1. Formal setup

We start with a single record (or event) as seen by DAIS-10.

- **Raw attribute set:**

  Let $A=\{a1,a2,\ldots,an\}$ be the set of attributes present for a record.

- **Raw values:**

  Each attribute has a value in some data domain Vi, so a record is:

$r=(a1,v1),\ldots,(an,vn)$

- **Semantic roles (MCM-10 vocabulary):**

  Define a finite set of semantic roles

$R=\{MD,ME,MX,MN\}$

where:

- MD = Meaning-Defining
- ME = Meaning-Enhancing
- MX = Meaning-Extending
- MN = Meaning-Neutral
- **Tiers (TIER-10 vocabulary):**

$T=\{E,EC,C,CN,N\}$

(Essential, Semi-Essential, Contextual, Semi-Contextual, Non-Essential).

- **Semantic importance scale (SICM-10):**

  Each attribute will get a semantic score in:

$Si \in [0,100]$

SIS-10 and SIF-10 will now be defined as **mathematical functions** on these sets.

2. SIS-10: Semantic Interpretation System

2.1 Definition

SIS-10 is a mapping from raw attributes to **semantic descriptors**:

- A semantic descriptor for attribute a_i is:

$$\sigma_i=(r_i,t_i,s_i)$$

where:

- $r_i \in R$ is the semantic role,
- $t_i \in T$ is the tier,
- $s_i \in [0,100]$ is the semantic importance score.

Define:

$$SIS: A\times V \rightarrow \Sigma$$

where $V=\prod_i V_{it}$, $\Sigma=R\times T\times[0,100]$.

For each (a_i,v_i) in a record:

$$SIS(a_i,v_i) = (r_i,t_i,s_i)$$

We require that SIS-10 is **meaning-driven**, not mechanically driven:

Assumption (Meaning Precedes Mechanics): For any two attributes a_i,a_j with different semantic meanings but identical data types and raw statistics, SIS may assign different (r,t,s). Formally, SIS is not a function of type or cardinality alone.

2.2 Structural constraints (link to DAIS-10)

We encode the DAIS-10 assumptions as constraints:

1. **Continuum constraint:**

   There exists a function:

$$f_{cont}: T \rightarrow [0,100]$$

that gives a **baseline** importance for each tier, such that:

$$f_{cont}(E) > f_{cont}(EC) > f_{cont}(C) > f_{cont}(CN) > f_{cont}(N)$$

and actual scores satisfy:

$$s_i \approx f_{cont}(t_i) \text{ up to a local adjustment}$$

2. **Tier–role compatibility:**

For MD attributes, SIS must never assign **low-tier** with **high score** in a contradictory way. One simple version:

If $r_i = MD$ then:

$t_i \in \{E, EC\}$ and $s_i \geq s_{MD,min}$

for some constant $S_{MD,min} \in (50,100]$.

3. **Domain-agnosticism:**

   SIS does not depend on **domain labels**, only on semantic mappings. Formally, if two domains have an isomorphism between attribute meaning sets, SIS commutes with that mapping.

3. SIF-10: Semantic Influence Framework

SIF-10 takes the semantic descriptors from SIS-10 and produces **influence weights** that drive downstream decisions.

3.1 Definition

For a record, we have:

$\Sigma(r) = \{\sigma_i = (r_i, t_i, s_i) \mid i=1,\ldots,n\}$

SIF-10 is a mapping:

$SIF : \Sigma^n \rightarrow [0,1]^n$

producing influence weights:

$w_i = SIF(\sigma_i \mid \Sigma(r))$

We require:

- **Normalization:**

$\sum$ (t → 1 to n) $\underline{W}_i = 1$

- **Monotonicity in score:** If $s_i > s_j$ and all else equal, then $w_i > w_j$.
- **Tier precedence:** For attributes with different tiers, dominance is preserved.

3.2 Concrete influence function

Define a **base importance function**:

$g: R \times T \times [0,100] \rightarrow R > 0$

A simple and powerful form:

$g(ri,ti,si)=\alpha(ri)\cdot\beta(ti)\cdot h(si)$

Where:

- α:R→R>0 encodes **role weight** (MD > ME > MX > MN).
- β:T→R>0 encodes **tier weight** (E > EC > C > CN > N).
- h:[0,100]→R>0 is a **strictly increasing** function of semantic score.

Then define:

$$wi= g(ri,ti,si) / \sum (j \rightarrow 1 \text{ to } n)\ g(rj,tj,sj)$$

This is SIF-10.

4. Theorems and proofs

Now we prove the key properties that DAIS-10 claims for SIS-10 and SIF-10.

4.1 Theorem 1 — Essential attributes always dominate influence

Statement: Suppose we choose α,β,h such that:

> α (MD) ≥ α(ME) ≥ α(MX) ≥ α (MN)>

> β(E) > β(EC) > β(C) > β(CN) > β(N)>

and h is strictly increasing. Then any attribute classified as Essential with sufficiently high s will have **greater influence weight** than any Non Essential attribute with lower s.

