

Ontorion Server with SDK

Cognitum



Ontorion



Semantic Knowledge Management Framework



Distributed Knowledge Management System with **Natural Language** interfaces (CNL) and built-in **rules engine**. It is compatible with **OWL2** and **SWRL** and can be hosted in **Cloud** or **On-Premise** environment. Ontorion is a family of products – server and client-side components for desktop and web allows for broad integration of custom software and existing corporate infrastructure.



Ontorion Key Features



- ✓ **Full OWL2/SWRL support**
OWL2 and SWRL implementation. XML/OWL or RDF/XML formats can be imported directly.
- ✓ **Description Logic engine**
OWL-DL (SROIQ) and OWL-EL (EL++) logics are supported.
- ✓ **OWL API compatible**
Full OWL API (v.3) compatibility.
- ✓ **CNL ready**
Controlled Language direct support for English, Polish and other languages.
- ✓ **Cloud ready**
Windows Azure deployment ready with Cassandra clusters. Any cloud IaaS can be supported.
- ✓ **Automated reasoning**
Built-in reasoning service. Both active and pro-active.
- ✓ **Collaborative Knowledge Editing**
This powerful feature allows many end-users to edit stored knowledge simultaneously with well-known update/commit scenario (real-time).
- ✓ **Innovative modularization algorithm**
Instant random access to huge ontologies.
- ✓ **Scalability**
Huge knowledge bases (ontologies) can be processed and accessed. Simply add more clusters to your deployment.
- ✓ **Safety**
Redundancy of datasets and spatial cluster decomposition.
- ✓ **Ontology Mapping***
Built-in ontology mapping mechanism.
- ✓ **Linked Data compatible***
RDF/SPARQL module can boost SPARQL queries against cached knowledge.
- ✓ **Solr/Lucene compatible***
Instant access to all names and linked documents. Build instant search apps with semantic enhancement.
- ✓ **Security and Auditing***
Restrict access on authorisation basis and audit knowledge change history.

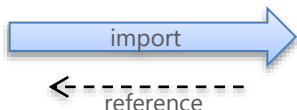
Challenge and Benefits

- * Easier and faster searching capabilities
- * Easier and faster data modeling
- * High performance
- * Reliability
- * Lower data maintenance costs



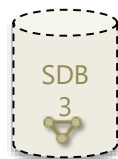
Standards
(ISO-15926)

"Every **pump** is an element."
"Every **valve** is an element."
"Every **pipe** is an element."



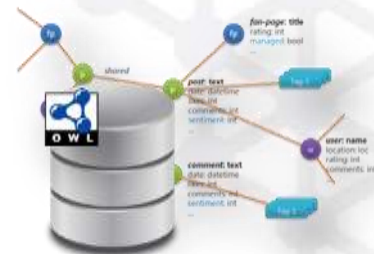
Corporate
Semantics

"Every **my-pump** is a **pump**"
"Every **my-valve** is a **valve**"
"Every **my-pipe** is a **pipe**"



Corporate
Infrastructure description

"**My-Pump-1** is **my-pump** and **is-installed-in Site-A.**"
"**My-Valve-1** **is-connected-to My-Pump-3** and **is-connected-to My-Pipe-1.**"
"**My-Pipe-1** is a **pipe.**"



