Section A

1. **How many bits of information does a four-digit decimal integer (a whole number in the range between 0000 and 9999, inclusive) contain?**

10,000 because zero counts and must be included.

1. **Mother tells her child: “If you wash the dishes, then you can go play with your friends.” The child does not wash the dishes, but still goes play. Using propositional logic, determine if the child has violated their mother’s directions. Let D be ‘the child washed the dishes’, let P be ‘the child played’. Express mother’s directions as a compound proposition and determine its truth value. If you find a discrepancy between formal logic and intuition, explain it and re-word the directions using different connectives.**

Y = D -> P = Child washed the dishes, therefore the child played.

Y is only false if antecedent (D) is true and the consequent (P) is false, therefore Y is true, and the girl did not violate her mother’s directions.

Reworded directions: You can go play if you wash the dishes.

1. **Determine the truth value of the compound proposition ((A ∧ (A → B)) → B) for all possible combinations of truth values of the constituent atomic propositions A and B. What is special about this compound proposition? In what ways propositions like this one may be useful?**

True. Always true.

1. **In Europe, dates are written as DD-MM-YYYY (day, month, year), while in many Asian countries the order is YYYY-MM-DD (year, month, day). Which of these two notations is big-endian and little-endian? Which notation is more conisistent with the endianness of the decimal system? What do you think about the way dates are written in the U.S.?**

Asian big-endian, European little-endian.

Asia is more decimal consistent.

U.S. is odd because it is neither.

Section B – I am struggling to figure out how to complete this section.

1. **Convert 7E316 to the decimal system.**
2. **Convert AB16 to the binary system.**

Section C

1. **Set up Github** – Done

Section D

1. **How much information is there in a coin toss? a single dice roll?**

1, 2.58

1. **Alice is telling Bob about the outcome of the U.S. presidential election (Bob doesn’t have prior knowledge of the outcome). The speed of the network connection between Alice and Bob is 10 Mbps (megabits per second). How long will it take Alice to transmit this information to Bob over this network connection?**

1/10,000,000th of a second.

1. **Eight teams are playing a soccer tournament using the single-elimination principle: They first play the quarter-final round; then in the semifinal round only four are left; then the two winners of the semifinals meet in the final round to determine the champion. In total, 4 quarter-final matches + 2 semifinal matches + 1 final match = 7 matches are held. Each match contributes one bit of information, so the total information of the tournament is 7 bits. On the other hand, since the tournament selects one champion out of eight teams, the information of the tournament should be log2(8) = 3 bits. Explain the inconsistency.**

Information cannot be lost so additional information such as who placed second must be retained.

1. **How much information is there in a three-letter English word? Will this amount of information be different for those who know English and for those who don’t? Is it possible that the amount of information will vary depending on the word? If so, under what circumstances?**

Log2 26 = 4.7 x 3 = 14.1

Yes, for someone unfamiliar with English and Roman letters, the information will be zero. It becomes even more complicated as English familiarity/proficiency increases as certain letters can be ruled out once other letters become known. For example, with “th\_” a proficient speaker of English would rule out all letters besides “e” “y” and possibly “o” (for the text-speak “tho”) as possibilities for the third spot.

1. **Alice and Bob are playing the 20-question game. Alice thinks of a natural number from a predefined range, and Bob tries to guess it by asking Alice yes/no questions. What largest predefined range of possible numbers would guarantee that Bob will win the game (using the best-available strategy) regardless of which particular number from the range Alice selects?**

Keep asking if the number is higher than the halfway point within the range.

220

2019

V=db^p

2019=d2^

2019 = 11111100011