```
% Basic Example
% sweden = [1,2,1,1,1;1,2,1,1,1;2,2,2,2,2;1,2,1,1,1;1,2,1,1,1];
% colormap(parula)
% imagesc(sweden)

[A, b , x ] = blur ( 256 , 5 , 1 ) ;

% Display the original and blurred images
% colormap ( gray )
% imagesc ( reshape (x , 256 , 256 ) )
% figure()
% colormap ( gray )
% imagesc ( reshape (b , 256 , 256 ) )

f = @(x) (norm(A*x-b))^2;

% Cmputing gradient elements beforehand
Y1 =A'*A;
Y = 2*Y1;
Z = 2*A'*b;
g = @(x) Y*x-Z; %2*A'*(A*x-b)

x0 = zeros(size(x));
tic;
% ***  Part 1  ***
[~ ,x_1,x_10,x_100,x_1000] = generic_grad_q3(f, g, exact_quad_q3(Y),
 x0,1000);
toc

figure('Name','Image after 1 Iteration of GD with Exact Quad');
colormap ( gray );
imagesc ( reshape (x_1 , 256 , 256 ) );


figure('Name','Image after 10 Iterations of GD with Exact Quad');
colormap ( gray );
imagesc ( reshape (x_10 , 256 , 256 ) );


figure('Name','Image after 100 Iterations of GD with Exact Quad');
colormap ( gray );
imagesc ( reshape (x_100 , 256 , 256 ) );


figure('Name','Image after 1000 Iterations of GD with Exact Quad');
colormap ( gray );
imagesc ( reshape (x_1000 , 256 , 256 ) );


% ***  Part 2  ***
L = 2*max(eigs(Y1));
tic;
```

```
[~ ,x_1,x_10,x_100,x_1000] = generic_grad_q3(f, g, const_step_q3(1/L),
 x0, 1000);
toc

figure('Name','Image after 1 Iteration of GD with Const Step');
colormap ( gray );
imagesc ( reshape (x_1 , 256 , 256 ) );


figure('Name','Image after 10 Iterations of GD with Const Step');
colormap ( gray );
imagesc ( reshape (x_10 , 256 , 256 ) );


figure('Name','Image after 100 Iterations of GD with Const Step');
colormap ( gray );
imagesc ( reshape (x_100 , 256 , 256 ) );


figure('Name','Image after 1000 Iterations of GD with Const Step');
colormap ( gray );
imagesc ( reshape (x_1000 , 256 , 256 ) );
```

```
Iteration 1 complete
Iteration 10 complete
Iteration 100 complete
Iteration 200 complete
Iteration 300 complete
Iteration 400 complete
Iteration 500 complete
Iteration 600 complete
Iteration 700 complete
Iteration 800 complete
Iteration 900 complete
Iteration 1000 complete
Generic Grad loop complete. Time taken:
Elapsed time is 90.797469 seconds.
Iteration 1 complete
Iteration 10 complete
Iteration 100 complete
Iteration 200 complete
Iteration 300 complete
Iteration 400 complete
Iteration 500 complete
Iteration 600 complete
Iteration 700 complete
Iteration 800 complete
Iteration 900 complete
Iteration 1000 complete
Generic Grad loop complete. Time taken:
Elapsed time is 35.759060 seconds.
