In this tutorial, it will be shown how Bayesian models can be used to develop artificial cognitive systems that can carry out complex tasks in real world environments. This tutorial summarises research on complex systems and processes for robotic perception resulting from the collaboration between researchers from fields as diverse as Robotics, Engineering, Computer Science, Mathematics, Neuroscience and Cognition.

During the tutorial, the mathematical background and Bayesian programming techniques used in probabilistic models for robotic perception will be presented, allowing researchers and PhD students to address the question of how data derived from different sensory modalities could be processed in order to converge and form a coherent and robust perception of the environment.

Three major topics will be concentrated on techniques to:

- represent 3D space and devise sensor models within a probabilistic framework;
- hierarchically combine Bayesian models and representations;
- define decision processes based on Bayesian programming and Bayesian models.

This tutorial will show how these three topics are central for the development of models of artificial perception based on Bayesian techniques.

During the tutorial several examples and case studies will be presented applying these techniques in Robotics. Many of these examples and applications take inspiration from processes believed to take place in the mammalian brain, and apply them in the development of innovative and self-learning robotic systems.

Contemporary robots and other cognitive artefacts are not yet ready to autonomously operate in complex real world environments and one of the major reasons for this failure in creating cognitive situated systems is the difficulty in the handling of incomplete knowledge and uncertainty. The development of these artificial perception systems are focussed on multimodal and multisensory integration using computational/statistical models supported by observations of biological systems and experimental evidences obtained by psycho-physical methods/studies.