Technische Universität München Fakultät für Informatik Lehrstuhl für Effiziente Algorithmen Prof. Dr. Ernst W. Mayr Chris Pinkau Spring Semester 2013 Problem Set 9 June 25, 2013

# **Complexity Theory**

## Due date: July 2, 2013 before class!

### Problem 1 (10 Points)

Show that

- (i) **RP** and **BPP** are closed under  $\leq_m^p$ ,
- (ii)  $\mathbf{RP}$  and  $\mathbf{BPP}$  are closed under union and intersection.

### Problem 2 (10 Points)

Show that, if  $\mathcal{NP} \subseteq \mathbf{BPP}$ , then  $\mathbf{RP} = \mathcal{NP}$ .

#### Problem 3 (10 Points)

Show that **RP** does not change if we replace  $\geq 2/3$  in the definition of **RP** by  $\geq n^{-k}$  or by  $1 - 2^{-n^d}$ .

#### Problem 4 (10 Points)

Prove that  $\mathbf{ZPP} = \mathbf{RP} \cap \mathbf{coRP}$ .