```

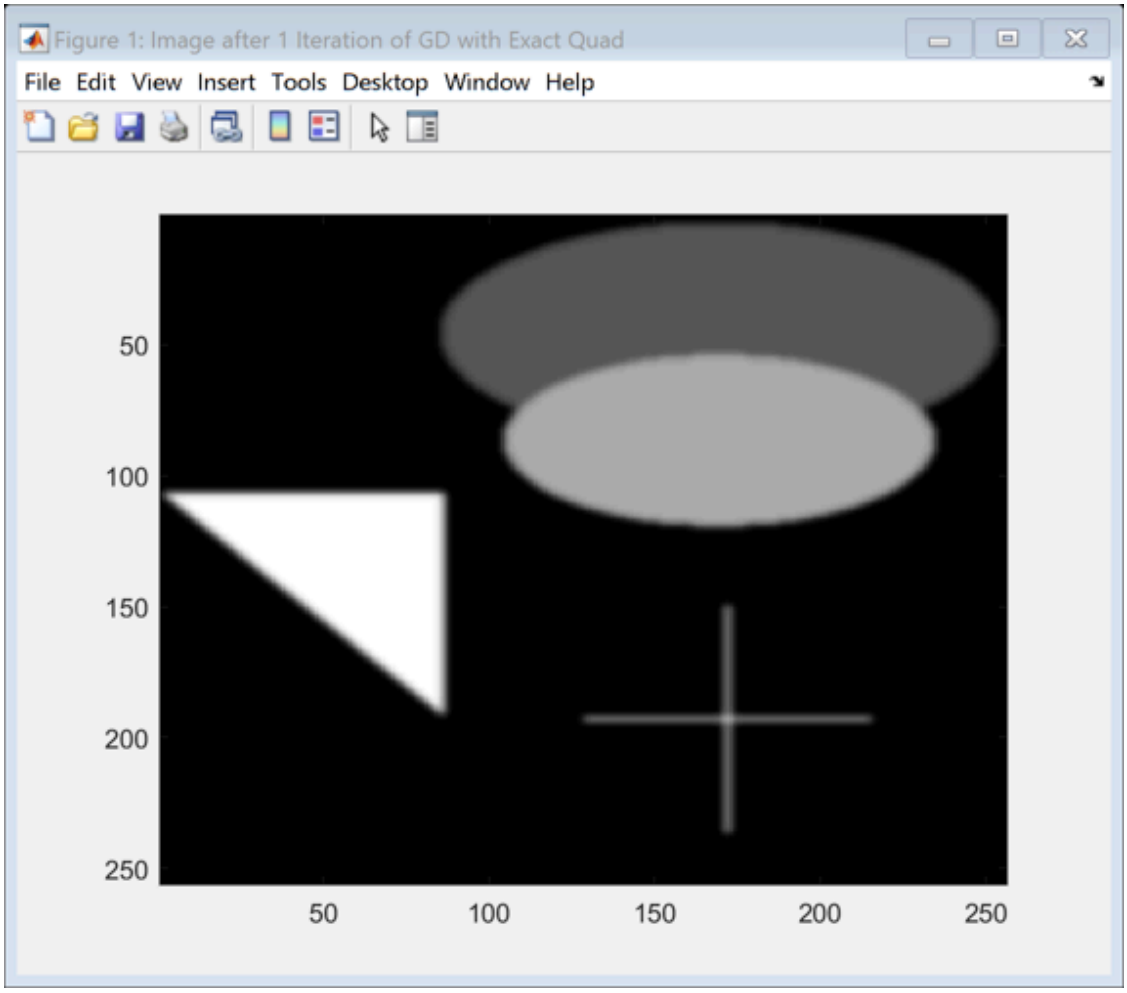
Figure 1: Image after 1 Iteration of GD with Exact Quad
File Edit View Insert Tools Desktop Window Help
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