1.1)

1. 14
2. 0
3. $\begin{bmatrix} 6 \\ 10 \\ 14 \end{bmatrix}$
4. $\sqrt{5}$
5. [0 1 2]
6. $\begin{bmatrix} 3 & 1 & 1 \\ 2 & 3 & 1 \\ 2 & 1 & 3 \end{bmatrix}$
7. $\begin{bmatrix} 6 \\ 5 \\ 7 \end{bmatrix}$

1.2)

1. True
2. True
3. True
4. False
5. False
6. True
7. False
8. True
9. True

1.3)

1. A square matrix equal to its transpose
2. A square matrix with a diagonal row of 1's (top left to bottom right) and 0's everywhere else
3. A square matrix where the transpose is equal to its inverse

2.1)

1. $\frac{1}{4}$
2. 4$
3. 0.55

2.2)

1. 0.010094
2. False positive
3. 0.0094115
4. Yes. Since most tests are false positives, it follows that there is a low probability that a person is a drug user given a positive test result
5. Increasing the true negative rate, P(T = 0 | D = 0) will have the largest impact on the test due to specificity.

3.1)

1. $\frac{14}{3}\ at\ x = \frac{1}{3}$
2. $\frac{1}{4}\ at\ x = \frac{1}{2}$
3. $0\ at\ x = 0, 1$
4. $-\frac{1}{e^x+1}$

3.2)

1. $\nabla f(x) = < 2x_1\ ,\ e^{x_2} >$
2. $\nabla f(x) = < e^{x_1+x_2x_3}\ ,\ x_3e^{x_1+x_2x_3}\ ,\ x_2e^{x_1+x_2x_3} >$
3. $\nabla f(x) = < a_1\ ,\ a_2 >$
4. $\nabla f(x) = < 4x_1 - 2x_2\ ,\ 2x_2 - 2x_1 >$
5. $\nabla f(x) = < x_1\ ,\ x_2\ , \dots\ ,\ x_d >$

3.2)

See /code/grads.py

4.1)

1. 2^l
2. $2^{l+1} - 1$

4.2)

1. O(n lg n)
2. O(n)
3. O(n)
4. O(n · d)

4.3)

1. func1 → O(n)
2. func2 → O(n)
3. func3 → O(1)
4. func4 → O(n^2)