CSCE 222 (Carlisle), Honors Discrete Structures for Computing
Fall 2020
Homework 5

Type your name below the pledge to sign
On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work.
Sameer Hussain

Instructions:

- The exercises are from the textbook. You are encouraged to work extra problems to aid in your learning; remember, the solutions to the odd-numbered problems are in the back of the book.
- Grading will be based on correctness, clarity, and whether your solution is of the appropriate length.
- Always justify your answers.
- Don't forget to acknowledge all sources of assistance in the section below, and write up your solutions on your own.
- *Turn in .pdf file to Gradescope by the start of class on Tuesday, September 29, 2020.* It is simpler to put each problem on its own page using the LaTeX clearpage command.

Help Received:

- https://en.wikipedia.org/wiki/Wikipedia:LaTeX_symbols
- https://www.overleaf.com/learn/latex/Integrals,_sums_and_limits

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Exercises for Section 3.1:

8: (2 points). Assume the list of integers is indexed 1,2,3...
For every integer between 1 to a_n,
if a_i is even, and is larger than the current largest, then replace it with the temporary holder for the "largest" even integer.
function largestEven($a_1 ... a_n$)
temp = 0 for i=1 to n
if a_i is even and $a_i >$ temp
then temp = a_i
return temp

14: (2 points)
Linear Search:
procedure linearSearch(7 : $a_1 ... a_8$)
i = 1
while (i $\leq$ 8 AND $a_i \neq 7$)
i = i + 1
if i $\leq$ 8 then location of 7 is i
else i = 0
return location i when $a_i = 7$

18: (2 points)
We need to define a minimum element position that will be found through iterating through the list of numbers.
procedure smallestElement($a_1 ... a_n$: integers where n $\geq$ 1)
min = 1
for i = 2 to n
if $a_i \leq$ min then min = i
return min
We are going from 2nd element to nth element and comparing to the minimum last iteration to see if the value is smaller than the current value. If the value is smaller then it becomes the new minimum comparison but if it is not then we go to the next element.

38: (2 points)
On the first run through of bubble sort,
the first two elements d and f are compared, they are in order. Then f and k are also compared and found to be in order. Then k and m, which are also in order are compared. Now m and a are compared, a comes before m in the alphabet so they are interchanged. The last two elements which are now m and b are compared and interchanged:
List now: d,f,k,a,b,m
On the second pass:
The list is run through again with no interchanges but it gets to k and a which are interchanged. Then it looks at k and b which are next to each other and interchanges them.
List now: d,f,a,b,k,m
On the third pass:
The list goes through and compares d and f with no interchanges then it checks f and a and interchanges and then f and b and interchanges those too.
List now: d,a,b,f,k,m
On the fourth pass:
First we compare the first two elements and realize that d and a need to be interchanged. Next, d and b are compared and interchanged as well
List now: a,b,d,f,k,m
On the fifth pass: The first two elements are compared a and b, which are in order so no interchange is needed
Final list: a,b,d,f,k,m

62: (2 points)
To show that a greedy algorithm schedules talks by selecting the talks that overlaps the fewest other talks does not provide the optimal schedule:
We can arrange the lectures according to the times that they finish:
1) 9:00 - 9:45
2) 9:50 - 10:15
3) 10:30 - 10:55
4) 11:00 - 11:15

Choosing lecture 1 first means that lectures 2 overlaps with it.
Then we choose lecture 3 but that means that lectures 4 and 5 overlap.
Then we choose lecture 6 and then that means 7 8 and 9 overlap. Then we choose lecture 11 to finish.

Exercises for Section 3.2:

8(a-d): (2 points)

a)

$n = 4$

$x^3 logx$ is not $O(x^3)$ n = 3 is too small so n = 4

b)

$n = 5$

c)

As x increases, the value gets close to 1.

So, $n = 0$ as this function is $O(1)$

d)

For large x the value of this function becomes $\frac{1}{x}$

22: (2 points)

$(logn)^3, \sqrt{n}logn, n^{99} + n^{98}, n^{100}, (1.5)^n, 10^n, (n!)^2$

26(a-c): (2 points)

a)

The big O estimate has C = 18 and k = 1

$f(n)$ is $O(n^3 logn)$

b)

$f(n) = (2^n + n^2)(n^3 + 3^n)$

$f(n) = (2^n(1 + 1) * 3^n(1 + 1))$

4(2*3)

C = 4, k = 3

$f(n)$ is $O(6^n)$

c)

$n \leq \frac{n^n}{2^n}$

$n * 2^n \leq n^n$

$f(n)$ is $O(n^n * n!)$

62: (2 points)

$\sum_{n=0}^{\infty} \frac{2^n}{n!} = e^2 < \infty$
Using the summation we know that $2^n/n!$ approaches 0 so $(2n)! = O(n!)$

74: (2 points)
$logn!$ is $\theta(nlogn)$
$logn! = logn + log(n-1) + ... + log1)$
$\geq logn + log(n-1) + log(n/2)$
$logn! \leq nlogn$
Therefore, $logn!$ is $\theta(nlogn)$