**Project title:** How to interpret users’ requirements in plain text to produce software functionalities powered by one or more microservices.

**Introduction**

Writing code for a software program is still a very complex and expensive IT function, which requires expertise in programming. While there are many affordable resources out there (such as books, online materials, and training courses) to get anyone willing to learn how to write code get up to speed, there are still people with non-IT expertise that would love to write program without necessarily having to go through any form of training (e.g., classes or self-learning).

**Problem statement – Aims and objectives**

This project attempts to produce some building blocks that should help non-programmers build software programs or at least coordinate one or more microservices to produce a functionality that will form part of an overall application. In doing so, this project will bridge the disconnect that often exists between experts working on a software development project and the end users that will ultimately use the software. The aforementioned disconnect may lead to failure of software development projects. With this approach, the development of software will start from the end user’s experience and walk backwards to the development phase rather than the other way around.

The idea of the present project is reminiscent of the way natural language processing (NLP) works for information seeking tasks (text classification, information retrieval, information extraction), whereby a user for example inputs a text in a given language (e.g., English or Spanish) and an NLP engine translates it into a desired language (e.g. French or Portuguese). There are a number of NLP implementations today such as Google Translate, Facebook Translate, Amazon Translate, and Amazon Transcribe.

The aim of the project is to leverage existing machine learning technologies such as natural language processing to build a model that would interpret user requirements submitted in textual form in plain English and produce the required program or service. Given the sheer variety of programs that are available out there and the complexities of business problems that software programs are designed to solve, the scope of this research project will be limited to commonly used services such as front-end technologies, client-side business logic and API services. The model will be used as a way for non-programmers and programmers alike to generate microservices that can be combined together to form a software application which solves a specific business process (e.g., registration, authentication, checkout, and payment). Backend services are therefore not within the scope of this project and may well be an opportunity to further this research.

It is important to have a way to measure the efficacy of the model. In order words, the service generated by the model would need to validated against a reference service or program of similar type; the purpose of the validation process is to judge and demonstrate how our engine provides a more efficient option to produce software as opposed to manual programming and more importantly how does the program produced by the engineer compares in terms of quality to the same program when it has been written by a software developer.

**Examples of real-life services**

Some examples of services that users might ask the model to produced are:

* Authentication service (a web page with username and password-based login module)
* Federation service with OAuth with third party applications such as Facebook, Twitter, LinkedIn
* Payment service (Ecommerce platform Online shopping kart, checkout and payment service)
* Chatbot service (web frontend interactive application with chatbot service to interact with customers
* Search service (A web page with a search service)
* Form submission service (An online sales system with user details form submission)

**How it will be done?**

Building ML models requires dataset that will serve as training data and an algorithm that will help identify common patterns in the dataset and make human-like decisions or make predictions. For this project the plan is to use existing codes for commonly used services such as authentication service or a payment service to train the model and design an algorithm based on NLP framework that will help make decision on which service to build/produce based on user defined requirements.