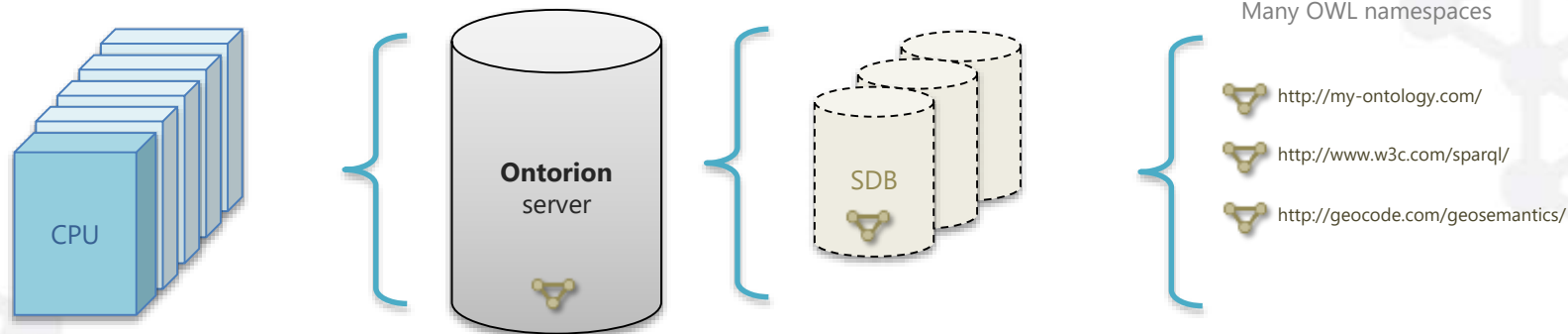
Physical & logical deployment



Ontorion **server** can be hosted on **one or more physical nodes** (cluster).

Each **server** (cluster) may host **one or more semantic databases**.

Each **semantic database** can manage **one or more OWL namespaces**.



Ontorion server

- Manage Semantic Databases
- Update Semantic Databases
- Access Semantic Databases

Ontorion nodes

- Storage node
- WebAccess node

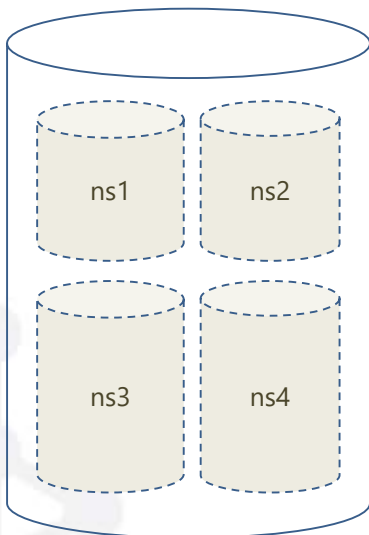
Semantic Database

- Different R/W access rights for each SDB

Many OWL namespaces

- <http://my-ontology.com/>
- <http://www.w3c.com/sparql/>
- <http://geocode.com/geosemantics/>

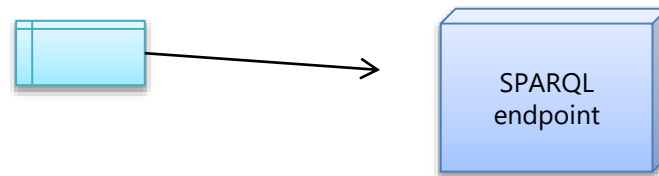
Single node / many databases



Ontorion server node

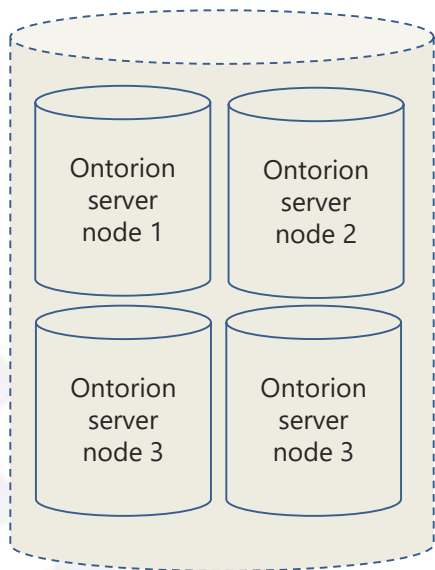
```
http://ontorion1.contoso.com/sparql/ns1/  
http://ontorion1.contoso.com/sparql/ns2/  
http://ontorion1.contoso.com/sparql/ns3/  
http://ontorion1.contoso.com/sparql/ns4/
```

```
OntorionDriver odriver = new OntorionDriver ("ontorion1.contoso.com", "ns1");  
odriver.Connect();
```





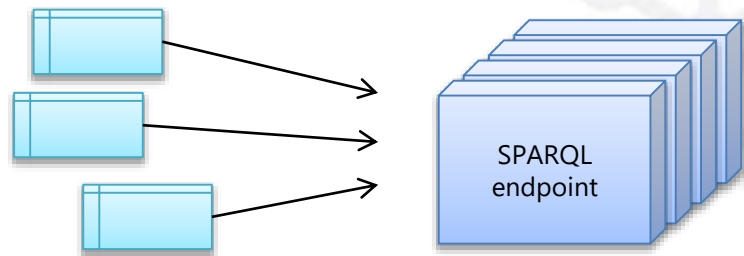
Clustered nodes / single database



database1(ns1)

```
http://ontorion1.contoso.com/sparql/ns1/  
http://ontorion2.contoso.com/sparql/ns1/  
http://ontorion3.contoso.com/sparql/ns1  
http://ontorion4.contoso.com/sparql/ns1/
```

```
OntorionDriver odriver = new OntorionDriver ("ontorion1.contoso.com", "ns1");  
odriver.Connect();
```



