

From Natural to Artificial Ecosystems

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Conventional computing increasingly resembles natural systems. One of the newest areas of computing is the app store. In an app store, coevolving systems of apps, developers, and users form complex relationships, filling niches, competing and cooperating, similar to species in a biological ecosystem. Apps can work together to improve one another's sales (symbiosis) or copy one another's features (parasitism); they also compete with one another for downloads (competing species).

The app store concept is very different from traditional software production. Until recently, commercial software has been developed by standalone product companies, which had to do the majority of their own innovation and marketing. In an app ecosystem, application software (such as games, productivity tools, and medical applications) that is built for one platform is sold via an app store running on the platform. The app store concept has democratised the software industry – almost anyone can build and sell apps. Once built, an app almost instantly becomes available to a worldwide market. Users of mobile devices can download the apps, use the apps immediately and provide feedback to the developers. The health of the app ecosystem is largely determined by the communities of developers that create innovative solutions that users want to buy.

App ecosystems are new to the software industry. After the initial success of Apple's iOS App Store in 2008, other mobile app stores have emerged in rapid succession, such as Android and Blackberry. App stores for web applications have followed suit, such as the Google Chrome Web Store and Facebook Apps and Games.

The app ecosystem is complex. Although the app stores can control how they rank apps (some stores such as the iOS App Store approve the apps before they can appear on the store), the interaction between the apps, users, and developers form a complex system. Unfortunately the stores are not designed in a coherent way. There is a lack of understanding about how best to operate the stores. Many store features are provided on a trial and error basis. Developers try to “cheat” by hiring users to download their products and manipulate their position in the rankings. There is little or no requirements elicitation performed by developers; it is also extremely difficult for users to find app that meet their needs amongst the thousands of alternatives. Competition within and across app ecosystems is fierce, with success often having little to do with app quality. (There was \$15 Billion worth of app sales in 2011, with unsuccessful app developers making close to nothing and successful developers earning of up to \$100 million a year.)

With competition becoming so significant, there is a real need for modelling and understanding these artificial ecosystems. We have considerable knowledge about natural ecosystems but we are not exploiting this knowledge to understand and improve app ecosystems. Our work to date on this topic comprises the development of AppEco an Artificial Life agent-based simulation of app ecosystems. AppEco consists of agents that are abstractions of app users and developers, as well as artefacts that are abstractions of apps. Developer agents build and upload apps to the app store; user agents browse the store and download the apps. A distinguishing feature of the AppEco model compared to more traditional agent-based models is the explicit modelling of artefacts as well as the agents that produce and use the artefacts. App artefacts are important in a model of an app ecosystem because the agents interact with one another via the apps.

We have used AppEco to simulate different developer strategies, such as copycats (copies other developers' successful apps), milkers (“milks” an app idea repeatedly), innovators (builds a highly different app each time), optimisers (improves on own best app) [1]. Our study showed that it can pay to be a copycat, but gaining at the expense of others is not sustainable across an ecosystem. No single developer strategy tends to be a guaranteed winner, but innovators and optimisers often do well and milkers often do badly. We have also used AppEco to model the effects of app publicity and study the resulting “app epidemics” [2]. Through models such as AppEco, we anticipate that we can gain a deeper understanding of app ecosystems. There are many avenues for future work, such as studying the effect of publicity on app downloads, and the evolutionary growth of apps through parasitism, symbiosis and species formation. AppEco can also be calibrated to study other app ecosystems, such as Android, Blackberry, and Chrome Web Store.

References

- [1] SL Lim and PJ Bentley (2012). How to be a Successful App Developer: Lessons from the Simulation of an App Ecosystem, Genetic and Evolutionary Computation Conference (GECCO'12), in press.
- [2] SL Lim and PJ Bentley (2012). App Epidemics: Modelling the Effects of Publicity in a Mobile App Ecosystem submitted to 13th International Conference of the Simulation and Synthesis of Living Systems (Alife13).