04/07/2025: Algorithm Efficiency

CSCI 246: Discrete Structures

Textbook reference: Sec 11.3, Epp

Graded Quiz Pickup

Quizzes are in the front of the room, grouped into four bins (A-G, H-L, M-R, S-Z) by last name. The quizzes are upside down with your last name on the back. Come find yours before, during, or after class. Only turn the quiz over if it's yours.

Today's Agenda

- Reading quiz (5 mins)
- Mini-lecture ($\approx$ 15 mins)
- Group exercises ($\approx$ 20 mins)

Feedback on Friday's Quizzes

Problem Quiz Scores

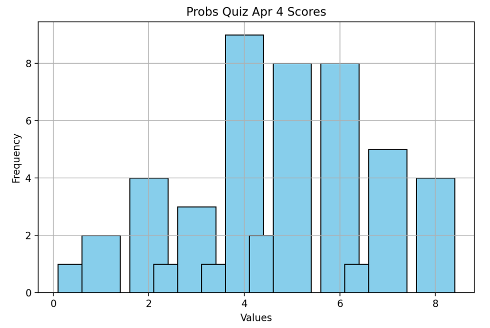

Figure 1: Median Score = 5/8 (62.5%)

Grading Rubric:

1. (4 points.) 2 points for $P(A|B)$ and 2 for $P(B|A)$. Must show work for full credit.
2. (4 points.) 1 point for correct answer, 1 point for stating correctly one of the 3 characterizations of independence, 2 points for correctly determining the probabilities needed for that characterization.

Reading Quiz Scores (Extra Credit)

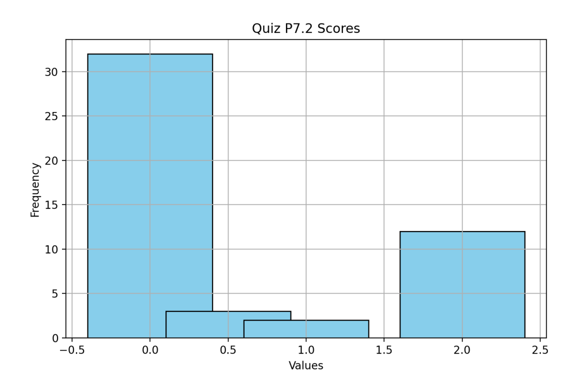

Figure 2: Median Score = 0 points extra credit

Grading Rubric: 2 points extra credit for perfect answer.

Today’s reading quiz

Reading Quiz (Algorithm Efficiency)

Assume n is a positive integer and consider the following algorithm segment:

$$p := 0, x := 2$$

$$\textbf{for } i := 2 \textbf{ to } n$$

$$\quad p := (p+i)\cdot x$$

$$\textbf{next } i$$

1. What is the actual number of elementary operations that are performed when this algorithm segment is executed? Justify your answer.
2. What is the order for this algorithm segment? Justify your answer.

Review of Problems Quiz

Thoughts On Algorithm Efficiency

Theorem: Sum of the first n natural numbers

For every natural number $n \geq 1$,

$$1 + 2 + \cdots + n = \frac{n\,(n+1)}{2}$$

How to visualize the above

1	2	3	4	5	6	7	8	9	10
10	9	8	7	6	5	4	3	2	1
11	11	11	11	11	11	11	11	11	11

Group exercises

aaron.loomis: 5
adam.wyszynski: 6
alexander.goetz: 18
alexander.knutson: 6
anthony.mann: 20
blake.leone: 16
bridger.voss: 14
caitlin.hermanson: 12
cameron.wittrock: 3
carsten.brooks: 1
carver.wambold: 4
colter.huber: 20
conner.reed1: 7
connor.mizner: 9
connor.yetter: 1
derek.price4: 7
devon.maurer: 17
emmeri.grooms: 4
erik.moore3: 9
ethan.johnson18: 12
evan.barth: 7
evan.schoening: 21
griffin.short: 8
jack.fry: 2
jacob.ketola: 15
jacob.ruiz1: 5
jacob.shepherd1: 14
jada.zorn: 21
jakob.kominsky: 18
james.brubaker: 15
jeremiah.mackey: 19
jett.girard: 2
john.fotheringham: 6
jonas.zeiler: 4
joseph.mergenthaler: 11
joseph.triem: 17
julia.larsen: 2
justice.mosso: 13
kaden.price: 15
lucas.jones6: 10
luka.derry: 3
luke.donaldson1: 16
lynsey.read: 17
mason.barnocky: 16
matthew.nagel: 8
micaylyn.parker: 10
michael.oswald: 13
nolan.scott1: 18
owen.obrien: 21
pendleton.johnston: 13
peter.buckley1: 9
reid.pickert: 8
ryan.barrett2: 14
samuel.hemmen: 12
samuel.mosier: 11
samuel.rollins: 3
sarah.periolat: 19
timothy.true: 11
tristan.nogacki: 1
tyler.broesel: 20
william.elder1: 5
yebin.wallace: 19
zeke.baumann: 10

Group exercises

For each of the algorithm segments below, assume n is a positive integer.

a. Compute the actual number of elementary operations (additions, subtractions, multiplications, divisions, and comparisons) that are performed when the algorithm segment is executed. For simplicity, however, count only comparisons that occur within the body of the **for-next** loops; ignore those required to determine when the **for-next** loops should terminate.

b. Use the theorem on polynomial orders to find an order for the algorithm segment.

Segment 1

for $i := 3$ **to** $n - 1$
 $a := 3 \cdot n + 2 \cdot i - 1$
next i

Segment 2

for $k := 1$ **to** $n - 1$
 for $j := 1$ **to** $k + 1$
  $x := a[k] + b[j]$
 next j
next k

Segment 3

for $i := 1$ **to** n
 for $j := 1$ **to** $\lfloor (i+1)/2 \rfloor$
  $a := (n - i) \cdot (n - j)$
 next j
next i