Tutorial Proposal: Evolving complex networks and their applications in web services

- Names and Affiliations of Speakers

Olayinka Adeleye, Auckland University of Technology, New Zealand

- Abstract, objectives and motivation (one or two paragraphs).

Despite the continual increase in the number of Web-APIs available on the internet, it is still challenging for API consumers to discover appropriate Web-APIs that could satisfy requirements. One of the main reasons for this is that Web-APIs registered on online directories such as ProgrammableWeb are in general isolated, as they are registered by diverse providers independently and progressively, ignoring continuous interactions among these APIs, which could enhance their discoverability. In this tutorial, we present an evolving complex network based approach for constructing evolving networks for Web-APIs that are capable of enhancing their discoverability. We first introduce mashups and Web-APIs interactions in the service ecosystem, and analyze their popularity distributions, and quantitatively measure two key node attachment dimensions within the ecosystem: Preferential Attachment and Similarity. Based on the analysis, we then propose two methods for constructing evolving Web-API networks using the theoretical procedures of the Barabasi-Albert and the Popularity-Similarity Optimization evolving complex network models.

- Keywords: Please provide at least three of them.

Web services, Service discovery, Complex networks, Evolving network models, ProgrammableWeb

- Intended Audience (one paragraph): Describe the background that attendees should have. Tutorials may range from introductory to the field for attendees new to a topic, to advanced (for experts).

Attendees with basic network theory and statistics knowledge should be able to benefit this tutorial.

- Content outline: A numbered list indicating the main sections or points to be addressed.

1. An introduction to web services, web APIS, and their ecosystem
2. Evolving complex network models
    a. The Barabasi-Albert model (BA model)
    b. The Popularity-Similarity Optimization model (PSO model)
3. Analyzing the topology of web service ecosystem
4. Constructing evolving Web-API networks

- Description: A statement (no more than 2 pages) providing the relevance of both the tutorial topic and the contents included in it.

  Web-APIs enable integration of cross-organizational business functions over the Web, and thus are the underlying basis of contemporary distributed service-based economy. The rapid development in Web service technology has led to a continual increase in the number of Web-APIs and their compositions on the Internet. Contemporary Web services with features such as RESTful architecture, JSON data, and/or JavaScript interfaces are usually called Web-APIs to distinguish them from the traditional SOAP-based Web services. By reusing these platform independent Web-APIs, service consumers can quickly compose new, value-added applications known as mashups that integrate multiple Web-APIs of diverse functionalities to satisfy complex user requirements. This process shortens software development life cycle and forms the basis for the formation of the so-called Web service ecosystem, where new services emerge, some old ones perish, and service vendors and developers collaborate to develop innovative software solutions.

  A typical representation of Web service ecosystem is ProgrammableWeb (http://www.programmableweb.com, which is currently the largest online Web-API directory, with over 19,000 Web-APIs belonging to more than 400 predefined categories, and over 7,000 mashups as at March 2020. It also provides information such as date of publication, service descriptions, tags and developer information. The perishing of some existing Web-APIs and the emergence of new ones coupled with their dynamic collaborations drive the evolution of this service ecosystem over time.

  However, for most Web service ecosystems, one of the main issues is the isolation of Web-APIs, which limit their discoverability. Web service registries like PW and Mashape consider Web-API ecosystem as isolated functional islands, where APIs are registered by diverse providers independently and progressively without considering relevant dynamic information or continuous social interactions that exist among the services which could influence their discovery. For instance, in PW registry, Web-APIs have categories, and several Web-APIs can be invoked by a mashup, however, there is no direct connection between any two Web-APIs. The reason behind this is that Web-APIs in PW registry are registered by diverse service providers independently over time, and the connections or social relationships between Web-APIs are never directly created or defined.

  Even-though a handful of Web-APIs are related based on their co-occurrences in mashups, there are a lot of APIs that are not involved in any mashup and therefore cannot be discovered via the social interactions or links in the ecosystem. To address these challenges, some existing works adopted a network-based approach to capture the relationships and social interactions among Web services and enhance service discovery. However, none of these works provide a clear cut theoretical approach/explanation of "how to construct an evolving, social network for web services" that could be used to facilitate service discovery application.

  We address these challenges in this paper from a complex network perspective. We assume that a Web service network should exhibit specific properties common to many real-world network systems such as World Wide Web and the Internet due to certain similarity these networks share with Web service ecosystems. For instance, just like most real-world networks, Web service ecosystems like ProgrammableWeb are not static but are dynamically evolving , and grow through publication of new Web services. In addition, certain service like Google Map have high tendency to be invoked more often than others (i.e. socially, more popular) an attribute that could either be likened to nodes with high degree centrality in real-world networks, and driven by popular natural phenomenon like Preferential Attachment (PA) observed in many real-world network systems. We believe that common network topological properties including small-worldness and navigability which uniquely play key roles in characterising real-world networks could be exploited to facilitate Web service discovery.

- Teaching mode: Whether the tutorial is planned to be face-to-face only, entirely virtual, or hybrid, assuming that the main conference will be face-to-face and few travel restrictions. A description of an alternative plan for how the tutorial will be run in the event that participants cannot attend due to travel restrictions (i.e., withdraw the tutorial, hybrid, or entirely virtual).

  Virtual presentation

- Materials: A description (one or two paragraphs) of materials to be provided to attendees through the conference website, such as slides, annotated bibliography, code snippets, etc. NOTE: the materials themselves do not need to be provided in the proposal.

  Slides.

- Additional information (optional): Any other information deemed necessary or appropriate to provide.

  N/A

- Bio-sketches: A maximum half-page bio-sketch of each tutorial presenter.

Olayinka Adeleye received the MSc degrees in mobile computing and communication networks from School of Computing, University of Leeds, United Kingdom, in 2015. He is currently pursuing PhD degree in the School of Engineering, Computer and Mathematical Sciences, Auckland University of Technology, New Zealand. His research interests include service computing, complex networks and recommender systems.