HOME WORK 2: THEORY OF COMPUTATION
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1 Time Complexity

Problem. 1
Order the following functions by their growth rate (the most slowly-growing function appearing first); if two functions are same, group them together.

(1)	1	(2)	7	(3)	$7^{\lg n}$
(4)	$(\lg n)^{\lg n}$	(5)	$\sqrt{n}\lg^2 n$	(6)	n
(7)	$n \lg n$	(8)	$n^{\frac{1}{\lg n}}$	(9)	$n^{\lg 7}$
(10)	$n^{1+\frac{\lg\lg n}{\lg n}}$	(11)	$n^{\lg \lg n}$	(12)	$\left(1-\frac{1}{n}\right)^n$
(13)	$\left(1-\frac{1}{7}\right)^n$	(14)	$\left(1+\frac{1}{n}\right)^n$	(15)	$\left(1+\frac{1}{7}\right)^n$

2 Context Free Grammar

Problem. 2
Exercise 2.4: e, f, g. (Sipser, pp 120).

3 Pumping Lemma

Problem. 3
Exercise 2.18: c, d. (Sipser, pp 121).

4 CFL and Dyck Language [HARD]

Problem. 4 A *Dyck Language* is a language with with k types of balanced parentheses. Formally, each Dyck language is, for some k, $\mathcal{L}_D = L(G_k)$, where G_k is the grammar:

$$S \rightarrow SS \mid [_1 S]_1 \mid [_2 S]_2 \mid \cdots \mid [_k S]_k \mid \epsilon.$$

Prove that every CFL $\mathcal{L} = h(\mathcal{L}_D \cap R)$, where h is a homomorphism, R a regular set and $\mathcal{L}_D$ a Dyck language.