Computational Complexity

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Lecture 5
Nov. 5, 2018

Reminders

- Homework A:
  - Out: Tue, Oct. 29
  - Due: Wed, Nov. 7 at 11:59pm
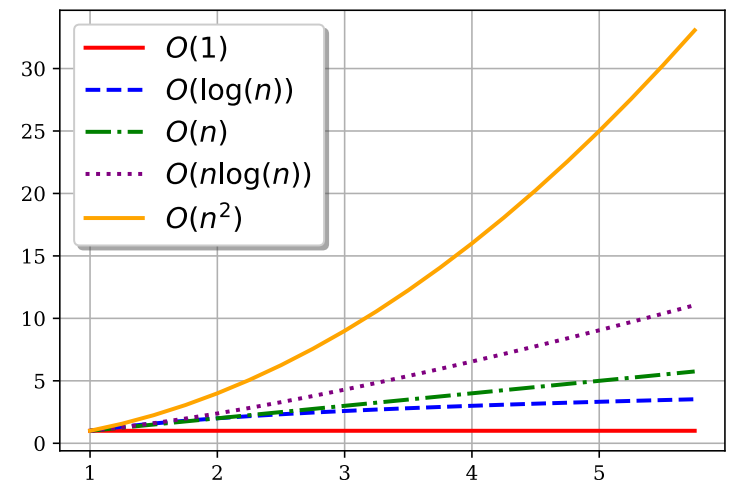- Matt's after-class office hours are back to normal

Q&A

COMPUTATIONAL COMPLEXITY

Analysis of Algorithms

Key Questions:

1. Given a single algorithm, will it complete on a given input in a reasonable amount of time/space?

2. Given two algorithms which one is better?

Analysis of Algorithms

Chalkboard:

- Counting operations
- Example: Euclidean norm of vector
- Example: vector dot product
- Example: Frobenius norm of matrix
- Example: vector-matrix multiplication
- Example: matrix-matrix multiplication

Analysis of Algorithms

Chalkboard:

- – Question: When is one function better than another in terms of runtime?

- – Worst case runtime
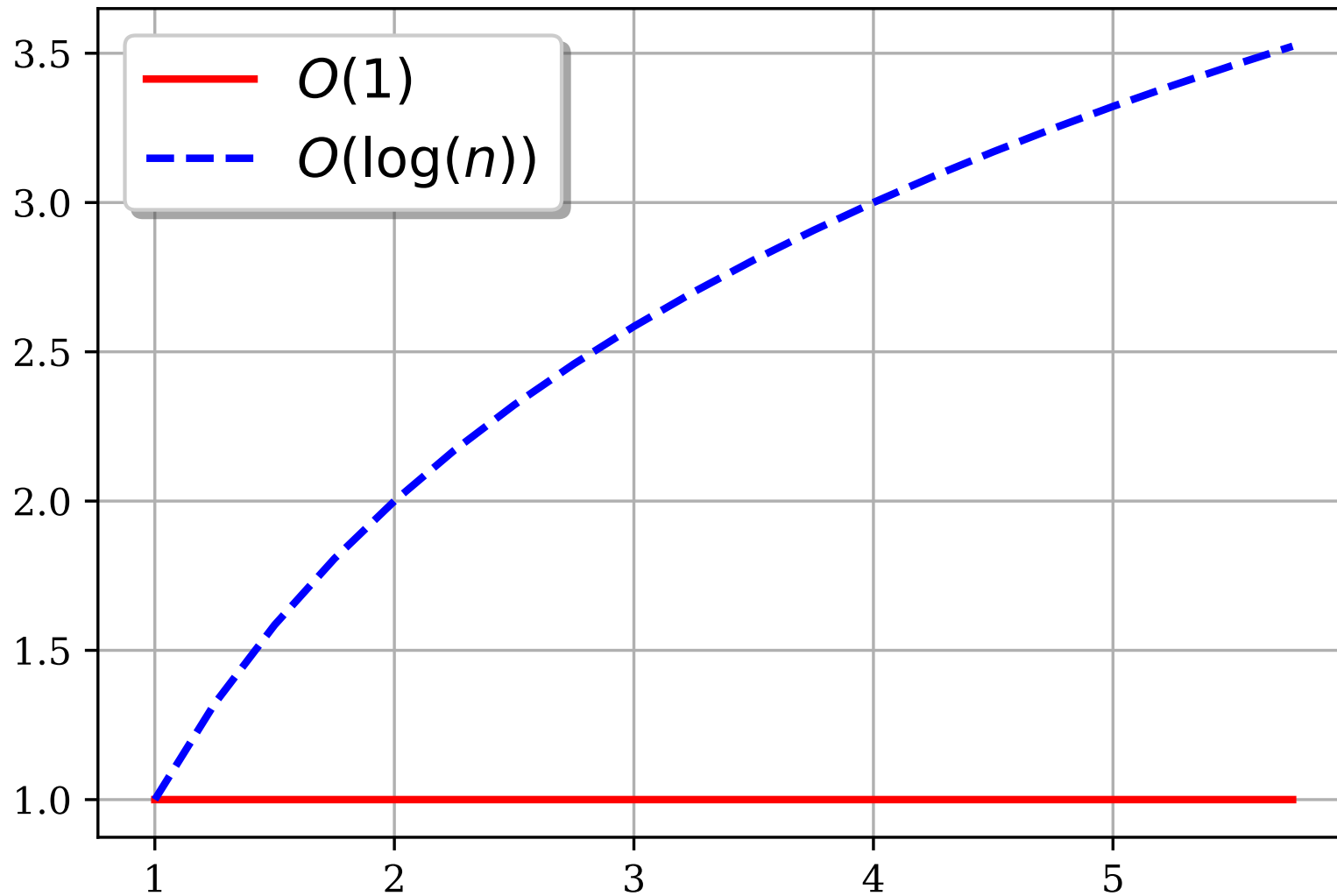
- – Definition: Big-O

