NCO-Style · Original Practice Content

Class 8 | Cyber Olympiad

40 Questions · With Answer Key
Syllabax Olympiad Series
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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 Haskell, what is a 'monad'?

A. a type class providing pure functions

B. a design pattern for handling effects (e.g. optionality, I/O) in a functional setting, providing bind (>>=) and return

C. a recursive data type

D. a type synonym

Q2. What is 'AES' (Advanced Encryption Standard) and what key sizes does it support?

A. asymmetric encryption; 512, 1024 bits

B. symmetric block cipher; 128, 192, or 256-bit keys

C. hashing algorithm; 256 or 512-bit output

D. stream cipher; 64-bit keys

Q3. What is a 'quine' in computing?

A. a program that solves the halting problem

B. a program that outputs its own source code as output

C. a self-modifying program

D. a program that runs infinitely without looping

Q4. In category theory (applied to type theory), a 'functor' maps:

A. between sets preserving addition

B. a category to itself only

C. objects and morphisms between categories in a structure-preserving way

D. types to values

Q5. What is 'oblivious RAM' (ORAM)?

A. RAM that ignores memory faults

B. a protocol for accessing memory such that the access pattern leaks no information about the data being accessed

C. encrypted RAM chips

D. virtual RAM using disk space

Q6. In LLVM, 'IR' (Intermediate Representation) is used to:

A. store compressed source code

B. represent hardware directly

C. provide a platform-independent, optimisable form of code between frontend and backend

D. interpret Python bytecode

Q7. What is 'taint analysis' in security?

A. checking for SQL injection

B. tracking data flow from untrusted sources to sensitive sinks to detect vulnerabilities

C. scanning for buffer overflows

D. monitoring network traffic

Q8. In the context of SAT solvers, 'DPLL' algorithm uses:

A. dynamic programming to solve 3-SAT

B. unit propagation and backtracking to efficiently determine satisfiability

C. random walk heuristics

D. a neural network to predict satisfying assignments

Q9. What is 'persistent data structure'?

A. data stored permanently on disk

B. a data structure that always preserves all previous versions after modification

C. a database with transactions

D. a data structure that never changes

Q10. In memory safety, what is 'use-after-free'?

A. reusing a variable after it has been redefined

B. accessing memory after it has been freed/deallocated, causing undefined behaviour

C. freeing memory twice

D. running out of heap memory

Q11. What is the 'Fisher-Yates shuffle' algorithm?

A. a sorting algorithm

B. a graph traversal

C. an unbiased in-place shuffling algorithm producing a uniformly random permutation in O(n)

D. a hashing algorithm

Q12. In Rust, what does the 'borrow checker' enforce?

A. that all functions are pure

B. memory safety at compile time: no dangling references, no data races, and exclusive mutable access

C. type inference

D. garbage collection

Q13. What is 'Grover's algorithm' in quantum computing?

A. factoring large numbers exponentially faster

B. quantum simulation of molecular systems

C. searching an unsorted database of N items in O(√N) time (quadratic speedup over classical)

D. creating quantum error-correcting codes

Q14. What is 'elliptic curve Diffie-Hellman' (ECDH)?

A. a block cipher

B. a key exchange protocol using elliptic curves, providing equivalent security to RSA with smaller keys

C. a hashing function

D. a symmetric encryption scheme

Q15. In deep learning, what is 'vanishing gradient problem'?

A. gradients growing too large during backpropagation

B. gradients becoming extremely small during backpropagation through deep networks, preventing early layers from learning

C. the model converging too quickly

D. loss function oscillating without converging

Q16. What is 'process isolation' in operating systems?

A. preventing processes from using the CPU

B. ensuring each process has its own protected address space so bugs or malicious code in one cannot corrupt another

C. limiting each process to one CPU core

D. preventing processes from accessing the Internet

Q17. What is 'Shor's algorithm'?

A. a quantum search algorithm

B. a quantum algorithm factoring integers in polynomial time, threatening RSA encryption

C. a classical algorithm for large-number factoring

D. a quantum error correction algorithm

Q18. In GPU programming (CUDA), what is a 'warp'?

A. a memory access pattern

B. a group of 32 threads that execute in lockstep on a GPU streaming multiprocessor

C. a data structure for GPU memory

D. a kernel launch configuration

Q19. What is 'dataflow programming'?

A. programming using if-else chains

B. a paradigm where computation is expressed as a directed graph of data flowing between operations

C. programming optimised for databases

D. programming without variables

Q20. In Python, what does 'Protocol' (from typing) enable?

A. runtime type enforcement

B. structural subtyping — a class satisfies a Protocol if it has the required methods, without explicit inheritance

C. dynamic typing

D. network protocol implementation

Q21. What is 'symbolic execution' in software testing?

A. executing code symbolically on paper

B. executing a program with symbolic inputs, generating path conditions to explore all execution paths

C. compiling code to symbolic assembly

D. running code without a CPU

Q22. In database theory, 'serialisability' of a schedule means:

A. all transactions run sequentially

B. the concurrent schedule is equivalent in outcome to some serial execution of the transactions

C. each transaction completes within a time limit

D. transactions are ordered alphabetically

Q23. What is 'Meltdown' vulnerability?

