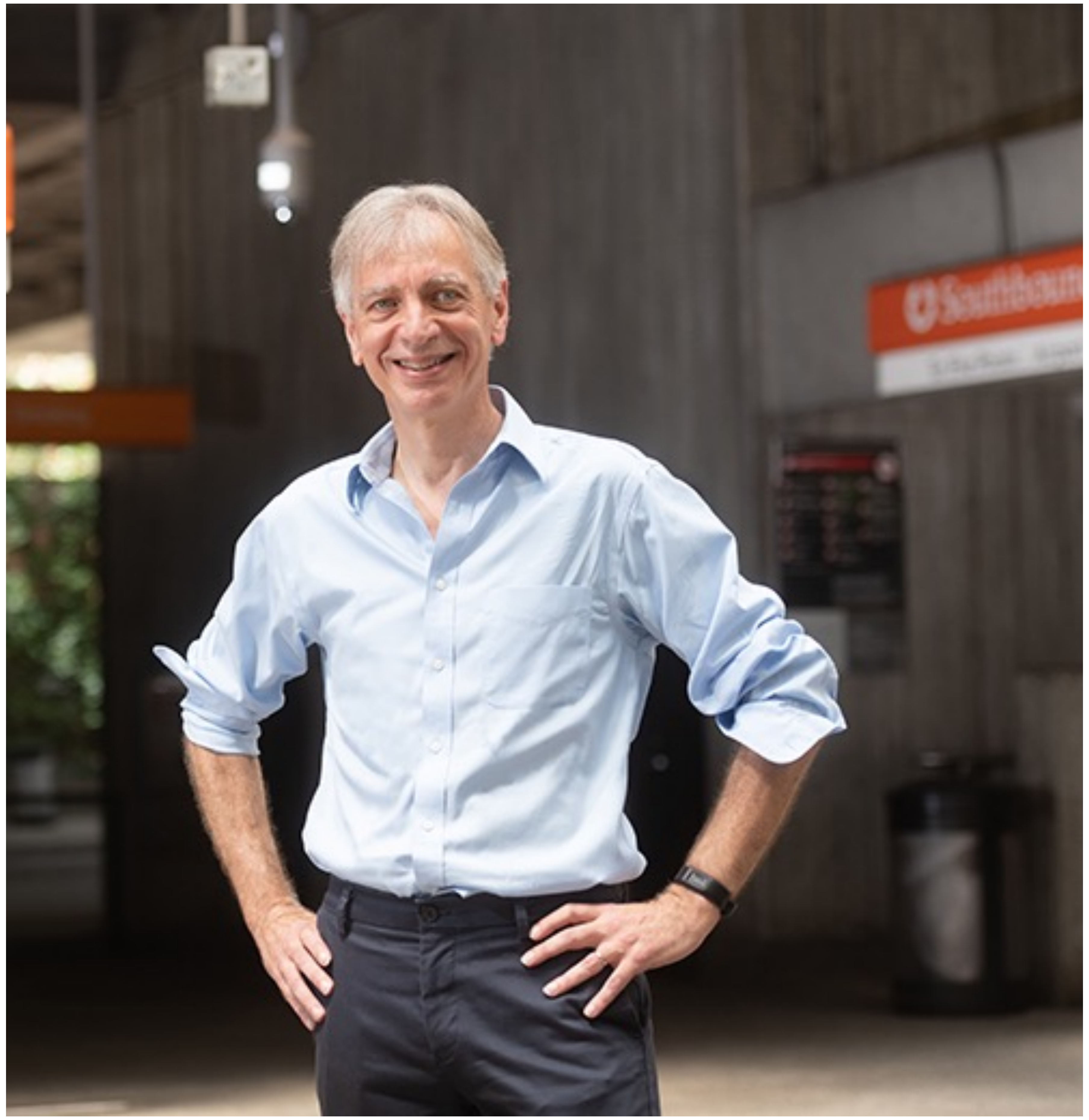
Modern Constraint Programming Education: Lessons for the Future

Tejas Santanam & Pascal Van Hentenryck, Georgia Tech

The Georgia Tech CP Course

AI Institute for Advances in Optimization



The Georgia Tech CP Course

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zoom

CANVAS

NSF

The Georgia Tech CP Course

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- Basics of CP
- Elements of CP
  - Reification
  - Optimization
- Global Constraints
- Modeling in CP
  - Symmetry breaking
  - Redundant constraints
- Search in CP
- Scheduling
  - Interval vars
  - Sequence vars
  - Cumulative constraints
- Advanced Topics
  - Routing
  - Scripting
  - CP in Python
  - MiniCP

