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ITU-T

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OF ITU

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(08/2020)

SERIES F: NON-TELEPHONE TELECOMMUNICATION SERVICES

Multimedia services

Interfaces for intelligent question answering system

Recommendation ITU-T F.746.11

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Recommendation ITU-T F.746.11

Interfaces for intelligent question answering system

Summary

Recommendation ITU-T F.746.11 describes interfaces for the intelligent question answering service framework (Recommendation ITU-T F.746.3). This Recommendation also defines the interfaces among functional modules to support the intelligent question answering service, which provides advanced functions to generate answers for the user's question in a natural language. The scope of this Recommendation is focused on describing interfaces and functional features for natural language processing function, question analysis function, candidate answer generation function, and answer inference/generation function of intelligent question answering system.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T F.746.11	2020-08-13	16	11.1002/1000/14328

Keywords

Natural language processing, QA intelligent system, QA interfaces QA metadata, question answering.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Recommendation ITU-T F.746.11

Interfaces for intelligent question answering system

1 Scope

This Recommendation addresses the descriptions for interfaces among modules and functions related to intelligent question answering systems. In particular, the scope of this Recommendation includes interfaces and functional features for the following modules of the intelligent question answering system:

– Natural language processing,

– Question analysis,

– Candidate answer generation,

– Answer inference/generation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T F.746.3] Recommendation ITU-T F.746.3 (2015), *Intelligent question answering service framework*.

[ITU-T F.746.7] Recommendation ITU-T F.746.7 (2018), *Metadata for an intelligent question answering service*.

[ITU-T H.703] Recommendation ITU-T H.703 (2016), *Enhanced user interface framework for IPTV terminal devices.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 named entity recognition [ITU-T F.746.3]: A function that recognizes named entities such as PLO which are people, locations and organizations from the sentences. The PLO can be decomposed into more specific named entities depending on the applications.

3.1.2 natural language processing [ITU-T F.746.3]: A method that analyses text in natural languages through several processes such as part-of- speech recognition, syntactic analysis and semantic analysis.

3.1.3 semantic analysis [ITU-T F.746.3]: A function that recognizes the semantic relations among the words around predicates that exist in the same sentence. The semantic analysis function then generates a semantic predicate argument structure (PAS).

3.1.4 speech [ITU-T H.703]: Speech is the vocalized form of human communication.

3.1.5 syntactic analysis [ITU-T F.746.3]: A function that analyses sentence structures and generates dependency relations among words based on dependency grammars.

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3.1.6 knowledge base [ITU-T F.746.7]: A collection of knowledge resources that consist of structured and unstructured data. The knowledge base is used to provide information to the various applications that are related to information provisioning such as QA systems and search systems.

3.1.7 question answering [ITU-T F.746.7]: A system that provides answers in a natural language to questions which are in the natural language form by analysing the questions and all the knowledge resources that are available to the system.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DB	Data Base
ID	Identifier
IQAS	Intelligent Question Answering Service
IR	Information Retrieval
KB	Knowledge Base
LAT	Lexical Answer Type
NE	Named Entity
NLP	Natural Language Processing
NNG	Noun General
PAS	Predicate Argument Structure
PLO	People, Location, Organization
POS	Part of Speech
QA	Question Answering
SAT	Semantic Answer Type
UIMA	Unstructured Information Management Architecture
VV	Verb
XML	extensible Mark-up Language

5 Conventions

None.

6 Overview

Intelligent question answering (QA) system is an advanced function to generate answers for the user's question in a natural language.

Figure 1 presents the exemplary QA architecture. The QA system consists of several functional blocks: Natural language processing, question analysis, candidate answer generation, answer inference and generation functional blocks.

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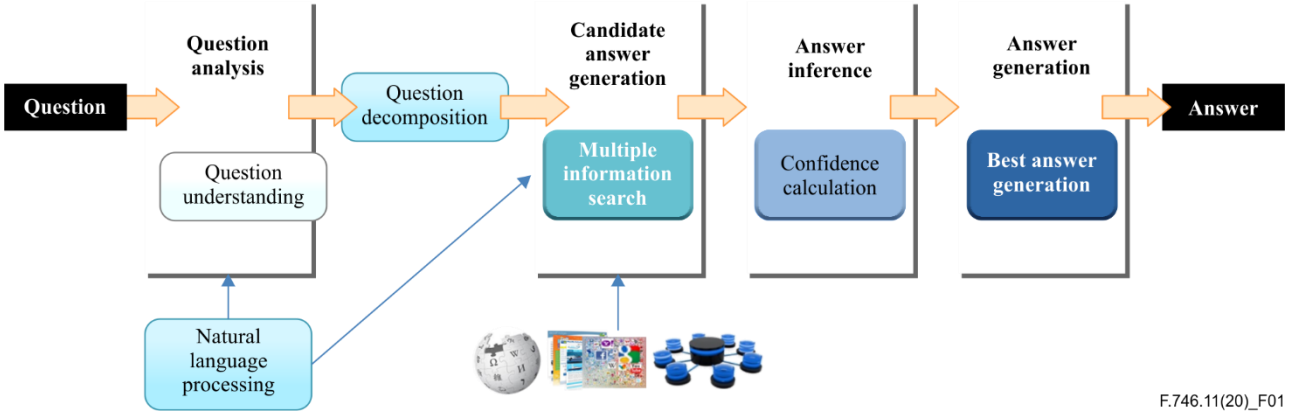

