

## Lab03

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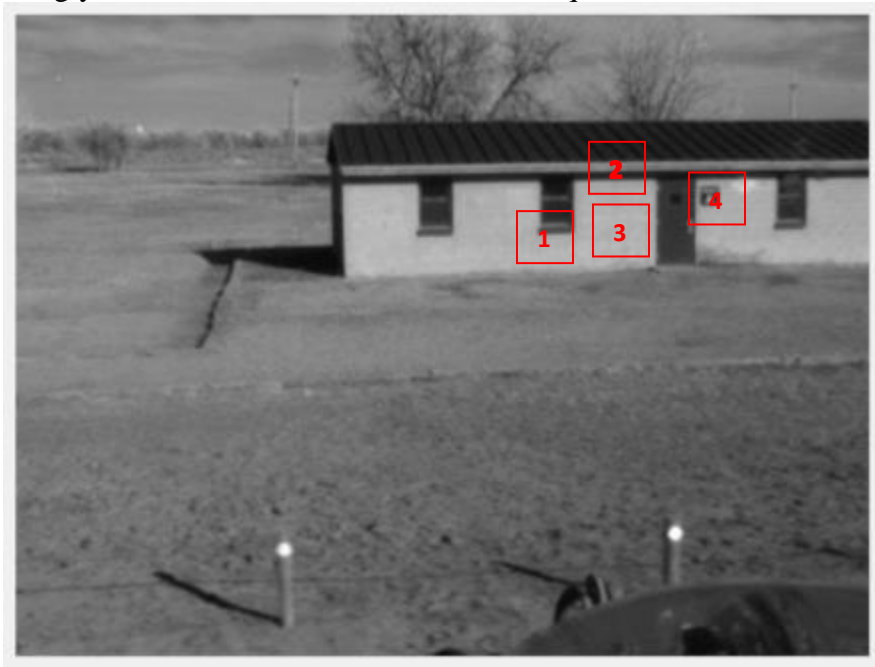
Use the **template matching** program we used in class as a guideline (in any programming language) to process each frame of the movie file “building.avi”. Namely, read the first image of the movie and let the user pick a template to track. Then use the method of “normalized cross correlation” to track that template to each subsequent image in the movie.

1. Draw a rectangle indicating the location of the matched template on each image. Create an output movie file showing the locations of the matched template on each image.

**Answer:** See attached files for movie output

2. Experiment with the choice of template that you extract from the first image. Try the corner of the window (point 1), the edge of the roof (point 2), the middle of the wall (point 3), and the sign next to the door (point 4). Which point seems to allow the best tracking, and why? (Note - the match may not be correct in every single image, no matter which point you pick.)

**Answer:** It looks like point 4 is best place to track since it's most unique and code get's least confused with it. Window corner gets confused with other window corners. Same with edge of the roof. Surprisingly, the middle of the wall also tracked quite well.



3. When the template is matched correctly, approximately what correlation scores do you see?

For correct matching, I see max correlation scores of 0.99. Typically within the range of 0.94 – 0.99.

Here is my code Just in case:

```
# -*- coding: utf-8 -*-
"""
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Zakaria Khitirishvili
"""

import cv2
import numpy as np
import sys

# Open the video file
cap = cv2.VideoCapture("C:\\Users\\zezva\\Desktop\\building.avi")

# Check if the video opened successfully
if not cap.isOpened():
    print("Error: Could not open video.")
    sys.exit()

# Read the first frame
ret, frame = cap.read()
if not ret:
    print("Error: Could not read the first frame.")
    cap.release()
    sys.exit()

# Convert the first frame to grayscale
gray_frame = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

# Display the first frame and let the user select a point
cv2.imshow('Select Template', gray_frame)
x, y, w, h = cv2.selectROI('Select Template', gray_frame, fromCenter=False,
showCrosshair=True)
cv2.destroyAllWindows()

# Ensure valid ROI selection
if w == 0 or h == 0:
    print("Error: Invalid ROI selection.")
    cap.release()
    sys.exit()

# Extract the template
template = gray_frame[int(y):int(y+h), int(x):int(x+w)]
template_h, template_w = template.shape
```

```
# Create a VideoWriter object to save the output video
out = cv2.VideoWriter('mymovie.avi', cv2.VideoWriter_fourcc(*'XVID'), 20.0,
(frame.shape[1], frame.shape[0]))

# Function to draw a rectangle around the matched area
def draw_rectangle(frame, top_left, bottom_right):
    cv2.rectangle(frame, top_left, bottom_right, (0, 0, 255), 2) # Red rectangle

# Process each frame
frame_count = 0
while True:
    ret, frame = cap.read()
    if not ret:
        print("End of video or failed to read frame.")
        break

    gray_frame = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    # Perform template matching
    res = cv2.matchTemplate(gray_frame, template, cv2.TM_CCOEFF_NORMED)
    min_val, max_val, min_loc, max_loc = cv2.minMaxLoc(res)

    # Get the top left corner of the matched area
    top_left = max_loc
    bottom_right = (top_left[0] + template_w, top_left[1] + template_h)

    # Draw a rectangle around the matched area
    draw_rectangle(frame, top_left, bottom_right)

    # Save the frame to the output video
    out.write(frame)

    # Display the frame with the rectangle
    cv2.imshow('Tracking', frame)

    frame_count += 1
    print(f"Processed frame {frame_count} - Max correlation score: {max_val}")

    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

# Release everything when job is finished
cap.release()
out.release()
cv2.destroyAllWindows()
```

```
print("Video processing complete.")
```