Efficient connection requires load-balanced farm for endpoints

```
http://webaccess.contoso.com/sparql/ns1/
```

Flexible, Cloud-ready Architecture



on-premise



Windows Azure



cloud: single node

Windows Azure

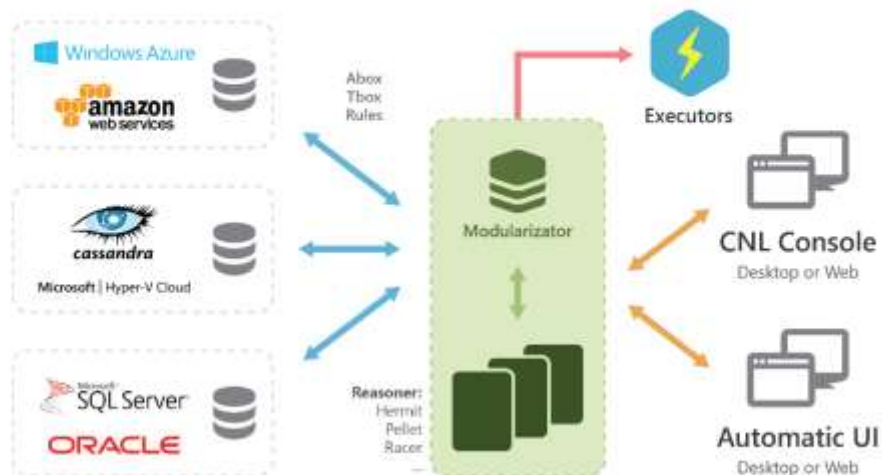


cloud: cluster
(using fast VN)

General Architecture



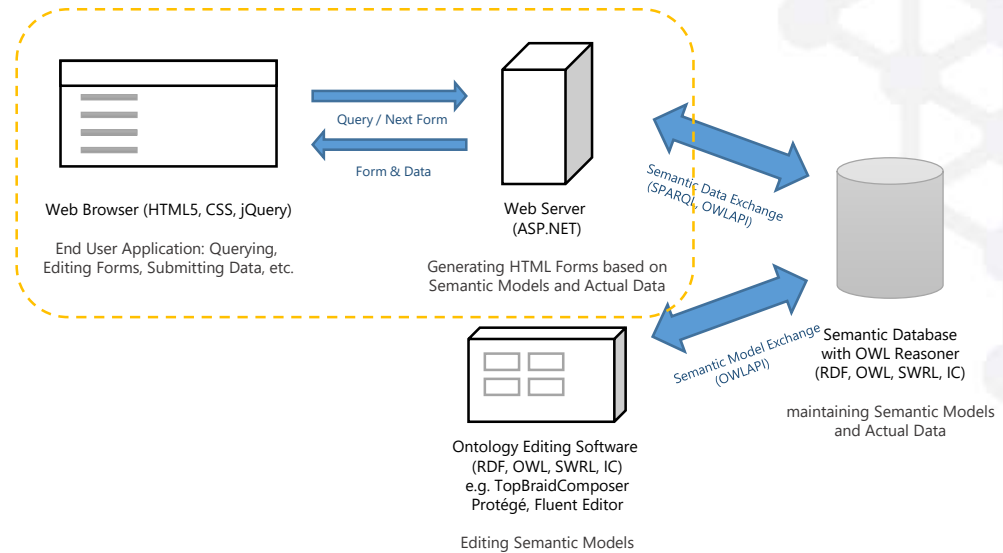
Ontorion Semantics Information Knowledge Framework



Ontorion™ Semantic Forms for ASP.NET



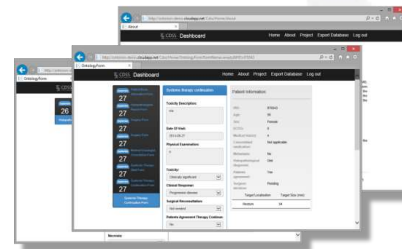
A Semantic Model-driven Application Engine with automatic UI generation.



