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## **Project title: Formulations, Models and Algorithms for The Personnel Task Scheduling Problem and its Variants (PTSP)**

**Project number:** IMURA0118

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### **Research Academy theme/s**

List only the research academy theme/s that is relevant to the project

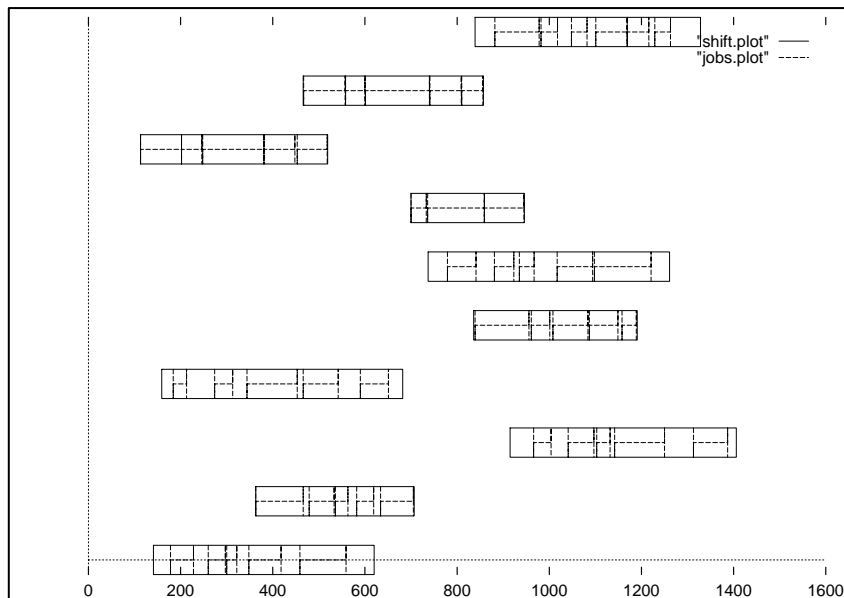
1. Advanced computational engineering, simulation and manufacture

### **The research problem**

The Fixed Task Scheduling Problems are concerned with assigning tasks with fixed start/end times to resources. A particular example of this is the personnel task scheduling problem (PTSP) where the tasks have to be assigned to a heterogeneous workforce. Other examples occur in a variety of supply chain scheduling applications where times are imposed for example by a rail timetable or the need to service customers at a given time. The types of constraints that typically have to be considered include limitations of which resources tasks can be allocated to (often with different costs), the need for multiple resources to complete a task, requirements on gaps between tasks (breaks, setup times) and others.

The PTSP and other fixed task scheduling problem variants are very difficult to solve optimally, even finding a feasible solution where all the tasks are assigned (or deciding that the problem instance is infeasible) is generally not possible in polynomial time. The aim of this project is to develop advanced algorithms based on both exact and heuristic approaches starting with integer programming approaches to formulating these problems.

In order to solve large problems it is desirable to make effective use of modern multi-core/multi-processor computers. A strategy to be explored in this project is to use decomposition techniques (eg based on Lagrangean relaxation) to allow the computation to be carried out in parallel.



## Expected outcomes

This project will look at new modelling and solution approaches to find feasible and cost minimizing schedules. The application of the approach to personnel scheduling in an organisation could ideally be used as a decision support tool that reduces costs related to the workforce, time and effort, and improve effectiveness of work. In addition promising approaches may be extended to other variants of fixed task scheduling problems such as supply chain scheduling or multi-processor task assignment, so that the results could also be applied to improving supply chain efficiency or the design of good parallel computer architectures.

## Specific Milestones and Deliverables

1. Literature review and development of suitable test data sets derived from real applications as well as randomly generated patterns.
2. Development of a formulation and decomposition approach to the PTSP and other fixed task scheduling problems.
3. Exploration of integer programming methods involving problem decomposition and perhaps development of specialised cut generation.
4. Development of parallel heuristics for solving very large PTSPs, in particular using dual (lagrangean) heuristics.
5. Extension of results to other fixed task scheduling variants.

## Project Inputs

While working at CSIRO the student may be provided with access to confidential data sets which can be used to develop suitably de-identified test data for use in the PhD research. Also access to CSIRO background IP in the form of algorithm implementations may be provided for the purposes of running comparisons of algorithm performances. However such background IP remains the property of CSIRO and such source code is not to be disseminated outside of CSIRO without the permission of CSIRO.