Recur3

- Due Feb 16 at 11:59pm
- Points 9
- Questions 3
- Available Feb 9 at 3:20pm - Feb 16 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Feb 16 at 11:59pm.

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	13 minutes	7.8 out of 9

ⓘ Correct answers are hidden.

Score for this attempt: 7.8 out of 9
Submitted Feb 15 at 3:06pm
This attempt took 13 minutes.

Question 1
3 / 3 pts

Recall that to apply the Master Theorem on a recurrence of the form
T(n) = a T(n/b) + f(n)
we need to compute r = log_b(a) .
Match recurrences with r = log_b(a)

T(n) = 8 T(n/2) + n^2

3

T(n) = 4 T(n/2) + 1

2

T(n) = 2 T(n/2) + n

1

T(n) = T(n/2) + n^2

0

T(n) = 9 T(n/3) + n^2

2

T(n) = T(n/3) + n

0

T(n) = 8 T(n/4) + n

1.5

T(n) = 4 T(n/4) + 1

1

T(n) = 2 T(n/4) + n^2

0.5

Question 2

3 / 3 pts

Match recurrences to their solution

(we write '+ Theta(n)' for '+ f(n) where f(n) \in Theta(n)', etc):

T(n) in 3 T(n/2) + Theta(n^2)

Theta(n^2)

T(n) in 4 T(n/2) + Theta(n)

Theta(n^2)

T(n) in 2 T(n/2) + Theta(n)

Theta(n lg(n))

T(n) in 2 T(n/2) + Theta(1)

Theta(n)

T(n) in T(n/2) + Theta(n)

Theta(n)

T(n) in T(n/2) + Theta(1)

Theta(lg n)

PartialQuestion 3

1.8 / 3 pts

Match recurrences to their solutions:

T(n) = 2 T(n/2) + n

Theta(n lg(n))

T(n) = 2 T(n/2) + n sqrt(n)

Theta(n sqrt(n))

T(n) = 2 T(n/2) + n/sqrt(n)

Theta(n)

T(n) = 2 T(n/2) + n lg(n)

Theta(n lg(lg(n)))

T(n) = 2 T(n/2) + n/lg(n)

Theta(n lg(n))

Quiz Score: 7.8 out of 9

Recur2

- Due Feb 14 at 11:59pm
- Points 5
- Questions 4
- Available Feb 7 at 3:20pm - Feb 14 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Feb 14 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 4	less than 1 minute	5 out of 5
LATEST	Attempt 4	less than 1 minute	5 out of 5
	Attempt 3	less than 1 minute	4 out of 5
	Attempt 2	less than 1 minute	3 out of 5
	Attempt 1	8 minutes	2 out of 5

ⓘ Correct answers are hidden.

Score for this attempt: 5 out of 5
Submitted Feb 14 at 8:30am
This attempt took less than 1 minute.

Question 1
2 / 2 pts

Suppose we want to prove, by induction in n, that P(n) holds for all non-negative integers n. Which approaches (check all that apply) will be sufficient to accomplish this?

- [ ] for all non-negative integers m, assume that P(m) holds, and then prove P(m+1)
- [x] for all non-negative integers m, assume that P(n) holds for all non-negative integers n with n < m, and then prove P(m)
- [ ] for all non-negative integers m, assume that P(n) holds for all non-negative integers n with n != m, and then prove P(m)
- [x] prove P(0), and then: for all non-negative integers m, assume that P(m) holds, and then prove P(m+1)

for all non-negative integers m, assume that P(n) holds for all non-negative integers n with n > m, and then prove P(m)

Question 2
1 / 1 pts

Consider the recurrence
T(n) = 2 T(n/2) + n^2.
We want to prove that for some c > 0, T(n) <= c n^2 for all n >= q. Without special assumptions on T, what is the smallest non-negative integer q for which this is possible?

1

Question 3
1 / 1 pts

Consider the recurrence
T(n) = 2 T(n/2) + n.
We want to prove that for some c > 0, T(n) <= c n lg(n) for all n >= q. Without special assumptions on T, what is the smallest non-negative integer q for which this is possible?

2

Question 4
1 / 1 pts

Consider the recurrence
T(n) = 2 T(n/2) + 1.
We want to prove that for some c > 0, T(n) <= c n for all n >= 1. When we try to prove that by induction, for which c does the inductive step go through?

- for no c
- for all c
- for c >= 2 but not when c < 2
- for c >= 1 but not when c < 1

Quiz Score: 5 out of 5

Recur1

- Due Feb 12 at 11:59pm
- Points 6
- Questions 3
- Available Feb 5 at 3:20pm - Feb 12 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Feb 12 at 11:59pm.