Use Case: Clinical Decision Supporting System

All information are managed in one place, semantically!

- Forms model
- Forms navigation model
- Recommendation rules
- Risk groups rules
- User Context



User Interface for accessing and collecting data is instantly generated automatically.

SWRL rules



Expert Panel:

Ref-1-Adj-No is a recommendation.
Ref-1-Adj-No has-description equal-to 'Adjuvant therapy should not be considered when the risk of relapse is low [[link to http://www.ncbi.nlm.nih.gov/pubmed/19286368](http://www.ncbi.nlm.nih.gov/pubmed/19286368)]'.
If a patient has-risk-group Risk-Group-3-A-E and the patient is concerned by a histopathological-report-form then the histopathological-report-form has-recommendation Ref-1-Adj-No.

If a patient has-risk-group Risk-Group-3-A-E and the patient is concerned by a histopathological-report-form then the histopathological-report-form has-recommendation Ref-1-Adj-No.

Description Logic:

$$\exists \text{opatient}(\text{?patient-x}) \wedge \text{have-risk-group}(\text{?patient-x}, \text{Risk-Group-3-A-E}) \wedge \text{opatient}(\text{?patient-x}) \wedge \text{ohistopathological-report-form}(\text{?histopathological-report-form-x}) \wedge \text{concern}(\text{?histopathological-report-form-x}, \text{?patient-x}) \rightarrow \text{have-recommendation}(\text{?histopathological-report-form-x}, \text{Ref-1-Adj-No})$$

XML/SWRL

```
<DLSafeRule
xmlns="http://www.w3.org/2002/07/
wrl#"
<Body>
<ClassAtom
<Class IRI="Patient" />
<Variable IRI="PatientX" />
</ClassAtom>
<ObjectPropertyAtom
<ObjectProperty
IRI="hasRiskGroup" />
<Variable IRI="PatientX" />
</ObjectPropertyAtom>
<AtomIndividual
IRI="RiskGroup3A-E" />
</ObjectPropertyAtom>
</ClassAtom>
<Class
IRI="HistopathologicalReportForm"
/>
<Variable
IRI="HistopathologicalReportFormX"
/>
</ClassAtom>
<ObjectPropertyAtom
<ObjectProperty
IRI="concern" />
<Variable
IRI="HistopathologicalReportFormX"
/>
<Variable IRI="PatientX" />
</ObjectPropertyAtom>
</Body>
<Head>
<ObjectPropertyAtom
<ObjectProperty
IRI="hasRecommendation" />
<Variable
IRI="HistopathologicalReportFormX"
/>
</ObjectPropertyAtom>
</Head>
</DLSafeRule>
```

Editing OWL & SWRL



The screenshot displays the 'Ontology Editor' application window. The main document area contains several SWRL rules and class definitions. The 'Taxonomy Tree' on the right shows a hierarchical structure of classes, including 'Clinical-Trial-Form', 'Decision-Continue-section', 'Decision-Not-Use', 'Change-Systemic-Therapy-Not-Ti', 'Clinical-Trial-Not-Ti', 'Follow-Up-Not-Ti', 'Surgical-Consultation-Not-Ti', 'enamelation', 'Sex', 'Sex-117', 'Sex-117-Not-Performed', 'Sex-117-Performed', 'Sex-117-Positive', 'Sex-117-Negative', 'Clinical-Response', 'Complete-Remission', 'Partial-Response', 'Progression-Disease', 'Stable-Disease', 'comorbidity', 'Applicable-Not-C', and 'Not-Applicable-Not-C'. The 'OWL/XML' view at the bottom left shows the XML representation of the ontology, including class declarations and property declarations.

```
Ref-1-Aej-No is a recommendation.  
Ref-1-Aej-No has-description equal-to 'Adjacent therapy should not be considered when the risk of relapse is low (link to http://www.ncj.gov/external/332883881)'.  
  
If a patient has-risk-group Risk-Group-3-A-E and the patient is concerned by a histopathological-report-form then the histopathological-report-form has-recommendation Ref-1-Aej-No.  
  
Risk-Group-3-A-E is a risk-group-3.  
Every risk-group-3 is a risk-group.  
  
If a patient has-mitotic-Index lower-or-equal-to 1 and the patient has-tumor-information a tumor-Info and the tumor-Info has-tumor-size greater-than 50 and the tumor-Info has-tumor-size lower-or-equal-to 100 and the tumor-Info has-tumor-localization (despathag) then the patient has-risk-group Risk-Group-3-A-E.  
Risk-Group-3-A-E has-description equal-to 'low (group 3g), percentage of patients due to relapse < 3, 0'.  
  
OWL/XML  
+ [DL]def:rule ontology: "http://www3.org/2002/07/owl#" +  
  + <body> +  
    + <ClassDecl> +  
      + <Class IRI = "Ref-1-Aej-No" /> +  
      + <Variable IRI = "Patient" /> +  
      + <ClassProperty IRI = "ref-1-Aej-No" /> +
```

