UMass Boston CS 444
Homework 4
Posted Tuesday, April 15, 2025
Due Wednesday, April 23, 2025 at 11:59pm

Homework must be typeset and converted to PDF. Handwritten answers will be rejected. Late submission gets zero points. To submit your homework, prepare PDF file called `hw4.pdf` — the filename must be exactly `hw4.pdf`. Upload the file to the `cs444` folder in your home directory on the CS Linux server.

This hw4 looks at virtualization, the fread command and the dining philosopher problem.

1. Virtualization is discussed first in Chapter 1, Tanenbaum and Bos. To understand the basic definitions, please see Figures 1.26, 1.27, 1.28 and 1.29. All of these figures show operating systems with a more advanced structure than the simple layering in Figure 1.1.

   (a) What was new in the Minix3 operating system shown in Figure 1.26, p67? Name at least three items.

   (b) What was new in the client-server operating system shown in Figure 1.27, p69? Name at least three items.

   (c) What was new in the VM/370 with CMOS operating system in Figure 1.28, p70? Name at least three items.

   (d) What was new in each of the three operating systems in Figure 1.29, p71? Name at least three things per picture.

2. Q2 True/False questions on Virtualization: Look over the table below showing a row of sections in Chapter 7, Virtualization and the Cloud and some sections in Chapter 10 Linux and Chapter 11 Windows. As requested below, find some statements in each of those sections that makes a point you consider important. The statement has to be a single sentence. Write the statement as it is and then write the statement negated.

Ch7	Intro	7.6	7.9						
Ch10	10.4								
Ch11			11.10						

Try to select statements that make a definite point so that flipping it to its negation will be obviously incorrect.

   (a) In the introduction to Ch7, pp477-480, find four statements. Use the eight items in bold as key points to choose from. Choose four. List them. Find one statement about each. State it. State its negation.

   (b) In Section 7.6, find three such statements. Give also the negations.

   (c) In Section 7.9, find three such statements. Give also the negations.

   (d) In Section 10.4, find two such statements. Give also the negations.

   (e) In Section 11.10, find two such statements. Give also the negations.

3. Q3 fread question.

   (a) Use the C standard library stdio.h. Write the prototype for the call to fread. See Kernighan and Ritchie, Section B1.5, Direct Input and Output Functions, p247.

   (b) Define object size (size) and number of objects (nobj) three ways. Each way would allow you to read in 1,024 bytes. In other words, object size could be 1 byte, 4 bytes or 32 bytes and number of objects would vary.

   (c) Write three fread statements with an appropriate return code that reads in from file fp into buffer b in accordance with the choices for object size and number of objects. Assume mode is "rb" and explain what it means. What will be the three return code values? (What fread returns is defined in the prototype.)

4. Q4. Dining Philosophers.

   (a) Using the Dining Philosopher's information (see Figure 6-3 and number the philosophers counterclockwise 0-4 so each has a left fork with the same number and a right fork numbered +1), explain the difference between the code in Figure 6-4 and Figure 6-5. Make a timeline of each philosopher's activities that assumes sequential execution. Can it deadlock? Why or why not?

   (b) Then select some other scheduling that can lead to deadlock. Explain the steps that lead to deadlock. Show the timelines.

   (c) Then list the four conditions for resource deadlocks given in section 6.2.1. Explain how they hold in the deadlock you constructed.

   (d) Then remove any one of the conditions and explain how deadlock cannot occur.