**Training Phase:**

**Learning**

**Algorithm**



**Model F**

**(X1, Y1)**

**(X1, Y1)**

**…**

**(Xn, Yn)**

**Prediction Phase**:

**X**

**Predicted Label**

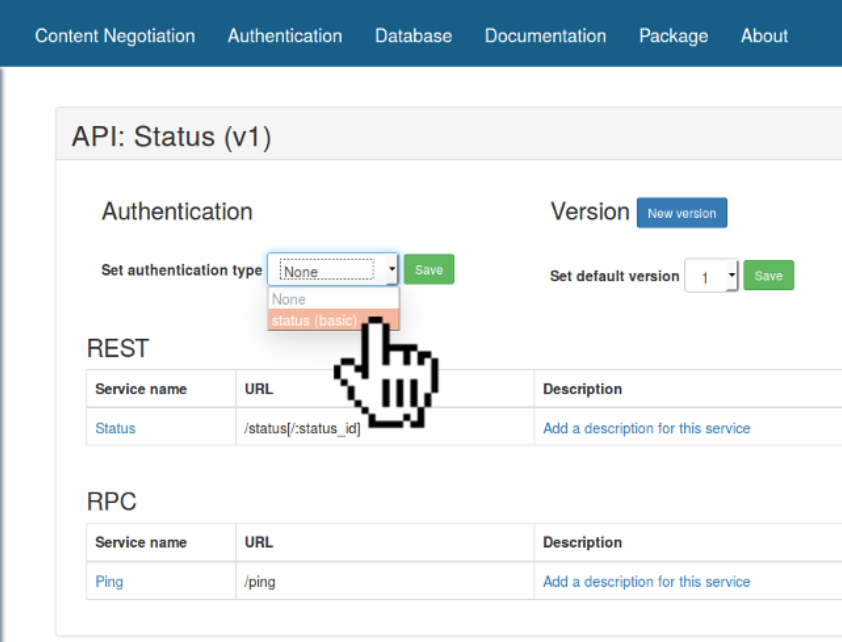
**Y=F(X)**

****

**User**

**Input Text**

**Model F**



**Input Text**

**Input Text**

**Service/Application**

As per the diagram above, the training phase consists in using a set of frequently used microservices as dataset (for example source codes from GitHub) and design an algorithm that would identify with maximum precision possible microservices and produce a model (Model F) which basically enables microservices to respond to particular user’s inputs in plain English.

In the prediction phase, a user enters his requirements for a particular microservice say an authentication service or a payment service, the model analyses the inputs and produces the required microservice ready for use or customized further.

**Project work packages**

The project will be broken down into the following work packages:

1. **User input module**

In order for user to obtain a specific functionality powered by a specific service or set services, he or she will be required to provide a number of specifications in plain in English as input. This process may be guided that is a user is restricted to specific type of inputs (e.g. an input form with specified attributes that need to be filled or menu selections), or completely open meaning user have the freedom to type any text they want to express their requirements and the model will interpret their inputs to produce the needed functionality in the form of coordinated microservices. The decision to use a guided or open approach for user inputs will depend on the complexity and the feasibility of one over the other within the scope of this project which means that one approach may constitute an opportunity for further research.

1. **Algorithm**

In order to identify pattern and learn from existing program/code and to translate users’ inputs into corresponding services one or more algorithms will be required which is basically a mathematical function that helps map an input to a desired output. Natural language processing (NLP) technologies in the way they work have a lot of similarities in terms of the problem this project is trying to solve so existing algorithms such as Naïve Bayes classifier, Probabilistic Context Free Grammar (PCFG) or Hidden Markov Model (HMM) to name but a few may be used or if necessary a completely new algorithm may be produced.

1. **Training data**

One of key steps in Machine and deep learning projects is to train the machine to be able to make predictions or human like decisions based on existing data. It is therefore vital that the data used to trained the machine be of very good quality. This work package will aim to do just that through data engineering steps in order to produce refined and good quality data sourced from github repository (codes) and public Universal Description, Discovery and Integration (UDDI) registries (services) and samples of users’ inputs.

1. **Service repository framework**

A service repository framework is basically a repository that stores all the services that will represent the engine behind any business functionality requested by a user through the input module. It may use a Service Oriented Architecture approach that is provider-subscriber model where the user through their inputs will act as consumer requesting a service which will be provisioned by a service provider stored in some form of registry within the framework.

1. **Learning**

This phase consists in training the machine so that it can identify specific patterns from the training data. For this project the goal will be to identify the different services from various input sources and be able to map them to users’ inputs such that when a user enters his requirements for a specific functionality, the machine triggers the corresponding service or combination of services to produce the desired functionality.

1. **Prediction or Processing**

This work package is basically a model that will be tested again real data as opposed to the learning phase where training data will be used. Basically, once the training phase is complete we should end up with a model which can be used for processing users’ inputs and generating the desired functionalities by triggering the coordination of services.

