IOS 2019

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

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)