Big-O

In-Class Exercise

Which of the following functions are in $O(n^2)$?
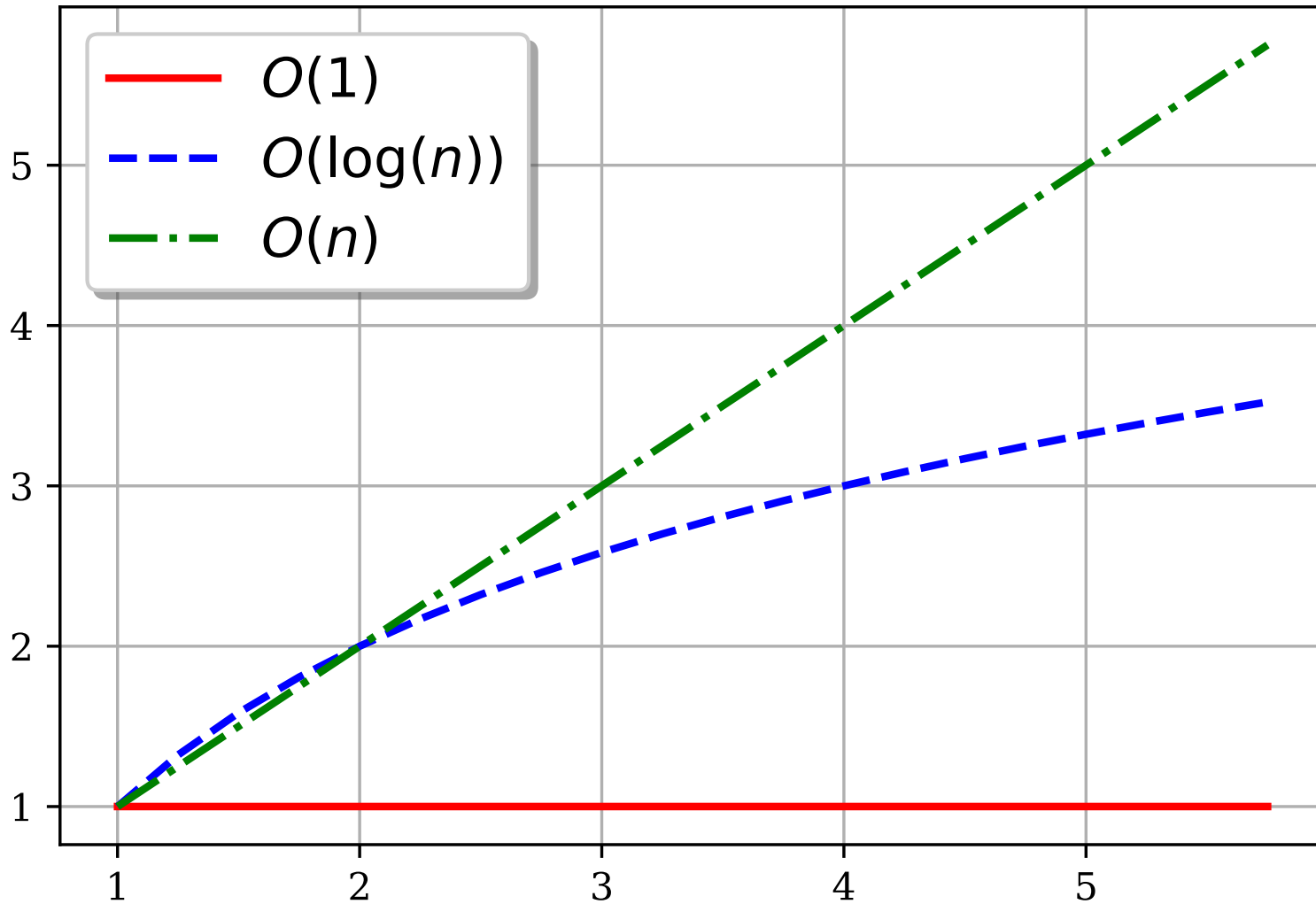
1. 1
2. n
3. $n \log(n)$