Lecture Videos

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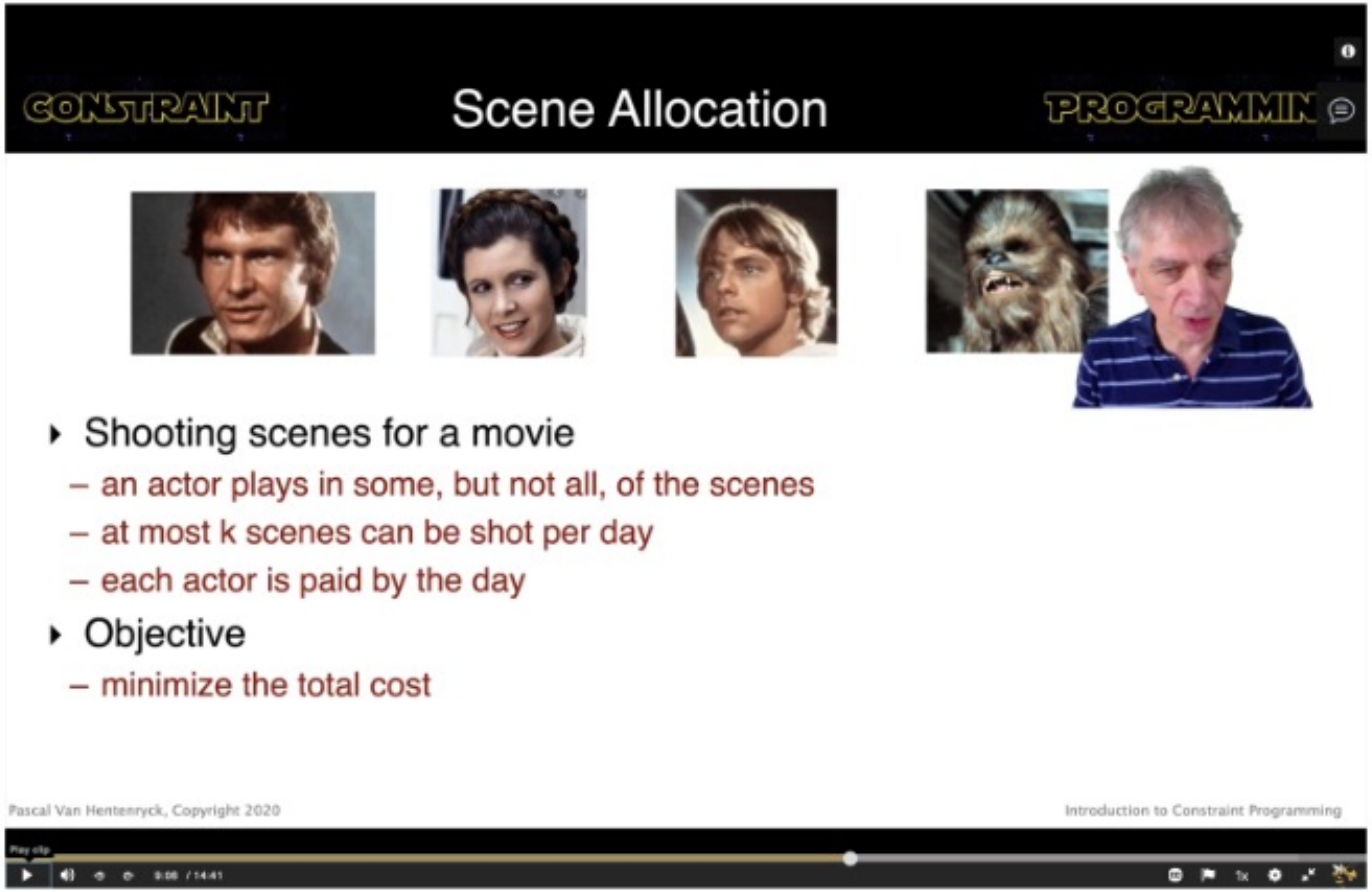

