b) The textbook lists a land-use, land-cover classification hierarchy in Table 9-1 and Table 9-2. Give five possible Level III classifications for the “21” class of agricultural land that is cropland and pasture. Use the Level III classes in Table 9-2 as an example and do not be concerned with exactly reproducing the specific work shown.

2. The “image” at right shows the NDVI of a set of vegetated and non-vegetated pixels. Determine the boundary between vegetated and non-vegetated using a K-means clustering approach.

2.01  0.232  0.211  0.204
0.186  0.166  0.167  0.170
0.188  0.187  0.182  0.171
0.192  0.200  0.223  0.209

3. a) Describe a method to remove the anomalously high and low data points (pixels 4 and 10) in the data set below while not affecting the row average of all other data points. The method should be capable of being implemented without user intervention.
b) Will your approach accurately reproduce how you think the real data set should appear? Explain.

<table>
<thead>
<tr>
<th>Column</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN value</td>
<td>130</td>
<td>130</td>
<td>125</td>
<td>5</td>
<td>115</td>
<td>115</td>
<td>100</td>
<td>90</td>
<td>120</td>
<td>225</td>
<td>130</td>
<td>135</td>
<td>140</td>
<td>140</td>
</tr>
</tbody>
</table>

4. Plot the results of applying a 3-pixel low pass filter to the data set below. Plot the results on the same graph from applying a 3-pixel, high-pass filter to the data.

<table>
<thead>
<tr>
<th>Column</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<tbody>
<tr>
<td>DN value</td>
<td>130</td>
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<td>120</td>
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<td>120</td>
<td>130</td>
<td>135</td>
<td>140</td>
<td>140</td>
</tr>
</tbody>
</table>

5. Within a given scene, a satellite system measures 1200 DN over a concrete parking area, 480 DN over a wheat field that is next to the parking area, and 150 DN over a small lake. Estimate the surface reflectance of the wheat using a dark-object subtraction approach if the incident solar irradiance perpendicular to the earth is 314 W/(m² sr µm), the solar zenith angle is 60 degrees, and the calibration coefficient is 0.06 [W/(m² sr µm)]/DN with a 20-DN offset.
6. Sketch the Fourier transform images for the following areas in the accompanying Tucson scene:
   a) A 100 by 100 pixel area centered on the intersection of 22nd St and Swan (white box top center)
   b) A 100 by 100 pixel area centered on the Davis-Monthan golf course (black box near bottom)
   c) A 50 by 50 pixel area centered on the Davis-Monthan runway (white box lower left)
   Be sure to explain your sketches.

7. a) Explain what methods/procedures you would go through to remove/filter the runway in the Tucson image using a Fourier approach with a notch filter (be sure to sketch the notch filter).
   b) Give the matrix form of a convolution filter that would do the same thing.

8. a) Explain the basic concept of a principal components analysis including why it is useful and one major problem with the approach.
   b) Why are the PCA images and tasseled cap different?

9. Give the output from applying two directional convolution filters to the center pixel of data at right. The two filters are a 45-degree filter to enhance features oriented from the upper left to the lower right and a 45-degree filter that enhances features from upper right to lower left.

10. a) Determine the transform between the following two data sets using the shaded pixels as GCPs (note you need only the x-transform) and find the error in the mapping the ground point (pixel 7) using your transformation?
    b) Map pixels 9-15 of the image data below to the reference “map” using an affine transform based on the GCPs of pixels 10 and 15 of the reference image and an appropriate resampling of your choice.