

Morse: Visual paradigm for Semantic Databases

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Abstract. Morse is a graphical tool to create, update and query semi structured Semantic Data. It manipulates complex semantic entities and makes it possible to create and query symmetric and asymmetric semantic relationships.

Its querying capabilities allow users to retrieve filtered datasets and networks and to create powerful flexible queries between non-adjacent entities, disclosing hidden relationships between the data objects.

Morse uses the same visual paradigm for data entry and for searches, making it very intuitive.

The results of multiple, disparate queries can be combined in a single workspace, in which it is also possible to add new data entities and create new links.

Keywords: Semantic, Visualiser, Symmetric and Asymmetric relationships, Non-Adjacent data objects,

1 Introduction

MORSE is a visualiser that sits on top of a Semantic Database.

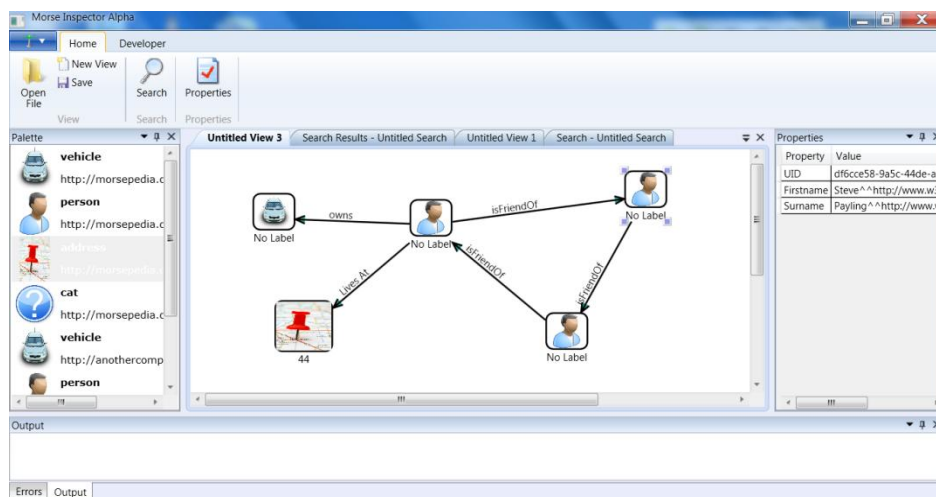


Fig. 1. Morse network

- It allows users to enter and link Semantic Data using graphical tools;
- It employs the same graphical paradigm to enter and to search the database;
- It benefits from capabilities inherent in Semantic Databases: It brings to the surface non-adjacent links between entities, thus exposing relationships between entities which are not immediately obvious;
- It has Whiteboard-like functionality: On a single workspace it is possible to drop results from multiple disparate searches, while at the same time adding new data and creating new links.

At its simplest, MORSE can work as an extremely powerful, search enabled, mind mapping or brainstorming tool; it visualises data in any size database, but when deployed on top of multiple, federated databases it can be an extremely effective investigative tool to detect fraud and aid in security related matters.

MORSE is a graphical blank canvas on which users can to draw and query their universe: all the data entities and the links between them are user defined.

There is no limit to the types of entities that can be created, and what is even more important, it doesn't matter if the initial design is not totally perfect: the entity definitions can evolve over time without data loss; MORSE adapts to the business requirements of the user.

The application has three following components: the Entity Manager, the Workspace and the Search engine

2 The Entity Manager

MORSE includes an Entity Manager to create the entities and relationships between them.

After the initial ontology has been designed the next step is to create the entity types and the relationships that represent the universe you want to create.

The Entity Manager 'speaks' EQL, an SQL-like layer that sits on top of SPARQL. EQL is very easy to learn and use; immediate and intuitive EQL provides the power of SPARQL with the ease of SQL's data definition, but augmented to include the definition, creation and manipulation of links.

For coders, EQL provides a programming interface to define, create and manipulate data in Semantic Databases without having to write a line of SPARQL.