Interactive Sessions and Discussion Forums

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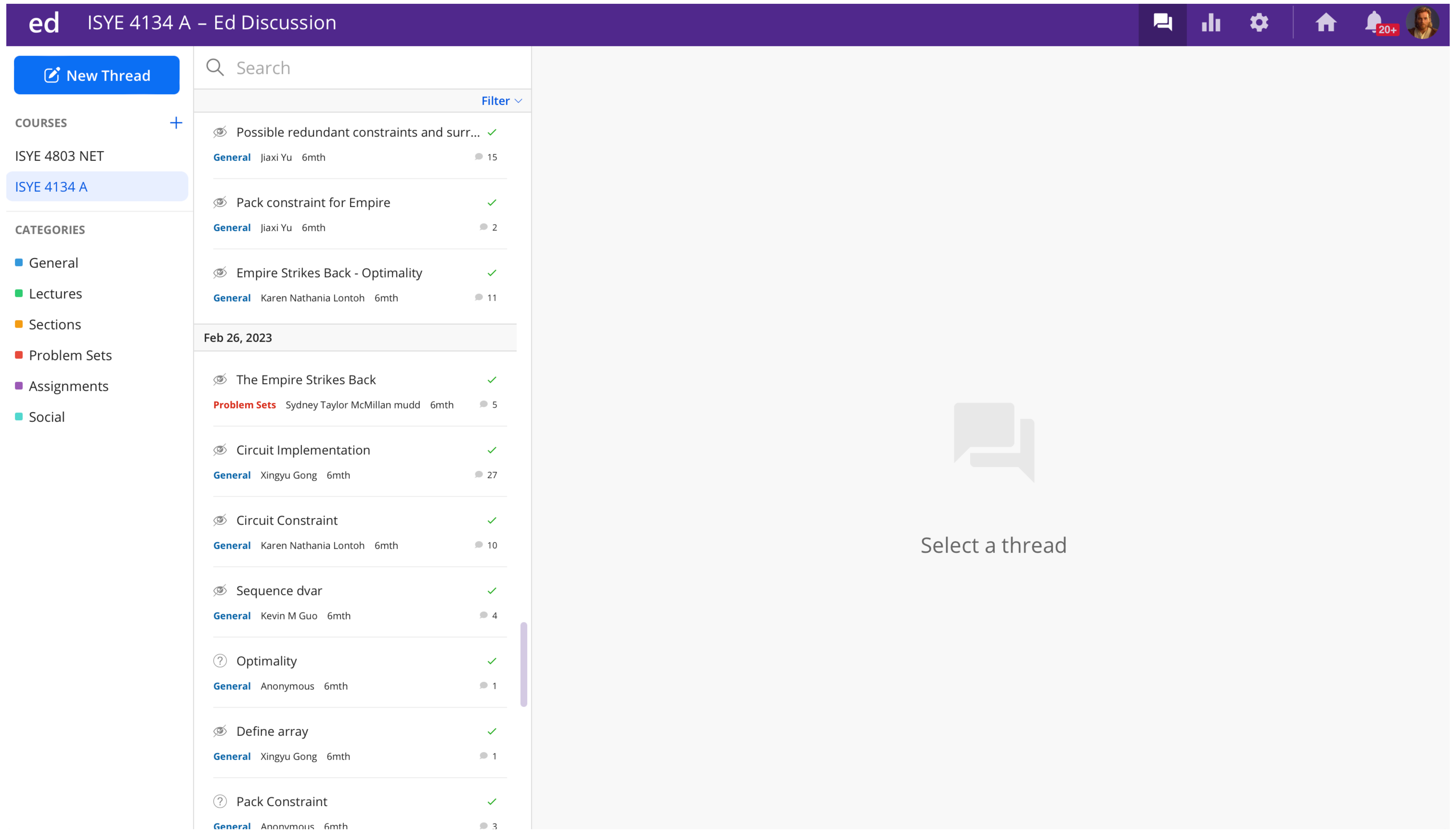

