CS 524 Homework #2

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. **(20 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;

7. **(5 points)** Find out what hypervisors *Amazon* is using in EC2, and describe their major characteristics.

8. **(5 points)** Find out the URL to the source code of the Nitro hypervisor

9. **(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?

10. **(10 points)** Find out about the pricing of the EC2 platforms and provide a few examples.

11. **(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)* on *;* 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?