

Topics for theses

Bachelors/Masters thesis

Sky Computing

Problem statement

Sky Computing [1] is a new paradigm for providing, consolidating, and operating services in the cloud computing context. Sky Computing is characterized by interoperability between clouds from different providers. Service offerings from public cloud service providers (CSPs) are mainly proprietary. In addition, these offerings are only compatible with other cloud platforms to a limited extent and are, therefore, difficult to combine. Additional layers of abstraction between the cloud services and the technological substructure should lead to an interoperable platform. Cloud services and the associated distributed heterogeneous infrastructures can thus be made available to end users. This should result in a standardized version of cloud computing.

Aspects of Sky Computing are compared to the Internet, which consists of the interconnection of many individual networks (network of networks). The various networks of the Internet can be used transparently by the user. The interconnection of the individual networks, the overarching routing, and the flow of information between the networks are irrelevant from the user's point of view. Based on the Internet, sky computing - concerning cloud computing - is intended to promote the merging of many individual clouds (cloud of clouds).

Possible Topics

Sky Computing – Presentation and explanation of the trend

This thesis should review the Sky Computing paradigm through a detailed literature review and present its origins and critical requirements. In their work, Stoica et al. compare the Internet and the standards, methods, and technologies used therein. In this thesis, this comparison shall be analyzed and processed in detail.

Comparison of Sky Computing to classic Cloud Computing

This thesis should analyze the Sky Computing paradigm through a detailed literature review and show the possibilities of this trend. Based on the literature research, the challenges and risks of sky computing shall also be identified. The core of this work is a detailed comparison of classic Cloud Computing with Sky Computing and an assessment and evaluation of the Sky Computing paradigm.

Analysis of hybrid cloud and multi-cloud concerning Sky Computing

Hybrid cloud environments are not a novelty in classic Cloud Computing but have been a standard in the industry. The trend in recent years has been towards multi-cloud environments. The difference between hybrid and multi-cloud environments lies in distributing services across cloud environments and how these services are used. This thesis shall analyze and classify hybrid and multi-cloud environments in conjunction with Sky Computing. The central purpose of this topic is to classify the paradigms and provide a critical analysis and evaluation.

Analysis of technical options for migrating services and workloads between different public cloud providers

Sky Computing aims to use cloud services from different public cloud providers and integrate them into existing services. It is crucial to migrate and use the services across the board. This leads to many challenges in providing and operating services for end users. In this thesis, methods and technologies for migrating cloud services concerning the development of Sky Computing environments are to be researched.

Architectures for the development of services suitable for Sky Computing

Cloud Computing originates in the world of distributed systems and uses the methods and technologies of this discipline. Over the last few years, new architectures have constantly evolved to meet cloud computing requirements. From service-oriented architectures to microservice architectures and cloud-native applications, new architectures for developing and providing services have evolved. In this thesis, cloud architectures will be analyzed and evaluated concerning the requirements of Sky Computing.

development of models for the billing of Sky Computing applications and for the automated collection of costs from public cloud providers

In Sky Computing, services are used across many cloud providers. A central problem here is the billing of these providers' services. The costs of the individual services must be consolidated and analyzed centrally so that the user has an overview of the total costs. In addition, the prices of the individual services must be collected via a suitable interface. The objectives of this work are an analysis followed by the development of a prototype application.

Analysis of the SkyPilot project and derivation of measures for use in a productive environment

SkyPilot [2] is an exciting project on sky computing. This project includes a prototype application for distributing workloads across different cloud providers and using different resources of these cloud services. In this thesis, the project is to be analyzed and evaluated. Depending on the scope of the thesis (Bachelor's or Master's thesis), the framework [3] should be installed and its usability analyzed in a Bachelor's thesis. In contrast, in a Master's thesis, the framework's context should be analyzed regarding generic cloud services. Use cases beyond Large Language Models (LLM) and artificial intelligence shall be analyzed here.

Requirements

To complete the Bachelors/Masters thesis, you should bring the following with you:

- Interest in distributed systems, computer networks and cloud computing.
- Linux shell knowledge and enthusiasm for cloud platforms.
- Interest in literature research and enthusiasm for familiarizing with new topics of current research.

The processing time of the Bachelors/Masters thesis is **9 weeks or 22 weeks**.

First Steps

If you are interested in a topic for your Bachelors/Masters thesis, please send an e-mail with a short synopsis (1-2 pages) on which you briefly outline your project.

Content of the synopsis:

1. **research topic** – short summary of your topic.
2. **objective** – What do you want to achieve in your work?
3. **concept** – What should your work look like? (e.g., overview diagram, methods, technologies, etc.)
4. **Preliminary outline** - Brief outline of your thesis.

References

- [1] I. Stoica and S. Shenker, “From cloud computing to sky computing,” in *Proceedings of the Workshop on Hot Topics in Operating Systems, HotOS '21*, (New York, NY, USA), p. 26–32, Association for Computing Machinery, 2021.
- [2] Z. Yang, Z. Wu, M. Luo, W.-L. Chiang, R. Bhardwaj, W. Kwon, S. Zhuang, F. S. Luan, G. Mittal, S. Shenker, and I. Stoica, “SkyPilot: An intercloud broker for sky computing,” in *20th USENIX Symposium on Networked Systems Design and Implementation (NSDI 23)*, (Boston, MA), pp. 437–455, USENIX Association, Apr. 2023.
- [3] “Skypilot.” <https://github.com/skypilot-org/skypilot>.

Contact

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