

# CSCI 1330 Homework Assignment 9

*Due Friday, November 18, 2022*

1. Virtual memory is a mechanism by which each process may run in a separate address space.
  - a. Describe circumstances in which identical virtual addresses of different processes are mapped to different real addresses.
  - b. Describe circumstances (i.e., how you might make this happen) in which different virtual addresses of different processes are mapped to the same real address.
  - c. Describe circumstances (i.e., how you might make this happen) in which different virtual addresses of one process are mapped to the same real address.
2. We have seen that modern processors cache recently (and soon-to-be) accessed instructions and data in high-speed memory composed of SRAM. Suppose you are a computer architect and are designing such a cache system. One concern is how items are identified in the cache: either using virtual addresses (as generated by the program) or real addresses (after being translated by the hardware from virtual addresses). One concern, for the case of using virtual addresses, is distinguishing instructions or data of different processes that are at the same virtual address but are, in fact, different. This might be done by associating with each process a unique *address-space ID* (ASID) and tagging items it puts into the cache with its ASID. Further complicating things is that, while each core has its own L1 and L2 caches, all cores on a chip share one L3 cache.

Which would be the most reasonable choice: using a cache accessed using virtual addresses (plus ASIDs) or a cache accessed using real addresses? Explain. [Hint: keep problem 1 in mind.]