EECS 203A: HOMEWORK #4 Solution
Spring 2022

1.a) $H(u,v) = 2\delta(u,v) + 0.5(\delta(u,v+8) + \delta(u,v-8)) \quad u = 0,1,\ldots,63 \quad v = 0,1,\ldots,63$

1.b) $H(u,v) = 2\delta(u,v) + 0.5(\delta(u,v-56) + \delta(u,v-8)) \quad u = 0,1,\ldots,63 \quad v = 0,1,\ldots,63$

2.a) The transform is in the form of a convolution so is linear. We can also use the definition of linear transform.

2.b)

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(x,y)      (x,y+1)      =      2   -1
(x+1,y)    (x+1,y+1)           -1    0
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2.c) $H(u,v) = 2 - e^{j2\pi u/M} - e^{j2\pi v/N}$

2.d) $|H(u,v)| = \sqrt{(2 - \cos(2\pi u/M) - \cos(2\pi v/N))^2 + (\sin(2\pi u/M) + \sin(2\pi v/N))^2}$

2.e) see plot

2.f) Highpass filter. At the lowest frequency $(u,v) = (0,0)$ we have $H(u,v) = 0$. At the highest x frequency $u = 0.5M$ we have $H(M/2,v) = 3 - e^{j2\pi v/N}$. At the highest y frequency $v = 0.5N$ we have $H(u,N/2) = 3 - e^{j2\pi u/M}$.

3.a) $H(u,v) = -4 + e^{j2\pi u/M} + e^{-j2\pi u/M} + e^{j2\pi v/N} + e^{-j2\pi v/N} = -4 + 2\cos(2\pi u/M) + 2\cos(2\pi v/N)$

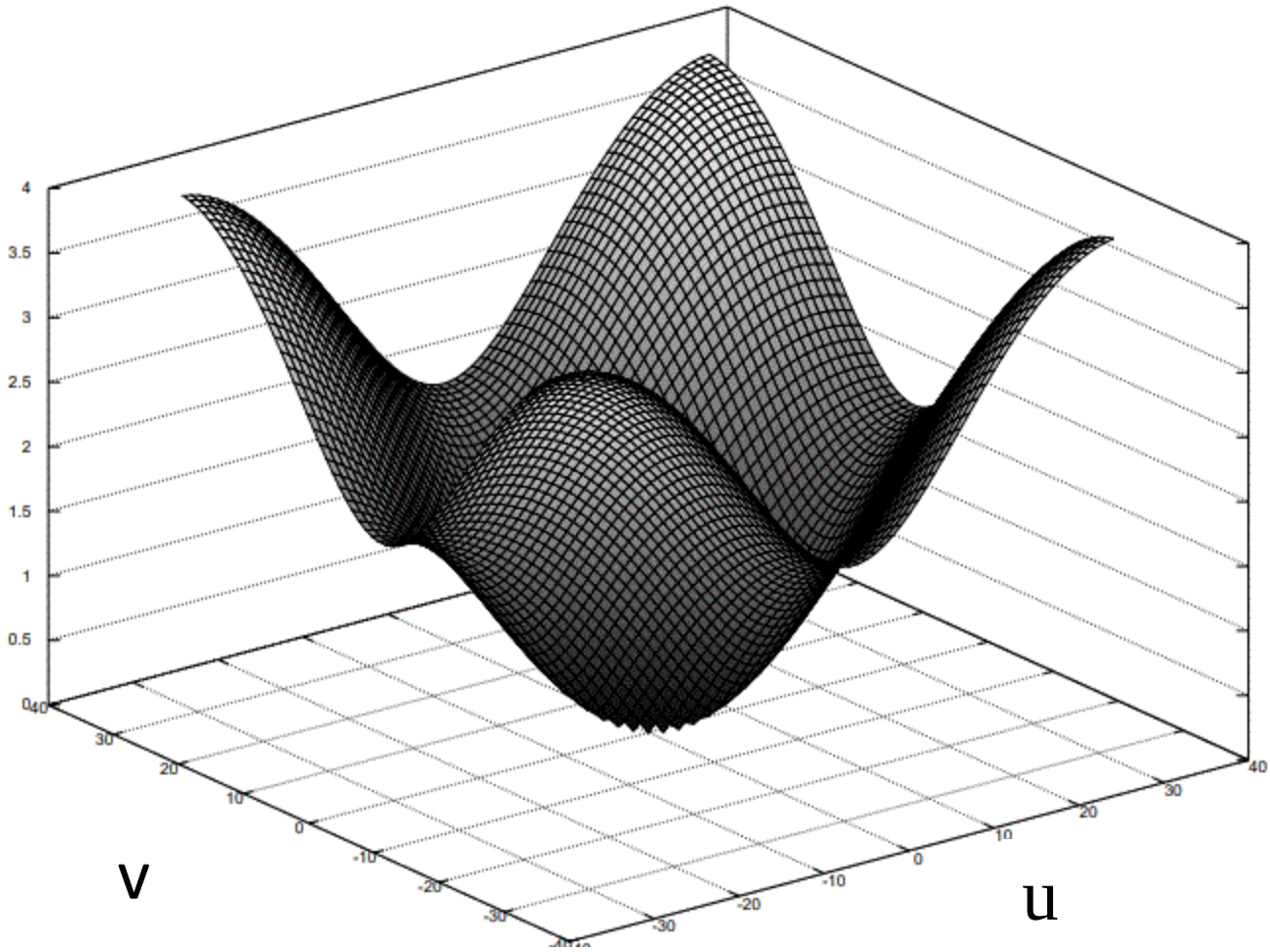
3.b) $|H(u,v)| = |-4 + 2\cos(2\pi u/M) + 2\cos(2\pi v/N)|$