Assignments

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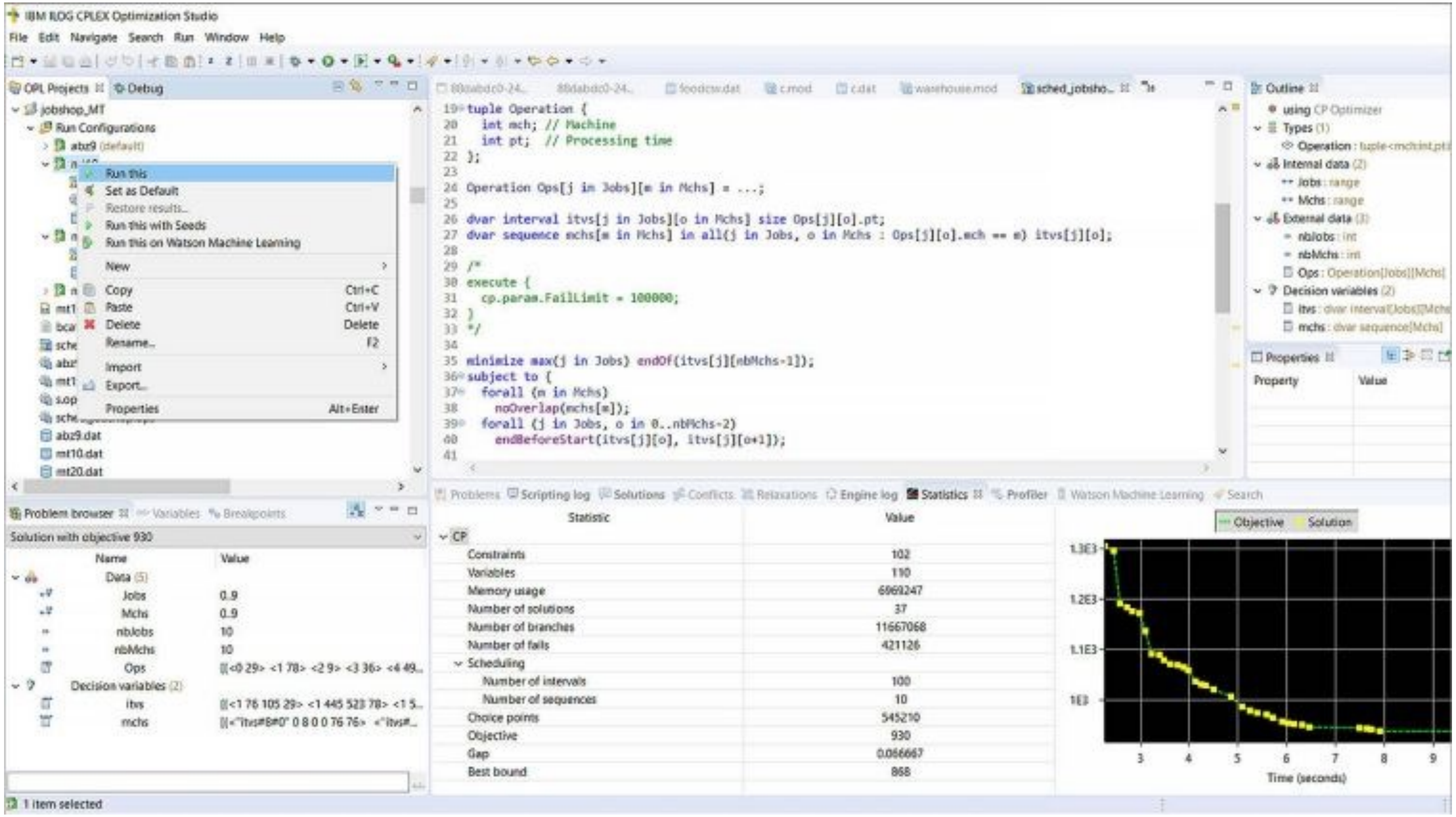

Star Wars Theme

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Student Engagement

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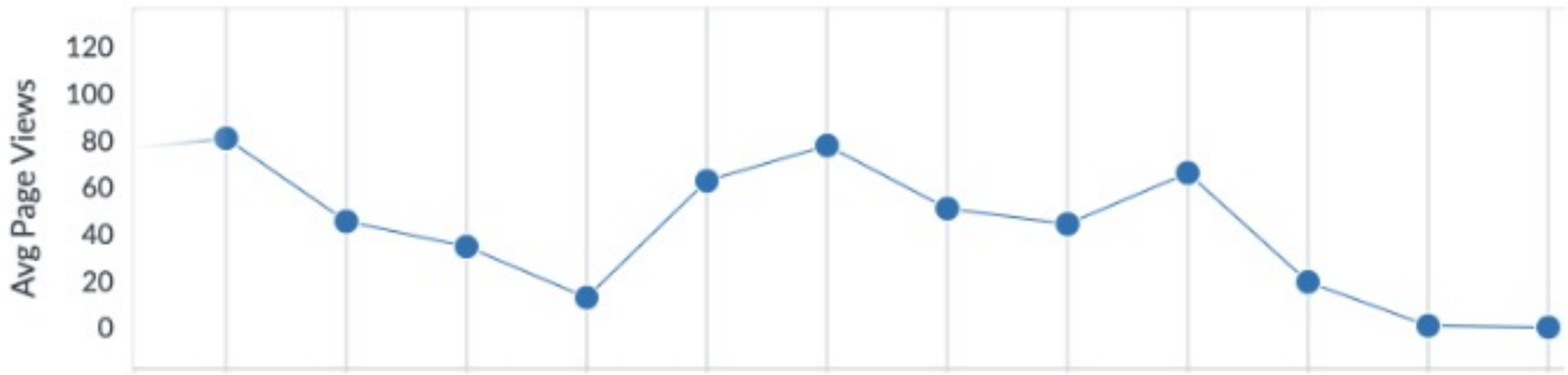
Figure 2 Average weekly student interaction with the course material over the semester