Figure 1 – Example of a QA architecture [ITU-T F.746.3]

This Recommendation addresses interfaces among modules and functions related to intelligent question answering services to present details of data and operation functions. [ITU-T F.746.3] and [ITU-T F.746.7] have specified some elements and metadata that are applicable to intelligent question answering services.

This Recommendation selects basic interfaces among modules and functions from these specifications that are applicable to intelligent question answering services. Names of elements/attributes and functional entities are quoted as they are in the specifications, to distinguish the relationship among the standards.

7 Functional components of intelligent question answering service

[ITU-T F.746.7] gives the definition for major functional components for intelligent question answering service (IQAS). IQAS functional components are basically composed of natural language processing, question analysis, candidate answer generation, answer inference and answer generation functional blocks as follows:

– **Natural language processing functional block**, which supports natural language processing on the QA server,

– **Question analysis functional block**, which supports question analysis on the terminal,

– **Candidate answer generation functional block**, which supports candidate answer generation by searching information in various data bases (DBs),

– **Answer inference/generation functional block**, which supports answer inference based on feature normalization and ranking of candidate answers and best answer generation on the terminal.

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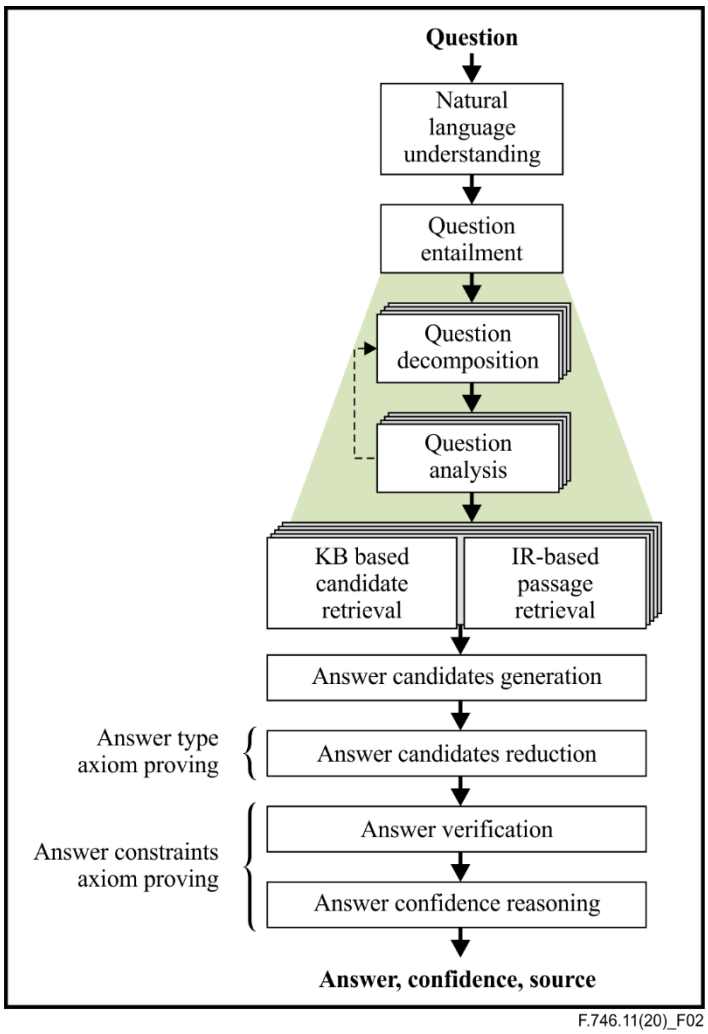

Figure 2 – Information flow of functional blocks in IQAS system [ITU-T F.746.7]

8 Interfaces for natural language processing

This clause specifies interfaces for natural language processing (NLP) function. The NLP module consists of part of speech (POS) analysis, named entity (NE) analysis, dependency analysis, semantic role labelling and ellipsis recovery. The natural language processing function analyses user's questions as well as target documents for knowledge extraction using the semantic and syntactic analysis technology.