3.c) see plot

3.d) Highpass. At the lowest frequency $(u,v) = (0,0)$ we have $H(u,v) = 0$. At the highest frequency $(u,v) = (0.5M, 0.5N)$ we have $|H(u,v)| = 8$.

2.e

|H(u,v)|


4
3.5
3
2.5
2
1.5
1
0.5
0
40
30
20
10
0
-10
-20
-30
-40
v
40
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20
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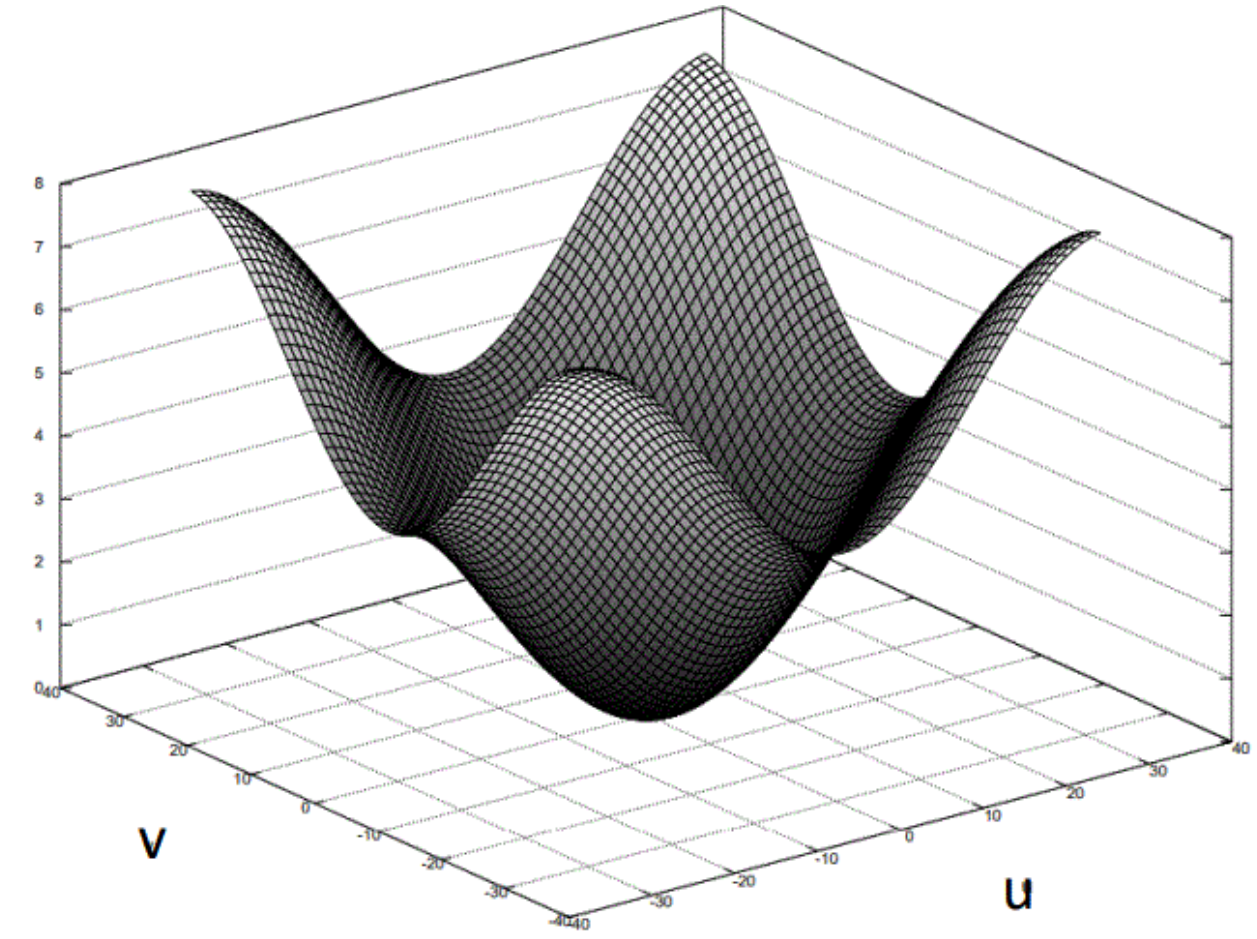
0
-10
-20
-30
u

3.c

|H(u,v)|


8
7
6
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v
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-40
u