Student Reception

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Table 1 Enrollment for past iterations of the Georgia Tech CP course

Semester	Fall 2018	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Spring 2023
Enrollment	26	41	94	100	183	30

Table 2 Survey ratings for past iterations of the Georgia Tech CP course

Semester	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Spring 2023
Number of Respondents	15	82	93	153	26
Amount Learned	4.9	4.8	4.5	4.4	4.6
Instructor stimulates interest	4.9	4.95	4.8	4.6	4.8
Instructor effectiveness	5	4.97	4.9	4.7	4.7
Course effectiveness	4.9	4.92	4.8	4.3	4.6

Teaching to Undergraduate and Engineering Students

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Modeling-Focused Teaching and Autograders

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transp4.mod

```
execute SETTINGS {
  settings.displayComponentName = true;
  settings.displayWidth = 40;
  writeln("Routes: ",Routes);
}

execute DISPLAY {
  function printRoute(r) {
    write("  ",r.p,":");
    writeln(r.e.o,"->",r.e.d);
  }

  writeln("Routes:");
  for (var r in Routes) {
    printRoute(r);
  }
}
{string} Orig[p in Products] = { c.o | <p,c> in Routes };
{string} Dest[p in Products] = { c.d | <p,c> in Routes };

{connection} CPs[p in Products] = { c | <p,c> in Routes };
```

