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BCA Honours | Semester IV | BCA4CJ206

Python Programming

Module 3 Comprehensive Notes

Module 3: Exception Handling, Persistent File I/O, and Regular Expressions

Building reliable enterprise software requires robust runtime error mitigation, structured file stream I/O, and expressive string pattern matching using regular expressions.

3.1 Exception Handling Architecture

Runtime anomalies that disrupt normal instruction flow generate Exception objects. Unhandled exceptions terminate process execution with a traceback.

The structured `try-except-else-finally` block manages exceptions cleanly:

```
try:
    file_handle = open("system_audit.log", "r")
    data = file_handle.read()
    metric_value = int(data.strip())
except FileNotFoundError as fnf_err:
    print(f"I/O Exception Caught: {fnf_err}")
except ValueError as val_err:
    print(f"Data Formatting Error: {val_err}")
except Exception as generic_err:
    print(f"Unexpected General Exception: {generic_err}")
else:
    # Executes if and only if NO exception occurred in the try block
    print(f"Successfully Parsed Metric: {metric_value}")
finally:
    # Guarantees execution under ALL circumstances (for resource cleanup)
    if 'file_handle' in locals() and not file_handle.closed:
        file_handle.close()
        print("File Stream Safely Closed.")
```

3.2 File I/O and Context Management

Persistent storage access uses the built-in `open(filename, mode)` function. Modes include `'r'` (read), `'w'` (overwrite), `'a'` (append), `'x'` (exclusive creation), and `'b'` (binary mode).

The idiomatic standard in Python is the `with` statement, which leverages the **Context Manager Protocol** (methods `__enter__` and `__exit__`) to guarantee automatic stream closure upon leaving the block, even if an unhandled exception occurs:

```
with open("telemetry.json", "w", encoding="utf-8") as f:
    f.write('{"status": "ONLINE", "latency_ms": 14.2}')
```

3.3 Object Serialization with Pickle and JSON

- `json` **Module:** Standard text-based serialization format interoperable across programming languages. Functions: `json.dump()`, `json.dumps()`, `json.load()`, `json.loads()`.

- `pickle` **Module:** Python-specific binary serialization protocol that serializes complex arbitrary Python object graphs (including classes and function closures) into byte streams.

3.4 Regular Expressions (The `re` Module)

Regular expressions define search patterns for advanced string validation, extraction, and substitution:

Metacharacter	Semantic Pattern Matching Role
`^` / `$`	Matches beginning / end of string.
`\d` / `\D`	Matches any decimal digit `[0-9]` / any non-digit.
`\w` / `\W`	Matches alphanumeric word character `[a-zA-Z0-9_]` / non-word.
`\s` / `\S`	Matches whitespace (space, tab, newline) / non-whitespace.
`*` / `+` / `?`	Quantifiers: 0 or more / 1 or more / 0 or 1 occurrence.
`{m, n}`	Matches between `m` and `n` repetitions.
`(...)`	Capturing group for sub-pattern extraction.

Core functions in `re` include: `re.match()` (anchored to string start), `re.search()` (scans entire string), `re.findall()` (returns list of all non-overlapping matches), and `re.sub()` (pattern replacement).

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1. Architectural Trade-offs and Computational Complexity

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- **Time Complexity Optimization versus Spatial Footprint:** In high-throughput algorithmic pipelines handling Module 3 Core Concepts and Methods, pre-computing intermediate lookup tables, spatial indices, and hashing structures achieves near-instantaneous $O(1)$ query latency, but inflates the physical memory footprint. Conversely, in-place algorithms minimize RAM utilization at the cost of higher CPU cycle counts. Modern architectures dynamically calibrate memory allocations using memory-mapped files and cache-aware structures.
- **Concurrency Scalability versus Thread Contention:** While multi-core hardware allows horizontal execution, concurrent modifications to shared state structures create severe lock contention, thread synchronization bottlenecks, and cache line invalidation storms. High-performance frameworks deploy lock-free algorithms, optimistic concurrency control, and atomic compare-and-swap (CAS) primitives.
- **Algorithmic Determinism versus Heuristic Scalability:** Exact mathematical algorithms frequently encounter NP-hard combinatorial barriers as problem dimensions scale. Contemporary

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2. Empirical Comparative Framework

A structured comparative assessment clarifies operational distinctions across conventional paradigms and modern production implementations in Python Programming:

Evaluation Dimension	Conventional Traditional Approach	Contemporary Integrated Paradigm	Strategic Impact Metric
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