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## About the Cognitive Software Group

The Cognitive Software Group researches and develops world leading software to transform data (structured and unstructured) to knowledge. Our technologies enable advanced analysis of the most complex data needs, using the advanced form of Artificial Intelligence, known as Semantic Computing.

Please go to [https://www.cognitivesoftware.com](https://www.cognitivesoftware.com) to learn how we can help your organisation derive new knowledge from your data.
Introduction

There is a growing realisation that many Artificial Intelligence techniques, including Machine Learning, are clever but not intelligent. **Semantic Computing** is the AI technique that facilitates true machine intelligence by providing contextual knowledge in a form that a computer can understand by itself, without human programming. In Semantic Computing, computer understandable knowledge is held in a specialised **Graph Database** called a **Semantic Knowledge Base**. There has been a rapidly growing demand for Knowledge Bases that use Graph Databases to provide a richer description of data than a relational database can.

The architecture and standards for Semantic Computing have been extended into a family of World Wide Web Consortium (W3C) Semantic Computing standards.

The **Cognitive Software Group** researches and develops software and services to allow organisations to transform their data into a Semantic Knowledge Base. We have developed the **cognitiveAI platform**, a cloud based semantic software platform, supported by **cognitiveAI services**.

The Technologies of Semantic Computing

Semantic computing uses the **Resource Description Framework (RDF)** to model data. RDF enables the means to describe real-world objects as entities and the relationships between them. RDF is the data model for atomic facts, expressed as a **triple**, in the form Subject-Predicate-Object, such as “Boston-Nickname-Beantown”. The **subject** denotes the resource, and the **predicate** denotes traits or aspects of the resource, and expresses a relationship between the **subject** and the **object**.

Multiple triples get combined together by matching the subjects or objects as nodes to one another (the predicates act as connectors or edges). As these node-edge-node triple statements get aggregated, a network structure emerges, known as an RDF graph.

This in its purist form within an **RDF Triple Store** (a type of Graph Database), makes the RDF data model far better suited to certain kinds of knowledge representation than other relational or ontological models. Triple Stores are the highest order of Graph Database.

An RDF Triple

An RDF Graph

Source: [https://www.slideshare.net/marianomx](https://www.slideshare.net/marianomx)
The Benefits of Semantic Computing

Because Semantic Computing is based on the sophisticated RDF data model, it offers the following advantages over alternative technologies:

1. **Richness** – RDF is capable of supporting complex descriptions of real-world objects, and complex descriptions of the relationships between them. This allows real-world insight without the limitations of artificial technical constructs.

2. **Flexibility** – The RDF data model can be added to easily without computer programmers being involved. In addition, Subject Matter Experts can ensure the model is aligned with changing business requirements (e.g. new products or markets).

3. **Inferred knowledge** – RDF supports inferencing engines that can derive new knowledge from existing knowledge automatically or via specific rules. This creates previously undiscovered relationships and concepts that provides new insight from existing data.

4. **Unambiguous** – every object in a Semantic Knowledge Base has a unique identifier (URI) ensuring complete integrity of the data model. This eliminates inconsistency between business objects at a technical and business level.

5. **Interoperability** – information can be mutually understood by humans and computers (software agents, applications) across technology platforms. This removes the cost of bespoke software development and specialised software developers by leveraging a shared business vocabulary (known as an *ontology*).

6. **Federated queries** – a query can be made across multiple internal and external sources, a unique and powerful feature of the semantic query language (known as SPARQL). Integration of information can be achieved dynamically, and data sources can remain in-situ. This effectively removes the cost of integration. Internal data can easily be enhanced with external data (e.g. Open Data) for new insight.

7. **Reusability** – in Semantic Knowledge Bases, the components that define knowledge can be reused. Domains of knowledge are defined only once and can be used by others without the need for specific subject matter expertise. This drives more accurate outcomes by leveraging external expertise.

8. **Standards** – Semantic Computing technologies have been recommended to, published, and ratified by the international standards body, W3C. Compliance to these standards reduces financial and operational risk. Individual organisations can benefit from the work of the global community.

The above benefits are not trivial, they go to the heart of why RDF Graph Knowledge Bases are strategic and tactical, while Property Graph Knowledge Bases are tactical.

For most Enterprise CIOs, CDO’s, Data Scientists, and Data Architects the above benefits are compelling - complexity, flexibility, data ambiguity, multiple data sources, re-usability and standards are bread and butter issues we live with every day. Property Graphs ignore them.
Introduction to cognitiveAI

The cognitiveAI solution provides the software and services to allow organisations to create a Semantic Knowledge Base. This allows users to leverage the context, meaning and intent of data and be able to infer previously unknown levels of knowledge and understanding.

The cognitiveAI solution rapidly ingests, structures and manages data from multiple data sources (and formats) into a semantically enriched environment.

This enables Semantic Interoperability, which is the ability of computer systems to exchange data with unambiguous, shared meaning which is a requirement to enable machine computable logic, inferencing, knowledge discovery, and data federation between information systems.

This provides value above and beyond traditional big data analytics approaches which work with simple data structures, only capturing relationships between data by programmed logic.

The cognitiveAI solution takes your data and transforms it into knowledge (as reflected in the diagram below).