Distance Learning

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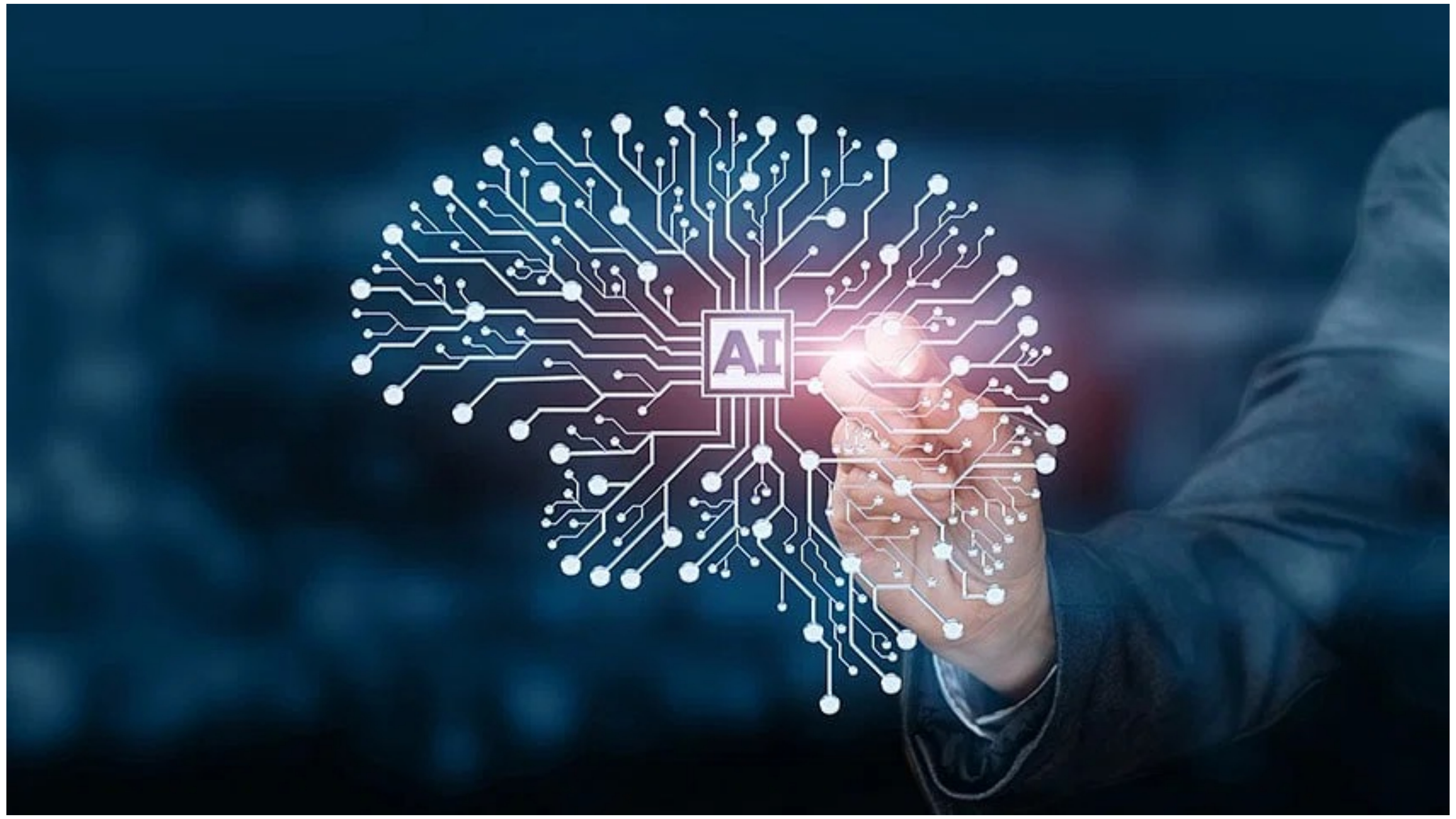