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	9 minutes	6 out of 6

ⓘ Correct answers are hidden.

Score for this attempt: 6 out of 6
Submitted Feb 12 at 6:32pm
This attempt took 9 minutes.

Question 1
2 / 2 pts

Consider the algorithm

```
F(A[1..n]) =
 if n = 1
   skip
 else if n = 2
   A[1] <-> A[2]
 else
   q <- n/2
   F(A[1..q])
   F(A[q+1..n])
   F(A[1..q])
```

Its running time T(n) can be described by the recurrence
T(n) = aT(n/b) + h(n) with h in Theta(n^q).
What is a, b, q?

a =

3

b =

2

q =

0

Question 2

1 / 1 pts

Assume that we have a recurrence for T(n), and that we want to use the **substitution method** to find an upper approximation of the asymptotic behavior of T(n), that is, to prove that for some function f and some constant c, T(n) <= c f(n) for n big enough. What must we do?

- we have to guess c; then the method will help to find f
- the method will help to find both f and c
- we have to guess both f and c
- we have to guess f; then the method will help to find c

Question 3

3 / 3 pts

Consider the recurrence

T(n) <= 2 T(floor(n/2)) + n^2

We may use the substitution method to prove that for some c > 0, T(n) <= c n^2 for all n >= 1.

For n >= 2, we have the calculation

T(n) =(A) 2 T(floor(n/2)) + n^2
<=(B) 2 c floor(n/2)^2 + n^2
<=(C) 2 c (n/2)^2 + n^2
=(D) (c/2 + 1) n^2
<=(E) c n^2

Match each (in)equality with its justification

A

recurrence

B

induction hypothesis

C

property of floor

D

arithmetic

E

when c >= 2

Quiz Score: 6 out of 6

Loops2

- Due Feb 5 at 11:59pm
- Points 6
- Questions 4
- Available Jan 29 at 3:20pm - Feb 5 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Feb 5 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 5	less than 1 minute	5 out of 6
LATEST	Attempt 5	less than 1 minute	5 out of 6
	Attempt 4	2 minutes	3.33 out of 6
	Attempt 3	1 minute	4 out of 6
	Attempt 2	5 minutes	2.67 out of 6
	Attempt 1	5 minutes	1.67 out of 6

ⓘ Correct answers are hidden.

Score for this attempt: 5 out of 6
Submitted Feb 5 at 8:30am
This attempt took less than 1 minute.

Question 1
2 / 2 pts

Which functions (of n) are smooth?

- [x] lg(n)
- [ ] 1/n
- [ ] 2^n
- [x] n^2
- [x] sqrt(n)

Question 2
1 / 1 pts

Which is a correct approximation of
sum_{i = 1}^{n} 2^i

- Theta(n^2)
- Theta(n 2^n)
- Theta(2^n)

Question 3
2 / 2 pts

According to our results,
sum_{i=1}^{n^4} sqrt(i)
is in
Theta(n^ [Select] sqrt(n^ [Select])) = Theta(n^6)

Answer 1:
4
6
2
8

Answer 2:
8
6
2
4

Answer 3:
8
4
6

IncorrectQuestion 4
0 / 1 pts

Consider the expression Theta(n^2 lg(n^2)). It

- can be simplified to Theta(n^2)
- cannot be simplified
- can be simplified to Theta(n^2 lg(n))
- can be simplified to Theta(n^2 lg(n)^2)

Quiz Score: 5 out of 6

Loops1

- Due Feb 2 at 11:59pm
- Points 5
- Questions 3
- Available Jan 26 at 3:20pm - Feb 2 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Feb 2 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 2	3 minutes	5 out of 5
LATEST	Attempt 2	3 minutes	5 out of 5
	Attempt 1	less than 1 minute	1 out of 5

Correct answers are hidden.

Score for this attempt: 5 out of 5
Submitted Jan 30 at 2:34pm
This attempt took 3 minutes.

