Towards Model Execution Environment for Investigation of Heart Valve Diseases

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1. Introduction

The main goal of investigations in the framework of the the EurValve project [1] is to combine a set of complex modeling tools to deliver a workflow which will permit the evaluation of medical prospects and outlook for individual patients presenting with cardiovascular symptoms suggesting valvular heart disease (VHD). These investigations should result in providing a decision support system (DSS) which can be applied in clinical practice. Simulations leading to elaboration of the DSS need a dedicated problem solving environment, called here Model Execution Environments. It will be elaborated of the basis of our experience with development of the Atmosphere cloud platform [2].
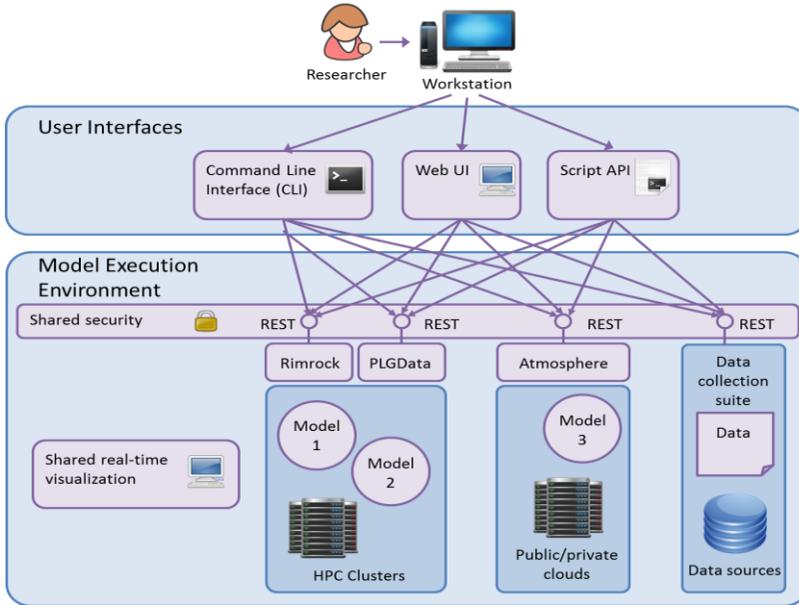
2. Model Execution Environment

The Model Execution Environment (MEE) should support a wide range of interaction types, as required by the application users. The nature of the tasks performed in the research environment includes both interactive and batch processes, some of which need to be invoked manually, whilst others can and should be automated, as they require repetitive use of similar computing steps (e.g. in the case of sensitivity analysis). A typical workflow of the user is thus to invoke some computations on the cluster, fetch the data to analyse it locally, launch an interactive cloud service to process the selected data, subsequently run a batch of jobs on the resulting datasets, etc. The architecture of the environment together with the interfaces is shown in Fig. 1.

3. Results – prototype services of MEE

The propotype of the MEE consists of three basic services. The EurValve Portal is an entry point for the EurValve research environment; it is a user-friendly web application integrated with external services and infrastructures, such as WebDav file storage or the Prometheus cluster provisioned by the PLGrid e-infrastructure. It simplifies daily duties of EurValve researches, including file management and sharing or patient case evaluations. The portal provides the opportunity to execute calculation on the largest Polish supercomputer – Prometheus (CPU 2.4 Pflops, 279 TB RAM) – available as part of the PLGrid e-infrastructure [3]. The File Store is a remotely accessible service that provides a user overlay for the secure storage components. It enables users to access, upload and share folders and files pertinent to EurValve. Externally, it mimics a standard WebDAV server and can thus be accessed by any

WebDAV-compliant library or standalone clients [4]. It is integrated with the EurValve security mechanisms which consist of an Identity Provider (IdP) capable of validating that users are actually who they claim they are, Security Web Platform (EV SWP), which includes an IdP assertion consumer, a JSON Web Token issuer, a Policy Decision Point and a Policy Retrieval Point.

Fig. 1. Architecture of the Model Execution Environment

4. Conclusion

On the basis of currently available requirements as well as on analysis of state-of-the-art in this area, we have proposed an architecture and detailed design recommendations for the research environments MEE. Elaborated prototype of MEE enables simulations aiming at development of the decision support system for heart valvular diseases treatment.

References

1. EurValve project website: `http://www.eurvalve.eu/`,
2. B. Balis, M. Kasztelnik, M. Bubak, T. Bartynski, T. Gubala, P. Nowakowski, and J. Broekhuijsen. The UrbanFlood Common Information Space for Early Warning Systems. Procedia Computer Science, 4:96-105, 2011. Proc. International Conference on Computational Science, ICCS 2011,
3. EurValve Portal is deployed at `https://valve.cyfronet.pl`,
4. EurValve FileStore - `https://files.valve.cyfronet.pl`.