A new paradigm of recommendation is emerging in intelligent personal assistants such as Apple's Siri, Google Now, and Microsoft Cortana, which recommends "the right information at the right time" and proactively helps you "get things done". This type of recommendation requires precisely tracking users' contemporaneous intent, i.e., what type of information (e.g., weather, stock prices) users currently intend to know, and what tasks (e.g., playing music, getting taxis) they intend to do. Users' intent is closely related to context, which includes both external environments such as time and location, and users' internal activities that can be sensed by personal assistants. The relationship between context and intent exhibits complicated co-occurring and sequential correlation, and contextual signals are also heterogeneous and sparse, which makes modeling the context-intent relationship a challenging task. To solve the intent tracking problem, we propose the Kalman filter regularized PARAFAC2 (KP2) nowcasting model, which compactly represents the structure and co-movement of context and intent. The KP2 model utilizes collaborative capabilities among users, and learns for each user a personalized dynamic system that enables efficient nowcasting of users' intent. Extensive experiments using real-world data sets from a commercial personal assistant show that the KP2 model significantly outperforms various methods, and provides inspiring implications for deploying large-scale proactive recommendation systems in personal assistants.
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