3 Entering Data

Once you have defined all the entity types and relationships you need now, you can start entering data into the system. When MORSE opens the system displays three main sections: The Workspace, the Palette and Properties

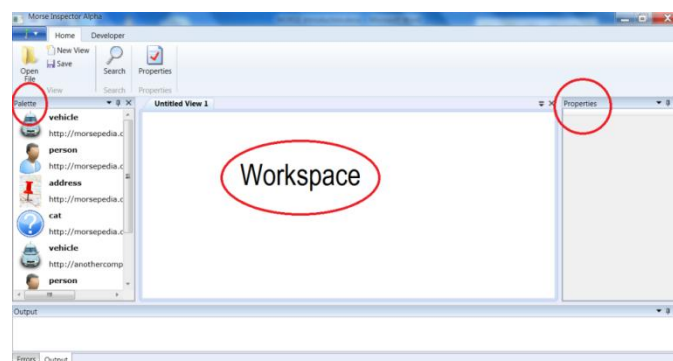


Fig. 2. Screen components

In the centre it shows **The Workspace**, on which you will drop the objects and create the links between them.

On the left of the screen we can see the **Entity Palette** containing the list of entity types currently available. We will drag the Entity Types out of the Palette and drop them on the workspace to create instances of the entities.

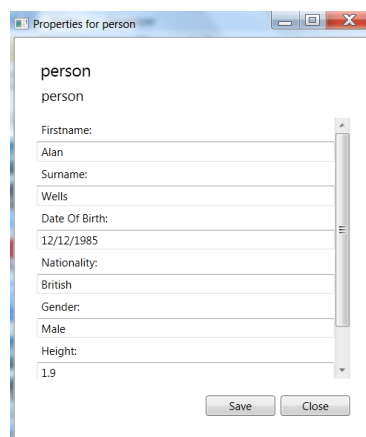
On the right hand side, the system displays the **Properties Sheet**, which lists the properties and associated values of the entity that is individually selected on The Workspace.

3.1 The Workspace

The Morse repository can be populated programmatically: other systems can send to the repository data of the correct type and format and new triples are added to the RDF Store, but it is also possible to create entities and relationships manually.

To enter data via the MORSE we select an entity type in the Entity Palette, drag the icon and drop it on The Workspace.

The system automatically opens the data entry grid corresponding with the object we have just selected. The data entry grids are built dynamically, driven by the Ontology Design.



person
person

Firstname:
Alan

Surname:
Wells

Date Of Birth:
12/12/1985

Nationality:
British

Gender:
Male

Height:
1.9

Save Close

Fig. 3. Data Entry grid

Once we have entered all the data in the grid we click the **Save** button and the entity data object is created. The workspace displays the icon representing Alan Wells; the Property Grid displays the data associated with him. We can resize the icon and move it about the screen.

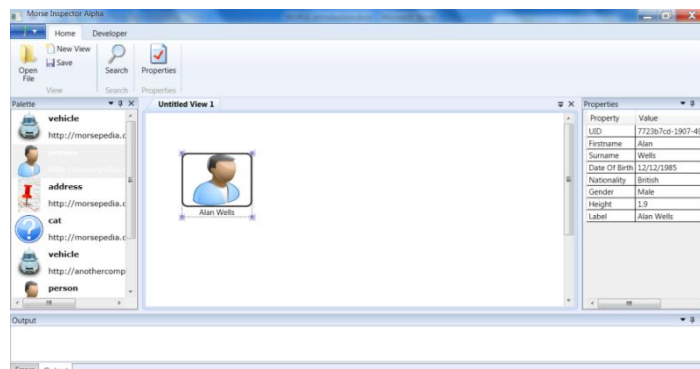


Fig. 4. Adding data in Morse

3.2 Creating Links between the Entities

One of the most powerful features of Semantic databases is the ability to create named links between objects. We will now explore how this is done in MORSE

We have already created Alan Wells. Now we will create a **Location**, the place where he lives and link him to it. Instead of the place where he lives, it could be the place where he works, where he has a drink, a place he frequents, etc. The link represents the nature of the relationship between Alan and the location.

We drag the **Location** icon out of the Palette and drop it onto The Workspace. The system opens the data entry screen listing the Location properties and we key in the details of the Alan's address.

We click the **Save** button and a new location entity is created.

When we created this Ontology we created a link type 'livesAt' between the Person entity type and the Location entity type. We now need to tell the system that Alan 'lives At' 15 Sunrise Avenue, we do that by linking Alan to the location using the 'livesAt' relationship. We right click on the Alan icon, and select **Add Link**.

