Scilab on Cloud and Textbook Companion Project: A Web 2.0 service for Open Source Education

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***Abstract*—The use of proprietary and licensed softwares for computational use cannot be taken for granted, especially in academia. Use of open source computational softwares like Scilab should be encouraged at all levels. Any desktop based computation software package's use can often be limited by its hardware requirements and most of them are not yet ready for the next generation of low cost hardware devices. Here we present a cloud based service model that allows user to run Scilab codes from remote locations using just a browser. We have also come up with a comprehensive database of Scilab examples from engineering textbooks : Textbook Companion Project. The user can select from a pool of more than 6000 Scilab examples and run it directly from the browser, thus making installation of Scilab natively unessential. Scilab on Cloud is offered as a Web 2.0 service with a public application programming interface(API) which can be used freely to execute codes on the cloud as a SaaS(Software as a Service). This service not only provides an educational interface to Scilab beginners but also makes Scilab computing accessible to low cost and minimal hardware computational devices.**

I. Introduction

Though proprietary and licensed softwares provide a good platform to fulfill the needs of scientific community and the academia for its numerical and computational needs, [2] they are limited by their huge licensing costs. Scilab is an open-source cross platform software that allows one to perform numerical calculations. Scilab is freely distributed by Scilab Enterprises [1] and has been widely used for teaching mathematics, engineering sciences and automatic control engineering in higher and secondary education institutions.

Textbook Companion Project [4] is an initiative to port solved examples from standard textbooks using an open source software system, such as Scilab. Owing to the contributions from numerous students, solved examples from more than 100 textbooks from various domains such as Analog Electronics, Chemical Engineering, Computer Programming, Control Theory and Control Systems, Digital Communications, Digital Electronics, Electrical Technology, Fluid Mechanics, Mathematics and Pure Science, Mechanical Engineering, Signal Processing, and Thermodynamics

have been ported to Scilab and have been made available for free download. The aim of Textbook Companion is to not only promote use of open source softwares like Scilab for solving numerical problems, but also to aid people in learning Scilab. A novice learning Scilab can browse through the examples and execute them directly from the browser.

The initial aim of the Scilab on Cloud project was to make Scilab available as SaaS(Software as a Service) hosted on the cloud. However the project evolved as it progressed to provide an API that would allow users to interact with the service via making API calls either from a browser or from a console. Subsequently, all the examples from the Textbook Companion Project were added to provide a learning platform for Scilab beginners.

In order to further enhance usability a Google-Chrome based extension [10] was created. This extension allows user to run Scilab Code from any website by just selecting the relevant part of the web page that has Scilab code. It is completely free of cost and has been released as an open source project.

II. The Architecture

In order to make Scilab available to remote users, a webservice was written utilizing the Python [5] based Django [6] web-framework. To make the webservice easily accessible and faster, it has been hosted on the cloud architecture provided by Garuda India [7]

A. Scilab on cloud : The Need

Scilab is an open source package distributed for various platforms. Though it is distributed as an easy to install package, it has a minimum set of hardware requirements as given in the requirements page [8]. This set of hardware requirements might not be available to

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everyone. In this era of low cost computing devices like the Aakash [12], it is impossible to satiate the list of requirements. Hence in order to make Scilab available to everyone, including the users of low cost devices, there was a dire need to make it available as an online service which could allow the user to submit codes through just a browser

There has been recently foray into the cloud technologies for scientific computing [3]. Scilab on Cloud derives from the same ideology of utilizing the power of cloud for scientific computing and in the process making the power of cloud available to all free of cost.

The Scilab Enterprise Wiki [11] mentions a set of services that provide on the cloud computing . Table 1 summarizes the comparison between all such available services. Though there have been previous attempts at making Scilab available via browser-server model. Scilab on Cloud is the first of its kinds that focusses not only on making the service publicly accessible free of cost but also providing examples from more than hundred textbooks that can be used as the first starting point for learning Scilab. Another very notable difference is in terms of visualization support. Most of the services mentioned in Table 1 do not have any support for running Scilab codes. So all those Scilab codes which generate a graph cannot be run on any of these services. Not only Scilab On Cloud allows plotting graphs as show in in Figure 2, it allows allows creating a PDF of the graph which can be saved locally by the user.

