Curricular Analytics

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THE UNIVERSITY of NEW MEXICO

Headline in the Chronicle of Higher Education:

Big State University Improves Graduation Rates by Training Advisors as Mimes!

Email from the provost later that day:

Dear <Insert UVP name here>,
Please see the attached article from the Chronicle.
What are we doing about advisor mime training?
How soon can we get this up and running?
Why didn't we think of this!

Student Success – Two Key Points

Rome wasn't built in a day.
–French Proverb, circa 1190

1. **Patience is required** – the time scale for substantive change is years.

All politics is local.
–Tip O'Neill

2. **Student success depends on local conditions** – what works at one place may not work at another.

Our president's hiring package included a bonus for improving the 6-year graduation rate – and he had one year to do it!

- By focusing on "near completers" you might be able to impact graduation rates by 1% in one year.
- A curriculum change takes one year to make it through the faculty senate, and three or more years to have full effect.

Student Success – Time Frame

Kurzweil and Wu, Building a Pathway to Student Success at Georgia State University, Ithaka S+R Case Study, 2015.

- Rapid improvements pre-date the innovate GPS advising system by 10 years. Large-scale improvement efforts began in 1999.
- No single initiative is responsible for the dramatic gains; the improvement represents the accumulated impact of a dozen or more relatively modest programs. There is no silver bullet.
- Most important ingredients:
  - A Systematic Problem-Solving Approach
  - A Comprehensive Data Warehouse
  - A Cross-Functional Organizational Structure
  - A Commitment to the Success of Underserved Students
  - Dedicated Support from University Leadership

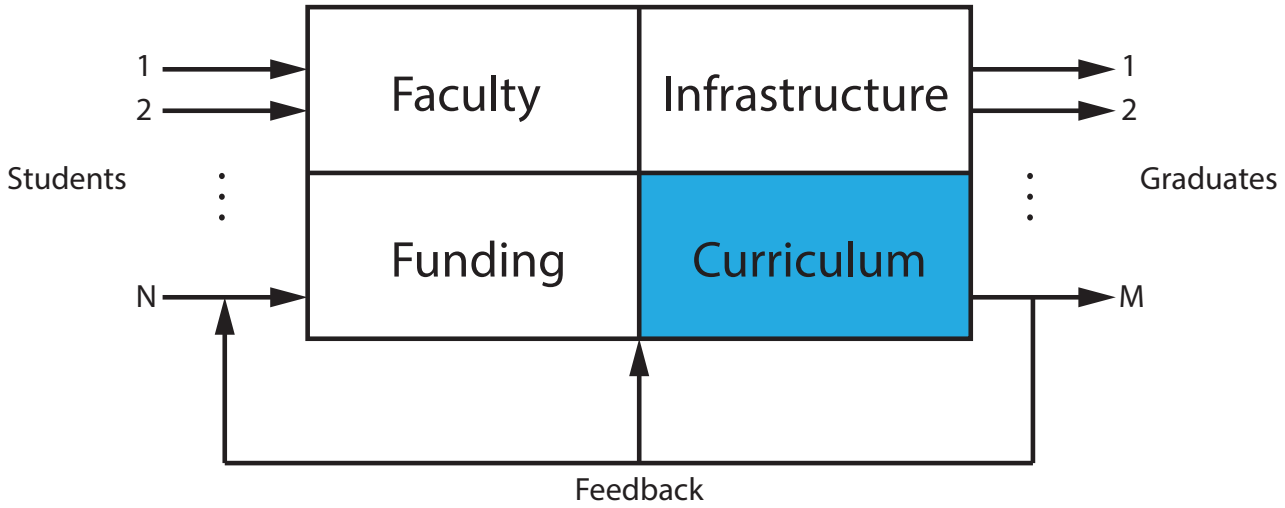
Student Success – Local Conditions

- Numerous factors influence student progression: support services, the timing of course offerings, who teaches particular courses, curriculum structure, etc.

- Why is it that improvements that work at one university may not work at another?

  The university "systems" are different.