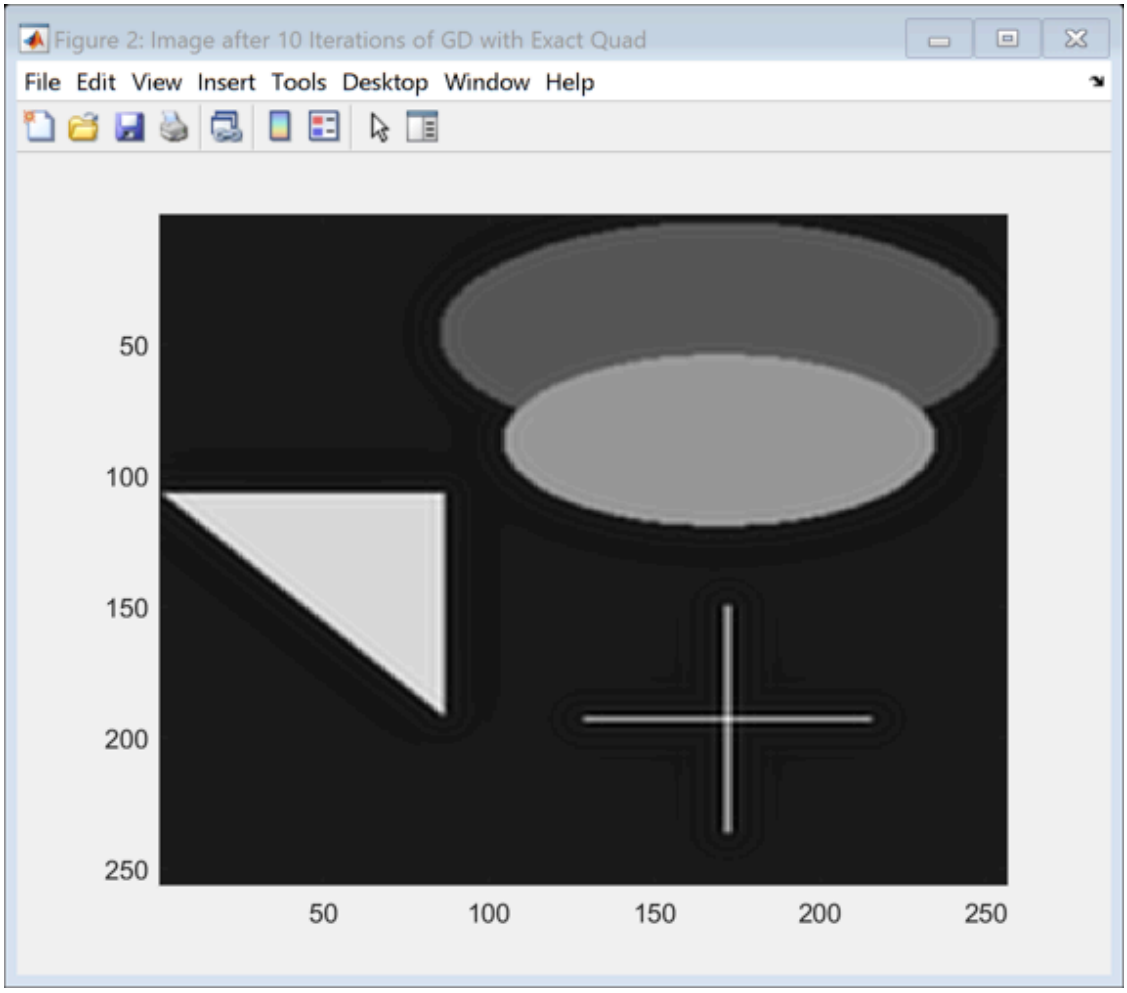
Figure 2: Image after 10 Iterations of GD with Exact Quad
File Edit View Insert Tools Desktop Window Help
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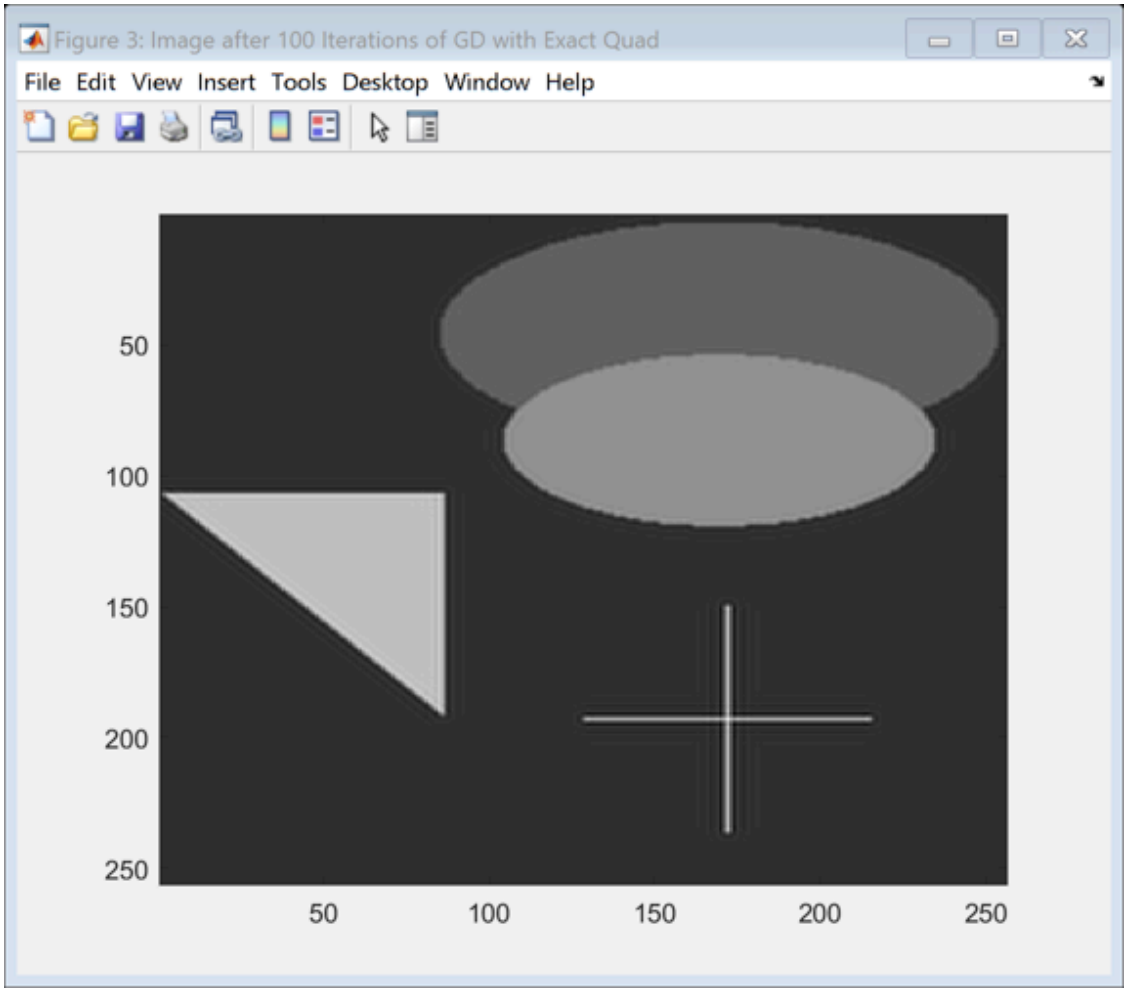