B. Scilab on Cloud : Architecture

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1) Web 2.0 Service: The webservice has been implemented in the form of an Application Programming Interface abbreviated as API. This API is publicly accessible. Thus any third party user, who wants to utilize the cloud architecture for running personal Scilab codes can do so provided one has an 'API client id' and an 'API client secret'. 'API client id' and 'API client secret' refer to a unique key pair assigned to a user, on request. Any user, interested in using the cloud based architecture for running personal Scilab codes can apply for obtaining the API keys. Once the API credentials are provided the user can interact with the webservice by performing a set of GET and POST requests on the specified url as mentioned in sub-section C.

C. Scilab on Cloud with Textbook Companion Project

In order to make Scilab on Cloud service accessible via a browser, a web interface was made available hosted at http://cloud.scilab.in This web interface interacts with the cloud's webservice to run Scilab codes.

As seen from Figure 1 the web interface is designed like a 'textbook interface', where there are two text-areas, the left one assigned for the input and the right one designated for output from Scilab engine. The user can either choose to run a code by selecting an example from the drop-down list of textbooks or can simply copy-paste his/her scilab code into the left text area. Clicking 'execute' causes the Scilab code to be sent to the Cloud server, where it is processed and run. Processing is explained in sub-section C.

1) Processing Scilab code on the Cloud: In order to make sure that the cloud server is not prone to attacks, the scilab code being run goes through a pre-processing engine. The pre-processing engine suppresses all the system commands available in Scilab to ensure that the system is not compromised. In order to also ensure that the server does not get overloaded every scilab code run has a timeout of two minutes. If the run scilab code happens to be running for more than 2minutes the process is killed and an error message is generated.

The API endpoint is :

- http://scilab-test.garudaindia.in/cloud/scilab_evaluate
    - scilab_code (POST,string) : scilab code to be evaluated
    - api_key (POST,string): api key of the user
    - api_secret (POST , string): api secret of the user

All responses are returned as a JSON [9] object.

D. Scilab on Cloud: Code Search

For a novice, finding the correct usage of a new Scilab command is essential. Though Scilab Enterprises' official website provides basic set of examples for all Scilab commands, they are often not exhaustive. To address this problem we came up with a 'TBC code search portal' [13] Let's say the user is looking for examples how the command 'nyquist', he would get at most one example on Scilab Enterprise's website (See Figure 3), but if the same search is performed on 'TBC code search portal' more than 65 examples that use 'nyquist' command show up and the user can chose to run the example at the click of a button(See Figure 4)

1) Scilab on Cloud: Google Chrome Extension: Scilab beginners often refer to online notes/tutorials for examples. It is however not so easy to try out those examples

