CS211 ALGORITHMS & DATA STRUCTURES II

LAB 8

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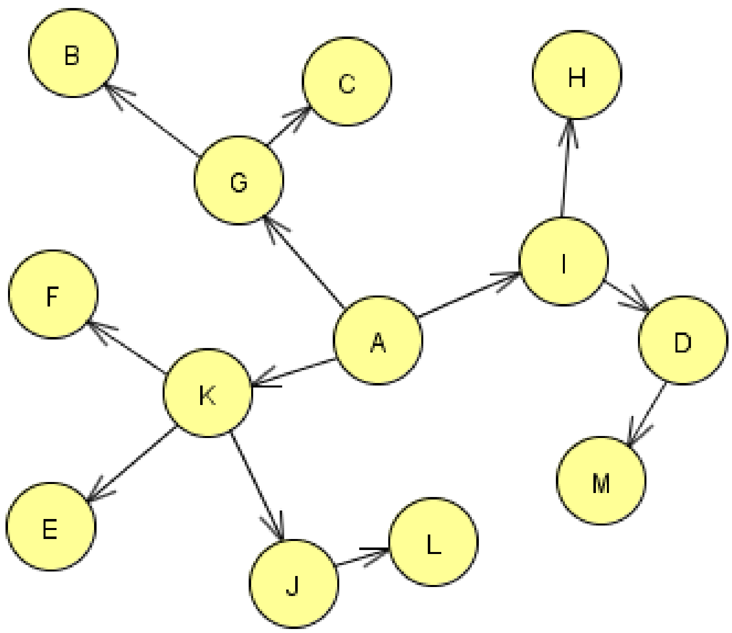
GRAPHS

PART I: Pen and paper exercise

Show the orders in which breadth-first search and depth-first search would traverse the following graph starting at vertex A. Show how the contents of the search queue and search stack are updated during the searches.



PART II: Programming exercise

Write a program which reads in two locations in GPS and finds the precise distance in km between them. Use it to find the distance between where you are sitting right now and the iconic **Ryugyong Hotel** in Pyongyang.

This is a good GPS locator site: http://www.gps.ie/gps-lat-long-finder.htm

The **haversine formula** is an equation important in navigation, giving great-circle distances between two points on a sphere from their longitudes and latitudes. It is a special case of a more general formula in spherical trigonometry, the **law of haversines**, relating the sides and angles of spherical "triangles".

For any two points on a sphere:

$$\operatorname{haversin}\left(\frac{d}{r}\right) = \operatorname{haversin}(\phi_2 - \phi_1) + \cos(\phi_1)\cos(\phi_2)\operatorname{haversin}(\psi_2 - \psi_1)$$

where

- *haversin* is the haversine function:

$$\operatorname{haversin}(\theta) = \sin(\theta/2)^2 = \frac{1-\cos(\theta)}{2}$$

- *d* is the distance between the two points (along a great circle of the sphere)
- *r* is the radius of the sphere,
- ϕ_1, ϕ_2: latitude of point 1 and latitude of point 2
- ψ_1, ψ_2: longitude of point 1 and longitude of point 2

On the left side of the equals sign, the argument to the haversine function is in radians. In degrees, haversin(*d*/*R*) in the formula would become haversin(180° *d*/π*R*).

One can then solve for *d* either by simply applying the inverse haversine (if available) or by using the arcsine (inverse sine) function:

$$d = r \operatorname{haversin}^{-1}(h) = 2r \arcsin\left(\sqrt{h}\right)$$

where

- *h* is haversin(*d*/*R*)

$$d = 2r \arcsin\left(\sqrt{\operatorname{haversin}(\phi_2 - \phi_1) + \cos(\phi_1)\cos(\phi_2)\operatorname{haversin}(\psi_2 - \psi_1)}\right)$$
$$= 2r \arcsin\left(\sqrt{\sin^2\left(\frac{\phi_2 - \phi_1}{2}\right) + \cos(\phi_1)\cos(\phi_2)\sin^2\left(\frac{\psi_2 - \psi_1}{2}\right)}\right)$$