Errata List (July 1999)
Online Computation and Competitive Analysis

Chapter 1

- **page 7, line -2;** The sentence would read better as follows: Suppose there are ν such asterik inversions.
- **Page 17, line 1;** $\text{OPT}^*(\sigma) = B$ (and not $\leq B$); also the sentence "Note that ..." should be removed.

Chapter 3

- **Page 38, exercise 3.5;** CLOCK is *not* a marking algorithm. Hence the line following the exercise is also incorrect. Corllary 3.3 remains correct since CLOCK is a conservative algorithm as stated in exercise 3.8. We thank Xiaobo Peng and Chi-Lok Chan for independently pointing out this error to us.

Chapter 6

- **page 86, line 7;** the displaced equation for $p(\ell|\mathbf{b})$ is incorrect. It cannot be defined in terms of weighted sums of pure strategy profiles when a game is nonlinear. In general, the value of $p(\ell|\mathbf{b})$, the probability of reaching the leaf ℓ given the profile b, can be calculated directly in the obvious way.

Chapter 9

- **page 129, proof of Lemma 9.1;** In general it is impossible to choose a real $\varepsilon < 1$ such that all fractions $\frac{r(i)-r(i-1)}{\varepsilon}$ are integer. In fact, the possibility to do so would imply that *all* ratios between real numbers are rational! However, for rational r(i) the claim is clearly true and since the real numbers can be approximated by the rationals we can assume that all task costs are rational.
- **page 133, line 4;** $z = \arg\min_x\{w_{i+1}(z) + d(x, s_i)\}$ should be $z = \arg\min_x\{w_{i+1}(x) + d(x, s_i)\}$
- **page 139;** "... an online-randomized algorithm is reasonable, if for all states $i \neq j$, $p_i = p_j + d$ implies $p_i = 0$" should read "... an online-

randomized algorithm is reasonable, if for all states $i \neq j$, $w_i = w_j + d$ implies $p_i = 0$"

- **page 146, line -5;** Amongst the important insigts of the Blum *et al.* and Seiden papers, we should have explicitly mentioned 'unfair metrical task systems' which plays a key role in the development of the results in section 9.6.1.

Chapter 11

- **page 200, line 3 of open question 11.4;** Typo: sentence should read: Although ..... ratio k in any .....

Chapter 12

- **page 206;** The Hint for Exercise 12.1 is misleading. The hint seems to imply that the defintion of the competitive ratio is $\max_\sigma \max_t \frac{\mathrm{ALG}_t(\sigma)}{\mathrm{OPT}_t(\sigma)}$. Given this definition, it is not hard to show that N is a lower bound on the competitive ratio for any online algorithm. The standard (and more reasonable) definition that is being used throughout this chapter is $\max_\sigma \frac{\max_t \mathrm{ALG}_t(\sigma)}{\max_t \mathrm{OPT}_t(\sigma)}$. The hint should read "Consider the above inequalities at the time when GREEDY assumes its maximum cost."

- **page 207, proof of Theorem 12.2;** In the proof that $R_i \leq W_i$, the paragraph devoted to showing $R_i \leq W_i$ is not correct. We unsuccesfully tried to simplify the original proof of Azar, Naor and Rom [35]. In their proof, R_{ij} is defined as the load from jobs scheduled by OPT on machine j that still has to be processed by GREEDY after layer i and W_{ij} is defined as the load assigned by GREEDY on machine j during layer i. Then one proves $R_{ij} \leq W_{ij}$ from which it immediately follows that $R_i \leq W_i$.

- **page 212, line 6;** The end of the sentence should read: "in order to process requests $r_1, \ldots, r_n$".

- **page 213;** The equality $= \log_a(\frac{1}{1-\gamma}) \log_a m \cdot \Lambda$ should be $= (\log_a(\frac{1}{1-\gamma}) + \log_a m) \cdot \Lambda$.

- **page 213, introductory paragraph of section 12.4;** The definition of the competitive ratio for temporary jobs is ambiguous. All competitive bounds in this chapter (and the following chapter) are defined as follows: Let $\mathrm{ALG}(\sigma, t)$ denote the load of algorithm ALG at time t on the input sequence σ. We then define $\text{ALG}(\sigma)$ to be $max_t(\text{ALG}(\sigma, t)$. We similarly define $\text{OPT}(\sigma, t)$ and $\text{OPT}(\sigma)$. The competitive ratio is then (essentially) the ratio $\text{ALG}(\sigma)$ / $\text{OPT}((\sigma)$.