4. n^2
5. $4n^2$
6. $4n^2 + n \log(n)$
7. $4n^2 + n \log(n) + n$
8. n^3
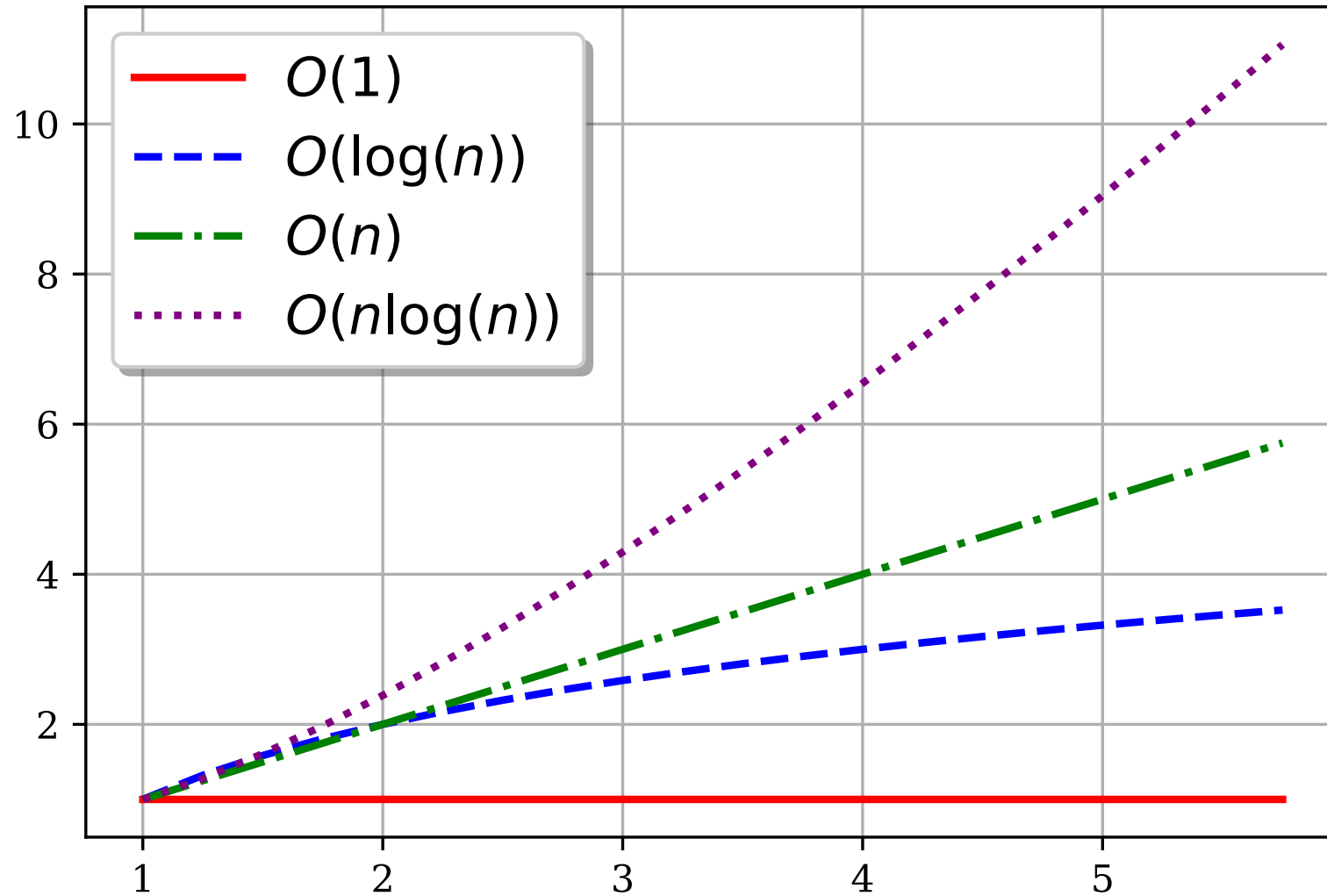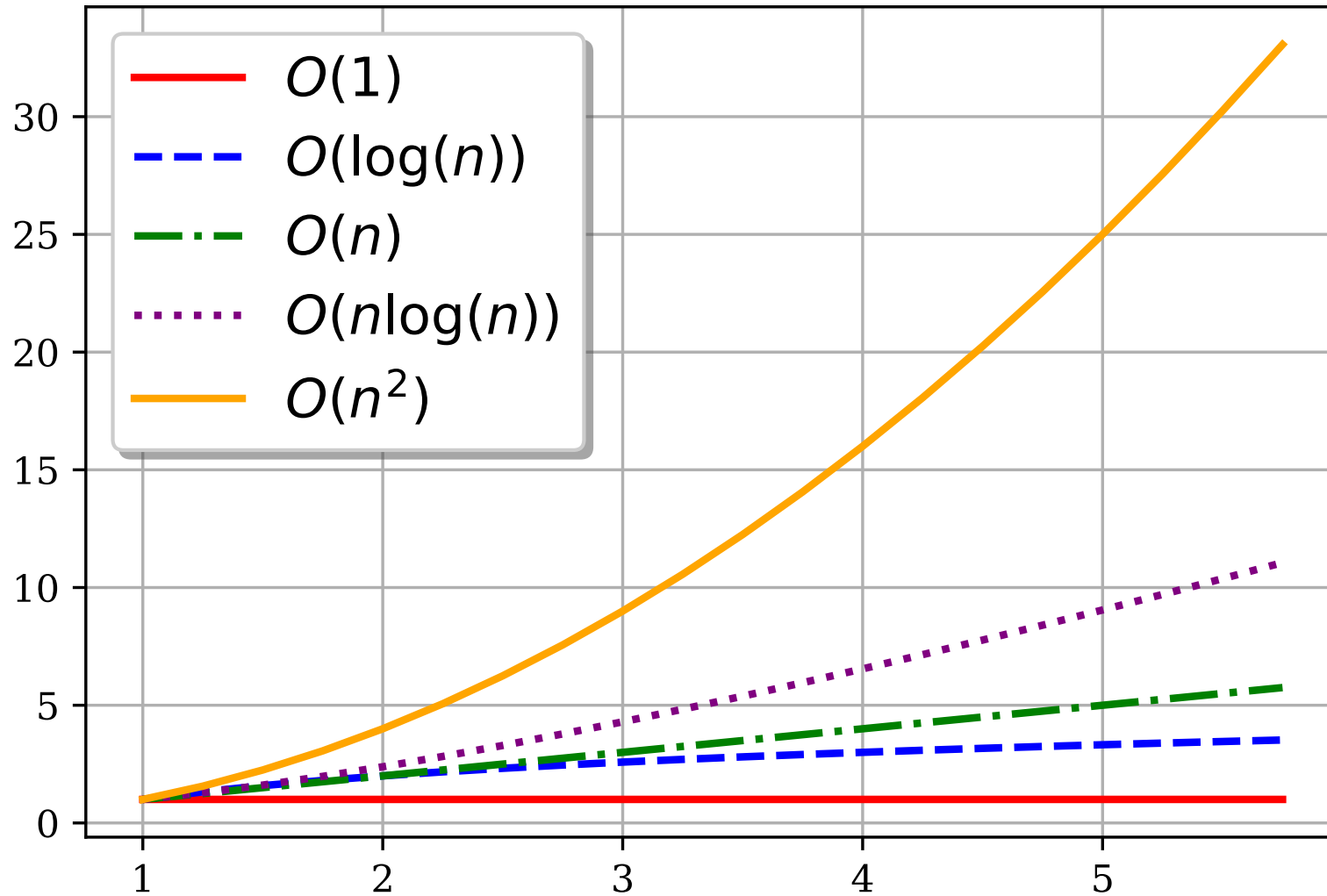