Sample output for correlation scores:

```
runfile('C:/Users/zezva/Desktop/CSCI507-LAB#3-3.py',  
wdir='C:/Users/zezva/Desktop')  
Processed frame 1 - Max correlation score: 0.9956074357032776  
Processed frame 2 - Max correlation score: 0.9909720420837402  
Processed frame 3 - Max correlation score: 0.9908495545387268  
Processed frame 4 - Max correlation score: 0.9879068732261658  
Processed frame 5 - Max correlation score: 0.9922354221343994  
Processed frame 6 - Max correlation score: 0.9890696406364441  
Processed frame 7 - Max correlation score: 0.98606938123703  
Processed frame 8 - Max correlation score: 0.992961049079895  
Processed frame 9 - Max correlation score: 0.9867303967475891  
Processed frame 10 - Max correlation score: 0.9942453503608704  
Processed frame 11 - Max correlation score: 0.9884640574455261  
Processed frame 12 - Max correlation score: 0.9911030530929565  
Processed frame 13 - Max correlation score: 0.9951488375663757  
Processed frame 14 - Max correlation score: 0.9916402697563171  
Processed frame 15 - Max correlation score: 0.9925581216812134  
Processed frame 16 - Max correlation score: 0.989090621471405  
Processed frame 17 - Max correlation score: 0.9926208257675171  
Processed frame 18 - Max correlation score: 0.9923107028007507  
Processed frame 19 - Max correlation score: 0.9890871047973633  
Processed frame 20 - Max correlation score: 0.989176332950592  
Processed frame 21 - Max correlation score: 0.9871498942375183  
Processed frame 22 - Max correlation score: 0.9907287359237671  
Processed frame 23 - Max correlation score: 0.9944791197776794  
Processed frame 24 - Max correlation score: 0.9908310770988464  
Processed frame 25 - Max correlation score: 0.9931696057319641  
Processed frame 26 - Max correlation score: 0.9916083812713623  
Processed frame 27 - Max correlation score: 0.9909360408782959  
Processed frame 28 - Max correlation score: 0.9927656650543213  
Processed frame 29 - Max correlation score: 0.9899799823760986  
Processed frame 30 - Max correlation score: 0.9864555597305298
```

Processed frame 31 - Max correlation score: 0.9916238784790039  
Processed frame 32 - Max correlation score: 0.9878840446472168  
Processed frame 33 - Max correlation score: 0.9927321076393127  
Processed frame 34 - Max correlation score: 0.9920399188995361  
Processed frame 35 - Max correlation score: 0.989408016204834  
Processed frame 36 - Max correlation score: 0.9909771680831909  
Processed frame 37 - Max correlation score: 0.9890813231468201  
Processed frame 38 - Max correlation score: 0.990885317325592  
Processed frame 39 - Max correlation score: 0.9901068210601807  
Processed frame 40 - Max correlation score: 0.9866614937782288  
Processed frame 41 - Max correlation score: 0.9870087504386902  
Processed frame 42 - Max correlation score: 0.9865188002586365  
Processed frame 43 - Max correlation score: 0.9925233721733093  
Processed frame 44 - Max correlation score: 0.9894925355911255  
Processed frame 45 - Max correlation score: 0.9885688424110413  
Processed frame 46 - Max correlation score: 0.9871740341186523  
Processed frame 47 - Max correlation score: 0.9865685701370239  
Processed frame 48 - Max correlation score: 0.9901403188705444  
Processed frame 49 - Max correlation score: 0.9897663593292236  
Processed frame 50 - Max correlation score: 0.989459753036499  
Processed frame 51 - Max correlation score: 0.9881475567817688  
Processed frame 52 - Max correlation score: 0.990161657333374  
Processed frame 53 - Max correlation score: 0.9863944053649902  
Processed frame 54 - Max correlation score: 0.987598180770874  
Processed frame 55 - Max correlation score: 0.9870626330375671  
Processed frame 56 - Max correlation score: 0.9864164590835571  
Processed frame 57 - Max correlation score: 0.7155341506004333  
Processed frame 58 - Max correlation score: 0.7552588582038879  
Processed frame 59 - Max correlation score: 0.7097023725509644  
Processed frame 60 - Max correlation score: 0.7422312498092651  
Processed frame 61 - Max correlation score: 0.8082722425460815  
Processed frame 62 - Max correlation score: 0.8002481460571289  
Processed frame 63 - Max correlation score: 0.7950363755226135  
Processed frame 64 - Max correlation score: 0.7916957139968872  
Processed frame 65 - Max correlation score: 0.7849764227867126  
Processed frame 66 - Max correlation score: 0.7806409001350403  
Processed frame 67 - Max correlation score: 0.7936215996742249

End of video or failed to read frame.  
Video processing complete.