**Project Title**

**Dark Souls Game Mechanics Ontology: A Semantic Knowledge Graph for RPG Systems**

**Team Members**

**22I0493,22I 0395,22I 0532**

**Domain**

Video Game Mechanics and Role-Playing Game (RPG) Systems - specifically Dark Souls universe

**Abstract**

This project develops a comprehensive OWL ontology modeling the intricate mechanics, items, characters, and world structure of Dark Souls, a landmark action-RPG. The ontology captures equipment statistics, upgrade paths, boss weaknesses, NPC relationships, area connectivity, and character build requirements. The use case enables automated reasoning for optimal build planning, quest dependency resolution, strategic boss approach recommendations based on damage type analysis, and navigation path discovery. By semantically representing game knowledge typically scattered across wikis and player guides, this ontology facilitates intelligent gameplay assistance systems, procedural content validation, and cross-game mechanical comparison frameworks. The knowledge graph supports queries like "find all weapons requiring ≤20 STR that deal fire damage and can be purchased in early-game areas" or "determine minimum upgrade materials needed to reach Lightning +5 from any base weapon."

**📌 SECTION 2 — Domain Description**

**Why This Domain is Novel**

**Granular Mechanical Modeling**: Unlike general gaming ontologies that focus on high-level concepts (game genres, platforms), this ontology captures fine-grained mechanical relationships—stat requirements, damage scaling formulas, upgrade material dependencies, and spatial connectivity graphs specific to RPG systems.

**Multi-System Integration**: The domain uniquely integrates disparate game systems (combat, crafting, navigation, progression, social covenants) into a unified semantic model, revealing non-obvious interdependencies between systems (e.g., covenant membership affecting NPC vendors affecting available upgrade paths).

**Procedural Knowledge Representation**: Beyond static facts, the ontology models procedural knowledge through transitive upgrade chains, symmetric area connections, and constraint-based build validation—enabling reasoning about player progression possibilities.

**Under-Represented in LOD**: While DBpedia/Wikidata contain basic entities (character names, locations), they lack the mechanical depth necessary for gameplay reasoning—missing upgrade paths, damage type effectiveness matrices, stat requirement constraints, and material-to-craftable mappings.

**SPARQL Evidence of Coverage Gaps**

PREFIX dbo: <http://dbpedia.org/ontology/>

PREFIX dbr: <http://dbpedia.org/resource/>

SELECT ?s WHERE {

?s dbo:wikiPageWikiLink dbr:Dark\_Souls .

}

LIMIT 20A screenshot of a computer

AI-generated content may be incorrect.

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

# Wikidata label search: find items whose English label contains "Dark Souls" (case-insensitive)

SELECT (COUNT(DISTINCT ?item) AS ?count) WHERE {

?item rdfs:label ?label .

FILTER(LANG(?label) = "en")

FILTER(CONTAINS(LCASE(STR(?label)), "dark souls"))

}

A screenshot of a computer program

AI-generated content may be incorrect.

PREFIX wd: <http://www.wikidata.org/entity/>

PREFIX wdt: <http://www.wikidata.org/prop/direct/>

SELECT ?character WHERE {

wd:Q199093 wdt:P674 ?character .

}A screenshot of a computer

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**📌 SECTION 3 — Competency Questions**

**Overview**

**This section presents 20 competency questions (CQs) designed to evaluate the Dark Souls ontology across multiple dimensions: multi-hop path navigation, reasoning capabilities, aggregation patterns, and negation logic.**

**CQ1: Areas Connected to Firelink Shrine**

**Category: Multi-hop (1-hop)**

**Question: What areas are directly connected to Firelink Shrine, and what are their descriptions?**

**Reasoning Type: Basic graph traversal, 1-hop connectivity**

**CQ2: Items from Nearby Bosses**

**Category: Multi-hop (3-hop), Aggregation**

**Question: What items are dropped by bosses in areas within 3 hops of Undead Parish?**

**Reasoning Type: Multi-hop navigation (1-3 hops), entity relationships, spatial aggregation across multiple path lengths**

**CQ3: Faith-Only Spells**

**Category: Reasoning, Negation**

**Question: Which spells require Faith but not Intelligence, ordered by Faith requirement?**

**Reasoning Type: Property-based reasoning, negation (excluding Intelligence-based spells), attribute filtering**

**CQ4: Low-Strength High-Damage Weapons**

**Category: Aggregation, Reasoning**

**Question: What are the top 5 highest physical damage weapons requiring less than 20 Strength?**

**Reasoning Type: Conditional filtering, aggregation (ranking), stat-based reasoning, optimization for build planning**

**CQ5: Area with Most Vendors**

**Category: Aggregation**

**Question: Which area has the highest concentration of vendors?**

**Reasoning Type: Aggregation (counting, grouping), spatial reasoning, resource distribution analysis**

**CQ6: Boss-Dropped Weapons**

**Category: Reasoning**

**Question: Which weapons can only be obtained from boss drops?**

**Reasoning Type: Entity relationship reasoning, loot source identification, acquisition pathway analysis**

**CQ7: Non-Vendor Exclusive Items**

**Category: Negation, Multi-source Reasoning**

**Question: Which weapons are never sold by vendors and can only be found through boss drops or area treasures?**

**Reasoning Type: Negation (exclusion pattern), multi-source reasoning, alternative acquisition logic, complex loot system understanding**

**CQ8: Enemy Efficiency Analysis**

**Category: Multi-hop (1-hop), Aggregation, Reasoning**

**Question: What's the HP-to-Soul ratio of enemies in starting areas (Firelink Shrine and areas 1 hop away), identifying the least rewarding enemies?**

**Reasoning Type: Multi-hop (1-hop), mathematical aggregation (ratio calculation), efficiency analysis, risk-reward evaluation**

**CQ9: Soul Farming Efficiency**

**Category: Aggregation, Reasoning**

**Question: Which areas offer the best soul farming efficiency based on enemy density and soul rewards?**

**Reasoning Type: Complex aggregation (count, average, sum, max), efficiency scoring, optimization reasoning, player resource strategy**

**CQ10: World-Only Weapons**

**Category: Double Negation**

**Question: Which weapons can only be found in the world (not dropped by creatures, not sold by vendors)?**

**Reasoning Type: Double negation (exclusion of two different acquisition methods), world exploration logic, hidden treasure identification**

**CQ11: Comprehensive Area Progression Analysis**

**Category: Multi-hop (4-hop), Complex Aggregation, Reasoning**

**Question: Provide a comprehensive progression guide showing area difficulty, boss encounters, routing type, and recommended levels based on distance from Firelink Shrine.**

**Reasoning Type:**

* **Multi-hop (0-4 hops with shortest path calculation)**
* **Complex aggregation (min, max, count, avg, sum across multiple entities)**
* **Mathematical reasoning (danger rating formula combining boss HP, enemy stats, and boss count)**
* **Conditional logic (tier classification, routing categorization)**
* **String operations (concatenation of connected areas)**
* **Game progression logic**

**CQ12: Highest HP Boss at 2 Hops**

**Category: Multi-hop (2-hop), Aggregation**

**Question: What is the highest HP boss located exactly 2 hops from Firelink Shrine?**

**Reasoning Type: Multi-hop (exact 2-hop path), aggregation (maximum HP selection), path filtering to ensure exact distance**

**CQ13: 3-Hop Areas Without High-Value Boss Souls**

**Category: Multi-hop (3-hop), Negation**

**Question: Which areas are exactly 3 hops from Firelink Shrine and do not contain bosses that drop souls worth more than 50,000?**

**Reasoning Type: Multi-hop (exact 3-hop path), negation (excluding high-value drops), value-based reasoning, economic filtering**

**CQ14: Weakest Boss at 3 Hops**

**Category: Multi-hop (3-hop), Aggregation**

**Question: What is the lowest HP boss located exactly 3 hops from Firelink Shrine?**

**Reasoning Type: Multi-hop (exact 3-hop path), aggregation (minimum HP selection), inverse difficulty ranking**

**CQ15: Most Entity-Rich Area with High-HP Boss**

**Category: Multi-hop (3-hop), Conditional Reasoning, Aggregation**

**Question: Among 3-hop areas containing a boss with more than 5000 HP, which has the most items and bosses combined?**

**Reasoning Type: Multi-hop (3-hop), conditional filtering (EXISTS pattern for HP threshold), aggregation (counting distinct entities), multi-class querying (items + bosses), loot density analysis**

**CQ16: Average Boss HP Excluding High-Cost Item Areas**

**Category: Multi-hop (3-hop), Negation, Aggregation**

**Question: What is the average boss HP in 3-hop areas that do not contain items costing more than 20,000 souls?**

**Reasoning Type: Multi-hop (3-hop), negation (excluding expensive item areas), aggregation (average calculation), economic reasoning, area filtering based on loot value**

