OLLSCOIL NA hÉIREANN, MÁ NUAD

NATIONAL UNIVERSITY OF IRELAND, MAYNOOTH

THIRD COMPUTER SCIENCE EXAMINATION

FOURTH COMPUTER SCIENCE EXAMINATION

THIRD COMPUTER SCIENCE AND SOFTWARE ENGINEERING EXAMINATION

FOURTH COMPUTER SCIENCE AND SOFTWARE ENGINEERING EXAMINATION

MASTERS OF COMPUTER SCIENCE (YEAR 1) EXAMINATION

MASTERS OF COMPUTER SCIENCE (YEAR 2) EXAMINATION

LAB TEST 2

PAPER CS355/SE307/CS403

COMPUTATION AND COMPLEXITY

T. Naughton.

Attempt ALL questions. Time Allowed: 35 minutes.

1. Let the language $\text{VARPOSITIVE}_\text{J}$ be defined as $\text{VARPOSITIVE}_\text{J} = \{\langle J, v\rangle : J$ is a Java program, v is an integer variable declared in J, and the value in v is positive at least once during the execution of $J\}$. Prove that $\text{VARPOSITIVE}_\text{J}$ is undecidable. You may use the supplied proof template if you wish. You are given that A_J is undecidable. A_J is defined as $\text{A}_\text{J} = \{\langle J, w\rangle : J$ is a Java program, w is some input string, and J accepts $w\}$. [20 marks]

2. Let the language SQUAREPAIRS $= \{\langle A\rangle : A$ is an array of positive integers, and A contains at least two different integers x and y that have the relationship $x^2 = y\}$. For example, $(1, 9, 7, 3) \in$ SQUAREPAIRS and $(1, 9, 7, 4) \notin$ SQUAREPAIRS. Prove that SQUAREPAIRS can be verified in polynomial time. To answer this question, you must define some certificate c and use it to construct an algorithm that verifies SQUAREPAIRS. Then you must analyse your algorithm to prove that it only requires a number of timesteps that is polynomial in n where n is the length of the array A. [15 marks]