**5. Adaptive Theory**

**5.1 What Is Adaptive Cryptography?**

**Adaptive cryptography** refers to encryption systems that adjust their behavior based on the characteristics of the input data. Unlike traditional ciphers such as AES—which apply a fixed sequence of operations regardless of structure—adaptive systems analyze input patterns (e.g., regularity, randomness, predictability) and tailor the transform sequence accordingly.

Mango’s adaptivity is **deterministic**, not random: the same input type will always result in the same sequence selection. This ensures repeatable, testable, and stable behavior.

**5.2 Why Adaptivity Matters**

Real-world data is rarely uniform or truly random. Static ciphers often underperform when applied to structured input, sometimes leaking subtle patterns that reduce diffusion or entropy.

Mango’s adaptive model mitigates this issue by profiling the input and selecting a pre-tuned transformation path optimized to disrupt structure and maximize cryptographic robustness.

**5.3 Input Profiling**

Mango classifies incoming data into one of the following core **InputTypes**:

* **Natural** – Text, prose, source code, config files
* **Random** – Encrypted files, compressed data, entropy sources
* **Sequence** – Incremental counters, numeric sequences, synthetic harnesses
* **Combined** – Mixed/heterogeneous input with hybrid structure
* **Default** – Fallback for unknown or unclassified input

The *Default* class is versatile but may underperform when compared to a sequence tailored for a specific structure.

**5.4 InputProfile: The Core of Execution**

Once an InputType is identified, Mango selects an **InputProfile**: a curated transform pipeline with per-transform round counts (TR) and an overall global round multiplier (GR).

Each InputProfile is:

* **Versioned**
* **Deterministic**
* **Cryptographically Tuned** for its input class

This abstraction enables Mango to operate securely and efficiently across vastly different data types while maintaining auditability and repeatability.

**5.5 The Workbench: Profile Discovery**

The **Mango Workbench** allows developers and researchers to construct sequences either manually or through automated methods such as **Munge**.

When a new sequence is created under a selected InputType, you are effectively proposing a new candidate **InputProfile**. This is exactly how Mango’s built-in profiles were discovered.

Munge evaluates tens of millions of permutations across multiple metrics (entropy, avalanche, bit variance, etc.). Once a high-scoring sequence is identified, it can be exported, versioned, and integrated into the profiling system.

**5.6 Real-World Adaptivity: Custom InputTypes**

Mango supports **custom data profiling**, making it ideal for domain-specific workloads such as:

* Genomic data
* Log streams
* Telemetry or sensor data
* Domain-specific encodings

To create a custom InputProfile:

1. Capture representative input samples.
2. Set InputType = UserData in the Workbench.
3. Initiate a Munge run.
4. Promote high-scoring sequences to reusable InputProfiles.

This workflow allows Mango to **adapt to your data**, not just data in general.

**5.7 Are Custom InputProfiles Portable?**

Yes. While Mango’s classification logic (via InputProfiler) can be customized, the resulting **InputProfile**—a pipeline of transform IDs and round settings—is always portable and deterministic.

These profiles are:

* Platform-independent
* Free of side effects or external dependencies
* Treated as self-contained “programs” for Mango’s adaptive engine

The engine does not care *why* a profile was selected—only what the sequence is.

**5.8 Security Considerations**

* ✅ **Production Sequences**: Mango Adaptive Cryptography uses only validated InputProfiles with known scores, derived through rigorous Munge/BTR discovery.
* ⚠️ **Workbench Sequences**: The Workbench is a powerful tool for exploration but does not enforce cryptographic correctness. Treat unvalidated sequences as experimental.
* 🔒 For sensitive workloads, only use sequences with:
  + A **PassCount of 9/9**
  + High aggregate scores
  + Known reversibility and avalanche performance