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Programming Exercises Compiler Construction

Tiger Programming

This programming exercise will acquaint you the Tiger programming language and the MIPS simulator used in this course.

Preparation

Download *Windows_Programs.zip* and install *QtSpim_9.1.9_Windows.zip*, the MIPS simulator used for executing MIPS assembler files. (QtSpim is also available for Linux and MacOS, http://spimsimulator.sourceforge.net/.)

Install the Tiger compiler *tiger.exe* (only available for Windows: DOS shell or *cygwin*).

String Compare Program

Write a Tiger program *strcmp.tig* consisting of the following functions:

- `function getString(strnm: string): string`
  Prints a message to input `strnm`, reads a string from the terminal and returns it. Characters are read until newline or EOF is encountered.
- `function getStringArray(): stringArray`
  Reads an integer n (0 < n ≤ 9) from the terminal. Then `getString` is called n times and the return values are stored in a string array of size n. Note that n should be stored in the enclosing scope of `getStringArray` so that it can be used in subsequent functions.
- `function printStringArray(sa: stringArray)`
  Outputs the n strings in `sa` on the terminal.
- `function strcmp(s1:string, s2: string): int`
  Compares two strings `s1` and `s2` lexicographically and returns -1 if `s1<s2`, 0 if `s1=s2` and +1 if `s1>s2`. If string `s2` is an extension of `s1` (i.e. `s1` is a prefix of `s2`), then `s1<s2`.
  Note that Tiger uses reference semantics for strings, i.e., strings can be copied by simple assignments.
- `function sortStringArray(sa: stringArray)`
  Sort the string array `sa` (size n) in ascending order by a sorting algorithm of your choice.

Finally, combine the functions to a program which reads a string array, sorts the strings and prints them.

Compile the program with the Tiger compiler. `tiger.exe strcmp.tig` will generate `strcmp.tig.s`. Concatenate this file with the runtime system `runtime.s`, generating a file `strcmp.s`.

Simulate `strcmp.s` with the *QtSpim MIPS* simulator by loading the assembler file with the menu *File → Reinitialize and Load File* and executing it with *Simulator → Run/Continue* (F5).

Optional Extension

Replace the string array by an array of records with the fields *key* (type string) and *value* (type int). Input the record array and sort it by the key.