



Supervisor's statement of a final thesis

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Thesis title: Usability improvements to JavaScript/ECMAScript
Branch / specialization: Web and Software Engineering, specialization Software Engineering
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Evaluation criteria

1. Fulfillment of the assignment

- ▶ [1] assignment fulfilled
- [2] assignment fulfilled with minor objections
- [3] assignment fulfilled with major objections
- [4] assignment not fulfilled

The goal, as assigned was to create a language that is interoperable with JavaScript and existing frameworks, legible and easy to learn for people already familiar with JavaScript, but substantially improved over JavaScript in terms of usability.

Note: I refer to ECMAScript/JavaScript as JS, TypeScript as TS, and the student's language as JoS.

The student created a language on top of JS (actually on top of TS). The language defined a syntax, grammar, and semantics that resemble JS (especially JS object notation) and put emphasis on more recent JS construct (eg. arrow functions), which is in line with the goal of making it more accessible to the existing userbase of JS developers. The language is simpler: more regular than JS and without as much subtle ambiguity which indeed makes it simpler for non-JS developers. The accessibility goals are met.

Interoperability with a complex language like JS is more complicated. The student proves interoperability to the extent that JoS works with existing JS frameworks. Despite this, passing the boundary between JoS and JS is likely to lead to subtle discrepancies within JoS code. Nevertheless, I consider the compatibility goals to have been met, within what is possible within a Master's thesis.

The thesis outline specifies the following specific subtasks:

1. identify ambiguities and redundancies in JS and propose specific solutions,
2. propose a new language based on the above,
3. develop an interpreter or compiler for this language,
4. perform experiments, surveys and/or interviews to show the improved usability over JS,
5. do case studies showing the extent of interoperability with JS and its ecosystem.

Subtask 4 was not concluded in full. The student started by surveying and interviewing people about their difficulties with JS in person and conducted a poll online, but he did not include this in the thesis. Followups were not conducted. While, it would be useful to see the impact of the language the student created on real developers, this task was always more of a stretch goal and the thesis is complete without it.

Subtasks 1-3 and 5 are unambiguously completed and included in the thesis.

2. Main written part

90/100 (A)

The structure of the thesis is straightforward and there is clear logical flow between them. The thesis starts with an introduction describing the problem in general terms and establishes the parameters of the thesis. The design chapter has two distinct parts: the first defines the problem in detail by analyzing JS and TS, pointing out problems and proposing specific solutions. The second part of the design chapter provides a description of the language. The implementation chapter talks about specifics of the compiler and provides implementation-level reflections on the work. The next chapter evaluates correctness and performance. Then, related work. Then, conclusions, which include future work. My only comment is that the design chapter is long and the related work chapter, while acceptable, would benefit from further development. All the parts of the thesis are necessary and fit for purpose.

The text is generally well written and logical. The explanations of problems have a propensity for overspecification (as opposed to generalization) that shows through in chapter 2. Apart from that small issue, the style and language are both good.

I found no factual errors, etc. The work contains no formal notation (this is in line with the implementation nature of the work).

Citations and outside concepts and work are all properly differentiated from the body of the work and their ethics are intact. Citations are done correctly, either as footnotes (for content accessed online) or as references to bibliography. The author attempts to be thorough with these, resulting in 150 footnotes, some of which could perhaps be consolidated. Nevertheless, it is better to see more than less. The citations often refer to non-technical works (primarily blog posts) which is usually done to support a statement about the general opinion of the JS community. Occasionally, a blog post illustrates a problem with JS---I believe this is because there are no relevant publications explaining these. These are acceptable departures from the usual standard of

quoting books, journals, and conference papers. The student cites the latter correctly where available.

The student uses numerous publically available open source dependencies from NPM. I believe their use is in accordance with their licenses.

Directive 26/2017 was superseded by directive 38/2019. The relevant article there is Art. 3. WRT Art 3. pt. 1. the required parts are included in the thesis. the thesis is within the prescribed length (at 87 pp). WRT Art. 3 pt. 2. all required formalities are applied accordingly. WRT Art 3. pt. 3 the student uses the prescribed LaTeX template. Art 3. pt. 4-7 are not relevant to the written part.

3. Non-written part, attachments

90/100 (A)

Upon inspection of the code, it looks well written. The student adeptly uses JS language creation tools, including a parser generator and an AST rewriting library. These are good labor saving devices that language designers should use. The student opts for a highly functional (as in the paradigm) style of code, which makes it compact and dense.

The experiments in the thesis are repeatable, in that the testing harness is available and can potentially be rerun. The repository also contains the raw results of the test that can be used for verification.