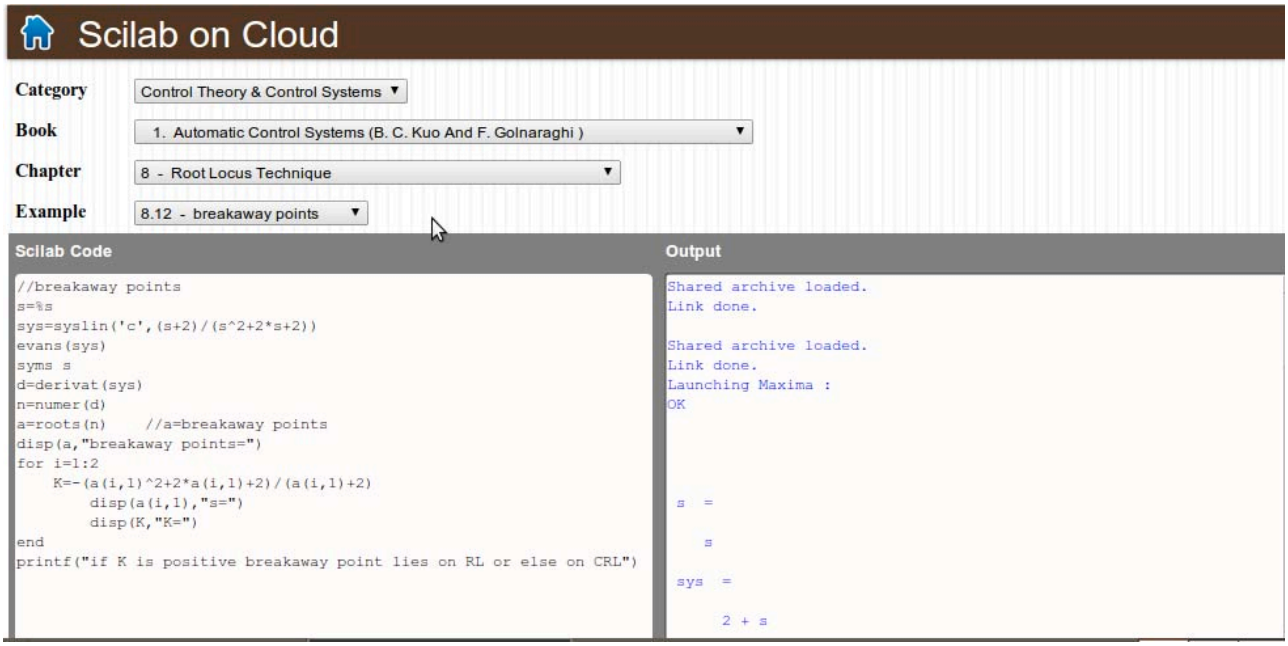

Fig. 1. Scilab on Cloud Web Interface. http://cloud.scilab.in

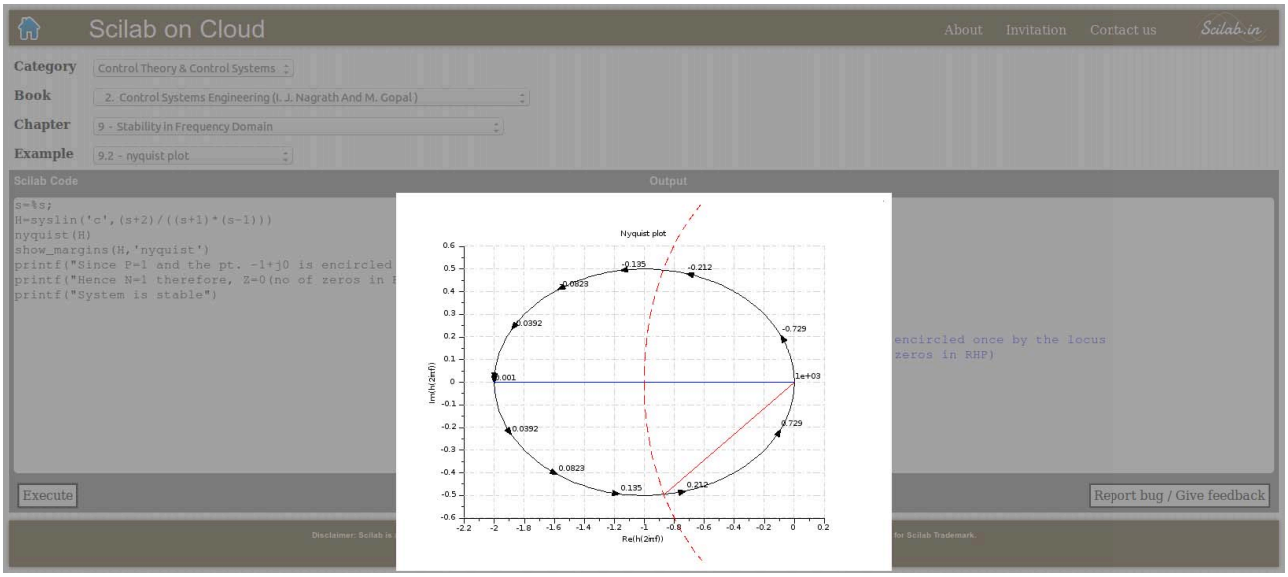

Fig. 2. Scilab on Cloud Web Interface showing an output graph for Example 2, Chapter9:Stability in Frequency Domain from *Control Systems Engineering by I.J Nagrath and M.J Gopal* showing nyquist plot http://cloud.scilab.in

while one is reading them on a webpage. To solve this problem we came up with a Google Chrome based browser extension. This extension allows the user to select text from any webpage, which is valid Scilab code and on the click of a button executes the selected text on Scilab on Cloud. The user can of course modify the code in the popup editor too.

