# IOS 2019

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| **1.** | * In how many different states can a computer with 1GB of memory be? Provide an exact formula. * How does the machine distinguish between code and data? * Can the same word sometimes be code and sometimes data? |
| **2.** | * Why do most computers encode information in binary? * Why is binary a popular format? * Convert some decimal number to binary. Provide the number and the formula. Also do it the other way around. * How are characters and strings encoded in bits? |
| **3.** | * Define Finite State Machines. * Name their key advantage. * Provide the FSM that recognizes the symbols if, while, (, ), {, }, == as a graph and in C\*. |
| **4.** | * Define a PDA * Provide a C\* code fragment that recognizes while statements in C\* |
| **5.** | * How do compilers manage names of procedures and global/local variables? * Name and discuss the data structure, its operations and how they're used. * What's the difference between a definition and a declaration? * What does a compiler do for a declaration and a definition of a variable and a procedure? |
| **6.** | * What's the memory layout for code generated by most compilers? * What's the difference between static and dynamic memory (with proper terminology)? * What's the simplest and most widely used form of dynamic memory allocation? |
| **7.** | * Define spatial and temporal isolation of software processes. * How is spatial isolation usually implemented? Use proper terminology. * How much memory does it take to manage a 4GB address space on a 64bit machine with 4KB pages? Provide the exact amount and a formula and explain. |
| **8.** | * M is a 600MHz machine that takes 1 cycle per instruction. * How many instructions does M execute in 6s? * E is an emulator of M running on M that needs 60 instructions of M to emulate executing one instruction of M * How many instructions does E execute in 6s? * E' is another instance of E running on E * How many instructions does E' execute in 6s? * Suppose M takes 1s to run a program P * How long do E and E' take? * How long does running P on a VM V of M take if V runs on M and does a context switch every 1M instructions that takes 1000 instructions? * How long does running P on V take if V runs on E? * Provide exact numbers in powers of 10 with currect units: #instructions, seconds, mins, hrs and show your calculations |

# IOS 2018

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| **1.** | * State of a machine and how to compute it? * How does a computer distinguish between data and code? * Can the same machine word sometimes be code and sometimes data? |
| **2.** | * Why do most computers encode information in binary? * What is decimal 123 in binary? What is the formula to convert it? * What is decimal -123 in two's complement? What is the formula to convert it? * Why is two's complement so popular? * How are characters and strings encoded in bits? |
| **3.** | * Define Finite State Machines. * Name their advantages. * Provide the FSM that recognizes the symbols if, while, (, ), {, }, == as a graph and in C\*. |
| **4.** | * Define a PDA * Provide a C\* code fragment that parses while statements with a PDA |
| **5.** | * What is the generated memory layout used by most compilers? * What is the difference between statically and dynamically allocated memory? * What is the most wide and used form of dynamic memory allocation? |
| **6.** | * What is temporal and spatial isolation? * What is the most common method for spatial isolation? * What is the page table size of 4GB adress space and 4kb pages? |
| **7.** | * Where does a compiler save information about the name of variables and procedures? What datastructure is used? * What operations can you do on that data structure? * How do you use such operations? * What is the difference between declaration and definition of a variable and proedure? * What does a compiler when declaring and defining a procedure and variable? |
| **8.** | * If you have a 600Mhz machine M which can execute every instruction in one cycle how many instructions can it execute in 1 sec? * If you have an emulator E running on that machine and M needs 60 instructions to emulate one istruction of E how many instructions can it execute in 6 sec? * If E' is the same emulator as E running on E how many instructions can it execute in 6 sec? * If a programm P takes 1000000 instructions how log would it run on M, E, E'? * If you have a virtual machine V running on M which does a context switch every 1000000 instructions which takes 1000 instructions, how long does it take to run P? * If V runs on E how long does it take to run P? * (For this task: Write #instructions, seconds, minutes hours) |