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CSC 28

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Final Exam

1. Big Endian stores the most significant byte of a 16-bit value in the smallest address in memory whereas little endian stores the least significant value at this same address. Endianness applies to both x64 and x86 architectures.

2. Side effects are unusual actions performed by a program/function not intentionally coded to be strange in nature, but cause strange things to happen nonetheless. I argue con this claim because it’s not necessarily bad to have side effects considering often times they are intentional. The design of the programming language determines whether side effects are enabled or disabled.

3. The Power Set P(S) = {},{a},{e},{ i},{ o},{a,e},{a, i},{a, o},{e, i},{e, o},{ i, o},{a,e, i},{a,e, o},{a, i, o},{e, i, o},{a,e, i, o}. There are 24 elements, or 16 elements.

4. Program to add two integers without using arithmetic operators in Java:

public static int (int a, int b){

    while (b != 0){

        int temp = (a & b); *// AND operator using 2 bits*

        a = a^b; *// XOR operator using 2 bits*

        b = temp << 1; *// Binary shift temp to 1 bit*

*// temp now equals a + b*

        return a;

    }

}

5. In a sequence, there can be any set of numbers or elements that are ordered according to some set of rules or formulae. In a set, the indices/positions of elements does not flow according to anything. Repetition of elements is also commonly allowed in sets, whereas not allowed in sequences.

6. Probability P is defined as the likelihood of something happening. The numeric range can be calculated by taking the number of different ways something can happen divided by the total number of outcomes.

7. Aliasing is the manipulation of a piece of data in memory that is pointed to by multiple different variables/addresses, thus any change to a single variable implicitly changes every other variable’s value as well. Languages can enable aliasing by allowing variable references without restrictions on pointer access. I argue that aliasing is poor practice, though this is not entirely the truth. Aliasing is typically unexpected by the programmer and can cause confusion when data is destroyed via this feature.

8. Start with the base case. This should hold a property (P) to be true for an initial element *n* with an indicated index (often 0). This can be written as P(0). Move to induction which requires that a hypothesis be made including the assertions made in the base case/starting claim. Finally, prove that because property P(n) holds true for the initial case, it is also true for P(n+1) and every iteration following it: (n+2), (n+3), …

9. The formula for C(n,m) would be as follows: n!/(m!(n-m)! The solution to both C(7,4) and C(7,3) = 35.

10. A value parameter (VP) is formal parameter that points to memory while the actual parameter (AP) is copied during runtime. A reference parameter (RP) is an addressable object that is implemented by passing the address of the actual parameter. A potential problem with VP is garbage collection and memory usage - as information is rapidly copied, the total incoming data is doubled which may be an issue for larger projects. A problem with RP is that the address of the AP is passed as a parameter which means one extra process is required to achieve the same goal.

11. When throwing two dice, there are 36 total combinations. The probability that both dice show a 4 is 1/6.

12. Recursion is the process wherein a function calls upon itself to execute the code written within its own block. The formula for recursion is as follows: an+1 = an + d

13. The formula for sequence **a** = n3+1

14. A graph is a non-linear structure that can be used to represent all types of physical and data structures. Data can be accessed in a graph even if two nodes aren’t connected because graphs are allowed to loop and multiple paths are allowed so navigation is easier. A key difference between graphs and trees is that graphs can have any number of paths and edges whereas trees have a root node that creates children.

15. The Pidgeon-hole principle states that if the amount of items is larger than the number of available spaces in storage, one node/container must have at least two items. A simple example: if there are more coats to hang than there are coat hangers, one hanger must hold at least 2 coats.

16. Given 15 members and a team of 11 players, the formula would be 15 choose 11 or C(15,11) which equals 1,365 different teams.

17. Insertion Sort’s worst-case cost (time complexity) is O(n2) whereas Bubble Sort’s worst-case is also O(n2). Both of these algorithms generally perform at the same time complexity in both best- and worst-case scenarios. Though it’s important to note that insertion sort is typically faster than bubble sort because it only looks at two elements at a time, contrast this with bubble sort that looks at three or more at a time. Insertion sort is particularly faster when sorting smaller sets of data, although this may not be extremely noticeable to the human.

18. Floating-point format, or IEEE 754, as used in 32-bit architectures allocates 1 bit for the sign bit, 8 bits for exponents, and the last 23 bits for fractions. Exponents are tracked using offset-binary representation, with 127 being the subtracted value to obtain the value of the original exponent.

19. Row major order means you read a set of data as if you were reading a book in English, left-to-right and row-by-row. Row major order is used in the ordering of matrices. Using row major order instead of column major order can actually benefit programs because it’s a slightly faster method of storing data in RAM.

20. Program to swap integer values ‘a’ and ‘b’ in Java:

public static void swap(int a, int b){

    int temp = a;

    a = b;

    b = temp;

}