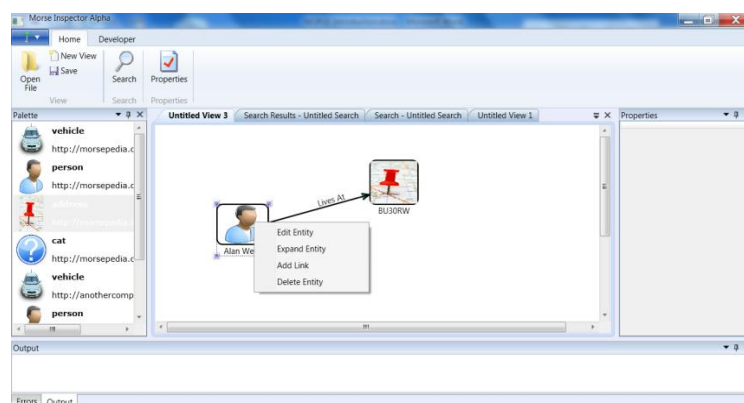


Fig. 5. Defining links

The system displays a line which we draw all the way to the Location icon. We click on the **Location** icon and the system opens the Link Configuration window.

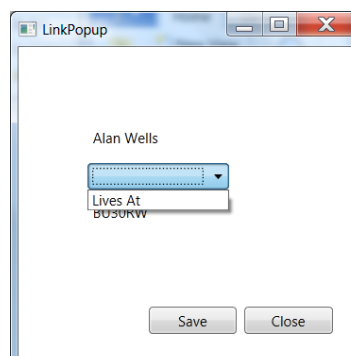


Fig. 6. Selecting from pre-defined link types

This window will only open if the Ontology specifies that these two objects can be linked, otherwise it displays an information message indicating that the objects cannot be linked.

We select the relationship 'livesAt' and click **Save**. The link is now created. The workspace now shows a named arrow linking Alan with 34 Lark Rise.

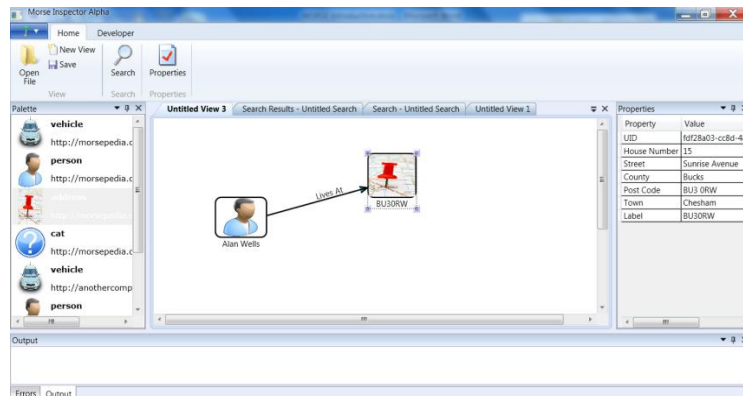


Fig. 7. Linked entities

In this universe we created one relationship between **Person** and **Location**, but we could have created several 'Owns', 'isLinkedTo', 'didWorkAt', 'hasAShareIn', etc., the list and nature of the links will reflect the universe of the user. When we click on the down arrow of the selection box and the system displays all the types of links that are permissible between the two entity types.

3 Searching the database

To start a search we need to click on the **Magnifying Glass** button in the ribbon.

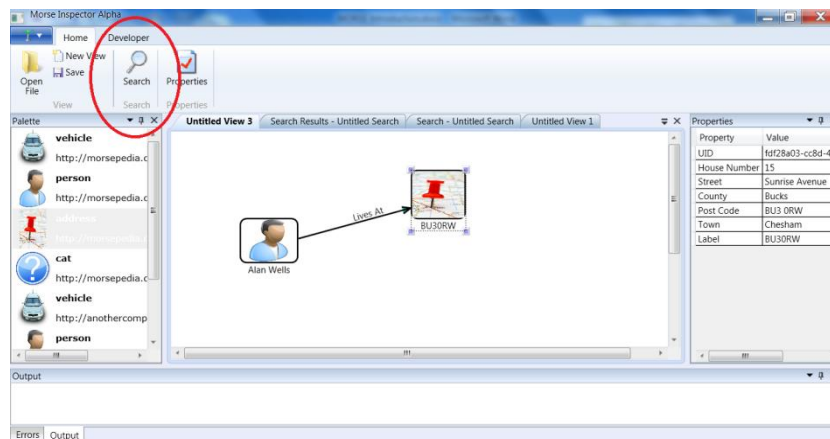


Fig. 8. Initiating a search

This opens the Search Window which looks very much like the main window. It contains the Entity Palette and a canvas on which we drop the types of entities which we want to use for the search.

