Dedicated OO Expertise Applied to Run II Software Projects

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Abstract

The change in software language and methodology by CDF and D0 to object-oriented from procedural Fortran is significant. Both experiments requested dedicated expertise that could be applied to software design, coding, advice and review. The Fermilab Run II offline computing outside review panel agreed strongly with the request and recommended that the Fermilab Computing Division hire dedicated OO expertise for the CDF/D0/Computing Division joint project effort. This was done and the two experts have been an invaluable addition to the CDF and D0 upgrade software projects and to the Computing Division in general. These experts have encouraged common approaches and increased the overall quality of the upgrade software. Advice on OO techniques and specific advice on C++ coding has been used. Recently a set of software reviews has been accomplished. This has been a very successful instance of a targeted application of computing expertise, and constitutes a very interesting study of how to move toward modern computing methodologies in HEP.

Keywords: C++,Object Oriented Programming,OO Design

1 Introduction

The Fermilab Run II experiments CDF and D0 have both been making major upgrades in their offline software. This change includes modifications which are required for the new detector configurations but also includes a major shift from procedural FORTRAN and C to Object-Oriented C++ coding. This change has been aided by the availability of two dedicated Object-Oriented experts, or “gurus”, who were hired by the Fermilab Computing Division to provide support for this change in methodology. This paper will discuss the reasons for providing this help, the type of activity that the experts are involved in, and some of the benefits of having the expertise available.

2 Need and Process for Providing Expertise

Both CDF and D0 embarked on major OO/C++ code development immediately following Run I. In both cases C++ expertise within the experiment was limited and had to be primarily developed internally. OO Design and C++ instruction was received by many in CDF and D0, from C++ experts hired by Fermilab to give classes and by others in the community such as Paul Kunz and CDF and D0 experts. It was found early on that the expertise available was limited and that the experts that did exist were very busy and not able to consult on major design or review activities within the collaborations. In addition, the laboratory’s outside Run II offline computing review panel (the ”von Rüden committee”) strongly recommended[1] in summer 1997 that Fermilab hire dedicated OO expertise to support CDF and D0 to make the transition to OO/C++.

This recommendation was followed, a search was initiated in late summer 1997, with the result that a first dedicated expert was hired in late 1997 and started at the laboratory in early 1998.

This expert had many years experience at Argonne National Laboratory and at Lucent Corporation and is an expert in design as well as C++ coding techniques.

After the first OO/C++ expert was hired and had worked for a time at the lab the von Rüden committee recommended[2] in summer 1998 that a second OO/C++ expert be hired. A search was initiated and a second OO/C++ expert was found in late 1998 and started in early 1999.

It is interesting to note that both hires came from scientific fields. This was true even though the search for people was quite broad and was focussed on OO/C++ expertise and not specifically on expertise with scientific expertise. This is likely a natural result given the problems that CDF, D0 and the Computing Division are trying to solve.

3 Activities of the OO/C++ Experts

The first OO/C++ expert (Jim Kowalkowski) started at Fermilab in early 1998. The initial goal was to provide assistance to both CDF and D0, with the effort being split approximately half to CDF and half to D0. The split in effort was achieved by having each experiment have one person (the offline leader or co-leader) be responsible for assigning tasks, priorities and time scales for Jim. The hiring of this expertise was done in the context of the joint CD/CDF/D0 Run 2 computing project at the laboratory, and the effort was being overseen by the Run II joint offline project steering committee. The steering committee consists of representatives from both experiments and from the Computing Division. In this context all problems, schedule conflicts, priority establishment, etc. were discussed and resolved by the joint project steering committee. Initially the steering committee did discuss the allocation of time and tasks for Jim, but within a few months a working relationship had been established which rarely required any discussion outside of the discussions among the designated CDF and D0 leaders and Computing Division management.

Early activities included design help as well as coding for both CDF and D0. These included major design efforts for software modules (e.g. the Calorimeter reconstruction code in CDF) and for whole software packages (e.g. the framework of D0). Some of this help was part of an iterative process. A physicist would code a module, an informal review of that module would take place, and the module would be modified or possibly rewritten. This ability to iterate over long periods of time was extremely useful and was a big benefit to having dedicated long-term expertise available. A large amount of consulting on C++ coding, general discussions of C++, debugger and other "infrastructure" issues were also performed during this time.

Larger projects and milestones sometimes produced a time scale that forced Jim to dedicated close to all of his time for days or even weeks to one experiment. This was accomplished by close discussion and negotiation between the two experiments, with the understanding that Jim's time was always to be split approximately equally when integrated over longer periods. In the end there were very few conflicts and those were always resolved without major issue.

Once the second OO/C++ expert (Marc Paterno) was hired (early 1999) more effort and flexibility was available. In addition, the focus of the help had shifted from design and coding to major reviews and occasionally dedicated help to a specific project which needed in-depth expertise. With the addition of a second expert the issues of coordination of effort and the equitable split of time again had to be addressed. Each expert was strong in some aspect of OO/C++ but they were not identical or interchangeable in all cases. It was decided that as much as possible both Jim and Marc should divide their time equally between CDF and D0 and that the experiment offline managers should decide on the priority and timing of tasks. If conflicts or problems arose the steering committee would get involved to discuss and provide a resolution. The fact that both experts worked on both experiments contributed as much as possible to the ability for the experiments to benefit from common approaches to solving problems, coding software, or in some cases to using common code.

In general the tasks were well-suited to a reasonable split in work. The design reviews were in most cases accomplished by both experts together and in some cases were major activities, taking many weeks. More dedicated tasks were normally assigned to one or the other of Jim and Marc and were usually non-controversial.

4 Impact, Lessons, Future

The impact of having dedicated OO/C++ expertise has been large and positive. Both of the experts have contributed to building better designed and presumably better running and more easily maintainable code. This is extremely important in Run 2, given that the code will have to run for many years on a large number of events and the code must be maintained by many people over the lifetime of the code. The expertise in this case was absolutely vital, given the change from FORTRAN and C to OO/C++.

It is true that having the expertise available earlier would have been very useful. The earlier efforts at designing and coding could have been sped-up and improved if such expertise could have been called upon and used in the early phases of learning and building frameworks, software structures, and software packages. It is also true that the two experts are always extremely busy and have a large backlog of tasks. Additional experts or coding assistance would have a positive impact on the projects as well.

After CDF and D0 have made the full transition to OO/C++ and the code is designed and running it is not clear how much continuing OO/C++ expertise will be required. These two experts will find other projects at Fermilab to work on (NUMI, CMS, Computing Division software projects etc.) and their help will always be extremely valuable.

An interesting question is whether this type of help will always be required when experiments write offline (or any other) software. Presumably OO/C++ will not be the final choice for software for HEP applications. Given that there will be future transitions. That will imply that this sort of help will be useful and likely vital to allow the physicists to concentrate on issues which are specific to the detectors, their response and behavior, and to the ability to convert that into physics.

It should be pointed out that both experts are software engineers and require coding and design projects of their own in order to keep current in OO/C++ skills and to provide a balance to the work of consulting and advising. The projects are part of the software of Run II and this has been a valuable addition to the code. Being skilled coders they are able to create large software packages very quickly and efficiently.

For more information on the work of the OO experts please refer to their web pages.[3]

References

1 http://fncduh.fnal.gov:8080/workinggroups/runII/reportv3.html

2 http://fncduh.fnal.gov:8080/workinggroups/runII/von_jul98.html

3 http://cdspecialproj.fnal.gov