

**Data Structures**, the first mid-term exam, October 27th, 2000.

1. Implement a queue as a linked structure. Don't use any other data structure classes as a basis of your construction.
2. a) Define the  $\mathcal{O}$ -notation.  
b) Show that  $n^2 \times \log n + n \times \log n \in \mathcal{O}(n^2 \times \log n)$ .  
c) Analyse the time requirements of the following method. Express your result using the  $\mathcal{O}$ -notation.

```
public static void selectionSort(int[] sequence) {
    for (int i = 0; i < sequence.length-1; ++i)
        for (int j = i+1; j < sequence.length; j++)
            if (sequence[i] > sequence[j]) {
                int apu = sequence[i];
                sequence[i] = sequence[j];
                sequence[j] = apu;
            }
}
```

3. a) Define the inorder of the nodes in a binary tree.  
b) Using pictures, show how the inorder successor of a node can be determined.  
c) Write an algorithm that returns the inorder successor of a parameter node. You can assume that every node also contains a pointer to its farther.
4. One of the following.

- a) Show step by step, how a heap is constructed when the array contains the numbers

4 1 3 2 16 9 10 14 8 7

(More precily, simulate the operation Build-Heap). Show at the end that in an arbitrary heap with  $n$  elements, there are at most  $\lceil n/2^{h+1} \rceil$  nodes of height  $h$ .

- b) Explain the priciples of the hashing. Especially, concentrate on hashing with chaining.