2011 BIOSTAT 615/815 Homework #3

Due is Tuesday February 15th, 08:30AM (before the class starts)

Problem 1. Dynamic programming

Write a program that calculates binomial coefficients, based on the following recursive rule.

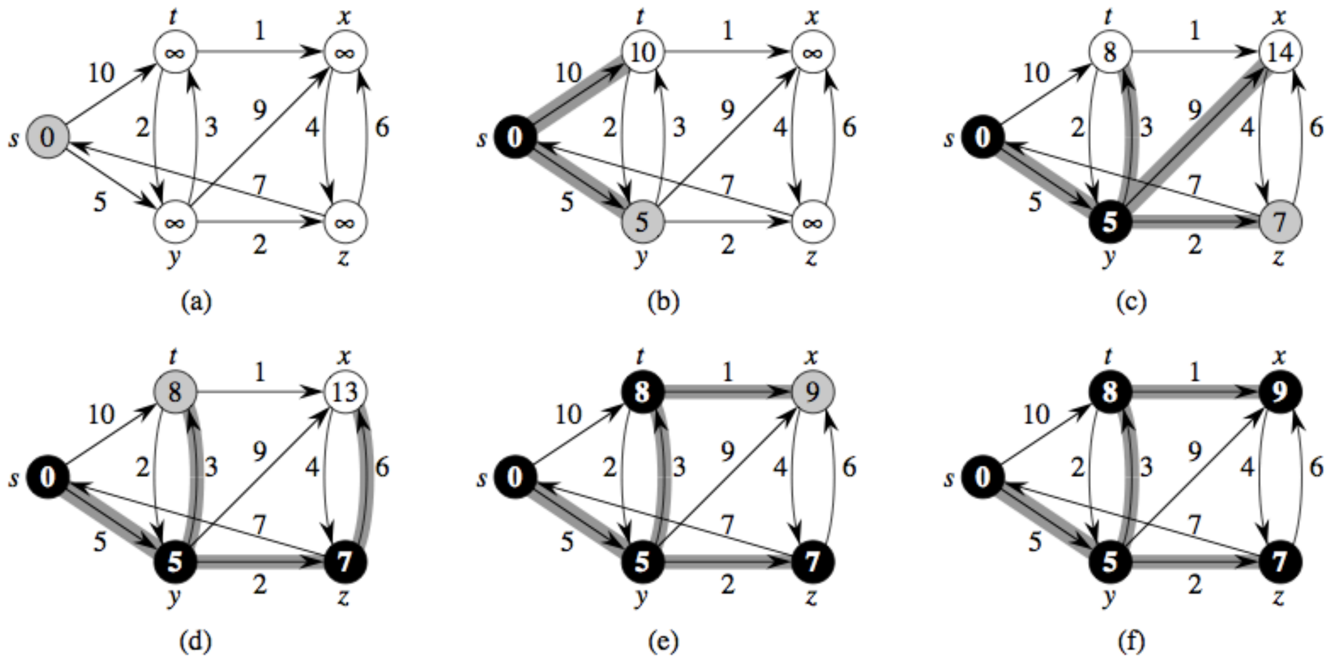
$$\begin{aligned}\binom{n}{k} &= \binom{n-1}{k} + \binom{n-1}{k-1} \\ \binom{n}{0} &= \binom{n}{n} = 1\end{aligned}$$

A suggested skeleton of the program is given below. Write down the full function `binom()`, and compute the value when $n = 30, k = 15$.

```
#include <iostream>

int binom(int n, int k, int** stored) {
  // fill in the function
}

int main(int argc, char** argv) {
  if ( argc != 3 ) {
    std::cerr << "Usage: " << argv[0] << " [n] [k] " << std::endl;
    return -1;
  }
  int n = atoi(argv[1]);
  int k = atoi(argv[2]);
  if ( k > n ) {
    std::cerr << "n = " << n << " is smaller than k = " << k << std::endl;
    return -1;
  }

  int** v = new int* [n+1];
  for(int i=0; i < n+1; ++i) {
    v[i] = new int[k+1]();
  }

  int binomCoefficient = binom(n, k, v);
  std::cerr << "choose(" << n << "," << k << ") = " << binomCoefficient << std::endl;

  for(int i=0; i < n+1; ++i) {
    delete[] v[i];
  }
  delete[] v;
  return 0;
}
```

Problem 2 - Dijkstra's algorithms

Modify `DijkstraMTP.cpp` from the class to compute the single-source shortest path of the graph below. In the modified program, print out the shortest paths and distances for each possible destination node. Submit your full source code to instructor by E-mail, and attached the hard copy of your source code too.



Problem 3 (Extra credit) - Implementation of Hash Tables

As an extension of Homework 2 - Problem 3, implement a hash table (either chained hash or open hash) - without support from the STL containers or other external libraries. Your container needs to support only Insert and Search (without Remove), and the Search function should simply return true/false value indicating whether the element exist in the container or not. For the simplicity of the implementation, you may assume that the key value is an integer type (i.e. no need to use template). Submit your code both by hard copy and by E-mail to instructor.