1. **Validation**

The validation phase will be all about comparing a functionality produced by the model to a similar functionality manually built or provided in a Software-as-a-Service (SaaS) model. This phase will help establish the viability of the model and what are the potential unique benefits it would offer to users in comparison to existing solutions available to them.

**References**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/1598694>

## [Natural language processing and knowledge](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/1598694/)

M. Nagao

[2005 International Conference on Natural Language Processing and Knowledge Engineering](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=10654)

Year: 2005

Page : 1

Cited by: [Papers (3)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/1598694/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/1629902>

## [A Natural Language Processing for Semantic Web Services](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/1629902/)

M. Stanojevic ; S. Vranes

[EUROCON 2005 - The International Conference on "Computer as a Tool"](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=10849)

Year: 2005 , Volume: 1

Page s: 229 - 232

Cited by: [Papers (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/1629902/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4810674>

## [Statistical Machine Learning in Natural Language Understanding: Object Constraint Language Translator for Business Process](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4810674/)

Li Zhao ; Feng Li

[2008 IEEE International Symposium on Knowledge Acquisition and Modeling Workshop](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=4805632)

Year: 2008

Page s: 1056 - 1059

Cited by: [Papers (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4810674/citations?tabFilter=papers#citations) | [Patents (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4810674/citations?tabFilter=patents#anchor-patent-citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/346491>

## [Natural language processing tools and environments: the field in perspective](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/346491/)

B.Z. Manaris

[Proceedings Sixth International Conference on Tools with Artificial Intelligence. TAI 94](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=1012)

Year: 1994

Page : 228

Cited by: [Papers (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/346491/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5260847>

## [Upon Dynamic Natural Language Processing](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5260847/)

Marius Crisan

[2009 International Conference on New Trends in Information and Service Science](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=5260408)

Year: 2009

Page s: 487 - 492

Cited by: [Papers (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5260847/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5431706>

## [An Automated Tool for Generating UML Models from Natural Language Requirements](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5431706/)

Deva Kumar Deeptimahanti ; Muhammad Ali Babar

[2009 IEEE/ACM International Conference on Automated Software Engineering](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=5431684)

Year: 2009

Page s: 680 - 682

Cited by: [Papers (16)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5431706/citations?tabFilter=papers#citations) | [Patents (11)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5431706/citations?tabFilter=patents#anchor-patent-citations)

**IEEE Conferences**

## [A processing system for programming specifications in a natural language](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/11876/)

H. Seki ; E. Nabika ; T. Matsumura ; Y. Sugiyama ; M. Fujii ; K. Torii ; T. Kasami

[[1988] Proceedings of the Twenty-First Annual Hawaii International Conference on System Sciences. Volume II: Software track](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=197)

Year: 1988 , Volume: 2

Page s: 754 - 763

Cited by: [Papers (3)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/11876/citations?tabFilter=papers#citations) | [Patents (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/11876/citations?tabFilter=patents#anchor-patent-citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/7338516>

## [Translation of natural language queries to structured data sources](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/7338516/)

Ruslan Posevkin ; Igor Bessmertny

[2015 9th International Conference on Application of Information and Communication Technologies (AICT)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=7327074)

Year: 2015

Page s: 57 - 59

Cited by: [Papers (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/7338516/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5575821>

## [Mapping Services to Activities in Service Oriented Architecture (SOA) Design: A Simulation-Driven Optimizing Method Based on DODAF2.0](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6830899/)

Yingchao Zhang ; Zhiping Jiang ; Xiaohao Yu ; Xiaoqiang Song

[2014 IEEE 8th International Symposium on Service Oriented System Engineering](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=6825321)

Year: 2014

Page s: 156 - 157

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6643228>

## [Service Oriented Architecture Design of Energy Consumption Information System about Petroleum Enterprise](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6643228/)

ChangSheng Zhu ; ManMan Chai ; YuFeng Lu ; YiDong Guo

[2013 International Conference on Computational and Information Sciences](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=6642226)

Year: 2013

Page s: 1174 - 1177

Cited by: [Papers (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6643228/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/7977299>

