Student Worksheet: Analyzing a Journal Article

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Journal Article Title: **Model Checking for Software Architectures by Radu Mateescu**

Step 1. What is the purpose/hypothesis/aim/objective of the study?	
a. Write down the exact statement in which the authors describe what they were testing. (Hint: This information may be provided in the article as a purpose statement or as a hypothesis). Include quotation marks around the exact wording, and indicate page number(s).	**"In this position paper, we discuss three different aspects related to the application of model checking techniques for analysing dynamic ADL descriptions: construction of the state space corresponding to an ADL description (Section 2), expression and verification of correctness requirements (Section 3), and handling of the state explosion problem (Section 4). Finally, we give some concluding remarks and directions for future research (Section 5)."** **(Page 2)**
b. Now describe the purpose of the study (as you understand it) in your own words.	**The purpose of the study is to describe three of the main factors taken into consideration when evaluating dynamic architecture description languages (ADL) using the model checking techniques.**
c. What was the "gap" in the research that the authors were trying to fill by doing their study?	**c. What was the "gap" in the research that the authors were trying to fill by doing their study?** **Although model checking has undoubtedly proven to be extremely useful to analyze software architectures (two of the most known software tools used for performing these analyses being WRIGHT and DARWIN), the scientific literature did not comprehensively tackle the mechanisms used to ensure the dynamicity and mobility of the ADLs.** **— WRIGHT allows describing dynamic reconfiguration and steady-state (static) behaviour orthogonally, using reconfiguration-triggering events** **— PADL uses transparent routers to model the dynamic reconfiguration**
Step 2. What is/are the major finding(s) of the study?	
a. Make some notes about the authors' major conclusions or findings as written in the article. Include quotation marks whenever you use their exact wording, and indicate page number(s).	**Given the fact that the current theoretical development and tools for model checking have become mature and robust, the author has only indicated several directions of further research "concerning the integration of model checking features within the design process of industrial systems based on software architectures and dynamic ADLs".** **(Page 5)**

| b. Now write those conclusions (as you understand them) in your own words. | The following suggestions of improvements inspired by model checking features (which integrate into existing dynamic ADLs software) describe the primary findings of the paper :

• updating the creation of dynamic processes to statically expand parallel composition when bounding the generated replicas, instead of using recursion (a feature already implemented in E-LOTOS);

• reducing the number of gates through which the processes communicate (in LOTOS several channels can be multiplexed on a single gate);

• handling higher-order processes by translating them into first-order constructs using π-calculus or by using a compiler for LOTOS (CAESAR compiler of CADP);

• integrating run-time verification tasks and memory verification algorithms to initially check the correct- ness of the requirements and their potential memory consumption;

• creating additional advanced user interfaces that could include: regular expressions, automated interpretation of the generated diagnostics;

• applying partial order reduction to eliminate the redundant interleaving of actions;

• avoiding to construct the entire state space before checking the validity of the requirements by

    • using compositional verification, a method which can prevent state explosion by building component micro-spaces, evaluate them gradually and recombining them in the final step;

    • using on-the-fly verification tools (that can explore the state space incrementally and detect errors in the system during the process) |

Step 3. How did the authors test their hypothesis?

a. Briefly summarize the main steps or measurements that the authors used in their methods. Try to explain in your own words as much as possible.	The author has initially narrowed his research to three aspects inspired by model checking techniques and applied in dynamic ADL descriptions. He analyzed the performance of each one of the potentials steps usable for constructing state spaces, checking requirements correctness and handling large systems. The three main categories were afterwards split into theirs compounding sub-processes and subjected to a comparative analysis among the existing standardized languages that are providing the specific features. For example, when describing the construction state spaces and analyzing the dynamic creation process was depicted by comparing the implementation from LOTOS and E-LOTOS languages. Lastly, he shared his performance findings and the potential enhancements that can be integrated to achieve better results.
b. Do the authors suggest any problems or limitations with their methodology? Do you see any problems or limitations with their methodology?	No, since most of the suggestions for improvement were already proven to be feasible in other software systems.
c. How did the authors analyse their data? What test/s did they use?	The author has compared the performance and limitations of the algorithms used in several ADLs when executing a specific task and underlined which features shown better results in a particular language or, if none of the languages supported the desired feature, he mentioned the theoretical solutions through which one may implement those features. The author is not mentioning how did he test his hypothesis.
Step 4. How reliable are the results?	
a. Do the authors suggest any problems with the study that could lead to unreliable results?	No, their suggestions for improvement were already implemented in other reliable software solutions so theoretically there should not be any concerns on this topic.
Step 5. Based on your analysis, are the claims made in this journal article accurate?	
a. Do the conclusions made (about the results) by the author make sense to you? Are the conclusions too broad or too narrow based on what was actually done in the study?	Since the study is meant to be only a theoretical one, providing some examples and guidelines for improving the existing dynamic ADL descriptions, based on the functionalities of other successful software systems, implicitly the results of the study made sense. However, they were not as innovative or ambitious as we would expect them to be.

b. Based on the accuracy of the methodology and the reliability of the results as described in Steps 3 and 4, do you think the conclusions can be believed?	**Yes, given the fact that the conclusions drawn from the article are mostly observations and suggestions derived naturally from domain literature and industrial software advancements.** **Although the author did not use specific metrics to sustain his results, the existence of compilers and tools that are already using the algorithms meant to solve the above-mentioned performance issues should state as valid testing sources.**

Step 6. What is the importance of this scientific work?

a. Write (in your own words) the significant contributions of the experimental work in this journal article as reported by the authors.	**The author succeeded in capturing and comparing the implementation of several ADL languages and managed to raise awareness regarding their limitations in specific areas (an example could be the state explosion problem - that industrial systems often en- counter when the size of the state space is exceeding the available resources).** **Apart from stating the issues that can occur in differ-ent dynamic scenarios, he did not limit his research to a nihilistic point of view. However, he included examples of how the limitations can be crossed using enhancements that were already implemented by other software tools (like using partial order reduction to eliminate redundant interleavings of actions that may occur when independent components are computing some tasks in parallel without directly synchronizing).**
b. Re-read your notes and explain why you think this is: • **a strong or weak scientific article** • **a strong or weak scientific study**	**Although the purpose of the study did not intended to bring any practical enhancements to the ADLs, I would have liked that the author would have included a section where he would try to simulate the potential results obtained by applying the solutions suggested in the paper.** **However, the study reveals the action points that can be further researched and implemented to improve the dynamic features of ADLs descriptions.**