Q1

The primary reason that binary is used - and not ternary - is because computers are based on transistor technology. Transistors, in general, are switches that provide an "on" state and an "off" state. Because of this, it would be much more complex and difficult to implement as a ternary system.

Decimal	**Binary**	**Ternary**
0	0000	0000
1	0001	0001
2	0010	0002
3	0011	0010
4	0100	0011
5	0101	0012
6	0110	0020
7	0111	0021
8	1000	0022
9	1001	0100
10	1010	0101
11	1011	0102
12	1100	0110
13	1101	0111
14	1110	0112
15	1111	0120

Q2

Assuming index starts at 0 (as opposed to 1). Because the order is row major order, the calculations are as follows:

$$RM[i][j] = 100 + i(20)(4) + j(4) = 100 + 80i + 4j$$

$$RM[5][3] = 100 + 5(80) + 3(4) = 512$$

$$RM[9][19] = 100 + 9(80) + 19(4) = 896$$

Q3

(a) The maximum number of non-zero elements is one half of the NxN square matrix, inclusive of the diagonal. This is given by:

$$\frac{N \cdot N}{2} + N$$

This can be simplified to:

$$\frac{N^2 - N}{2} + \frac{2N}{2} = \frac{N^2 + N}{2} = \frac{N(N+1)}{2}$$

(b) The numbers can be stored sequentially by using arrays of the following form:

i	0	1	1	2	2	2	3	3	3	3	4	4	4	4	4
j	0	0	1	0	1	2	0	1	2	3	0	1	2	3	4
k	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
delta	0	0	0	1	1	1	3	3	3	3	6	6	6	6	6

(c) First, see the the following holds true:

$$k = i + j + \Delta_(i - 1)$$

In addition, observe that for each increment of i, the delta value increases according the triangular number series.

Thus, k can be represented by the following:

$$k = \Delta_i + j = \frac{i^2 + i}{2} + j$$

Q4

(a) The equation can be given by the following:

$$N + 2(N - 1) = N + 2N - 2 = 3N - 2$$

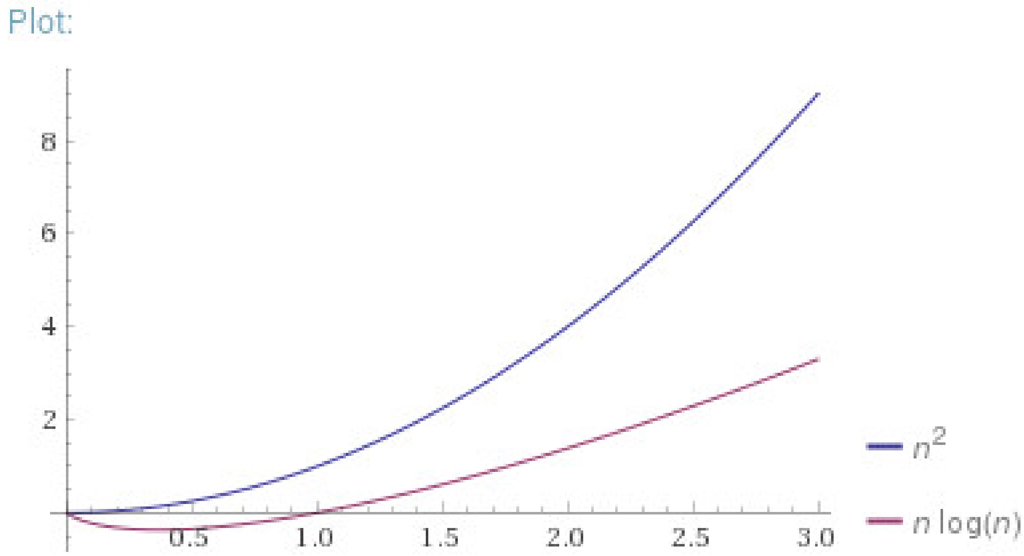
(b) The numbers can be stored sequentially by using arrays of the following form:

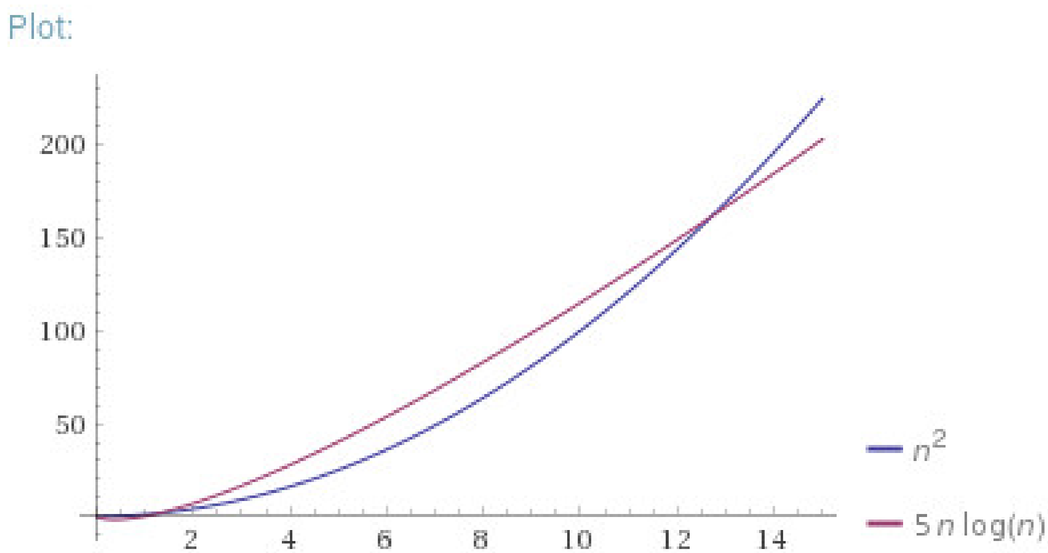
i	0	0	1	1	1	2	2	2	3	3	3	4	4	4
j	0	1	0	1	2	1	2	3	2	3	4	3	4	5
k	0	1	2	3	4	5	6	7	8	9	10	11	12	13

(c) k can be represented by the following:

$$k = 2i + j$$

Q5





The case of n^2 will generally quickly outpace nlg(n). We can try to solve for n via the following:

$$an^2 = bnlg(n)$$
$$\frac{a}{b} = \frac{1}{n}lg(n)$$
$$\frac{a}{b} = lg(n^{\frac{1}{n}})$$
$$e^{\frac{a}{b}} = n^{\frac{1}{n}}$$

Q6

$$1hr = 3600s = 3.6e9\mu s$$
$$lg(n) = 3.6e9\mu s$$
$$n = e^{3.6e9}$$

Q7

$$1hr = 3600s = 3.6e9\mu s$$
$$n^3 = 3.6e9\mu s$$
$$n = (3.6e9)^{\frac{1}{3}}$$