Assignment 1

**R-1.1 Graph the functions 12n, 6n log n, n2, n3, and 2n using logarithmic scale for the x- and y-axes; that is, if the function value f(n) is y, plot this as a point with x-coordinate at log n and y-coordinate at log y.**

Answer:

Tool: https://www.desmos.com/calculator

A picture containing screenshot, plot, line

Description automatically generated

**R-1.2 Algorithm A uses 10n log n operations, while algorithm B uses n2 operations. Determine the value n0 such that A is better than B for n ≥ n0.**

Answer:

|  |  |  |  |
| --- | --- | --- | --- |
| the value n0 = 10 that A is better than B for n ≥ n0 | | | |
| **n** | **A = 10n log n** | **B = n2** |
| 2 | 6.02 | 4 |
| 3 | 14.31 | 9 |
| 4 | 24.08 | 16 |
| 5 | 34.95 | 25 |
| 6 | 46.69 | 36 |
| 7 | 59.16 | 49 |
| 8 | 72.25 | 64 |
| 9 | 85.89 | 81 |
| 10 | 100 | 100 |
| 11 | 114.55 | 121 |
| 12 | 129.50 | 144 |
| 13 | 144.81 | 169 |
| 14 | 160.46 | 196 |
| 15 | 176.41 | 225 |
| 16 | 192.66 | 256 |
| 17 | 209.18 | 289 |
| 18 | 225.95 | 324 |
| 19 | 242.96 | 361 |
| 20 | 260.21 | 400 |
| 21 | 277.67 | 441 |
| 22 | 295.33 | 484 |
| 23 | 313.20 | 529 |
| 24 | 331.25 | 576 |
| 25 | 349.49 | 625 |
| 26 | 367.89 | 676 |
| 27 | 386.47 | 729 |
| 28 | 405.20 | 784 |
| 29 | 424.10 | 841 |
| 30 | 443.14 | 900 |

**R-1.6 Order the following list of functions by the big-O notation.**

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Answer:

1/n < log log n < √n < 5n< n log n < 2n log2 n < 4n3/2 < 4log n

< n2 log n < n3 < 2n < 4n

**R-1.10 Give a big-O characterization, in terms of n, of the running time of the Loop1 method below:**

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Answer:

|  |  |
| --- | --- |
| **Algorithm Loop1(n)** | **Big - Oh** |
| s ← 0 | O(1) |
| for *i* ← 1 to *n* do | O(n) |
| *s* ← *s* + *i* | O(n) |
| T(n) | O(n) |

**R-1.14 Perform a similar analysis for method Loop5 below:**

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Answer

|  |  |
| --- | --- |
| **Algorithm Loop5(n)** | **Big - Oh** |
| s ← 0 | O(1) |
| for *i* ← 1 to *n*2 do | O(n2) |
| for *j* ← 1 to i do | O(n4) 🡨 n2 (n2+1) / 2 |
| *s* ← *s* + *i* | O(n4) |
| T(n) | O(n4) |

**Prove: logbxa =a logbx**

Answer:

Definition: y = logbx

So 🡪 x = by

🡪 xa = (by)a = bya

🡪 logbxa = ya

🡪 logbxa = a logbx *(Replace y = logbx from Definition).*

🡪 Proved.