The University System



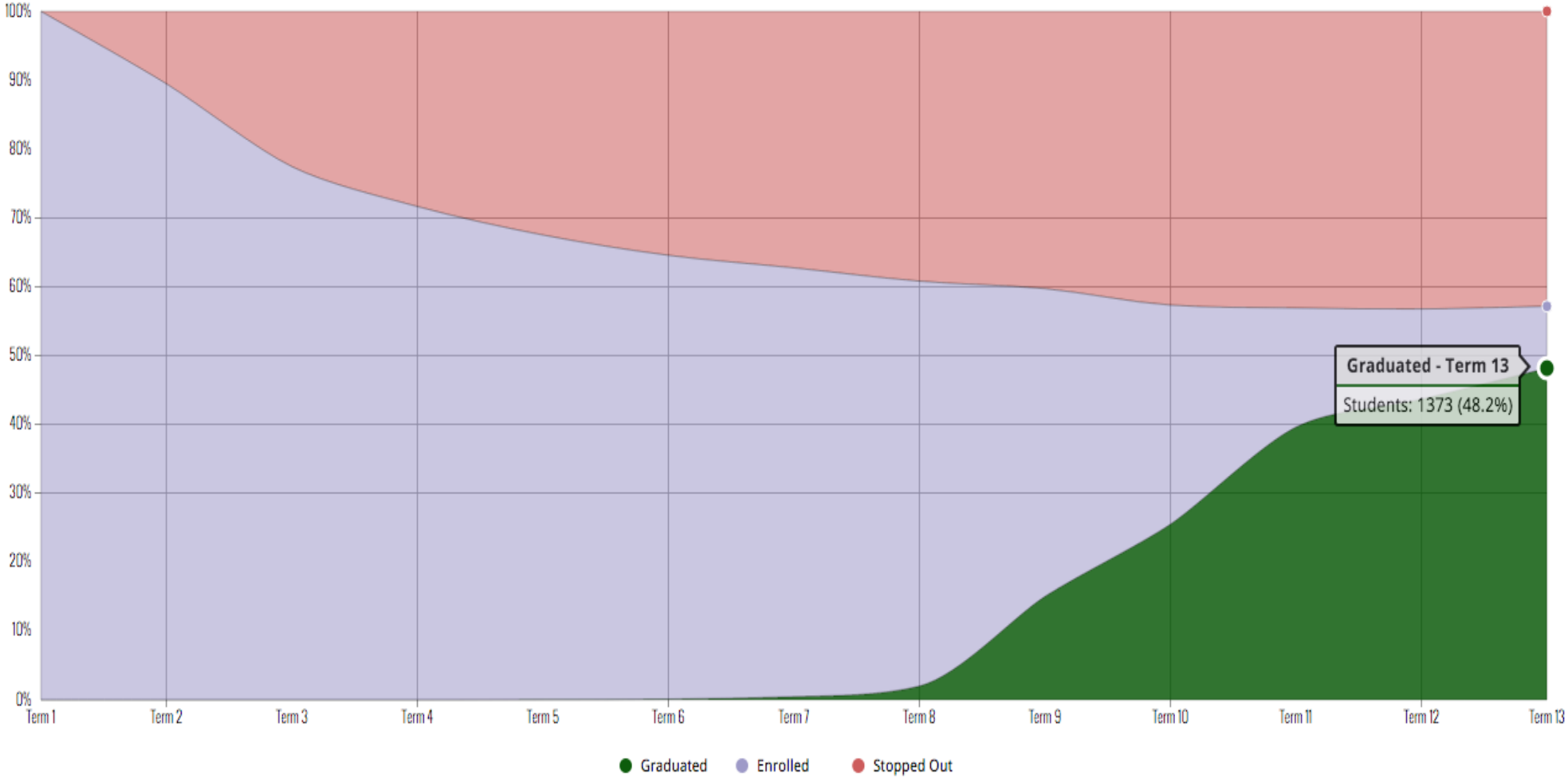
- We can think of the university as a **system**.
- Input: **Students**. Measurable characteristics: preparation, background, demographics, etc.
- Output: **Graduates**. Measurable characteristics: assessed outcomes, research productivity, career achievements, etc.
- **Feedback** can improve system performance, and inform admissions.
- Given the constraints we operate under, finding **curricular** efficiencies can be an effective way to improve the university system.

