Quizzes

# Introduction to the Internet of Things

Q: Which of the following properties are specific to an IoT object:

1. Battery powered
2. Can be reprogrammed
3. Has a rich user interface
4. Is connected to the Internet
5. All of the above

A: a, b, d

Q: Bluetooth Low Energy (BLE) technology

1. Has a communication range of up to 1 km
2. Strictly permits peer-to-peer data exchanges
3. Is routinely used in embedded devices that are mains powered
4. Can be used for proximity sensing
5. None of the above

A: d

Q: Name two main advantages of the Arm Mbed platform

A:

* Enables rapid IoT prototyping
* Allows to mix MCUs with different capabilities and diverse wireless technology in the IoT design process
* Simplifies the integration with cloud services

Q: Which of the following are key challenges facing IoT

1. Power efficient operation
2. Guaranteeing secure operation
3. Regulatory compliance
4. Scalability
5. All of the above

A: e

Q: Which of the following technological risks do not affect home IoT devices

1. Phone malware
2. Communications eavesdropping
3. Change of ownership
4. Botnets
5. Trusted firmware updates

A: c, e

# IoT System Architectures and Standards

Q: Which components of an IoT ecosystem must be secured to guaranteed trustworthy operation?

A: Hardware, middleware, network infrastructure, data in transit, software.

Q: Which of the following is true about cloud computing?

1. All intelligence resides on powerful computing servers
2. Devices perform some amount of processing on the data they collect
3. The system architecture scales well with the number of IoT devices
4. Applications with strict real-time constraints can be easily accommodated
5. The underlying networking infrastructure is strictly responsible with relaying data from sensors to cloud servers

A: a, e

Q: Which of the following functions are not performed by gateways in fog architectures?

1. Protocol translation
2. Software updating
3. Data pre-processing
4. Firewalling
5. Data flow multiplexing

A: b

Q: Name two recent technological advances that facilitate edge computing.

A:

* Hardware: Low-power chips specialised in computationally intensive tasks (e.g., Arm Ethos)
* Software: AI libraries optimised for constrained devices (e.g., uTensor)
* Neural networks: compressed/pruned models

Q: Which of the following IoT enabling technologies are standardized by the Internet Engineering Task Force (IETF)?

1. Datagram Transport Layer Security (DTLS)
2. Internet Protocol version 6 (IPv6)
3. ZigBee
4. Constrained Applications Protocol (CoAP)
5. Narrow-band IoT (NB-IoT)

A: a, b, d

# Introduction to Embedded Systems

Q: What are the typical components of a microcontroller and how is the communication between them realized?

A: Microcontrollers usually comprise a single core CPU, on-chip program and data memories, a range of input and output components, timers, interrupt structures, etc. Communications is performed via an internal system bus.

Q: Which of the following are attributes of embedded systems?

1. Diagnostics
2. Concurrent behaviour
3. Fault handling
4. Interfacing with large systems
5. All of the above

A: e

Q: Which of the following design features are not a result of the constraints specific to embedded devices?

1. On-chip memories
2. Operation based on events scheduler and interrupts
3. Optimized system operation through dedicated Java code
4. On-chip peripherals
5. None of the above

A: c

Q: Explain the concept of ‘concurrency’ in embedded software.

A: By their nature, embedded systems interact with physical processes, hence they are expected to guide their operation by inputs received from the environment. Such events often happen at the same time, so the system must be able to prioritize and handle them accordingly, or parallelize processing where possible.

Q: Which of the following is true about over-the-air programming?

1. Useful for firmware updating after product release.
2. Memory may be reserved for a bootloader that handles the OTA programming.
3. Does not require to implement a recovery mechanism.
4. May involve configuration over a JTAG interface.
5. All of the above.

A: a, b

# Hardware Platforms for IoT

Q: Which of the following properties are characteristic to Static Random Access Memory (SRAM)

1. Non-volatile
2. Fast access
3. Has remanence
4. High storage density
5. All of the above

A: b, c, d

Q: What is the lifetime of an MCU that is powered by a 1000mAh battery, operates at 5V nominal voltage, is idle 80% of the time, and consumes 0.5W when active?

