

# VU Programm- und Systemverifikation

## Assignment 2: Equivalence Partitioning and Boundary Value Testing

Name: \_\_\_\_\_ Matr. number: \_\_\_\_\_

Due: April 29, 4pm

**Task 1: Equivalence Partitioning (5 points).** A univariate polynomial equation of degree  $n$  is an equation of the form

$$\sum_{i=0}^n a_i \cdot x^i = 0 \quad \text{or} \quad a_n \cdot x^n + a_{n-1} \cdot x^{n-1} + \dots + a_2 \cdot x^2 + a_1 \cdot x + a_0 = 0,$$

where  $a_i \in \mathbb{R}$  (for  $0 \leq i \leq n$ ) are numerical constants called *coefficients* and  $x$  is a *variable*. A polynomial equation is *zero* if all coefficients are zero, and *non-zero* otherwise. The solutions of this equation are the *roots* of the polynomial. A number  $a$  is a root if and only if the polynomial  $(x - a)$  (where  $a \in \mathbb{R}$ ) divides  $\sum_{i=0}^n a_i \cdot x^i$ . If  $(x - a)^2$  divides  $\sum_{i=0}^n a_i \cdot x^i$  then  $a$  is called a *multiple* root, otherwise  $a$  is a *simple* root. For non-zero polynomials, there is a highest power  $m$  such that  $(x - a)^m$  divides  $\sum_{i=0}^n a_i \cdot x^i$ , which is called the *multiplicity* of the root  $a$ . If the polynomial is non-zero, the number of roots cannot exceed its degree (even counting the respective multiplicities). Note that there are polynomial equations which have no roots (e.g.  $x^2 + 1 = 0$ ).

Let **unsigned roots** (float  $a_0, \dots$ ) be a function (which takes at least one parameter) that returns the number of roots of the non-zero polynomial determined by the coefficients given as a parameter. Multiplicities are counted accordingly, i.e., for the polynomial equation  $x^3 + 2 \cdot x^2 - 7 \cdot x + 4 = 0$  which can be written as  $(x + 4) \cdot (x - 1)^2$  and has the roots -4 and 1 with multiplicity 1 and 2, respectively, the output should be 3.

Provide *at least 5* equivalence classes derived using equivalence partitioning.

Condition	Valid	ID	Invalid	ID

**Task 2: Boundary Value Testing (10 points).** Use *Boundary Value Testing* to derive a test-suite for the method `roots`. For each test case, provide a brief explanation (why is this a boundary case?) and indicate which equivalence class(es) it covers. You can receive up to 1 point per test case.

Input	Output	Classes Covered

Please hand in your assignment via TUWEL (as a single PDF file) by April 29, 2015, 4pm.