The University System – Manipulating Inputs

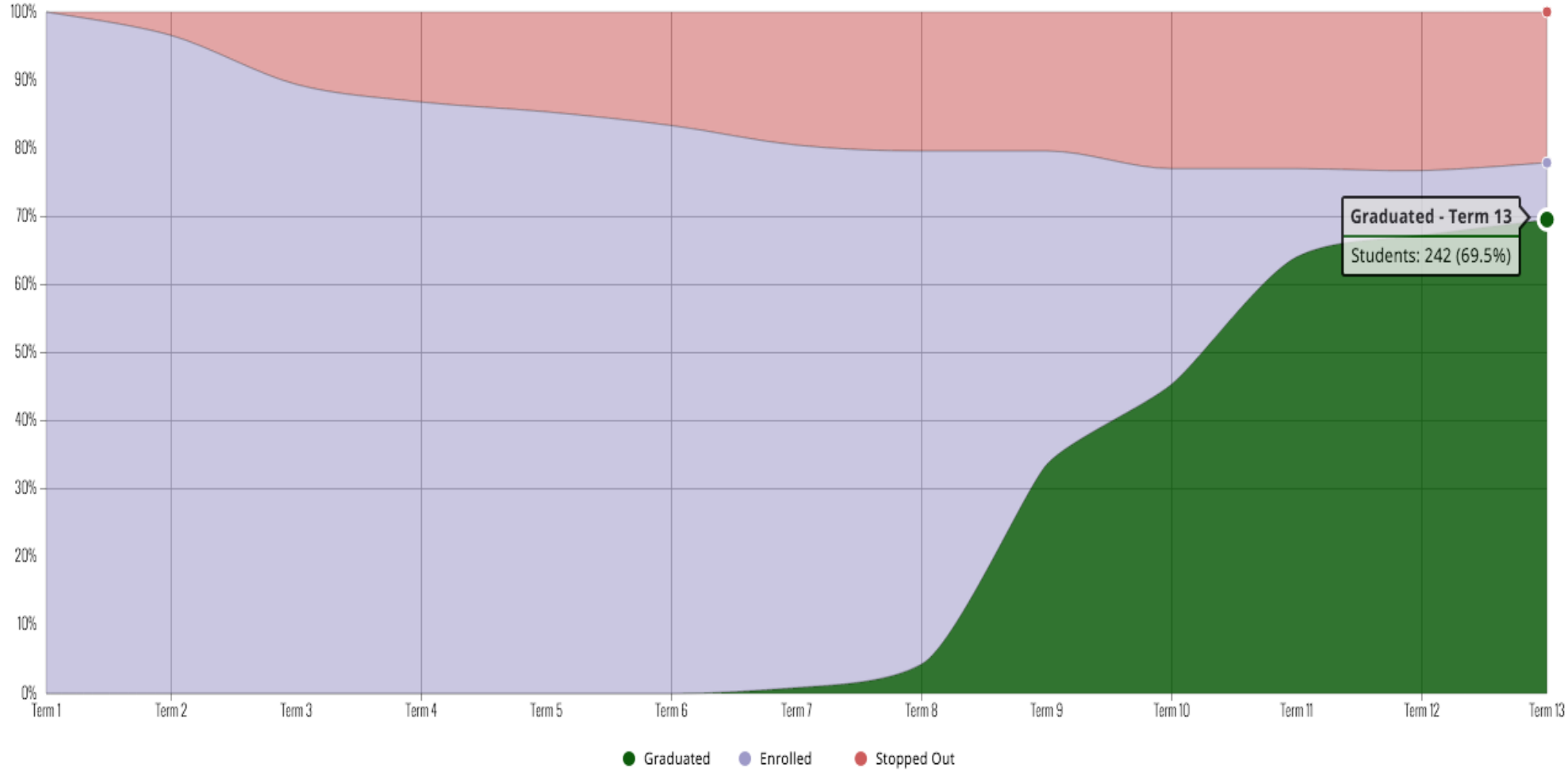
The easiest way to improve student success statistics:
Adjust the inputs.

- **Increase selectivity**, without changing the university system.
- Success rates will increase automatically.
- Degree production will drop — but not if you have increasing admissions competitiveness (demand/academic profile).
- Many of us do not have this luxury.
  studentflows.unm.edu

UNM's 2007 FTFT Freshman Cohort:



Composite ACT $\geq$ 27:

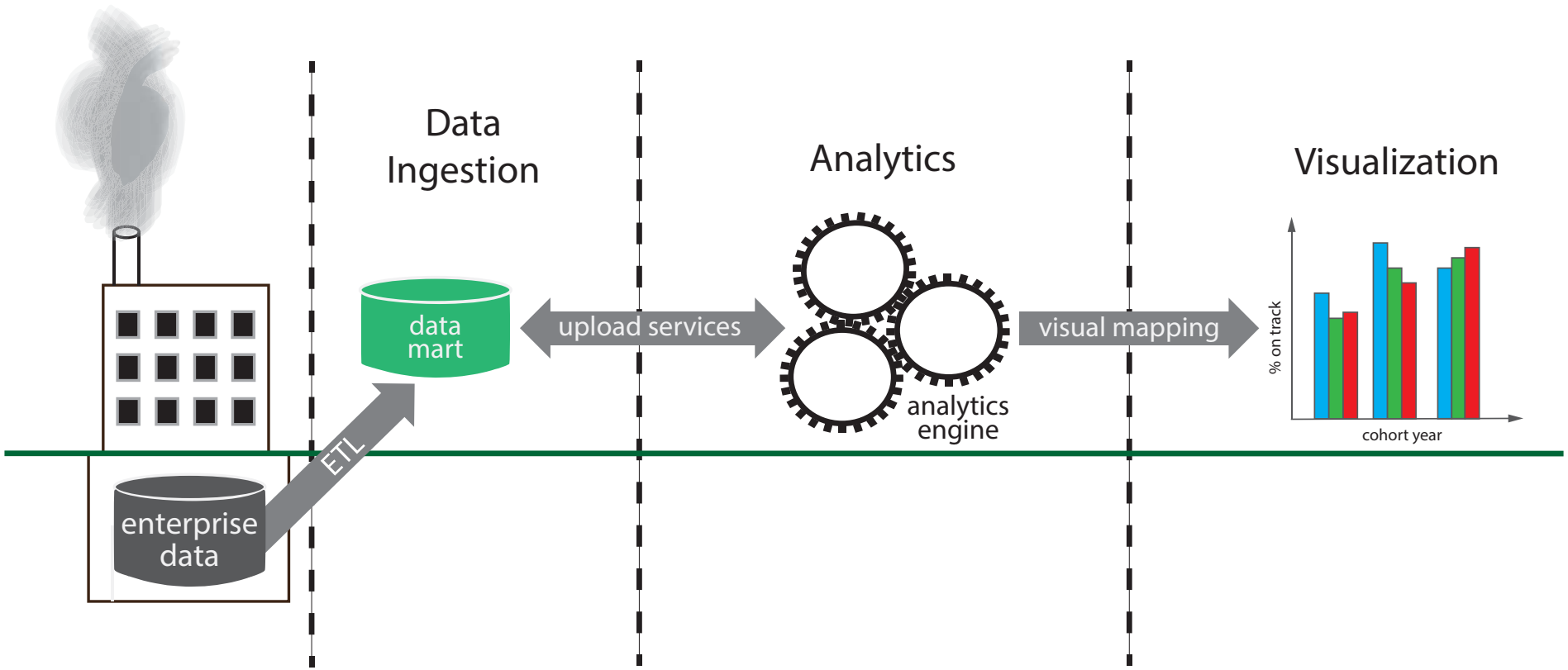


The University System – System Change

Changing the university system through improvement efforts requires:

- **Data Collection** — Often harder than you think.
- **System analysis (analytics)** — What should we analyze, and what are the potential benefits?
- **Change Management** — The "art of the deal."
  - The right thing to do is often resisted because of institutional culture, misunderstandings or fear of change.
  - Use analytics to focus improvement efforts on reality, rather than the perceptions of various interested parties.

Analytics Workflow



Curricular Complexity – a (structural) measure of how difficult it is for a student to traverse a curriculum.

