GRADUATE CERTIFICATE: Intelligent Reasoning Systems (IRS)
PRACTICE MODULE: Project Proposal

Date of proposal:

16 March 2020

Project Title:

Enterprise Knowledge Graph System
(Knowledge Graph Solution that leads to Enterprise AI)

Sponsor/Client: *(Name, Address, Telephone No. and Contact Name)*

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Background/Aims/Objectives:

In order to develop end-to-end business operation process and solution architecture design for internal stakeholders (e.g. Enterprise Architect, Solutions Designer and Business Analyst etc.). in both high quality and efficiency, the proposed intelligent system is designed to provide systematic overview and recommendation about optimized process/solution strategy.

While interact with the system, those internal customers can input text (natural language) and submit requests to find out all relationships and properties among people, process and technology for an organization or a department. The search result can be presented on a multi-relational data graph with necessary brief summary.

Requirements Overview:

- **Knowledge Discovery**
  - Extract enterprise operation knowledge from industry-agreed process, solution framework and domain knowledge portions.

- **Knowledge Modelling**
  - Establish graph data structure based on linked nodes with labels and properties.
  - Represent enterprise entities and process flow with path cost attributes inclusion, such as time and effort cost.

- **Knowledge Inference**
  - Adopt AI search/reasoning algorithms to generate optimal recommendation of the process/solution according to configurable node properties and path cost attributes.

- **Cognitive System**
  - Capture user text input and translate it into searching or reasoning rules of the system through the rule-based decision tree method.

Resource Requirements (please list Hardware, Software and any other resources)

- Hardware proposed for consideration:
  - Any local/cloud system able to host Docker container.

- Software proposed for consideration:

Front end:
- Web Brower (Chrome/IE/Firefox)
- NGNIX/NodeJS (Web Server)

Middleware:
- SpringBoot
- Drools decision tree and rule engine library

Back end:
- Relational DB: SQLite or MySQL
- Graph DB: Neo4j
- Reasoning engine: Neo4j graph algorithm pack.

- Overall application runtime container:
  - Docker, JDK11

- Programming language:
  - HTML, CSS
  - Java, JavaScript
  - SQL, Cypher

Number of Learner Interns required: (Please specify their tasks if possible)

A team of three project members:
- Yang Lu Yi - Team leader, overall system design and modelling, use case and algorithm design and implementation.

- Yin Tian Shi - Team member, overall system design and modelling, technical architecture design and implementation.

- Yu Yu - Team member, overall system implementation and validation, project management and documentation.

Methods and Standards:

- **Knowledge Discovery**

- Extract knowledge from structured data (CSV format) and un-structured data (guideline for best-practice) from TMForum, Framworx standards, as well as our domain knowledges.

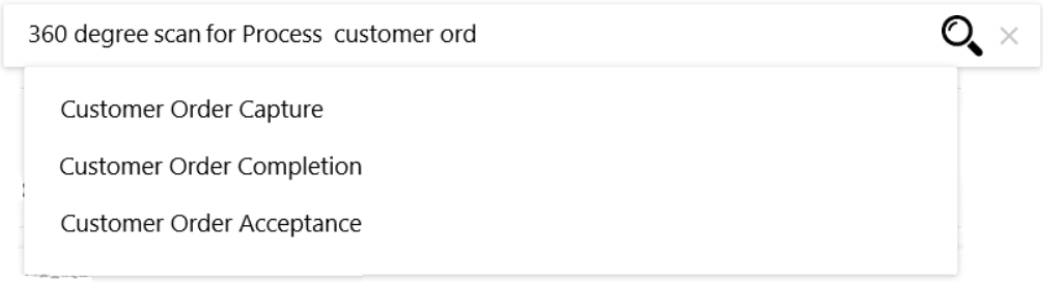
➢ Business Use Case Design

Use cases for Searching and Reasoning requests are as below:

