May’s meeting of the YHORG took place at the West Yorkshire Playhouse and looked at two diverse applications of OR. Paul Smith concentrated on experiences and trends relating to crew scheduling, particularly within the context of solution approaches that are embedded within commercial software. Sanja Petrovic presented a Case-based reasoning approach to radiotherapy treatment planning and how it utilises the knowledge of experts to learn and optimise.

Paul is a Senior Consultant at Omnibus and leads the technical support and development of the CrewPLAN system. Omnibus provide passenger transport software and CrewPLAN links with other units to produce crew schedules. In itself CrewPLAN needs a lot of information about the scheduling environment in order to be flexible to different requirements, and similarly needs to output sufficient detail to be useful in preparing the details of the work to be done by individual drivers. The software uses heuristics to reduce the problem size, and a generate-and-select approach to produce a set of shifts to cover the work, but optimality cannot be determined in isolation to the need for a fair weekly workload when the shifts are combined. Indeed optimality is a difficult concept because subjective costs can be used to discourage the inclusion of shifts with particular features. Increases in computer speed and storage have allowed for many improvements in crew scheduling but it remains important to retain an iterative process whereby users can investigate “what-if” scenarios and use their expertise to work with the system to produce the best solutions. Efficient crew scheduling saves lots of money for a company and computer-based solvers can explore a much bigger solution space, but full automation is unlikely to be better than the joint efforts of computers and experienced schedulers.

Sanja is a Professor of Operational Research at the Nottingham University Business School. Sanja presented current investigations into the use of a Case-based Reasoning (CBR) approach to radiotherapy treatment planning for brain tumours. As instances of cancer are predicted to increase by 75% in the next 2 decades, treatment plans are vital in continuing to improve survival rates. Where radiotherapy is used the aims include attaining the uniform tumoricidal dose minimising the radiation dose received by organs at risk and surrounding healthy tissue. It may take a few hours but also several days to produce a treatment plan, which includes decisions regarding the radiation dose, the number of beams and the angle of beams. Case-based reasoning utilises the knowledge of experts and Sanja presented this approach using real-world brain cancer patient records from the Nottingham University Hospitals NHS Trust. For a new patient the attributes of the cancer are identified and compared to the Case Base for which treatment plans are recorded. The Case base has 64 cases in the training set and 22 cases in the test set and successful retrieval was defined as identifying the same beam number and a difference between beam angles of <20%. A two-phase retrieval was used to first select cases with the same beam number, and then use this to filter the beam angle results. Different similarity measures were tested and fuzzy similarity with local fuzzy sets and local attribute weights performed well. The approach was adapted using Neural Networks to learn how the difference in attribute values affects the output (i.e. the beam number). The success rate of the Adaption-guided retrieval for over 80 cases was 90% and shows the value of the approach, which contains the knowledge of the clinicians. Also it can learn after each new treatment so that, over time, can suggest different treatment plans. With extremely encouraging results the work will be further developed and include more cases

There were several questions and discussion from an audience interested in seeing two very practical applications of OR