III. User Feedbacks and Comments

For a project to be called successful it is essential that it is put under review by its users and their feedback is collected. We posted information about Scilab on Cloud on public forums and received feedback. Some of them are listed here:

"This was the best Scilab cloud server we found for

Fig. 4. Search for 'nyquist' on http://scilab.org website shows only one relevant example link

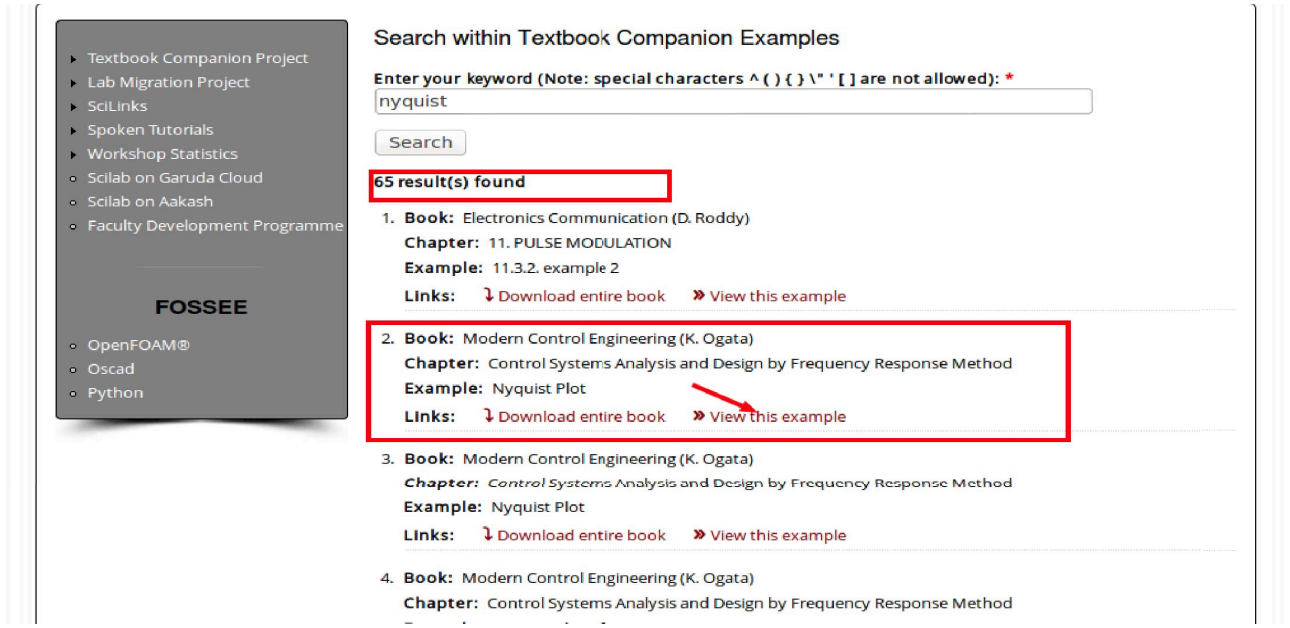

Fig. 5. Search for 'nyquist' on our website shows only 65 relevant examples which can be directly run by clicking on 'View example'

several reasons, including a) it also has graphics capabilities and b) users do not have to register a user account using a valid email address. Use simply by typing or preferably pasting commands or Scilab routines from a notebook or text file." – Mohamed Jamaloodeen [14] Other comments are accessible via this link : http://cloud.scilab.in/track-comments.php