The two components of the cognitiveAI solution are:

- **The cognitiveAI Platform** – software to ingest and manage semantically enriched data in a comprehensive, secure and easy to use workbench.

- **cognitiveAI Services** - services to support organisations to build and leverage Semantic Knowledge Bases.
The cognitiveAI Platform

The cognitiveAI Platform is a cloud-based software platform for deriving new levels of business value from multiple data sources. It is a functionally rich platform to manage data and knowledge. The platform is designed to be cost effective, easily deployed and used to simplify complexity while unlocking the power of Semantic Computing.

The platform consists of two functional Suites and the Security Suite.

- **Data Management Suite** - ingests data from multiple sources and formats into the platform. Stores the data as RDF Triples in our Semantic Graph database. The suite also manages the retrieval of this semantic data and automatically creates an ontology from the original data structure.

- **Knowledge Management Suite** - allows a subject matter/domain expert to develop and manage external and internally generated ontologies, which model the semantics of a domain in a machine-understandable language.

The functions of each suite are detailed in the diagram below:

![Diagram showing the functions of each suite]

The platform makes the semantic data and knowledge available for generating new levels of insight. This can be through a specialised query language called SPARQL, which is generated by the user or other applications for business intelligence, analytics and visualisation.
The cognitiveAI Services

The cognitiveAI services are bespoke offerings designed to assist organisations to move data into a semantic knowledge base within the cognitiveAI platform to drive business outcomes. Based on the nature of your data we offer the following three services:

- **Data to Knowledge** – moving structured or semi-structured data into a semantic knowledge base and automatically generating an ontology. During this process we can leverage our patented **Data Transformation Pre-Processor**.

- **Text to Knowledge** – extracting knowledge from unstructured information using a range of techniques including Machine Learning and Natural Language Processing. A Semantic Knowledge Base is then created through annotation, Deep Learning and Inference capabilities.

- **Edge/IoT to Knowledge** - collect data from IoT and Edge devices, where the data has been selectively chosen using user-driven mapping of target requirements. Once the data has been collected, Data to Knowledge (above) is used to create the Semantic Knowledge Base. Data can be selectively sourced from our intelligent adapter technology imbedded in edge devices of your choice and using persistent message queuing, and/or a data integration hub feeding our cognitiveAI platform.
How Organisations are using cognitive AI

The cognitive AI solution delivers new value across a wide range of industries and applications. As examples, some of the areas we are working in with clients can be grouped into:

- **Data Interoperability**: Ability to integrate data from a variety of IoT and computing based sources easily and effectively.

- **Relationship Finding**: Finding all relationships between two or more concepts across large amounts of different data sources. With semantic computing this can be done easily without having to understand specific data schema nor the connection you are looking for. Applications include Fraud/Risk, service delivery and total customer relationship analytics.

- **Linked Open Data**: The ability to seamlessly link Government data, Government Open data initiative and Linked Open Data sources for greater insight. This has wide applications including deepening customer insight.

- **Cognitive Search**: Creating a semantic knowledge base to enable true cognitive search. Applications include compliance and advanced unstructured text analysis for deep insight.

- **Comparative Analysis**: The ability to compare siloed sources of data looking for commonality beyond simple word matching. Applications include policy alignment & adherence.

- **Inferencing**: Identifying previously unknown relationships revealed through business rules or axioms, deriving new knowledge.

- **Data Integration**: Using ontologies and RDF Triples and a data integration hub for enterprise data silos. The approach is very effective with the added benefit of making the data semantically available.

- **Unstructured Text Processing**: Ability to combine semantic technologies with Natural Language Processing and Machine Learning to create a Semantic Knowledge Base from a corpus.

Working with other AI techniques

The cognitive AI Solution is designed to work in conjunction with other Artificial Intelligence technologies.

Semantic technology is based on ontologies (knowledge) and RDF Triples (data) which combined with other AI techniques including Machine Learning models/algorithms and Natural Language Processing (such as in our approach to unstructured text processing) provide the user with more precise data management options. It is also designed to make data more valuable to other external AI applications.
Unique Benefits of cognitiveAI

The cognitiveAI solution leverages the techniques of Semantic Computing in an automated, easy to use and cost-effective platform. This powerful solution allows users to create a true knowledge base of various sources of data and deploy advanced analytics to uncover previously unknown knowledge and insight. The cognitiveAI solution:

- Ingests and transforms data from multiple disparate sources and formats into a Semantic Knowledge Base
- Automatically generates an ontology from the structure of the source data (catalogue, schema etc.) which can then be enriched using standard ontology engineering practices
- Uses an inferencing engine and/or semantic rules to discover new knowledge (entities or relationships) from existing knowledge
- Includes a security suite to manage user profiles and permissions
- Can leverage Linked Open Data (LOD) to derive additional value from external data sources
- Is designed to manage and manipulate ontologies using a variety of functions including pruning, visualising and validating while retaining the ontology’s integrity
- Exposes semantic data to other analytic and BI software and also other AI techniques
- Is built on W3C Semantic Web standards which allows the platform to co-exist with other W3C compliant products
- Supports the formatting and ingestion of IOT and Edge data streams
- Is protected by our substantial and growing patent portfolio for current and future functional product enhancements