COS126: General Computer Science	**Spring 1996**

Exercise # 6

Handed out:April 19, 1996

These exercises are meant to guide class discussion and to help you prepare for exams. *Do not* turn in solutions.

1. Suppose `struct tree` is defined as in lecture. Write a function `countnodes` with the declaration
   `int countnodes(struct tree *t)`
   that receives a pointer to a tree as an argument and returns the number of nodes in the tree. Estimate the running time of your program using $O(\cdot)$ notation, letting n denote the number of nodes.

2. What does the following program do? Under what conditions does it not run as expected?

```
#include <stdio.h>
#include <stdlib.h>
void main()
{
 int s;
 FILE *p1, *p2;

 p1= fopen("w", "r");
 p2=fopen("r", "w");
 while((s= fgetc(p1))!= '\n')
  fputc(s, p2);
}
```

3. Write a function that takes a parse tree and outputs a fully parenthesized expression.

4. Suppose that we wished to parse fully parenthesized expressions with the unary operator '`-`' in addition to the binary operators '`+`', '`-`', and '`*`'. Then, for example, the expressions `(a + (-b))` and `(a * (-(b+c)))` would be legal. Show how to modify the parsing function `expr` given in lecture to also handle the unary '`-`'. Use the convention that in the parse tree, the left child of a unary '`-`' should be NULL and the right child non-NULL.

5. Suppose a paged virtual memory system uses 2^{10}-byte pages. An address is 32 bits long (addressing bytes), and there are 2^{26} bytes (64Megabytes) of physical memory. How many bits are used for a *virtual* page name; how many bits for a *physical* page? ("page name" is also called "page number".)

6. Supposed a paged virtual memory system has a 64-bit address (addressing bytes) with 2^{16}-byte pages. There are 2^{28} bytes of physical memory. Suppose virtual page

0A1000B560F1 is not in physical memory and virtual page 133B2111FF02 is in physical page 231. Suppose an address in virtual page 0A1000B560F1 is accessed, causing a page fault, and virtual page 0A1000B560F1 is brought in to physical page 231. Show the page table entries for virtual pages 0A1000B560F1 and 133B2111FF02 before and after this page fault.