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ControVol: Let yesterday’s data catch up with today’s application code

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ABSTRACT
In building software-as-a-service applications, a flexible development environment is key to shipping early and often. Therefore, schema-flexible data stores are becoming more and more popular. They can store data with heterogeneous structure, allowing for new releases to be pushed frequently, without having to migrate legacy data first. However, the current application code must continue to work with any legacy data that has already been persisted in production. To let legacy data structurally “catch up” with the latest application code, developers commonly employ object mapper libraries with life-cycle annotations. Yet when used without caution, they can cause runtime errors and even data loss. We present ControVol, an IDE plugin that detects evolutionary changes to the application code that are incompatible with legacy data. ControVol warns developers already at development time, and even suggests automatic fixes for lazily migrating legacy data when it is loaded into the application. Thus, ControVol ensures that the structure of legacy data can catch up with the structure expected by the latest software release. A demo video on ControVol is available at

http://tinyurl.com/mh7a743

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1. INTRODUCTION

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In agile development of software-as-a-service applications, software developers commonly strive to ship early and often: A first release is made as early as possible, to catch the time-to-market window. The software is then evolved incrementally, to improve performance and to account for user feedback. This approach requires flexible development and production environments. For instance, platform- and database-as-a-service products such as Google App Engine [1] and Google Cloud Datastore are very popular software stacks, especially in the startup community:

1. When applications are hosted by a platform-as-a-service provider, the developers can focus on application development, without having to worry too much about the scalability of their infrastructure.
2. Platform-as-a-service providers commonly support sophisticated release management tasks out-of-the-box. For instance, they can host different versions of an application running against the same data store, to allow for A/B-testing of new features [1].
3. If the data is persisted in a NoSQL data store, especially when provided as-a-service, developers do not need to worry about storage limits. Moreover, schema-flexible NoSQL data stores can persist structurally heterogeneous data. This makes it possible to re-release the application without prior data migration, since the data stored in production up to that point need not be migrated immediately.

Yet eventually, the legacy data needs to structurally “catch up” with the latest application code, to allow for long-term maintainability and efficiency in software development. We illustrate this in Figure [1](a). Above the time line, we see Java class declarations for players in an online role playing game. Players are identified by their login. In the initial release, each player has a name and is playing at a certain level. The object mapper annotation @Entity makes player objects persistent. Object mapper libraries such as Objectify [2] simplify application development by taking care of persisting and loading objects. The annotation @Id marks the identifying attribute. Below the time line to the left, we see a JSON entity persisted according to the initial release. NoSQL data stores are commonly accessed programmatically, by a simple API with a put() command for storing, and a get() command for loading objects by their key.

In the subsequent release, attribute level is renamed to rank. While all incoming user requests are now being served

1E.g., traffic splitting in Google App Engine https://cloud.google.com/appengine/docs/adminconsole/trafficsplitting
by the new application code, the NoSQL data store still contains objects persisted by the earlier version. We consider data like Frodo’s JSON entity with the outdated structure a legacy entity. If Frodo’s player is now loaded into the application, not all class member attributes can be mapped. The unmapped rank attribute is set to null. Worse yet, when the object is persisted (overwriting the legacy entity with the put() command), the value of level is irretrievably lost.

Figure 1(b) shows a revised class declaration that allows for the legacy data to “catch up” with what the latest application code expects to load from storage: Several NoSQL object mappers provide migration-specific life-cycle annotations or have announced them on their feature roadmap [3]. For instance, due to the Objectify annotation @AlsoLoad, Frodo’s legacy entity can be loaded by the latest application code without data loss: Frodo’s level value is also loaded and then assigned to the rank attribute. The next time that Frodo’s player object is persisted, its level is stored as rank.

Today, the robustness of lazy data migration with the help of object mappers completely relies on the developers’ discipline and foresight to properly specify the annotations: Developers work without any tool support that could reliably catch problems already at development time, and ideally, to automatically suggest the proper life-cycle annotations.

Figure 1: (a) Legacy-data agnostic application code can lead to data loss. (b) Legacy-data aware application code.