Week 8
Implementing Arrays

Announcements
- Late submission of Project Part 2
  - Allowed, but implies 20 point lateness penalty
  - Anyone who wishes may submit up until 11pm Thursday
  - Don’t plan on late submission for remaining project parts
- Special section tonight
  - W evening, Mar 17
  - 7:30 to 8:20 PM
  - 205 Upson
  - David Levitan
  - Discuss Eclipse, an IDE for Java
  - Answer any remaining questions about Part 2

Recall Stack Frames for Functions
- A new frame (on the stack) is created for each function call
- We use the FBR (Frame Base Register) to indicate the current frame
- The caller and the callee share responsibility for:
  - creating the stack frame
  - cleaning up the stack frame when the function is done

New in Part 3
- New data types char and float
- Arrays
- Functions
- Recursive (i.e., need stack frames)
- Overloading
- Type casting
- Error handling

Arrays
- An array type is represented by a type followed by brackets
- Examples:
  - int [] myIntegers;
  - char [] myCharacters;
- After these declarations, both myIntegers and myCharacters have the value null
- To initialize an array, assign an array value

Multidimensional Arrays; Array Size
- Multidimensional arrays can be created by adding more brackets
- Example declaration:
  - int [][] values;
- Example initializations:
  - values = int [1, 2, 3];
  - values[] = [1, 2, 3, [4, 5, 6]];
  - Produces 2-by-3 array of integers
  - values = [1];
  - Produces Rows of varying length
- To determine size (number of elements) of an array
  - Each size is the size of the dimension:
    - myIntegers.size
    - Produces the value 4
    - values.size
    - Produces the value 2
Implementing Arrays

- Use the instruction MALLOC
  - Reserves space in the Heap
- Example sam-code
  
PUSHIMM 4
MALLOC
  - These instructions reserve a block of size 5 in SaM's Heap
    - 4 words for the array
    - 1 word to indicate the size of the block
  - In this case, the block size is 5
  - MALLOC leaves the block's address on top of the Stack
    - This is the address of the word that holds the block size
    - The array itself is located at address +1, address +2, address +3, and address +4
- The SaM Simulator does automatic garbage collection, so there is no need to free heap-space for arrays that are no longer in use

Overloading Functions

- Functions in Bali can be overloaded
  - Functions can share same name as long as they differ in number or type of parameters
  - A function’s signature determines which function to call
    - Signature encodes function’s name as well as number and types of parameters
- Functions that share a name must all have same return type
- Bali does no automatic conversion of types
  - Thus function arguments and function parameters must match types exactly
- You can encode a function’s signature in any way you want, but a Java String works fine

Type Casting & Error Handling

- Type Casting
  - Bali allows limited type conversions
  - An expression of the form item.type can be used to cast
    - float to int (decimal part is truncated)
    - int to float
    - char to int
    - int to char
  - There are sam-code instructions that do these conversions
- Error Handling
  - We will test your Part 3 compiler’s response to errors in supplied Bali programs
  - Two kinds of errors
    - Syntax errors: code that violates the rules of the Bali grammar
    - Semantic errors: code that violates the rules of Bali semantics

Expression Statement vs. Assignment Statement

- According to Bali’s grammar
  - An expression statement and an assignment statement both start out looking like an expression
  - No way to tell that you are parsing an assignment statement until you get to the equal sign (=)
- Suggestion
  - Start parsing as if you are parsing an expression
  - Once the “expression” is complete you can check for the equal sign (=)
  - If in an assignment statement
    - You need to re-examine the AST you just built (for the expression) to see if it can be the target of an assignment statement
    - Your compiler should throw a BaliSyntaxException if the expression is inappropriate as a target