

Class 9 | Cyber Olympiad

Instructions: Each question has one correct answer. Choose the best option (A/B/C/D). Answer key is provided at the end. This paper is for practice only — not an official exam paper. Recommended time: **45 minutes**.

Q1. In Rust, what does 'lifetime annotation' enforce?

A. the maximum execution time of a function

B. the order in which variables are initialised

C. that references cannot outlive the data they point to, preventing dangling pointers

D. the version of the compiler required

Q2. What is 'continuation monad' in functional programming?

A. a monad for optional values

B. a monad encapsulating a continuation (the rest of a computation), enabling control flow manipulation

C. a monad for list processing

D. a monad for error handling

Q3. The 'omega test' in compiler optimisation is used for:

A. profiling code performance

B. testing for integer arithmetic overflow

C. deciding dependence between array accesses for loop parallelisation

D. optimising floating-point operations

Q4. What is 'secure multi-party computation' (SMPC)?

A. running multiple programs securely

B. a cryptographic protocol allowing parties to jointly compute a function over their inputs while keeping those inputs private

C. encrypting communications between servers

D. multi-factor authentication

Q5. In quantum computing, 'quantum error correction' is necessary because:

A. qubits compute too slowly

B. quantum gates are deterministic

C. qubits decohere and gate operations are noisy, introducing errors that must be corrected

D. classical computers cannot simulate quantum circuits

Q6. What is 'polyglot persistence' in modern databases?

A. using one database for all data types

B. writing database queries in multiple languages

C. using different database types for different parts of an application based on data requirements

D. translating SQL queries automatically

Q7. In machine learning, 'few-shot learning' refers to:

A. training with unlimited data

B. a model that can learn new tasks from very few training examples

C. a model with very few parameters

D. training that takes very little time

Q8. What is 'plasma (programmable logic and smart memory array)'? In computing contexts, what is an FPGA?

A. a type of RAM

B. a fixed-function processor

C. a field-programmable gate array — hardware logic that can be reconfigured after manufacturing

D. a type of solid-state drive

Q9. In formal language theory, what is the 'Myhill-Nerode theorem' used for?

A. proving NP-completeness

B. minimising the number of states in a DFA and characterising regular languages

C. constructing a CFG from a DFA

D. proving undecidability

Q10. What is 'lattice-based cryptography'?

A. cryptography using lattice structures in physical hardware

B. a family of cryptographic schemes believed to be resistant to quantum attacks, based on hard lattice problems

C. cryptography using RSA lattice reduction

D. visual cryptography using grid patterns

Q11. In deep learning, 'dropout' regularisation works by:

A. reducing the learning rate randomly

B. removing neurons permanently

C. randomly deactivating a fraction of neurons during each training step to prevent co-adaptation

D. reducing the batch size randomly

Q12. What is 'Merkle tree' used for in blockchains?

A. storing user identities

B. a tree structure where each non-leaf node is the hash of its children, enabling efficient and secure verification of data integrity

C. consensus between nodes

D. encrypting transactions

Q13. In the context of CPUs, what is 'Tomasulo's algorithm'?

A. a branch prediction algorithm

B. a cache replacement algorithm

C. a hardware algorithm for dynamic scheduling and out-of-order execution using register renaming

D. a memory prefetching algorithm

Q14. What is 'temporal logic' used for in computing?

A. measuring execution time

B. specifying and verifying properties of systems that evolve over time (e.g. 'the system will eventually respond')

C. scheduling tasks by time

D. debugging time-sensitive code

Q15. In Python, what does 'Protocol Buffer' (protobuf) offer over JSON?

A. human readability

B. easier debugging

C. schema-based, compact binary serialisation that is faster and smaller than JSON

D. support for more data types

Q16. What is 'WebRTC'?

A. a web content rendering technology

B. a framework for building real-time, peer-to-peer communication (audio, video, data) in web browsers

C. a web server runtime

D. a web security standard

Q17. In operating systems, what is 'copy-on-write fork' vs 'exec'?

A. fork creates a new process; exec replaces the process image with a new program

B. fork replaces the process; exec creates a child

C. fork and exec are identical

D. fork only works on Linux; exec only on Windows

Q18. What is 'dependent type system' as exemplified by Coq or Agda?

A. types that depend on the operating system

B. types that can depend on values, enabling proofs of program correctness to be expressed as types

C. dynamic type systems

D. polymorphic type systems

Q19. In database systems, what is 'MVCC' (Multi-Version Concurrency Control)?

A. a method for storing multiple backups

B. a technique where each transaction sees a consistent snapshot of the database, avoiding locks by keeping multiple versions of data

C. a consensus protocol

D. a versioning system for schema changes

Q20. What is the 'Chomsky hierarchy' in formal language theory?

A. a ranking of programming languages by difficulty

B. a containment hierarchy of language classes: regular \subset context-free \subset context-sensitive \subset recursively enumerable

C. a classification of parsing algorithms

D. a hierarchy of grammar rules by complexity

Q21. In security, what is 'TOCTOU' (time-of-check to time-of-use)?

