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Graphical methods for optimising academic programmes

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13 June 2018

Motivation

- Visual information is easier to digest and understand
- Relationships between factors simpler to evaluate graphically
- Techniques in institutional research not always suitable
- Interventions for factors outside of institutional control not readily apparent
- Shift focus to institutional variables which can more readily be addressed

Overview

- Sankey Diagrams
  - Analysis at academic programme level
  - Graphical representation of student flow

- Bayesian Networks
  - Analysis at course / module level
  - Graphical representation of inter module relationships

Sankey Diagrams

Visualising inter programme student flow

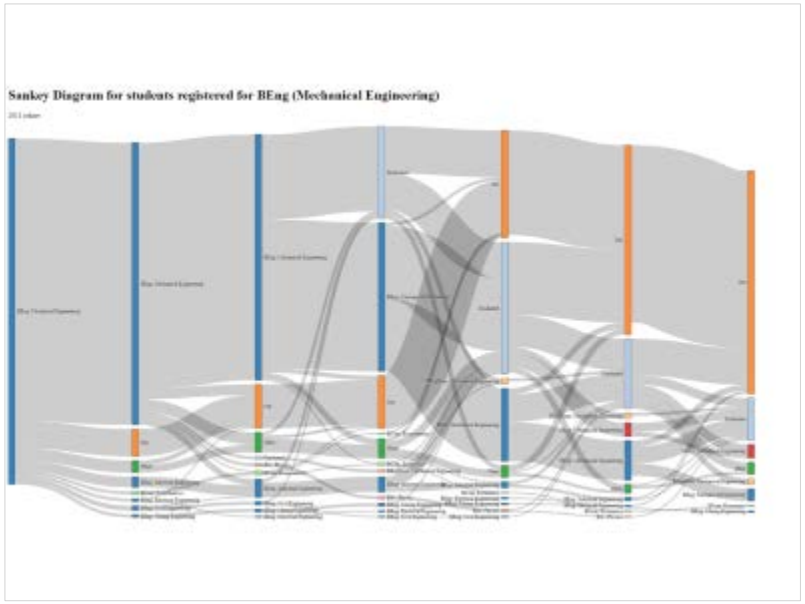
Setup

- Tracks cohort of students from a given base year until termination of studies

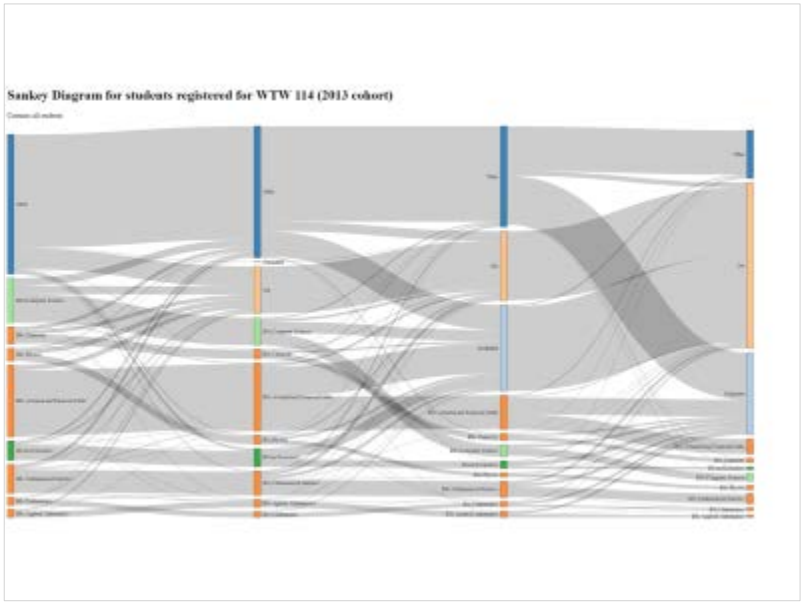
- Three implementations:
  - Tracking students from a specific programme
  - Tracking students given a specific module
  - Tracking students within a group of programmes (e.g. all students from the Faculty of Engineering)

