A new algorithm for the Generalised Flexible Resource Constrained Project Scheduling Problem (GFRCPSP)

Jack Trainer

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What is a PSP?

- The **Project Scheduling Problem**

![Network Diagram]

**Figure**: Network representing the relationships between activities in a typical project with 0 and 7 as dummy start and end activities.
What is a PSP?

**Figure:** Typical activities in the basic PSP, all have fixed durations and resource allocations.
What is a RCPSP?

- The **Resource Constrained Project Scheduling Problem**
What is a RCPSP?

A new algorithm for the GFRCPS
What is a RCPSP?

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A new algorithm for the GFRCPSP
What is a RCPSP?

A new algorithm for the GFRCPSP
What is a FRCPSP?

- The **Flexible Resource Constrained Project Scheduling Problem**

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What is a FRCPSP?

$q_{min} = 1$, $q_{max} = 4$, $l_{min} = 2$
Figure: A diagram showing an example of a minimum time lag (Top) and a maximum time lead (Bottom)
Precedence Constraints

Figure: A network for a project showing time constraints between activities and a dummy start and end activity. Negative numbers correspond to maximum time leads and positive numbers to minimum time lags.
The Schedule Generation Scheme

- The main program

Start

Read project information from file. Set popsize. Set n = 0

Test if project is viable with respect to time constraints

Is n < popsize?

No

Generate ALR increment n

Print makespan and activity start and ends

Print failure

Yes

Schedule using SGS

Does the schedule fail?

Yes

Finish

No
The Schedule Generation Scheme

- The greedy SGS

```
Start -> Set n = 0

Is n < length of ALR? -> Yes
Choose activity in ALR

Is activity past its Latest start? -> Yes
Schedule activity in each time period with max resources

No

Add activity to schedule
Increment n.

No

Return Schedule

Finish

Fail schedule
```
The Schedule Generation Scheme

- The self improving SGS

Start → Set n = 0 → Is n < length of ALR? → Yes → Add activity to schedule Increment n. → No → Choose activity in ALR → Is activity past its Latest start? → No → Schedule activity in each time period with max resources → Yes → Find successors with a negative minimum time lag → Is min duration of successor > time lag? → Yes → Remove these tasks from the schedule → Find Intervening tasks → No → Reschedule min time lag successor at the current makespan of the project → No → Reschedule failed task and increment n. → Return Schedule → Finish
The Schedule Generation Scheme

A new algorithm for the GFRCPSP
The greedy SGS

A new algorithm for the GFRCSP

Diagram:

- Y-axis: Primary Resource
- X-axis: Time Units

Graph shows a horizontal line at Primary Resource 10.
The greedy SGS

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A new algorithm for the GFRCPS
The greedy SGS

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A new algorithm for the GFRCPSP
The greedy SGS

A new algorithm for the GFRCPSPL
The greedy SGS

Start → Set n = 0

Is n < length of ALR?

Yes → Choose activity in ALR

No → Return Schedule

Fail schedule → Finish

Add activity to schedule
Increment n.

Is activity past its Latest start?

Yes → Schedule activity in each time period with max resources

No
The self improving SGS

A new algorithm for the GFRCPSP
The self improving SGS

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A new algorithm for the GFRCPSP
The self improving SGS

Start

Set n = 0

Is n < length of ALR?

Yes

Choose activity in ALR

Is activity past its Latest start?

No

Schedule activity in each time period with max resources

Yes

Find successors with a negative minimum time lag

Find Intervening tasks

No

Reschedule min time lag successor at the current makespan of the project

Reschedule min time lag successor w/ min resources.

Return Schedule

Reschedule failed task and increment n.

Finish

Is min duration of successor > time lag?

Yes

Remove these tasks from the schedule

No
The self improving SGS

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The self improving SGS

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A new algorithm for the GFRCPSP
An example of another way the greedy SGS can fail

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A new algorithm for the GFRCPSP
An example of another way the greedy SGS can fail
Comparisons between the two SGS

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**Figure:** A table with conditional formatting showing the differences between the old SGS and new SGS over 90 projects each containing 10 activities.
Other ideas to explore

**Figure:** A diagram showing the idea of combining activities with maximum time leads in order to facilitate more optimised scheduling.

\[
\text{Total work} = 100 \\
q_{\text{min}} = 8, \ q_{\text{max}} = 10
\]
Any Questions?