Exam Question
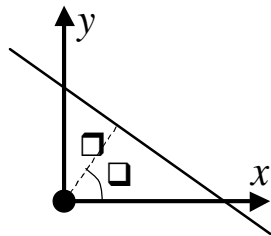
After performing edge detection on a 4x4 image suspected to contain a number of straight edges or lines, 7 pixels were found to lie on sufficiently strong edges, their coordinates are:
(2,2),(2,1),(2,-1),(2,-2),(1,-1),(-2,2), and (-2,-2)

The equation used to describe a line is:
$$x\cos(q) + y\sin(q) = r$$
where x,y are the coordinates of a point on the line
and the parameters r and q are defined as in the figure:

You are required to detect the two strongest lines in the image using the Hough Transform ($[r1,q1]$ and $[r2,q2]$).

Note: Use the following quantized values for r and q, respectively.
[-3 -2 -1 0 1 2 3] and [0 **p**/4 **p**/2 3**p**/4].

Solution
the histogram (hit/hough/accumulation) matrix is constructed:

	-3	-2	-1	0	1	2	3
0							
p/4							
p/2							
3**p**/4							

For each point on a strong edge we find the lines that it may belong to:

For the point p1(2,2) and q:
0:    r=2*cos(0)+2*sin(0)=2   ==> line [2,0]
pi/4: r=2*cos(**p**/4)+2*sin(**p**/4)=2.8284~3   ==> line [3,**p**/4]
pi/2: r=2*cos(**p**/2)+2*sin(**p**/2)=2   ==> line [2,**p**/2]
3pi/4:r=2*cos(3**p**/4)+2*sin(3**p**/4)=0   ==> line [0,3**p**/4]

	-3	-2	-1	0	1	2	3
0						//	
p/4						/	/
p/2					/	/	
3**p**/4			/	/			

Finding the possible lines and updating the histogram matrix for the remaining 5 points, we obtain:

	-3	-2	-1	0	1	2	3
0		//			/	////	
p/4	/			///	/	/	/
p/2		//	//		/	//	
3**p**/4	/	/	//	//			/

Identifying the two lines with the maximum number of hits:

Line 1: [r_1 , q_1]=[2,0]

Line 2: [r_2 , q_2]=[0,**p**/4]

Examining the detected lines on the image with the strong edge points, we obtain agreeable results: