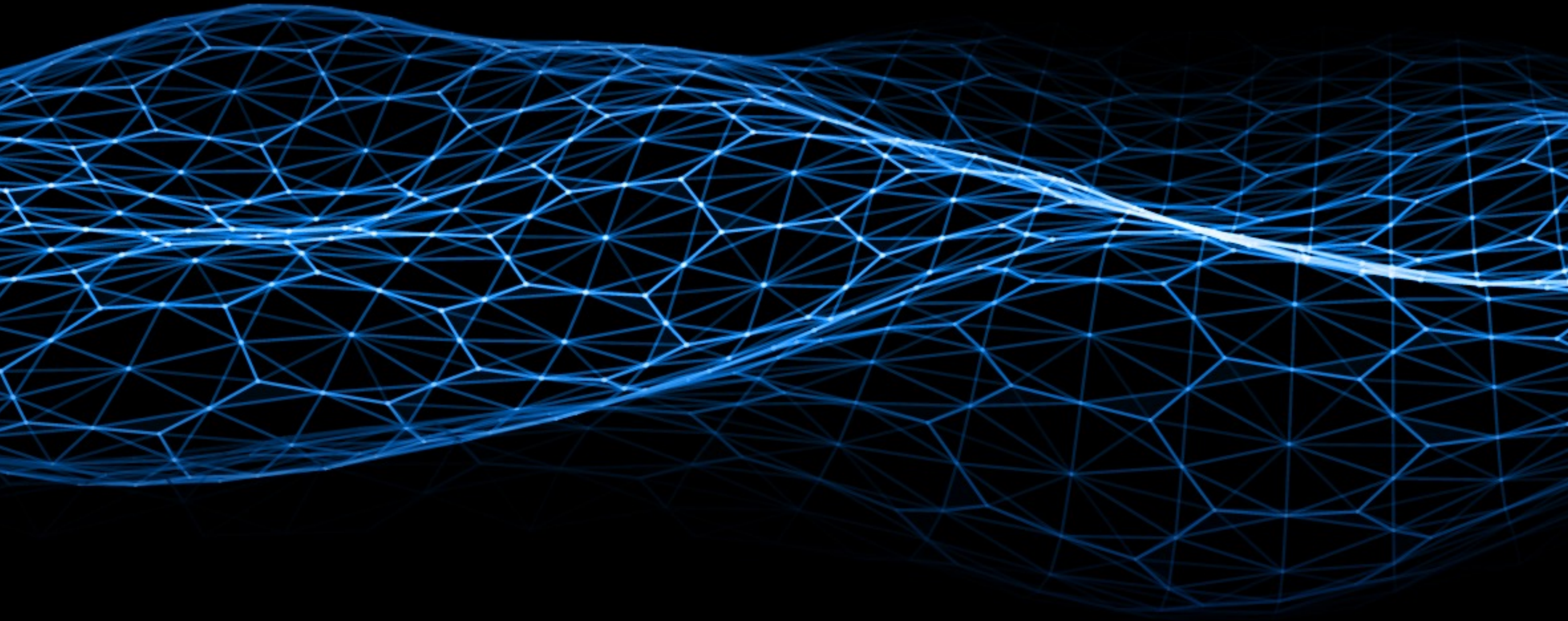


# Modern Constraint Programming Education: Lessons for the Future



Tejas Santanam & Pascal Van Hentenryck, Georgia Tech



# The Georgia Tech CP Course





# The Georgia Tech CP Course


The Zoom logo, consisting of the word "zoom" in white lowercase letters on a blue background.

# The Georgia Tech CP Course

- ▶ 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

**CONSTRAINT**      Scene Allocation      **PROGRAMMIN**



- ▶ Shooting scenes for a movie
  - an actor plays in some, but not all, of the scenes
  - at most  $k$  scenes can be shot per day
  - each actor is paid by the day
- ▶ Objective
  - minimize the total cost

Pascal Van Hentenryck, Copyright 2020      Introduction to Constraint Programming

Play clip      9:08 / 14:41



# Interactive Sessions and Discussion Forums



ed ISYE 4134 A – Ed Discussion

New Thread

COURSES

ISYE 4803 NET

ISYE 4134 A

CATEGORIES

General

Lectures

Sections

Problem Sets

Assignments

Social

Search

Filter

Possible redundant constraints and surr...

General

Jiaxi Yu

6mth

15

Pack constraint for Empire

General

Jiaxi Yu

6mth

2

Empire Strikes Back - Optimality

General

Karen Nathania Lontoh

6mth

11

Feb 26, 2023

The Empire Strikes Back

Problem Sets

Sydney Taylor McMillan mudd

6mth

5

Circuit Implementation

General

Xingyu Gong

6mth

27

Circuit Constraint

General

Karen Nathania Lontoh

6mth

10

Sequence dvar

General

Kevin M Guo

6mth

4

Optimality

General

Anonymous

6mth

1

Define array

General

Xingyu Gong

6mth

1

Pack Constraint

General

Anonymous

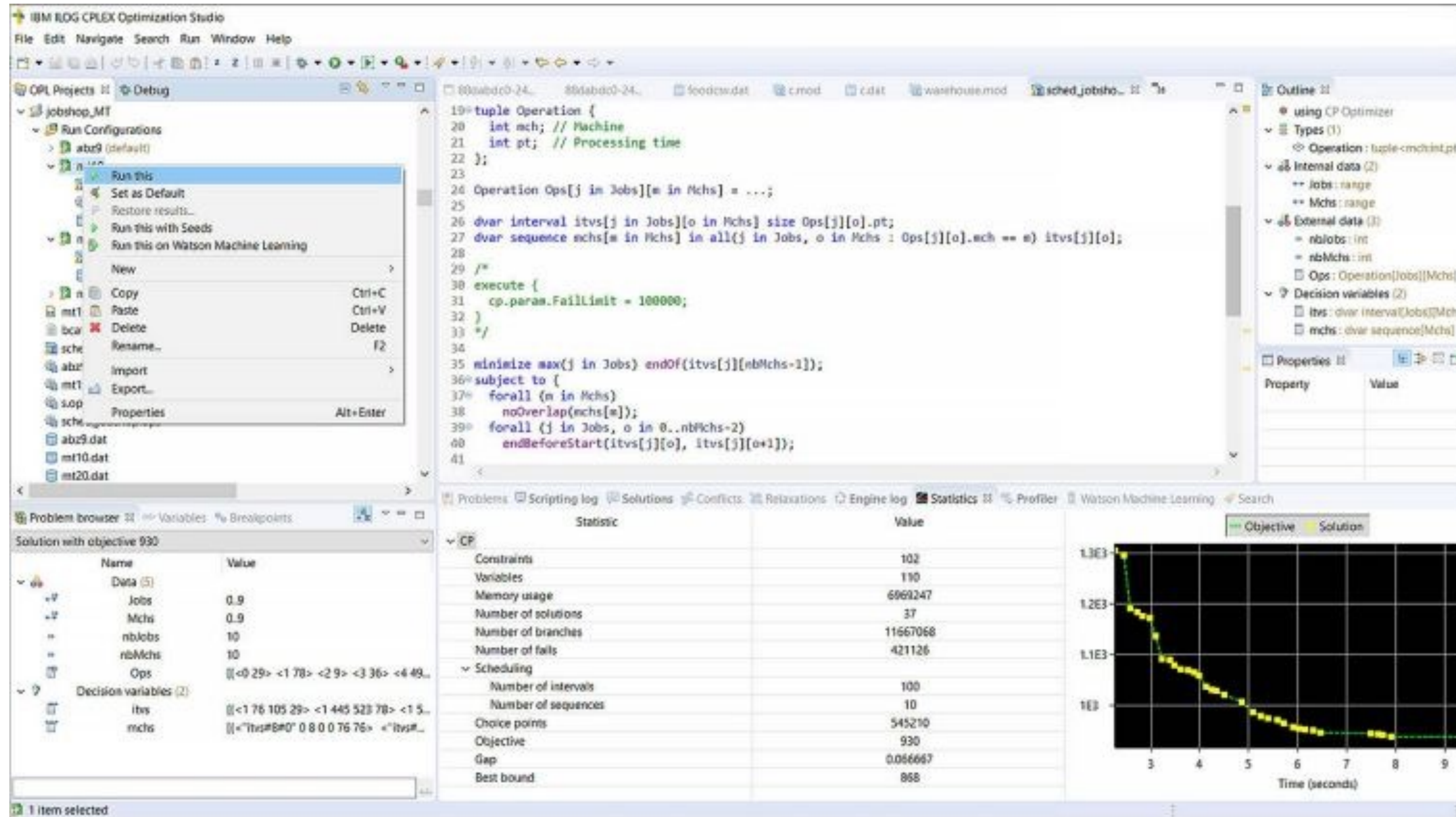
6mth

3

Select a thread



# Assignments





# Star Wars Theme





# Student Engagement

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





# Student Reception

■ **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





# Modeling-Focused Teaching and Autograders

```
transp4.mod X
59
60 execute SETTINGS {
61   settings.displayComponentName = true;
62   settings.displayWidth = 40;
63   writeln("Routes: ", Routes);
64 }
65
66 execute DISPLAY {
67   function printRoute(r) {
68     write("  ", r.p, ":");
69     writeln(r.e.o, "->", r.e.d);
70   }
71
72   writeln("Routes:");
73   for (var r in Routes) {
74     printRoute(r);
75   }
76 }
77 {string} Orig[p in Products] = { c.o | <p,c> in Routes };
78 {string} Dest[p in Products] = { c.d | <p,c> in Routes };
79
80 {connection} CPs[p in Products] = { c | <p,c> in Routes };
81
```

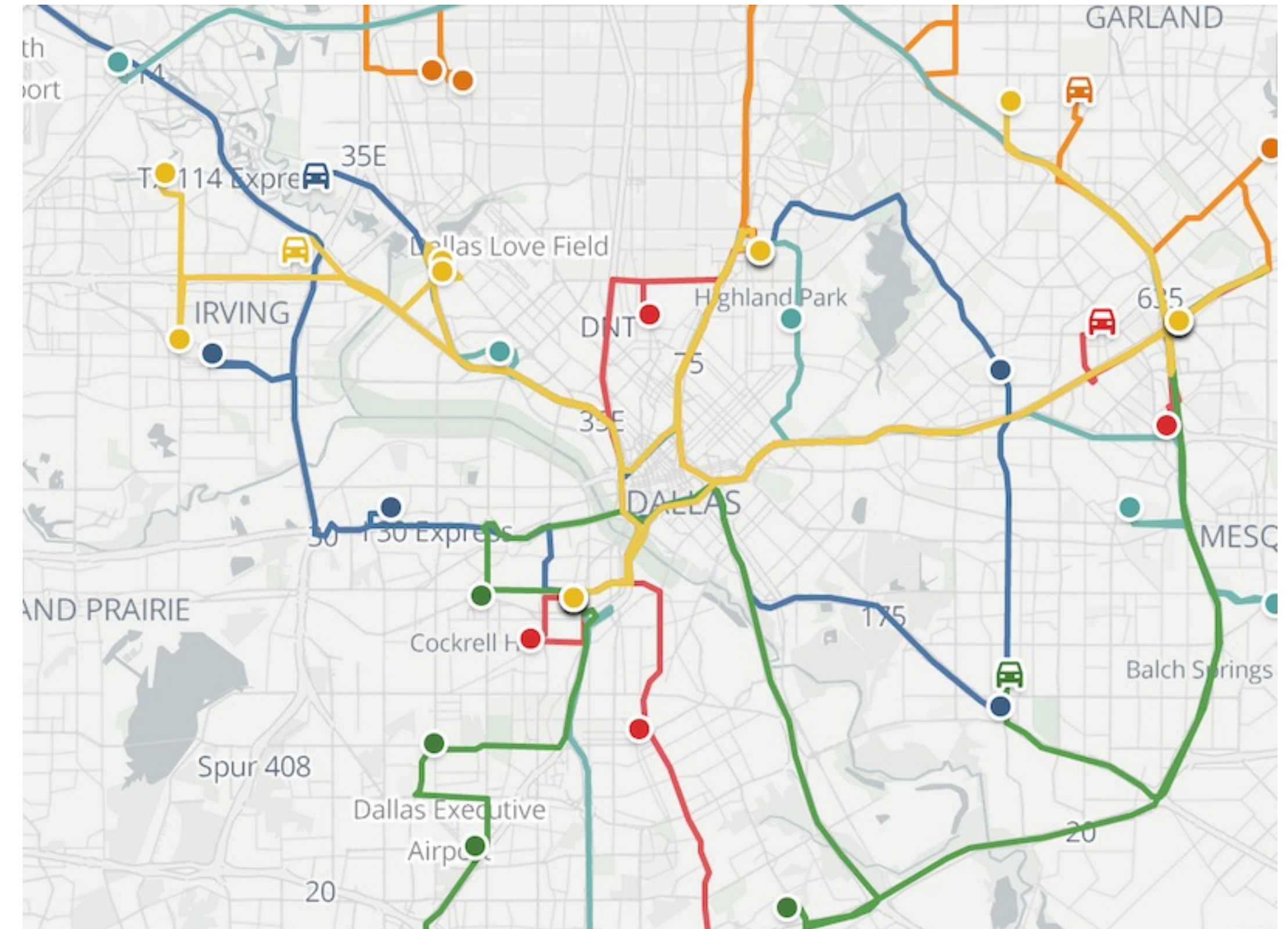