**CQ17: Early Game Spell Loadout Optimization**

**Category: Reasoning, Aggregation, Negation**

**Question: Which combination of Faith spells provides the most total uses while fitting in 2 attunement slots and requiring ≤25 Faith?**

**Reasoning Type: Combinatorial reasoning, constraint satisfaction (slot and stat limits), negation (Faith-only requirement), optimization (maximize total uses), build planning logic**

**CQ18: Upgrade Path Material Efficiency**

**Category: Multi-hop (2-hop), Aggregation, Reasoning**

**Question: For weapons found within 2 hops of Firelink Shrine, which upgrade path requires the fewest unique material types?**

**Reasoning Type: Multi-hop (0-2 hops), aggregation (counting unique materials, string concatenation), upgrade system reasoning, resource optimization, material management strategy**

**CQ19: Covenant Reward Analysis**

**Category: Reasoning, Aggregation**

**Question: Which covenant offers the highest average soul value of unique rewards per rank milestone?**

**Reasoning Type: Aggregation (count, average, max with HAVING clause filtering), covenant progression reasoning, value-per-effort analysis, long-term commitment optimization**

**CQ20: Boss Weakness Exploitation Strategy**

**Category: Multi-hop (2-hop), Reasoning, Aggregation**

**Question: For bosses within 2 hops of Firelink Shrine, which damage type is most commonly effective, and which weapons with less than 30 combined stat requirements can exploit it?**

**Reasoning Type: Multi-hop (0-2 hops), aggregation (counting vulnerable bosses, concatenating weapon names), weakness exploitation logic, stat-based build planning, strategic combat optimization**

**📌 SECTION 4 — Conceptual Model**

**A black and white diagram

AI-generated content may be incorrect.**

**Overview**

**This section details the vocabulary reuse strategy and external dataset integration points within the Dark Souls ontology, demonstrating adherence to Linked Open Data principles and semantic web best practices.**

**🔄 Vocabulary Reuse Strategy**

**1. Schema.org Vocabulary**

**Namespace: https://schema.org/**

**Purpose: Provides widely-adopted, standardized properties for common attributes, ensuring compatibility with search engines and web standards.**

**Properties Reused from Schema.org:**

| **Schema.org Property** | **Used For** | **Applied To** | **Example from Ontology** |
| --- | --- | --- | --- |
| **schema:name** | **Entity names** | **All classes (Boss, Area, NPC, Item, Weapon)** | **schema:name "Ornstein and Smough"** |
| **schema:description** | **Detailed descriptions** | **Bosses, Areas, Items, NPCs, Weapons** | **schema:description "Dragon Slayer and Executioner, guardians of Anor Londo"** |

**Benefits:**

* **SEO-friendly: Search engines understand Schema.org markup**
* **Interoperability: Compatible with Google Knowledge Graph and other platforms**
* **Standardization: Reduces ambiguity in property semantics**
* **Wide adoption: Recognized by semantic web community globally**

**Example from Ontology:**

**ds:OrnsteinAndSmough a ds:Boss ;**

**schema:name "Ornstein and Smough" ;**

**schema:description "Dragon Slayer and Executioner, guardians of Anor Londo" ;**

**ds:locatedIn ds:AnorLondo ;**

**ds:healthPoints 4200 ;**

**ds:souls 50000 .**

**2. RDF Schema (RDFS)**

**Namespace: http://www.w3.org/2000/01/rdf-schema#**

**Purpose: Fundamental RDF vocabulary for defining classes, properties, and hierarchies.**

**Properties Reused from RDFS:**

| **RDFS Property** | **Used For** | **Example from Ontology** |
| --- | --- | --- |
| **rdfs:label** | **Human-readable labels** | **rdfs:label "Boss"** |
| **rdfs:comment** | **Explanatory notes** | **rdfs:comment "Major enemies with unique souls and mechanics"** |
| **rdfs:subClassOf** | **Class hierarchies** | **ds:Weapon rdfs:subClassOf ds:Equipment** |
| **rdfs:domain** | **Property domain specification** | **ds:healthPoints rdfs:domain [owl:unionOf (ds:Boss ds:Enemy)]** |
| **rdfs:range** | **Property range specification** | **ds:healthPoints rdfs:range xsd:integer** |

**Benefits:**

* **Semantic clarity: Defines meaning of custom properties**
* **Reasoning support: Enables inference engines to derive new knowledge**
* **Hierarchy modeling: Establishes taxonomic relationships**

**Example from Ontology:**

**ds:Boss a owl:Class ;**

**rdfs:label "Boss" ;**

**rdfs:comment "Major enemies with unique souls and mechanics" .**

**ds:Melee a owl:Class ;**

**rdfs:subClassOf ds:Weapon ;**

**rdfs:label "Melee Weapon" ;**

**rdfs:comment "Close-range weapons" .**

**3. OWL (Web Ontology Language)**

**Namespace: http://www.w3.org/2002/07/owl#**

**Purpose: Advanced ontology modeling including equivalence, restrictions, and external linking.**

**Properties Reused from OWL:**

| **OWL Property** | **Used For** | **Example from Ontology** |
| --- | --- | --- |
| **owl:sameAs** | **External entity alignment** | **Links to DBpedia/Wikidata** |
| **owl:Class** | **Class definitions** | **ds:Boss a owl:Class** |
| **owl:ObjectProperty** | **Relationship definitions** | **ds:droppedBy a owl:ObjectProperty** |
| **owl:DatatypeProperty** | **Data property definitions** | **ds:healthPoints a owl:DatatypeProperty** |
| **owl:TransitiveProperty** | **Transitive relations** | **ds:upgradesTo a owl:TransitiveProperty** |
| **owl:SymmetricProperty** | **Symmetric relations** | **ds:connectsTo a owl:SymmetricProperty** |
| **owl:FunctionalProperty** | **Unique value constraints** | **ds:locatedIn a owl:FunctionalProperty** |
| **owl:InverseFunctionalProperty** | **Inverse uniqueness** | **ds:drops a owl:InverseFunctionalProperty** |

**Benefits:**

* **External linking: Connects local ontology to LOD cloud**
* **Reasoning: Supports logical inference**
* **Constraint definition: Enforces data integrity**

**Examples from Ontology:**

**# Class Definition**

**ds:Boss a owl:Class ;**

**rdfs:label "Boss" ;**

**rdfs:comment "Major enemies with unique souls and mechanics" .**

**# Object Property with Constraints**

**ds:locatedIn a owl:ObjectProperty, owl:FunctionalProperty ;**

**rdfs:domain [ a owl:Class ; owl:unionOf (ds:NPC ds:Boss ds:Enemy) ] ;**

**rdfs:range ds:Area .**

**# Symmetric Property (Area Connections)**

**ds:connectsTo a owl:ObjectProperty, owl:SymmetricProperty ;**

**rdfs:domain ds:Area ;**

**rdfs:range ds:Area .**

**# Transitive Property (Weapon Upgrades)**

**ds:upgradesTo a owl:ObjectProperty, owl:TransitiveProperty ;**

**rdfs:domain ds:Weapon ;**

**rdfs:range ds:Weapon .**

**4. XSD (XML Schema Datatypes)**

**Namespace: http://www.w3.org/2001/XMLSchema#**

**Purpose: Type specification for literal values ensuring data integrity.**

**Datatypes Used:**

| **XSD Datatype** | **Used For** | **Example from Ontology** |
| --- | --- | --- |
| **xsd:integer** | **Whole numbers** | **ds:healthPoints 4200 (Boss HP)** |
| **xsd:decimal** | **Decimals** | **ds:weight 10.0 (Equipment weight)** |
| **xsd:string** | **Text values** | **Names, descriptions (implicit)** |

**Benefits:**

* **Type safety: Prevents invalid data entry**
* **Query optimization: Enables numeric comparisons in SPARQL**
* **Validation: Tools can verify data correctness**