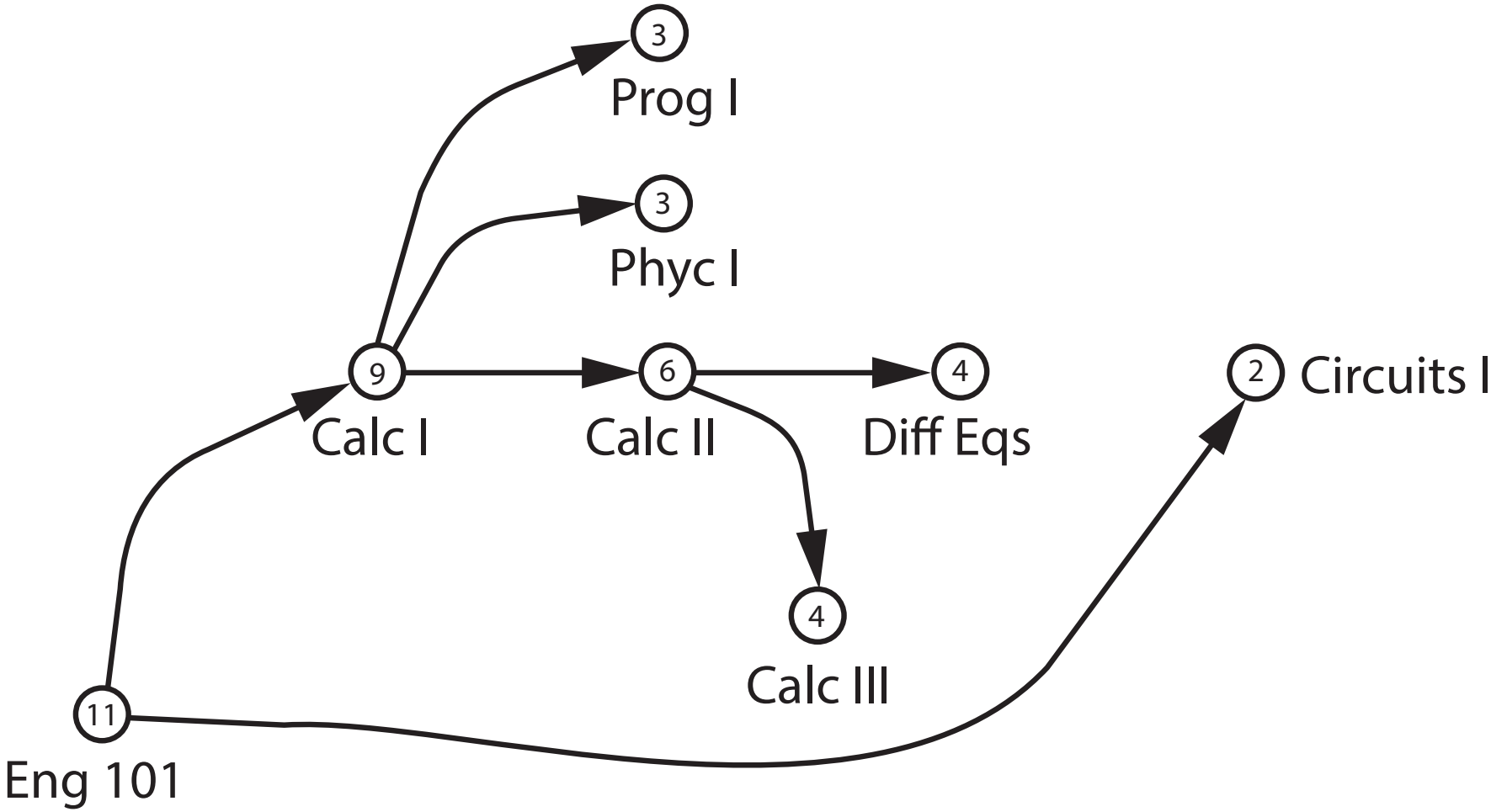
Curricular Efficiency – inversely related to curricular complexity.

Scorecard:

- **Data Requirements:** Low (degree requirements/courses/prereqs).
- **Analytics Difficulty:** Low (simple graph properties).
- **Improvement Potential:** High (curricular complexity highly correlated to wasted credit hours)
- **Change Management:** High (changing the curriculum).

Curricular Efficiency – Example

Curricular Complexity = 56 → 39 **Curricular Complexity = 56 →**



Curricular Efficiency – Change Management

Faculty:

- Ability to compare efficiency of similar programs at other schools.
- Supports "what if" analyses on their own curricula.

Deans:

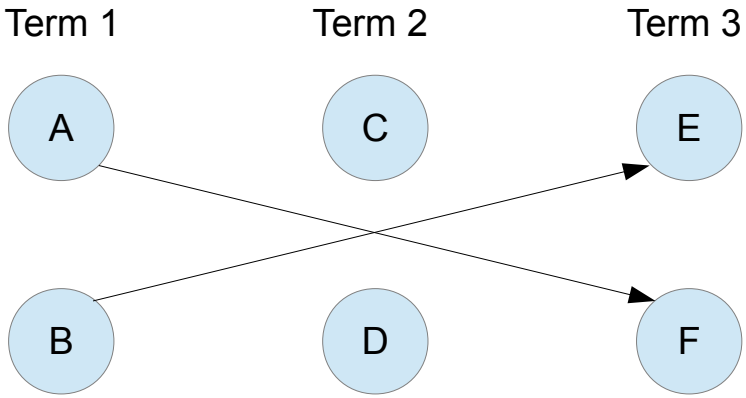
- Healthy competition – how efficient are my school's curricula, how many credit hours have we saved, etc.
- Give them a fair way to measure themselves, and they will use it. This dashboard is all that was needed:
  informatics.unm.edu/degrees/degrees.html