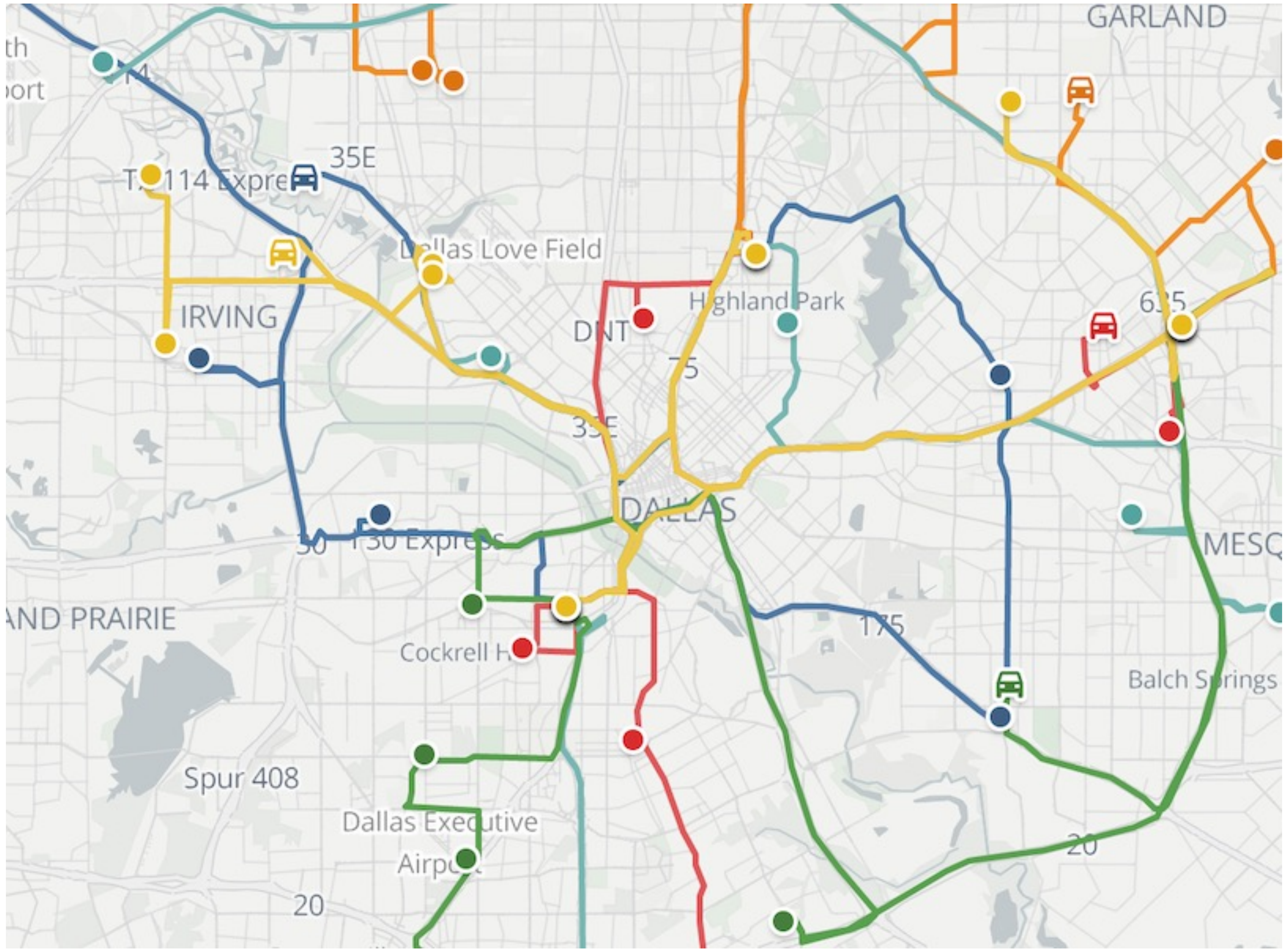
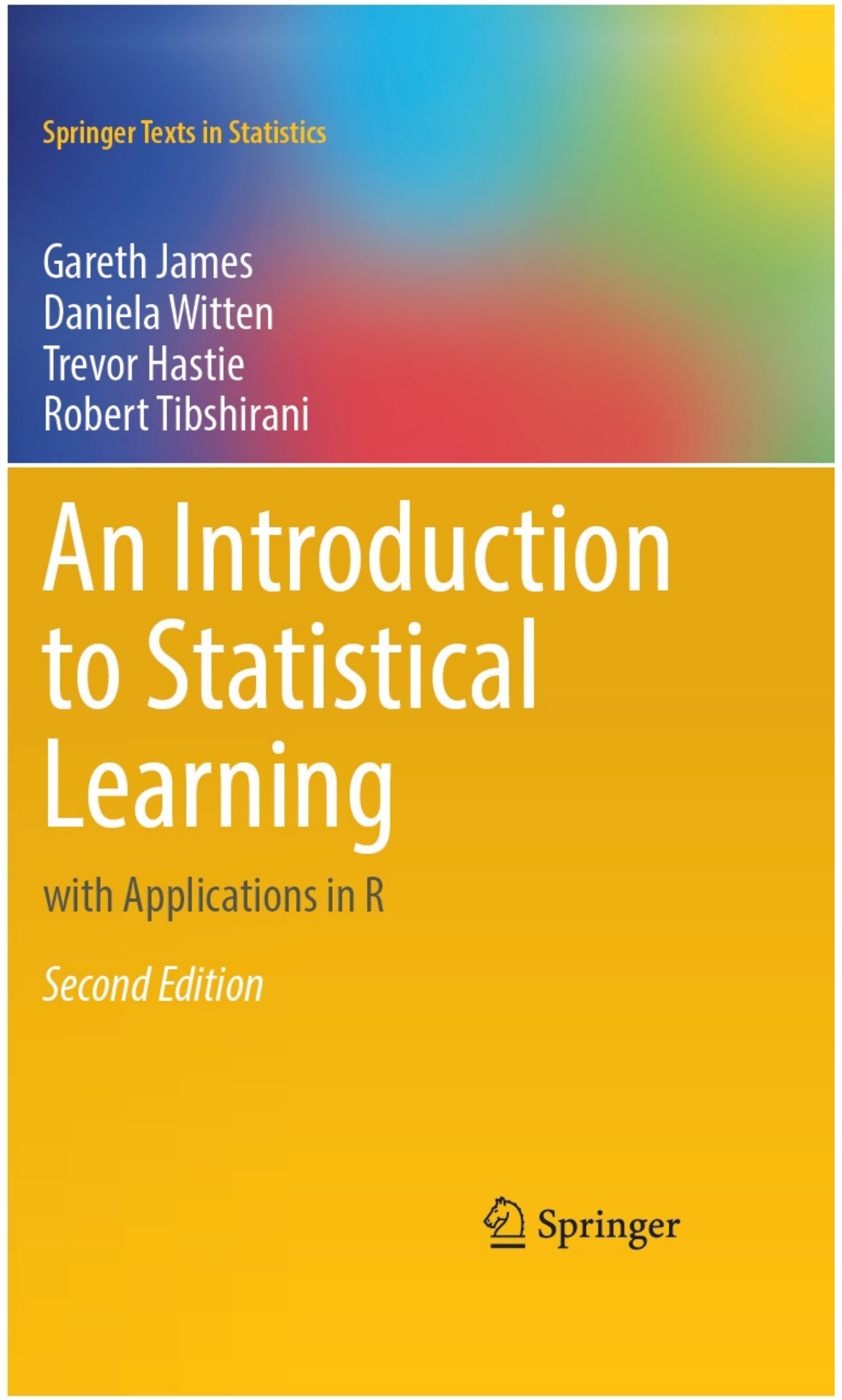
Promotion of CP





