Tutorial 1 - Asymptotic Notations

Find the relationship between $f(n)$ and $g(n)$. It can be:

- $f(n) = \mathcal{O}(g(n))$
- $f(n) = \Omega(g(n))$
- $f(n) = \Theta(g(n))$

1. $f(n) = \frac{n^2-n}{2}$ and $g(n) = n$

2. $f(n) = n + 2\sqrt{n}$ and $g(n) = n^2$

3. $f(n) = n + \log n$ and $g(n) = n\sqrt{n}$

4. $f(n) = 2(\log n)^2$ and $g(n) = \log n + 1$

5. $f(n) = n^2$ and $g(n) = n^3$

6. $f(n) = 2n^2 + 1$ and $g(n) = n^2$

7. $f(n) = 3n^2 + \sqrt{n}$ and $g(n) = n + n\sqrt{n} + \sqrt{n}$

8. $f(n) = n \log n$ and $g(n) = n\sqrt{n}$

9. $f(n) = n^2 + 3n$ and $g(n) = 6n + 7$

10. $f(n) = n\sqrt{n}$ and $g(n) = n^2 - n$

11. $f(n) = n^{\log n}$ and $g(n) = (\log n)^n$

12. $f(n) = 3n\lfloor \log n \rfloor$ and $g(n) = n^2$

13. Rank the following functions by increasing order of growth (i.e., the slowest-growing first, the fastest-growing last)
    (a) $(\log \log n)^2$
    (b) $\log(n!)$
    (c) $\sqrt{n}$
    (d) $n^{1.1}$
    (e) $n \log n$
    (f) 2^n

(g) n^2

(h) $(\log n)^{0.3}$

(i) $10 \log n$

(j) $2^{\log n}$

14. Compute simple, tight upper bounds for f(n), where f(n) is the following:

(a) $\log_{ln_5}(log^{log100}n)$

(b) $5^{log(3)}n^3 + 10^{80}n^2 + log(3)n^{3.1} + 6006$

15. Sort the functions in increasing order of asymptotic (big-O) complexity:

(a) $f_1(n) = n^{0.999999}logn$

(b) $f_2(n) = 100000n$

(c) $f_3(n) = 1.000000001^n$

(d) $f_4(n) = n^2$