Question 1
2 / 2 pts

Consider the program (with E some expression)

```
z <- 0
k <- n
while k > 1
    z <- z+1
    k <- E
```

For each E, state what is the asymptotic running time of the resulting program, as a function of n

E subtracts by two: k - 2

Theta(n)

E divides by two: k / 2

Theta(lg n)

Question 2
2 / 2 pts

Consider the program

```
x <- 0
m <- n * n
for i <- 1 to m
  q <- i * i * i
  for k <- 1 to q
    x <- x + 1
```

Its asymptotic running time, as a function of n, is given by

sum_{i = 1}^{n^2 } i^3

Answer 1:

m

m^2

n^2

n^3

Answer 2:

n^3

i^2

n^2

i^3

Question 3
1 / 1 pts

Consider the program

```
x <- 0
for i <- 1 to n
  q <- 1
  while q <= i
    q <- q + q
    x <- x + 1
```

Its asymptotic running time, as a function of n, is given by

sum_{i = 1}^{n} E where E is

- i^2
- lg i
- sqrt(i)
- i

Quiz Score: 5 out of 5

Intro2

- Due Jan 26 at 11:59pm
- Points 9
- Questions 5
- Available Jan 19 at 3:20pm - Jan 26 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Jan 26 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 5	2 minutes	9 out of 9
LATEST	Attempt 5	2 minutes	9 out of 9
	Attempt 4	4 minutes	4 out of 9
	Attempt 3	5 minutes	3 out of 9
	Attempt 2	2 minutes	5.5 out of 9
	Attempt 1	1 minute	1.5 out of 9

ⓘ Correct answers are hidden.

Score for this attempt: 9 out of 9
Submitted Jan 23 at 4:52pm
This attempt took 2 minutes.

Question 1
1 / 1 pts

How do we in our pseudocode express the assignment of value 7 to variable w?

- (●) w <- 7
- ( ) w <-> 7
- ( ) w := 7
- ( ) w = 7

Question 2
1 / 1 pts

Assume that x is 5 and y is 7 before the parallel assignment
x,y <- y, x+y
What are the values of x and y afterwards?

x is

7

y is

12

Question 3
3 / 3 pts

Consider the iterative implementation of Insertion Sort.
It runs in time proportional to

the size of the input

when the input is (almost) sc

the square of the size of the input

when the input is randomly

the cube of the size of the input

never

Question 4
1 / 1 pts

Which claims are true about the space use of the iterative implementation of Insertion Sort?

- [ ] it uses space proportional to the size of the input array
- [x] it is in-place

- [x] it uses space at most logarithmic in the size of the input
- [ ] running it causes the stack to grow

Question 5

3 / 3 pts

Let B[1..n] be an array of integers. To express that no integer occurs twice in B, we may write (check all that applies)

- [ ] forall i in 1..n, forall j in 1..n, i != j and B[i] != B[j]
- [ ] forall i in 1..n, forall j in 1..n, B[i] != B[j]
- [x] forall i in 1..n, forall j in i+1..n, B[i] != B[j]
- [x] forall i in 1..n, forall j in 1..n, i != j implies B[i] != B[j]
- [ ] forall i in 1..n-1, B[i] != B[i+1]
- [x] forall i in 1..n, forall j in 1..n, B[i] = B[j] implies i = j

Quiz Score: 9 out of 9

Intro1

- Due Jan 24 at 11:59pm
- Points 5
- Questions 4
- Available Jan 17 at 3:20pm - Jan 24 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Jan 24 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 3	less than 1 minute	5 out of 5
LATEST	Attempt 3	less than 1 minute	5 out of 5
	Attempt 2	1 minute	4 out of 5
	Attempt 1	2 minutes	3 out of 5

ⓘ Correct answers are hidden.

Score for this attempt: 5 out of 5
Submitted Jan 19 at 2:28pm
This attempt took less than 1 minute.

Question 1
1 / 1 pts

Assume we must implement a given specification, with a precondition and a postcondition. For which input is our implementation required to establish the postcondition?

- (●) for input that satisfies the precondition
- ( ) for no input
- ( ) for all input

Question 2
1 / 1 pts

Which is **NOT** a valid way to express that an array B[1..n] is "non-decreasing"?

- forall i forall j (1 <= i < j <= n => B[i] <= B[j])
- forall i forall j (1 <= i < j <= n => B[i] < B[j])
- forall i forall j (1 <= i <= j <= n => B[i] <= B[j])

Question 3

1 / 1 pts

Which is **NOT** a valid way to express that an array B[1..n] is "non-decreasing"?

- forall k (1 <= k <= n => B[k] <= B[k+1])
- forall j (1 < j <= n => B[j-1] <= B[j])
- forall i (1 <= i < n => B[i] <= B[i+1])

Question 4

2 / 2 pts

Consider the array B with content [21,17,21,28,17].
Given the specification of the selection problem, what is then the

2nd smallest element of B

17

3rd smallest element of B

21

Quiz Score: 5 out of 5

Graphs2

- Due Feb 9 at 11:59pm
- Points 7
- Questions 3
- Available Feb 2 at 3:20pm - Feb 9 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Feb 9 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 3	less than 1 minute	7 out of 7
LATEST	Attempt 3	less than 1 minute	7 out of 7
	Attempt 2	4 minutes	6 out of 7
	Attempt 1	less than 1 minute	1 out of 7

Correct answers are hidden.

