TA Lab Week 8 – Graphs

The goal of this lab is to further improve your understanding of graph algorithms, as well as look at interesting applications involving graph manipulations.

Exercise 1 – Finding all Bridges in a graph

A bridge in a graph is an edge that, if removed, would increase the number of connected components. A graph with no bridges is said to be two-edge connected. Design and implement a linear time DFS-based algorithm to find all bridges in a graph. Reflect on the computational cost of your solution when G is dense vs when G is sparse.

Exercise 2 – Seam Carving

Seam carving is an algorithm used to resize images without causing distortion. Intuitively, an image of NxM pixels is represented as a graph G, where nodes are pixels, and each pixel has edges connecting it to the adjacent pixels in the next row. A seam (or *path of least importance*) is then a path of connected pixels from top to bottom of an image, with one pixel in each row (this is the definition of a vertical seam; you can similarly define a horizontal seam as a path of connected pixels from left to right of an image, with one pixel in each column).

The seam carving algorithm works by iteratively determining what seam to remove from the image (vertical, if we aim to reduce image width; horizontal, if we aim to reduce image height). The process repeats until the desired width/height is reached. In this lab you are going to implement Dijkstra's shortest-path algorithm to determine what seam to remove at each iteration. Note that the framework to compute the importance of pixels (e.g., by measuring their contrast to neighbouring ones) is being provided in the framework notebook.