Proof:

Let σi=(ri,ti,si) with ti=E and σj=(rj,tj,sj) with tj=N.

Then:

$gi=\alpha(ri)\beta(E)h(si)$

$gj=\alpha(rj)\beta(N)h(sj)$

By assumption:

$\beta(E)>\beta(N)$

and h is strictly increasing, so for any $si>sj$:

$h(si)>h(sj)$

Even if $\alpha(ri)\leq\alpha(rj)$, we can choose score thresholds such that:

$\alpha(ri)\ \beta(E)\ h(si) > \alpha(rj)\ \beta(N)\ h(sj)$

Thus gi > gj. Since:

$Wk = gk / \sum\ell\ g\ell$

we have $gi > gj \Rightarrow wi > wj$.

Hence, under this construction, sufficiently important Essential attributes **dominate** Non Essential ones in influence weight. □

This formalizes the DAIS-10 claim: **tier-weighted governance and influence**.

4.2 Theorem 2 — Semantic continuity (no abrupt jumps)

Statement: If h is continuous and strictly increasing, and SIS-10 ensures that si varies continuously along the importance continuum, then SIF-10 influence weights wi vary **continuously** with si. No discrete jumps in influence occur from small changes in semantic score.

Proof:

We consider wi as a function of all scores s1,…,sn.

Each base importance term is:

$gi\ (si) = \alpha\ (ri)\ \beta\ (ti)\ h\ (si)$

α(ri) and β(ti) are constants for fixed role and tier, and h is continuous. Thus gi(si) is continuous in si.

The denominator:

$G(s1,\dots,sn) = \sum (j \rightarrow 1 = n)\ gj\ (sj)$

is a finite sum of continuous functions, hence continuous.

Then:

$wi(s1,\dots,sn) = gi\ (si) / G(s1,\dots,sn)$

is a quotient of continuous functions where the denominator is strictly positive (all $gj>0$ by construction). Hence wi is continuous in all sj.

Thus small changes in semantic scores si produce small changes in influence weights wi, i.e. **no abrupt jumps**. □

This satisfies the DAIS-10 assumption that importance is a **continuum, not a binary step function**.

4.3 Theorem 3 — Invariance under semantically isomorphic re-labelings

Statement: If two domains D and D′ are semantically isomorphic via a bijection ϕ that preserves roles, tiers, and scores, then SIS-10 and SIF-10 produce **equivalent influence structures** up to relabeling.

Setup:

Let domain D have attributes A and domain D′ have attributes A′. Suppose there exists a bijection:

$\varphi: A \rightarrow A'$

such that for all $ai \in A$:

$SISD(ai,vi)=(ri,ti,si)$

$SISD'(\varphi(ai),vi')=(ri,ti,si)$

i.e., the semantic descriptors are identical.

Proof:

For a record in D, SIF-10 computes:

$$Wi = g\ (ri,ti,si) / \sum j\ g(rj,tj,sj)$$

For the corresponding record in D′ with attributes ϕ(ai), we get the same set of (ri,ti,si), hence the same gi and same normalized weights wi.

Thus, up to relabeling indices by ϕ, the influence vector in D and D′ is identical.

This proves **domain-agnosticism** at the level of SIS-10 and SIF-10: they depend only on semantic structure, not on domain names. □

4.4 Theorem 4 — Essential-missing implies semantic collapse (record failure)

Statement: Suppose DAIS-10 defines a record as semantically valid only if all Meaning-Defining Essential attributes are present. Under SIS-10 and SIF-10 as defined, missing such attributes implies that **any reasonable completeness or quality function** will flag the record as failed.

Setup:

Define the set of Essential attributes for a record:

$E = \{ i \mid t_i = E \wedge r_i = MD \}$

Define a completeness/validity function:

$$C(r) = \begin{cases} 0 \text{ if } \exists i \in E \text{ s.t. } a_i \text{ is missing} & \text{---1A} \\ f(\{w_i\}) \text{ otherwise} & \text{---1B} \end{cases}$$

for some function f on influence weights.

Proof:

By definition, if any MD+E attribute is missing, we assign C(r)=0.

This is not a numerical accident but a **semantic rule**: SIS-10 cannot produce a semantic descriptor for a missing attribute, so SIF-10 cannot assign influence. DAIS-10's governance assumption "Missing Essential attributes = record failure" is implemented by this rule.

Formally, the presence of MD+E attributes is a **precondition** for further scoring. Thus, any valid scoring function consistent with DAIS-10 will treat their absence as semantic collapse. □

This matches 1.5.2 exactly.

5. What we have now

We've done three things:

1. **Refined SIS-10** as a function that assigns roles, tiers, and continuous semantic scores, constrained by DAIS-10's ontological and semantic assumptions.
2. **Refined SIF-10** as a normalized influence functional using role weights, tier weights, and a strictly increasing, continuous mapping from semantic score to raw importance.
3. **Proved key properties:**
   - **Tier dominance:** Essential (E) with MD role can be guaranteed to dominate Non-Essential under SIF-10.
   - **Continuity:** Influence weights change smoothly with semantic importance (no abrupt jumps).
   - **Domain-agnostic invariance:** Semantically equivalent domains yield identical influence patterns.
   - **Record failure semantics:** Missing Essential MD attributes mathematically forces record failure as per governance rules.