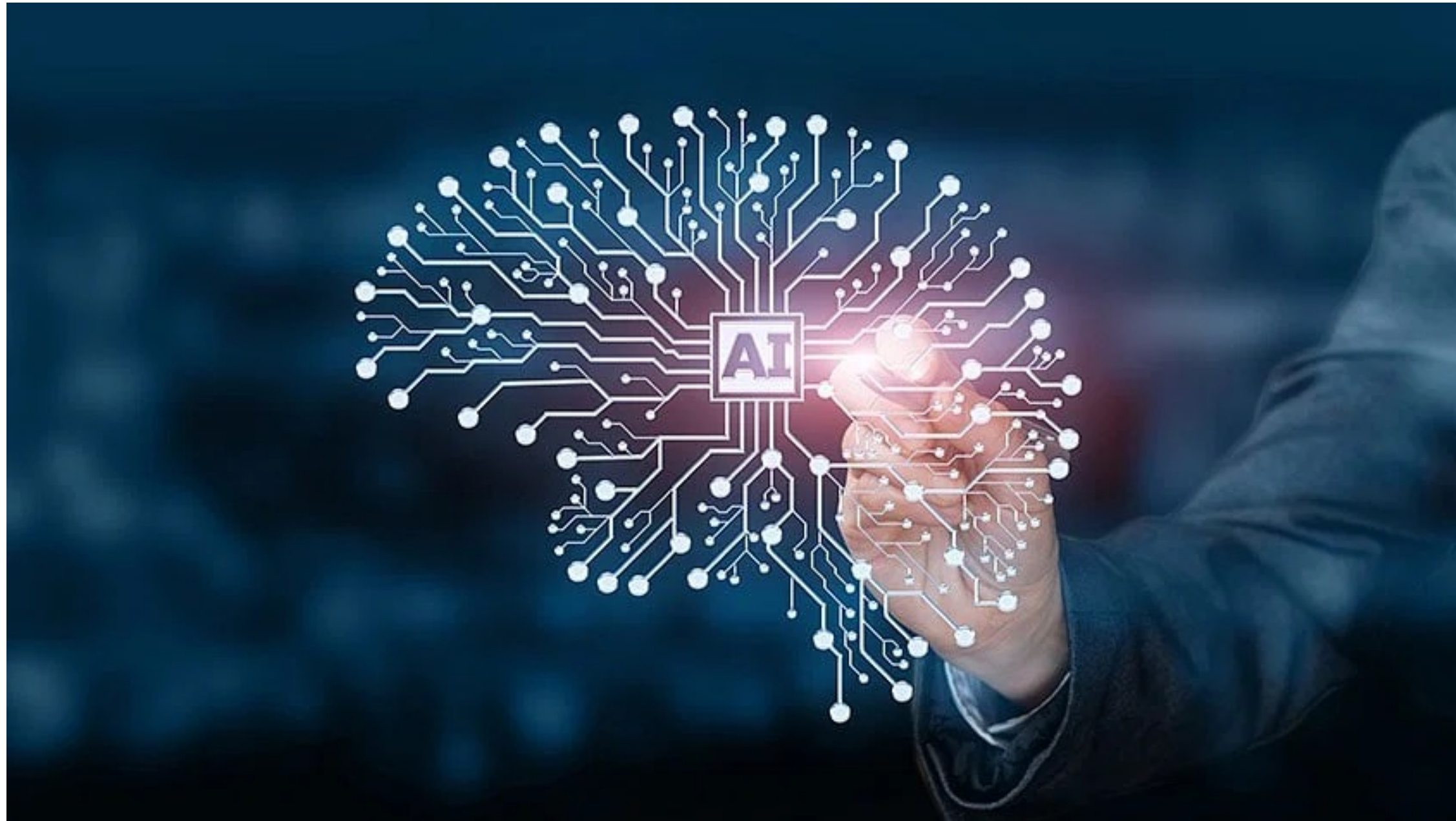