The information flow of natural language processing is described in Figure 3 as sequentially connected submodules which analyse input documents to generate one best main result for each processing sub-module.

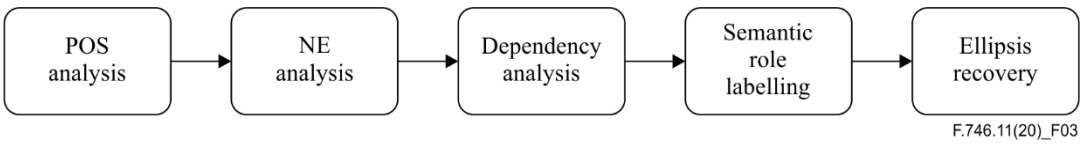

Figure 3 – Information flow of natural language processing

Table 8-1 illustrates the functional description and summarizes the input/output of each submodule for the natural language processing module.

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Table 8-1 – Interfaces of functional blocks for natural language processing module

Functional blocks	Function description	Input	Output
POS analysis	To recognize parts of speech in the sentences and assign relevant POS tags considering contextual meaning of the target sentences.	Input sentence	POS tagged sentence in N-doc structure
NE analysis	To recognize named entities such as people, locations, organizations (PLO) and others from the sentences.	POS tagged sentence in N-doc	NE tagged sentence in N-doc structure
Dependency analysis	To analyse sentence structures and generate dependency relations among words based on dependency grammars.	POS/NE tagged sentence in N-doc	Dependency marked sentence components in N-doc structure
Semantic role labelling	To recognize the semantic relations among the words around predicates that exist in the same sentence and assign roles to the analysed semantic entities.	N-doc marked with POS/NE/Dependency	Semantic roles for each component stored in N-doc structure
Ellipsis recovery	To detect the ellipsis in a sentence and replace them with relevant noun phrases for the input sentences.	N-doc with previous analysis results	N-doc filled with recovered entities as a list

The boxes below present example class API for the POS analysis submodule. The input is a structure called "N_doc structure" of the input sentence. The output of this module is the unit of words with assigned POS tags.

The input of the POS analysis submodule is exemplified in the following box.

```
{
    "sentence": [
        {
            "id": 0,
            "text": "Olympic Tug of war is an Olympic program that pits two
teams against each other in the Olympic games ",            "morp": [],
            "word": []
        }
    ]
}
```

Output of the POS analysis is exemplified in the following box. The output is the N-Doc structure which stores the words and results of the POS analysis.

```
{
    "sentence": [
        {
            "id": 0,
            "text": "Tug of war is an Olympic program that pits two teams
                  against each other in the Olympic games.",
            "morp": [
```


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```
                {"id": 0, "lemma": "Olympic", "type": "NNG", "position": 0,
                  "weight": 0.9},
                {"id": 1, "lemma": " Tug of war", "type": "NNG", "position":
                  10, "weight": 0.0701606},
                {"id": 2, "lemma": "in", "type": "JKB", "position": 22,
                  "weight": 0.0332677},
                {"id": 3, "lemma": " Olympic", "type": "NNG", "position": 26,
                  "weight": 0.9},
                {"id": 4, "lemma": "an", "type": "JKB", "position": 35,
                  "weight": 0.153407},
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                  "weight": 0.0789692},
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                  "weight": 0.0822907},
                {"id": 7, "lemma": "teams", "type": "NNG", "position": 58,
                  "weight": 0.152575},
                {"id": 8, "lemma": "against", "type": "JKO", "position": 64,
                  "weight": 0.137686},
                {"id": 9, "lemma": "each", "type": "VV", "position": 68,
                  "weight": 0.9},
                {"id": 10, "lemma": "other", "type": "ETM", "position": 74,
                  "weight": 0.184941},
                {"id": 11, "lemma": "Olympic", "type": "NNG", "position": 78,
                  "weight": 0.9},
                {"id": 12, "lemma": "games", "type": "NNG", "position": 88,
                  "weight": 0.135556}, ],
            "word": [
                {"id": 0, "text": "Olympic""type": "", "begin": 0, "end": 0},
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                  "end": 2},
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                  4},
                {"id": 3, "text": "Program", "type": "", "begin": 5, "end":
                  6},
                {"id": 4, "text": "pits", "type": "", "begin": 7, "end": 8},
                {"id": 5, "text": "teams", "type": "", "begin": 9, "end": 10},
                {"id": 6, "text": "Olympic", "type": "", "begin": 11, "end":
                  11},
                {"id": 7, "text": " games", "type": "", "begin": 12, "end":
                  12},            ]
        }
    ]
}
```


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