Curriculum Balancing – create a degree plan that optimally balances course workload across semesters.

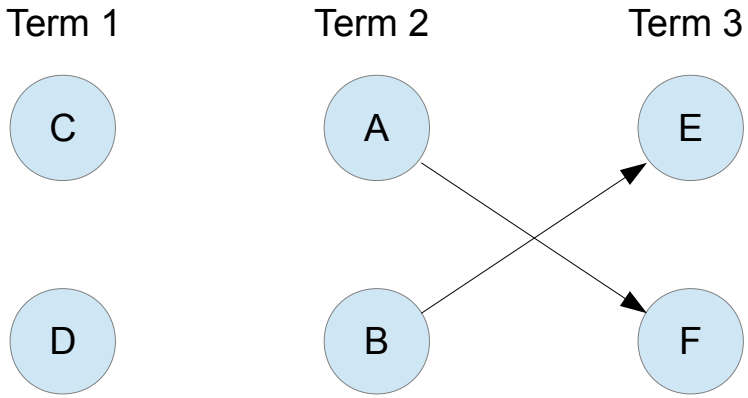
Scorecard:

- **Data Requirements:** Low (degree requirements/courses/prereqs).
- **Analytics Difficulty:** Medium (multi-objective optimization).
- **Improvement Potential:** Medium (when a course is taken matters).
- **Change Management:** Low (changing the degree plan, not the curriculum).

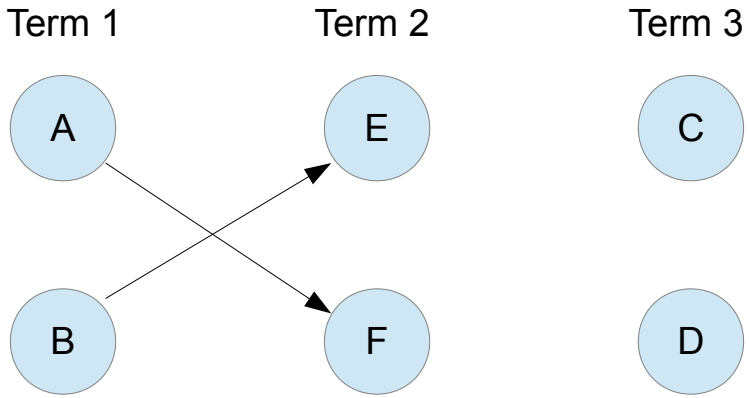
- **Balanced Academic Curriculum Problem (BACP)** – Create on optimal degree plan, balancing the credit hours associated with degree requirements across terms.
- **Relevance-Based Curriculum Balancing (RBCB)** – Place relevant courses closer together in the degree plan. A generalized quadratic assignment problem.
- **Crucial Course-based Curriculum Balancing (CBCB)** – Place crucial courses earlier in the degree plan. A multi-objective optimization problem.