Figure 3: Image after 100 Iterations of GD with Exact Quad
File Edit View Insert Tools Desktop Window Help
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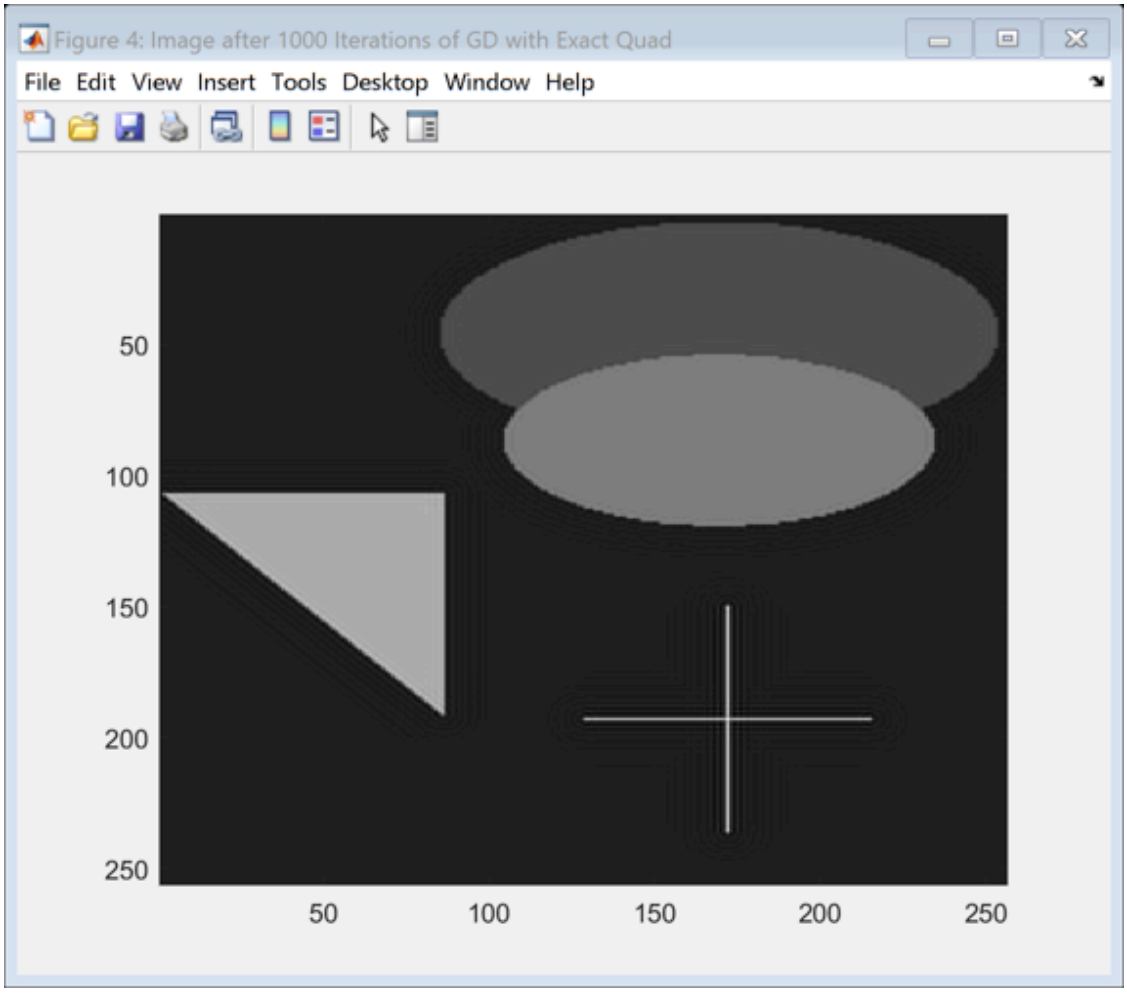
