“Take-home” questions can be done after the indicated lecture (“L2”=lecture 2) to test your understanding. They do not need to be submitted. The answers will usually be discussed at the start of the next lecture.

Take-home questions

1. Write down a 3x3 filter that returns a positive value if the average value of the 4-adjacent neighbors is less than the center and a negative value otherwise

2. Write down a filter that will compute the gradient in the x-direction:

```
gradx(y,x) = im(y,x+1)-im(y,x) for each x, y
```

Take-home questions

3. Fill in the blanks:

Filtering Operator

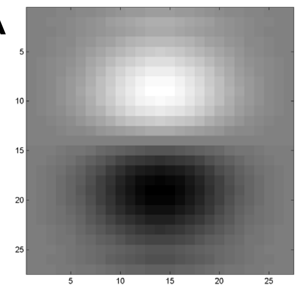
a) ___ = D * B

b) A = ___ * ___

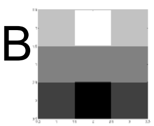
c) F = D * ___

d) ___ = D * D

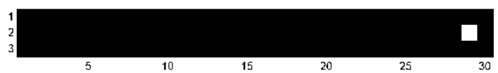
A



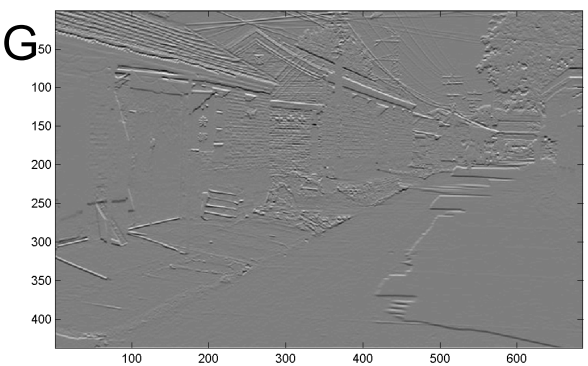
B



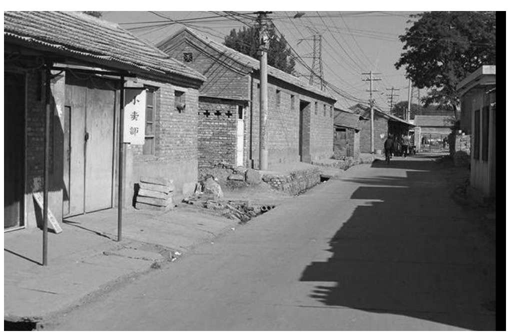
E



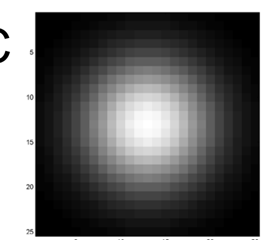
G



F

