

QB2

Big Oh with logs and roots

Do NOT write on this test. Record all answers on the bubble sheet. **Closed book. No notes.** Work strictly from memory. No time limit. **No calculators. Scratch paper okay.**

1/2p. Give a tight big-oh $\Theta()$ bound on the running time $T(n)$ of this program.

Assume `atoi`, `simpleStatement`, and `simpleCompare` each run in $\Theta(1)$ time.

- (A) $n^2\sqrt{n}$ (C) $n\sqrt{n}$ (E) $n \lg n$ (G) $\sqrt{n} \lg^2 n$ (I) $\lg^3 n$
(B) n^2 (D) $n \lg^2 n$ (F) n (H) $\sqrt{n} \lg n$ (J) $\lg^2 n$

```
int main ( int argc, char * * argv ) {
    int n = atoi(argv[1]);
    b = 1; while ( b * b < n ) {
        a = n; do {
            if ( simpleCompare ) {
                f = n; do {
                    simpleStatement;
                    f /= 5; } while ( f > 1 );
            }
            a /= 2; } while ( a > 1 );
        b += 10; }
    return 0; }
```

2/2p. Give a tight big-oh $\Theta()$ bound on the running time $T(n)$ of this program.

Assume `atoi`, `simpleStatement`, and `simpleCompare` each run in $\Theta(1)$ time.

- (A) $n^2\sqrt{n}$ (C) n^2 (E) $n \lg n$ (G) \sqrt{n} (I) $\lg n$
(B) $n^2 \lg n$ (D) $n\sqrt{n} \lg n$ (F) $\sqrt{n} \lg n$ (H) $\lg^2 n$ (J) 1

```
int main ( int argc, char * * argv ) {
    int n = atoi(argv[1]);
    if ( simpleCompare ) {
        if ( simpleCompare ) {
            if ( simpleCompare ) {
                simpleStatement;
            } else {
                simpleStatement;
            }
        } else {
            simpleStatement;
        }
    }
    } else {
        if ( simpleCompare ) {
            simpleStatement;
        } else {
            simpleStatement;
        }
    }
    return 0; }
```

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3/2p. Give a tight big-oh $\Theta()$ bound on the running time $T(n)$ of this program.
Assume `atoi`, `simpleStatement`, and `simpleCompare` each run in $\Theta(1)$ time.

- (A) $n^2\sqrt{n}$ (C) n^2 (E) $n \lg n$ (G) $\sqrt{n} \lg n$ (I) $\lg^2 n$
(B) $n^2 \lg n$ (D) $n\sqrt{n}$ (F) n (H) \sqrt{n} (J) $\lg n$

```
int main ( int argc, char * * argv ) {
    int n = atoi(argv[1]);
    for ( j = 1 ; j * j < n ; j++ ) {
        if ( simpleCompare ) {
            if ( simpleCompare ) {
                if ( simpleCompare ) {
                    if ( simpleCompare ) {
                        if ( simpleCompare ) {
                            if ( simpleCompare ) {
                                a = n; while ( a > 1 ) {
                                    simpleStatement;
                                    a /= 5; }
                            } else {
                                simpleStatement;
                            }
                        } else {
                            for ( d = n ; d > 1 ; d /= 5 ) {
                                simpleStatement;
                            }
                        }
                    }
                }
            }
        } else {
            if ( simpleCompare ) {
                if ( simpleCompare ) {
                    if ( simpleCompare ) {
                        simpleStatement;
                    } else {
                        simpleStatement;
                    }
                } else {
                    simpleStatement;
                }
            } else {
                if ( simpleCompare ) {
                    simpleStatement;
                }
            }
        }
    }
    return 0; }
```

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4/2p. Give a tight big-oh $\Theta()$ bound on the running time $T(n)$ of this program. Assume `atoi`, `simpleStatement`, and `simpleCompare` each run in $\Theta(1)$ time.

- (A) $n^4 \lg n$ (C) $n^3 \lg^2 n$ (E) $n^2 \lg^2 n$ (G) $n\sqrt{n} \lg^2 n$ (I) $\sqrt{n} \lg^4 n$
(B) $n^3 \sqrt{n} \lg n$ (D) $n^2 \sqrt{n}$ (F) $n^2 \lg n$ (H) $n \lg^4 n$ (J) $\sqrt{n} \lg n$

```
int main ( int argc, char * * argv ) {
    int n = atoi(argv[1]);
    if ( simpleCompare ) {
        k = 1; do {
            if ( simpleCompare ) {
                i = n; do {
                    b = 1; do {
                        c = n; while ( c > 1 ) {
                            j = 1; do {
                                simpleStatement;
                                j++; } while ( j < n );
                            c--; }
                        b += 1; } while ( b < n );
                    i /= 3; } while ( i > 1 );
                }
            k += 1; } while ( k * k < n );
        } else {
            if ( simpleCompare ) {
                if ( simpleCompare ) {
                    e = 1; do {
                        if ( simpleCompare ) {
                            simpleStatement;
                        } else {
                            simpleStatement;
                        }
                    }
                    e *= 3; } while ( e < n );
                } else {
                    simpleStatement;
                }
            } else {
                if ( simpleCompare ) {
                    simpleStatement;
                } else {
                    simpleStatement;
                }
            }
        }
    }
    return 0; }
```

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5/2p. Give a tight big-oh $\Theta()$ bound on the running time $T(n)$ of this program.
Assume `atoi`, `simpleStatement`, and `simpleCompare` each run in $\Theta(1)$ time.

- (A) $n^2\sqrt{n}$ (C) n^2 (E) $n \lg n$ (G) $\sqrt{n} \lg n$ (I) $\lg n$
(B) $n^2 \lg n$ (D) $n\sqrt{n}$ (F) n (H) $\lg^2 n$ (J) 1

```
int main ( int argc, char * * argv ) {
    int n = atoi(argv[1]);
    if ( simpleCompare ) {
        if ( simpleCompare ) {
            for ( c = 1 ; c < n ; c *= 3 ) {
                if ( simpleCompare ) {
                    for ( d = n ; d > 1 ; d-- ) {
                        simpleStatement;
                    }
                } else {
                    simpleStatement;
                }
            }
        } else {
            if ( simpleCompare ) {
                simpleStatement;
            } else {
                simpleStatement;
            }
        }
    } else {
        if ( simpleCompare ) {
            if ( simpleCompare ) {
                if ( simpleCompare ) {
                    simpleStatement;
                } else {
                    simpleStatement;
                }
            } else {
                simpleStatement;
            }
        } else {
            if ( simpleCompare ) {
                simpleStatement;
            }
        }
    }
    return 0; }
```

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CS 201 Big Oh with logs and roots

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Total points 10.

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Answer Key (points per line)

- | | |
|--------|----------------------------|
| 1 (2). | G ($\sqrt{n} \lg^2 n$) |
| 2 (2). | J (1) |
| 3 (2). | G ($\sqrt{n} \lg n$) |
| 4 (2). | B ($n^3 \sqrt{n} \lg n$) |
| 5 (2). | E ($n \lg n$) |

Total points 10.