Examples

- Single programme

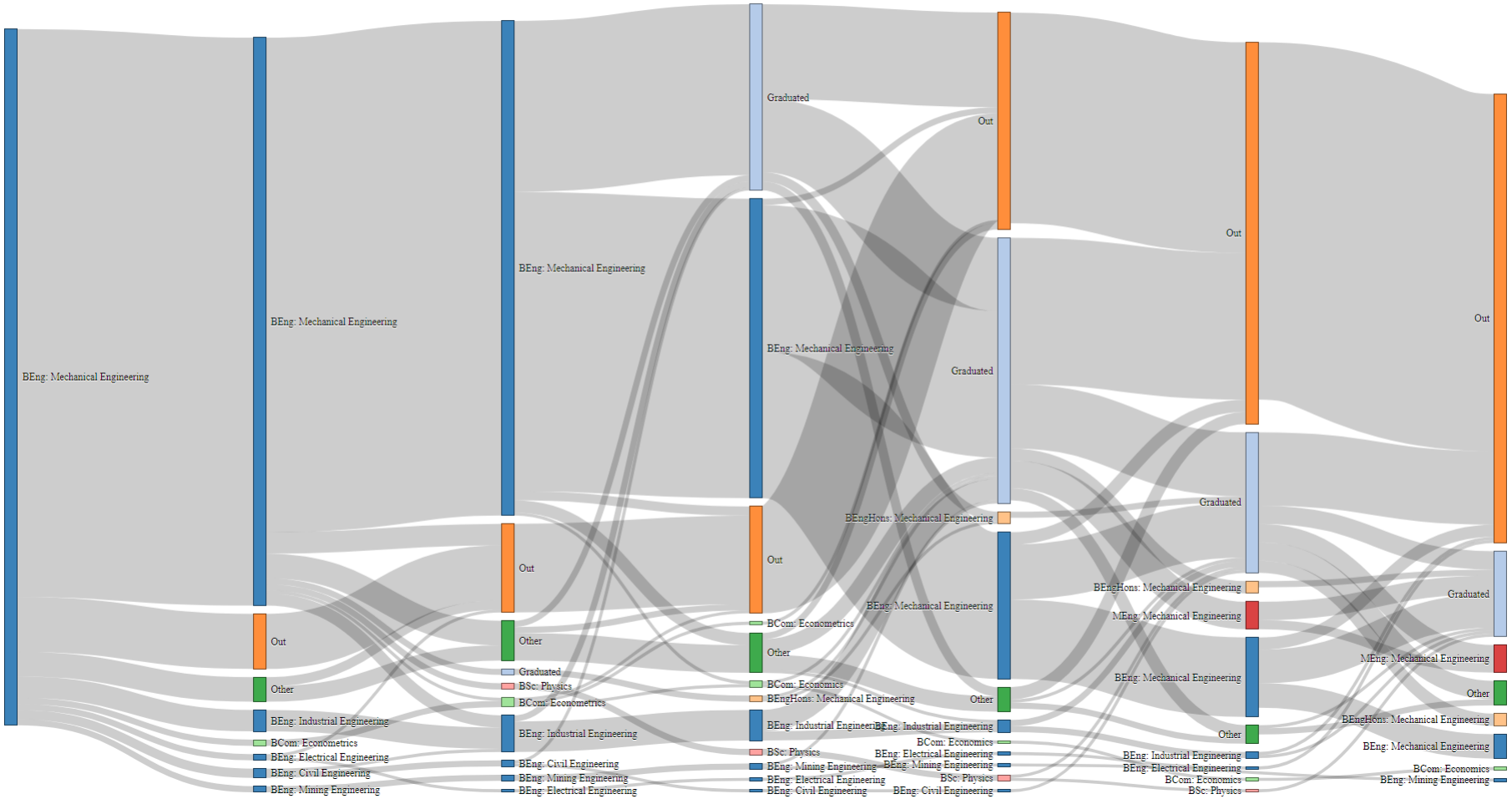


- Multiple programmes



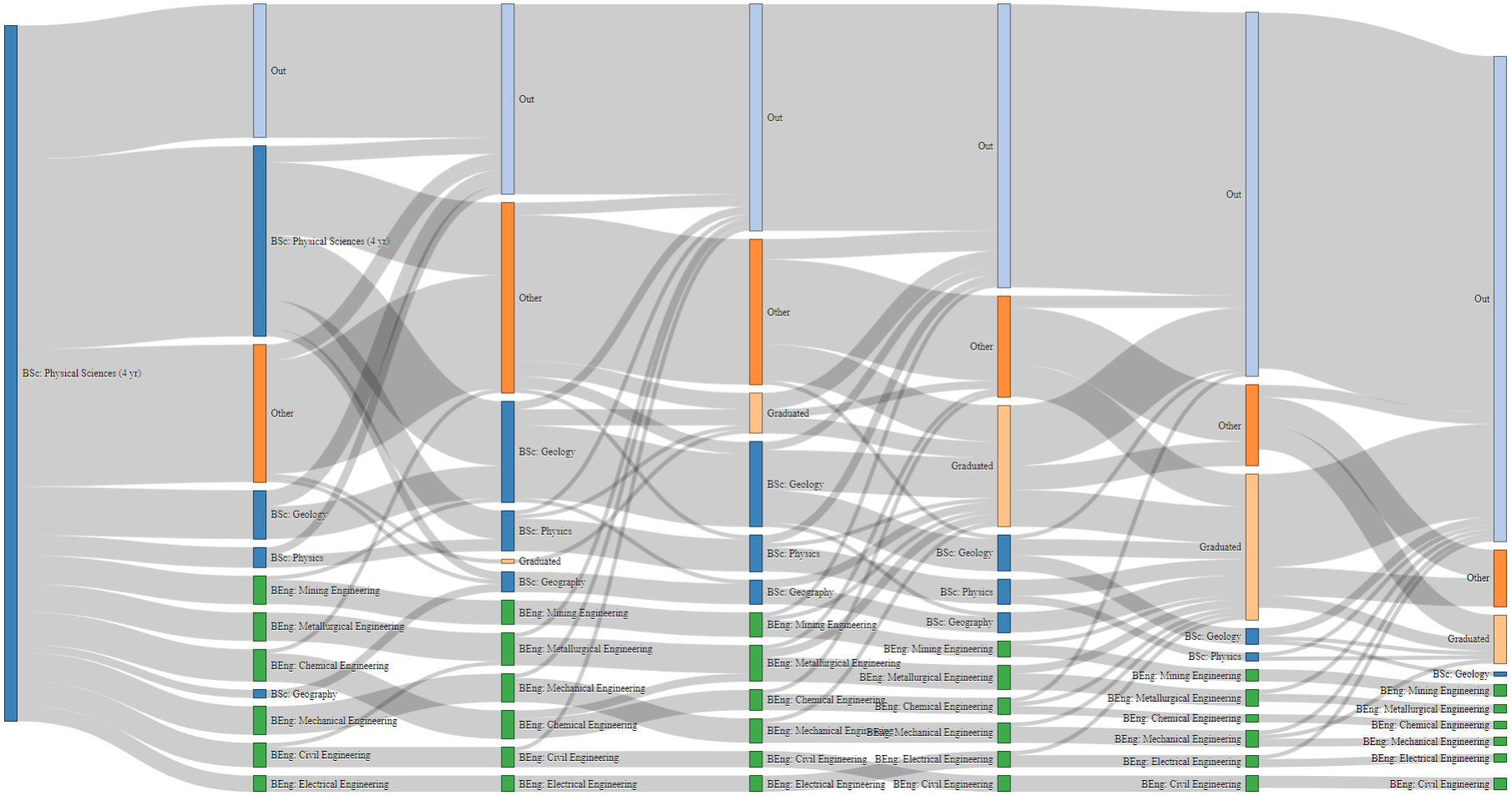
Sankey Diagram for students registered for BEng (Mechanical Engineering)