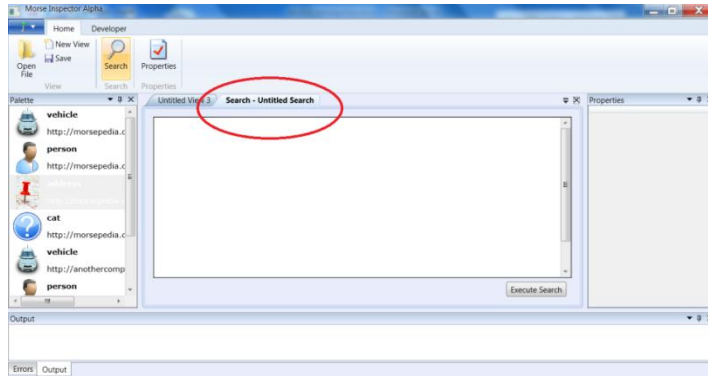


Fig. 9. The Search workspace

3.1 Simple Queries

Once within the query window we drag one of the entity types to the canvas. In this example we will drag a **Person** icon. The system automatically opens a window in which we can enter the search criteria.

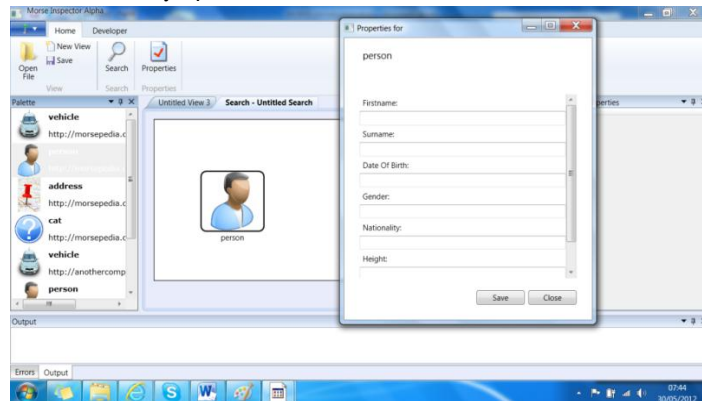


Fig. 10. Entering the Search Criteria

In this example we want to use a very simple search. Let us imagine that the reason to start the search is because we are interested in exploring the data we have in the system relating to a person called Martin Bradford. We enter his details in the Data Filter window and click **Save**. This returns us to the Search screen where we can add entities and links to the search.

Once back in the Search screen we click the button **Execute Search** which runs the query and retrieves all the records that match the search criteria. The system opens the Returns screen. In this instance there is only one match.

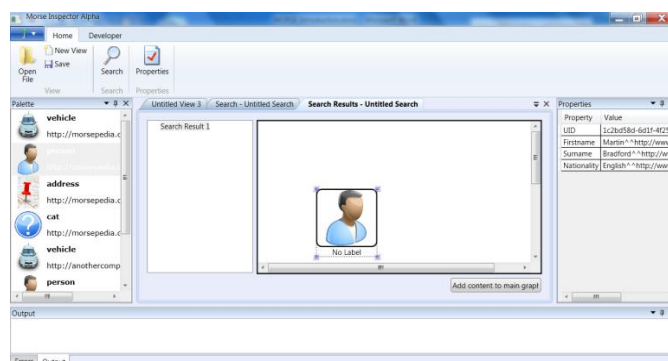


Fig. 11. The Results Screen

We click on the icon, and the system populates the property sheet on the bottom left of the screen. This confirms that we have retrieved the correct person.

Once the data has been retrieved, we want to explore it further. We click **Add result to Graph**. This takes the data belonging to Martin Bradford into the Main screen where we can explore the information we hold relating to this individual. We can either add this result to the main view, to any other open view or to a new view.

