

# Cal Poly Optimization Schedule Builder

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# 1. Motivation

## Current System

*How many units does CSC 357 feel like?*

- Real units: 4 units
- Feels like units: 7.5 units

CSC307  
Introduction to  
Software Engineering  
**4 units**

Feels Like Units

5 units

CSC430  
Programming  
Languages  
**4 units**

5.25 units

CSC453  
Introduction to  
Operating Systems  
**4 units**

4.5 units

CSC445  
Theory of Computation  
**4 units**

4 units

**16 units**

18.75 units



# *Goal*

Average out the “Feels Like” unit count over all quarters





## 2. Implementation

## Data Base

- Flowchart Data: PFB Creator
- Feels Like Units:
  - Ourselves - 31%
  - Friends - 44%
  - Social Media - 25%

## Optimization modeling



- Framework for creating Mathematical Models
- Model Solvers

## Modeling The Problem

- You need to define the following:
  - Data sets
  - Decision Variables
  - Objective
  - Constraints



## Modeling The Problem: Data Sets

*QS: List of quarters in the schedule*

*CS: List of all classes in the schedule*

## Modeling The Problem: Decision Variables

- $SA(C, Q) = 0/1$  : A given class (C) and quarter (Q) is either assigned (1) or not (0)
  - Binary under linear solvers
  - Continuous under non-linear solvers
- $\max FL \geq 0$ : Most amount of "feels like" units of a quarter in the schedule

## Modeling The Problem: Objective Function

minimize: (maxFL)

## Modeling The Problem: Constraints

Constraint 1: Each quarter must have a total real unit count of at least 12

$$\sum_C^{CS} SA(C, Q)^2 \cdot GRU(C) \geq 12 \quad \forall Q \in QS$$

\*  $GRU(C)$ : real units of a class

## Modeling The Problem: Constraints

Constraint 2: Each quarter must have a total real unit count of at most 22

$$\sum_C^{CS} SA(C, Q)^2 \cdot GRU(C) \leq 22 \quad \forall Q \in QS$$

\*  $GRU(C)$ : real units of a class

## Modeling The Problem: Constraints

Constraint 3: Each class must be assigned exactly once

$$\sum_Q SA(C, Q) = 1 \quad \forall C \in CS$$

## Modeling The Problem: Constraints

Constraint 4: maxFL must be greater than or equal to the total “feels like” units of any quarter

$$\sum_C SA(C, Q) \cdot GFLU(C) \leq maxFL \quad \forall Q \in QS$$

\* $GFLU(C)$ : “feels like” units of a class

## Modeling The Problem: Constraints

Constraint 5: For each class that has prereqs, the sum of the class assignments of it's prereqs in the previous quarters must match the length of the prereqs list

$$\sum_Q^{QS} SA(C, Q) \cdot SA(C2, Q2) \quad \forall C2 \in PREQ(C) \quad \forall Q2 \in QS[: Q - 1] = PREQ(C).len \quad \forall C \in CS \wedge PREQ(C)$$

\*  $PREQ(C)$ : prereqs of a class



## Modeling The Problem: Constraints

Constraint 6: Each class that requires concurrent classes (labs), the sum of the class assignments of the concurrent classes in the same quarter must match the length of the list of concurrent classes of the given class

$$\sum_Q^{QS} SA(C, Q) \cdot SA(C2, Q) \quad \forall C2 \in PREQ(C) = PCON(C).len \quad \forall C \in CS \wedge PCON(C)$$

\*  $PCON(C)$ : concurrent classes of a given class

The background features several overlapping, slanted rectangular shapes in various shades of green and blue, creating a modern, geometric aesthetic. The text is centered within a horizontal band of a darker blue color.

