Name: ______________________________

Practice Final

1. What is cache coherence?
2. What is cache consistency? How does it differ from cache coherence.
3. List and explain the three main principles of cache coherence.
4. What is an SMP? How does an SMP differ from machines with different memory models?
5. Be able to step through the MSI protocol. For example,
   (a) Suppose processor $P1$ has block B in its cache in the shared state. What should it do when it writes to block B?
   (b) Suppose processor $P1$ has block B in its cache in the modified state. What should it do when it writes to block B?
   (c) Suppose processor $P1$ has block B in its cache in the shared state. What bus messages is it looking for? How should it respond?
   (d) Suppose processor $P1$ has block B in its cache in the modified state. What bus messages is it looking for? How should it respond?
   (e) Suppose processor $P1$ has block B in its cache in the shared state. What should it do if it wants to evict B from its cache?
6. Explain the MESI protocol and how it differs from MSI.
7. Explain what it means for a quantum bit to be in a "superposition".
8. Explain what it means for a quantum bit to be "entangled".
9. Design a 4x4 matrix that will map modify states x and y to (x or y) and (x and y).
10. Can you actually build a quantum computer with the operation you constructed above? If not, why not?
11. Given the vector below:
    (a) What is the probability of measuring x to be "up" and y to be "down"?
    (b) What is the probability of measuring x to be "down"?
    (c) Does the vector below describe an entangled state, or a separable state? How do you know?

$$\begin{bmatrix} \frac{1}{2} \\ \frac{1}{\sqrt{2}} \\ \frac{1}{2\sqrt{3}} \\ \frac{1}{\sqrt{6}} \end{bmatrix}$$

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12. (Just for fun) The qubit for an electron with spin axis (θ, ϕ) is given by

$$\begin{bmatrix} \cos(\frac{\theta}{2}) \\ (\cos(\phi) + \sin(\phi))(\sin(\frac{\theta}{2})) \end{bmatrix}$$

The probability of each possible observation is given by the norm of the complex number (i.e., the distance to 0). Show that the probabilities of observing spin up and spin down sum to 1.

13. What is your favorite xkcd comic, and why? (See `https://xkcd.com`. Set a timer for 10 minutes, then get back to work)