Formal Languages and Automata Theory, SS 2018. Homework 1 (due Week 2)

1. Give examples of NP-hard problems. Explain.
2. Specify the language generated by the grammar $G = (V_N, V_T, S, P)$:
   (a) $V_N = \{A\},\ V_T = \{a, b\},\ S = A,\ P = \{A \to aA|b\}$
   (b) $V_N = \{x_0, x_1, x_2\},\ V_T = \{A, B, ..., Z\},\ S = x_0,\ P = \{x_0 \to Ex_1, x_1 \to Nx_2, x_2 \to D\}$
   (c) $V_N = \{A\},\ V_T = \{0, 1, 2\},\ S = A,\ P = \{A \to 0A0|1A1|2A2|\lambda\}$
   (d) $V_N = \{S, A\},\ V_T = \{0, 1, ..., 9, .\},\ P = \{S \to A.A, A \to 0A|1A|...|9A|0|1|...|9\}$
   (e) $V_N = \{S\},\ V_T = \{USR, PNL, PSD, ANR\},\ P = \{USR|PNL|PSD|ANR\}$. Why don't we have a starting point specified?
   (f) $V_N = \{A, B, C\},\ V_T = \{0, 1\},\ S = A,\ P = \{A \to 0A|1B|1,\ B \to 0C|1A,\ C \to 0B|1C|0\}$
   (g) $V_N = \{S, A, B, C\},\ V_T = \{0, 1, ..., 9, +, -\},\ P = \{S \to +A|-A|A,\ A \to 0A|1A|...|9A|0|...|9\}$
   (h) $V_N = \{S\},\ V_T = \{(,)\},\ P = \{S \to S(S)S|\lambda\}$
   (i) $V_N = \{E, T, F\},\ V_T = \{(,), i, +, *\},\ S = E,\ P = \{E \to E + T|T, T \to T * F|F, F \to (E)|i\}$
   (j) $V_N = \{S, A, B\},\ V_T = \{a, b, c\},\ S = E,\ P = \{S \to abc|aAbc, Ab \to bA, Ac \to Bbcc, bB \to Bb, aB \to aaA|aa\}$
   (k) $V_N = \{S, A, B, C, D, E\},\ V_T = \{a\},\ P = \{S \to ACaB, Ca \to aaC, CB \to DB|E, aD \to Da, AD \to AC, aE \to Ea, AE \to \lambda\}$
   (l) $V_N = \{S, A, B, C, D, E\},\ V_T = \{a, b\},\ P = \{S \to ABC, AB \to aAD|bAE, DC \to BaC, EC \to BbC, Da \to aD, Db \to bD, Ea \to aE, Eb \to bE, Db \to bD, AB \to \lambda, C \to \lambda, aB \to Ba, bB \to Bb\}$