Risk groups



The screenshot displays the CDSS Dashboard interface. The main content area is titled "Histopathological report" and contains several sections with dropdown menus and checkboxes:

- Histopathological Diagnosis:** (Date)
- Histopathological Diagnosis Date:** 2014-10-03
- Surgery:** (Tumor section)
- Tumor Excision Procedure:** (Metastasectomy)
- Tumor Locality:** (Distal)
- Preexcision Treatment:** (Previous surgery)
- Tumor Margins:** (Positive for p16)
- Treatment Effect:**
- Tumor Localization:** (Oropharynx)
- Tumor Size:** (8)
- Glut Subtype:** (Mixed)

Patient Information:

HLI:	152003
Age:	18
Sex:	Female
DOB:	8
Consent for medication:	Not applicable
Metastasis:	No
Histopathological diagnosis:	Dist

Risk groups: Risk groups 3 a e

Target Localization	Target Size (cm)
Oropharynx	8

Recommendations:

- 5a1-4d1-8a

Adjunct therapy should not be considered when the risk of relapse is low (link to <http://www.ncbi.nlm.nih.gov/pubmed/13258388>)

Building complex risk rules with SWRL



XML/SWRL

If a patient has-mitotic-index lower-or-equal-to 5 and the patient has-tumor-information a tumor-info and the tumor-info has-tumor-size greater-than 50 and the tumor-info has-tumor-size lower-or-equal-to 100 and the tumor-info has-tumor-localization Oesophagus then the patient has-risk-group Risk-Group-3-A-E.

```

<?xml version="1.0" encoding="UTF-8" ?>
<swrl:rule
  xmlns:swrl="http://www.w3.org/2003/03/swrl#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
  xmlns:rif="http://www.w3.org/2003/03/rif#"
  xmlns="http://www.w3.org/2003/03/swrl#"
  >
  <swrl:body>
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#patient-x" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-x" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-y" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-z" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-w" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-v" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-u" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-t" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-s" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-r" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-q" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-p" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-o" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-n" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-m" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-l" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-k" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-j" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-i" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-h" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-g" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-f" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-e" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-d" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-c" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-b" />
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#tumor-info-a" />
  </swrl:body>
  <swrl:consequent>
    <swrl:atom
      class="http://www.w3.org/2003/03/swrl#Variable"
      href="#risk-group" />
  </swrl:consequent>
  <swrl:ruleName
    href="#Risk-Group-3-A-E" />
</swrl:rule>

```

Description Logic:

$\Delta \text{opatient}(\text{?patient-x}) \wedge \text{have-mitotic-index}(\text{?patient-x}, \text{?.value-tmp-1}) \wedge \leq 5(\text{?.value-tmp-1}) \wedge \text{opatient}(\text{?patient-x}) \wedge \text{otumor-info}(\text{?tumor-info-x}) \wedge \text{have-tumor-information}(\text{?patient-x}, \text{?tumor-info-x}) \wedge \text{otumor-info}(\text{?tumor-info-x}) \wedge \text{have-tumor-size}(\text{?tumor-info-x}, \text{?.value-tmp-2}) \wedge > 50(\text{?.value-tmp-2}) \wedge \text{otumor-info}(\text{?tumor-info-x}) \wedge \text{have-tumor-size}(\text{?tumor-info-x}, \text{?.value-tmp-3}) \wedge \leq 100(\text{?.value-tmp-3}) \wedge \text{otumor-info}(\text{?tumor-info-x}) \wedge \text{have-tumor-localization}(\text{?tumor-info-x}, \text{Oesophagus}) \rightarrow \text{have-risk-group}(\text{?patient-x}, \text{Risk-Group-3-A-E})$



