### Dear Students,

Thank you very much for your interest in CS585, Image and Video Computing. I want everyone who takes the class to have a positive, enriching learning experience. To help make sure that everyone is on the same page, please evaluate your pre-requisites using the questions below. If you are not able to answer these questions without consulting the internet, you should be sure to familiarize yourself with these topics before the start of the semester.

## 1 Graph Theory

1. How many connected components are in this graph?



2. Is A reachable from C in this graph?



3. Is A reachable from C in this graph?



4. What is the lowest-cost path from A to D in this graph?



# 2 Computer Science

1. What is the computational complexity of the following algorithm, in terms of X, Y, N, and M?

Input: Image – a matrix of size X by Y, mask – a matrix of size M by N

```
for(int x=0; x<X; x++)
{
   for(int y=0; y<Y; y++)
   {
      double accumulator = 0;
      for(int m = 0; m<M; m++)
      {
           for(int n= 0; n<N; n++)
           {
               accumulator += image[x+m][y+n]*mask[m][n];
            }
               output[x][y] = accumulator;
      }
}</pre>
```

2. Bonus: What is the bug in the loop above? Hint: indexes into the image variable

### 3 Linear Algebra

- 1. What is the sum of the following two vectors: [1,3,4] + [6,3,5]
- 2. What is the dot product of the following two vectors:  $[1,3,4] \cdot [6,3,5]$
- 3. What is the sum of these two matrices:

$$\left[\begin{array}{rrr}1&2\\3&4\end{array}\right]+\left[\begin{array}{rrr}-2&1\\1.5&-0.5\end{array}\right]$$

4. What is the product of these two matrices:

$$\left[\begin{array}{rrr}1&2\\3&4\end{array}\right]\left[\begin{array}{rrr}-2&1\\1.5&-0.5\end{array}\right]$$

5. What is the name of the relationship between these two matrices:

$$\left[\begin{array}{rrr}1&2\\3&4\end{array}\right]\left[\begin{array}{rrr}-2&1\\1.5&-0.5\end{array}\right]$$

6. What is the name of the relationship between these two matrices:

Γ1	ი	2 1	[1]	4
	2 5	6	2	5
L 4	0	ΟJ	3	6

7. What is the determinant of this matrix? Trick question: What is the inverse of this matrix:

[ 1	2 ]	
2	4	

#### 4 Calculus

- 1. What is the derivative of  $2x^2 + \sin(x)$ ?
- 2. (A partial derivative of a function with respect to a particular variable is found by treating any other symbol in the equation as a constant, and differentiating the equation as normal. Since the CS major at BU does not require multi-variate calculus, feel free to look up how to answer these two questions.)
  - What is the partial derivative of  $2x^2 + 3y^3$  with respect to x?
  - What is the partial derivative of  $2x^2 + 3y^3$  with respect to y?