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Migrating a web application to serverless architecture

Master's Thesis in Information Technology

January 30, 2018

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Title: Migrating a web application to serverless architecture

Työn nimi: Web-sovelluksen siirtäminen serverless-arkkitehtuuriin

Project: Master's Thesis

Study line: Master's Thesis in Information Technology

Page count: 11+1

Abstract: This document is a sample gradu3 thesis document class document. It also functions as a user manual and supplies guidelines for structuring a thesis document.

The abstact is typically short and discusses the background, the aims, the research methods, the obtained results, the interpretation of the results and the conculsions of the thesis. It should be so short that it, the Finnish translation, and all other meta information fit on the same page.

The Finnish tiivistelmä of a thesis should usually say exactly the same things as the abstract.

Keywords: serverless, FaaS, architecture, cloud architecture, web applications

Suomenkielinen tiivistelmä: Tämä kirjoitelma on esimerkki siitä, kuinka gradu3-tutkielmapohjaa käytetään. Se sisältää myös käyttöohjeet ja tutkielman rakennetta koskevia ohjeita.

Tutkielman tiivistelmä on tyypillisesti lyhyt esitys, jossa kerrotaan tutkielman taustoista, tavoitteesta, tutkimusmenetelmistä, saavutetuista tuloksista, tulosten tulkinnasta ja johtopäätöksistä. Tiivistelmän tulee olla niin lyhyt, että se, englanninkielinen abstrakti ja muut metatiedot mahtuvat kaikki samalle sivulle.

Sen tulee kertoa täsmälleen samat asiat kuin englannikielinen abstrakti.

Avainsanat: serverless, FaaS, arkkitehtuuri, pilviarkkitehtuuri, web-sovellukset

Glossary

FaaS	Function-as-a-Service.

Contents

1 Introduction

Introos (Adzic and Chatley 2017) cloud computing is important trending towards PaaS, containerization etc serverless is one of these trends serverless has key benefits, economically attractive serverless requires changes in application architecture lack of research on patterns

It is a good idea to start the Introduction with the main thesis statement or research question of the thesis. After that, it is a good idea to clarify things by defining any necessary terms.[1] The introduction is also a good place to discuss why your thesis statement is scientifically or practically relevant and interesting. Ideally, it would be relevant and interesting from both the scientific and the practical point of view. It would also be excellent if you explained, in the introduction, what your contribution is; that is, what such knowledge your thesis contains that you have investigated personally instead of reading it from somewhere. The contribution could well be, that you have personally checked the truth of a claim you found in a book or article. At the end of the Introduction, it is customary to briefly explain the structure of the thesis – what each chapter is about.

1. Definitions after the thesis statement! Also, don't babble in the introduction.

2 Serverless

Description and implications of serverless computing. Main features or tenets. Relation to SOA, cloud-native, microservices, FaaS. What to take into consideration when migrating to serverless?

- cold start

- bottlenecks and circuit breakers when interacting with non-serverless components like a database. Spanner and Aurora?

- vendor lock-in

Baldini, Cheng, et al. (2017) identify three competing constraints: functions should be considered as black boxes; function composition should obey a substitution principle with respect to synchronous invocation; and invocations should not be double-billed.

Lynn et al. (2017) provide an overview and multi-level feature analysis of seven enterprise serverless computing platforms.

Adzic and Chatley (2017) list a number of limitations.

The goal of the theoretical part of a thesis is to develop the theoretical background required in the thesis. The idea is that a reader of the thesis should, based on just the thesis itself, be able to understand all the special concepts and methods used in the thesis. A good thesis also gives well-argued reasons for why exactly these concepts and methods are in use in the thesis (with the main alternatives given in the literature mentioned).

The best way to present and use the theoretical background depends on what the thesis is like. The theoretical part of a mathematico-theoretical work differs considerably fron the theoretical part of a constructive software development work; quite different from both is the theoretical part of a quantitative or qualitative empirical study that is based on the traditions of the behavioral or the social sciences. Reading other theses of the same type, as well as similar published research reports, will give you a good impression of what is required of your own thesis.

3 Serverless design patterns

Survey of serverless design patterns. How to compose individual functions into larger systems?