A. a timing attack on encryption

B. a race condition vulnerability where a check and the subsequent use of a resource can be manipulated in between

C. a type of SQL injection

D. a cache timing attack

Q22. What is 'software-defined networking' (SDN)?

A. writing network drivers in software

B. an approach decoupling the network control plane from the data plane, enabling programmable, centralised network management

C. networking without physical cables

D. emulating networks in software for testing

Q23. In Python, what does 'functools.reduce(func, iterable)' do?

A. removes duplicate elements

B. filters elements

C. cumulatively applies func to elements, reducing the iterable to a single value

D. maps a function across elements

Q24. What is 'rowhammer' attack?

A. a physical attack hammering DRAM chips

B. repeatedly accessing DRAM rows to cause bit flips in adjacent rows, bypassing memory isolation

C. a DDoS attack on database rows

D. a type of SQL injection

Q25. In deep learning, 'batch size' affects training in which way?

A. larger batch size always improves generalisation

B. batch size has no effect on training dynamics

C. smaller batch sizes add noise to updates (better generalisation but noisier); larger batches are more stable but may generalise worse

D. batch size only affects memory, not accuracy

Q26. What is the difference between 'mutex' and 'semaphore'?

A. they are identical

B. a mutex is owned by one thread and used for mutual exclusion; a semaphore is a signalling mechanism that can have a count > 1

C. a semaphore is binary; a mutex can have any value

D. mutexes are only used in operating systems; semaphores are only in user space

Q27. What is 'abstract machine' in computing theory?

A. a machine that runs abstract code

B. a theoretical model of computation defining operational semantics for a language or algorithm

C. a virtual machine for abstract data types

D. a machine with no I/O capabilities

Q28. In Python, what is 'ctypes' used for?

A. defining custom type hints

B. calling C shared libraries from Python code

C. converting between Python types

D. type-checking at runtime

Q29. What is 'write-ahead logging' (WAL) in databases?

A. logging user actions before they occur

B. writing all changes to a log before applying them to the data files, ensuring durability and crash recovery

C. pre-computing query results

D. archiving old data before deleting

Q30. In machine learning, 'knowledge distillation' involves:

A. extracting features from raw data

B. training a smaller 'student' model to mimic the behaviour of a larger 'teacher' model

C. compressing datasets

D. reducing the number of layers in a neural network

Q31. What is 'profile-guided optimisation' (PGO)?

A. optimising code based on code style

B. using profiling data from real runs to guide compiler optimisations

C. optimising code by removing profile-related functions

D. a type of static analysis

Q32. In Kubernetes, what is a 'StatefulSet' used for?

A. managing stateless applications

B. running batch jobs

C. managing stateful applications requiring stable network identity and persistent storage (e.g. databases)

D. ingress traffic routing

Q33. What is 'program synthesis' in computer science?

A. generating machine code from assembly

B. automatically constructing a program from a high-level specification

C. synthesising audio with code

D. combining multiple programs into one

Q34. In cryptography, what is 'key stretching'?

A. extending a key with random padding

B. making a key longer without adding entropy

C. using a computationally expensive function to derive a strong key from a weak password, making brute-force harder

D. distributing encryption keys across servers

Q35. What is 'reactive programming'?

A. programming that reacts to security threats

B. a programming paradigm based on asynchronous data streams and the propagation of change

C. event-driven programming without loops

D. declarative UI programming only

Q36. In computer architecture, what is 'memory-level parallelism' (MLP)?

A. storing data in parallel arrays

B. the ability to issue and execute multiple memory operations simultaneously to hide memory latency

C. using SIMD for memory access

D. partitioning memory across CPU cores

Q37. What is the 'Stern-Brocot tree' relevant to?

A. a data structure for binary search

B. a binary tree representation of all positive rational numbers used in fraction approximation

C. a cryptographic tree structure

D. a parse tree for arithmetic expressions

Q38. In ML, 'contrastive learning' trains models by:

A. using labelled data exclusively

B. learning representations by pulling similar examples together and pushing dissimilar ones apart in embedding space

C. minimising the difference between predicted and actual values

D. comparing multiple neural network architectures

Q39. What is 'instruction-level parallelism' (ILP)?

A. running the same instruction on multiple data

B. the potential to execute multiple instructions simultaneously within a single processor

C. parallelising code across multiple CPUs

D. executing instructions in a different order than written

Q40. In Python, 'weakref' module provides:

A. a way to create weak type hints

B. references to objects that do not prevent garbage collection, useful for caches and callbacks

C. slower reference counting

D. a reference to None

Answer Key

Q1: C Q2: B Q3: C Q4: B Q5: C Q6: C Q7: B Q8: C Q9: B Q10: B
Q11: C Q12: B Q13: C Q14: B Q15: C Q16: B Q17: A Q18: B Q19: B
Q20: B Q21: B Q22: B Q23: C Q24: B Q25: C Q26: B Q27: B Q28: B
Q29: B Q30: B Q31: B Q32: C Q33: B Q34: C Q35: B Q36: B Q37: B
Q38: B Q39: B Q40: B