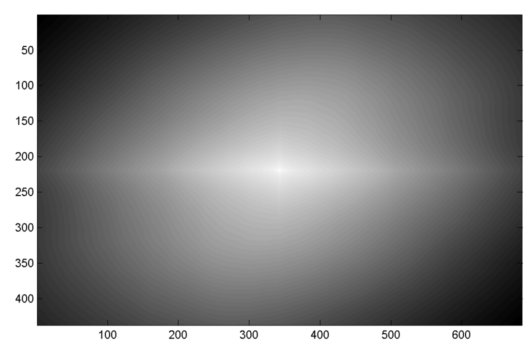


C

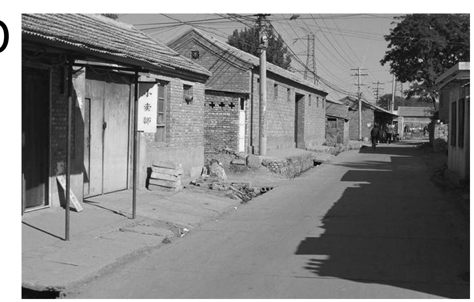


H

I



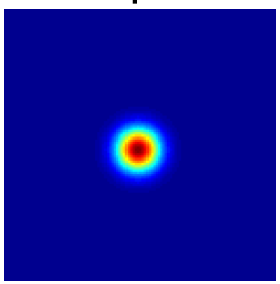
D

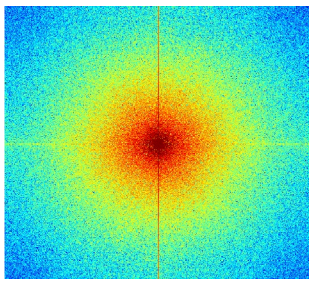


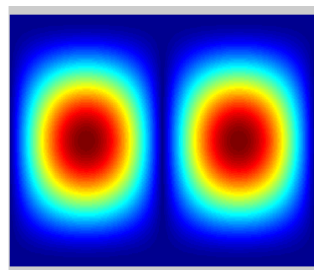
L3

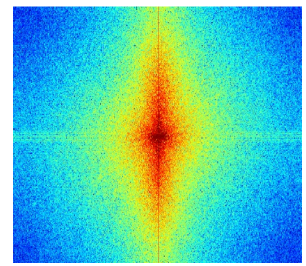
Take-home question

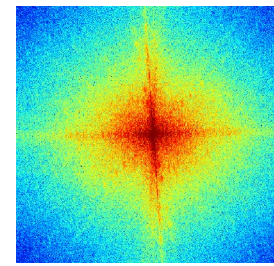
1. Match the spatial domain image to the Fourier magnitude image

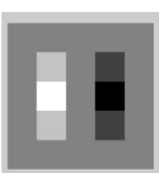
1


2


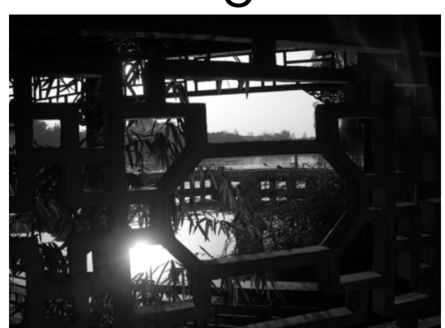
3


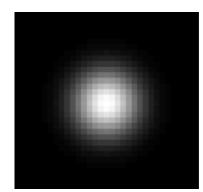
4


5


A


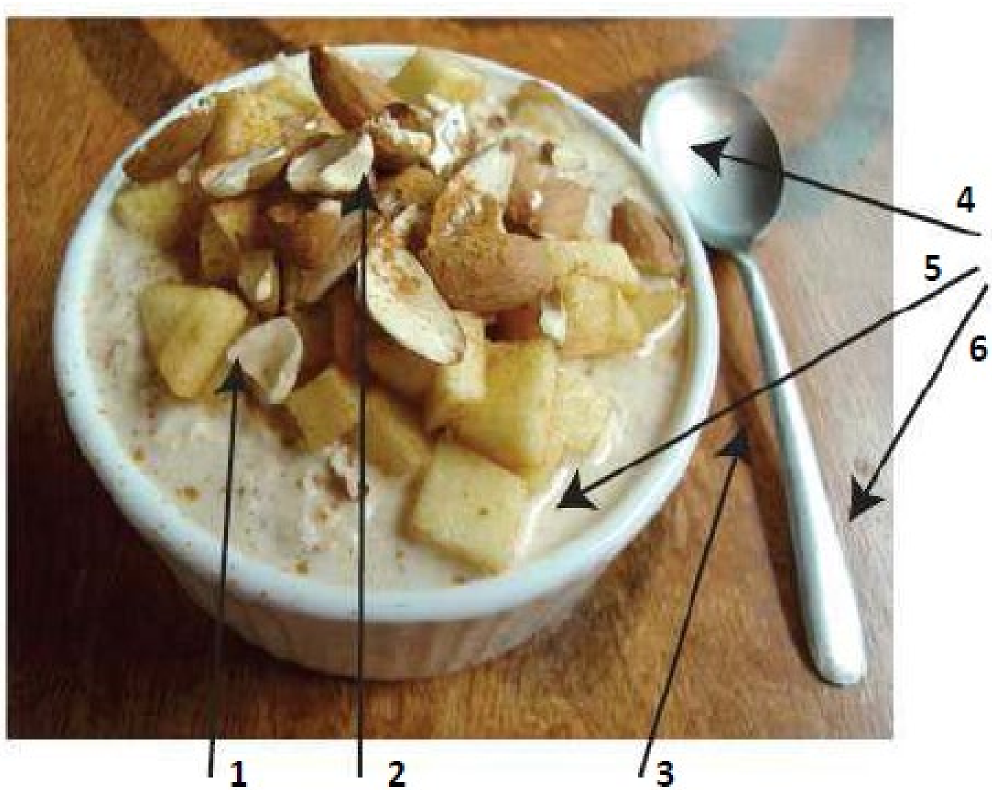
B


C


D


E


Take-home questions



A. For each of the arrows in the above image, name the reasons the pixel near the end of the arrow has its brightness value and explain very briefly. The arrow pointing to milk is pointing to the thin bright line at the edge of the piece of apple; the arrow pointing to the spoon handle is pointing to the bright area on the handle.