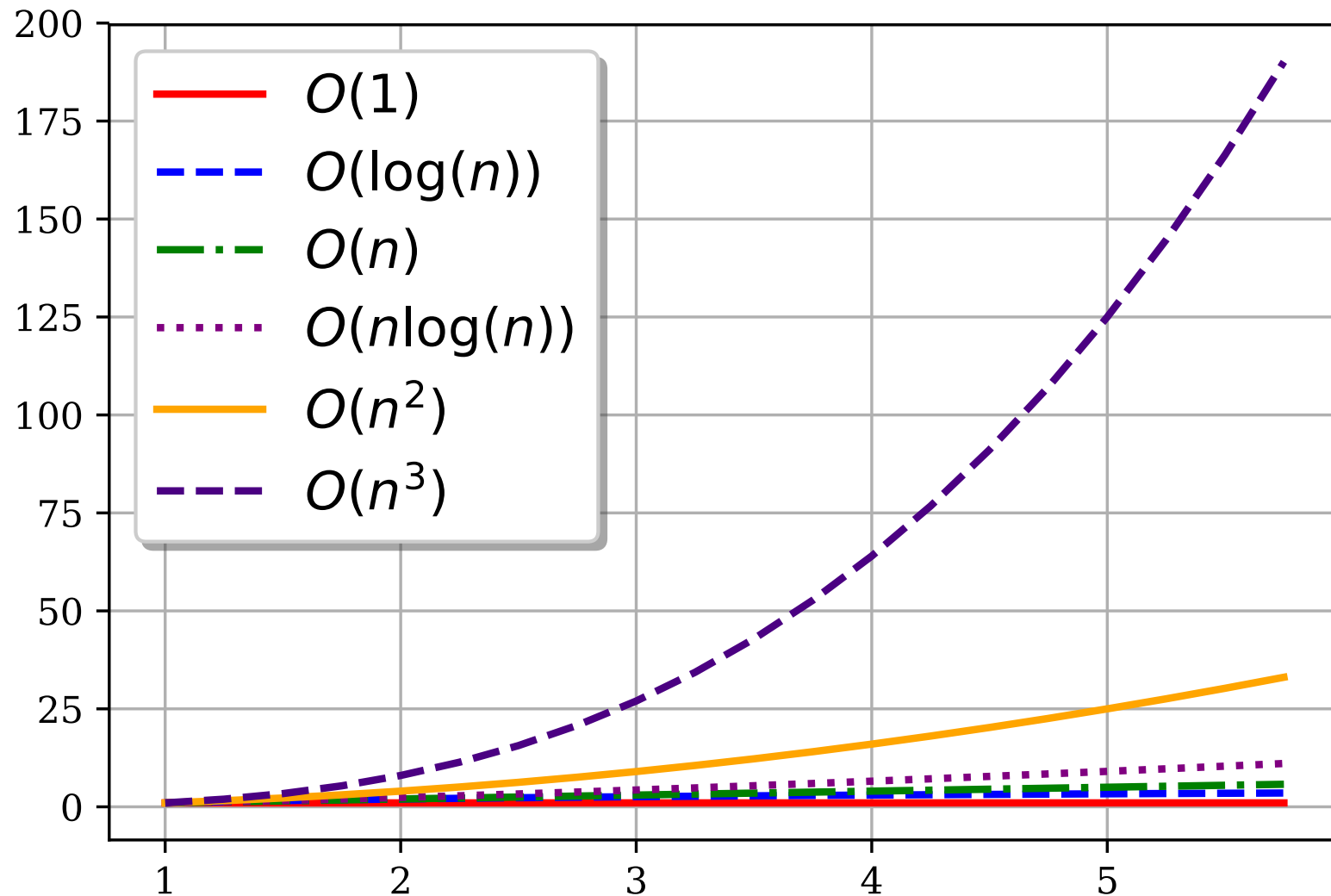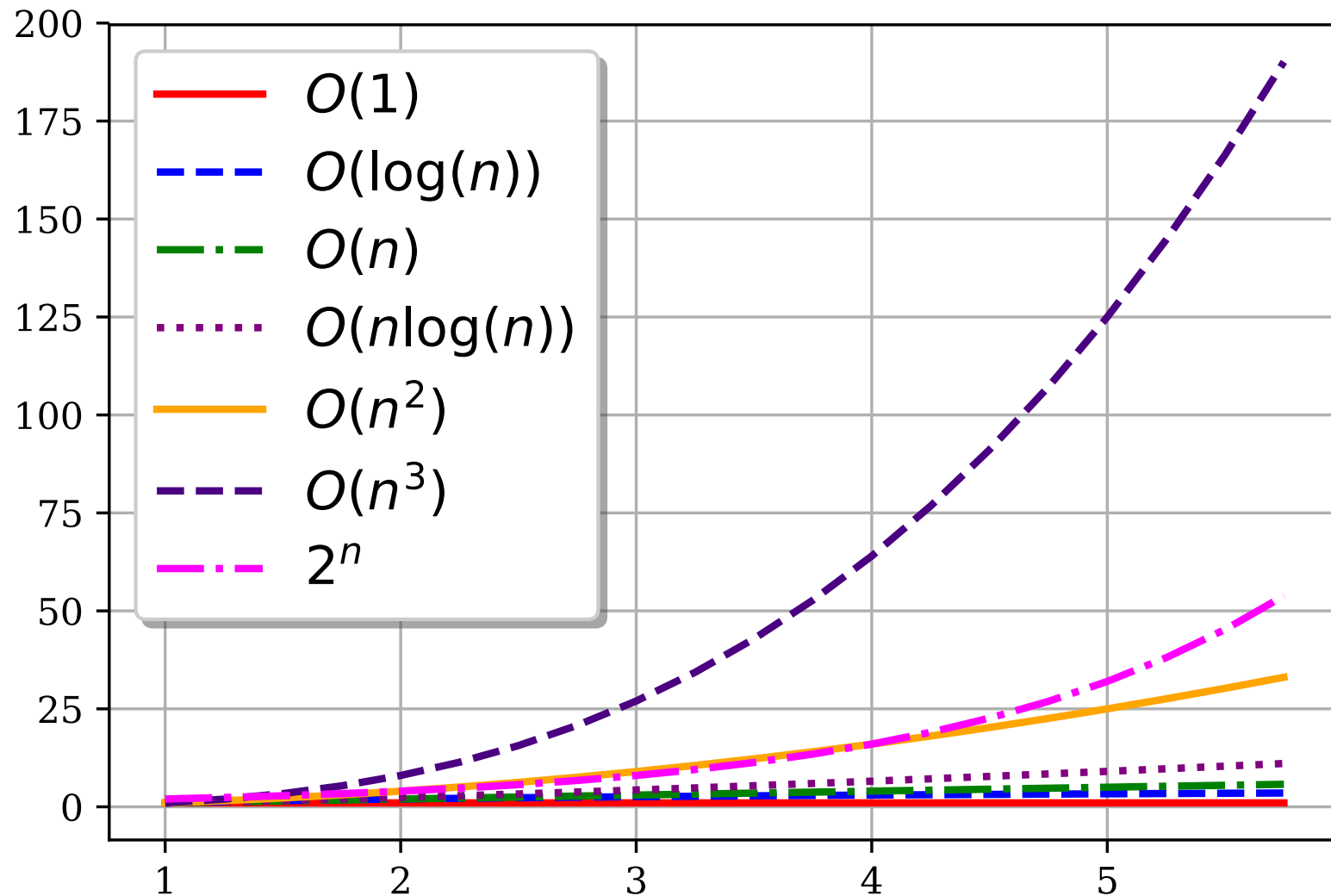