Score for this attempt: 7 out of 7
Submitted Feb 9 at 9:39am
This attempt took less than 1 minute.

Question 1
2 / 2 pts

With the Adjacency **Matrix** representation of graphs, which operations always run in constant time? (check all that apply)

- [x] Put
- [x] Get
- [ ] AllFrom
- [x] Delete

Question 2
2 / 2 pts

With the Adjacency Lists representation of graphs, which operations always run in constant time? (check all that apply)

- [ ] Get
- [x] AllFrom
- [x] Put
- [ ] Delete

Question 3
3 / 3 pts

In which situation

can we expect the 'get' operator to take the most time?

a dense graph represented b

can we expect a graph to require the least amount of space?

a sparse graph represented l

does the AllFrom operator have a running time that is linear in the number of nodes but yet will return a very short list?

a sparse graph represented l

Quiz Score: 7 out of 7

Graphs1

- Due Feb 7 at 11:59pm
- Points 8
- Questions 7
- Available Jan 31 at 3:20pm - Feb 7 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Feb 7 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 4	less than 1 minute	8 out of 8
LATEST	Attempt 4	less than 1 minute	8 out of 8
	Attempt 3	less than 1 minute	7.5 out of 8
	Attempt 2	1 minute	6 out of 8
	Attempt 1	8 minutes	5.5 out of 8

Correct answers are hidden.

Score for this attempt: 8 out of 8
Submitted Feb 4 at 3:32pm
This attempt took less than 1 minute.

Question 1
1 / 1 pts

Assume that a directed graph G has 5 nodes. What is the highest possible number of edges in G?

25

Question 2
1 / 1 pts

Assume that an **un**directed graph G has 5 nodes. What is the highest possible number of edges in G?

10

Question 3
1 / 1 pts

What is the smallest number of nodes needed to form a cycle

in a directed graph

1

in an undirected graph

3

Question 4
1 / 1 pts

Assume that the undirected graph G has exactly 5 nodes, and that G is connected. What is the smallest possible number of edges in G?

4

Question 5
1 / 1 pts

Assume that the **directed** graph G has exactly 5 nodes, and that G is **strongly** connected. What is the smallest possible number of edges in G?

5

Question 6
2 / 2 pts

If a graph algorithm has running time in Theta(n+a) then we can write that running time as

Theta(n) , if we know

a in O(n)

Theta(n^2), if we know

a in Omega(n^2)

Question 7

1 / 1 pts

Assume that a tree has 5 nodes. Which situations are then possible (check all that applies)

- [x] it has 4 edges
- [ ] it has 5 edges
- [ ] it has 3 edges

Quiz Score: 8 out of 8

Correct1

- Due Feb 19 at 11:59pm
- Points 8
- Questions 7
- Available Feb 12 at 3:20pm - Feb 19 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Feb 19 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 2	2 minutes	8 out of 8
LATEST	Attempt 2	2 minutes	8 out of 8
	Attempt 1	7 minutes	6.5 out of 8

ⓘ Correct answers are hidden.

Score for this attempt: 8 out of 8
Submitted Feb 19 at 6:02pm
This attempt took 2 minutes.

Question 1
1 / 1 pts

At which points must a loop invariant hold (check all that apply)

- [x] just before the loop is entered for the first time
- [ ] in the middle of the loop body
- [x] at the end of the loop body
- [x] just after loop exit
- [x] at the beginning of the loop body

Question 2
1 / 1 pts

What must we prove about the code before a loop? (check all that apply)

- [ ] that it makes the loop guard true
- [x] that it makes the loop invariant true
- [ ] that it makes the loop guard false

Question 3

1 / 1 pts

What must we prove about the loop body (check all that apply)

- [ ] that it makes the loop guard false
- [x] that it makes the loop invariant true
- [ ] that it makes the loop guard true

Question 4

1 / 1 pts

What can we assume when analyzing the loop body (check all that apply)

- [x] that the loop guard is true in the beginning
- [x] that the loop invariant is true in the beginning
- [ ] that the loop guard is false in the beginning

Question 5

1 / 1 pts

What can we assume just after loop exit (check all that apply)

- [ ] that the loop guard is true
- [x] that the loop guard is false
- [x] that the loop invariant is true

Question 6

1 / 1 pts

Assume that the postcondition is of the form

P and Q

and that the loop invariant is Q. What is then a suitable loop guard?