No.	Use Case	Functionality	User Input	System Output
1	Searching Request: The related nodes and mutual relationships can be used for impact analysis and risk assessment.	Search bar is targeting for user to key in search content in a structured text format (close to natural language). With application of Cognitive System techniques, the system is designed to understand and map the text into searching rules, fulfil user's searching request by using Machine Reasoning technologies. The search bar supports both error correction and suggested features for the original text.	"360 Scan for People <Sales Agent> in <Market Sales Domain>"; "Relationship scan between Process <Customer Interaction Management> and Technology <Customer Self-Management>"; "End to End Process Stream Scan for <Request-to-Answer>".	A 360-degree overview graph of both the node and relationships can be presented on the web page; Brief text summary is also generated for reference.
2	Reasoning Request: Recommend the optimal process stream according to user's specific requirement. E.g. 1) Lowest cost to fulfil Request-to-Answer request from customer. 2) Shortest response time to fulfil Request-to-Answer request from customer.	Same as above.	"Recommend a solution to fulfil Request-to-Answer request with lowest cost"; "Recommend a solution to fulfil Request-to-Answer request with shortest time";	A 360-degree overview graph with necessary text summary represents the optimal end-to-end business operation process stream among People (customer, customer service representative, etc), Process (Customer Interaction Management, etc) and Technology (Customer Self-Management application, etc).

➢ **Cognitive System UI** (mock-up)

User can interact with the system via input natural-language-like text.



➢ Cognitive System backend

With adoption of the Rule-based decision tree method to capture user requests and translate them into searching and reasoning rules.

No.	Input Text Contains	Search Rules	Algorithms Reference
Following rules are relevant to the **"360-degree Scan"** function:			Depth First Search & Breadth First Search algorithms.
1	360-degree scan	Demonstrate all linked nodes & relationships of the nodes.	
2	People <Sales Agent>	Add constraint on the Search Rule, to search node with label as People & node property "name" as Sales Agent only.	
3	with < domain: Market Sales Domain>	Add constraint on the Search Rule, to search node with property "domain" as Market Sales Domain only.	
Following rules are relevant to **"Relationship Scan"** function:			Decision Tree Algorithm of the rule-based Cognitive Systems.
4	Relationship scan	Demonstrate specific relationships of the node only.	
5	with < domain: Market Sales Domain>	Add constraint on the Search Rule, to search node with property "domain" as Market Sales Domain only.	
Following rules are relevant to **"End-to-End Process Scan"** function:			Decision Tree Algorithm of the rule-based Cognitive Systems.
6	End-to-End Process Scan	Demonstrate all the nodes which are linked with the relationship "route".	
7	for <Process Stream: Request-to-Answer>	Add constraint on the search rule, to search relationship with property Process Stream as "Request-to-Answer".	

Following rules are relevant to "**Process/Solution recommendation and optimization**" function:

No.	Input Text Contains	Reasoning Rules	Algorithms Reference
1	Recommend a solution	search for a solution in an end-to-end business process stream.	Search & Optimization algorithms (Dijkstra)
2	fulfil <process stream: Request-to-Answer>	Add a constraint to the Reasoning Rule #1 and search for relationship with property process stream “Request-to-Answer” only.	
3	with lowest cost	Add a search constraint to Reasoning Rule #1 and search for the route with the lowest path cost.	
4	with the shortest response time	Add a search constraint to the Reasoning Rule #1 and search for the shortest response time path.	