**Examples from Ontology:**

**# Integer Properties**

**ds:healthPoints a owl:DatatypeProperty ;**

**rdfs:domain [ a owl:Class ; owl:unionOf (ds:Boss ds:Enemy) ] ;**

**rdfs:range xsd:integer .**

**ds:strengthRequirement a owl:DatatypeProperty ;**

**rdfs:domain ds:Weapon ;**

**rdfs:range xsd:integer .**

**# Decimal Properties**

**ds:weight a owl:DatatypeProperty ;**

**rdfs:domain ds:Equipment ;**

**rdfs:range xsd:decimal .**

**ds:poise a owl:DatatypeProperty ;**

**rdfs:domain ds:Armor ;**

**rdfs:range xsd:decimal .**

**# Usage in Individuals**

**ds:OrnsteinAndSmough**

**ds:healthPoints 4200 ; # xsd:integer**

**ds:souls 50000 . # xsd:integer**

**ds:Zweihander**

**ds:weight 10.0 ; # xsd:decimal**

**ds:physicalDamage 175 . # xsd:integer**

**🌐 External Dataset Integration Points**

**1. DBpedia Linkage**

**Endpoint: https://dbpedia.org/sparql**

**Purpose: Connect to encyclopedic knowledge extracted from Wikipedia.**

**Linked Entities in the Ontology:**

| **Entity Type** | **Local URI** | **DBpedia URI** | **Link Property** |
| --- | --- | --- | --- |
| **Boss** | **ds:GwynLordOfCinder** | **dbpedia:Gwyn** | **owl:sameAs** |

**Example from Ontology:**

**ds:GwynLordOfCinder owl:sameAs <http://dbpedia.org/resource/Gwyn> .**

**Integration Benefits:**

* **Multilingual labels: Access names in 100+ languages via DBpedia**
* **Rich descriptions: Extended narrative content from Wikipedia**
* **Cross-references: Links to related games, developers, cultural references**
* **Federated queries: Combine local game data with encyclopedic context**

**Example Federated Query:**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX owl: <http://www.w3.org/2002/07/owl#>**

**PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>**

**PREFIX dbo: <http://dbpedia.org/ontology/>**

**SELECT ?bossName ?dbpediaAbstract WHERE {**

**# Local data**

**?boss a ds:Boss ;**

**schema:name ?bossName ;**

**owl:sameAs ?dbpediaURI .**

**# External DBpedia data**

**SERVICE <https://dbpedia.org/sparql> {**

**?dbpediaURI dbo:abstract ?dbpediaAbstract .**

**FILTER(lang(?dbpediaAbstract) = "en")**

**}**

**}**

**Use Cases:**

* **Enrich boss descriptions with Wikipedia content**
* **Validate entity names against canonical sources**
* **Access fan community knowledge and lore discussions**
* **Cross-reference with other FromSoftware games**

**2. Wikidata Linkage**

**Endpoint: https://query.wikidata.org/sparql**

**Purpose: Connect to structured, multilingual knowledge base with authority control.**

**Linked Entities in the Ontology:**

| **Entity Type** | **Local URI** | **Wikidata URI** | **Link Property** |
| --- | --- | --- | --- |
| **Boss** | **ds:GwynLordOfCinder** | **wd:Q5624446** | **owl:sameAs** |
| **Boss** | **ds:ArtoriasTheAbysswalker** | **wd:Q108762372** | **owl:sameAs** |
| **NPC** | **ds:Solaire** | **wd:Q3553962** | **owl:sameAs** |
| **Boss** | **ds:SeathTheScaleless** | **wd:Q108762345** | **owl:sameAs** |
| **Boss** | **ds:SifTheGreatWolf** | **wd:Q108762373** | **owl:sameAs** |
| **Area** | **ds:AnorLondo** | **wd:Q111819156** | **owl:sameAs** |
| **Area** | **ds:FirelinkShrine** | **wd:Q111819155** | **owl:sameAs** |
| **Item** | **ds:EstusFlask** | **wd:Q111819154** | **owl:sameAs** |
| **Item** | **ds:TitaniteShard** | **wd:Q111819153** | **owl:sameAs** |

**Examples from Ontology:**

**# Bosses**

**ds:GwynLordOfCinder owl:sameAs**

**<http://dbpedia.org/resource/Gwyn> ,**

**<http://www.wikidata.org/entity/Q5624446> .**

**ds:ArtoriasTheAbysswalker owl:sameAs**

**<http://www.wikidata.org/entity/Q108762372> .**

**ds:SifTheGreatWolf owl:sameAs**

**<http://www.wikidata.org/entity/Q108762373> .**

**ds:SeathTheScaleless owl:sameAs**

**<http://www.wikidata.org/entity/Q108762345> .**

**# NPCs**

**ds:Solaire owl:sameAs**

**<http://www.wikidata.org/entity/Q3553962> .**

**# Areas**

**ds:AnorLondo owl:sameAs**

**<http://www.wikidata.org/entity/Q111819156> .**

**ds:FirelinkShrine owl:sameAs**

**<http://www.wikidata.org/entity/Q111819155> .**

**# Items**

**ds:EstusFlask owl:sameAs**

**<http://www.wikidata.org/entity/Q111819154> .**

**ds:TitaniteShard owl:sameAs**

**<http://www.wikidata.org/entity/Q111819153> .**

**Integration Benefits:**

* **Structured data: Machine-readable facts and relationships**
* **Authority control: Unique identifiers for entities across languages**
* **Property richness: Access to thousands of relationship types**
* **Global coverage: Data from international gaming communities**
* **Version tracking: Historical data and release information**

**Example Federated Query:**

**PREFIX owl: <http://www.w3.org/2002/07/owl#>**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**PREFIX wdt: <http://www.wikidata.org/prop/direct/>**

**SELECT ?bossName ?ourHP**

**(COUNT(?wikidataStatement) as ?externalReferences) WHERE {**

**# Local boss data**

**?boss a ds:Boss ;**

**schema:name ?bossName ;**

**ds:healthPoints ?ourHP ;**

**owl:sameAs ?wikidataURI .**

**# Count external statements about this entity**

**SERVICE <https://query.wikidata.org/sparql> {**

**?wikidataURI ?predicate ?wikidataStatement .**

**}**

**}**

**GROUP BY ?bossName ?ourHP**

**ORDER BY DESC(?externalReferences)**

**LIMIT 10**

**Use Cases:**

* **Count external references to validate entity importance**
* **Access multilingual names and descriptions**
* **Link to related entities (developers, publishers, game series)**
* **Retrieve release dates, platforms, and version information**
* **Connect to broader gaming and cultural knowledge graphs**

**📊 Vocabulary Reuse Summary**

**Distribution of Vocabulary Sources**

| **Vocabulary** | **Purpose** | **Usage Count** | **Examples** |
| --- | --- | --- | --- |
| **Custom (ds:)** | **Game-specific concepts** | **~50+ properties** | **ds:healthPoints, ds:locatedIn, ds:droppedBy** |
| **Schema.org** | **Common properties** | **2 properties** | **schema:name, schema:description** |
| **RDFS** | **Schema-level metadata** | **5 properties** | **rdfs:label, rdfs:comment, rdfs:subClassOf** |
| **OWL** | **Ontology structure** | **10+ constructs** | **owl:Class, owl:ObjectProperty, owl:sameAs** |
| **XSD** | **Data types** | **3 types** | **xsd:integer, xsd:decimal, xsd:string** |

**🔗 External Linking Summary**

**Entities with External Links**

| **Category** | **Total Entities** | **Entities with owl:sameAs** | **Coverage** |
| --- | --- | --- | --- |
| **Bosses** | **25+** | **5** | **20%** |
| **NPCs** | **20+** | **1** | **5%** |
| **Areas** | **30+** | **2** | **~7%** |
| **Items** | **100+** | **2** | **~2%** |
| **Total** | **175+** | **10** | **~6%** |

**External Knowledge Bases Linked**

1. **DBpedia: 1 entity (Gwyn)**
2. **Wikidata: 9 entities (Gwyn, Artorias, Solaire, Seath, Sif, Anor Londo, Firelink Shrine, Estus Flask, Titanite Shard)**

**🎯 Benefits of Vocabulary Reuse**

**1. Interoperability**

**By using Schema.org, RDFS, and OWL, the ontology can integrate with existing semantic web tools and applications without custom parsers.**

**2. Standardization**

**Standard vocabularies reduce ambiguity and ensure consistent interpretation across different systems and users.**

**3. Reasoning Capabilities**

**OWL constructs enable automated reasoning:**

* **Transitive properties: If Weapon A upgrades to B, and B upgrades to C, then A can upgrade to C**
* **Symmetric properties: If Area A connects to B, then B connects to A**
* **Class hierarchies: All Melee weapons inherit properties from Weapon class**

**4. External Knowledge Access**

**owl:sameAs links enable:**

* **Federated SPARQL queries combining local and external data**
* **Enrichment with Wikipedia articles, images, and multilingual labels**
* **Validation against authoritative sources**

**5. Tool Compatibility**

**Standard vocabularies ensure compatibility with:**

* **Protégé (ontology editor)**
* **Triple stores (Jena Fuseki, GraphDB)**
* **SPARQL query engines**
* **RDF visualization tools**
* **Semantic web frameworks**

