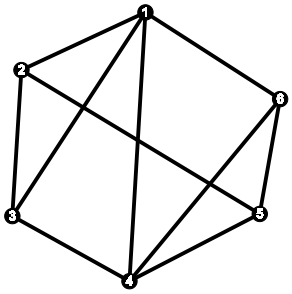
Graph Implementation

1. How do we represent a graph via an ***adjacency matrix***?
   (a) How does this provide us with convenient storage of node- and/or edge-weights?
   (b) In general, what affects whether an adjacency matrix a better or worse choice?

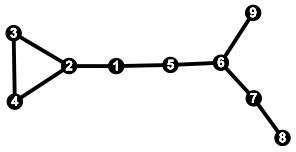
2. How do we represent a graph via ***adjacency lists***?
   (a) In general, what affects whether an adjacency list a better or worse choice?

3. Write out matrix and adjacency-list representations for each of the following graphs, and compare:

(a)



(b)



Graph Applications

4. What is a ***trie***, and what purpose does a trie serve?
   (a) Form a trie for the (spelled-out) numbers from zero to thirteen in a tree, and envision what text-completion would look like with this trie.
   (b) Think about tries next time you get auto-completion from a device!

5. How does ***Huffman encoding*** work for data, and what makes it useful?
   (a) Given the frequency data to the right for the letters in American English, find the associated Huffman encoding.
   (b) `Count up the total bits used to encode these letters via your encoding above.`
   How did it do, relative to, say, 5 bits per letter?
   (c) Will this encoding work well for all sets of words?
   Why or why not?

E 12.02	D 4.32	P 1.82
T 9.10	L 3.9	B 1.49
A 8.12	U 2.88	V 1.11
O 7.68	C 2.71	K 0.69
I 7.31	M 2.61	X 0.17
N 6.95	F 2.30	Q 0.11
S 6.28	Y 2.11	J 0.10
R 6.02	W 2.09	Z 0.07
H 5.92	G 2.03	

6. What is a ***Markov chain***?
   (a) How can we represent a Markov chain by an edge-weighted digraph?
   What are the rules for the edge-weights, and why?
   (b) Briefly explain MCMC (Markov Chain Monte Carlo) as a computational means of helping to understand a large Markov chain.
   (c) Draw an edge-weighted digraph for the following super-simplified flow of a basketball [or soccer/hockey/lacrosse] game:

   States: ① Team A has the ball ② Team B has the ball
   ③ Team A scores ④ Team B scores

   Transitions: When either team has the ball, 40% of the time they score, 20% of the time they miss but recover the ball, and 40% of the time, the other team gets the ball via a rebound or turnover.

   After a team scores, the other team gets the ball 100% of the time.