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## PROGRESS REPORT FOR THE ACADEMIC YEAR 2023

**Scholar's Name:** ARJUN H KUMAR

**Roll No:** S21008

**School:** SCEE

**Date of Registration:** 9<sup>th</sup> August 2021

**Semester:** IV

**CGPA:** 8.57

**Date of Last Presentation:** 29<sup>th</sup> July 2022

**Date of Current Presentation:** x July 2023

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## 1 Research Objectives

Using program analysis-

1. Identify various access patterns under which value-type objects should be flattened in their respective containers.
2. Build an appropriate flattening strategy for such objects in Eclipse OpenJ9 VM.
3. Improve Java applications by using static + JIT analysis based on the developed flattening strategy.
4. Explore prospective optimizations that can be enabled in JVM due to the introduction of value types.

## 2 Introduction

In modern object-oriented programming languages, object identity enables fundamental features such as field mutation and synchronization. However, it also significantly affects the performance. In particular, each distinct field access requires a memory load of the corresponding object followed by an indirection. Several compiler analyses and optimizations such as escape analysis and field scalarization can eliminate these costs in specific scenarios; however, such optimizations are usually limited in their scope and applicability. Languages like Java allow for optimizing the access cost for objects of certain “primitive” types; however, OO programs often contain additional user-defined types whose objects do not depend on an identity that is separate from their “value”. An important development in this space has been the Project Valhalla [2], which aims to improve the performance profile of conventional objects in Java, and make it comparable to the performance of primitive types. Valhalla introduces the notion of value types [4], which essentially empowers objects to be identity-less. In order to facilitate an improved performance for such objects, an important optimization that can be performed by a value-types supporting Java Virtual Machine (JVM) is object inlining [1] or flattening.



### **3 Work Done and Target Set for Last Year**

#### **3.1 Identification of value-type classes**

#### **3.2 Implementation in OpenJ9**



**3.3 Changing granularity from class level to field level**

**3.4 Cache distance analysis**



## 4 Planned Work for the Next Year

1. Implementing a static + dynamic analysis to compute the number of distinct cache loads possible between two inlined field loads.
2. Evaluating the strategy over a set of standard benchmarks for JVM.
3. Preparing a manuscript describing the complete work.

## 5 Workshops/Conferences Attended

1. International Conference on Systems, Programming, Languages, and Applications: Software for Humanity (SPLASH Companion), Virtual, December 5th-10th, 2022.
2. 16<sup>th</sup> Innovations in Software Engineering Conference (ISEC), IIIT Allahabad, India, February 23rd-25th, 2023.
3. Software Engineering Research in India (SERI) Update Meeting, Goa University, India, June 2nd-3rd, 2023

## 6 Papers Published/Communicated and Other Achievements:

1. Arjun Harikumar and Manas Thakur. "ValFinder: Finding Hidden Value-Type Classes". 6th Workshop on Advances in Open Runtimes and Cloud Performance Technologies (AOR-CPT), part of IBM WeaveSphere, Toronto, Canada, November 16th, 2022.



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## References



**REPORT BY APC/DC COMMITTEE**

1. Has the student met the targets set for last year?

(a) Mention the Achieved Targets:

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(b) If not what are the major reasons?

N/A

2. Is there a reasonable target set for next year? Give detailed plan.

3. What is the perception of the student and guide(s) about the fraction of thesis work completed?

N/A

4. What is the approximate time scale for thesis submission (only for students in their 5<sup>th</sup> year or above for Ph.D. and 3<sup>rd</sup> year and above for M.S. students).

N/A

5. Any other observations of the committee.



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## Recommendation of APC/DC (Tick Appropriately)

- (a) Continuation of Registration is **Recommended/ Not Recommended**.  
(b) Continuation of Scholarship/Research Assistantship **Recommended/ Not Recommended**.  
(c) Enhancement of Scholarship from JRF to SRF is **Recommended/ Not Recommended** (only after Two Year of Registration).
- Source of Funding/Scholarship:**
- OVERALL PERFORMANCE: Very Good/Good/Satisfactory/Unsatisfactory**
- Any Other Recommendation/Comments** (Attach separate sheet). Same as the above observation.

## COMMITTEE MEMBERS

S. No.	Faculty Name	School/Department	Signature	Remarks
1.	Dr. A.D. Dileep	SCEE		
2.	Dr. Aditya Nigam	SCEE		
3.	Dr. Gaurav Bhutani	SCEE		
4.	Dr. Manas Thakur	SCEE		
5.	Dr. Varunkumar Jayapaul	SCEE		

**Signature of the Supervisor**

Date:

**School Chairperson**

Date:

**Associate Dean (Research)**

Date:

## Note:

- Ph.D. Scholar shall, after Registration, submit a written report to Doctoral Committee in the required format, annually for the first three years, and every six months thereafter.
- M.S. Scholar shall, after Registration, submit annually a written report to Academic Progress Committee.
- Attach additional sheets if required.



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## APC/DC RECOMMENDATION (Part B)

Scholar's Name: ARJUN H KUMAR

Roll No: S21008

School: SCEE

Date of APC/DC meeting: X July 2022

	<b>Performance</b> (Poor, Average, Good, Very good, Exceptional)	<b>Suggestions</b>
<b>Oral Communication and Presentation</b>		
<b>Subject Knowledge</b>		
<b>Research Output</b>		
<b>OVERALL PERFORMANCE (as per Part-A): Very Good/Good/Satisfactory/Unsatisfactory:</b>		
<b>Overall feedback/Remarks:</b>		

### APC/Doctoral Committee

	<b>Faculty Name</b>	<b>Signature</b>
<b>Chairperson APC/DC</b>	Dr. Aditya Nigam	
<b>Guide</b>	Dr. Manas Thakur	
<b>Member</b>	Dr. A.D. Dileep	
<b>Member</b>	Dr. Gaurav Bhutani	
<b>Member</b>	Dr. Varunkumar Jayapaul	

I have read and noted the above for compliance:

**Signature of the scholar with Date:**