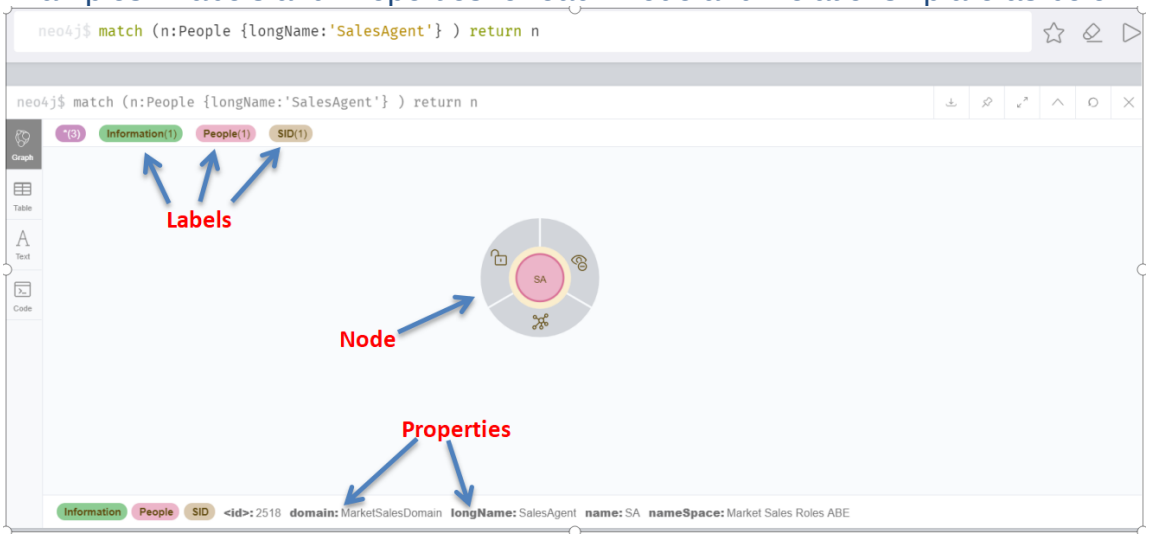
➢ Knowledge Modelling and Inference

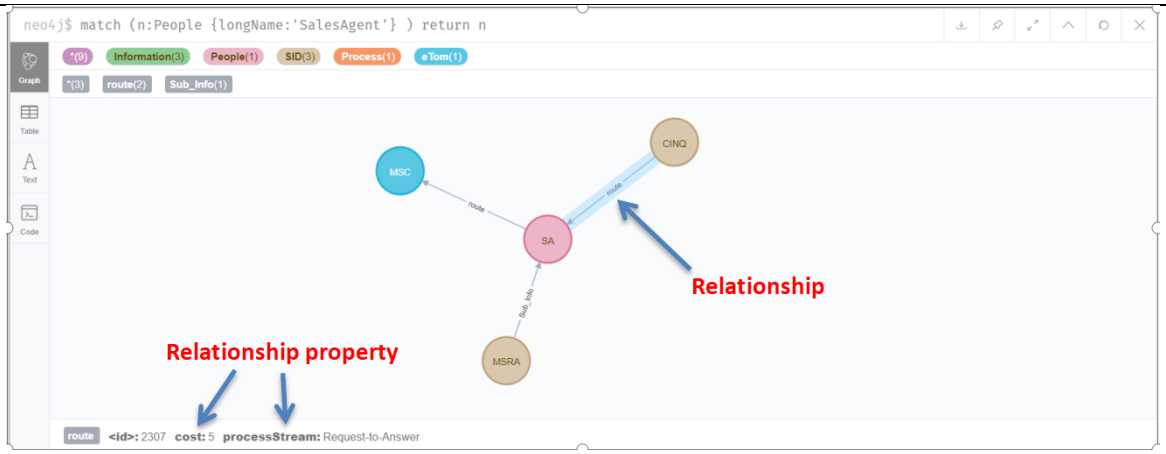
The enterprise knowledge is stored as a graph structure which contains different nodes and various relationships.

Listed the total quantities of Labels & Properties for Nodes and Relationship.

