CISS350: Data Structures and Advanced Algorithms
Quiz q10301

Name: YOUR EMAIL Score:

All questions below refer to our standard bubblesort. There are slight variations to the bubblesort algorithm. You must use the one in my notes/classes. For big-O, your answer should be of the form $O(n^k)$ for $k = 0, 1, 2, 3, ...$ Of course $O(n^0)$ is $O(1)$.

Q1. Write down the array $\{5, 3, 1, 4, 2\}$ after two passes.
Answer:

$\{?, ?, ?, ?, ?\}$

Q2. For the array $\{5, 3, 1, 4, 2\}$ how many swaps are performed when the sorting ends?
Answer:

?

Q3. What array of size 5 that containing the values 1,2,3,4,5 will cause the algorithm to perform the most number of swaps? (This will give the highest wallclock time for integer array of size 5.)
Answer:

$\{?, ?, ?, ?, ?\}$

Q4. What array of size 5 that contains the values 1,2,3,4,5 will cause the algorithm to perform the least number of swaps? (This will give the lowest wallclock time for integer array of size 5.)
Answer:

$\{?, ?, ?, ?, ?\}$

Q5. Is it stable? Write YES or NO.
Answer:

?

Q6. If it is not stable write down the simplest array (of smallest size and using

smallest positive integers) to show that it is so. If it is stable, erase all contents in the answer box and leave it blank.

Answer:

$\{?, ?\}$

Q7. What is the big-O of the runtime in terms of n where n is the size of the array?

Answer:

$O(?)$

Q8. What is the big-O of the best runtime in terms of n where n is the size of the array?

Answer:

$O(?)$

Q9. What is the space complexity (i.e., memory usage) in terms of n where n is the size of the array?

Answer:

$O(?)$

Note. Note that an array `x` of size n that gives you the highest the number of swaps (and therefore highest wallclock time) and an array `y` of size n that gives you the lowers number of swaps (and therefore lowest wallclock time) can both give you the same big-O runtime. Why? Because the first might give you a runtime $T_1(n) = A_1 n + B_1$ and the second gives you $T_2(n) = A_2 n + B_2$ where $A_1 > A_2$. But when you compute the big-O, $T_1(n) = O(n)$ and $T_2(n) = O(n)$ – in terms of big-O, they are the same. So the concept of "best and worst wallclock times" is not the same as the concept of "best and worst (big-O) runtimes".

Instructions

In the file `thispreamble.tex` look for

```
\renewcommand\AUTHOR{}
```

and enter your email address:

```
\renewcommand\AUTHOR{jdoe5@cougars.ccis.edu}
```

(This is not really necessary since alex will change that for you when you execute `make`.) In your bash shell, execute "`make`" to recompile `main.pdf`. Execute "`make v`" to view `main.pdf`.

Enter your answers in `main.tex`. In the bash shell, execute "`make`" to recompile `main.pdf`. Execute "`make v`" to view `main.pdf`.

For each question, you'll see boxes for you to fill. For small boxes, if you see

```
1 + 1 = \answerbox{}.
```

you do this:

```
1 + 1 = \answerbox{2}.
```

`answerbox` will also appear in "true/false" and "multiple-choice" questions.

For longer answers that need typewriter font, if you see

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
\end{answercode}
```

you do this:

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
int x;
\end{answercode}
```

`answercode` will appear in questions asking for code, algorithm, and program output. In this case, indentation and spacing is significant. For program output, I do look at spaces and newlines.

For long answers (not in typewriter font) if you see

```
What is the color of the sky?
\begin{answerlong}
\end{answerlong}
```

you can write

```
What is the color of the sky?
\begin{answerlong}
The color of the sky is blue.
\end{answerlong}
```

A question that begins with "T or F or M" requires you to identify whether it is true or false, or meaningless. "Meaningless" means something's wrong with the question and it is not well-defined. Something like "$1 + 2 = 4$" is either true or false (of course it's false). Something like "$1+_2 = 4$?" does not make sense.

When writing results of computations, make sure it's simplified. For instance write 2 instead of $1 + 1$.

Higher level classes.

For students beyond 245: You can put LaTeX commands in `answerlong`.

More examples of meaningless statements: Questions such as "Is $42 = 1+_2$ true or false?" or "Is $42 = \{2\}^{\{3\}}$ true or false?" does not make sense. "Is $P(42) = \{42\}$ true or false?" is meaningless because $P(X)$ is only defined if X is a set. For "Is $1 + 2 + 3$ true or false?", "$1 + 2 + 3$" is well–defined but as a "numerical expression", not as a "proposition", i.e., it cannot be true or false. Therefore "Is $1 + 2 + 3$ true or false?" is also not a well-defined question.

More examples of simplification: When you write down sets, if the answer is $\{1\}$, do not write $\{1, 1\}$. And when the values can be ordered, write the elements of the set in ascending order. When writing polynomials, begin with the highest degree term.

When writing a counterexample, always write the simplest.