

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

```
int main ( int argc, char * * argv ) {
    int n = atoi(argv[1]);
    if ( simpleCompare ) {
        b = 1; do {
            c = n; do {
                for ( j = 1 ; j * j < n ; j++ ) {
                    simpleStatement;
                }
                c /= 5; } while ( c > 1 );
            b += 3; } while ( b * b < n );
    } else {
        f = n; do {
            simpleStatement;
            f /= 2; } while ( f > 1 );
    }
    return 0; }
```

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- 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 (G) \sqrt{n} (I) $\lg n$
 (B) $n^2\lg n$ (D) $n\sqrt{n}$ (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 ) {
                for ( f = 1 ; f * f < n ; f++ ) {
                    simpleStatement;
                }
            }
        } else {
            simpleStatement;
        }
    } else {
        a = 1; while ( a < n ) {
            simpleStatement;
            a *= 2; }
    }
    return 0; }
```

QB2

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

```
int main ( int argc, char * * argv ) {
    int n = atoi(argv[1]);
    if ( simpleCompare ) {
        for ( a = 1 ; a < n ; a *= 2 ) {
            for ( d = n ; d > 1 ; d /= 3 ) {
                f = 1; while ( f * f < n ) {
                    if ( simpleCompare ) {
                        if ( simpleCompare ) {
                            h = n; do {
                                if ( simpleCompare ) {
                                    if ( simpleCompare ) {
                                        simpleStatement;
                                    } else {
                                        simpleStatement;
                                    }
                                } else {
                                    simpleStatement;
                                }
                                h--; } while ( h > 1 );
                            } else {
                                for ( i = 1 ; i < n ; i *= 2 ) {
                                    simpleStatement;
                                }
                            }
                        } else {
                            c = 1; do {
                                if ( simpleCompare ) {
                                    if ( simpleCompare ) {
                                        if ( simpleCompare ) {
                                            simpleStatement;
                                        }
                                    }
                                }
                                c++; } while ( c < n );
                            }
                            f += 5; }
                    }
                }
            }
        }
    }
    return 0; }
```

QB2

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) $n^3 \lg n$ (C) $n\sqrt{n} \lg n$ (E) $n \lg n$ (G) $\lg^4 n$ (I) $\lg n$
(B) n^2 (D) $n\sqrt{n}$ (F) \sqrt{n} (H) $\lg^2 n$ (J) 1

```
int main ( int argc, char * * argv ) {
    int n = atoi(argv[1]);
    i = 1; while ( i * i < n ) {
        for ( h = 1 ; h * h < n ; h++ ) {
            if ( simpleCompare ) {
                if ( simpleCompare ) {
                    if ( simpleCompare ) {
                        if ( simpleCompare ) {
                            for ( e = n ; e > 1 ; e /= 3 ) {
                                b = 1; while ( b * b < n ) {
                                    if ( simpleCompare ) {
                                        if ( simpleCompare ) {
                                            simpleStatement;
                                        } else {
                                            simpleStatement;
                                        }
                                    } else {
                                        simpleStatement;
                                    }
                                }
                                b += 3; }
                            }
                        }
                    } else {
                        simpleStatement;
                    }
                } else {
                    if ( simpleCompare ) {
                        k = 1; while ( k < n ) {
                            c = 1; while ( c * c < n ) {
                                simpleStatement;
                                c += 10; }
                            k *= 3; }
                        } else {
                            if ( simpleCompare ) {
                                simpleStatement;
                            } else {
                                simpleStatement;
                            }
                        }
                    }
                }
            }
        }
    }
    i++; }
return 0; }
```

QB2

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} (I) $\lg n$
(B) $n^2 \lg n$ (D) $n\sqrt{n} \lg n$ (F) n (H) $\lg^2 n$ (J) 1

```
int main ( int argc, char * * argv ) {
    int n = atoi(argv[1]);
    if ( simpleCompare ) {
        if ( simpleCompare ) {
            if ( simpleCompare ) {
                if ( simpleCompare ) {
                    if ( simpleCompare ) {
                        if ( simpleCompare ) {
                            simpleStatement;
                        }
                    }
                }
            }
        } else {
            if ( simpleCompare ) {
                simpleStatement;
            } else {
                simpleStatement;
            }
        }
    } else {
        if ( simpleCompare ) {
            if ( simpleCompare ) {
                if ( simpleCompare ) {
                    simpleStatement;
                } else {
                    simpleStatement;
                }
            } else {
                simpleStatement;
            }
        } else {
            b = n; while ( b > 1 ) {
                simpleStatement;
                b /= 2; }
        }
    }
}
return 0; }
```

QB2

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CS 201 Big Oh with logs and roots

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Total points 10.

QB2

Answer Key (points per line)

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

Total points 10.