- ( ) P
- ( ) P and Q

not P

not Q

Question 7

2 / 2 pts

Consider the program (where we assume n >= 0)

```
 x,z <- n,0
 while x > 0
   B
```

where we want the loop (with yet unspecified body B) to have invariant x + z = n.

We now propose some options for B; you should evaluate each.

x,z <- x+1,z+1

does not maintain invariant

x,z <- x+1,z-1

maintains invariant, but does

x,z <- x-1,z+1

maintains invariant and mak

x,z <- x-1,z-1

makes progress towards terr

Quiz Score: 8 out of 8

Asymp1

- Due Jan 29 at 11:59pm
- Points 5
- Questions 5
- Available Jan 22 at 3:20pm - Jan 29 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Jan 29 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 4	less than 1 minute	5 out of 5
LATEST	Attempt 4	less than 1 minute	5 out of 5
	Attempt 3	less than 1 minute	4 out of 5
	Attempt 2	less than 1 minute	4 out of 5
	Attempt 1	3 minutes	4.5 out of 5

Correct answers are hidden.

Score for this attempt: 5 out of 5
Submitted Jan 24 at 1:35pm
This attempt took less than 1 minute.

Question 1
1 / 1 pts

Assume that we have analyzed an algorithm, and found that on input of size n it runs in time (measured in microseconds)
5 n^3 + 973 n^2 + 28n + 46.
Which parts of that formula shall we consider essential information?

- all of it
- 973 n^2
- n^3
- 5

Question 2

1 / 1 pts

Given a set with n elements, how many subsets are there?

- (•) 2^n
- ( ) n^n
- ( ) n^2
- ( ) n

Question 3

1 / 1 pts

Find the smallest integer n such that 2^n is at least one billion (that is, 10^9)

30

Question 4

1 / 1 pts

Which functions belong to O(n^2)? (check all that apply)

- [ ] n^3 - 4n + 8
- [x] 7n + 3
- [x] 5n^2 + 4n + 8
- [ ] 2^n

Question 5

1 / 1 pts

What is the (sufficient and necessary) condition for n^p to belong to O(n^q)?

- ( ) p >= q
- ( ) p = q
- (•) p <= q
- ( ) p < q
- ( ) p > q

Quiz Score: 5 out of 5

Asymp2

- Due Jan 31 at 11:59pm
- Points 9
- Questions 6
- Available Jan 24 at 3:20pm - Jan 31 at 11:59pm
- Time Limit None
- Allowed Attempts 5

This quiz was locked Jan 31 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 4	1 minute	9 out of 9
LATEST	Attempt 4	1 minute	9 out of 9
	Attempt 3	2 minutes	8.5 out of 9
	Attempt 2	3 minutes	8 out of 9
	Attempt 1	3 minutes	2.33 out of 9

ⓘ Correct answers are hidden.

Score for this attempt: 9 out of 9
Submitted Jan 31 at 2:28pm
This attempt took 1 minute.

Question 1
1 / 1 pts

Which functions belong to Omega(n^2)?

- [ ] n lg(n)
- [ ] 3n
- [x] (n+7)^2
- [x] 5n^3 + 4n

Question 2
1 / 1 pts

Which functions belong to Theta(n^2)?

- [x] (n+7)^2
- [ ] 2n^3 + 4n + 8
- [x] 5n^2 + 3n + 7
- [ ] 3n + 8

Question 3
1 / 1 pts

Which functions belong to o(n^2)?

- [ ] (n+1)^2
- [x] n lg(n)
- [x] 27n + 33
- [ ] 0.03 n^2

Question 4
1 / 1 pts

Which functions belong to omega(n^2)?

- [x] n^2 lg(n)
- [x] (1,001)^n
- [ ] n lg(n)
- [ ] 237 n^2 + 8n

Question 5
4 / 4 pts

The running time of insertion sort is in

O(n)

for the best-case interpretat

O(n^2)

for both interpretations

O(n^3)

for both interpretations

Omega(n)

for both interpretations

Omega(n^2)

for the worst-case interpreta

Omega(n^3)

for no interpretation

Theta(n)

for the best-case interpretat

Theta(n^2)

for the worst-case interpreta

Question 6
1 / 1 pts

Match each ??? with the appropriate symbol (here lg is the binary logarithm, and ln the natural logarithm)

lg(n) in ???(sqrt(n))

little-o

(1.001)^n in ???(n^7)

little-omega

lg(n) in ???(ln n)

big-Theta

Quiz Score: 9 out of 9