(a) BACP Solution



(b) RBCB Solution

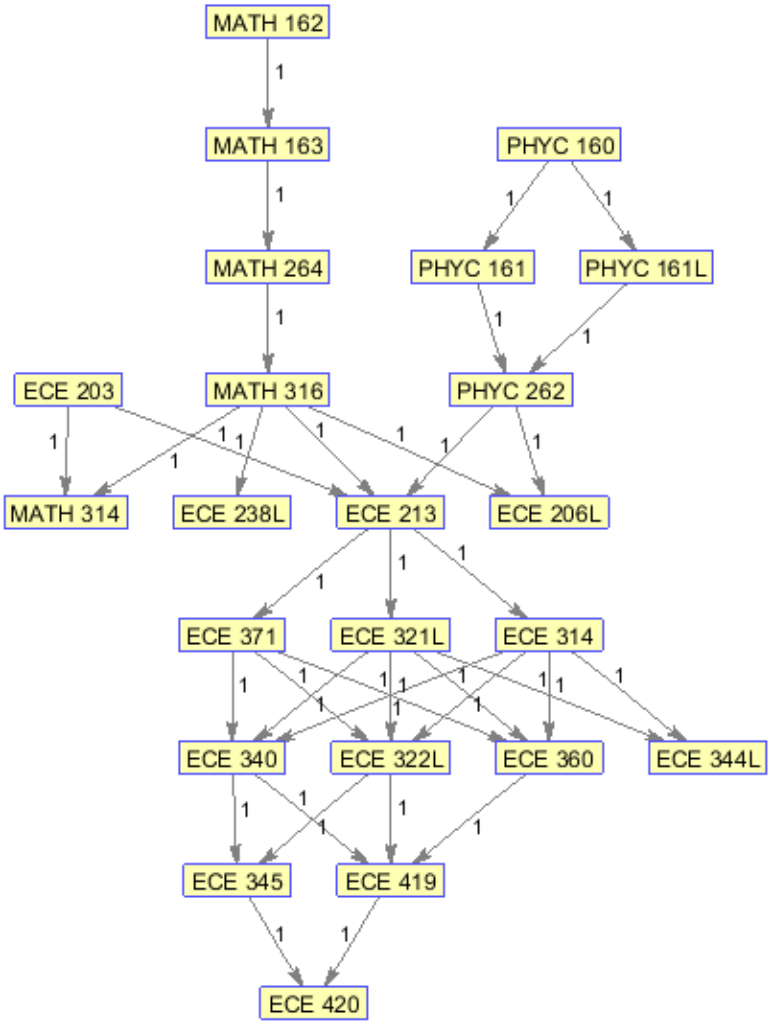


(c) CBCB Solution

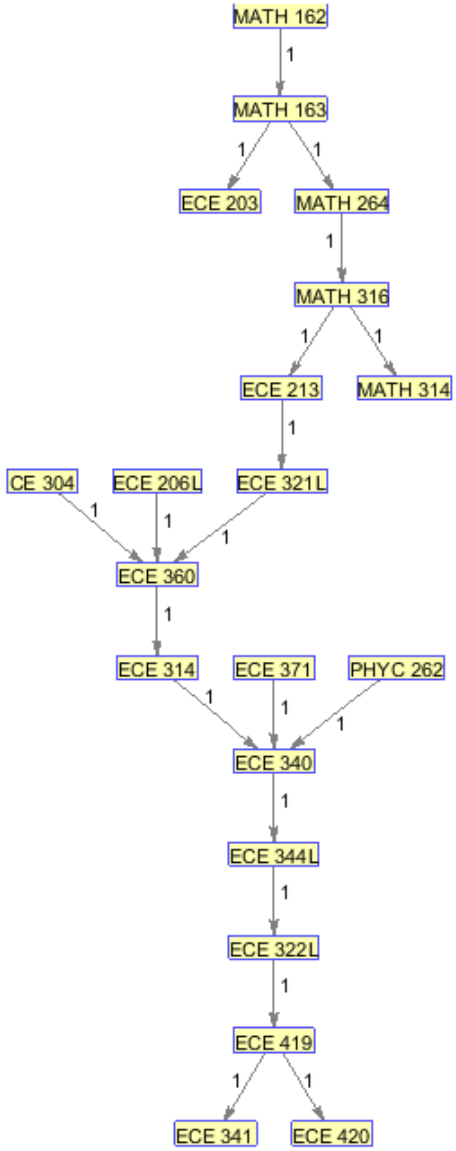
Curricular Sequences – Mining the most common course sequence for high- and low-performing students.

Scorecard:

- **Data Requirements:** High (requires student data).
- **Analytics Difficulty:** High (sequential pattern mining).
- **Improvement Potential:** Medium (when a course is taken matters).
- **Change Management:** Low (changing the degree plan, not the curriculum).



(d) High Performing



(e) Low Peforming

Sometimes you just need to explore:

analytics.academicdashboards.org

workforce.unm.edu

Dashboard showcase:

showcase.academicdashboards.org

Scorecard:

- **Data Requirements:** High (requires student data mart).
- **Analytics Difficulty:** Low, Medium, High (use your imagination).
- **Improvement Potential:** Low, Medium, High (use your imagination).
- **Change Management:** High (FERPA data in the cloud!).

Questions?