Will there be patterns for building serverless solutions? How do we combine low granularity basic building blocks of serverless into bigger solutions? How are we going to decompose apps into functions so that they optimize resource usage? For example how do we identify CPU-bound parts of applications built to run in serverless services? Can we use well-defined patterns for composing functions and external APIs? What should be done on the server vs. client (e.g., are thicker clients more appropriate here)? Are there lessons learned that can be applied from OOP design patterns, Enterprise Integration Patterns, etc.? (Baldini, Castro, et al. 2017)

Sbarski and Kroonenburg (2017) introduce the following five patterns: Command, Messaging Priority queue, Fan-out and Pipes and filters.

Include something from Enterprise Integration Patterns?

Adzic and Chatley (2017) suggest connecting clients directly to services without any need for controllers in the middle. Embrace the platform.

3.1 After the theory

The theoretical part is followed by your contribution:

- In a mathematico-theoretical thesis it is usually a sequence of definitions and lemmas of your own devising, which then culminate in the proof of your main theorem.
- In a constructive thesis it is usually a computer program or other artefact that you have made yourself.
- In an empirical thesis it is a set of empirical results obtained by applying a empirical research method.

You should present your contribution with precision, giving reasons for the choices you have

made. You should follow the best practices of the research tradition you are using.

4 Using the literature

The theoretical part is almost always based solely on the literature. When discussing your contribution, you may also need to cite the literature.

Remember to avoid plagiarism. If you copy, either verbatim or with slight changes (or, example, in your own translation) text from some source, make it clear to the reader. Mark your quotes (using quotation marks or some other clear manner) and give a precise citation. If you do not quote verbatim, mark any changes you have made. In most situations, however, it is better to use your own words, based on more than one source. Even then, give clear citations.

5 Conclusion

The last chapter of a thesis is the Conclusion (some authors use Conculsions, instead). Keep it short, and discuss what one can conclude about the thesis statement or research question given in the Introduction, in light of all that has been written in the thesis. The Conclusion is also the place to discuss any limitations and weaknesses of the thesis (especially those that cast doubt on the reliabliity of the results given in the thesis), if they have not been already discussed, for example in a Discussion chapter. It is also customary to state, what further research might be beneficial in light of this thesis.

If the Conclusion threatens to become too long, it is a good idea to split the interpretation of the results into its own chapter, often called Discussion, making Conclusion short and sweet.

After Conclusion, there is the bibliography, indicated by the \printbibliography command, followed by appendices, if any.

Bibliography

Adzic, Gojko, and Robert Chatley. 2017. “Serverless computing: economic and architectural impact”. In *Proceedings of the 2017 11th Joint Meeting on Foundations of Software Engineering,* 884–889. ACM.

Baldini, Ioana, Paul C. Castro, Kerry Shih-Ping Chang, Perry Cheng, Stephen J. Fink, Vatche Ishakian, Nick Mitchell, et al. 2017. “Serverless Computing: Current Trends and Open Problems”. *CoRR* abs/1706.03178. arXiv: 1706.03178. http://arxiv.org/abs/1706.03178.

Baldini, Ioana, Perry Cheng, Stephen J. Fink, Nick Mitchell, Vinod Muthusamy, Rodric Rabbah, Philippe Suter, and Olivier Tardieu. 2017. “The Serverless Trilemma: Function Composition for Serverless Computing”. In *Proceedings of the 2017 ACM SIGPLAN International Symposium on New Ideas, New Paradigms, and Reflections on Programming and Software,* 89–103. Onward! 2017. Vancouver, BC, Canada: ACM. ISBN: 978-1-4503-5530-8. doi:10.1145/3133850.3133855. http://doi.acm.org/10.1145/3133850.3133855.

Lynn, Theo, Pierangelo Rosati, Arnaud Lejeune, and Vincent Emeakaroha. 2017. “A Preliminary Review of Enterprise Serverless Cloud Computing (Function-as-a-Service) Platforms”. In *2017 IEEE International Conference on Cloud Computing Technology and Science (CloudCom),* 162–169. IEEE.

Sbarski, Peter, and S Kroonenburg. 2017. *Serverless Architectures on AWS: With examples using AWS Lambda.* Manning Publications, Shelter Island.

Appendices

A Moving from gradu2 to gradu3

Moving an incomplete thesis from gradu2 to gradu4 is not particularly difficult. The first thing to do is to change gradu2 into gradu3 in the \documentclass command. Most of the options given to it must be removed, as they are not supported. A “kandi” option is changed into “bachelor”; any “english” option is retained, and so is “utf8”, “latin1”, or “latin9”.