## 3. Validation & Results



## Solving The Model

- Non-linear solvers treat binary variables as continuous
  - Only approximates optimal solution
- Some of the less constrained classes (GEs/placeholder blocks) don't get assigned

# Input To The System

Fall 2021	Winter 2022	Spring 2022	Fall 2022	Winter 2023	Spring 2023	Fall 2023	Winter 2024	Spring 2024	Fall 2024	Winter 2025	Spring 2025
<b>CPE100</b> Computer Engineering Orientation  1 unit <a href="#">i</a>	<b>CPE101</b> Fundamentals of Computer Science  4 units <a href="#">i</a>	<b>CPE202</b> Data Structures  4 units <a href="#">i</a>	<b>CPE203</b> Project-Based Object-Oriented Programmin...  4 units <a href="#">i</a>	<b>EE211</b> Electric Circuit Analysis II  3 units <a href="#">i</a>	<b>EE212</b> Electric Circuit Analysis III  3 units <a href="#">i</a>	<b>CPE327</b> Digital Signals and Systems  3 units <a href="#">i</a>	<b>EE307</b> Digital Electronics and Integrated Circuits  3 units <a href="#">i</a>	<b>CPE453</b> Introduction to Operating Systems  4 units <a href="#">i</a>	<b>CPE464</b> Introduction to Computer Networks  4 units <a href="#">i</a>	<b>CPE461</b> Senior Project I  3 units <a href="#">i</a>	<b>CPE462</b> Senior Project II  2 units <a href="#">i</a>
<b>CPE123</b> Introduction to Computing  4 units <a href="#">i</a>	<b>PHYS141</b> General Physics IA  4 units <a href="#">i</a>	<b>EE113</b> Electric Circuit Analysis I  3 units <a href="#">i</a>	<b>CPE133</b> Digital Design  4 units <a href="#">i</a>	<b>EE241</b> Electric Circuit Analysis Laboratory II  1 unit <a href="#">i</a>	<b>EE242</b> Electric Circuit Analysis Laboratory III  1 unit <a href="#">i</a>	<b>CPE367</b> Digital Signals and Systems Laboratory  1 unit <a href="#">i</a>	<b>EE347</b> Digital Electronics and Integrated Circuits...  1 unit <a href="#">i</a>	<b>CPE333</b> Computer Hardware Architecture and...  4 units <a href="#">i</a>	<b>CPE350</b> Capstone I  4 units <a href="#">i</a>	<b>CPE450</b> Capstone II  3 units <a href="#">i</a>	<b>Approved Technical...</b>  4 units <a href="#">i</a>
<b>MATH141</b> Calculus I  4 units <a href="#">i</a>	<b>COMS101</b> Public Speaking  4 units <a href="#">i</a>	<b>EE143</b> Electronics Manufacturing and...  1 unit <a href="#">i</a>	<b>PHYS133</b> General Physics III  4 units <a href="#">i</a>	<b>CPE233</b> Computer Design and Assembly Language...  4 units <a href="#">i</a>	<b>CSC248</b> Discrete Structures  4 units <a href="#">i</a>	<b>CPE357</b> Systems Programming  4 units <a href="#">i</a>	<b>Approved Elective</b> CSC, EE, Math, or Science 3-4 units <a href="#">i</a>	<b>CPE316</b> Microcontrollers and Embedded Applications  4 units <a href="#">i</a>	<b>STAT350</b> Probability and Random Processes for...  4 units <a href="#">i</a>	<b>Approved Technical...</b>  4 units <a href="#">i</a>	<b>Approved Technical...</b>  4 units <a href="#">i</a>
<b>CHEM124</b> General Chemistry for Physical Science and...  4 units <a href="#">i</a>	<b>MATH142</b> Calculus II  4 units <a href="#">i</a>	<b>MATH143</b> Calculus III  4 units <a href="#">i</a>	<b>MATH241</b> Calculus IV  4 units <a href="#">i</a>	<b>PHYS132</b> General Physics II  4 units <a href="#">i</a>	<b>PHYS211</b> Modern Physics I  4 units <a href="#">i</a>	<b>EE306</b> Semiconductor Device Electronics  3 units <a href="#">i</a>	<b>GE</b>  4 units <a href="#">i</a>	<b>GE</b>  4 units <a href="#">i</a>	<b>GE</b>  4 units <a href="#">i</a>	<b>GE</b>  4 units <a href="#">i</a>	<b>GE</b>  4 units <a href="#">i</a>
<b>ENGL134</b> Writing and Rhetoric  4 units <a href="#">i</a>		<b>ENGL147</b> Writing Arguments about STEM  4 units <a href="#">i</a>		<b>MATH244</b> Linear Analysis I  4 units <a href="#">i</a>	<b>Philosophical Classics</b> PHIL230 or PHIL231  4 units <a href="#">i</a>	<b>EE346</b> Semiconductor Device Electronics Laboratory  1 unit <a href="#">i</a>	<b>GE</b>  4 units <a href="#">i</a>		<b>GE</b>  4 units <a href="#">i</a>		
<b>14.36</b>	<b>15.34</b>	<b>17.30</b>	<b>15.75</b>	<b>18.83</b>	<b>15.58</b>	<b>20.50</b>	<b>17.00</b>	<b>17.50</b>	<b>16.50</b>	<b>18.00</b>	<b>14.00</b>
17	16	16	16	16	16	16	15-16	16	16	18	14