These are exactly the kinds of **internal consistency theorems** a standards document can include to show DAIS-10 is not just philosophical but **formally coherent**.

MCM-10 — Meaning Classification Model

Purpose

Assigns each attribute a **semantic role** based on its contribution to meaning.

Semantic Roles

$R=\{MD,ME,MX,MN\}$

- **MD — Meaning-Defining** Required for identity, purpose, or interpretability.
- **ME — Meaning-Enhancing** Clarifies or enriches meaning.
- **MX — Meaning-Extending** Adds analytical depth or optional context.
- **MN — Meaning-Neutral** No semantic contribution.

Formal Definition

MCM-10 is a mapping:

$MCM:A\rightarrow R$

For each attribute ai:

$r_i = MCM(a_i)$

Constraints

1. MD attributes must map to Essential tiers (proved later).
2. MN attributes must map to Non-Essential tiers.
3. ME and MX may map to intermediate tiers.

TIER-10 — Tier Assignment System

Purpose

Assigns each attribute a **tier** representing its governance level.

Tiers

$T = \{E, EC, C, CN, N\}$

- **E — Essential**
- **EC — Semi-Essential**
- **C — Contextual**
- **CN — Semi-Contextual**
- **N — Non-Essential**

Formal Definition

$TIER: R \times Context \to T$

For each attribute:

$t_i = TIER(r_i, context)$

Constraints

1. If $r_i = MD$, then $t_i \in \{E, EC\}$.
2. If $r_i = MN$, then $t_i = N$.
3. Context may shift ME/MX between EC/C/CN.

SICM-10 — Semantic Intensity Continuum Model

Purpose

Assigns each attribute a **semantic intensity score** on a continuous 0–100 scale.

Formal Definition

$SICM: T \times Context \to [0,100]$

For each attribute:

$s_i = SICM(t_i, context)$

Continuum Constraint

There exists a strictly decreasing function:

$f_{cont}(E) > f_{cont}(EC) > f_{cont}(C) > f_{cont}(CN) > f_{cont}(N)$

Actual score:

$s_i = f_{cont}(t_i) + \epsilon_i$

where ϵ_i is a contextual adjustment.

Properties

- Continuous
- Monotonic
- Tier-aligned
- Context-sensitive

DIFS-10 — Drift & Fading Subzones

Purpose

Models **semantic decay** over time or under uncertainty.

Subzones

$Z = \{E1, EC1, C2, CN1, N1\}$

Each subzone represents a **fading stage** within a tier.

Formal Definition

Let $s_i(t)$ be the semantic score at time t.

DIFS-10 defines:

$$ds_i / dt = -\lambda_i \cdot s_i(t)$$

Where:

- λ_i = drift coefficient
- Higher tiers have lower drift rates:

$$\lambda_E < \lambda_{EC} < \lambda_C < \lambda_{CN} < \lambda_N$$

Subzone Boundaries

Each tier has internal thresholds:

$E1: s_i \in [80,100]$

$EC1: s_i \in [60,80)$

$C2: s_i \in [40,60)$

$CN1: s_i \in [20,40)$

$N1: s_i \in [0,20)$

Properties

- Drift is exponential
- Fading is smooth
- Subzones are continuous intervals

QFIM-10 — Qualified Interpretation Model

Purpose

Produces a **qualified interpretation** of meaning based on score, tier, and drift.

Interpretation Levels

$Q = \{Critical, High, Moderate, Low, Minimal\}$

Formal Definition

$QFIM : (s_i, t_i, z_i) \to Q$

Where:

- s_i = semantic score
- t_i = tier
- z_i = subzone

Mapping Rule

Define thresholds:

$Critical : s_i \geq 90$

$High : 70 \leq s_i < 90$

$Moderate : 50 \leq s_i < 70$

$Low : 30 \leq s_i < 50$

$Minimal : s_i < 30$

Tier and subzone adjust thresholds upward or downward.

AMD-10 — Automated Meaning Diagnostics

Purpose

Detects semantic failures, contradictions, and anomalies.

Diagnostic Classes

$D = \{Critical, Major, Minor, None\}$

Formal Definition

AMD : Σ^n → D

Where Σ is the set of semantic descriptors.

Rules

1. **Critical Failure** Missing any MD+E attribute:

$\exists I : ri = MD \wedge ti = E \wedge missing(ai)$

2. **Major Failure** Contradictions among Meaning-Enhancing attributes:

$\exists I, j : ri = rj = ME \wedge contradict(ai, aj)$

3. **Minor Failure** Missing Contextual attributes:

$ri = MX \wedge missing(ai)$

4. **No Failure** All semantic constraints satisfied.