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until 20.11.2012 (only Java sources and
PDFs accepted)

Tutorials for “Formal methods for Java” Exercise sheet 4

Exercise 1: Compiling into Java Bytecode

To compile a Java statement or expression into Java Bytecode, we can define the function *xlat*. This function takes as input a Java statement or a Java expression and returns a sequence of Java Bytecode instructions. To access local variables, we assume an auxiliary function *slot* that takes the name of a local variable and returns the slot of that variable on the stack. We illustrate these two functions on two simple examples:

$$\begin{aligned}xlat(e_1 \cdot e_2) &\equiv xlat(e_1) \\ &\quad xlat(e_2) \\ &\quad \text{"imul"}\end{aligned}$$

That is, we translate a multiplication into the sequence of instructions corresponding to the description “First evaluate e_1 , then e_2 , then execute the instruction `imul`”.

The next example simply evaluates the local integer variable `x`:

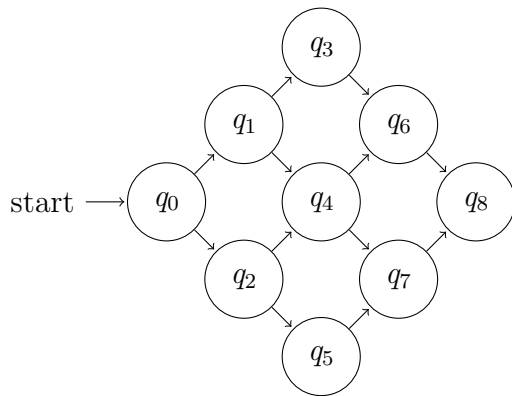
$$xlat(x) \equiv \text{"iload" } slot(x)$$

Here, the code produced by *xlat* states “Load the value of the variable stored at the slot of `x`.”

- (a) Give the translation for the statement `x = e`; where `x` is a local integer variable and `e` some integer expression, i. e., specify what $xlat(x = e;)$ expands to.
- (b) Give the translation for the statement `e1.f = e2`; where `e1` evaluates to some object of class `C`, `f` is an integer field, and `e2` is an integer expression, i. e., specify what $xlat(e1.f = e2;)$ expands to.

Exercise 2: Graph Search

Consider the following graph and heuristic function.



$$heuristic(v) = \begin{cases} 4 & \text{if } v = q_0 \\ 1 & \text{if } v = q_1 \\ 3 & \text{if } v = q_2 \\ 1 & \text{if } v = q_3 \\ 1 & \text{if } v = q_4 \\ 2 & \text{if } v = q_5 \\ 1 & \text{if } v = q_6 \\ 0 & \text{if } v = q_7 \\ 0 & \text{if } v = q_8 \end{cases}$$

- (a) For each search technique covered in the lecture (DFS, BFS, Greedy, and A*) give the order in which the nodes are closed. If multiple decisions are possible at a step, choose one and make this choice explicit (i.e., state the choice you made).
- (b) Is the heuristic admissible if node q_8 is the goal state? Justify your claim.