Figure 4: Image after 1000 Iterations of GD with Exact Quad
File Edit View Insert Tools Desktop Window Help
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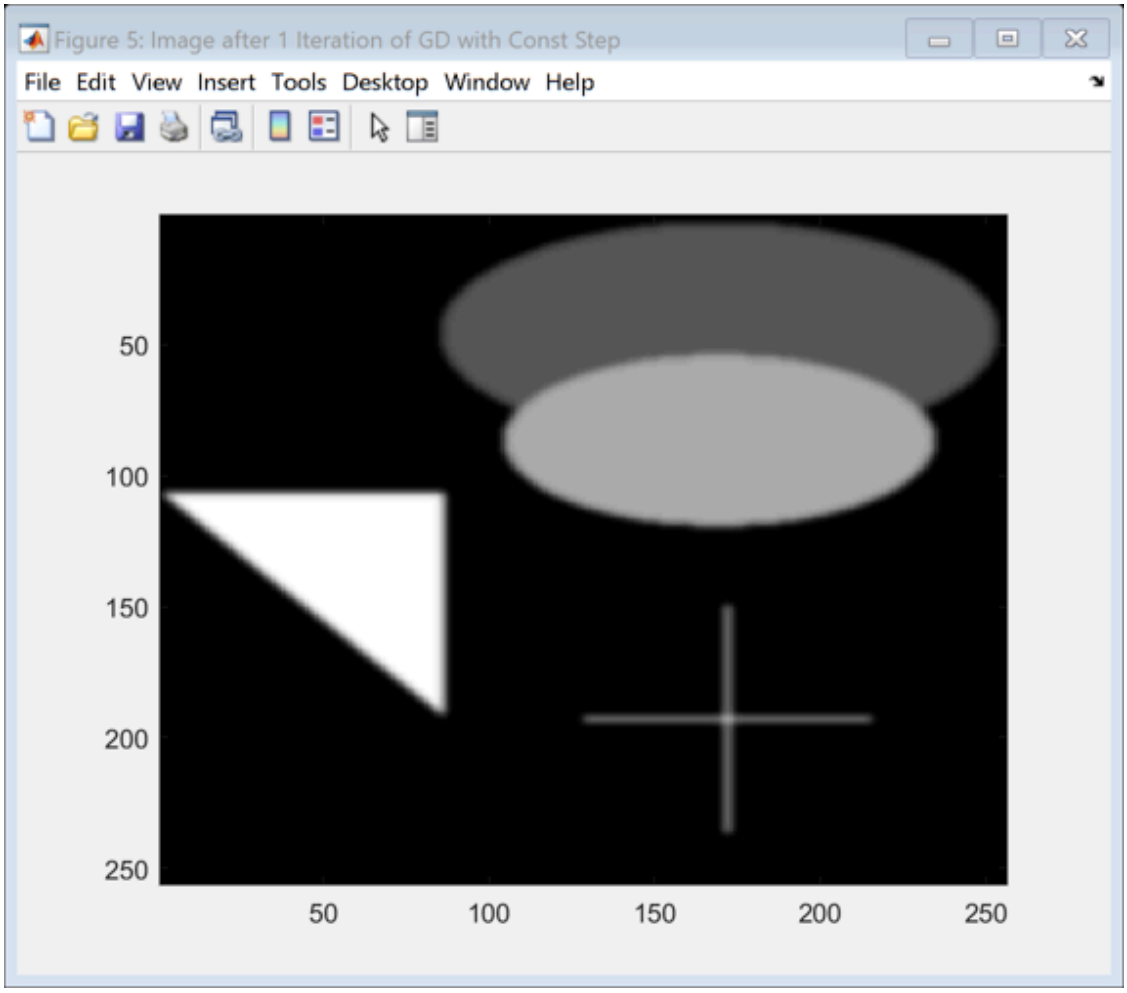