Chapter 13

- **page 244, first paragraph;** We did not provide the appropriate references for the claim that the optimal deterministic competitive ratio for the problem of disjoint paths on an $N \times N$ array is $\Theta(\sqrt{N})$. The upper bound is due to Kleinberg and Tardos and appears in citation [227]. It is a special case of their more general result which we state (but do not prove) in Lemma F.1 (page 376). Kleinberg attributes the lower bound to an unpublished manuscript by Blum, Karloff, Fiat, and Rabani. He presents his own proof in his PHD thesis which can be obtained by accessing:
`http://simon.cs.cornell.edu/home/kleinber/kleinber.html#papers`.

- **page 254;** There is some ambiguity in the specification of Algorithm RECG_w. First, we should say that the set $\{r_{j_1}, \ldots r_{j_s}\}$ is a lexicographically first minimal set of intervals so that this set is consistently and unambiguously defined. Second, we should say that when $\sigma' r_{n+1}$ has maximum edge congestion $k+1$, we color A by FFC using colors different than those used for σ'.

- **page 255, third paragraph;** The sentence "Then, by the above argument, r_1, r_2, and r_3 do not pairwise intersect" is correct but not that helpful. The sentence should read "Then r_1, r_2, and r_3 must be disjoint intervals; for otherwise if r_i and $r-j$ intersect, then r, r_i and r_j would contradict the argument above."

- **page 257;** The comment following Theorem 13.25 is inappropriate since the deterministic upper bound of Theorem 13.12 is being compared to the randomized lower bound in Theorem 13.25. Recently, Leonardi and Vitaletti (in RANDOM 98) establish an $\Omega(\log\log N) = \Omega(\log D)$ randomized lower bound for path coloring on a complete binary tree of depth D. (See Open Question 13.6.)

Chapter 14

- **page 272, equation (14.6) is incorrect.** It should read $c_n^*(\varphi) = \varphi(1 - \frac{(\varphi-1)^n}{(\varphi^{\frac{n}{n-1}}-1)^{n-1}})$

- **page 277, Theorem 14.5 (i);** it is informative to mention that $c_2^*(\varphi) < 2$ for all φ and limits to 2 as φ increases. We should also note that the comment $c_2^*(\varphi) > 1$ assumes that $\varphi > 1$.

- **page 278, line -3;** Should read: "Otherwise, invest a fraction b of dollars in yen where ..." Also, there is an underlying assumption that $\phi > 1$. (If $\phi = 1$ (and $x_1 < 1$) then when $n = 2$, we obviously dont want to trade any dollars into Yen.

- **page 293;** In the first inequality leading to (14.23), in the denominator of the right hand side, $x^i_{ij_i}$ should be x_{ij_i}

- **page 298, equation (14.29);** It is misleading to use the subsript d here; d should be replaced by $m - 1$.

- **page 299, Lemma 14.7;** No need to mention first equality in which case there is no need to netion F or f.

- **page 299, last line of the proof;** The integral is missing dy.

- **page 302, the displayed equation at the top of the page;** This equation (which has 4 inequalities and two equalities) has two errors. The explanations for the third and fourth inequalities should be interchanged. Also, the right hand side of the third inequality (line 6) has a typo: $\mathrm{com}(\mathbf{b}^*, \mathbf{b}^*)$ should be $\mathrm{com}(\mathbf{b}^*, \mathbf{b})$.

- **page 302, Corollary 14.13;** instead of the binomial coefficient in the right hand side of the inequality there should be its reciprocal.

- **page 307, Corollary 14.17;** the lower bound (14.35) holds for any online portfolio selection algorithm.

Chapter 15

- page 340, Example 15.5; In this lottery one receives 2^{n-1} if the first heads occurs in the nth trial.

- **page 341, first line;** The sum should be $\sum_i \frac{1}{2^i} \ln 2^{i-1} = \ln(2)$. Then, the certainty equivalent of this lottery is 2 (and not 4).

- **page 345, Section 17.7.3, line 1;** "von NM" should be "NM"