hard and soft cuts
hard_cut_frames = [frame_list[i] for i in hard_cuts]
soft_cut_frames = [frame_list[i] for i in soft_cuts]

display_frames(hard_cut_frames, "Detected Hard Cuts")
display_frames(soft_cut_frames, "Detected Soft Cuts")
```

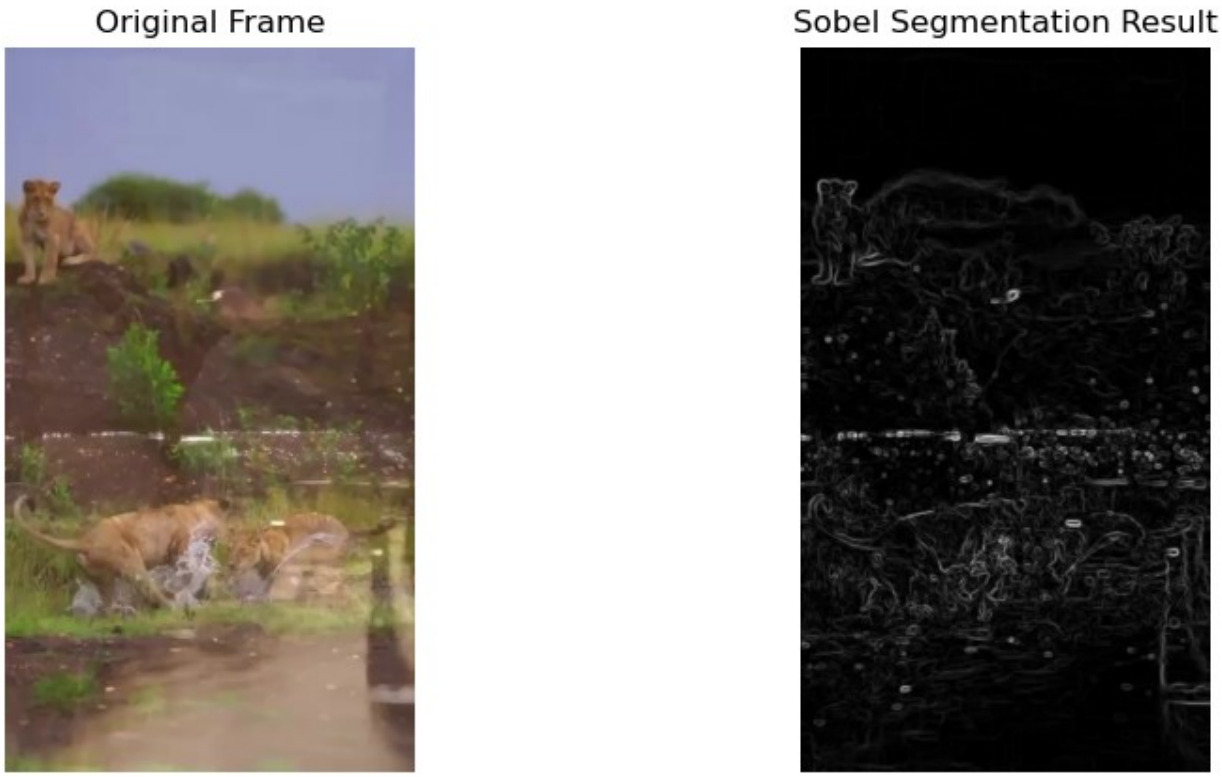




Step - 6 show segmentation results for selected frames.

```
# Optional: Apply Sobel segmentation and display results for selected
frames (e.g., first hard cut)
def sobel_segmentation(frame):
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
    sobel_x = cv2.Sobel(gray, cv2.CV_64F, 1, 0, ksize=5)
    sobel_y = cv2.Sobel(gray, cv2.CV_64F, 0, 1, ksize=5)
    sobel_magnitude = cv2.magnitude(sobel_x, sobel_y)
    return sobel_magnitude

# Visualize segmentation results for the first hard cut
if hard_cuts:
    selected_frame_index = hard_cuts[0]
    segmented_frame =
sobel_segmentation(frame_list[selected_frame_index])
    plt.figure(figsize=(10, 5))
    plt.subplot(1, 2, 1)
    plt.imshow(cv2.cvtColor(frame_list[selected_frame_index],
```

```
cv2.COLOR_BGR2RGB))
    plt.title("Original Frame")
    plt.axis('off')
    plt.subplot(1, 2, 2)
    plt.imshow(segmented_frame, cmap='gray')
    plt.title("Sobel Segmentation Result")
    plt.axis('off')
    plt.show()
```



Sobel segmentation is applied to the first detected hard cut frame, and both the original frame and the segmented result are displayed side by side.