Discrete Structures for CS Extra Credit Problems

Try to solve as many problems as possible. Show your work.

1. Solve this logic puzzle (a modification of the famous zebra puzzle made by Einstein).

Five students with different majors who go to different schools live in consecutive houses on a street. These houses are painted different colors. The students use different TV streaming services and have different favorite foods. Determine (a) who uses BitTorrent and (b) who uses Crackle, given these clues:

- The student who eats tacos lives next to a student who watches Crackle.
- The computer science major lives in the leftmost house.
- The student who eats hamburgers uses Amazon streaming service.
- The math major goes to the University of Akron.
- The biology major lives in the yellow house.
- The green house is immediately to the right of the blue one.
- The computer scientist lives next to the red house.
- The owner of the white house eats pancakes.
- The history major watches Netflix.
- The art major eats waffles.
- The student who watches Hulu lives next to the student who eats pancakes.
- The center house's owner goes to Case Western Reserve.
- The student who eats tacos lives next to the student who goes to Kent State University.
- The owner of the blue house goes to Ohio State.
- The Tri-C community college student eats lobster.

For both (a) and (b), **identify the persons who use BitTorrent and Crackle based on their major. Show your work.** (*Hint*: Make a table where the columns represent the houses and students who live in it, and the rows represent the color of their houses, their majors, what school they go to, their favorite food, and what streaming services they use. Then use logical reasoning to determine the correct entries in the table.)

2. Five married couples (including a host and hostess) attend a party together. At the end of the party, the host asks each of the nine others how many people he or she met for the first time that evening. He receives nine different answers. **What did the hostess answer? Explain why.**

3. Sir Arthur de Templar was paid 9 gold coins for the information he provided in the last known location of the Holy Grail. Soon later, from highly trusted sources, he learns that one of the 9 gold coins is not fully gold (it has some admixture of other elements and so it's weight differs, either heavier or lighter, from the weight of the other 8 true gold coins). Sir Arthur pays a visit to his closest friend drug-maker Mr. Drugless and within a few seconds they identify the fake coin. Legend says that they used just an old weighing device (shown in the figure) and could identify the fake coin in only 3 weighings. A weighing is an operation of putting k coins on one plate of the device and k other coins on the other plate ($k=1,2,3,\ldots$) and checking if the device is in equilibrium, and if not, which plate is heavier or lighter.

Repeat (and clearly describe) the procedure used by Sir Arthur and Mr. Drugless for identifying the fake coin among 9 gold coins in just 3 weighings.