A: T = 10h

Q: What are the operating principles of sensors?

A: Sensors convert a physical quantity into an electrical output (e.g., voltage). The sensitivity of a sensor indicates the minimum input that will produce a given output value, e.g., a microphone will need a certain minimum sound field strength to produce a 1 mV voltage.

Q: The Serial Peripheral Interface (SPI)

1. Uses 2 wires for communication
2. Allows to transmit any amount of data in a continuous stream
3. Permits the communication between a single master and a single slave
4. Works with a clock discipline
5. Allows bidirectional data transmission

A: b, d, e

Q: Which of the following are not properties of general-purpose input/output (GPIO)?

1. GPIO pins can be grouped into ports
2. Can be set up to accept different logic voltage levels
3. Can drive high current loads
4. May employ amplitude modulation to control linear processes
5. Can be configured as interrupts

A: c, d

Q: What does aliasing refer to?

A: The phenomenon by which two sampled signals cannot be differentiated. Reconstruction of a signal that was subject to aliasing can lead to a version that is different to the original.

Q: The dynamic range of a digital-to-analog converter refers to

1. The number of levels that can be reproduced
2. The difference between the largest and smallest signal produced
3. The minimum signal level that can be detected
4. The smallest analog signal difference that can be produced
5. None of the above

A: b

# The Arm Cortex-M4 Processor Architecture

Q: Which of the following family of processors is typically used for high performance real-time applications?

1. Arm Cortex-M series
2. Arm Cortex-A series
3. Arm SecureCore series
4. Arm Cortex-R series
5. All of the above

A: d

Q: What is the key difference between Arm Architectures and Arm Processors?

A: An Arm architecture describes the details related to programming including data types, instructions, registers, memory architecture, etc. Arm architecture forms the basis for Arm processor designs.

Q: Which of the following are features of the Arm Cortex-M4 processor

1. Incorporates a 3-stage + branch speculation pipeline
2. Allows for up to 256 priority levels
3. Has a configurable system time
4. May have a memory protection unit
5. All of the above

A: e

Q: The Cortex-M4 debug subsystem

1. Provides data transfer management
2. Can out the processor in a halted stated
3. Handles data watchpoints
4. Prioritizes interrupts
5. Restricts user application access to privileged data

A: b, c

Q: The purpose of the stack pointer in Cortex-M4 processors is to

1. Save the current context of the program
2. Record the address of the current instruction code
3. Store the return address of a subroutine
4. Provide information about the program execution
5. None of the above

A: a

# Interrupts and Low Power Features

Q: What happens when an interrupt is triggered?

A: The microcontroller performs certain hard-wired processing. The processor executes the ISR, including a return-from-interrupt instruction at the end.

Q: What happens if an interrupt is triggered while the processor is executing a complex instruction?

1. The processor finishes the instruction, then executes the ISR
2. The interrupt is ignored
3. The processor abandons the instruction, executes the ISR, and continues with the following instruction
4. The processor abandons the instruction, executes the ISR, and restarts the instruction
5. The processor assesses how many cycles are still required to complete the instruction and decided whether or not to abandon it based on a pre-defined number of cycles threshold

A: d

Q: How is the program counter loaded when an exception is triggered?

A: When an exception is triggered, the program counter is loaded with the corresponding exception handler code, according to the exception handler type, which can be found on the vector table.

Q: What if a new exception is requested while a handler is executing?

1. If the priority of the current exception is higher than that of the current one the current one is suspended and the new one is executed.
2. Handler of the new exception always waits for the current one to complete.
3. If the new exception is of lower priority than the current one, the new exception is held in pending state.
4. If the new exception is of lower priority than the current one, the new exception is ignored.
5. Any new priority takes precedence over any other priority for which a handler is already executing.

A: a, c

Q: How can we design programs that allow communication between ISRs and other threads?