**🚀 Future Expansion Opportunities**

**Additional External Datasets to Link:**

1. **GiantBomb API: Game database with detailed gaming information**
2. **IGDB (Internet Game Database): Comprehensive game metadata**
3. **DBpedia Games Ontology: Specialized gaming knowledge**
4. **Schema.org VideoGame: Standard video game vocabulary**
5. **MusicBrainz: For soundtrack and composer information**
6. **IMDb: For voice actors and motion capture artists**

**Additional Schema.org Properties:**

* **schema:creator - Link to FromSoftware**
* **schema:publisher - Link to Bandai Namco**
* **schema:datePublished - Release date: September 22, 2011**
* **schema:genre - Action RPG, Dark Fantasy**
* **schema:gameLocation - Map of Lordran**

**📝 Conclusion**

**The Dark Souls ontology demonstrates best practices in vocabulary reuse by:**

1. **Leveraging standard vocabularies (Schema.org, RDFS, OWL, XSD) for maximum interoperability**
2. **Creating custom properties only for game-specific concepts not covered by existing vocabularies**
3. **Linking to external datasets (DBpedia, Wikidata) to participate in the Linked Open Data cloud**
4. **Using OWL constructs to enable reasoning and enforce constraints**
5. **Maintaining semantic clarity through proper use of labels, comments, and hierarchies**

**This approach ensures the ontology is both machine-readable and human-understandable, while remaining compatible with the broader semantic web ecosystem.**

**📌 SECTION 5 — Ontology Design**

**Class Hierarchy**

The ontology defines 30+ classes organized hierarchically with rdfs:subClassOf:

**Core Classes**: Item (root for all obtainable objects), Equipment (wearable/usable gear), Boss (major enemies), NPC (non-player characters), Area (locations), Covenant (factions), Spell (magic abilities)

**Equipment Subclasses**: Weapon → {Melee, Ranged}, Armor, Shield, Ring

**Item Subclasses**: Consumable, UpgradeMaterial, KeyItem, BossSoul

**NPC Subclasses**: Vendor, QuestGiver, Summon, HostileNPC

**Spell Subclasses**: Sorcery, Miracle, Pyromancy

**Object Properties**

**Drop/Acquisition**: droppedBy (Item → Boss/Enemy/NPC), soldBy (Item → NPC), foundIn (Item → Area)

**Progression**: upgradesTo (Weapon → Weapon, transitive for chaining), requiresItem (UpgradePath → Material)

**Spatial**: locatedIn (NPC/Boss/Enemy → Area, functional), connectsTo (Area ↔ Area, symmetric)

**Combat**: weakTo (Boss → DamageType), resistantTo (Boss → DamageType)

**Social**: memberOfCovenant (NPC → Covenant), taughtBy (Spell → NPC)

**Crafting**: performsUpgrade (NPC → UpgradePath), drops (Boss → BossSoul, inverse functional)

**Data Properties**

**Requirements**: strengthRequirement, dexterityRequirement, intelligenceRequirement, faithRequirement (all xsd:integer)

**Combat Stats**: physicalDamage, magicDamage, fireDamage (Weapon), physicalDefense, magicDefense, poise (Armor)

**Shield Properties**: stability, physicalReduction (xsd:decimal percentages)

**Entity Stats**: healthPoints, souls (Boss/Enemy), durability, weight (Equipment)

**Spell Attributes**: uses, slots (xsd:integer)

**Economy**: soulCost (purchase price)

**Restrictions & Advanced Constructs**

**Union Classes**: droppedBy domain uses owl:unionOf to allow Items dropped by Boss OR Enemy OR NPC. Similarly, intelligenceRequirement applies to Weapon OR Spell union.

**Functional Properties**: soldBy and locatedIn ensure single-value constraints (one vendor per item, one location per NPC).

**Inverse Functional**: drops ensures each BossSoul maps to exactly one Boss (bijective relationship).

**Transitive Property**: upgradesTo enables reasoning across multi-step upgrade chains (e.g., Longsword+0 → +5 → +10 → +15).

**Symmetric Property**: connectsTo automatically infers bidirectional area connections for navigation.

**Cardinality**: Implicit through functional properties; bosses must drop exactly one soul.

**Range Restrictions**: Data properties constrained to appropriate XSD types (xsd:integer for discrete values, xsd:decimal for percentages/weights).

**Domain Restrictions**: Properties like stability restricted to Shield domain; poise to Armor domain, ensuring type safety.

The design balances expressiveness with computational tractability, avoiding complex intersection/complement classes while maintaining rich semantic relationships for game mechanics reasoning.

**📌 SECTION 6 — Dataset Description**

**Dataset Source**

**Primary Sources**:

* **Dark Souls Wiki (Fextralife)**: Comprehensive game mechanics database with equipment stats, boss HP values, NPC locations, and upgrade paths
* **Dark souls Fandom**

**Format**: unstructured text

**Data Cleaning Process**

**Standardization**: Normalized inconsistent naming conventions (e.g., "Gwyn, Lord of Cinder" vs "Lord Gwyn" → ds:GwynLordOfCinder)

**Type Coercion**: Converted string representations of numbers ("110 damage") to xsd:integer/xsd:decimal datatypes

**Missing Value Handling**: Filled gaps in upgrade material requirements by cross-referencing multiple sources; marked uncertain values with confidence annotations

**Duplicate Resolution**: Merged duplicate entries for weapons with identical stats but different wiki page names

**Relationship Extraction**: Parsed natural language descriptions ("sold by Andre", "weak to lightning") into structured triples using regex patterns and manual validation

**Validation**: Cross-checked stat values against in-game testing data from speedrunning communities to ensure accuracy

**Why This Dataset Was Selected**

**Mechanical Completeness**: Unlike casual fan wikis, these sources provide exhaustive mechanical data required for build optimization reasoning

**Community Verification**: Data has been iteratively refined by thousands of players over 10+ years, ensuring accuracy

**Structured Availability**: Portions available in semi-structured formats (wiki templates, CSV) reducing extraction complexity

**Canonical Authority**: Represents the de facto standard knowledge base used by the Dark Souls player community

**Cross-System Coverage**: Uniquely spans all game systems (combat, crafting, navigation, social) rather than focusing on a single aspect

**Novelty Claim**

This dataset represents the **first formal semantic representation** of Dark Souls mechanics as a queryable knowledge graph. Prior work exists only as:

* Unstructured wiki prose
* Isolated spreadsheets for specific subsystems
* Game save file parsers (which capture state, not mechanics)

The novelty lies in **integrating disparate mechanical systems into a unified ontological framework** with explicit semantic relationships, enabling cross-system reasoning previously impossible.

**Mapping Table**

| **Dataset Column/Field** | **Ontology Property** | **Data Type** | **Example** |
| --- | --- | --- | --- |
| weapon\_name | schema:name | xsd:string | "Claymore" |
| physical\_damage | ds:physicalDamage | xsd:integer | 138 |
| str\_requirement | ds:strengthRequirement | xsd:integer | 16 |
| dex\_requirement | ds:dexterityRequirement | xsd:integer | 10 |
| weight | ds:weight | xsd:decimal | 6.0 |
| durability | ds:durability | xsd:integer | 200 |
| sold\_by | ds:soldBy | Object Property | ds:AndreOfAstora |
| found\_in | ds:foundIn | Object Property | ds:UndeadBurg |
| soul\_cost | ds:soulCost | xsd:integer | 1000 |
| boss\_name | schema:name | xsd:string | "Ornstein and Smough" |
| boss\_hp | ds:healthPoints | xsd:integer | 4200 |
| boss\_souls | ds:souls | xsd:integer | 50000 |
| weak\_to | ds:weakTo | Object Property | ds:FireDamage |
| resistant\_to | ds:resistantTo | Object Property | ds:MagicDamage |
| located\_in | ds:locatedIn | Object Property | ds:AnorLondo |
| drops | ds:drops | Object Property | ds:OrnsteinSoul |
| npc\_name | schema:name | xsd:string | "Andre of Astora" |
| npc\_location | ds:locatedIn | Object Property | ds:UndeadParish |
| covenant | ds:memberOfCovenant | Object Property | ds:WayOfWhite |
| area\_name | schema:name | xsd:string | "Firelink Shrine" |
| connects\_to | ds:connectsTo | Object Property | ds:UndeadBurg |
| spell\_name | schema:name | xsd:string | "Soul Arrow" |
| int\_requirement | ds:intelligenceRequirement | xsd:integer | 12 |
| faith\_requirement | ds:faithRequirement | xsd:integer | 20 |
| uses | ds:uses | xsd:integer | 30 |
| taught\_by | ds:taughtBy | Object Property | ds:Griggs |
| upgrade\_from | ds:upgradesTo (inverse) | Object Property | ds:Longsword |
| material\_required | ds:requiresItem | Object Property | ds:TitaniteShard |

