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CS 251
Project 1: Percolation Analysis
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The data collected confirmed that the weighted quick union method is faster than the quick find method. The data collected has been put into a logarithmic graph as can be seen by Figure 1. For an N value of 10 or 25 both methods seem to take similar times to complete the process. However, when N is 50 and above a gap in processing time appears and is most evident when N is 250 and 500. While quick find takes over 200 seconds to complete a 500-by-500 grid with 30 trials, weighted quick union takes a fraction of one second. As the N value increases, quick find will take exponentially longer to process compared to the weighted quick union method.

The comparison between weighted quick union and quick find for the Mean P-Star seems to show a similar line pattern with the exception of weighted quick union at N equal to 10. The line fluctuates around 0.593 Mean P-Star for most of the N values. The equation, (opened cells / (N * N)), implemented in our code is most likely the reason why the Mean P-Star values stay around 0.59. This mean that the mean threshold has been calculated to roughly 0.59 from the implementation of the Monte Carlo simulations. It is clear that the union find method used does not have any effect on the Mean P-Star result. Even with randomly generated opened cells it seems it may be possible to come up with an estimation for the Mean P-Star using the N value. As the N value grows the graph starts to smooth out and become more consistent.

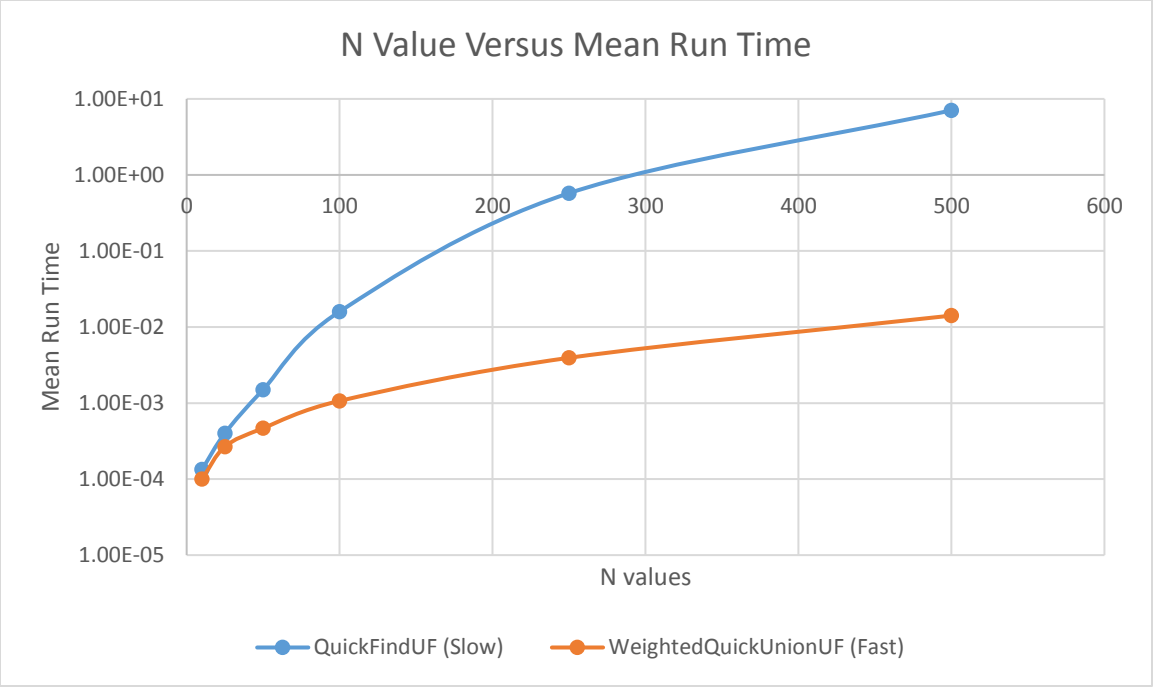

Figure 1 N-value vs Mean Run-Time

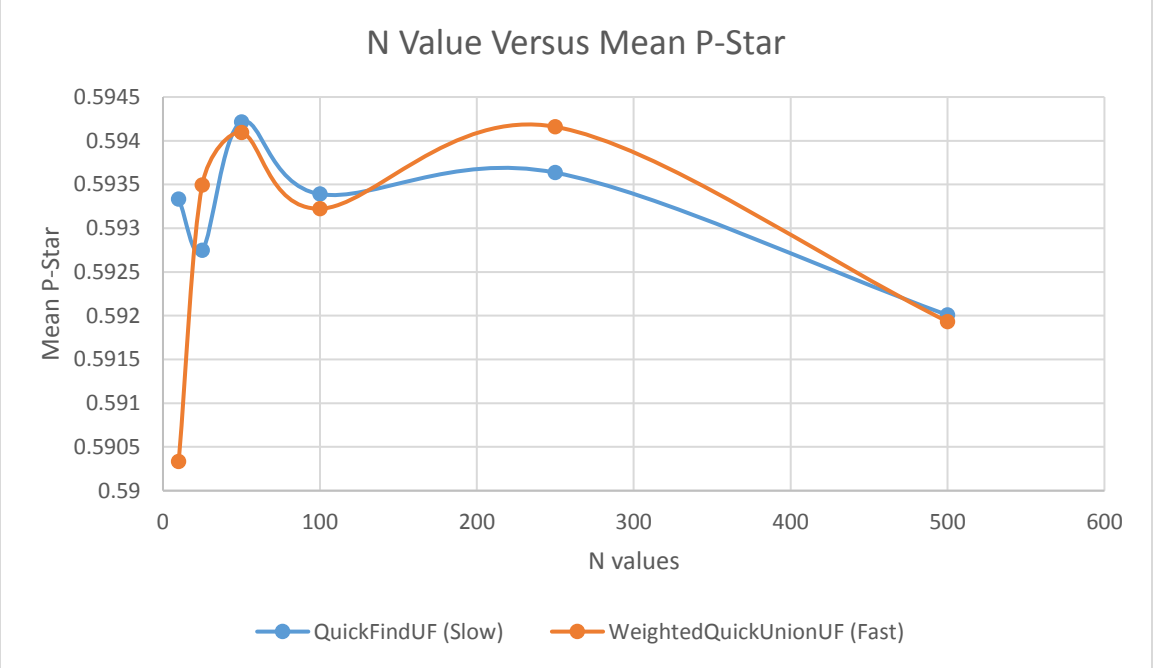

Figure 2 N-value vs Mean P-Star

Data Used to Create the Above Graphs:

PercolationSlow Data (QuickFindUF) using 30 trials:

N = 10
