Homework 2:

Problem 1:

According to the Master Theorem, what is the asymptotic behavior of the function $t(n)$ if:

(a) $t(n) = 3t(n/2) + 1$
(b) $t(n) = 2t(n/3) + 1$
(c) $t(n) = t(n/2) + n$

Problem 2:

StupidSort sorts an array by using direct comparisons if the array has less than 4 elements. Otherwise it partitions the array into thirds. Then it sorts (in place) the first two thirds, then the last two thirds, and finally again the first two thirds. This actually works. Here is some pseudo-code:

```
def stupid_sort(array, beg, end):
   if end-beg < 4:
      #direct comparisons ordering array[beg : end]
      return
   else:
       one_third = beg + (end-beg)//3
       two_third = beg + 2*(end-beg)//3
       stupid_sort(array, beg, two_third)
       stupid_sort(array, one_third, end)
       stupid_sort(array, beg, two_third)
       return
```

What is a recurrence formula for the run-time of StupidSort? Solve for the asymptotic run-time and compare with Bubble-Sort.

Problem 3:

Use scholar.google.com or wikipedia to understand how a hard drive operates. Access time to a block in a hard-drive consists of seeking (including potentially a head switch time), rotational delay, and transferring the block contents. For the purpose of this exercise, we can neglect the last one. Assume an average seek time of 3 milli-seconds and a rotational delay of 2 milli-seconds. Disk blocks are 4KB large. Assume a very large data structure such as a B-tree and a *random placement of blocks.* Thus, between two block accesses, we have the access time as described above. What is the data rate at which we can access data on the disk?

Problem 4:

Read: Hu, Xiao-Yu, Evangelos Eleftheriou, Robert Haas, Ilias Iliadis, and Roman Pletka. "Write amplification analysis in flash-based solid state drives." In *Proceedings of SYSTOR 2009: The Israeli Experimental Systems Conference*, pp. 1-9. 2009. (You can search in scholar.google.com

and if you are logged into Marquette via the VPN or are on campus, you have free access to the ACM and IEEE digital libraries.) Explain in your own words what *write amplification for Flash drives (a.k.a. Solid State Drives)* is and how it comes about.