Technical University of Denmark

Practice Examination

Course: Networked Embedded Systems

Course No.: 02226

Notes:

- The final written exam will not be in PDF format like this test exam.
- Instead, it will be hosted by the Digital Exam (DE) platform of DTU as a Multiple Choice Exam.
- The final written exam will be with all aids allowed (written aids and electronic aids allowed, but no internet).
- The final written exam will have a duration of 4 hours.
- The final written exam will be composed of 50 multiple choice questions.
- DE will present the questions in random order and the answers within each question also in random order.
- There will be always only one correct answer: a response that is more correct than the rest. There are always 3 incorrect answers.
- Students will be only able to select one answer per question.
- Every correct answer corresponds to 1 point.
- Every incorrect answer corresponds to 0 points (incorrect answers do not result in subtraction of points).
- The final grading policy assumes that students follow the following strategy: students select the correct answer for all the questions they know, and a random answer for all the questions they do not know.
- For example. Alice needs to know 25 questions to pass. If she also responds to the other 25 questions randomly, she will get on average approximately 6 more points by random change, for a total of 31 points. This is better visualized in Figure 1.
- It is, therefore, against your interests to leave any question unanswered.
- The final grade will result from an overall assessment of the final written examination and the project.

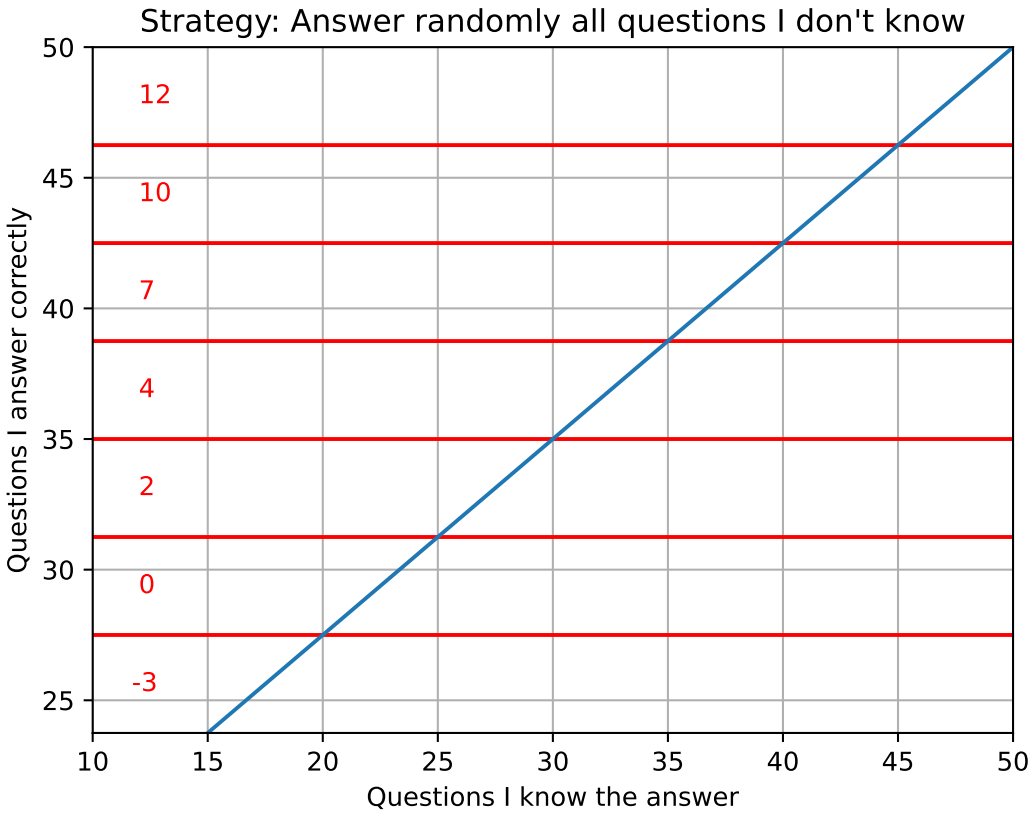

Figure 1: The grading policy is based on the questions a student knows, assuming that they answer all the questions they do not know randomly.

Test Exam

Q1. Which of the following statements is true?

A. If I buy two 1K resistors and I measure them, their resistances will be identical.

B. The output voltage from an AC-DC converter is a constant flat DC voltage.

C. A voltage divider can be used to shift a 3.3V signal to a 5V signal.

D. Batteries build internal resistance that limits the maximum current they can source.

Q2. Assuming a 10-bit single-ended ADC with reference voltage at 5V, which of the following statements is false?

A. An input voltage of 10V will be mapped to the number 2047.

B. An input voltage of 5V will be mapped to the number 1023.

C. An input voltage of 2.5V will be mapped to the number 511.

D. An input voltage of 1.25V will be mapped to the number 255.

Q3. Which of the following serial protocols uses identification numbers to specify the peripheral that should use the bus?

A. UART

B. SPI

C. I2C

D. GPIO

Q4. Four CAN devices (A, B, C, D) transmit concurrently. Their IDs are the following, A: 10101010101, B: 11101110111, C:11011011011, D:11110111101. Which device will get the priority?

A. A

B. B

C. C

D. D

Q5. You are designing the wireless communication between a battery-powered indoor air quality sensor and a mains-powered IoT Hub. Your objective is to maximize the battery lifetime of the sensor. Which of the following MAC schemes is the most energy-efficient wireless solution for this objective?

A. CSMA/CA

B. Duty-Cycled CSMA/CA

C. Synchronous MAC based on time slots

D. Duty Cycling based on a wakeup radio

Q6. Assuming that REG is an 8-bit register, which of the following C statements toggles the second least significant bit of REG?

A. `REG = (0x01<<1)^REG;`

B. `REG = (0x01<<2)^REG;`

C. `REG = (0x01<<1)|REG;`

D. `REG = (0x01<<2)|REG;`

Q7. In which of the following applications, minimizing the active power consumption is more important than minimizing the idle power consumption?

A. The wireless key of a vehicle.

B. A temperature sensor used in building heating automation.

C. A wearable sensor capturing continuous high-frequency health-oriented data.

D. A smoke detector and alarm.

Q8. Which of the following statements about time synchronization is false?

A. Periodic time synchronization is needed because clocks used by embedded systems drift from each other and from the UTC time.

B. GPS is famous for its localization services, but it is also used for time synchronization with the satellites' atomic clocks.

C. PTP has the same assumptions as NTP but achieves better performance by taking better timestamps at hardware level.

D. A way to eliminate time synchronization problems in networks embedded systems is to measure the drift of their clocks and calibrate it with a constant adjustment.

Q9. Which of the following statements about TSCH is false?

A. TSCH uses channel hopping to avoid external interference.

B. Collisions in TSCH are impossible.

C. In TSCH, each device periodically synchronizes its clock with its time source.

D. TSCH supports multi-hop networks.

Q10. Which of the following statements about Embedded AI is false?

A. Embedded AI has typically a lower latency compared to cloud-based AI.

B. Embedded AI is typically more accurate than cloud-based AI.

C. Embedded AI is typically more private than cloud-based AI.

D. Embedded AI is typically more resource-efficient than cloud-based AI.