mean threshold=0.5933333333333333
std dev=0.07183954022841378
time=0.004
mean time=1.3333333333333334E-4
stddev time=4.3417248545530495E-4

N = 25
mean threshold=0.5927466666666666
std dev=0.04235856574477025
time=0.012000000000000004
mean time=4.0000000000000013E-4
stddev time=8.550055454548932E-4

N = 50
mean threshold=0.5942133333333336
std dev=0.026659070182369567
time=0.045000000000000026
mean time=0.001500000000000001
stddev time=0.0013064825110670776

N = 100
mean threshold=0.5933900000000001
std dev=0.012341920434032948
time=0.4790000000000003
mean time=0.015966666666666678
stddev time=0.0015643293888377883

N = 250
mean threshold=0.5936351999999999
std dev=0.00786776942670057
time=17.286999999999995
mean time=0.5762333333333332
stddev time=0.013171765344814266

N = 500
mean threshold=0.5920076000000001
std dev=0.0045238135087632535
time=212.166
mean time=7.0722
stddev time=0.1004027750681191

Percolation Data (WeightedQuickUnionUF) using 30 trials:

N = 10
mean threshold=0.5903333333333334
std dev=0.06805085995217024
time=0.003
mean time=1.0E-4
stddev time=3.0512857662936453E-4

N = 25
mean threshold=0.5934933333333333
std dev=0.05294430993055804
time=0.008
mean time=2.666666666666667E-4
stddev time=5.20830459762188E-4

N = 50
mean threshold=0.5940933333333334
std dev=0.026762543734227442
time=0.014000000000000005
mean time=4.666666666666668E-4
stddev time=6.814453874610601E-4

N = 100
mean threshold=0.5932233333333335
std dev=0.015776492406225095
time=0.032000000000000015
mean time=0.0010666666666666672
stddev time=9.071871393197366E-4

N = 250
mean threshold=0.5941594666666666
std dev=0.007783773670584925
time=0.11800000000000006
mean time=0.0039333333333333356
stddev time=0.0020499509385774853

N = 500
mean threshold=0.5919330666666667
std dev=0.0054568130583723595
time=0.4240000000000002
mean time=0.01413333333333334
stddev time=0.0049251874344402235