2011 cohort



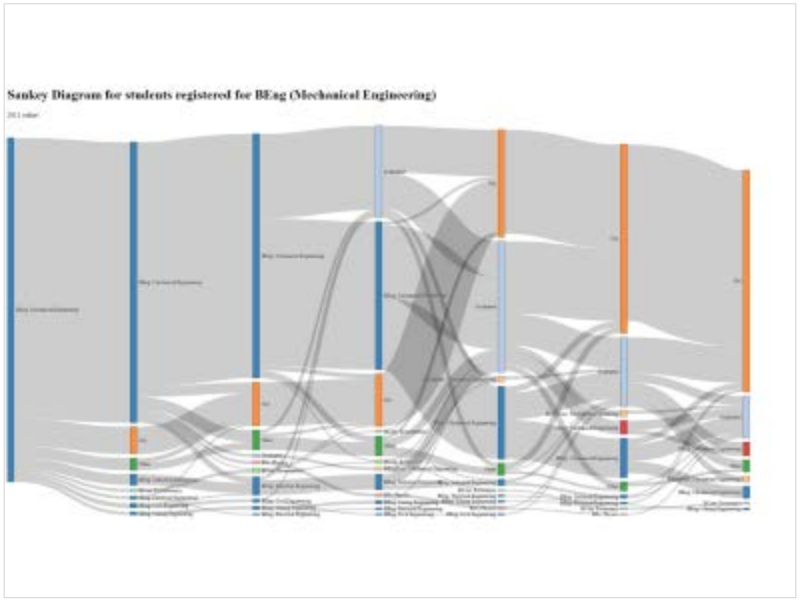
Sankey Diagram for students registered for BSc (Physical Sciences - Extended programme)

