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1. Discuss how stack architecture computer works by giving example. And compare the pros and cons between stack-based virtual machine and register-based virtual machine.

Stack architecture computers are a computer processor or a virtual machine in which the primary interaction is moving short lived temporary values to and from a push down stack. Likewise, it is a type of computer architecture where the primary data structure used for computations is a stack. A stack is a Last-In-First-Out (LIFO) data structure, where the last item added to the stack is the first one to be removed. In a stack-based computer, the operands for a given operation are pushed onto the stack, the operation is performed, and the result is pushed back onto the stack. The next operation will then take the necessary operands from the stack and continue in the same way.

One example of a stack-based computer is the Forth programming language. Forth is a language that uses a postfix notation, where the operator comes after the operands. For example, to add two numbers together, you would write "5 6 +" instead of "5 + 6" like in traditional infix notation. Reverse Polish notation (RPN) is a method for representing expressions in which the operator symbol is placed after the arguments being operated on. In Forth, the operands are pushed onto the stack, and the operator pops them off the stack to perform the operation.

Example:

The steps that have to follow are the following:

Push the number 5 onto the stack.

Push the number 6 onto the stack.

Pop the top two values (5 and 6) off the stack and add them together, pushing the result (11) back onto the stack.

Push the number 11 onto the stack.

If the value is in two register it will go like this: C = A + B

push A

push B

add

pop C

To compare the between stack virtual machine and register based virtual machine. Stack-based virtual machines, like the Java Virtual Machine (JVM), use a stack to pass parameters and results between instructions. This can make it easier to write code, as you don't need to explicitly allocate registers to hold values. In a stack-based virtual machine, operands are pushed onto the stack before an operation, and the result is pushed onto the stack after the operation.

Advantage of stack-based virtual machines is that they can make writing code easier, as you don't need to explicitly allocate registers to hold values. This can make the code more compact and easier to read. Additionally, stack-based virtual machines can make it easier to implement certain optimizations, such as instruction scheduling and register allocation.

However, stack-based virtual machines can be slower than register-based virtual machines because of the overhead involved in pushing and popping values onto the stack. Additionally, stack-based virtual machines can have limitations on the number of values that can be pushed onto the stack, which can lead to performance problems for certain algorithms.

Register-based virtual machines, like the Lua VM, use registers to hold values instead of a stack. In a register-based virtual machine, operands are stored in registers before an operation, and the result is stored in a register after the operation.

1. Processor is one of most important components in computing system. Its   
   performance can make big impact to the whole system. Discuss about processor design metrics and benchmarking tools.

Processors, also known as central processing units (CPUs), are the brain of a computer system. The performance of a processor can have a significant impact on the overall performance of the system. Therefore, it is important to understand the various processor design metrics and benchmarking tools used to evaluate and compare processor performance.

The Processor Design Metrics are the following:

Clock Speed: Clock speed is the frequency at which a processor can execute instructions. It is measured in Hertz (Hz) and represents the number of clock cycles per second. A higher clock speed generally results in faster processing.

Instruction Set Architecture (ISA): ISA is a set of instructions that a processor can execute. Different processors can have different ISAs. A processor with a larger and more complex ISA can execute a wider range of instructions, which can result in higher performance.

Pipelining: Pipelining is a technique used to increase the performance of a processor by dividing the execution of instructions into smaller stages. In a pipelined processor, multiple instructions can be executed at the same time, which can result in faster processing.

Cache Size: Cache is a type of memory that stores frequently used data and instructions for quick access. A larger cache size can result in faster processing as more data and instructions can be stored in cache.

Number of Cores: A processor can have one or multiple cores, which are individual processing units that can execute instructions independently. A processor with multiple cores can execute multiple instructions simultaneously, which can result in higher performance.

Benchmarking tools are SPEC: The Standard Performance Evaluation Corporation (SPEC) is an organization that develops benchmarking tools to evaluate the performance of computer systems, including processors. SPEC CPU benchmarks evaluate processor performance by measuring the execution time of a set of standardized workloads.

Geekbench: Geekbench is a cross-platform benchmarking tool that evaluates the performance of processors by running a set of tests that simulate real-world tasks such as image processing and encryption.

PassMark: PassMark is a benchmarking tool that evaluates the performance of processors by running a set of tests that simulate different types of workloads, such as gaming, video playback, and productivity.

Cinebench: Cinebench is a benchmarking tool that evaluates the performance of processors by running a set of tests that simulate 3D rendering tasks.

Intel XTU: Intel Extreme Tuning Utility (XTU) is a benchmarking tool that evaluates the performance of Intel processors by running a set of tests that simulate different types of workloads, such as gaming, video playback, and productivity. It also provides tools for overclocking and tweaking processor settings to improve performance.

In conclusion, processor performance is an important factor in determining the overall performance of a computer system. The key design metrics for processors include clock speed, instruction set architecture, pipelining, cache size, and number of cores. Benchmarking tools such as SPEC, Geekbench, PassMark, Cinebench, and Intel XTU can be used to evaluate and compare processor performance by running a set of standardized tests. It is important to consider both design metrics and benchmarking results when selecting a processor for a particular application.