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	abstract	A comprehensive artificial intelligence system needs to not only perceive the environment with different 'senses' (e.g., seeing and hearing) but also infer the world's conditional (or even causal) relations and corresponding uncertainty. The past decade has seen major advances in many perception tasks such as visual object recognition and speech recognition using deep learning models. For higher-level inference, however, probabilistic graphical models with their Bayesian nature are still more powerful and flexible. In recent years, Bayesian deep learning has emerged as a unified probabilistic framework to tightly integrate deep learning and Bayesian models. In this general framework, the perception of text or images using deep learning can boost the performance of higher-level inference and in turn, the feedback from the inference process is able to enhance the perception of text or images. This survey provides a comprehensive introduction to Bayesian deep learning and reviews its recent applications on recommender systems, topic models, control, etc. Besides, we also discuss the relationship and differences between Bayesian deep learning and other related topics such as Bayesian treatment of neural networks. For a constantly updating project page, please refer to https://github.com/js05212/BayesianDeepLearning-Survey.	**abstract**	A comprehensive artificial intelligence system needs to not only perceive the environment with different `senses' (e.g., seeing and hearing) but also infer the world's conditional (or even causal) relations and corresponding uncertainty. The past decade has seen major advances in many perception tasks such as visual object recognition and speech recognition using deep learning models. For higher-level inference, however, probabilistic graphical models with their Bayesian nature are still more powerful and flexible. In recent years, Bayesian deep learning has emerged as a unified probabilistic framework to tightly integrate deep learning and Bayesian models. In this general framework, the perception of text or images using deep learning can boost the performance of higher-level inference and in turn, the feedback from the inference process is able to enhance the perception of text or images. This survey provides a comprehensive introduction to Bayesian deep learning and reviews its recent applications on recommender systems, topic models, control, etc. Besides, we also discuss the relationship and differences between Bayesian deep learning and other related topics such as Bayesian treatment of neural networks.Comment: To appear in ACM Computing Surveys (CSUR) 202		
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