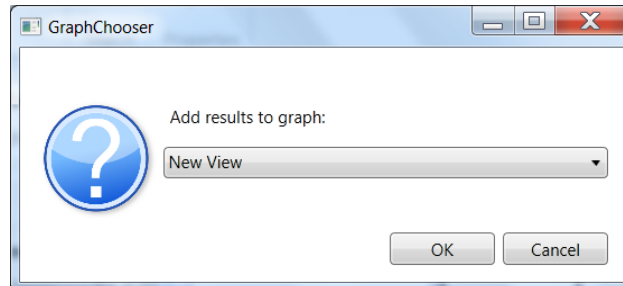


Fig. 12. Selecting the workspace to return the results of the search

The system returns confirmation that the graph has been added to The Workspace. This functionality gives Morse the ability to combine the results of multiple disparate queries into a single workspace, and what is more, it is also possible to add new data entities to the view and to create links between entities retrieved as result of the multiple queries.

In this case we only retrieved a single entity, but other searches could return multiple entities and the relationships between them.

Click **OK**. This takes us back to the search window where we can run additional searches and send the data back to the main window for further investigation.

In this instance we don't want to search on anything else, so we close the Search window and go back to the Main Workspace.

3.2 Search using Expand

Once we have the entity on The Workspace we can use another Search mechanism which retrieves all the entities that are directly linked to the entity in which are interested.

We right click the mouse button while pointing at Martin Bradford. A popup menu comes up with three options, **Expand**, **Edit entity** and **Add link**. This time we are select **Expand**.

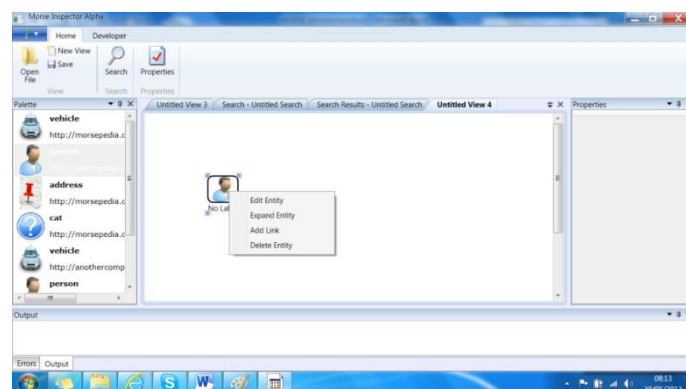


Fig. 13. The Expand option

The system retrieves all the entities which have direct links with Martin. We can rearrange and resize the entities to highlight the areas that are of particular interest.

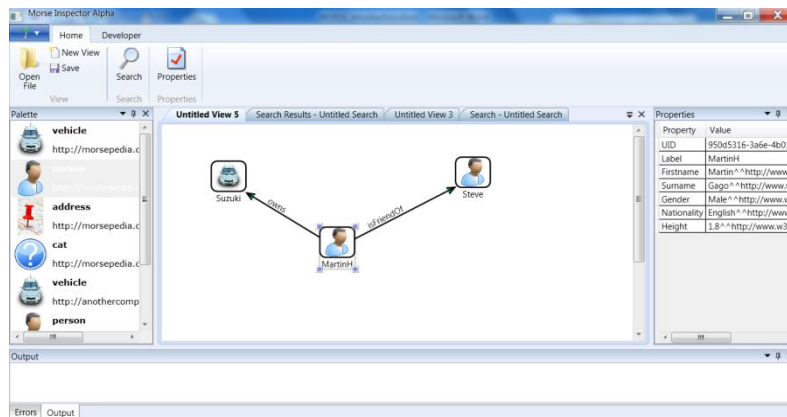


Fig. 14. The expanded network

We can then invoke **Expand** on each of the entities returned thus delving into the data without having to provide any additional filters.

3.3 Elastic or Flexible link

The Elastic Link is a feature that relies on the capabilities provided by the Semantic Database on which MORSE is built. Elastic Links make it possible to formulate queries which relate entities that satisfy the criteria within 'n' hops of the starting entity. We can call them nodes or jumps; the data does not have to have direct links to the starting entity in order to be retrieved, but needs to be within the 'n' hops defined in the search.

We start with the network represented below: Martin H has two friends and is linked to his mother Antonia.

