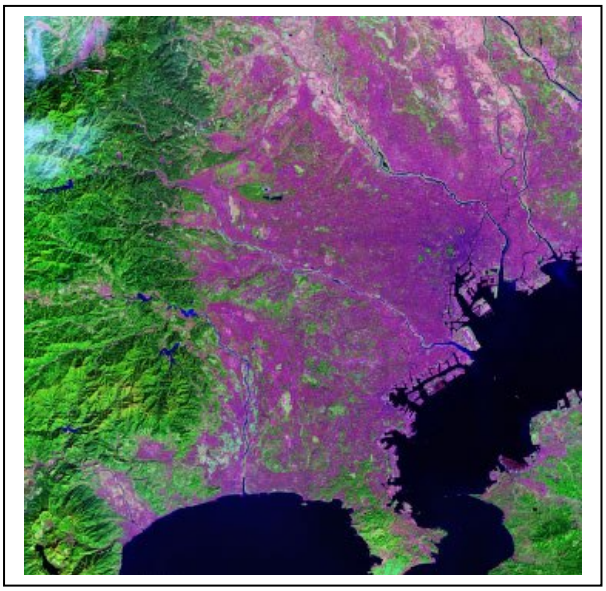


Images taken from a satellite are often used to display, both the appearance of an object and the contents of the object. For example, the Landsat image to the left shows Tokyo, Japan. The pixels that make up the image have been colorized to bring out specific details. Purple is used to represent areas that have been developed. Green is for forested areas. By obtaining images of the same scene using different filters, scientists can identify the specific 'colors' of hundreds of different surface features. Let's see how this works!

Suppose that an astronomer has obtained the first crude image of a planet orbiting another star. The satellite observatory was able to image the surface of this planet within a 8x9-pixel (rows X columns) portion of a larger image of the star and its surroundings. Images were obtained in three different color filters Red, Green and Blue, so that surface markings could be classified as water, land, snow or plants/trees. The pixel data sequences for the three images are shown below:

Red = { 0,0,0,0,5,0,0,0,0,0,0,0,5,5,5,0,0,0,0,0,0,0,0,5,0,0,0,0,0,0,5,5,5,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,5,5,5,0,0,0,0,0,0,0,5,0,0,0,0}

Blue= {0,0,0,0,5,0,0,0,0,0,0,0,5,5,5,0,0,0,0,0,5,5,5,0,5,0,0,0,5,5,0,0,0,5,5,0,
0,5,0,0,0,0,0,5,5,0,0,5,0,0,5,5,5,0,0,0,0,0,5,5,5,0,0,0,0,0,0,0,5,0,0,0,0 }

Green= {0,0,0,0,5,0,0,0,0,0,0,0,5,5,5,0,0,0,0,0,0,0,0,5,0,0,0,0,0,0,5,5,5,0,0,0,
0,0,5,5,5,0,0,0,0,0,0,0,5,5,0,0,0,0,0,0,0,5,5,5,0,0,0,0,0,0,0,5,0,0,0,0 }

Problem 1 – Create an array table for each of the three images showing the pixel values in their appropriate locations assuming that the images were read-out from the top left pixel to the lower right pixel in the sequence.

Problem 2 – By comparing the colors for each pixel, determine whether the pixel indicates dark sky S(R,B,G) = S(0,0,0); water W(0,5,0); ice I(5,5,5); land L(5,0,5) or plants P(0,0,5). Create a blank grid and fill in the corresponding pixels with the symbols S, W, I, L and P. If there are no matches, place a question mark in that pixel.

Problem 3 – Using colors of your choosing, create a blank grid and color each pixel with a color suitable for the various symbols (e.g. ice = white, water = blue etc).

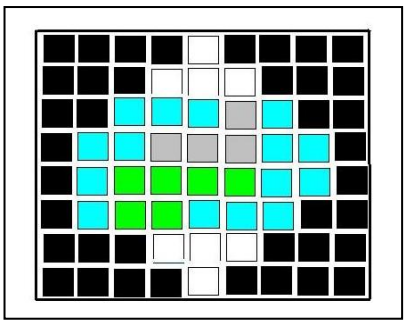
Problem 4 – Assuming that the planet is perfectly round, draw and color an image of the planet as it might actually appear using the above surface composition information as a clue.

Problem 1 – Create an array table for each of the three images showing the pixel values in their appropriate locations assuming that the images were read-out from the top left pixel to the lower right pixel in the sequence. Answer:

$$R = \begin{pmatrix} 0&0&0&0&5&0&0&0&0 \\ 0&0&0&5&5&5&0&0&0 \\ 0&0&0&0&0&5&0&0&0 \\ 0&0&0&5&5&5&0&0&0 \\ 0&0&0&0&0&0&0&0&0 \\ 0&0&0&0&0&0&0&0&0 \\ 0&0&0&5&5&5&0&0&0 \\ 0&0&0&0&5&0&0&0&0 \end{pmatrix} \quad B = \begin{pmatrix} 0&0&0&0&5&0&0&0&0 \\ 0&0&0&5&5&5&0&0&0 \\ 0&0&5&5&5&0&5&0&0 \\ 0&5&5&0&0&0&5&5&0 \\ 0&5&0&0&0&0&5&5&0 \\ 0&5&0&0&5&5&5&0&0 \\ 0&0&0&5&5&5&0&0&0 \\ 0&0&0&0&5&0&0&0&0 \end{pmatrix} \quad G = \begin{pmatrix} 0&0&0&0&5&0&0&0&0 \\ 0&0&0&5&5&5&0&0&0 \\ 0&0&0&0&0&5&0&0&0 \\ 0&0&0&5&5&5&0&0&0 \\ 0&0&5&5&5&0&0&0&0 \\ 0&0&5&5&0&0&0&0&0 \\ 0&0&0&5&5&5&0&0&0 \\ 0&0&0&0&5&0&0&0&0 \end{pmatrix}$$

Problem 2 – By comparing the colors for each pixel, determine whether the pixel indicates dark sky S(R,B,G) = S(0,0,0); water W(0,5,0); ice I(5,5,5); land L(5,0,5) or plants P(0,0,5). Create a blank grid and fill in the corresponding pixels with the symbols S, W, I, L and P.

S	S	S	S	I	S	S	S	S
S	S	S	I	I	I	S	S	S
S	S	W	W	W	L	W	S	S
S	W	W	L	L	L	W	W	S
S	W	G	G	G	G	W	W	S
S	W	G	G	W	W	W	S	S
S	S	S	I	I	I	S	S	S
S	S	S	S	I	S	S	S	S



Problem 3 – Using colors of your choosing, create a blank grid and color each pixel with a color suitable for the various symbols (e.g. ice = white, water = blue etc). Answer: **See above**.

Problem 4 – Assuming that the planet is perfectly round, draw and color an image of the planet as it might actually appear using the above surface composition information as a clue.
Answer: **This is a round planet with polar icecaps (white) and a landmass (grey and green) bordered by an ocean (blue).The landmass contains plant life (green) in the equatorial zone. The planet is surrounded by empty space (black)**.