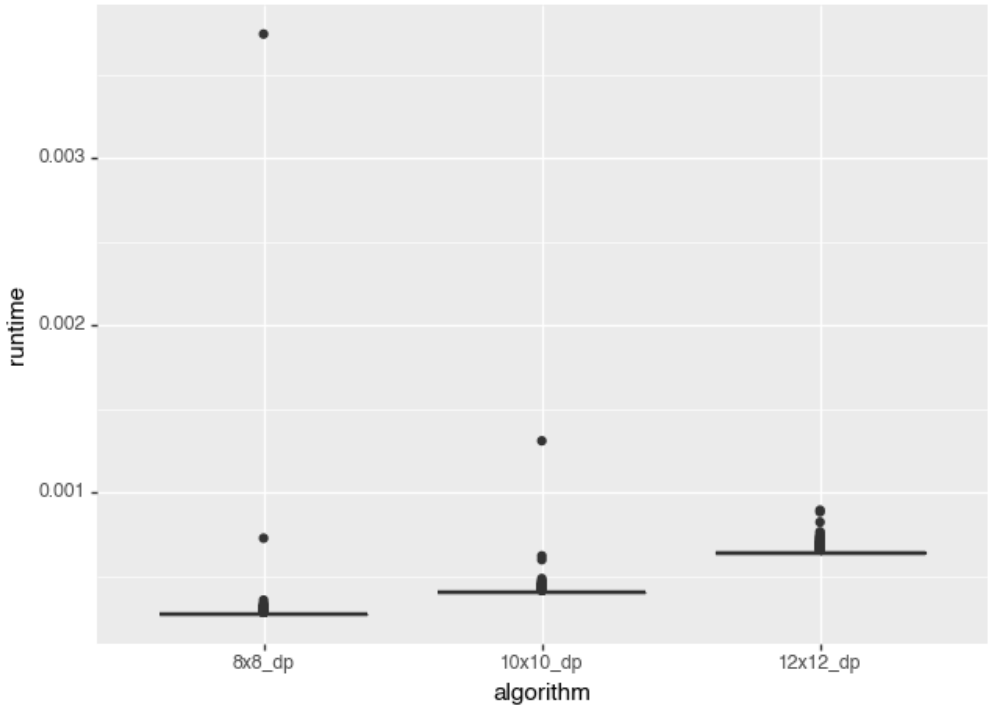
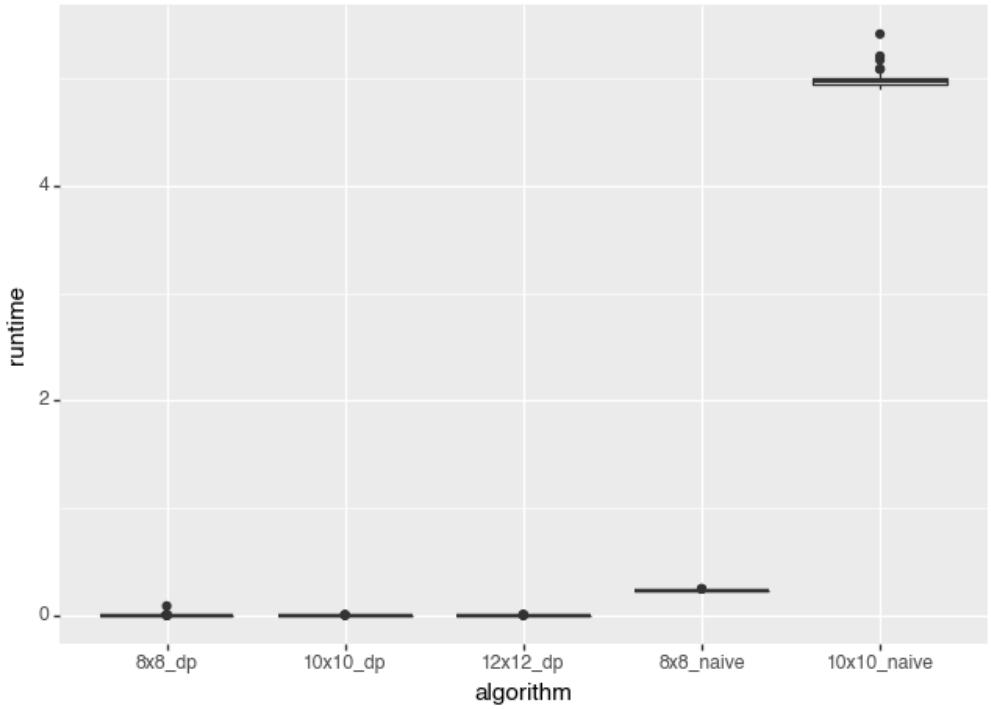
Benchmarking: Joseph Nihill

