## Keynotes Speakers

### Skill and Understanding in Mathematics: Rivals or Partners?

*Prof. Deborah Hughes Hallett, University of Arizona, Adjunct Professor if Public Policy: Harvard Kennedy School*

An effective mathematics course develops both computational skill and conceptual understanding. The appropriate balance between them depends on the particular students you have. This talk will center on how to create such a balance and its benefits— how understanding and skill reinforce each other, generating increased confidence and better retention of material. We will discuss some of the tools available—including engaging applications, probing problems, ConcepTests, on-line homework, and projects.

### Integer and Constraint Programming for the two-dimensional bin packing problem with due dates

*Prof. Rym M'Hallah, University of Kuwait*

This talk addresses a combination of two practical yet computationally difficult optimisation problems: bin packing and scheduling. It deals with packing a set of rectangular items, which may be rotated by 90°, into identical rectangular bins. Each item is characterized by its width, height, and due date. Its lateness is the difference between its completion time and its due date, where its completion time is that of its assigned bin. All bins' processing times are equal regardless of their assigned items. The problem distributes all items among the bins and packs them without overlap as to minimise the maximum lateness of the items.

This problem prevails in make-to-order low-volume production systems such as steel, wood and furniture manufacturing. It occurs in fleet planning and logistics as well as during rescue and defence operations. In these contexts, packing efficiency might be increased by mixing up several orders; however, the increased efficiency cannot be at the cost of customer service. The problem is computationally challenging due to a large number of ways that items can be positioned in the bins. Thus, finding efficient solution techniques is highly important from practical perspectives. Problems like this often require new approaches combining different algorithmic techniques to handle multiple aspects of the problem with maximal efficiency.

As for all difficult optimisation problems, finding an optimal solution, in a reasonable time, for large-sized instances is hard. The paper proposes an approximate approach for the problem and, unlike the existing techniques, explores the complementary strengths of constraint programming and mixed integer programming techniques. In this sense, it bridges the gap between artificial intelligence and operations research constructing an algorithm where methods traditional to these fields find synergy in their combination. The approach combines heuristic search with mixed integer programming, which is in turn guided by feasibility constraints. In addition, it applies an innovative lookahead strategy that (i) forbids searching in directions that will eventually lead to incorrect solutions and (ii) directs the search towards improving solutions only. This approach improves existing solutions by 27.4% on average, and achieves optimum for 33.9% of the test instances. Consequently, it is a viable alternative to the constructive heuristics traditionally applied to bin packing.

The work is of a great significance for an academic community, especially for a large group of researchers working on cutting and packing problems. The proposed approach is easily adaptable to similar real-world problems ranging from organising on-time delivery of electrical goods from a store to production planning of make-to-order built-in furniture to managing the load of air fleet with respect to time requirements. Most importantly, this talk highlights the fundamental role of simple mathematical tools in solving highly complex but commonly occurring problems.

## On Recent Generalizations of Metric Spaces and Fixed Point Theory

*Prof. Zead Mustafa, Qatar University*

Now-a-days, the study of metric spaces is considered fascinating and highly useful because of its increasing role in mathematics and the applied sciences. It has been increasingly realized that this branch of mathematics provides a convenient and very powerful way of examining the behavior of various mathematical models, and it clarifies and unifies the underlying concepts in mathematics, engineering, theoretical physics, applied mathematics, economics and other applied fields.

In the past two decades, metric spaces have gained much attention through advances in Metric fixed point theory. Special classes of metric spaces have been intensively investigated; geodesic metric spaces, hyperbolic metric spaces and hyperconvex spaces to name a few. There have also been a number of attempts to extend the theory to spaces that are more general than the ordinary metric spaces.

The purpose of this Talk is to highlights the recent generalizations of Metric Spaces with a comparison between them. Moreover, I will present the recent development of fixed-point theory of b-metric endowed with graph.