# Output

Summer 2021	Fall 2021	Winter 2022	Spring 2022	Summer 2022	Fall 2022	Winter 2023	Spring 2023	Summer 2023	Fall 2023	Winter 2024	Spring 2024
<b>MATH141</b> Calculus I  4 units 	<b>MATH142</b> Calculus II  4 units 	<b>CHEM124</b> General Chemistry for Physical Science and...  4 units 	<b>EE113</b> Electric Circuit Analysis I  3 units 	<b>CPE100</b> Computer Engineering Orientation  1 unit 	<b>CPE123</b> Introduction to Computing  4 units 	<b>CPE203</b> Project-Based Object-Oriented Programmin...  4 units 	<b>ENGL134</b> Writing and Rhetoric  4 units 	<b>MATH241</b> Calculus IV  4 units 	<b>PHYS211</b> Modern Physics I  4 units 	<b>EE306</b> Semiconductor Device Electronics  3 units 	<b>EE307</b> Digital Electronics and Integrated Circuits  3 units 
<b>CPE101</b> Fundamentals of Computer Science  4 units 	<b>ENGL147</b> Writing Arguments about STEM  4 units 	<b>CPE202</b> Data Structures  4 units 	<b>EE143</b> Electronics Manufacturing and...  1 unit 	<b>MATH143</b> Calculus III  4 units 	<b>COMS101</b> Public Speaking  4 units 	<b>Approved Elective</b> CSC, EE, Math, or Science 3-4 units 	<b>EE212</b> Electric Circuit Analysis III  3 units 	<b>CPE327</b> Digital Signals and Systems  3 units 	<b>CPE464</b> Introduction to Computer Networks  4 units 	<b>EE346</b> Semiconductor Device Electronics Laboratory  1 unit 	<b>EE347</b> Digital Electronics and Integrated Circuits...  1 unit 
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 <b>GE</b>  4 units 	<b>Approved Technical...</b>  4 units 	<b>Ethics</b> Choose One  4 units 	<b>CPE233</b> Computer Design and Assembly Language...  4 units 	<b>EE241</b> Electric Circuit Analysis Laboratory II  1 unit 	<b>MATH244</b> Linear Analysis I  4 units 	<b>GE</b>  4 units 	<b>CSC248</b> Discrete Structures  4 units 	<b>CPE316</b> Microcontrollers and Embedded Applications  4 units 	<b>STAT350</b> Probability and Random Processes for...  4 units 	<b>CPE461</b> Senior Project I  3 units 	<b>Approved Technical...</b>  4 units 
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<b>15.63</b>	<b>15.75</b>	<b>16.36</b>	<b>17.25</b>	<b>17.55</b>	<b>19.04</b>	<b>16.00</b>	<b>15.83</b>	<b>16.00</b>	<b>16.25</b>	<b>15.00</b>	<b>16.50</b>
16	16	16	16	13	16	16	16	16	16	14	14

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*LIVE DEMO*

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The background is a solid dark blue. On the left and right sides, there are several overlapping, slanted rectangular shapes in various shades of green and blue, creating a dynamic, layered effect. In the center, a horizontal band of a slightly lighter blue color contains the text.

## 4. Conclusion

## Conclusion

A lot of room for growth

- More constraints will improve the quality of the results
- More data (different types) needed to create new constraints
- A little bit more tweaking...





5. Questions?

The background features a dark blue gradient with several overlapping, semi-transparent geometric shapes in shades of green and blue. These shapes are primarily parallelograms and trapezoids, some of which are tilted at an angle, creating a dynamic, layered effect. The shapes are positioned on the left and right sides of the slide, framing the central text.

## 6. Resources