Possible factors: albedo, shadows, texture, specularities, curvature, lighting direction

Take-home questions

1. What would be the result in “Intelligent Scissors” if all of the edge costs were set to 1?

2. How could you change boundary costs for graph cuts to work better for objects with many thin parts?

Take-home questions

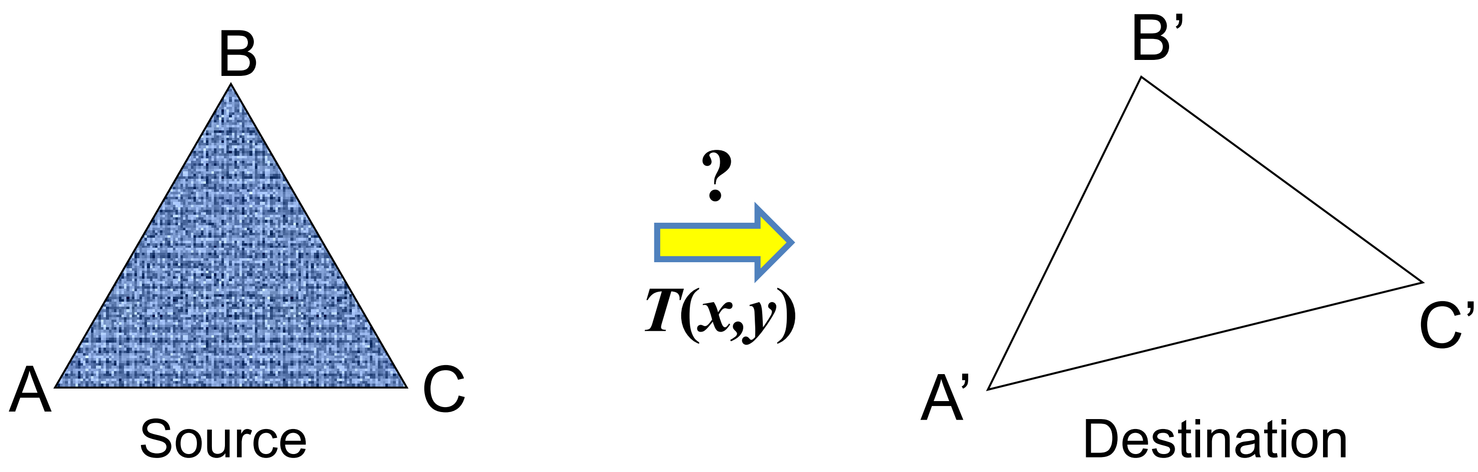
1) I am trying to blend this bear into this pool. What problems will I have if I use:
   a) Alpha compositing with feathering
   b) Laplacian pyramid blending
   c) Poisson editing?

Take-home questions

2) How would you make a sharpening filter using gradient domain processing? What are the constraints on the gradients and the intensities?