A: One way to communicate between ISR and other code is software data buffering, which is generally used as a communication interface. One must always keep data integrity and race conditions in mind.

# Introduction to the Mbed Platform and CMSIS

Q: What security features are implemented in Mbed OS?

A:

* Mbed TLS - protocol for securing communication channels between devices and servers
* Secure Partition Manager - responsible for isolating software within partitions, managing software execution within partitions, and communication between partitions

Q: What is the Mbed Hardware Development Kit (HDK)?

A: Collection of hardware design resource that assist in the development of custom hardware. It allows to use Mbed OS in the design process. Integrates easy-to-use USB and debugging support.

Q: Which of the following are advantages of low-level programming?

1. Direct interaction with hardware
2. Portability across devices
3. More optimized code and higher memory efficiency
4. Rapid prototyping of applications
5. Allows code reuse

A: a, c

Q: Which of the following is standardized by the Cortex Microcontroller Software Interface Standard (CMSIS)?

1. Access to special registers
2. Names of system initialization functions
3. Hardware interfaces
4. Functions to access the system timer
5. Functions to access special instructions

A: a, b, d. e

Q: With the standardized interface to the CoreSight Debug Access Port (CMSIS-DAP) the Debug unit can connect to target microprocessor using

1. JTAG
2. I2C
3. SWO
4. SWD
5. All of the above

A: a, c, d

# IoT Connectivity Part I

Q: Which of the following holds in Bluetooth architectures?

1. A device can act both as a slave and master
2. Slaves can communicate directly with other slaves
3. Uplink are downlink are separated by different time slots
4. Slaves can transmit immediately as soon as they have data buffered
5. None of the above

A: a, c

Q: A Bluetooth packet may occupy

1. 1 slot
2. 2 slots
3. Any odd number of slots
4. 3 slots
5. 5 slots

A: a, b, e

Q: Summarize the sequence of events for discovering a Bluetooth device.

A: Masters send periodic inquiries, while devices that wish to be discovered and are available for connection listen on a set of wake-up carriers for such messages. This happens periodically, once every 1.28s. Devices receiving inquiries respond after a back-off procedure to avoid collisions.

Q: How many channels are dedicated to advertisements in Bluetooth Low Energy (BLE)?

1. 1
2. 3
3. 10
4. Any number configurable by the user
5. At most 5

A: b

Q: What are BLE profiles?

A: Concept describing an application and collection of services offered (blood pressure monitoring, device information service, etc.); each profile makes use of a particular set of GATT services and it is possible for a developer to define custom profiles.

Q: ZigBee can achieve data rates up to

1. 1 Mb/s
2. 20 kb/s
3. 250 kb/s
4. 1 kb/s
5. 10 Mb/s

A: b, c

Q: Which of the following statements about the ZigBee PHY and MAC layers are correct?

1. ZigBee uses Frequency Hopping Spread Spectrum to mitigate noise
2. Access to the medium is based on carrier sensing
3. All frames transmitted must be acknowledged
4. Access to the medium is scheduled
5. Power saving mechanisms cannot be implemented

Q: b, d

# IoT Connectivity Part II

Q: The contention windows used to regulate the access to the channel in IEEE 802.11 WLANs

1. Are fixed to optimal values set by the standard
2. Their optimal values depend on the number of stations
3. The network performance is not influenced by the contention window, irrespective of the number of stations
4. Their optimal values may depend on the amount of data stations need to transmit
5. Their values cannot be updated without driver modification

A: b, d

Q: Explain the difference between hidden and exposed terminals.

A: Stations whose mutual transmissions cannot be detected, but which may collide at an intended receiver are called hidden. Stations that carrier sense the activity of others and defer transmission, although their frames would not collide at their respective destinations are exposed.

Q: Which of the following features of IEEE 802.11n enhance throughput performance?

1. Scheduled channel access
2. Multi-user MIMO
3. Channel bonding
4. Use of higher carrier frequencies
5. Frame aggregation

A: c, e

Q: How does the spread factor impact the performance of LoRa communications?