Introductory Resources and Availability

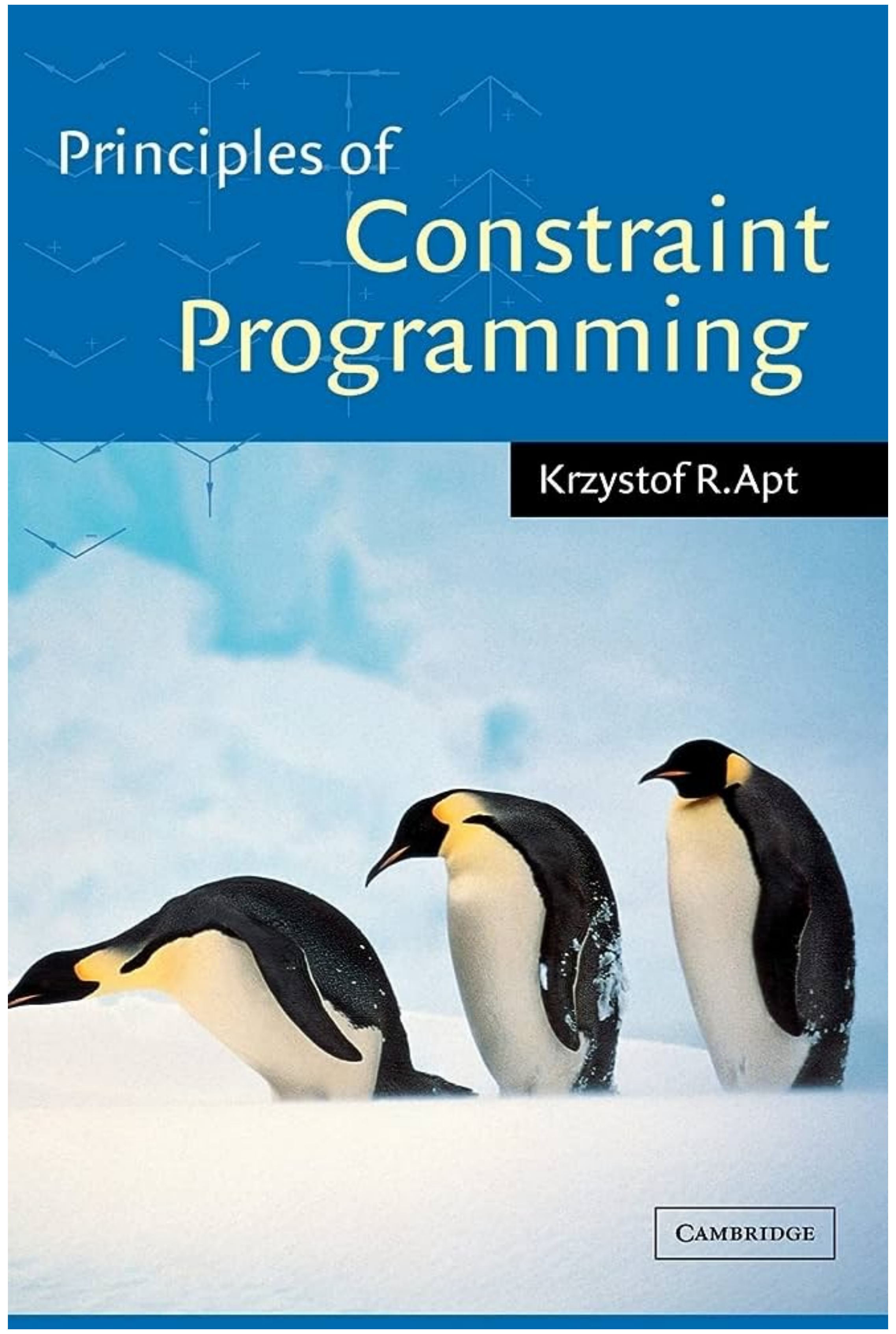


scikit learn

python

edX

Mini Zn



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Impact of LLMs

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```
// Sets and parameters
int n = ...; // number of legions
range Legions = 1..n;

// Decision variables
int s[Legions]; // position of each legion

// Constraints
subject to {
  forall (i in Legions, j in Legions: i != j) {
    s[i] != s[j]; // each legion must be positioned at a unique site
  }

  forall (i in Legions: i < n) {
    forall (j in Legions: j > i) {
      |s[j] - s[i]| != j - i; // distances between legions must be distinct
    }
  }
}
```

Regenerate response

Thank you!