Project Examples

Semantic Project Examples

Clinical Decision Supporting System for GIST Cancer Treatment



European Society for Medical Oncology



Ontorion™ Fluent Editor™ 2014

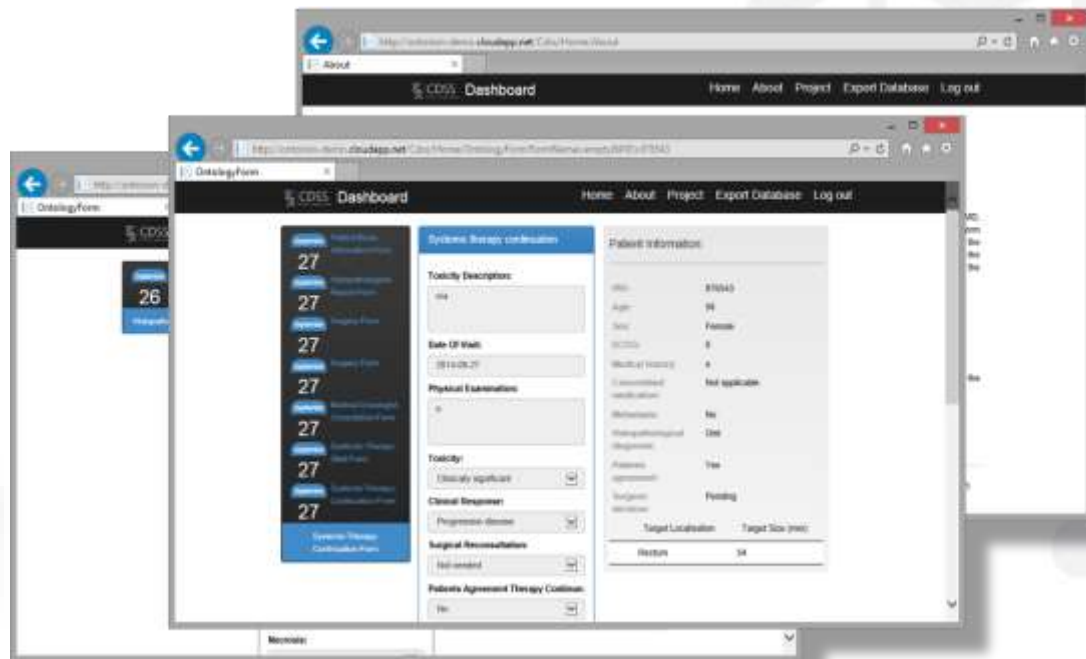
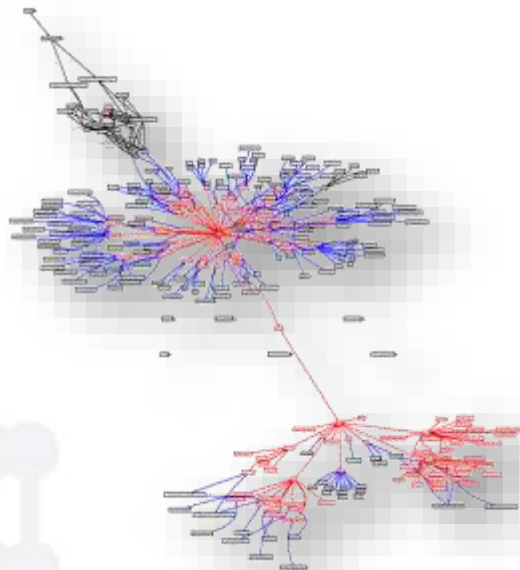


