

Turn this assignment in electronically using the Curator system. No late assignments will be accepted.

For Problems 1 and 2, consider the following function: $f(n) = 5n + \frac{3}{2}n \log n + 4$

- [10 points] Using Theorem 8 from the course notes, prove that $f(n)$ is $O(n \log n)$.
- [15 points] Write and simplify $T(n)$ expressions and determine the Θ category for the complexity function of each of the following code fragments. Be sure to clearly label and show both your $T(n)$ expression AND your Θ category in your answer.

(a)

```
for (int i = 0; i < n; i++) {  
    for (int j = 1; j <= n; j++) {  
        x = x + y[j];  
    }  
}
```

(b)

```
for (int i = 0; i < n; i++) {  
    for (int j = 1; j <= i; j++)  
        x = x + y[j];  
}
```

(c)

```
for (int i = 0; i < n; i *= 2) {  
    for (int j = 1; j <= n; j++)  
        x = x + y[j];  
}
```

(d)

```
for (int i = 0; i < n; i *= 2) {  
    for (int j = 1; j <= 5; j++)  
        x = x + y[j];  
}
```

- [15 points] Divide the following 12 functions into non-overlapping categories (Θ equivalence classes), so that two functions, $f(n)$ and $g(n)$, are in the same category if and only if $f(n)$ is $\Theta(g(n))$. Arrange the categories from the lowest order of magnitude to the highest. A function may be in a category by itself, or there may be several functions in the same category. Clearly label each category and the functions it contains.

$$n^{1/2}$$

$$5$$

$$2n + \log n$$

$$(\log n)^3$$

$$2n^{0.5}$$

$$n^{3/4}$$

$$5 \log n^2$$

$$(n^2 + 2)^{1/2}$$

$$2^n$$

$$n^2 \log n$$

$$3n^2 - 2n^2 + 1$$

$$3n^2 - 3n^2 + 1$$