Test Grades in Natural Computing

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On the same row of every student (code) the grade for each of the eight exercises is reported (/ denotes a missing solution), beside the final grade (in the last column). Vast majority of the students passed the test, with a grade which may be incremented up to 30L by a valuable homework (project), to be assigned. Normally, following votes superior or equal to 18 will be registered by the instructor on the exam session in February 2020, alternatively to regular oral exams.

Code	**Ex1**	**Ex2**	**Ex3**	**Ex4**	**Ex5**	**Ex6**	**Ex7**	**Ex8**	**Grade**
VR433863	4	2	4	4	3	3	4	6	30
VR438862	4	2	4	4	3	3	2	6	28
VR433864	4	2	4	4	3	3	2	6	28
VR438849	4	–	4	4	3	3	4	5	27
VR433443	4	2	4	3	3	3	2	4	25
VR433409	4	2	4	3	3	3	2	4	25
VR436965	4	1	4	3	/	3	4	5	24
VR432685	4	2	1	4	3	3	2	4	23
VR417502	4	2	4	2	/	3	2	6	23
VR439145	2	2	4	3	3	3	2	4	23
VR433385	4	2	4	4	–	3	2	3	22
VR434413	4	1	4	3	–	3	2	4	21
VR438715	4	2	4	3	–	3	–	4	20
VR437279	3	1	4	3	3	3	2	–	19
VR437110	3	1	4	3	3	2	2	/	18
VR434432	2	1	/	2	–	2	–	1	8
VR406802	3	/	2	1	/	1	/	1	8

Test exercises are reported in the following, with corresponding grades.

1. Give the scheme of evolutionary computing strategy, and specify main differences between genetic and memetic algorithms.**[2+2]**

2. Explain how nature solves the enzymatic paradox. [**2**]

3. Pick one between the Sakamoto's and the Jonoska's algorithm solving SAT and explain it, both in formal and implementation terms. [**4**]

4. Report the quaternary recombination algorithm to generate DNA libraries, prove its correctness, and show corresponding evidence strings. [**2+1+1**]

5. Report a membrane system computing the square function: $n \mapsto n^2$. [**3**]

6. Given a metabolic system with rules $r_1 : a \to ba$, $r_2 : a \to bc$, $r_3 : b \to bc$, $r_4 : b \to ab$, corresponding flux maps: $u_1 = f_1(a,b,c) = b, u_2 = f_2(a,b,c) = 2, u_3 = f_3(a,b,c) = a, u_4 = f_4(a,b,c) = c$, and initial state X[0] = (3,1,2), execute two computational steps: from X[0] to X[1] and from X[1] to X[2]. [**2+1**]

7. In the framework of informational genomics, for a genome G over the alphabet Σ: *i*) define the recurrence distance distribution (RDD) for a genomic word α occurring in G, and *ii*) prove that $MFL \leq MHL{+}1$, where Minimal Forbidden Length is defined by $\min\{k : D_k(G) \neq \Sigma^k\}$ and Mimimal Hapax Length by $\min\{k : H_k(G) \neq \emptyset\}$, with $D_k(G)$ the dictionary of k-mers occurring in G and $H_k(G)$ the dictionary of k-mers occurring once. [**2+2**]

8. Prove that: *i*) the trisomatic language $L = \{a^n, b^n, c^n \mid n \in \mathbb{N}\}$ is decidable, *ii*) it cannot be recognized by a PDA, *iii*) it may be used as a counterexample to show that CF is not a Boolean algebra. [**2+2+2**]

   (Hint: one grammar generating L is $\{S \to abc, S \to aSBc, cB \to Bc, bB \to bb\}$).