Exercise No. 6

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Part 1: creating Q^4

```python
#! /usr/bin/python3

import numpy as np

Q4l = []
for NP in np.arange(15, 31):

    # creating Q
    Q = np.diagflat([1.]*NP)
    for n in np.arange(NP):
        for m in np.arange(NP):
            if n==m-1:
                #print (n,m)
                Q[n,m] = np.sqrt(float(m))
            if n==m+1:
                #print (n,m)
                Q[n,m] = np.sqrt(float(m))

    # creating Q2 and Q4
    Q2 = np.dot(Q,Q)
    Q4 = np.dot(Q2,Q2)

    h0 = np.diagflat(np.arange(.5, NP+.5, 1))
    h = h0 + .1*Q4

    Q4l.append(Q4)

import pandas as pd

Q41 = pd.DataFrame(Q4l[0])

f = open("q.tex", 'w')
f.write(
    pd.DataFrame(Q41).transpose().to_latex(escape=False, formatters=[lambda x: "
        {:.0f}".format(x)]*15)
)
f.close()


Q42 = pd.DataFrame(Q4l[15])

f = open("q2.tex", 'w')
f.write(
    pd.DataFrame(Q42).transpose().to_latex(escape=False, formatters=[lambda x: "
        {:.0f}".format(x)]*30)
)
f.close()
```

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	10	15	19	19	10	5	0	0	0	0	0	0	0	0	0
2	14	28	48	47	44	20	11	0	0	0	0	0	0	0	0
3	10	33	58	90	79	76	31	19	0	0	0	0	0	0	0
4	5	20	62	91	145	115	116	44	29	0	0	0	0	0	0
5	0	11	31	98	129	211	156	164	58	41	0	0	0	0	0
6	0	0	19	44	142	171	289	200	220	73	55	0	0	0	0
7	0	0	0	29	58	194	216	379	248	284	90	71	0	0	0
8	0	0	0	0	41	73	254	265	481	299	356	107	89	0	0
9	0	0	0	0	0	55	90	322	317	595	354	436	126	109	0
10	0	0	0	0	0	0	71	107	398	373	721	411	524	145	131
11	0	0	0	0	0	0	0	89	126	482	431	859	471	620	166
12	0	0	0	0	0	0	0	0	109	145	574	491	1009	533	543
13	0	0	0	0	0	0	0	0	0	131	166	674	555	975	389
14	0	0	0	0	0	0	0	0	0	0	155	187	586	404	432

Figure 1: (rounded to int)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	10	15	19	19	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	14	28	48	47	44	20	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	10	33	58	90	79	76	31	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	5	20	62	91	145	115	116	44	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	11	31	98	129	211	156	164	58	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	19	44	142	171	289	200	220	73	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	29	58	194	216	379	248	284	90	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	41	73	254	265	481	299	356	107	89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	55	90	322	317	595	354	436	126	109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	71	107	398	373	721	411	524	145	131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	89	126	482	431	859	471	620	166	155	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	109	145	574	491	1009	533	724	187	181	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	131	166	674	555	1171	598	836	209	209	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	155	187	782	621	1345	666	956	232	239	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	181	209	898	689	1531	735	1084	255	271	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	209	232	1022	760	1729	808	1220	280	305	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	239	255	1154	832	1939	882	1364	305	341	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	271	280	1294	908	2161	958	1516	331	379	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	305	305	1442	985	2395	1037	1676	357	419	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	341	331	1598	1064	2641	1118	1844	384	461	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	379	357	1762	1145	2899	1200	2020	412	505	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	419	384	1934	1229	3169	1285	2204	441	551	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	461	412	2114	1314	3451	1371	2396	470	599	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	505	441	2302	1401	3745	1460	2596	500	649	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	551	470	2498	1490	4051	1550	2804	530	701
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	599	500	2702	1580	4369	1642	3020	561
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	649	530	2914	1673	4699	1735	2433
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	701	561	3134	1767	4200	1206
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	755	592	2521	1228	1767

Figure 2: (rounded to int)