Figure 5: Image after 1 Iteration of GD with Const Step
File Edit View Insert Tools Desktop Window Help
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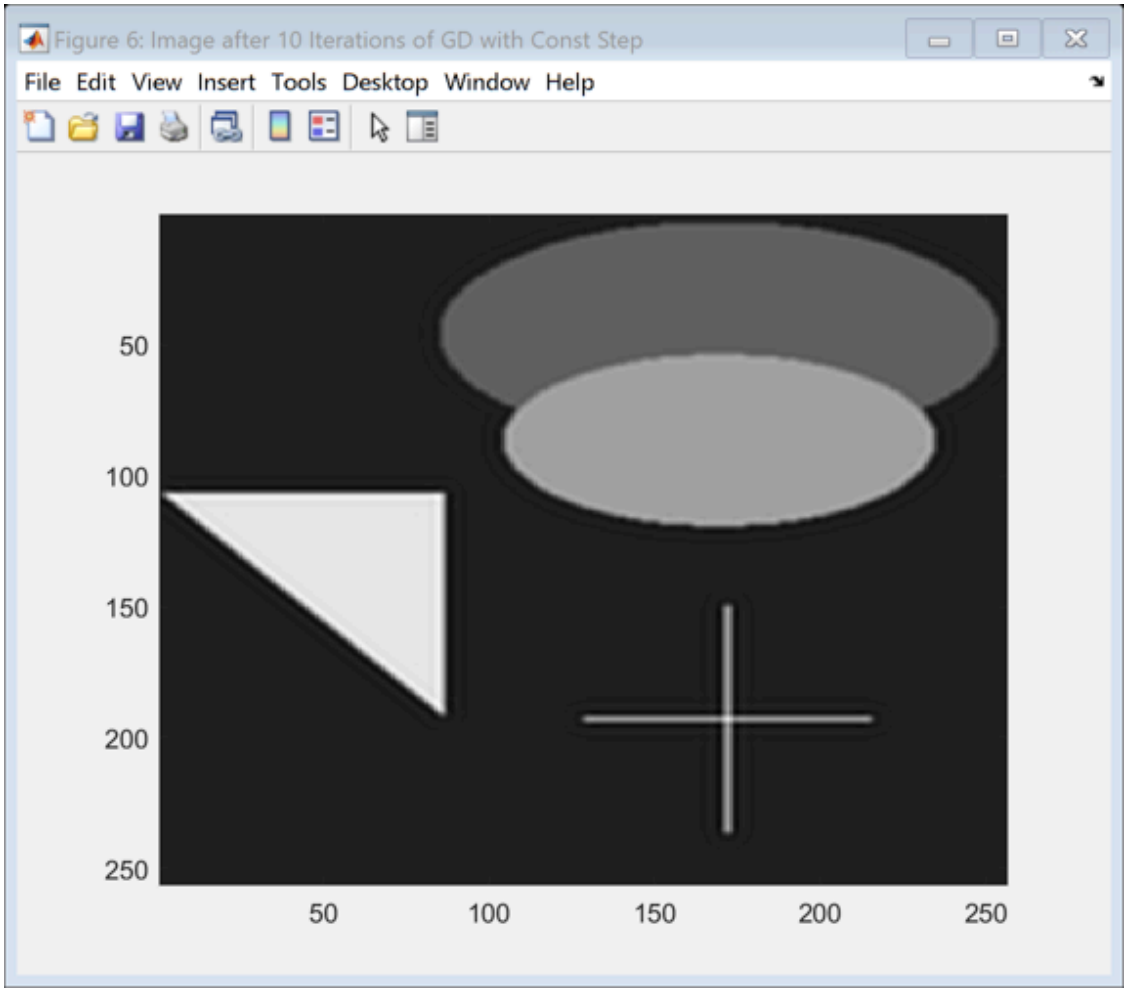