Ontorion™ Server with SDK



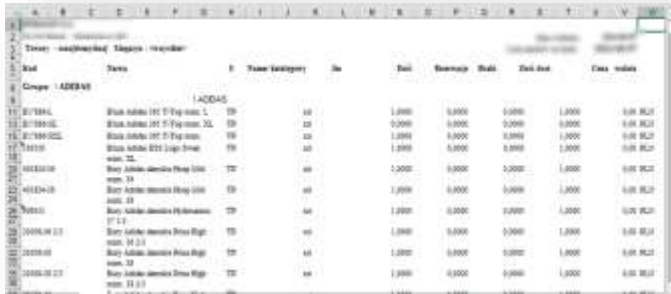
Ontorion™ Semantic Forms for ASP.NET

Managing system complexity



Intelligent Stockhouse Management

Powered by  Ontorion



Stock	Date	Type	Quantity	Price	Value	Cost	Profit
1000000000	2014-01-01	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-02	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-03	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-04	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-05	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-06	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-07	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-08	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-09	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-10	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-11	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-12	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-13	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-14	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-15	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-16	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-17	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-18	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-19	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-20	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-21	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-22	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-23	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-24	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-25	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-26	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-27	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-28	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-29	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-30	Buy	10000	10.00	1000000	1000000	0.00
1000000000	2014-01-31	Buy	10000	10.00	1000000	1000000	0.00



AUDYTEL 



Ontorion™ Fluent Editor™ 2014



Ontorion™ Server with SDK

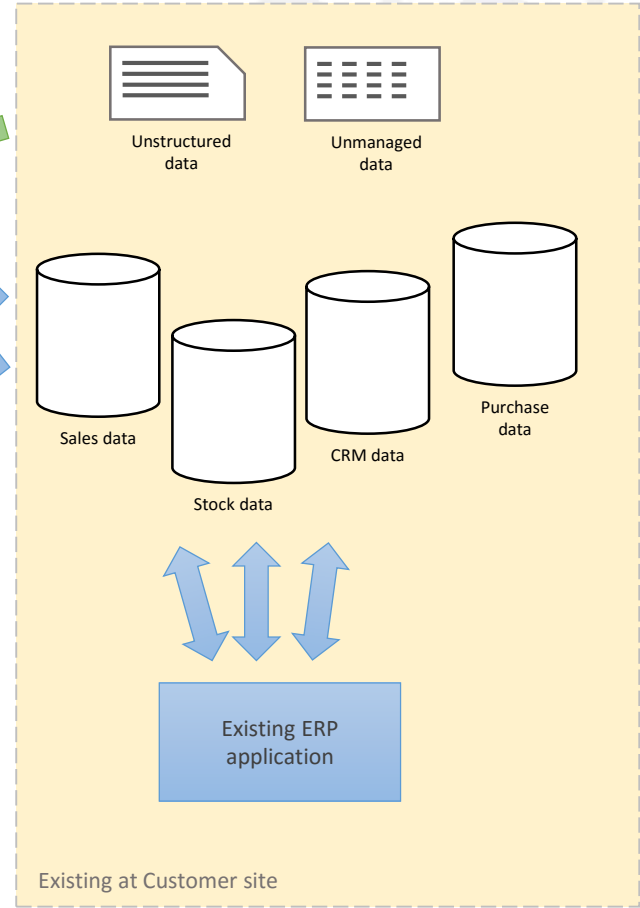
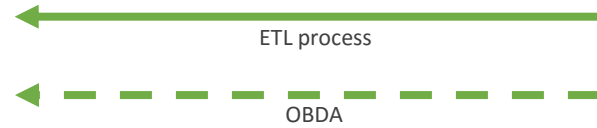
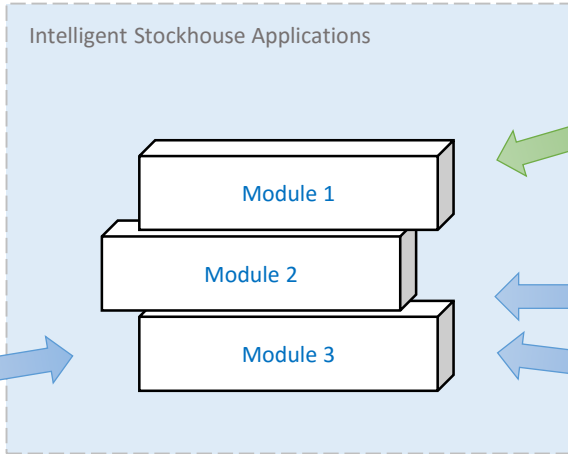


Ontorion™ Text Mining Tools



Semantic Data (OWL/SWRL)
Instance Data (RDF)
Structured Data (BigTable)

Powered by 



Thank you!

Pawel Zarzycki
Cognitum CEO

p.zarzycki@cognitum.eu



W3C MEMBER

Windows Azure Circle Partner
 **Windows Azure**

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