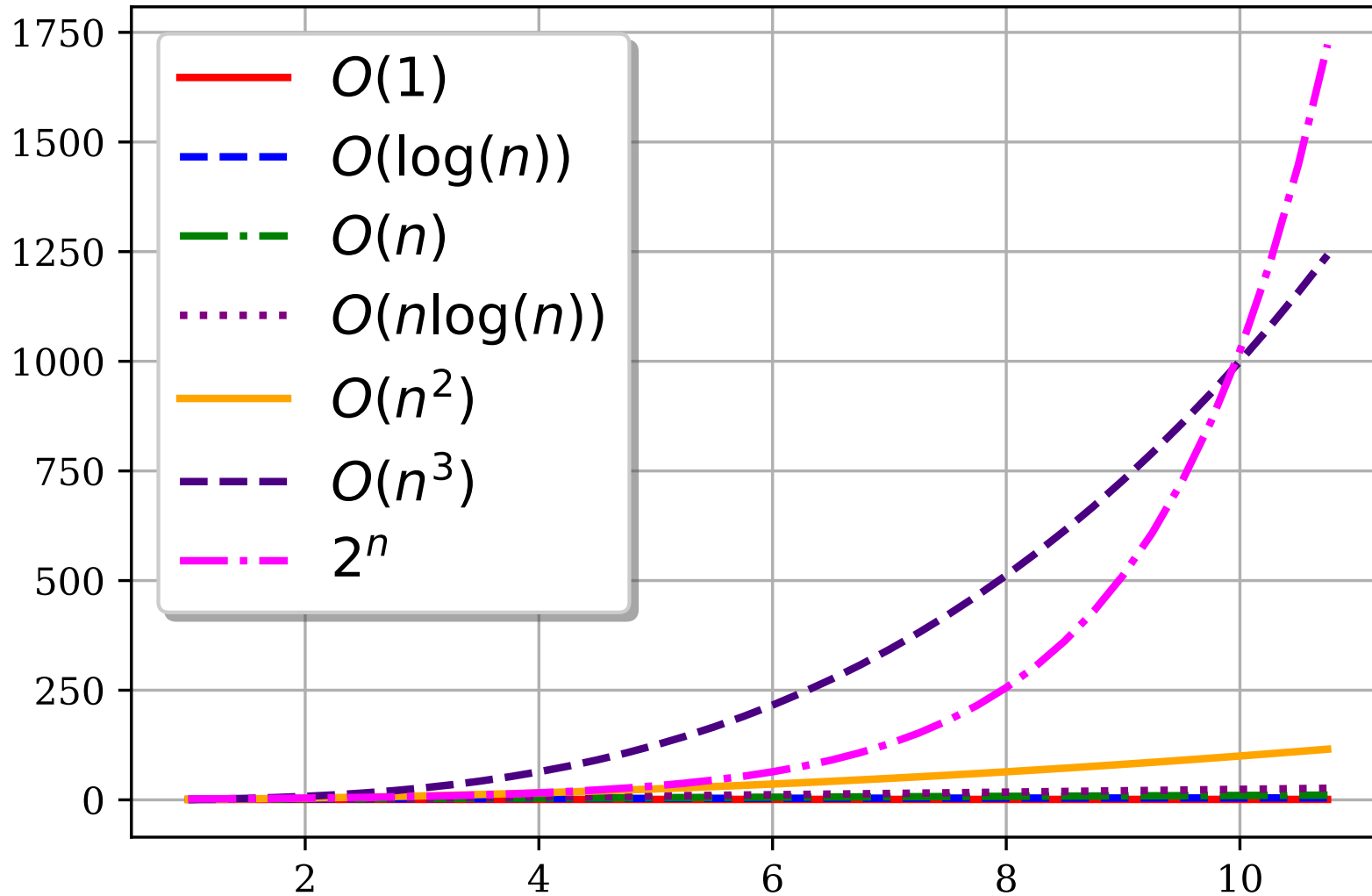9. $n^3 + n^2$

