(a) Applications: Cognitive applications based on computer vision, speech recognition, natural language processing and machine learning will play a big role in the future. These applications will be often deployed on mobile or embedded computing systems with limited power budgets, which will be a problem because these applications demand high performance.

(b) Systems: We need customization either by domain or by application. Since most computing systems cater to more than one application, emerging and future hardware systems will be heterogeneous in nature, with many specialized computing elements. In connection with part (a), it is important to develop energy-efficient parallel architectures for cognitive applications.

(c) Technologies: Unless a fundamentally different device technology emerge, power and thermal limitations will be key constraints on future systems. There are a number of technologies in the research arena, but no clear winner is apparent. It is likely that the future will see incremental improvements (in material, geometry, device architecture) for CMOS technology, but not with the same rapid pace outlined in Moore’s law.

(d) Methodologies: The specialization of HW implies tighter integration between the HW and SW, where the distinction is blurry. Programming languages should be aware of the underlying HW models, and HW architectures are customized based on the expected to SW to deliver improved performance.

(e) Risks: A good aspect of XPS success is educational. Schooling should include parallel programming as part of the normal curriculum. Rather than taking it as optional or advanced component, parallel programming should be taught as the default.