CONCORDIA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

COMP 6651: Algorithm Design Techniques

Fall 2014 Quiz # 6

First Name	Last Name	ID#

Question 1

Assume that you are solving a combinatorial **minimization** problem using a branch-and-bound method with a best first strategy.

- Recall the definition of the incumbent value as a function of some of the subproblem lower or upper bounds

$$z^{\text{BEST}} = \min_k \overline{z}_k.$$

- A representation of the current search tree associated with the branch-and-bound method is depicted in Figure 1. What is the incumbent value?

$$z^{\text{BEST}} = 40.$$

- Recall the test allowing to fathom a node (i.e., subproblem $\#k$), which involves the incumbent value and the lower or upper bound of sub-problem $\#k$

Prune subproblem associated with node k in the search tree if $z^{\text{BEST}} \leq \underline{z}_k$.

- Best first strategy: what is the selection rule of the next sub-problem to investigate further following the best first strategy that was discussed during the class.

Investigate node $\#k$ associated with the worst lower bound, i.e., with $\min_k \underline{z}_k$.

- Represent the max-min heap that is associated with the search tree of the branch-and-bound
  See Figure 2. Only consider the live nodes!
- Are there any subproblem that can be fathomed?
  Three subproblems can be pruned: $\#17$ ($\underline{z}_{17} = 45$), $\#16$ ($\underline{z}_{16} = 40$), $\#6$ ($\underline{z}_6 = 41$).
- If yes, provide the max-min heap after the fathoming step.
  See Figure 3.

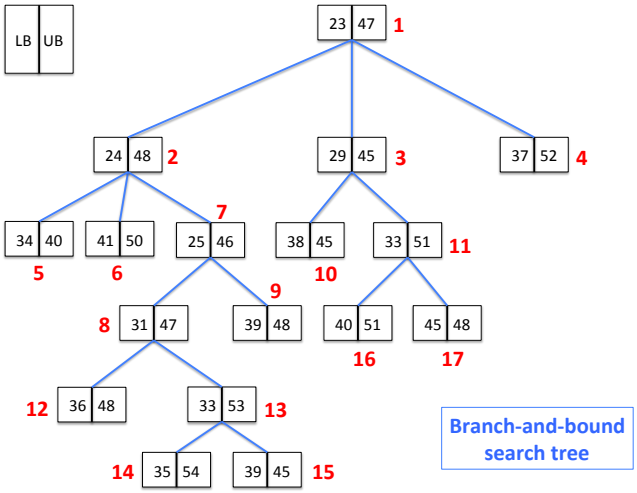

Figure 1: Search tree of the branch-and-bound method

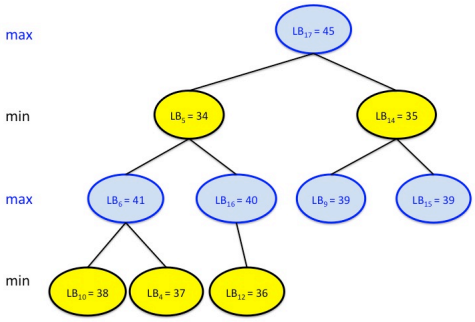

Figure 2: Max-min heap before the fathoming step

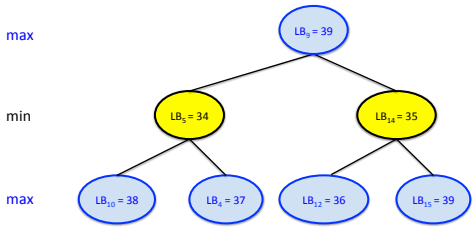

Figure 3: Max-min heap after the fathoming step

Question 2

Illustrate the KMP algorithm on the following example:

$$T = bacbababababacaca \qquad P = ababaca$$

In order to do,

- Provide the failure function for $P \rightsquigarrow$ fill the first table provided below
- Indicate the successive positions of P to be considered in the second table that is provided below

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	1	2	3	4	5	6	7
P	a	b	a	b	a	c	a
Failure Function							

T	b	a	c	b	a	b	a	b	a	b	a	c	a	c	a
Position 1															
Position 2															
Position 3															
Position 4															
Position 5															
...															

What is the complexity of the KMP algorithm?