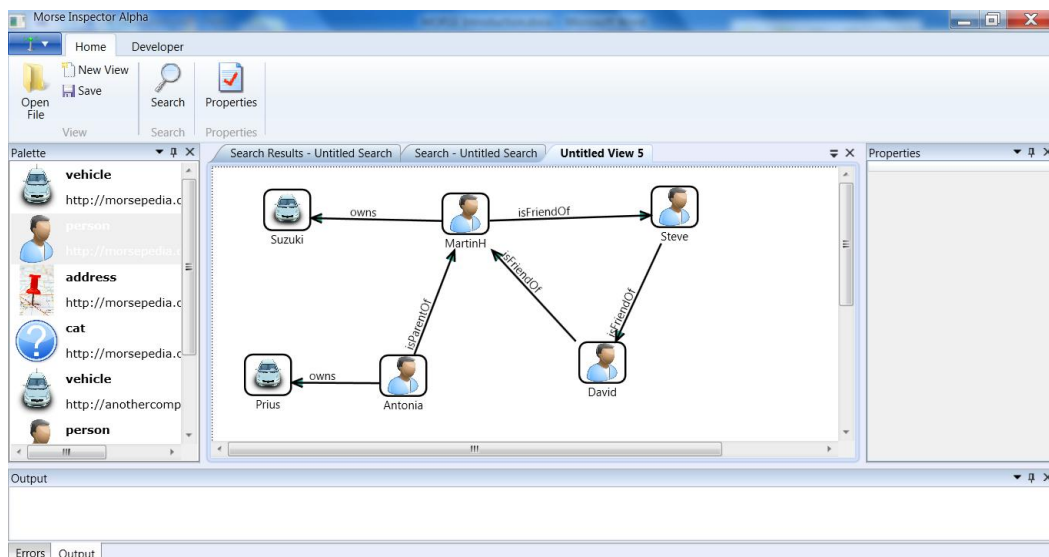


Fig. 15. The underlying data

We suspect that David Walter is somehow linked to a Blue Suzuki, but we know he does not own one. We start the query in the normal way, clicking the Magnifying glass.

The Search window opens, we drag and drop a Person entity type. The system opens the Filter window, we enter David's details and click **Save**.

We then drag and drop a Vehicle icon. This time we do not enter any filter criteria, since we want to retrieve details of any vehicles linked to David.

We right click on David. The system opens a pop up window with the following options: **Edit entity**, **Add Link**, **Edit Entity**. This time we select **Add Link**. The system opens the Search Link dialog box.

This gives us the option to select one of the pre-defined links, as shown in the image above, or use the Elastic link. In this example we wish to use the Elastic link.

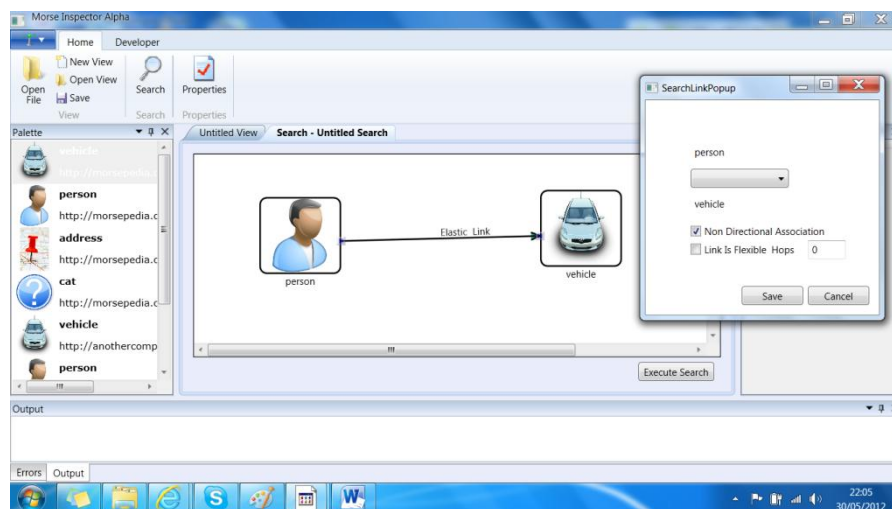


Fig. 16. The Flexible link definition

We tick the checkbox 'Link is Flexible Hops' and we enter the number of hops. We recommend that you don't use more than 3 hops, since anything beyond that number will return large volumes of data which is largely irrelevant. For this query we enter the value 2

We click **Save**. The system closes the pop up window and returns to the Search screen, which shows the two people linked by an Elastic link.

We drop the data into the view of our choice and we carry on working. We can add or edit entities, and we can create links between those entities and the result of the search.

This is just the introduction of Morse...lots more interesting ways to discover the data and the relationships that are hiding in your computer!