Answer Here:

Comparing Algorithm Runtimes

Comparing Algorithm Runtimes

Comparing Algorithm Runtimes

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Comparing Algorithm Runtimes
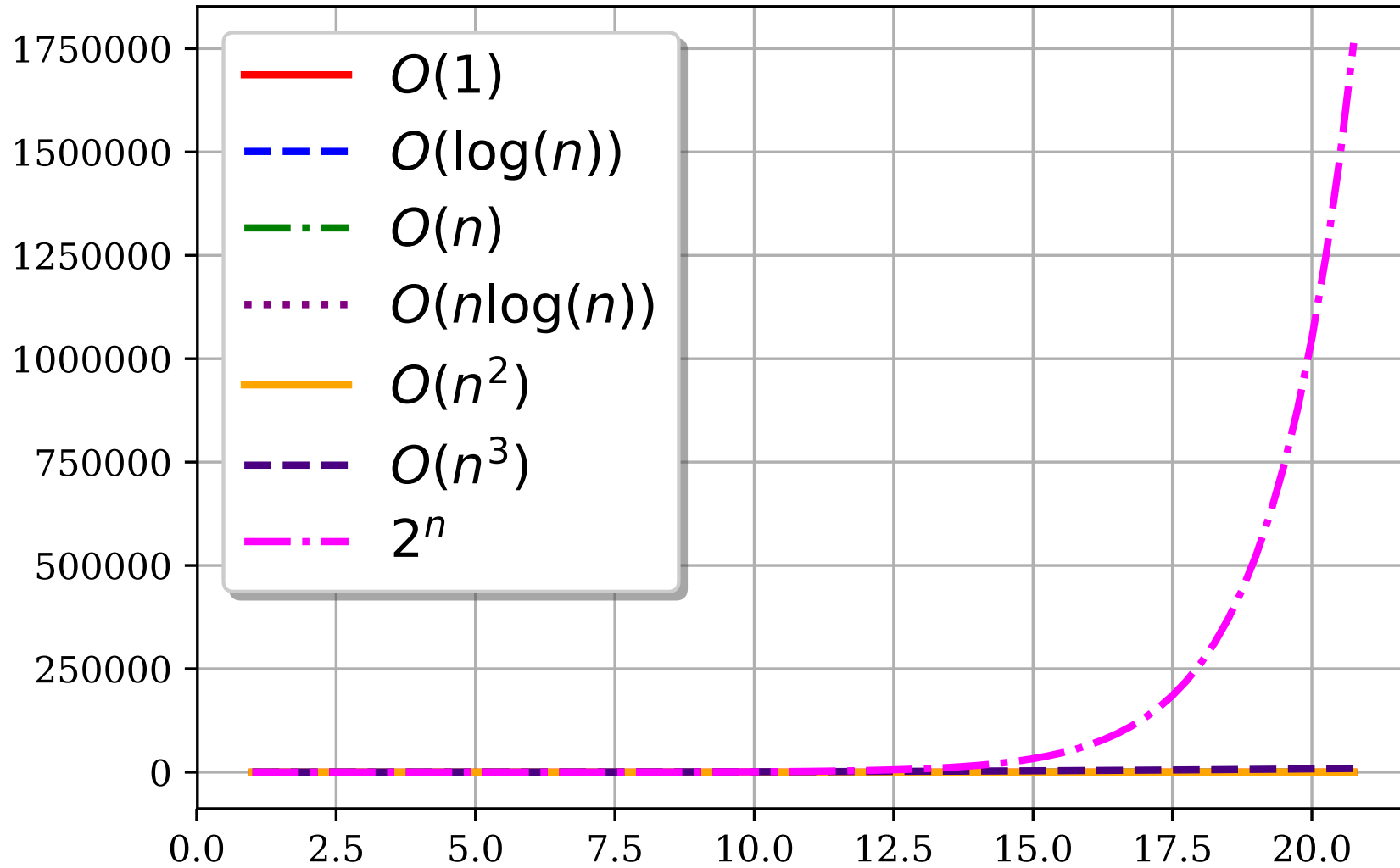
Computational Complexity	Name
$O(1)$	constant
$O(\log(n))$	logarithmic
$O(n)$	linear
$O(n \log(n))$	--
$O(n^2)$	quadratic
$O(n^3)$	cubic
$O(2^n)$	exponential
$O(n!)$	factorial
$O(n^n)$	superexponential