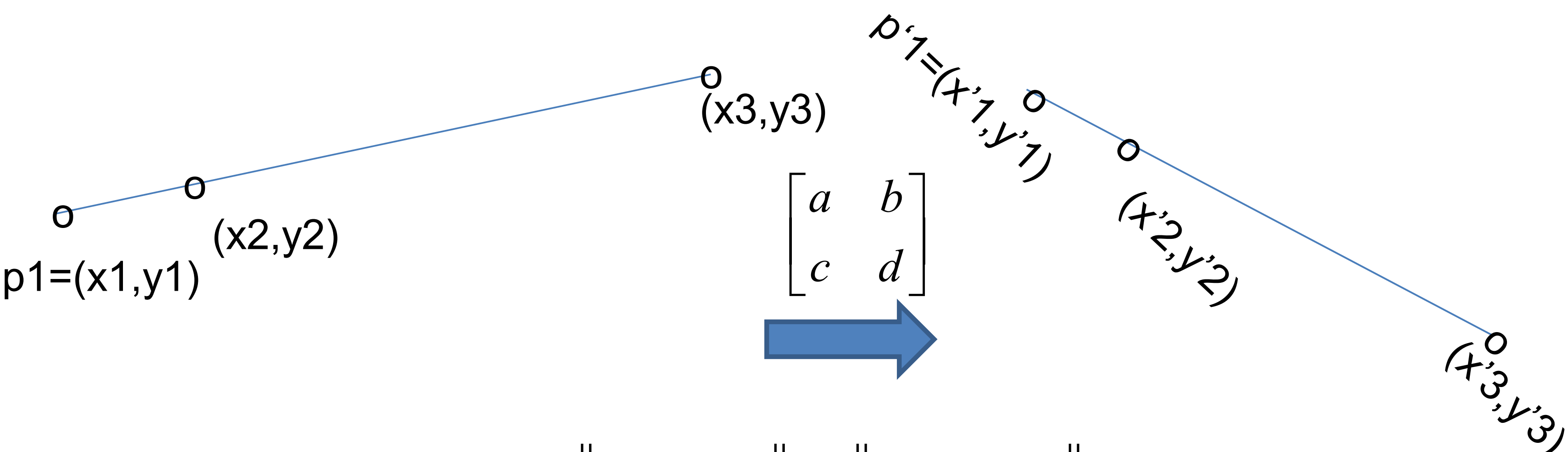
Take-home Question

1) Suppose we have two triangles: ABC and A'B'C'. What transformation will map A to A', B to B', and C to C'? How can we get the parameters?



Take-home Question

2) Show that distance ratios along a line are preserved under 2d linear transformations.



$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

$$\frac{\|p2 - p1\|}{\|p3 - p1\|} = \frac{\|p'2 - p'1\|}{\|p'3 - p'1\|}$$

Hint: Write down x2 in terms of x1 and x3, given that the three points are co-linear

Take-home questions

- Suppose the camera axis is in the direction of (x=0, y=0, z=1) in its own coordinate system. What is the camera axis in world coordinates given the extrinsic parameters ***R***, ***t***

- Suppose a camera at height y=*h (x=0,z=0)* observes a point at *(u,v)* known to be on the ground (*y*=0). Assume *R* is identity. What is the 3D position of the point in terms of *f*, u_0, v_0?

Take-home question

Suppose you have estimated finite three vanishing points corresponding to orthogonal directions:

1) How to solve for intrinsic matrix? (assume K has three parameters)
   - The transpose of the rotation matrix is its inverse
   - Use the fact that the 3D directions are orthogonal
2) How to recover the rotation matrix that is aligned with the 3D axes defined by these points?
   - In homogeneous coordinates, 3d point at infinity is (X, Y, Z, 0)

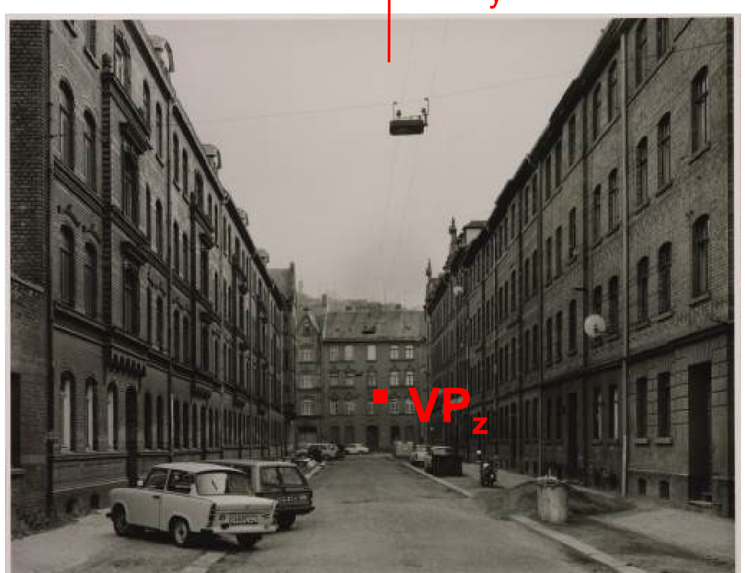


Photo from online Tate collection

Take-home question

Assume that the man is 6 ft tall.

- What is the height of the front of the building?
- What is the height of the camera?