Parallel Computing **Assignment #2**

1. Assume that you are writting a weather forecasting model. The atmosphere is discretized into an $n \times n \times n$ grid. During each time-step, for each discretization point, you need to take the values at each of the six neighboring points and perform t_c computation on it. Given p processors, it is possible to view the processors either as a $\sqrt{p} \times \sqrt{p}$ grid or a $\sqrt[3]{p} \times \sqrt[3]{p} \times \sqrt[3]{p}$ cube. In the first case, each processor gets a subdomain of size $n \times \frac{n}{\sqrt{p}} \times \frac{n}{\sqrt{p}}$ and in the second case, $\frac{n}{\sqrt[3]{p}} \times \frac{n}{\sqrt[3]{p}} \times \frac{n}{\sqrt[3]{p}}$. For each of these cases, computing the parallel runtime (in terms of t_s, t_w, and t_c). Plug in values of $t_c = 0.7$, $t_s = 75$, and $t_w = 0.1$ microseconds. For $n = 100$, plot the speedup as p varies from 1 to 256. What can you say about the performance of the two domain partitioning strategies?

2. The parallel runtime of an n-point parallel FFT is given by $T_p = t_c(n/p)\log n + t_w(n/p)\log p$ (assuming $t_s = 0$). The maximum number of processors that can be used by this formulation is n. What is the number of processors at which the parallel runtime is minimized? For $t_c = 1$ and $t_w = 0.1$ microseconds, what is the minimum runtime, the speedup at the minimum runtime and the corresponding efficiency?