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Homework 11

1. A dangling pointer is a type of pointer that points to a heap-dynamic that has been deallocated. These are dangerous because there is a chance that the memory may have been reallocated, type checking is not valid, the value is no longer meaningful even if the data is of the same type and the storage manager may fail if it attempts to use the pointer. Some available options in the language designer to deal with dangling pointers are the tombstone method, the lock-and-key method or explicitly removing the responsibility of deallocating dynamic variables by allowing the framework to complete garbage colletion.

1. A memory leak is a situation where a heap-dynamic variable is no longer accessible by the program, but has not been deallocated yet (often known as garbage). The options available to the language designer for dealing with memory leaks are reference counters and a mark/sweep process which are responsible for garbage collection operations.
2. When the operands of an operator are of compatible types, it means that each operand is either legal for the requested operation or the operand is implicitly allowed based on the language rules. If the operand is a part of the language rules, it is converted by the compiler-generated code to a legal type for the operand which is called coercion.
3. The reference counter approach to garbage collection is a solution where a counter is maintained in each cell that contains the number of pointers that currently point to the dynamic-heap variable. When the count reaches zero and the variable becomes inaccessible garbage collection is performed. The main disadvantages are that a lot of extra space is required to store this counter, execution time is slower due to the need to maintain and update counter and circularly referenced pointers are often difficult to deal with. The advantages are that the maintaining the counter is a simple incremental, so there is never a significant delay.
4. The mark/sweep approach to garbage collection is based on a two-step process. At run-time the system allocates storage cells as requested and disconnects pointers from each cell as necessary. In this scheme, every cell in the heap as an extra bit that is used by the collection algorithm to determine whether the cell is unreachable. Every pointer is then traced into the heap and all reachable cells are marked as not garbage which is known as the mark process. The second part of the process is the sweep where all of the cells marked as garbage are returned to a list of cells that are available for allocation.
5. If a language is said to exhibit guaranteed short circuiting this means that when using the logical AND and logical OR operations, if the result of the expression is known after the evaluation of the left hand operand, then it is guaranteed that the right hand operand will not be evaluated.
6. A widening conversion is where a conversion includes, at the very least, approximations to all values of an original type. An example of a widening conversion is an int to a long, float or double. A narrowing conversion on the other hand is one where not all values of the original type can be included. An example of a narrowing conversion is a long to a byte, short, char, int or long.
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8. When the assignment operation is also an expression, this means that an assignment statement can be used as one of the operands in a logical statement (as an expression). In languages such as C, C++, Perl and JavaScript, where the assignment operation is also an expression, the result of the expression is the value assigned to the target of the assignment statement where the side effect is changing the value of the target variable. The advantage of treating the assignment operator like an expression is that it can be used as one half of a logical operation. The main disadvantage of this method is that it provides another type of expression side effect that can lead to expressions that are difficult to read and understand.
9. When a program dereferences a pointer it means that