## [A service identification model for service oriented architecture](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/7977299/)

Anurag Shashwat ; Deepak Kumar

[2017 3rd International Conference on Computational Intelligence & Communication Technology (CICT)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=7966625)

Year: 2017

Page s: 1 - 5

Cited by: [Papers (2)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/7977299/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4730479>

## [Formal Approach for the Development of Business Processes in Terms of Service-Oriented Architectures Using Pi-ADL](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4730479/)

Flavio Oquendo

[2008 IEEE International Symposium on Service-Oriented System Engineering](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=4730444)

Year: 2008

Page s: 154 - 159

Cited by: [Papers (2)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4730479/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6649637>

## [LISA: Linked Services Architecture Based on the Linked Data and Service Broker](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6649637/)

Mikio Aoyama ; Hirotaka Kojima

[2013 IEEE 20th International Conference on Web Services](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=6596022)

Year: 2013

Page s: 617 - 618

Cited by: [Papers (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6649637/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5974947>

## [Research and design of one security model for service-oriented multi-application architecture](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5974947/)

Xiaojun Wu ; Cong Li

[2011 International Conference on Computer Science and Service System (CSSS)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=5959270)

Year: 2011

Page s: 3990 - 3993

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5575818>

## [SOI (Service Oriented Integration) and SIMM (Service Integration Maturity Model An Analysis](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5575818/)

Gandhi Sivakumar ; Faried Abrahams ; Kerard Hogg ; John Hartley

[2010 6th World Congress on Services](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=5575322)

Year: 2010

Page s: 178 - 182

Cited by: [Papers (2)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5575818/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5982335>

## [Using service oriented architecture in a new anonymous mobile payment system](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5982335/)

Bakhtiari Shaghayegh

[2011 IEEE 2nd International Conference on Software Engineering and Service Science](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=5967841)

Year: 2011

Page s: 393 - 396

Cited by: [Papers (1)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/5982335/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/8117134>

## [Comparing autonomy and collaboration between agent-oriented architecture and service-oriented architecture](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/8117134/)

Parisa Lotfallahtabrizi ; Yasser Morgan

[2017 8th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=8103827)

Year: 2017

Page s: 25 - 31

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4278821>

## [A Systematic Analysis and Design Approach to Develop Adaptable Services in Service Oriented Computing](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4278821/)

Soo Ho Chang

[2007 IEEE Congress on Services (Services 2007)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=4278748)

Year: 2007

Page s: 375 - 378

Cited by: [Papers (3)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/4278821/citations?tabFilter=papers#citations)

**IEEE Conferences**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/8082679>

## [Information Handling and Processing Using Enterprise Service Bus in Service-Oriented Architecture System](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/8082679/)

Nikhil Chaudhari ; Robin Singh Bhadoria ; Siddharth Prasad

[2016 8th International Conference on Computational Intelligence and Communication Networks (CICN)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=8049191)

Year: 2016

Page s: 418 - 421

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6898686>

## [Service-Oriented Architecture and Legacy Systems](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6898686/)

Nicolas Serrano ; Josune Hernantes ; Gorka Gallardo

[IEEE Software](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/RecentIssue.jsp?punumber=52)

Year: 2014 , Volume: 31 , [Issue: 5](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/tocresult.jsp?isnumber=6898682)

Page s: 15 - 19

Cited by: [Papers (10)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6898686/citations?tabFilter=papers#citations)

**IEEE Journals & Magazines**

<https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6009335>

## [On-Demand Service-Oriented Architecture and Standardization](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6009335/)

Fei He ; Keqing He ; Peng Liang ; Jian Wang

[2011 IEEE International Conference on Services Computing](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/xpl/mostRecentIssue.jsp?punumber=6009116)

Year: 2011

Page s: 739 - 740

Cited by: [Papers (8)](https://ieeexplore-ieee-org.ezproxy4.lib.le.ac.uk/document/6009335/citations?tabFilter=papers#citations)

**IEEE Conferences**