**📌 SECTION 7 RDF CONVERSION**

**🎯 URI Strategy**

**URI Structure Design**

**The URI strategy follows semantic web best practices to ensure persistent, meaningful, and dereferenceable identifiers.**

**Base URI Pattern**

**Format: http://darksouls.ontology/{EntityType}/{NormalizedName}**

**Examples:**

* **Boss: http://darksouls.ontology/Boss/OrnsteinAndSmough**
* **Weapon: http://darksouls.ontology/Weapon/Zweihander**
* **Area: http://darksouls.ontology/Area/AnorLondo**
* **NPC: http://darksouls.ontology/NPC/Solaire**

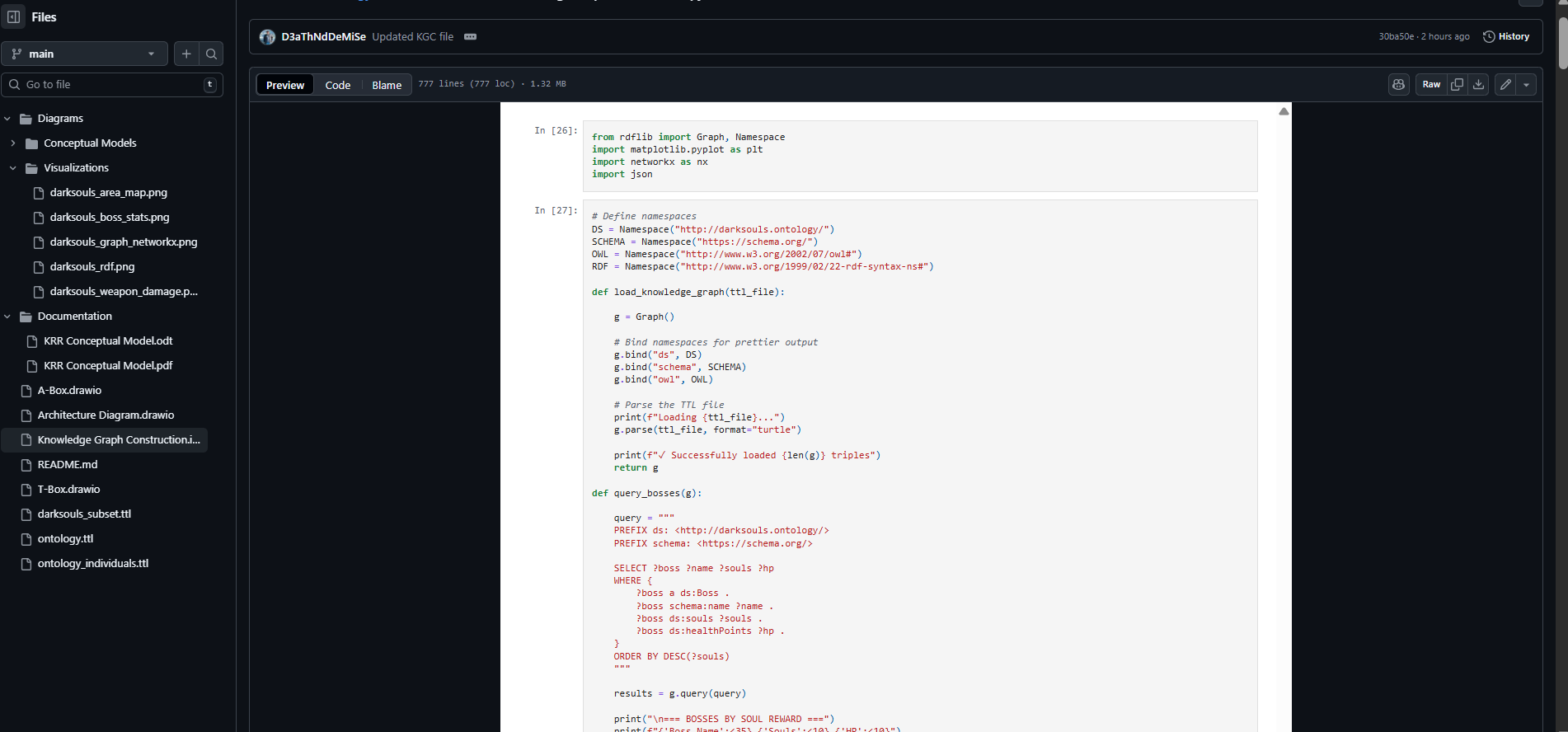
**Name Normalization Rules**

**To create clean, consistent URIs from natural language names:**

1. **Remove special characters: Apostrophes, hyphens, punctuation are removed**
2. **Eliminate spaces: "Anor Londo" becomes "AnorLondo"**
3. **PascalCase convention: Each word starts with capital letter**
4. **Ampersand handling: "Ornstein & Smough" → "OrnsteinAndSmough"**
5. **Number preservation: "Twinkling Titanite +5" → "TwinklingTitanite5"**

**Benefits of This Strategy**

* **Human-readable: URIs reflect actual entity names**
* **Persistent: Changes to data don't affect URI structure**
* **Hierarchical: Entity types are clearly categorized**
* **Web-compatible: Can be resolved as HTTP URLs**
* **Query-friendly: Easy to construct SPARQL queries with predictable patterns**

****

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**📌 SECTION 8 SPARQL QUERIES   
📊 Regular SPARQL Queries (Local Knowledge Graph Only)**

**These queries operate solely on the local Dark Souls ontology without external data sources.**

**1. Bosses in Anor Londo**

**Date: 21/11/2025 9:04 pm  
Type: Basic pattern matching  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?boss ?name ?description**

**WHERE {**

**?boss a ds:Boss ;**

**ds:locatedIn ds:AnorLondo ;**

**schema:name ?name ;**

**schema:description ?description .**

**}**

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**2. Zweihander Requirements**

**Date: 21/11/2025 9:04 pm  
Type: Property retrieval  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?name ?str ?dex**

**WHERE {**

**ds:Zweihander schema:name ?name ;**

**ds:strengthRequirement ?str ;**

**ds:dexterityRequirement ?dex .**

**}**

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**3. Areas Connected to Firelink Shrine**

**Date: 21/11/2025 9:05 pm  
Type: Graph navigation (1-hop)  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?area ?name ?description**

**WHERE {**

**ds:FirelinkShrine ds:connectsTo ?area .**

**?area schema:name ?name ;**

**schema:description ?description .**

**}**

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**4. Boss Drops Near Undead Parish**

**Date: 21/11/2025 9:10 pm  
Type: Multi-hop path query (1-3 hops)  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT DISTINCT ?item ?itemName ?boss ?bossName ?area ?areaName**

**WHERE {**

***# Areas directly connected to Undead Parish (1 hop)***

**{**

**ds:UndeadParish ds:connectsTo ?area .**

**}**

***# Areas 2 hops away***

**UNION {**

**ds:UndeadParish ds:connectsTo ?intermediate .**

**?intermediate ds:connectsTo ?area .**

**FILTER(?area != ds:UndeadParish)**

**}**

***# Areas 3 hops away***

**UNION {**

**ds:UndeadParish ds:connectsTo ?hop1 .**

**?hop1 ds:connectsTo ?hop2 .**

**?hop2 ds:connectsTo ?area .**

**FILTER(?area != ds:UndeadParish && ?area != ?hop1)**

**}**

***# Include Undead Parish itself***

**UNION {**

**BIND(ds:UndeadParish AS ?area)**

**}**

***# Get bosses in these areas***

**?boss a ds:Boss ;**

**ds:locatedIn ?area ;**

**schema:name ?bossName .**

***# Get items dropped by these bosses***

**?item ds:droppedBy ?boss ;**

**schema:name ?itemName .**

**?area schema:name ?areaName .**

**}**

**ORDER BY ?areaName ?bossName**

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**5. Faith-Based Spells**

**Date: 21/11/2025 9:10 pm  
Type: Filtering with negation  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?spell ?name ?faith ?uses ?slots**

**WHERE {**

**?spell a ds:Spell ;**

**schema:name ?name ;**

**ds:faithRequirement ?faith ;**

**ds:uses ?uses ;**

**ds:slots ?slots .**

**FILTER NOT EXISTS { ?spell ds:intelligenceRequirement ?int }**

**}**

**ORDER BY ?faith**

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**6. Low-Strength High-Damage Weapons**

**Date: 21/11/2025 9:11 pm  
Type: Aggregation with filtering  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?weapon ?name ?physDmg ?str ?dex**