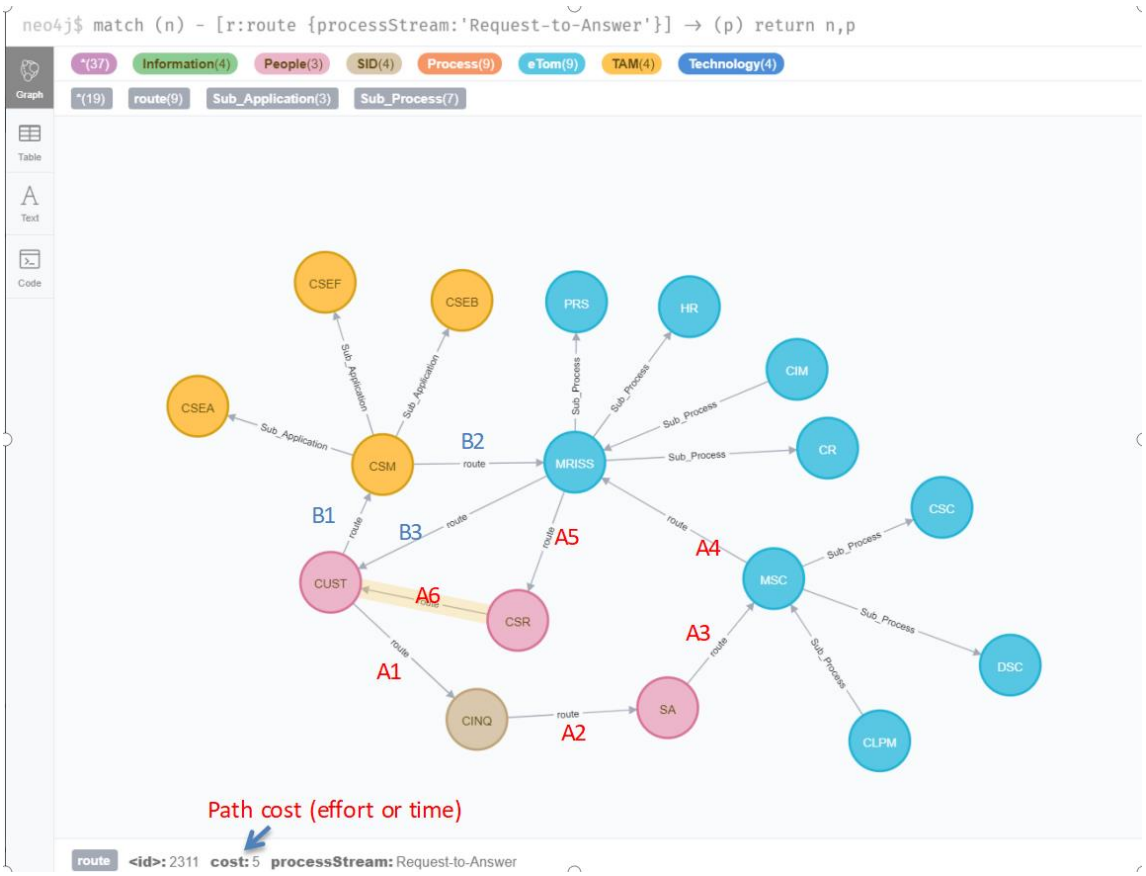
Category	Labels	Properties	In Total	Remarks
Nodes	Information People Process TAM Technology	Cost Description (Brief & Detailed) Domain ID Name (Abbr. & Full Name) Quality Resource Time	Labels: 5 Properties: 10	Not every node includes all supportive labels and properties.
Relationship	Not Applicable	ID Cost Process Stream Quality Time	Labels: 0 Properties: 5	Not every relationship includes all supportive properties.

Examples - Labels and Properties for each Node and Relationship are as below.





In the following “Request-to-Answer” stream graph, it represents two different routes for customer’s general information enquiry. The path from A1 to A6 provides a human-assisted solution that customer can reach to actual Sales Agent for help via customer service representative, while the path B1-to-B3 recommends customer to find out results via self-service management application. When complete the whole operation process (path A/ B), the generated path cost (e.g. monetary cost/ time cost) between each two nodes will be stored as a property in the relationship object.



In addition, we can use some constraint satisfaction or planning methods to calculate the optimal solution according to specific business requirements. For

example, checking the shortest path cost in terms of either monetary cost or shortest time.

- **Further enhancement on the system from next semester onwards**

Because of the tight schedule (deadline - 3rd May 2020), the following further enhancement will be considered to implement from next semester onwards.

- Extend more widely useful end-to-end business processes for both internal and external consumers, such as “Order-to-Payment”, “Request-to-Change” & “Termination-to-Confirmation” processes, etc.
- Develop more use cases including job scheduling & field engineer route planning, etc.
- Further strengthen the practical business value of the system. For example, with application of a large number of data shared by actual organizations, to customize reasonable and specific knowledge models for different kinds of requests.

Team Formation & Registration

Team Name: Project Group 2
Project Title (repeated): Enterprise Knowledge Graph System
System Name (if decided): EKGS
Team Member 1 Name: Yu Yu
Team Member 1 Matriculation Number:
Team Member 1 Contact (Mobile/Email):
Team Member 2 Name: Yin Tian Shi
Team Member 2 Matriculation Number:
Team Member 2 Contact (Mobile/Email):
Team Member 3 Name: Yang Lu Yi
Team Member 3 Matriculation Number:
Team Member 3 Contact (Mobile/Email):

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Programme Name:	**Project No:**	**Learner Batch:**
Accepted/Rejected/KIV:		
Learners Assigned:		
Advisor Assigned: Contact: Mr. GU ZHAN / Lecturer & Consultant Telephone No.: 65-6516 8021 Email: zhan.gu@nus.edu.sg		