ENGIN 112: Homework 12

Due date: 12/13/22 5:00 p.m.

Please submit your answers via Gradescope as a single PDF file. You can write your answers electronically or by hand and submit a scan or photo.

Question 1

This question explores protocols in embedded computer systems. Look up the datasheet for a Texas Instruments TM4C1230C3PM Microcontroller (`https://www.ti.com/lit/ds/symlink/tm4c1230c3pm.pdf`). Identify the communication components of the microcontroller and list three protocols used on these interfaces. You only need to look at Table 1-1 on page 37 to answer this question.

Question 2

Assume you want to transfer an 8-bit digital number from one system to another using two wires (one as ground and one to carry the information by varying voltage). The sender and receiver need to agree on a "protocol" for this information transfer. List three aspects of the protocol specification that would be necessary to ensure correct information transfer between the systems. Provide 1–2 sentences with each aspect to explain. (For example: "Bit order: The sender and receiver need to agree if the most significant bit or the least significant bit gets transmitted first." – example does not count as solution.)

Question 3

Consider an exchange between a customer and a merchant (via the Internet) consisting of the following six step:

- Step 1: Customer queries merchant about availability of product (e.g., "list all available t-shirts").
- Step 2: Merchant sends lists of products (e.g., "green t-shirt $10, blue t-shirt $14, grey t-shirt $12, ...").
- Step 3: Customer chooses product (e.g., "want to buy blue t-shirt").
- Step 4: Merchant requests payment (e.g., "provide payment for $14").
- Step 5: Customer sends credit card information (e.g., "charge to Visa 1234 ..., exp 12/26").
- Step 6: Merchant confirms order (e.g., "order #XYZ987 complete").

For each step, consider the following five security properties: confidentiality, integrity, authentication, non-repudiation, availability. Create a table with steps (rows) and security properties (columns) and indicate if that security property for that step is necessary ("yes" if necessary, "no" if not necessary or optional).

Question 4

Consider the following report that lists Data Breaches in 2018: `https://www.idtheftcenter.org/wp-content/uploads/2019/02/ITRC_2018-End-of-Year-Aftermath_FINAL_V2_combinedWEB.pdf`

(a) Identify which breach event had the largest number of exposed record (see Appendix (PDF page 24 and following)). State the affected company or agency, the number of exposed records, and what information was lost.

(b) Consider the breach category summary on PDF page 23. Discuss what you observe. Discuss how the total number of breached records relates to the total population of the U.S.

Consider the following web site by the U.S. Federal Trade Commission: `https://www.consumer.ftc.gov/articles/protect-your-personal-information-and-data`

(c) List the three suggestions on how to keep your personal information secure that you think are most important.

Question 5

It is estimated that the entire Internet transfers around 270 Exabytes of traffic per month. Based on this assumption, answer the following questions. For your answer please distinguish carefully between bytes and bits (e.g., 1 MB = 1 Megabyte, 1Mb = 1 Megabit; 1 byte = 8 bit).

(a) How much data traffic is transferred in the entire Internet in one second?

(b) Assuming a Blu-ray disk can hold 50 Gigabytes of data, how many Blu-ray disks would be necessary to store 1 second worth of (all) Internet traffic?

(c) Assume there are 5 billion devices connected to the Internet that are always on and that send equal amounts of traffic. (This latter assumption really is not true, but simplifies the assignment.) How much traffic is sent by each device per month?

Question 6

Identify three Internet of Things systems (or cyber-physical system), which are characterized by sensing, computation, and physical response. For each system, state its use and list its sensing, computation, and actuation operation(s). (For example: "Internet-enabled home thermostat. Sensing: temperature in home; Computation: determine control response based on actual temperature, user setting, and weather forecast; Response: Turn on or off heating or cooling system." – example does not count as solution.)