A. a network attack flooding servers

B. a CPU side-channel vulnerability exploiting out-of-order execution to read kernel memory from userspace

C. a software bug in Linux kernel

D. a Wi-Fi eavesdropping attack

Q24. In machine learning, 'RLHF' (Reinforcement Learning from Human Feedback) is used to:

A. speed up training of convolutional networks

B. align language model outputs with human preferences using human-rated examples

C. train robots using physical feedback

D. optimise hyperparameters automatically

Q25. What is 'link-time optimisation' (LTO)?

A. optimising code during editing

B. performing optimisations across the entire program at link time, enabling cross-module inlining and dead code elimination

C. reducing binary size by removing debug symbols

D. optimising network protocols

Q26. What is the 'actor model' of concurrency?

A. a model where threads share memory directly

B. a model where independent actors communicate via message passing, with no shared state

C. an OOP pattern using actor classes

D. a model for parallel sorting

Q27. In formal methods, 'Hoare logic' provides:

A. a type system for functional languages

B. a formal system for reasoning about program correctness using pre/post conditions and loop invariants

C. an algorithm for model checking

D. a temporal logic for systems

Q28. What is 'chaos engineering' in software development?

A. randomly generating test data

B. intentionally introducing failures in production to identify weaknesses in system resilience

C. writing code without following standards

D. deploying untested code to production

Q29. In Python, what is the purpose of '__new__' vs '__init__'?

A. they are identical

B. __new__ creates the instance (controls allocation); __init__ initialises it (sets attributes)

C. __init__ creates the instance; __new__ initialises it

D. __new__ is only used in C extensions

Q30. What is 'WASM' (WebAssembly)?

A. an assembly language for web servers

B. a low-level binary format for the web enabling near-native performance in browsers

C. a JavaScript optimisation layer

D. a web standard for 3D graphics

Q31. In security, what is 'return-oriented programming' (ROP)?

A. a technique for returning values from functions

B. a code reuse attack chaining 'gadgets' (code sequences ending in RET) to execute arbitrary logic without injecting code

C. a buffer overflow exploit injecting shellcode

D. a type of SQL injection

Q32. What is 'probabilistic data structure' exemplified by HyperLogLog?

A. a data structure that is always exact

B. a space-efficient structure trading exactness for memory, e.g. estimating cardinality (count of distinct elements)

C. a hash table with probabilistic keys

D. a tree structure with random branching

Q33. What does 'CRDTs' (Conflict-free Replicated Data Types) solve?

A. database security

B. allowing replicas to be updated independently and merged without conflicts, guaranteeing eventual consistency

C. data type conflicts in Python

D. preventing SQL injection

Q34. In machine learning, the 'transformer architecture' introduces self-attention. The complexity of self-attention with sequence length n is:

A. $O(n)$

B. $O(n \log n)$

C. $O(n^2)$

D. $O(n^3)$

Q35. What is 'signed distance function' (SDF) used for in computer graphics?

A. rendering text

B. representing 3D shapes implicitly as the distance to the nearest surface (negative inside, positive outside)

C. texture mapping

D. animation blending

Q36. In Python's asyncio, what is the difference between 'Task' and 'Coroutine'?

A. they are identical

B. a coroutine is a function defined with async def; a Task wraps a coroutine and schedules it for concurrent execution

C. tasks run synchronously; coroutines run asynchronously

D. coroutines are for I/O; tasks are for CPU-bound work

Q37. What is 'abstract interpretation' in program analysis?

A. interpreting code without executing it line by line

B. a framework for sound approximation of program semantics using abstract domains to prove properties

C. creating documentation from code comments

D. converting code to abstract syntax trees

Q38. In graphics, what is 'path tracing'?

A. tracing the path a user takes through a website

B. a global illumination rendering algorithm that simulates light paths (including indirect bounces) using Monte Carlo integration

C. tracking the path of animated objects

D. rendering wireframe models

Q39. What is 'Byzantine agreement' used for in blockchain?

A. encrypting transactions

B. ensuring that honest nodes agree on the same value even when some nodes are faulty or malicious

C. compressing blockchain data

D. mining new blocks

Q40. In Python, what is 'introspection'?

A. examining the CPU state

B. the ability of a program to examine its own structure, types, and attributes at runtime

C. profiling memory usage

D. logging function calls

Answer Key

Q1: B Q2: B Q3: B Q4: C Q5: B Q6: C Q7: B Q8: B Q9: B Q10: B

Q11: C Q12: B Q13: C Q14: B Q15: B Q16: B Q17: B Q18: B Q19: B

Q20: B Q21: B Q22: B Q23: B Q24: B Q25: B Q26: B Q27: B Q28: B

Q29: B Q30: B Q31: B Q32: B Q33: B Q34: C Q35: B Q36: B Q37: B

Q38: B Q39: B Q40: B