2011 cohort

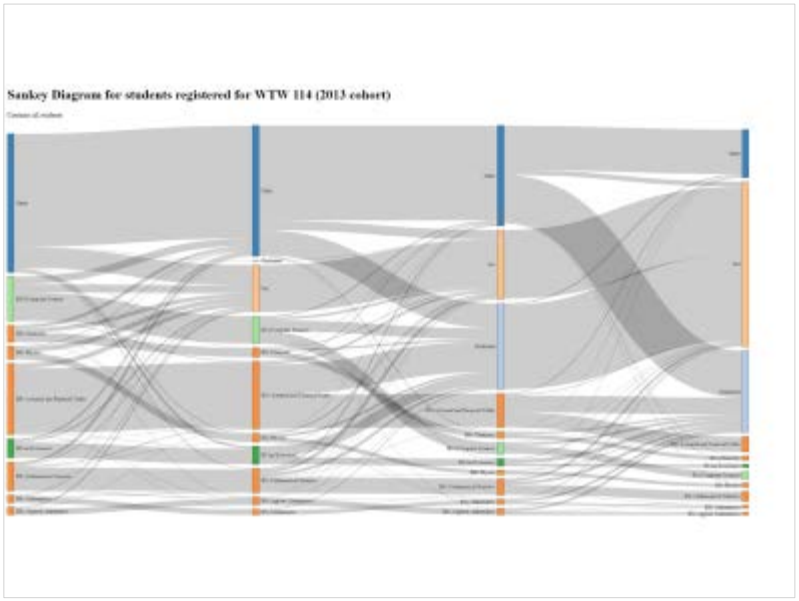


Examples

- Single programme

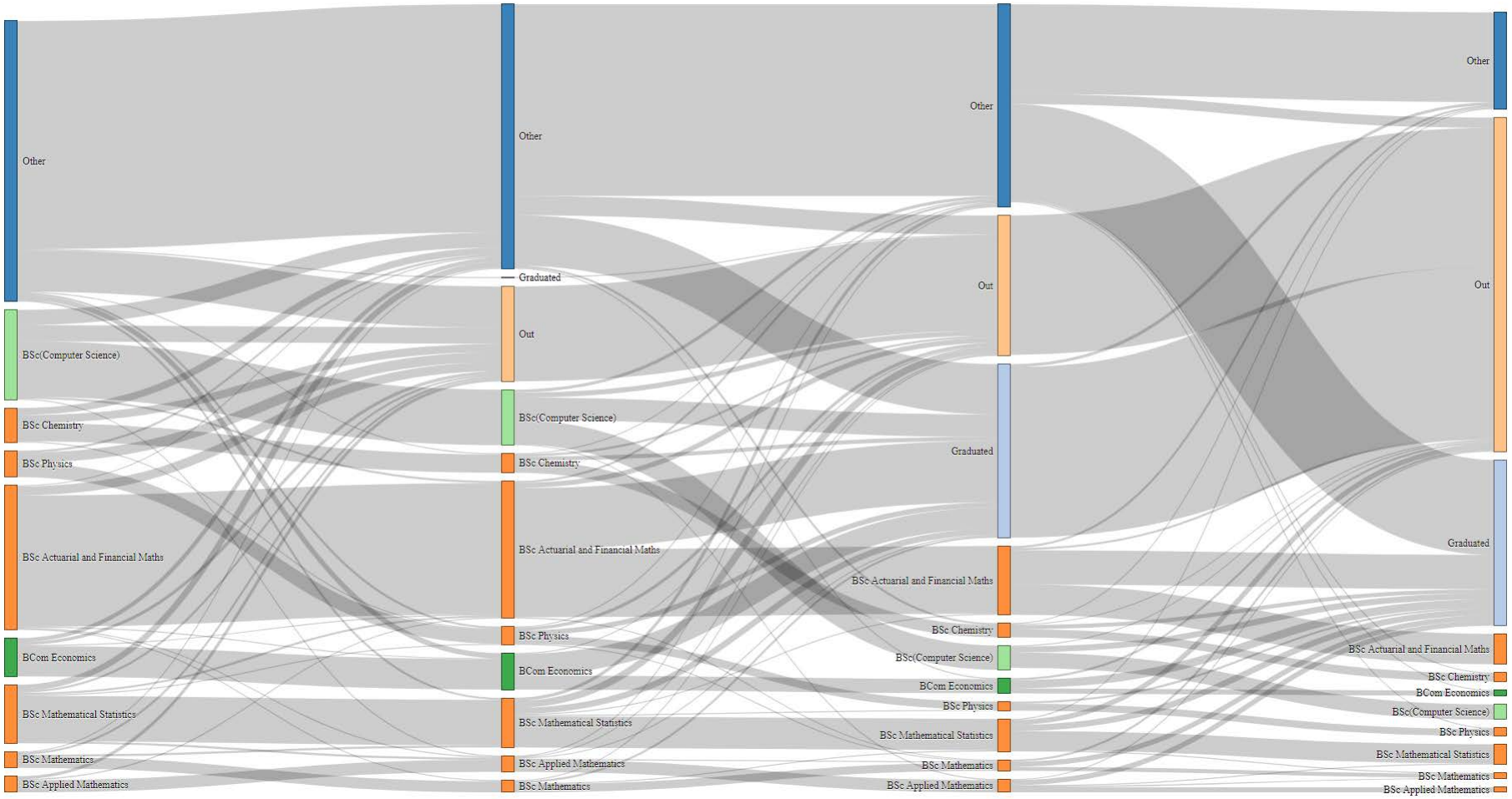


- Multiple programmes



Sankey Diagram for students registered for WTW 114 (2013 cohort)