IV. Conclusion

Scilab on Cloud is a fast and easily available solution for running Scilab codes. Access to examples from Textbook Companion Projects' provides a novice in Scilab a good starting point. Scilab on Cloud's API is publicly accessible and thus allows any remote user to run scilab codes, on a cloud platform with the only requisite being

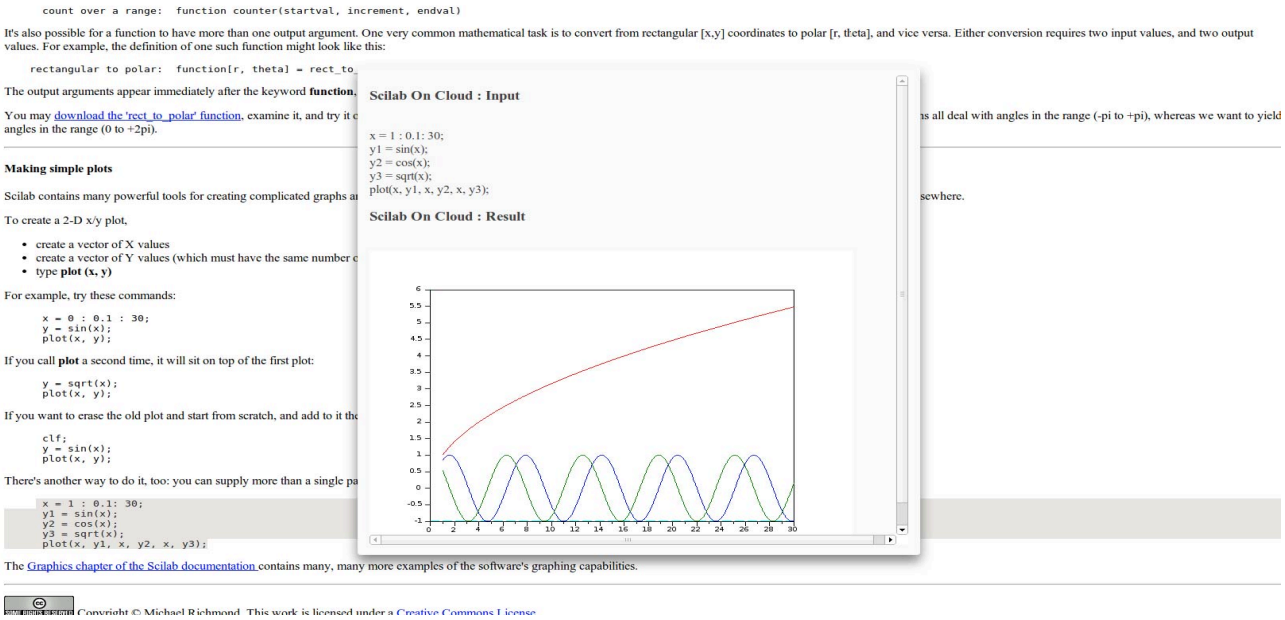

Fig. 6. Google Chrome Extension For running Scilab codes. The user can run Scilab Codes by just selecting the relevant text