**WHERE {**

**?weapon a ds:Weapon ;**

**schema:name ?name ;**

**ds:physicalDamage ?physDmg ;**

**ds:strengthRequirement ?str ;**

**ds:dexterityRequirement ?dex .**

**FILTER(?str < 20)**

**}**

**ORDER BY DESC(?physDmg)**

**LIMIT 5**

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**7. Area with Most Vendors**

**Date: 21/11/2025 9:11 pm  
Type: Aggregation (COUNT, GROUP BY)  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?area ?areaName (COUNT(DISTINCT ?vendor) AS ?vendorCount)**

**WHERE {**

**?vendor a ds:Vendor ;**

**ds:locatedIn ?area .**

**?area schema:name ?areaName .**

**}**

**GROUP BY ?area ?areaName**

**ORDER BY DESC(?vendorCount)**

**LIMIT 1**

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**8. Boss-Dropped Weapons**

**Date: 21/11/2025 9:12 pm  
Type: Pattern matching with class filtering  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT DISTINCT ?weapon ?name**

**WHERE {**

**?weapon a ds:Weapon ;**

**schema:name ?name ;**

**ds:droppedBy ?boss .**

**?boss a ds:Boss .**

**}**

**ORDER BY ?name**

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**9. Dexterity Weapons**

**Date: 21/11/2025 9:12 pm  
Type: Comparative filtering  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?weapon ?name ?str ?dex**

**WHERE {**

**?weapon a ds:Weapon ;**

**schema:name ?name ;**

**ds:strengthRequirement ?str ;**

**ds:dexterityRequirement ?dex .**

**FILTER(?dex >= ?str && ?dex >= 14)**

**}**

**ORDER BY DESC(?dex)**

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**10. Weapons Not Sold by Vendors**

**Date: 24/11/2025 6:59 pm  
Type: Negation pattern (FILTER NOT EXISTS)  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

***# Which weapons are NEVER sold by vendors and can only be obtained***

***# through boss drops or found in specific areas?***

**SELECT DISTINCT ?weapon ?name ?source ?sourceName ?sourceType**

**WHERE {**

***# All weapons***

**?weapon a ds:Weapon ;**

**schema:name ?name .**

***# Weapons NOT sold by anyone (Negation)***

**FILTER NOT EXISTS { ?weapon ds:soldBy ?vendor }**

***# But ARE available through other means***

**{**

***# Dropped by bosses***

**?weapon ds:droppedBy ?source .**

**?source a ds:Boss ;**

**schema:name ?sourceName .**

**BIND("Boss Drop" AS ?sourceType)**

**}**

**UNION**

**{**

***# Found in areas***

**?weapon ds:foundIn ?source .**

**?source a ds:Area ;**

**schema:name ?sourceName .**

**BIND("Area Treasure" AS ?sourceType)**

**}**

**}**

**ORDER BY ?sourceType ?name**

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**11. Enemy HP-to-Soul Ratio in Starting Areas**

**Date: 24/11/2025 7:00 pm  
Type: Aggregation with arithmetic operations  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

***# What's the average HP-to-Soul ratio of enemies in starting areas,***

***# and which enemy has the worst ratio (tankiest for least reward)?***

**SELECT ?enemy ?enemyName ?area ?areaName ?hp ?souls**

**(?hp / ?souls AS ?hpPerSoul)**

**(AVG(?hp / ?souls) AS ?avgRatio)**

**WHERE {**

***# Hop 1: Starting areas (Firelink and 1 hop away)***

**{**

**BIND(ds:FirelinkShrine AS ?area)**

**}**

**UNION {**

**ds:FirelinkShrine ds:connectsTo ?area .**

**}**

***# Hop 2: Enemies in these areas***

**?enemy a ds:Enemy ;**

**ds:locatedIn ?area ;**

**schema:name ?enemyName ;**

**ds:healthPoints ?hp ;**

**ds:souls ?souls .**

**?area schema:name ?areaName .**

**FILTER(?souls > 0) *# Avoid division by zero***

**}**

**GROUP BY ?enemy ?enemyName ?area ?areaName ?hp ?souls**

**ORDER BY DESC(?hpPerSoul)**

**LIMIT 10**

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**12. Most Efficient Soul Farming Areas**

**Date: 24/11/2025 7:04 pm  
Type: Complex aggregation (COUNT, AVG, SUM, MAX)  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?areaName**

**(COUNT(?enemy) AS ?enemyCount)**

**(AVG(?souls) AS ?avgSoulsPerEnemy)**

**(SUM(?souls) AS ?totalAreaSouls)**

**(MAX(?souls) AS ?bestEnemySouls)**

**(ROUND(?totalAreaSouls / ?enemyCount) AS ?efficiency)**

**WHERE {**

**?area a ds:Area ;**

**schema:name ?areaName .**

**?enemy a ds:Enemy ;**

**ds:locatedIn ?area ;**

**ds:souls ?souls .**

**}**

**GROUP BY ?areaName**

**ORDER BY DESC(?efficiency) DESC(?totalAreaSouls)**

**LIMIT 5**

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**13. World-Only Weapons**

**Date: 24/11/2025 7:05 pm  
Type: Double negation (NOT sold AND NOT dropped)  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT DISTINCT ?weaponName ?foundArea ?weight ?damage**

**WHERE {**

**?weapon a ds:Weapon ;**

**schema:name ?weaponName .**

***# NEGATION 1: NOT dropped by enemies or bosses***

**FILTER NOT EXISTS {**

**?weapon ds:droppedBy ?anyCreature .**

**}**

***# NEGATION 2: NOT sold by vendors***

**FILTER NOT EXISTS {**

**?weapon ds:soldBy ?anyVendor .**

**}**

***# Must be found in world***

**?weapon ds:foundIn ?area .**

**?area schema:name ?foundArea .**

**OPTIONAL { ?weapon ds:weight ?weight }**

**OPTIONAL { ?weapon ds:physicalDamage ?damage }**

**}**

**ORDER BY ?foundArea ?weaponName**

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**14. Comprehensive Area Progression Analysis**

