Problem Solving and Search in Artificial Intelligence

Final Exam, 20.06.2011

Student:
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I. (Closed book part of the exam) - 10 points

1. Explain which are possibilities for tuning of parameters? Which methods could be used for on-line parameter tuning? (5p)
2. How does k-tournament selection work? (5p)

II (Open book part of the exam) - 50 points

Consider a simple break scheduling problem defined below:
7 employees start their work at 7:00 and finish at 16:00. Each employee must have during the working time 5 breaks (each 15 minutes long), and a lunch break (30 min). The aim is to find a schedule of breaks for each employee such that the following constraints are fulfilled:

- In each time slot (length of slot: 15 minutes) at least 5 employees must work (not have a break).
- An employee can not have a break in the first and the last 30 minutes of his working time.
- The distance between two breaks must be at least 45 minutes.
- The maximal distance between two breaks is 90 minutes.
- The lunch break must be located between 11:00-14:00.

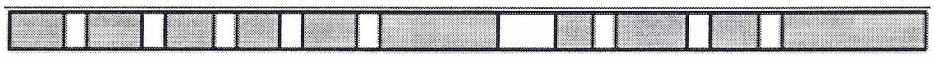

Figure 1: An example of employee which has 8 breaks (each 15 min) and a lunch break (30 min)

1. Formulate this problem as CSP and: (15 p)
   a. Illustrate how you could solve it by using forward checking (only few steps)
   b. Draw a part of constraint graph for this problem. Do you think that this graph will have small tree width (explain your answer)
2. Find an appropriate solution representation for this problem. (5 p)
3. Define an evaluation function which could be used by heuristic techniques. (5p)
4. Define at least two moves which can be used by local search, and one crossover operator. (8 p)
5. How could you apply tabu list for this problem. Present few steps of tabu search algorithm. (9 p)
6. Explain shortly how you could apply min-conflicts heuristic for this problem. (6 p)

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① 1) • Parameters are determined manually
• Automated algorithm configuration
↳ off-line parameter setting
↳ on-line — " —

manual: → select different configurations for parameters
→ select representative instances
→ run experiments with different parameter configurations
→ statistical analysis → select best configurati.

offline: search problem for best parameters out of a parameter search
number of solutions = number of parameter configurat.

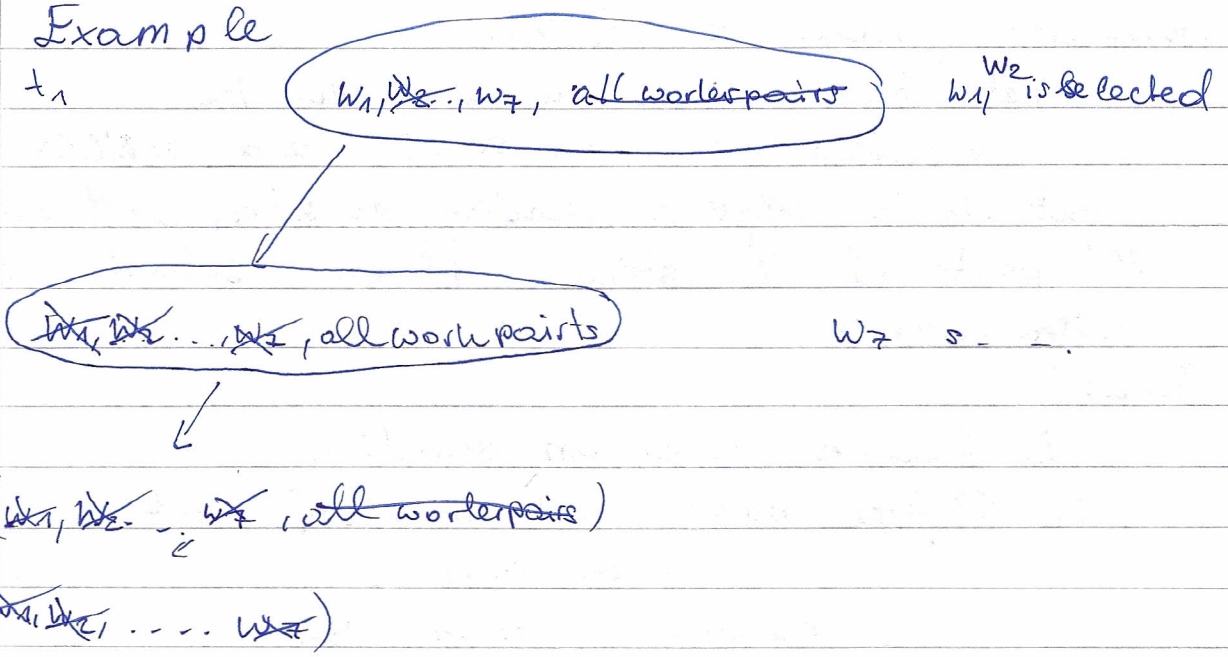
online: parameters are changed based on the feedback during the search
possible parameter changes: → increase tabu length
→ mutation size
→ apply neighbourhood relations
machine learning techniques

2) Tournament selection is a method of seleding an individual from a population of individuals in a genetic algorithm. First k individuals are chosen. Then the best individual (fitness) is chosen with probabieity p. Then the second best wit $p \cdot (1-p)$... third bestone $p \cdot (1-p)^2$ and so on
deterministic tournament selection chooses the best individual ($p=1$)

$(1 \leq k \leq 7)$

1) a) forward checking: assign a worker w_k at t_s, wher $1 \leq s \leq n$ and remove w_k out of t_{s+1}, t_{s+2} and t_{s+3}. if the next set of possible values is empty this branch is not a possible solution

Example



2)

	t_1	t_2	t_3	.....	t_{n-1}	t_n
w_1	0	1	0		1	0
w_2	1	0	0			
w_3	0	1	0			
w_4	0	0	1			
w_5	1	0	0			
w_6	0	0	0			
w_7	0	0	1			

1 = break
0 = working

maxbreaktime: 105min

3) eval function: $f(w_i) = g(w_i) + f(w_i)$

$g(w_i)$: max breaktime − already taken time

$f(w_i)$: break count · 15min

take employee with max $f(w_i)$