Quiz I (CS6013)

13-Feb-2017

Read all the instructions and questions carefully. You can make any reasonable assumptions that you think are necessary; but state them clearly. There are total four questions, totalling 45 marks (+ 5 bonus marks). You will need approximately 15 minutes for answering a 15 marks question (plan your time accordingly). The bonus part may take more time. For questions with sub-parts, the division for the sub-parts are given in square brackets.

You will get an answer sheet with 12 pages (if you get a answer sheet with fewer pages then ask for a replacement sheet). Leave the first page empty. Start each question on a new page. Think about the question before you start writing and write briefly. Each question also specifies the maximum number of allowed pages for the question. If the answer for any question is spanning more than specified number of pages, we will strictly ignore the spill-over text. If you scratch/cross some part of the answer, you can use space from the next page.

1. [15 marks, 2 pages] **Code Generation**:
   Present a scheme to translate a program written in C to Java, with main focus on C structures. Assume the following restrictions about the input language: (i) It allows only three types of data-types: `struct`, `int`, and pointer to `struct` type. (ii) It has no pointer arithmetic (e.g., ptr++ etc) or typedefs.

   Mention how you will translate the following: 1. `struct` declaration [1.5]. 2. Declaration of a variable of `struct` type [4.5]. 3. Declaration of a variable of `struct` * type [1.5]. 4. Passing of a `struct` variable as argument [3]. 5. Passing of a `struct` * variable as argument [1.5]. 6. Dereferencing of struct fields [0.75]. 7. Declaring a variable of `int` type [0.75]. 8. sizeof operator [1.5].
2. [15 marks, 2 pages] **Undeclared and Uninitialized variables**:
   In a new language a variable's use is considered *undefined*, if it is both undeclared and uninitialized. Assume that only the following types of statements are present: i) variable declaration (for example, int x, or boolean y), ii) copy statement (for example, x = constant, or x = y), iii) if-statement, iv) loops.

   Write an algorithm to i) identify undefined uses of variables [7.5], ii) type check the copy statement [7.5].
3. [15 marks, 2 pages] **Control Flow Analysis**:
   Give an algorithm to compute CFG with extended basic blocks marked [10]. Input: IR code in three-address-codes, O/P: CFG and EBB information.

   Write an algorithm to eliminate unreachable code [5]. A code is considered unreachable, if control cannot reach that part. Inp: IR, Output: optimized IR. Assume an IR that includes unconditional jumps, conditional jumps, and return statements, among other statements.
4. [5 marks, 1 page] **Bonus: Correctness**
   Give a formal argument on why the constant propagation algorithm presented in the class is correct.