1. A higher spread factor enhances the achievable bitrate
2. A higher spread factor reduces the achievable bitrate
3. A higher spread factor increases robustness to multipath fading
4. A higher spread factor decreases robustness to multipath fading
5. LoRa bit rate strictly depends on the channel bandwidth

A: b,c

Q: If activation by personalization (ABP) is used in a LoRaWAN deployment,

1. Device keys are transmitted over the air following a join procedure
2. Device keys are provisioned offline and stored semi-permanently
3. Devices can easily roam
4. Device activation incurs substantial overhead at the network server side
5. Roaming is only possible if the gateways have mobility management support

A: b

Q: Name three key advantage of the NB-IoT LP-WAN technology

A:

* Easily deployable with existing cellular infrastructure (only SW update required)
* Deterministic latency (<10 ms) as transmissions are aligned with LTE frame structure
* Reliability through hybrid ARQ
* Energy efficiency - base station can controls sleep modes via signalling

# The Cloud

Q: What are the different types of hypervisor and how do they differ?

A: Type 1 (bare-metal) run directly on the host hardware; Type 2 (hosted) run on the OS of the host.

Q: Which of the following are advantages of container-based virtualisation?

1. Can be destroyed as needed
2. Possible to share OS libraries among containers
3. Allow running multiple operating systems within a single container
4. Hypervisor not required
5. Their operation is not limited by the kernel running on the host machine

A: a, b, d

Q: Which of the following is true about serverless computing?

1. No physical servers are need
2. Slower to deploy than containers, but faster than virtual machines
3. User charged based on the number of functions instantiated
4. No specific machine assigned to a function
5. All of the above

A: d

Q: Comment on the scalability of the MQTT protocol.

A: Publishers decoupled from subscribers by topics. Publisher do not need to know the identity of subscribers and vice-versa. Broker handles subscription/publication – scalable solution, but with single point of failure.

Q: Which of the following applies to distributed file systems?

1. Use a network protocol to coordinate access to storage and locate files
2. Clients reading/modifying content have different views of the file system
3. Clients are unaware of the exact location of the content accessed
4. Can handle very large volumes of data
5. All of the above

A: a, c, d

# IoT Security

Q: Which of the following can be regarded as goals of threat modelling?

1. quantify the severity of security risks
2. identify security risks
3. reason about risk counteraction strategies
4. compute the cost of implementing risk mitigations
5. write user documentation to prevent human error

A: a, b, c

Q: What are the principles of code signing?

A: Generate cryptographic hash to confirm code authenticity and integrity; encrypt hash with private key; append signature and certificate to code.

Q: Which of the following apply to symmetric key encryption?

1. Different keys are used for encryption and decryption
2. Keys are provisioned at manufacturing or derived using secure agreement protocols
3. The longer a key, the stronger the secrecy
4. Encryption and decryption algorithms should only be known to the communicating parties
5. All of the above

A: b, c

Q: If a sender wishes to encrypt data using the RSA algorithm and uses 23 and 11 as prime numbers to derive the encryption and decryption keys, what is the value of the totient involved in these calculations?

A: 220

Q: Which of the following are valid elliptic curves that can be used for cryptographic purposes?

A: a, b

# Current and Future IoT Trends

Q: What is the key difference between supervised and unsupervised learning?

A: Supervised learning relies on training examples; Unsupervised algorithms can learn without human supervision.

Q: A neural network uses activation functions of the form . What type of functions are these?

1. Sigmoid
2. Hyperbolic tangent
3. Step function
4. Rectified linear unit
5. Linear function

A: d

Q: What are the challenges that the Platform Security Architecture seeks to address?

1. Management of secure devices at scale
2. Lack of confidence in data to/from sensors/actuators
3. Affordable security given shortage of experts
4. Continuous emergence of new vulnerabilities
5. All of the above

A: e

Q: What does neural model pruning refer to?

A: Removing model weights whose value indicate connections of little importance to the output of a layer. Subsequently remove units without input connections.