Figure 6: Image after 10 Iterations of GD with Const Step
File Edit View Insert Tools Desktop Window Help
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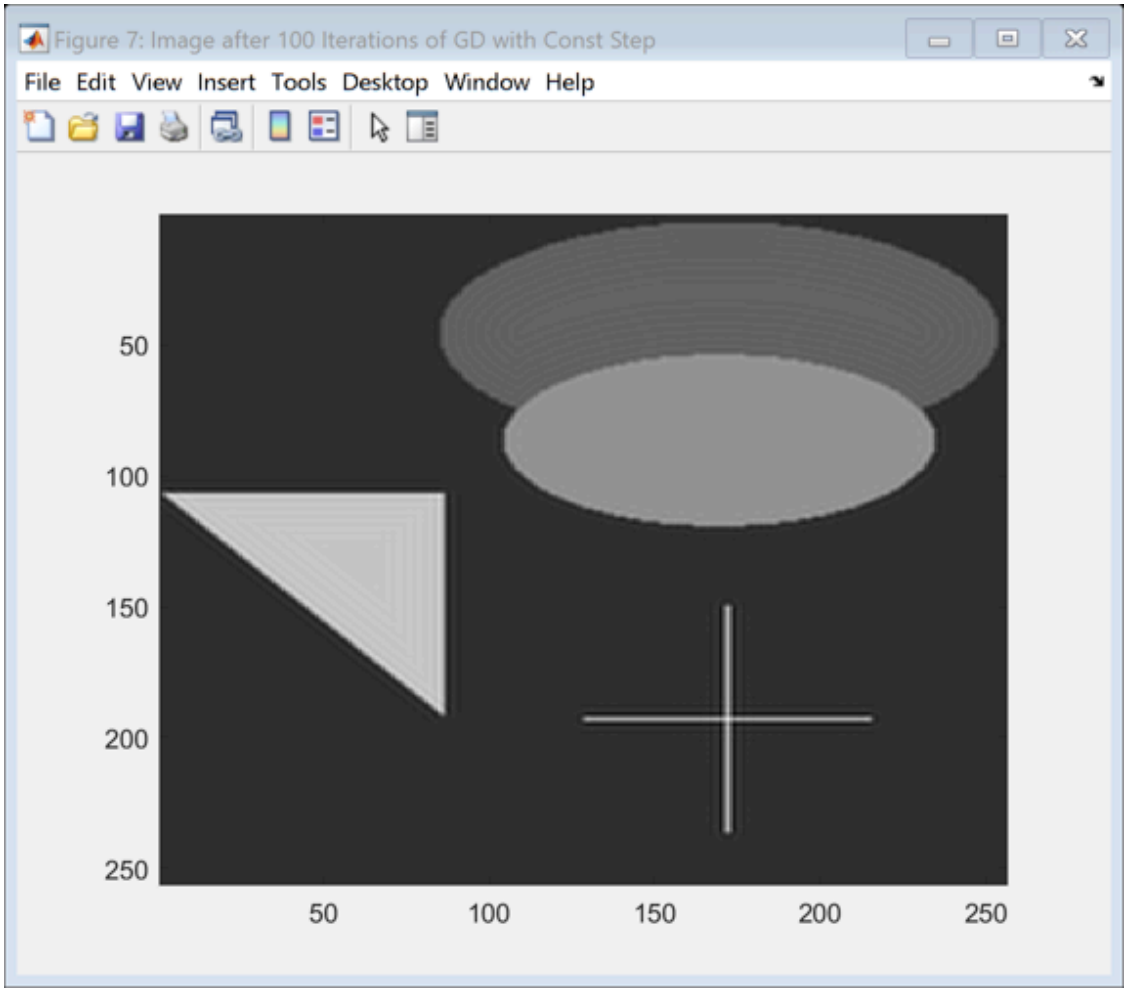