Contains all students



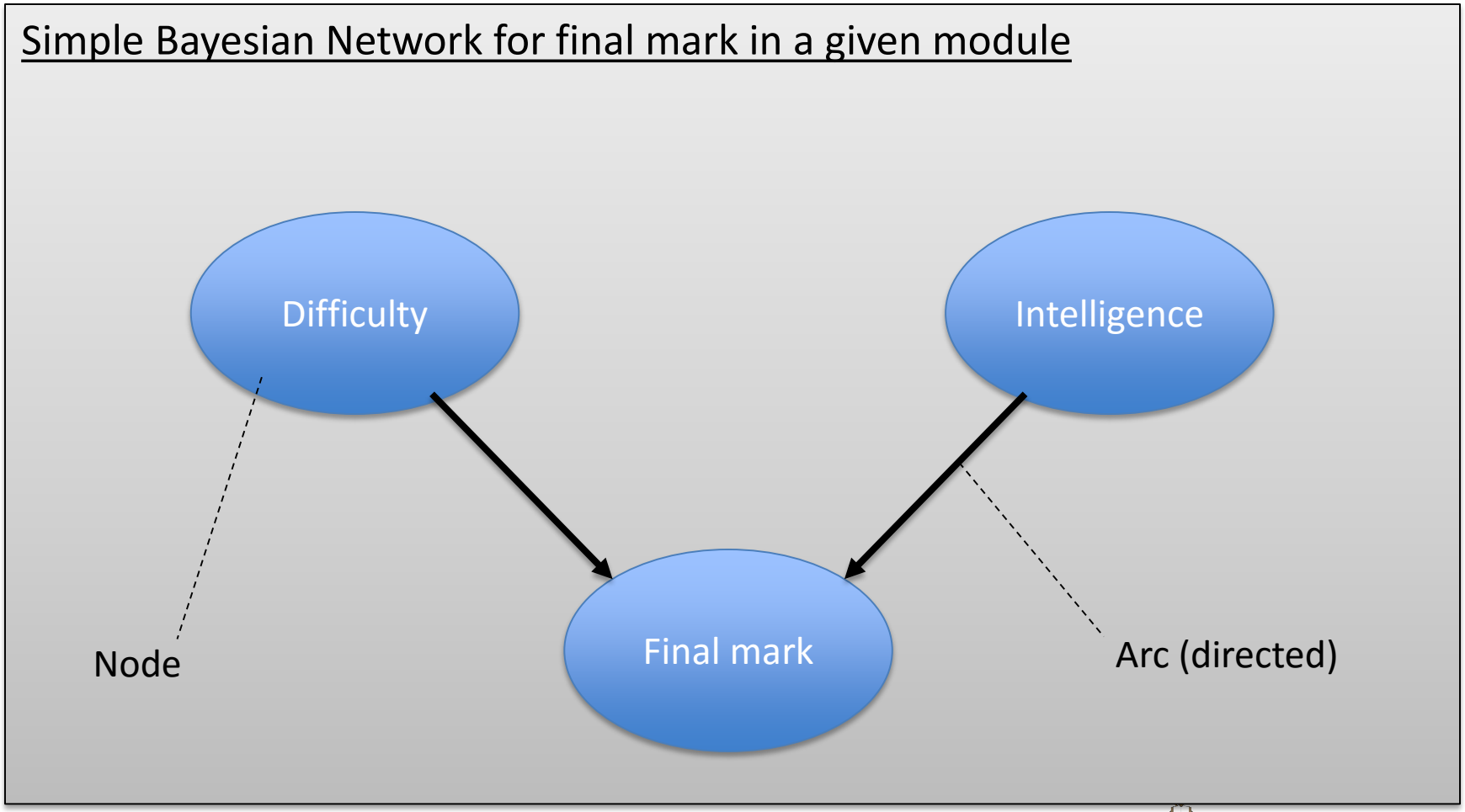
Bayesian Networks

Module level analysis

What are Bayesian Networks?

- Probabilistic Graphical Model
- Graphical / Visual representation of variables
- Variables represented as nodes
- Conditional dependencies represented via arcs
- Useful for inference and predictive modelling

Basic example



Application

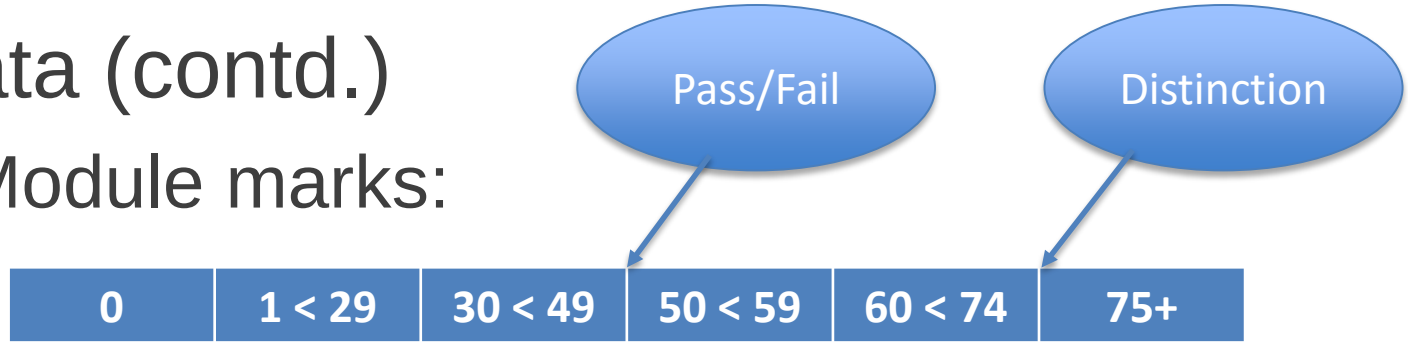
- Data
  - 2011 Cohort – All Engineering programmes
  - Format:

Student Number	Module 1 (mark)	Module 2 (mark)	…	Outcome
…	e.g. 78	e.g. 56	…	Graduated

  - Outcome:
    - Graduated
    - Not Graduated

Application

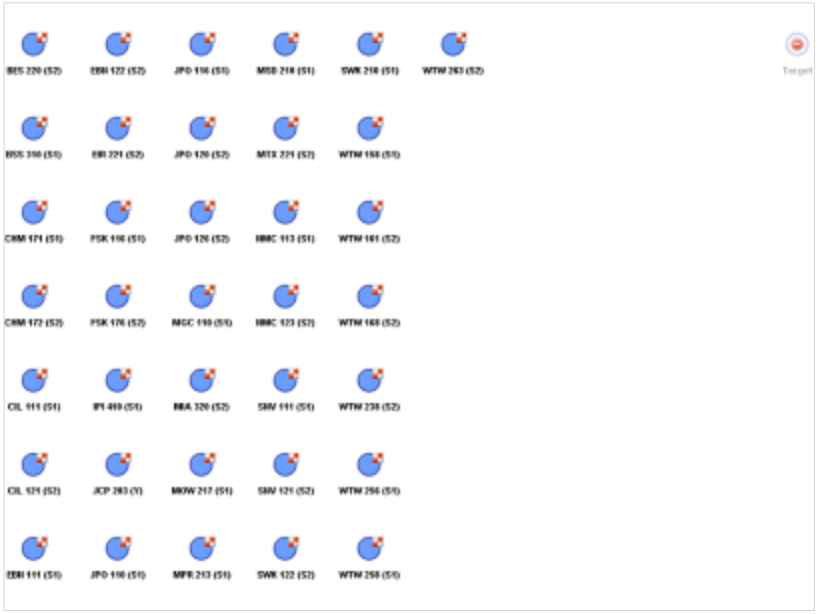
- Data (contd.)
  - Module marks:

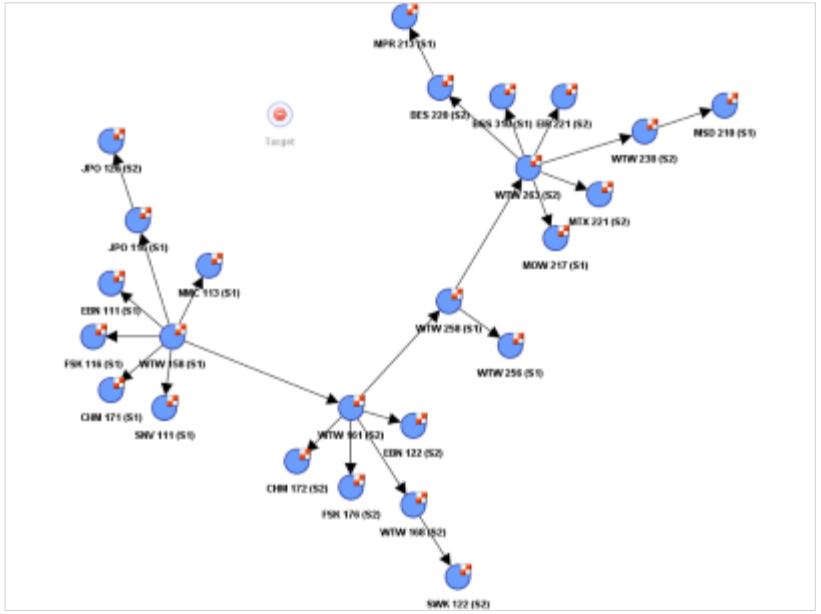


- Objective
  - Identify conditional dependency structure between modules (unsupervised)
  - Identify relationship of outcome to modules (supervised)

Unsupervised

- Unconnected
- Connected






BES 220 (S2)


EBN 122 (S2)


JPO 116 (S1)


MSD 210 (S1)


SWK 210 (S1)


WTW 263 (S2)


Target


BSS 310 (S1)


EIR 221 (S2)


JPO 120 (S2)


MTX 221 (S2)


WTW 158 (S1)


CHM 171 (S1)


FSK 116 (S1)


JPO 126 (S2)


NMC 113 (S1)


WTW 161 (S2)


CHM 172 (S2)


FSK 176 (S2)


MGC 110 (S1)


NMC 123 (S2)


WTW 168 (S2)


CIL 111 (S1)


IPI 410 (S1)


MIA 320 (S2)


SNV 111 (S1)


WTW 238 (S2)


CIL 121 (S2)


JCP 203 (Y)


MOW 217 (S1)


SNV 121 (S2)


WTW 256 (S1)


EBN 111 (S1)


JPO 110 (S1)

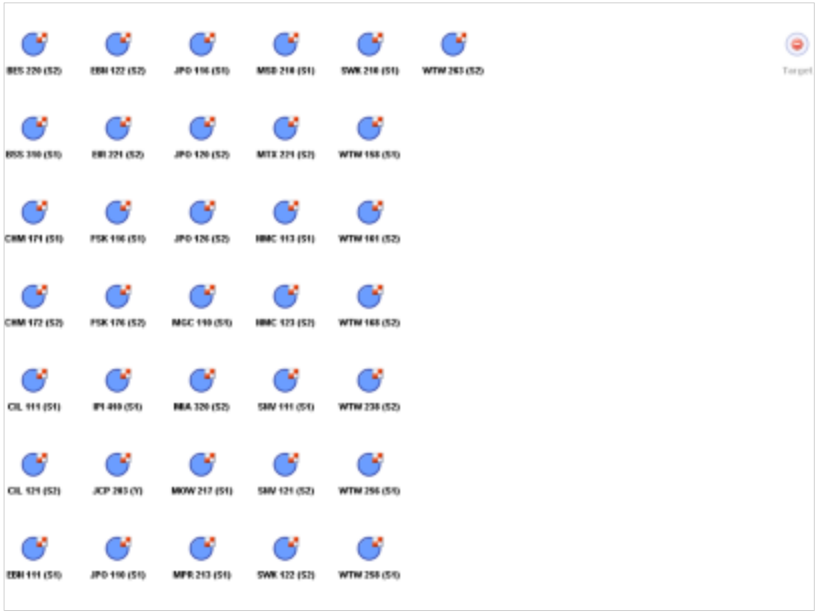

MPR 213 (S1)

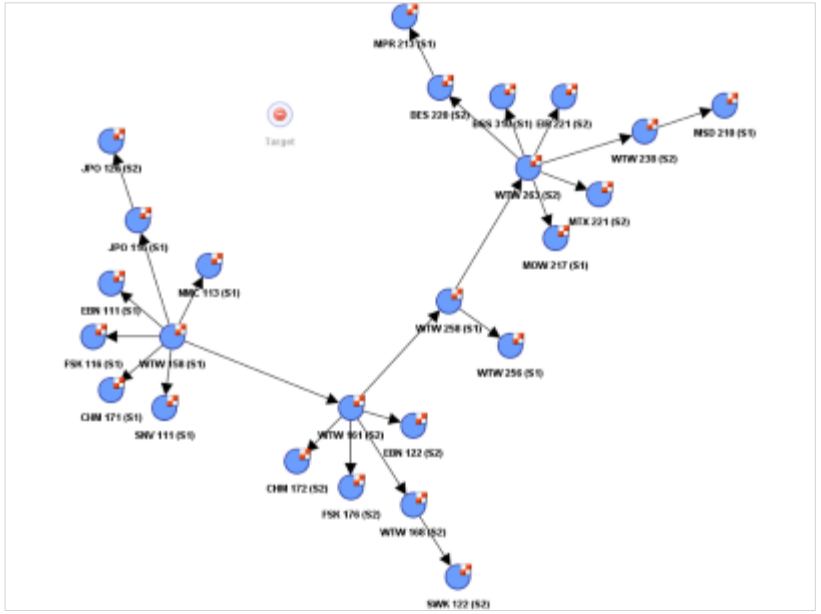

SWK 122 (S2)

