

## Exercise Sheet 02

Due date: next tutorial session

### Tutorial Exercise T2.1

Let  $S_N$  be the expected number of pushes on the stack in the Quicksort program, where the input consists of a random permutation of  $N$  distinct keys. Analyze  $S_N$  for all values of  $N$  and  $M$ .

### Tutorial Exercise T2.2

The next program is presented in x86 assembler language: Again the array `ds[0]...ds[2*N-2]` contains  $N$  pairwise distance natural numbers. Each permutation occurs with the same probability. How often is each instruction of this program executed on average?

<code>maxElem:</code>	<code>mov ax, 0xFFFF</code>	$A \ ax \leftarrow -1;$
	<code>xor dx, dx</code>	$A \ dx \leftarrow 0;$
<code>next:</code>	<code>cmp dx, N</code>	$B \ i < N ?$
	<code>jae done</code>	$B \ \text{jump if above or equal } (i \geq N)$
	<code>mov bx, ds:[2*dx]</code>	$C \ bx \leftarrow a[dx]$
	<code>cmp bx, max</code>	$C \ bx > max ?$
	<code>jna skip</code>	$C \ \text{jump if not above } (bx \leq N)$
	<code>mov ax, bx</code>	$D \ ax \leftarrow bx$
<code>skip:</code>	<code>add dx, 0x0002</code>	$E \ ax \leftarrow ax + 1;$
	<code>jmp next</code>	$E \ \text{jump}$
<code>done:</code>	<code>push ax</code>	$F \ \text{push the maximum on the stack}$

### Homework Exercise H2.1

We already analyzed  $C_n$ , the *total* expected number of comparisons in the two innermost `while`-loops of the quicksort algorithm (see the program fragment below).

What is the expected number of executions of the single comparison `a[i] < k`?

```
[...]
  i = l - 1; j = r ; k = a[j];
  do{
    do{i++;} while ( a[i] < k );
    do{j--;} while ( k < a[j] );
    t = a[i]; a[i] = a[j]; a[j] = t;
  } while ( i < j );
[...]
```

### Homework Exercise H2.2

We consider the following Algorithm. The array `a` contains a random permutation of the numbers  $1, \dots, N$ .

```
void doSomething(int *a, int N)
{
    int i;

    for (i=0; i<N-1; i++) /* 1 */
        while (a[i] > a[i+1]) /* 2 */
            a[i]--; /* 3 */
}
```

How often is line 3 executed on average?