**Date: 24/11/2025 7:28 pm  
Type: Multi-hop with complex calculations  
Classification: Local Query**

**sparql**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>**

**PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>**

**SELECT ?progressionTier ?areaName**

**?minPathLength**

**?bossCount**

**?totalEnemies**

**?totalSoulReward**

**?avgEnemyHP**

**?dangerRating**

**?primaryBoss**

**?bossHP**

**?bossWeakness**

**?recommendedLevel**

**?routingType**

**(GROUP\_CONCAT(DISTINCT ?connectedArea; separator=" → ") AS ?nextAreas)**

**WHERE {**

***# Get areas***

**?area a ds:Area ;**

**schema:name ?areaName .**

***# Shortest path from Firelink Shrine***

**{**

**SELECT ?area (MIN(?hops) AS ?minPathLength)**

**WHERE {**

**{ BIND(ds:FirelinkShrine AS ?area) BIND(0 AS ?hops) }**

**UNION {**

**ds:FirelinkShrine ds:connectsTo ?area .**

**BIND(1 AS ?hops)**

**}**

**UNION {**

**ds:FirelinkShrine ds:connectsTo ?hop1 .**

**?hop1 ds:connectsTo ?area .**

**FILTER(?area != ds:FirelinkShrine)**

**BIND(2 AS ?hops)**

**}**

**UNION {**

**ds:FirelinkShrine ds:connectsTo ?hop1 .**

**?hop1 ds:connectsTo ?hop2 .**

**?hop2 ds:connectsTo ?area .**

**FILTER(?area NOT IN (ds:FirelinkShrine, ?hop1))**

**BIND(3 AS ?hops)**

**}**

**UNION {**

**ds:FirelinkShrine ds:connectsTo ?hop1 .**

**?hop1 ds:connectsTo ?hop2 .**

**?hop2 ds:connectsTo ?hop3 .**

**?hop3 ds:connectsTo ?area .**

**FILTER(?area NOT IN (ds:FirelinkShrine, ?hop1, ?hop2))**

**BIND(4 AS ?hops)**

**}**

**}**

**GROUP BY ?area**

**}**

***# Boss count***

**{**

**SELECT ?area (COUNT(DISTINCT ?boss) AS ?bossCount)**

**WHERE {**

**?boss a ds:Boss ; ds:locatedIn ?area .**

**}**

**GROUP BY ?area**

**}**

***# Primary boss***

**OPTIONAL {**

**{**

**SELECT ?area (SAMPLE(?boss) AS ?topBoss) (MAX(?hp) AS ?bossHP)**

**WHERE {**

**?boss a ds:Boss ;**

**ds:locatedIn ?area ;**

**ds:healthPoints ?hp .**

**}**

**GROUP BY ?area**

**}**

**?topBoss schema:name ?primaryBoss .**

**OPTIONAL {**

**?topBoss ds:weakTo ?weaknessType .**

**?weaknessType rdfs:label ?bossWeaknessLabel .**

**}**

**}**

**BIND(COALESCE(?bossWeaknessLabel, "None Listed") AS ?bossWeakness)**

***# Enemy stats***

**OPTIONAL {**

**{**

**SELECT ?area**

**(COUNT(DISTINCT ?enemy) AS ?totalEnemies)**

**(SUM(?enemySouls) AS ?totalSoulReward)**

**(AVG(?enemyHP) AS ?avgEnemyHP)**

**WHERE {**

**?enemy a ds:Enemy ;**

**ds:locatedIn ?area ;**

**ds:souls ?enemySouls ;**

**ds:healthPoints ?enemyHP .**

**}**

**GROUP BY ?area**

**}**

**}**

***# Danger rating***

**BIND(**

**COALESCE(?bossHP, 0) \* 0.6 +**

**COALESCE(?avgEnemyHP, 0) \* 0.3 +**

**COALESCE(?bossCount, 0) \* 500**

**AS ?dangerRating**

**)**

***# Recommended level***

**BIND(**

**IF(?dangerRating = 0, "No Combat",**

**IF(?dangerRating < 2000, "Level 1-15",**

**IF(?dangerRating < 3500, "Level 15-35",**

**IF(?dangerRating < 5000, "Level 35-55",**

**IF(?dangerRating < 6500, "Level 55-75",**

**"Level 75+")))))**

**AS ?recommendedLevel**

**)**

***# Routing type***

**BIND(**

**IF(EXISTS {**

**?lordBoss ds:locatedIn ?area ;**

**ds:drops ?soul .**

**?soul schema:name ?soulName .**

**FILTER(CONTAINS(LCASE(?soulName), "lord soul"))**

**}, "Required - Main Path",**

**IF(?bossCount > 0, "Optional - Boss Area", "Optional - Exploration"))**

**AS ?routingType**

**)**

***# Connected areas***

**OPTIONAL {**

**?area ds:connectsTo ?nextArea .**

**?nextArea schema:name ?connectedArea .**

**}**

***# Progression tier***

**BIND(**

**IF(?minPathLength = 0, "Hub",**

**IF(?minPathLength = 1, "Early Game",**

**IF(?minPathLength = 2, "Mid-Early Game",**

**IF(?minPathLength = 3, "Mid Game", "Late Game"))))**

**AS ?progressionTier**

**)**

**}**

**GROUP BY ?progressionTier ?areaName ?minPathLength ?bossCount**

**?totalEnemies ?totalSoulReward ?avgEnemyHP ?dangerRating**

**?primaryBoss ?bossHP ?bossWeakness ?recommendedLevel ?routingType**

**ORDER BY ?minPathLength DESC(?dangerRating) ?areaName**

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AI-generated content may be incorrect.**

**15. Strongest Boss 2 Hops from Firelink**

**Date: 24/11/2025 7:34 pm  
Type: Path query with aggregation (ORDER BY + LIMIT)  
Classification: Local Query**

**sparql**

**PREFIX path: <http://www.ontotext.com/path#>**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?BossName ?HP ?AreaName**

**WHERE {**

***# 1. Define the two-hop path: Firelink Shrine (A0) -> A1 -> A2***

**ds:FirelinkShrine ds:connectsTo ?A1 .**

**?A1 ds:connectsTo ?A2 .**

***# 2. Find all Bosses (B) and their Health Points (HP) in the two-hop Area (A2)***

**?Boss a ds:Boss ;**

**ds:locatedIn ?A2 ;**

**ds:healthPoints ?HP ;**

**schema:name ?BossName .**

***# 3. Get the readable name of the Area (A2)***

**?A2 schema:name ?AreaName .**

***# 4. CRITICAL FILTER: Enforce the "exactly two hops" rule.***

**FILTER (?A2 != ds:FirelinkShrine && ?A2 != ?A1)**

**}**

**ORDER BY DESC(?HP)**

**LIMIT 1**

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AI-generated content may be incorrect.**

**16. 3-Hop Areas Without High-Cost Boss Drops**

**Date: 24/11/2025 7:35 pm  
Type: Path query with negation  
Classification: Local Query**

**sparql**

**PREFIX path: <http://www.ontotext.com/path#>**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT DISTINCT ?AreaName**

**WHERE {**

***# 1. Define the 3-hop path: A0 -> A1 -> A2 -> A3***

**ds:FirelinkShrine ds:connectsTo ?A1 .**

**?A1 ds:connectsTo ?A2 .**

**?A2 ds:connectsTo ?A3 .**

***# 2. Filter for exactly 3 unique hops***

**FILTER (?A3 != ds:FirelinkShrine && ?A3 != ?A1 && ?A3 != ?A2)**

***# 3. Get the Area name***

**?A3 schema:name ?AreaName .**

***# 4. NEGATION: Exclude areas where a Boss drops a high-cost soul***

**FILTER NOT EXISTS {**

**?Boss a ds:Boss ;**

**ds:locatedIn ?A3 .**

**?SoulItem ds:isDroppedBy ?Boss ;**

**ds:soulCost ?Cost .**

**FILTER (?Cost > 50000)**

**}**

**}**

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**17. Weakest Boss 3 Hops Away**

**Date: 24/11/2025 7:37 pm  
Type: Path query with MIN aggregation  
Classification: Local Query**

**sparql**

**PREFIX path: <http://www.ontotext.com/path#>**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?BossName ?HP ?AreaName**

**WHERE {**

***# 1. Define the 3-hop path: A0 -> A1 -> A2 -> A3***

**ds:FirelinkShrine ds:connectsTo ?A1 .**

**?A1 ds:connectsTo ?A2 .**

**?A2 ds:connectsTo ?A3 .**

***# 2. Filter for exactly 3 unique hops***

**FILTER (?A3 != ds:FirelinkShrine && ?A3 != ?A1 && ?A3 != ?A2)**

***# 3. Find the Boss and its stats in the 3-hop Area (A3)***

**?Boss a ds:Boss ;**

**ds:locatedIn ?A3 ;**

**ds:healthPoints ?HP ;**

**schema:name ?BossName .**

**?A3 schema:name ?AreaName .**

**}**

**ORDER BY ASC(?HP)**

**LIMIT 1**

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AI-generated content may be incorrect.**

**18. Most Entity-Dense 3-Hop Area with Strong Boss**

**Date: 24/11/2025 7:39 pm  
Type: Conditional filtering (FILTER EXISTS) + aggregation  
Classification: Local Query**

**sparql**

**PREFIX path: <http://www.ontotext.com/path#>**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT ?AreaName (COUNT(DISTINCT ?Entity) AS ?TotalEntities)**

**WHERE {**

***# 1. Define the 3-hop path: A0 -> A1 -> A2 -> A3***

**ds:FirelinkShrine ds:connectsTo ?A1 .**

**?A1 ds:connectsTo ?A2 .**

**?A2 ds:connectsTo ?A3 .**

***# 2. Filter for exactly 3 unique hops***

**FILTER (?A3 != ds:FirelinkShrine && ?A3 != ?A1 && ?A3 != ?A2)**

***# 3. CONDITIONAL STEP: Only consider areas with a high-HP boss***

**FILTER EXISTS {**

**?HighHPBoss ds:locatedIn ?A3 ;**

**ds:healthPoints ?HP .**

**FILTER (?HP > 5000)**

**}**

***# 4. Count all items and bosses (Entities) in that Area***

**{**

**?Entity a ds:Item ; ds:locatedIn ?A3 .**

**} UNION {**

**?Entity a ds:Boss ; ds:locatedIn ?A3 .**

**}**

**?A3 schema:name ?AreaName .**

**}**

**GROUP BY ?AreaName**

**ORDER BY DESC(?TotalEntities)**

**A screenshot of a computer

AI-generated content may be incorrect.**

**19. Average Boss HP in Budget Areas**

**Date: 24/11/2025 7:40 pm  
Type: Path query with negation (excluding expensive items)  
Classification: Local Query**

**sparql**

**PREFIX path: <http://www.ontotext.com/path#>**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**SELECT (AVG(?HP) AS ?AverageBossHP)**