Figure 7: Image after 100 Iterations of GD with Const Step
File Edit View Insert Tools Desktop Window Help
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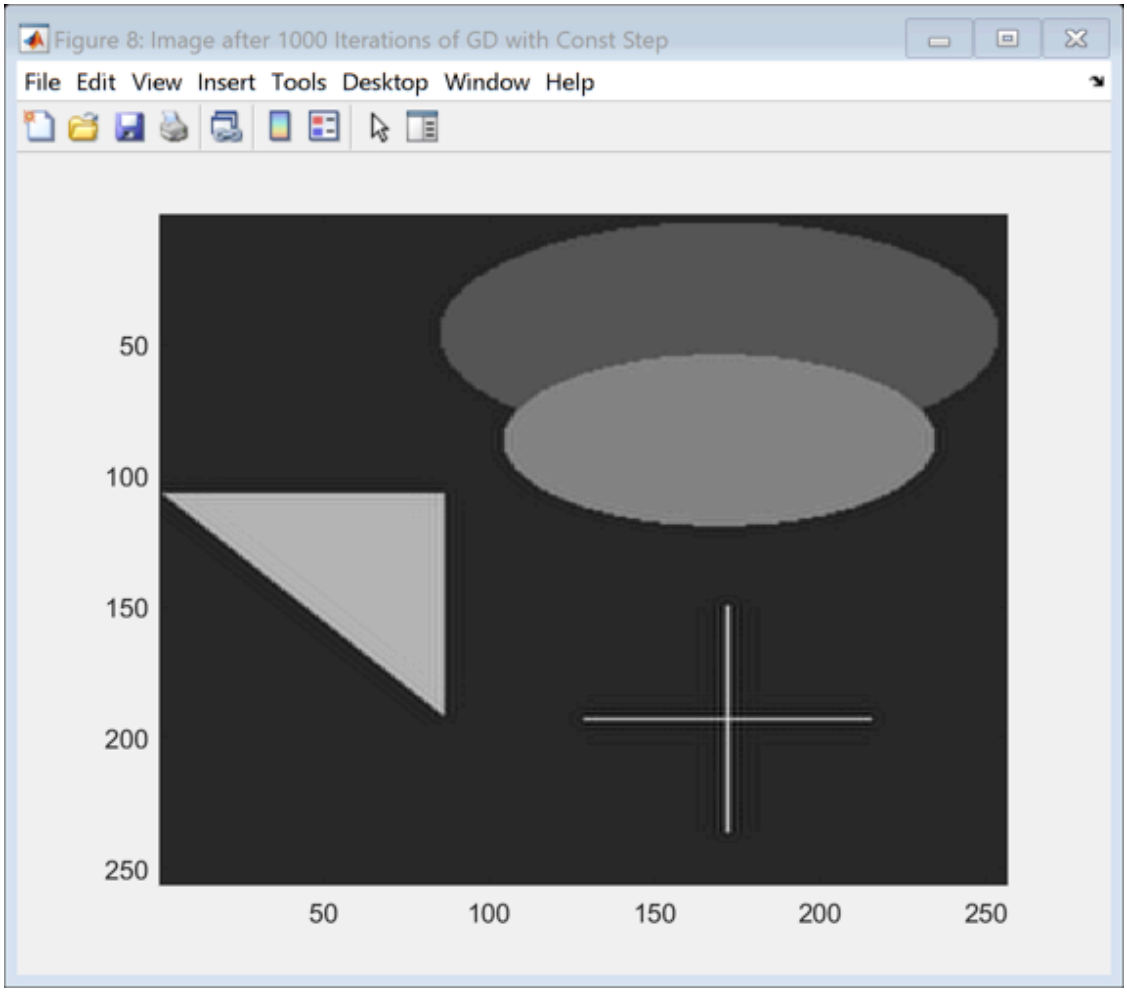

Published with MATLAB® R2019a