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```
% FML_LAB_6: Hopfield Network Pattern Completion with uploaded distorted
image
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clear; clc;
```

Load training images (Plane, Tank, Helicopter)

```
plane_img = imread('Plane.png');
tank_img = imread('Tank.png');
heli_img = imread('Helicopter.png');

% Convert to grayscale if needed
if size(plane_img,3)==3, plane_img = rgb2gray(plane_img); end
if size(tank_img,3)==3,  tank_img  = rgb2gray(tank_img);  end
if size(heli_img,3)==3,  heli_img  = rgb2gray(heli_img);  end

% Resize to 12x12
plane_img = imresize(plane_img,[12 12]);
tank_img  = imresize(tank_img,[12 12]);
heli_img  = imresize(heli_img,[12 12]);

% Binarize
bw_plane = imbinarize(plane_img);
bw_tank  = imbinarize(tank_img);
bw_heli  = imbinarize(heli_img);

% Convert to bipolar vectors
toBipolar = @(img) 2*img(:)-1;
X1 = toBipolar(bw_plane);
X2 = toBipolar(bw_tank);
X3 = toBipolar(bw_heli);

X = [X1 X2 X3];
N = length(X1);
```

Train Hopfield network

```
W = zeros(N,N);
for i = 1:size(X,2)
```

```
    W = W + X(:,i)*X(:,i)';
end
W = W/N;
W(1:N+1:end) = 0;  % zero diagonal
```

Load distorted image

```
dist_img = imread('Distorted.png');   % your uploaded distorted image
if size(dist_img,3)==3, dist_img = rgb2gray(dist_img); end
dist_img = imresize(dist_img,[12 12]);
bw_dist = imbinarize(dist_img);
x_distorted = toBipolar(bw_dist);
```

Retrieval

```
sgn = @(v) 2*(v>=0)-1;
x_retrieved = sgn(W * x_distorted);
```

Compare with stored memories

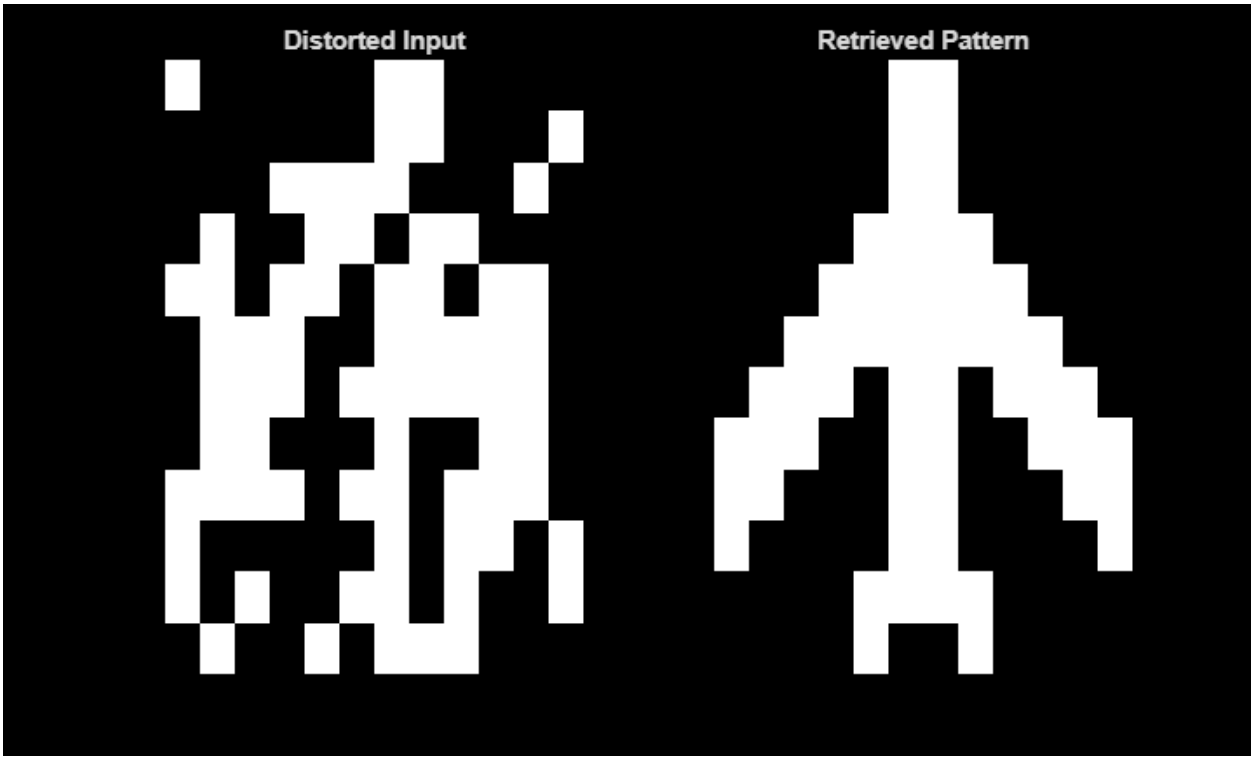
```
hamming = @(a,b) sum(a~=b);
dists = [hamming(x_retrieved,X1), hamming(x_retrieved,X2),
hamming(x_retrieved,X3)];
[~, match] = min(dists);

fprintf('Distorted image most closely matches: ');
switch match
    case 1, disp('PLANE');
    case 2, disp('TANK');
    case 3, disp('HELICOPTER');
end
fprintf('Hamming distances: Plane=%d, Tank=%d, Helicopter=%d\n', dists);
```

```
Distorted image most closely matches: PLANE
Hamming distances: Plane=0, Tank=52, Helicopter=54
```

Visualize retrieved image

```
figure;
subplot(1,2,1); imagesc(reshape(x_distorted,12,12)); colormap(gray); axis
off;
title('Distorted Input');
subplot(1,2,2); imagesc(reshape(x_retrieved,12,12)); colormap(gray); axis
off;
title('Retrieved Pattern');
```



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