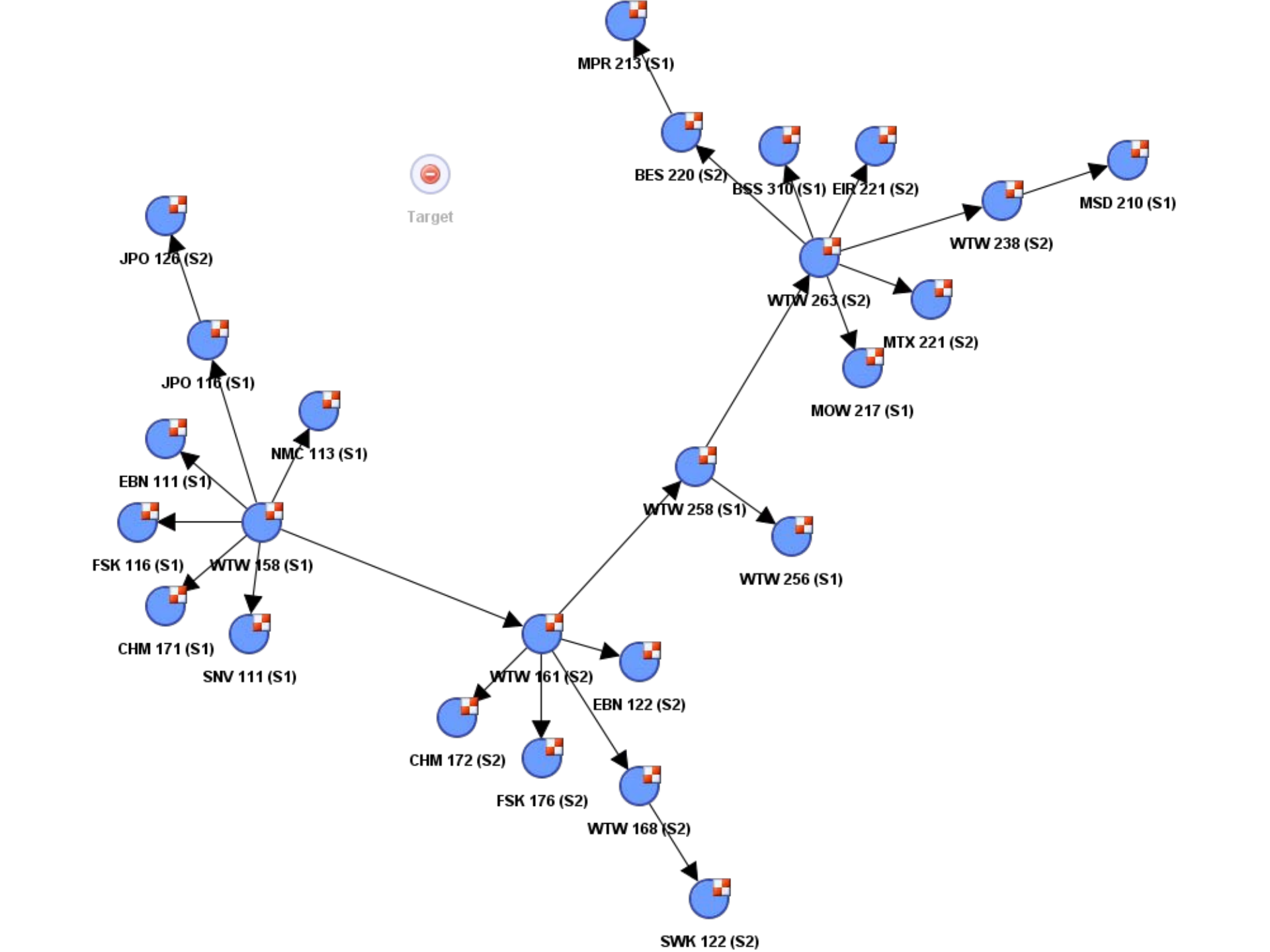

WTW 258 (S1)

