

# CS 524 Homework #2

Due: February 18, 2020

This homework contains both technical and business-related problems, for the total of 100 points.

1. Complete reading Chapter 3 of the textbook and the lecture materials. **Please note the errata: The references to [19] on p. 56 of the book should be replaced with references to [20]!** Please also read [20] (available free) at <https://www.kernel.org/doc/ols/2007/ols2007v2-pages-87-96.pdf>.
2. **(10 points)** Explain the advantage that paravirtualization provides for handling timers in virtual machines.
3. **(10 points)** Explain how paravirtualization helps in minimizing access to APIC.
4. **(5 points)** Find out if *Linux* (like *Unix*) has both the user-mode and system-mode stacks for each process it runs.
5. **(10 points)** Find out what “unscrambled” means in the description of the *Intel LSL* instruction (you can, for example, use the Intel manual referenced in the lecture).
6. **(25 points)** Read the following two papers:
  - Carl Waldspurger and Rosenblum, M. (2012) *I/O Virtualization*. Communications of the ACM, vol. 55, No 1. January 2012. Pages 66-72; and
  - Muli Ben-Yehuda; Xenidis, J.; Ostrowski, M.; Rister, K.; Bruemmer, A.; Van Doorn, L. (2007). *The Price of Safety: Evaluating IOMMU Performance*. Proceedings of the Linux Symposium on June 27th–30th, 2007. Ottawa, Ontario. Pages 225-230.
  - 1) Explain the advantages and disadvantages of using I/O MMU by citing the appropriate text from the paper;
  - 2) Research the Web to find what is meant by “carrier-grade hypervisors”. What products are available?
7. **(5 points)** Find out what hypervisors *Amazon* is using in EC2, and describe their major characteristics.
8. **(10 points)** Examine the *Amazon* EC2 VM offer capabilities and particularly the Amazon Machine Image (AMI) ((<https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/AMIs.html>)) and answer the following questions:
  - a. How (i.e., in what units) does EC2 measure the CPU power of a virtual machine and how is the unit in question translated into the power of the physical processors)?

- b. What kinds of machine instances are there as characterized by the power of their respective CPUs, platform (i.e., 32-bit or 64-bit), memory, storage, etc.? Please list all the instances in the nomenclature along with their respective characteristics;
  - c. Which operating systems are available on the above systems?
  - d. What is an AMI and what is its relationship to an *instance*?
  - e. What are the components of an AMI?
9. **(10 points)** Find out about the pricing of the EC2 platforms and provide a few examples.
10. **(15 points)** From the above exercise, you will learn that it is possible to create a free machine instance. Please, do the following:
- a. Find out and document the essence of the respective *Service Level Agreement (SLA)*; in particular write down what one needs to do in order to maintain this service **free**;
  - b. Describe the process (i.e., what exactly one needs to do) to create a free machine instance that could be used as a server. (**Do not**, however, create anything yet!)
  - c. Can you create a machine instance equivalent to your own PC and then transfer your own PC image there? If so, how would you achieve that?