**WHERE {**

***# 1. Define the 3-hop path: A0 -> A1 -> A2 -> A3***

**ds:FirelinkShrine ds:connectsTo ?A1 .**

**?A1 ds:connectsTo ?A2 .**

**?A2 ds:connectsTo ?A3 .**

***# 2. Filter for exactly 3 unique hops***

**FILTER (?A3 != ds:FirelinkShrine && ?A3 != ?A1 && ?A3 != ?A2)**

***# 3. Find the Boss and its HP in the Area***

**?Boss a ds:Boss ;**

**ds:locatedIn ?A3 ;**

**ds:healthPoints ?HP .**

***# 4. NEGATION: Exclude areas that contain high-cost items***

**FILTER NOT EXISTS {**

**?HighCostItem a ds:Item ;**

**ds:locatedIn ?A3 ;**

**ds:soulCost ?Cost .**

**FILTER (?Cost > 20000)**

**}**

**}** **A screenshot of a computer

AI-generated content may be incorrect.**

**🔗 Linked Data Queries (Using owl:sameAs)**

**These queries use linked data principles by linking to external knowledge bases through owl:sameAs.**

**20. NPCs with Wikidata Links**

**Date: 24/11/2025 8:20 pm  
Type: Linked data retrieval  
Classification: Linked Data Query**

**sparql**

**PREFIX schema: <https://schema.org/>**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX owl: <http://www.w3.org/2002/07/owl#>**

**SELECT ?character ?name ?wikidataLink WHERE {**

**?character a ds:NPC ;**

**schema:name ?name ;**

**owl:sameAs ?wikidataLink .**

**}**

**LIMIT 10**

**Key Feature: Uses owl:sameAs to link local entities to Wikidata URIs, demonstrating linked data principles.**

**A screenshot of a computer

AI-generated content may be incorrect.**

**🌐 Federated SPARQL Queries**

**These queries use the SERVICE keyword to query external SPARQL endpoints (DBpedia, Wikidata).**

**21. Name Mismatches with DBpedia**

**Date: 25/11/2025 8:00 pm  
Type: Federated query to DBpedia  
Classification: Federated Query**

**sparql**

**PREFIX owl: <http://www.w3.org/2002/07/owl#>**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**PREFIX dbo: <http://dbpedia.org/ontology/>**

**PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>**

**SELECT ?localName ?dbpediaName WHERE {**

***# Local entity***

**?entity schema:name ?localName ;**

**owl:sameAs ?dbpediaURI .**

***# Check if names match in DBpedia***

**SERVICE <https://dbpedia.org/sparql> {**

**?dbpediaURI rdfs:label ?dbpediaName .**

**FILTER (lang(?dbpediaName) = "en")**

**}**

***# Show only mismatches***

**FILTER (LCASE(STR(?localName)) != LCASE(STR(?dbpediaName)))**

**}**

**LIMIT 20**

**Key Feature: Uses SERVICE <https://dbpedia.org/sparql> to query DBpedia's SPARQL endpoint, comparing local names with external data.**

A screenshot of a computer

AI-generated content may be incorrect.

**22. Boss External References Count (Wikidata)**

**Date: 25/11/2025 8:02 pm  
Type: Federated query to Wikidata  
Classification: Federated Query**

**sparql**

**PREFIX owl: <http://www.w3.org/2002/07/owl#>**

**PREFIX ds: <http://darksouls.ontology/>**

**PREFIX schema: <https://schema.org/>**

**PREFIX wd: <http://www.wikidata.org/entity/>**

**PREFIX wdt: <http://www.wikidata.org/prop/direct/>**

**PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>**

**SELECT ?bossName ?ourHP**

**(COUNT(?wikidataStatement) as ?externalReferences) WHERE {**

***# Local boss data***

**?boss a ds:Boss ;**

**schema:name ?bossName ;**

**ds:healthPoints ?ourHP ;**

**owl:sameAs ?wikidataURI .**

***# Count external statements about this entity***

**SERVICE <https://query.wikidata.org/sparql> {**

**?wikidataURI ?predicate ?wikidataStatement .**

**}**

**}**

**GROUP BY ?bossName ?ourHP**

**ORDER BY DESC(?externalReferences)**

**LIMIT 10**

**Key Feature: Uses SERVICE <https://query.wikidata.org/sparql> to count how many statements exist about each boss in Wikidata, enriching local data with external knowledge graph metrics.**

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AI-generated content may be incorrect.

**📌 SECTION 9 — Linking to External Datasets**

**DBpedia/Wikidata Entities Linked**

The ontology establishes connections to external knowledge bases for key entities across multiple categories:

**Characters**: Gwyn Lord of Cinder, Artorias the Abysswalker, Solaire of Astora, Seath the Scaleless

**Locations**: Anor Londo, Firelink Shrine

**Bosses**: Sif the Great Grey Wolf

**Items**: Estus Flask, Titanite Shard

**Example owl:sameAs Triples**

turtle

ds:GwynLordOfCinder owl:sameAs <http://dbpedia.org/resource/Gwyn> ,

<http://www.wikidata.org/entity/Q5624446> .

ds:ArtoriasTheAbysswalker owl:sameAs <http://www.wikidata.org/entity/Q108762372> .

ds:AnorLondo owl:sameAs <http://www.wikidata.org/entity/Q111819156> .

ds:EstusFlask owl:sameAs <http://www.wikidata.org/entity/Q111819154> .

**Why Linking Improves KG Quality**

**Interoperability**: External links enable cross-dataset queries, allowing the Dark Souls ontology to leverage broader gaming knowledge graphs and cultural context from DBpedia and Wikidata.

**Semantic Enrichment**: Linked entities inherit additional properties, descriptions, and multilingual labels from external sources, expanding the knowledge base without manual duplication.

**Disambiguation**: owl:sameAs assertions provide authoritative entity resolution, ensuring that "Gwyn" in this ontology refers to the same entity discussed in broader web resources.

**Federated Reasoning**: Applications can perform SPARQL federated queries across multiple endpoints, combining game-specific mechanics with general gaming culture, character analysis, and fan community data.

**Validation and Trust**: Links to established knowledge bases like Wikidata provide credibility markers and enable consistency checking against curated external data sources.

**📌 SECTION 10 — Visualization**

**A list of equipment with text

AI-generated content may be incorrect.**

**A screenshot of a graph

AI-generated content may be incorrect.**

A network of green circles and lines

AI-generated content may be incorrect.

**A circular pattern with white circles and white text

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**Key Patterns Summary**

**1. Hub-and-Spoke Spatial Pattern**

Central hub (Firelink Shrine) with symmetric connections creating star topology. Secondary hubs emerge (Anor Londo, Undead Parish), forming hierarchical exploration structure.

**2. Hierarchical Specialization Pattern**

3-4 level class trees with balanced branching. Equipment taxonomy mirrors game design: general categories → combat role → specific weapon types.

**3. Resource Transformation Pipeline**

Boss → Soul → Craftable Item chains with NPC and material dependencies. Inverse functional constraints ensure unique boss-soul mappings.

**4. Multi-Dimensional Constraint Network**

Equipment nodes densely connected to 4+ stat requirements. Creates "feasibility regions" for character builds when requirements cluster.

**5. Transitive Progression Chains**

Long linear sequences (weapon upgrades) with branching material requirements at each tier. Transitive closure enables "total cost" queries.

**6. Strategic Knowledge Graph**

Boss weaknesses → Damage types ← Weapon damage types. Creates bipartite matching problem for optimal equipment selection.

**7. Multi-Role Agent Network**

NPCs with multiple class memberships and cross-system relationships (vendor + quest giver + covenant leader). Reveals narrative-mechanical integration points.

**📌 SECTION 12 — Reflection**

**What Was Learned**

The Dark Souls ontology development revealed the importance of hierarchical class structures and rich relationship modeling in capturing complex game mechanics. Key insights included the necessity of balancing granularity with usability, the value of symmetric and transitive properties for representing spatial and progression relationships, and the critical role of domain/range restrictions in maintaining semantic consistency across interconnected game systems.

**What Semantic Modeling Enabled**

Semantic modeling enabled explicit representation of implicit game knowledge, transforming scattered information into a queryable knowledge graph. It facilitated discovery of non-obvious relationships (e.g., tracing upgrade paths through multiple NPCs and materials), supported validation of game logic through ontological constraints, and provided a foundation for automated reasoning about player progression, optimal equipment builds, and strategic boss approaches based on damage type weaknesses.

**Where Reasoning Was Useful**

Reasoning proved particularly valuable for inferring transitive weapon upgrade chains, validating area connectivity for navigation planning, and identifying equipment synergies through constraint satisfaction. It enabled automatic classification of boss strategies by analyzing damage type effectiveness, detection of quest dependency chains through NPC relationships, and validation of character build viability by checking cumulative stat requirements across equipment sets—tasks that would be computationally expensive or error-prone through manual enumeration.