Q1: All terms for the cost function are shown in q3.h

$(1) + (n+1) + (n^2+n) + (n^2) + (n^2) + (n^2) + (n) + (n) + (n)$

cost function $= 4n^2 + 5n + 2$

The barometer operations is the inner while loop comparisons, which is executed n^2+n times. The body of this while loop is only executed n^2 times. Although when n gets large the $+n$ won't affect that much as n^2. So, the printing of the cartesian product, incrementing j, and the printing of the space are technically counted as barometer operations as well.

This function is $O(n^2)$

Q2: All terms for cost function are shown in a3.h

$$2\left[(n+1)+(n)+\left(\frac{n^2+n}{2}\right)+(n)+2\left(\frac{n^2+n}{2}\right)+2n\right]+(1)$$

$$2\left[\frac{3n^2+3n}{2}+5n+1\right]+1$$

$$3n^2+3n+10n+2+1$$

cost function $= 3n^2+13n+3$

The barometer operations are the inner while loop comparisons, which are executed $(n^2+n)/2+n$ times. The body of these two while loops are only executed $(n^2+n)/2$ times but when n gets large the $+n$ won't have that much of an affect as n^2 would, so the body of the while loop are also considered to be barometer operations, which are the lines the print j and increment j.

This function is $O(n^2)$

Q3: All terms for the cost function are shown in q3.h

$$3 + 2n + 1 + 3n^2 + n + n^3 + n^2 + 3n^3 + n^3 + 3n^2 + n$$

$$5n^3 + 7n^2 + 4n + 4$$

The cost function is $5n^3 + 7n^2 + 4n + 4$

The barometer operation is the inner most while loop (while(iNext < rows)) which is executed $n^3 + n^2$ times. This statement is executed the most in this function so the barometer operations are the while loop comparisons, the addition to next and the increment of iNext.

This function is $O(n^3)$

Q4: All terms for the cost function are shown in q3.h

$$n + 2n - 2 + \frac{(n^2 - n)}{2} + n - 1 + \frac{n^2 - n}{2} + \frac{n^2 - n}{2} + 3n - 3$$

Generic function $= \frac{3n^2 - 3n}{2} + 7n - 6$

Cost function

if n is odd $\frac{3n^2 - 3n}{2} + 7n - 6 + \lfloor \frac{n}{2} \rfloor \left(\lfloor \frac{n}{2} \rfloor + 1 \right)$

if n is even $\frac{3n^2 - 3n}{2} + 7n - 6 + \left(\frac{n}{2} \right)^2$

The barometer operations is the while loop comparison, the if statement comparison, increment of next. These statements are executed the most in this function. As the function is bounded by n^2 time complexity these statements are run quadratic number of times.

This function is $O(n^2)$

Q5: $\left(2^{\log_2 n+1}-1\right)+\left(2^{\log_2 n+1}\right)+4\left(2^{\log_2 n+1}-1\right)$
$+\left(2^{\log_2 n+1}-1\right)+3n(\log n+1)+\left(2^{\log_2 n+1}-1\right)$
$+2\left(2^{\log_2 n+1}-1\right)$
$=9\left(2^{\log_2 n+1}-1\right)+3n(\log n+1)+\left(2^{\log_2 n+1}\right)$

$18n-9+3n\log n+3n+2n$

$T(n)=3n\log n+23n-9$

The barometer functions are the while loop comparisons the printing of the asterisk, and the incrementing of ast. which are executed $n(\log n+1)$ amount of times, the while loop makes $n(\log n+1)+1$ for the terminating condition in each iteration.

comparisons

This function is $O(n\log n)$

Q6: All terms for the cost function are shown in q3.h

$$(2^n - 1) + (2^n - 1) + (2^{n-1} - 1) + (2^{n-1} - 1)$$

$$= 2(2^n) - 2 + 2(2^{n-1}) - 2$$

$$= 2(2^n) + 2^n - 4$$

$$= 3(2^n) - 4$$

The cost function is $3(2^n) - 4$

The barometer operations are the first two if statements because they are executed $(2^n - 1)$ times. The two if statements are if(len==0) and if(arr[0] == target).

This function is $O(2^n)$

Q7: All terms for the cost function are shown in q3.h

$$1 + \lceil \log_2(n+1) \rceil + 1 + \lceil \log_2(n+1) \rceil + \lceil \log_2(n+1) \rceil + 2\lceil \log_2(n+1$$

$$= 5\lceil \log_2(n+1) \rceil + 2 \quad (n = exp)$$

The cost function is $5\lceil \log_2(n+1) \rceil + 2$

The barometer operations are the while loop comparisons and each line of code in the loop. Each line in the while loop is executed $\lceil \log_2(n+1) \rceil$ times, the while loop has $\lceil \log_2(n+1) \rceil + 1$ comparisons. In the worst case when exp would be a binary with all ones like 15 = 1111, each line of the while loop would be executed every time.

This function is $O(\log n)$