Unsupervised

- Unconnected
- Connected



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Target
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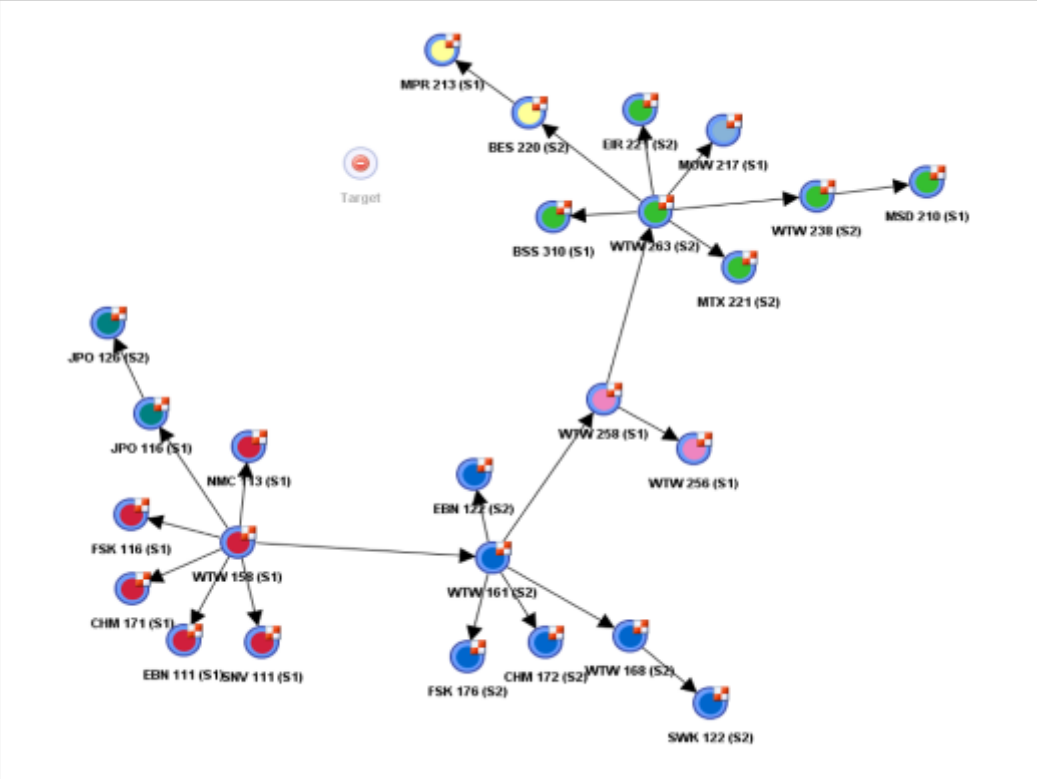
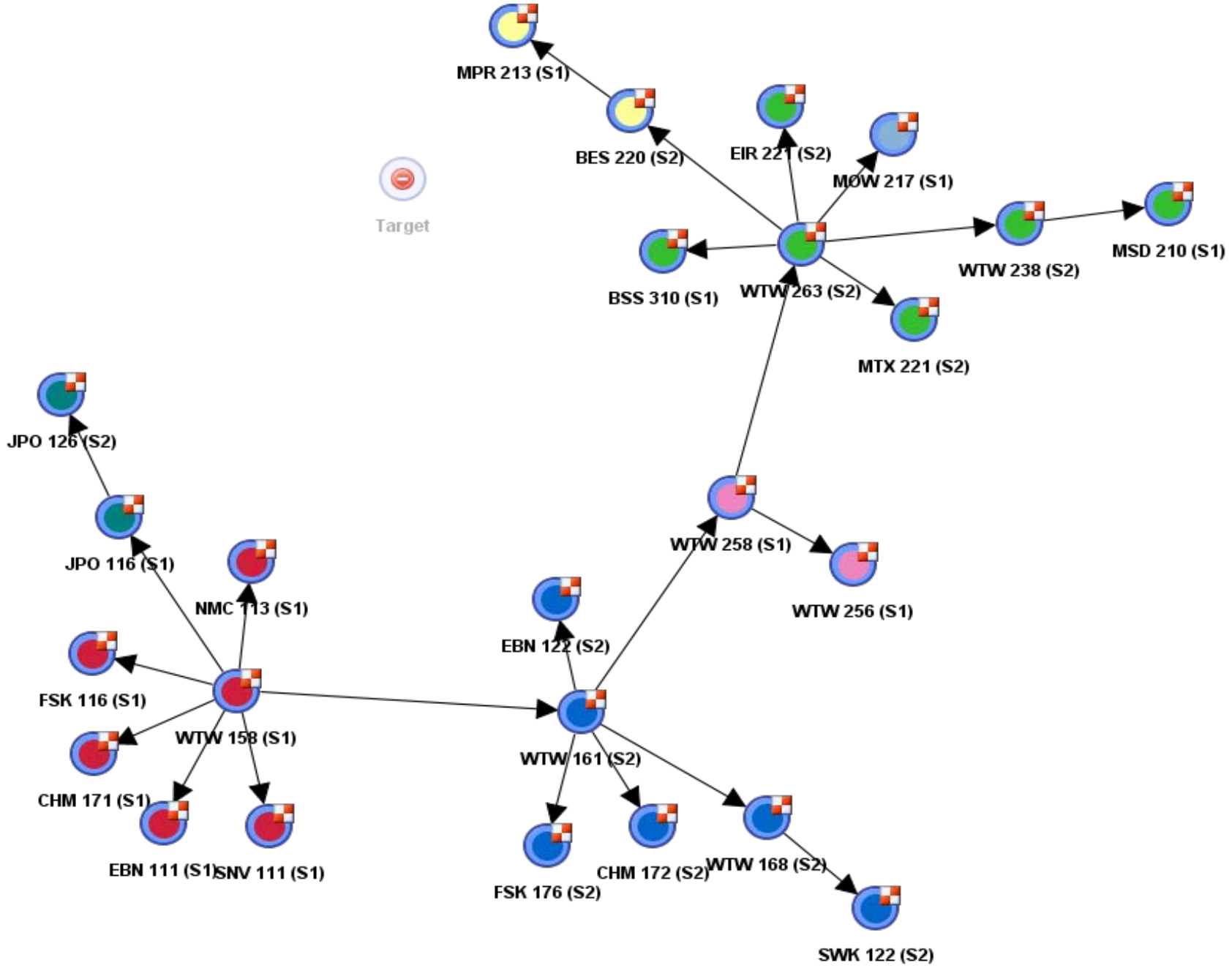
WTW 258 (S1)
FSK 116 (S1)
WTW 158 (S1)
WTW 256 (S1)
CHM 171 (S1)
SNV 111 (S1)
WTW 161 (S2)
EBN 122 (S2)
CHM 172 (S2)
FSK 176 (S2)
WTW 168 (S2)
SWK 122 (S2)

Unsupervised

- Clustered modules

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WTW 168 (S2)
SWK 122 (S2)

Conclusion

- Current work
  - Add target variable to unsupervised structure
  - Evaluating performance of model
  - Test different target variable setups
  - Inferential analysis based on model
- Future work
  - Supervised methods
  - Comparison to other non-graphical methods

Acknowledgements

- Funding
  - NRF (Bursary)
  - Kresge foundation (Internship)

- Data
  - UP Bureau for Institutional Research & Planning (BIRAP)