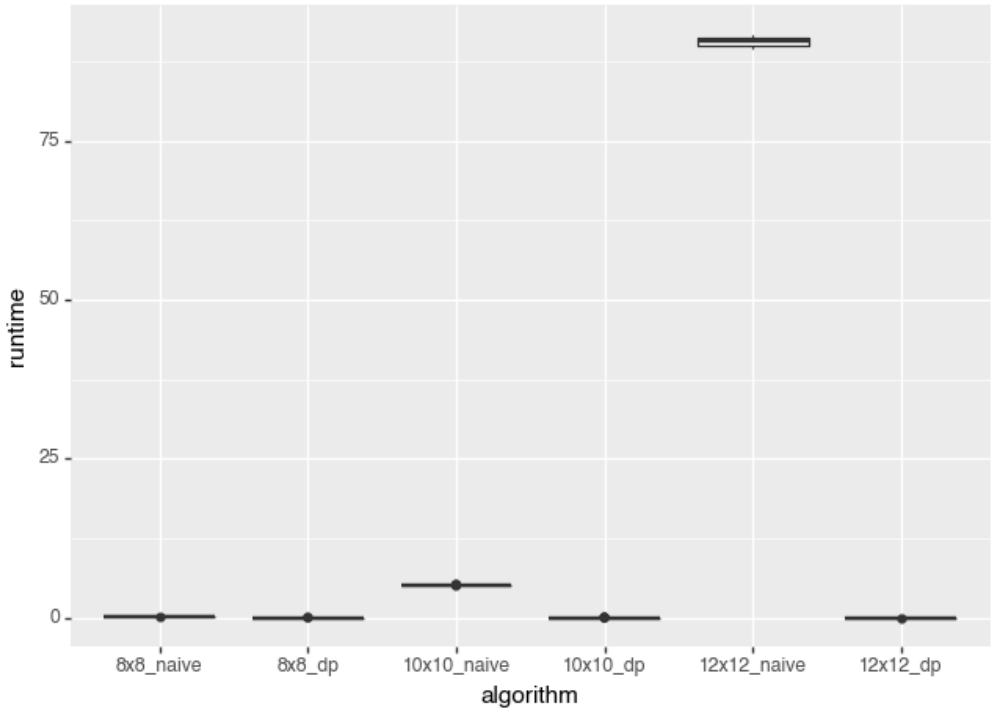
DP algorithm with respective 8x8 pixel image, 10x10 pixel image with num_iters = 1000.



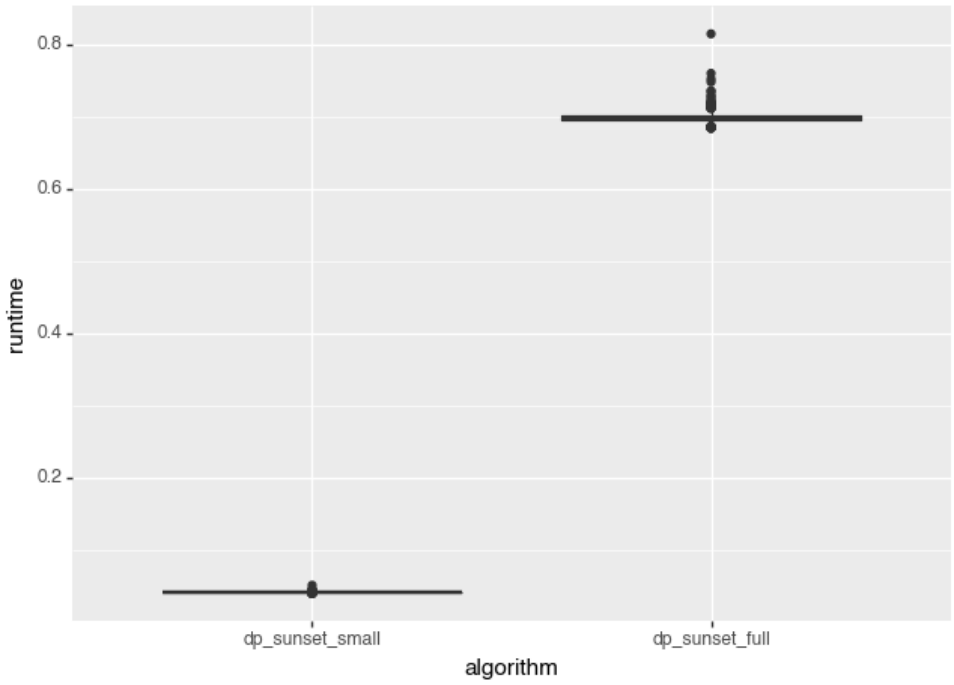
Naïve versus DP algorithm with respective 8x8 pixel image, 10x10 pixel image, and only 12x12 dp pixel image with num_iters = 100.



Naïve versus DP algorithm with respective 8x8 pixel image, 10x10 pixel image, 12x12 pixel image with num_iters = 20.



DP algorithm runtime for sunset_small and sunset_full using num_iters = 250. The runtime for the Naïve algorithm is not recordable since it was greater than 70 seconds for a 12 x 12 image.



Analysis

1.What is the recurrence for a horizontal seam?

$M(i,j) = e(i,j) + \min(M(i-1,j-1), M(i-1,j), M(i-1,j+1))$

2.Assume m>1. Show that the set of potential vertical seams grows in complexity at least exponential in n.

Let M denote the first column, for the first column there are M choices, for the second column there are M^2 choices because there are M possible choices for each M. For the third column, M^3, and for the Nth column there are M^n choices.

3.What is the asymptotic time complexity of the dynamic programming algorithm?

Initializing first row of matrix = O(M)
Constructing matrix = O(M*N)
Finding minimum entry on last row = O(M)
Traversing Matrix from bottom to top = O(N)

Overall time complexity = O(M*N)

4.Does the time complexity of both the DP and non-DP algorithm make sense given the results of the benchmarking?

Yes, it can be derived from benchmarking that the non-DP algorithm grows exponentially for $O(M^n)$ because the function explores every possibility. 8x8 Naïve ~ .2s, 10x10 Naïve ~ 5s, 12x12 Naïve ~ 84s. Since the DP algorithm is storing the values as it goes, the DP algorithm is incredibly more efficient by growing by a factor of O(M * N), we can see this in the run time of sunset small at ~.045s and sunset large at ~.7s.