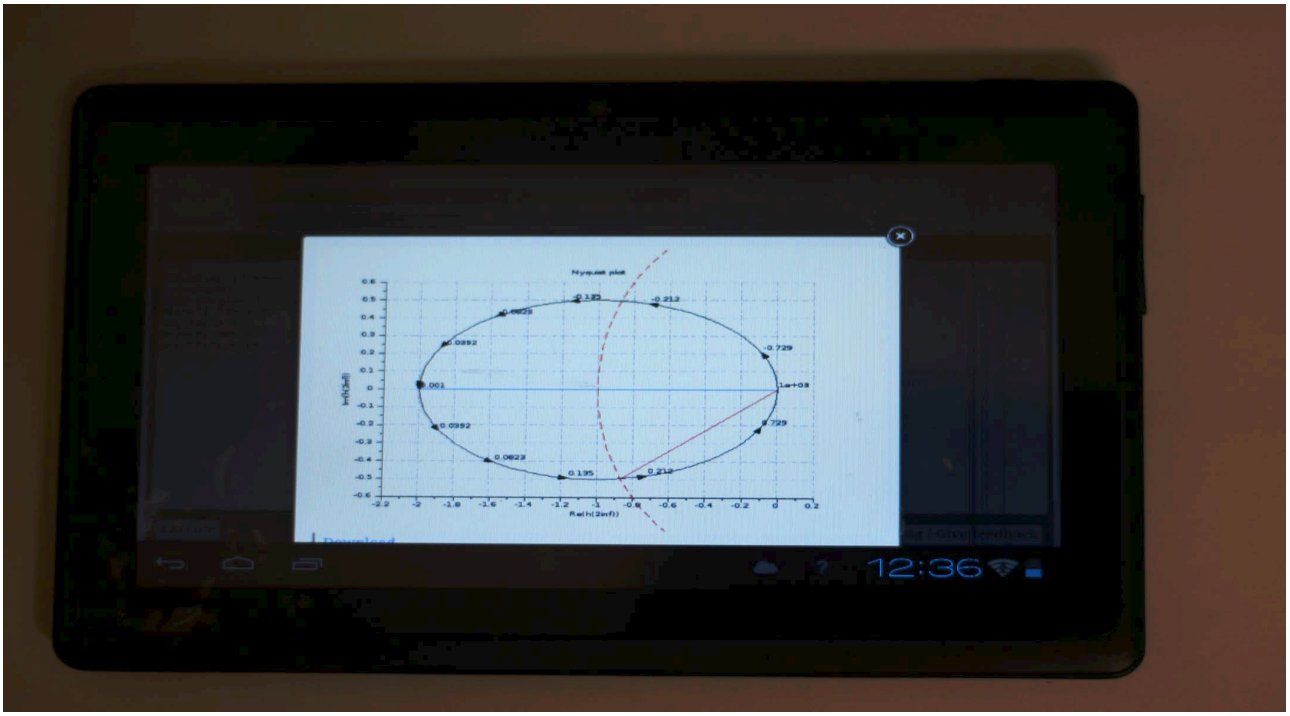

Fig. 7. Scilab on Cloud running on the low cost tablet Aakash

an internet connection.

Thus Scilab on Cloud and Textbook Companion Project can go a long way in popularizing the use of open source softwares like Scilab for numerical computations, besides making an easily and freely accessible cloud based service to run Scilab codes.

The 'TBC code search portal' is designed to aid Scilab beginners to learn the usage of commands. This will ease out the learning curve involved with Scilab and will lead to its better adaptation at all levels.

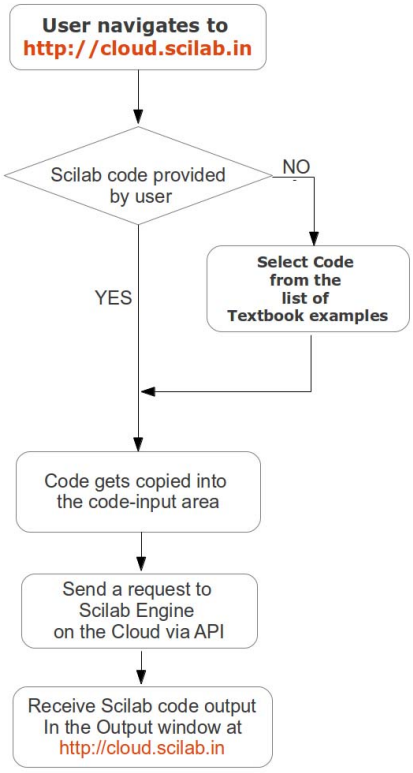

Fig. 3. Scilab on Cloud Web Interface Flowchart

TABLE I. COMPARISON OF FEATURES OF SCILAB ON CLOUD WITH OTHER SERVICES

Service	Equalis	Hotcalculi	Extreme Factory	Scilab on Cloud
API	No	No	No	Yes
Visualisation	No	No	Yes	Yes
Access	Free	Free	Paid	Free
Example Codes	Limited	No	No	Yes
Login Required	Yes	Yes	Yes	No

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