I tried using the students language to write simple programs (eg. Fibonacci) and some slightly more complex application (eg. an interpreter for the BF language). The simple programs were relatively straightforward. The larger program turned out to be surprisingly difficult due to the limitations of the language and/or a lack of documentation. I would specifically advise to make error messages more user friendly.

4. Evaluation of results, publication outputs and awards

90/100 (A)

The question of practical use has two aspects: the applicability of the concept and the quality fo the execution.

In terms of cocnept, the student makes a good argument for the need for an improved but compatible JS. The numerous voices in the JS community often refer to the unintuitive semantics of JS. There have been other languages (etc.) attempting to do the same thing with slightly different approached, also supporting the neccesity of this work. The main difference is that previous work are more gentle about backwards compatibility or discard the need to make the language JS-like, making it less accessible for JS developers. I think the student's take is novel and interesting in that he creates a language that resembles executable JSON and pushes JS to the limits of its functional paradigm. The student has written a pop sci piece in Medium about his attempt and received some amount of support, suggesting that the idea has wider interest.

The implementation also has potential for practical use. The student is treating it as such, making the language available publically. The

implementation currently has a few unresolved problems (described in the thesis), including a performance problem, which, in my belief need, to be ironed out before wider acceptance. Nevertheless, the potential is there. Wider dissemination also necessarily will involve a serious documentation effort, as the thesis or any accompanying documents do not help to get one started. Whether any wider adoption is actually forthcoming is an open question.

5. Activity of the student

- ▶ [1] excellent activity
- [2] very good activity
- [3] average activity
- [4] weaker, but still sufficient activity
- [5] insufficient activity

The student was active throughout, punctual, and prepared for consultations, including a pre-prepared agenda for each meeting.

6. Self-reliance of the student

- ▶ [1] excellent self-reliance
- [2] very good self-reliance
- [3] average self-reliance
- [4] weaker, but still sufficient self-reliance
- [5] insufficient self-reliance

The student is very self-reliant. The thesis was his concept and he drove the execution in full. He is capable of developing creative work independently in the future.

The overall evaluation

90 /100 (A)

In final assessment, the student fulfilled the tasks set out before him. I am impressed by the student's independence, enthusiasm, and sheer implementation effort. The language that he created is of good quality, and while I have some qualms with respect to its design, these are stylistic and philosophical aspects that do not cast doubt on the outcome. I would only advise the student to take into better consideration the perspective of a naïve novice who would be faced with one's work and how they could navigate the depths of the system one has built.

Instructions

Fulfillment of the assignment

Assess whether the submitted FT defines the objectives sufficiently and in line with the assignment; whether the objectives are formulated correctly and fulfilled sufficiently. In the comment, specify the points of the assignment that have not been met, assess the severity, impact, and, if appropriate, also the cause of the deficiencies. If the assignment differs substantially from the standards for the FT or if the student has developed the FT beyond the assignment, describe the way it got reflected on the quality of the assignment's fulfilment and the way it affected your final evaluation.

Main written part

Evaluate whether the extent of the FT is adequate to its content and scope: are all the parts of the FT contentful and necessary? Next, consider whether the submitted FT is actually correct – are there factual errors or inaccuracies?

Evaluate the logical structure of the FT, the thematic flow between chapters and whether the text is comprehensible to the reader. Assess whether the formal notations in the FT are used correctly. Assess the typographic and language aspects of the FT, follow the Dean's Directive No. 26/2017, Art. 3.

Evaluate whether the relevant sources are properly used, quoted and cited. Verify that all quotes are properly distinguished from the results achieved in the FT, thus, that the citation ethics has not been violated and that the citations are complete and in accordance with citation practices and standards. Finally, evaluate whether the software and other copyrighted works have been used in accordance with their license terms.

Non-written part, attachments

Depending on the nature of the FT, comment on the non-written part of the thesis. For example: SW work – the overall quality of the program. Is the technology used (from the development to deployment) suitable and adequate? HW – functional sample. Evaluate the technology and tools used. Research and experimental work – repeatability of the experiment.

Evaluation of results, publication outputs and awards

Depending on the nature of the thesis, estimate whether the thesis results could be deployed in practice; alternatively, evaluate whether the results of the FT extend the already published/known results or whether they bring in completely new findings.

Activity of the student

From your experience with the course of the work on the thesis and its outcome, review the student's activity while working on the thesis, his/her punctuality when meeting the deadlines and whether he/she consulted you as he/she went along and also, whether he/she was well prepared for these consultations.

Self-reliance of the student

From your experience with the course of the work on the thesis and its outcome, assess the student's ability to develop independent creative work.

The overall evaluation

Summarize which of the aspects of the FT affected your grading process the most. The overall grade does not need to be an arithmetic mean (or other value) calculated from the evaluation in the previous criteria. Generally, a well-fulfilled assignment is assessed by grade A.