# Q1.1

2 Points

$$f(n) = n^2 \ln n \ g(n) = \sum_{i=1}^n i$$

# Q1.2

2 Points

$$f(n) = 1.001^n \ g(n) = n^{1.001}$$

# Q1.3

2 Points

$$f(n)=2n! \ g(n)=(2n)!$$

# Q1.4

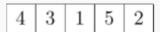
2 Points

$$f(n) = \sum_{i=1}^{2n} i^2 \ g(n) = \sum_{i=1}^{2n} (2i)^2$$

## Q2

#### 6 Points

This question tests your understanding of the Insertion Sort algorithm as stated in the textbook and the lecture slides. Assume that we use Insertion Sort to sort the array A with 5 elements where the initial values of the array elements (from A[1] to A[5]) are A:



During the execution of the algorithm, we may have to write into one of the 5 memory locations of the array elements, i.e., write into A[i] for some  $i \in \{1, 2, 3, 4, 5\}$ . Every time we write into one of these locations, we say that A is overwritten. Check the corresponding box on the answer sheet to answer each of the following questions.

#### Q2.1

3 Points

- (a) What is the array content immediately after A is overwritten the 1st time?
- $\bigcirc$  A = 13452
- $\bigcirc$  A = 34452
- $\bigcirc$  A = 44152
- O None of the above

### **Save Answer**

## Q2.2

3 Points

- (b) What is the array content immediately after A is overwritten the 3rd time?
- $\bigcirc$  A = 13452
- O A = 34452
- O A = 44152
- O None of the above

### Q3

#### 3 Points

Let  $f(n)=3n^2-1000$ . In order to prove that  $f(n)\in\Omega(n^2)$ , we need to find a positive constant c>0 and an integer  $N\geq 1$  such that

$$f(n) \geq c imes n^2, orall n \geq N$$

Answer the following questions on the answer sheet.

- (a1) Will c = 1, N = 8 make the proof correct?
- (a2) Will c = 3, N = 12 make the proof correct?
- (a3) Will c = 5, N = 13 make the proof correct?

## Q4

#### 3 Points

Let  $g(n)=13n^2+1000.$  In order to prove that  $f(n)\in O(n^2)$ , we need to find a positive constant c>0 and an integer  $N\geq 1$  such that

$$g(n) \leq c imes n^2, orall n \geq N$$

Answer the following questions on the answer sheet.

- (b1) Will c = 12, N = 20 make the proof correct?
- (b2) Will c = 13, N = 20 make the proof correct?
- (b3) Will c = 14, N = 10 make the proof correct?

## Q5

### **10 Points**

For each of the following 5 statements, check the corresponding box on the answer sheet if and only if the statement is true.

(a) If 
$$f(n) \in \mathrm{O}(n)$$
 and  $g(n) \in \Theta(n)$ , then  $f(n) + n imes g(n) \in \Theta(n^2)$ .

(b) If 
$$f(n) \in O(n)$$
 and  $g(n) \in \Theta(n)$ , then  $n imes f(n) + g(n) \in \Theta(n^2)$ .

(c) If 
$$f(n) \in O(n)$$
, then  $n imes f(n) + 1000n \in \Theta(n^2)$ .

(d) If 
$$f(n) \in O(n)$$
, then  $n imes f(n) + 1000 n^2 \in \Theta(n^2)$ .

(e) 
$$n! \in O(3^n)$$
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