# Distance Learning



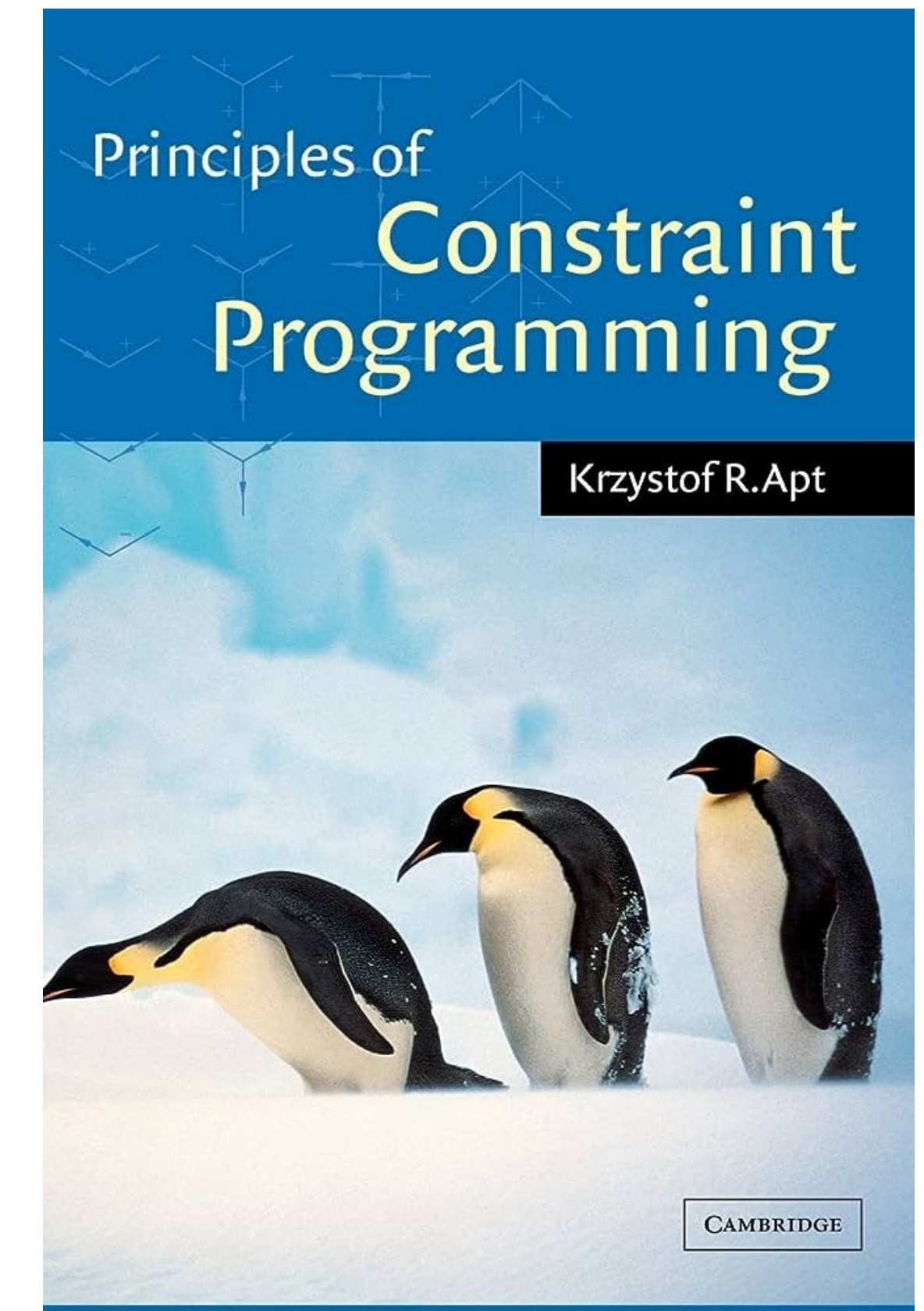
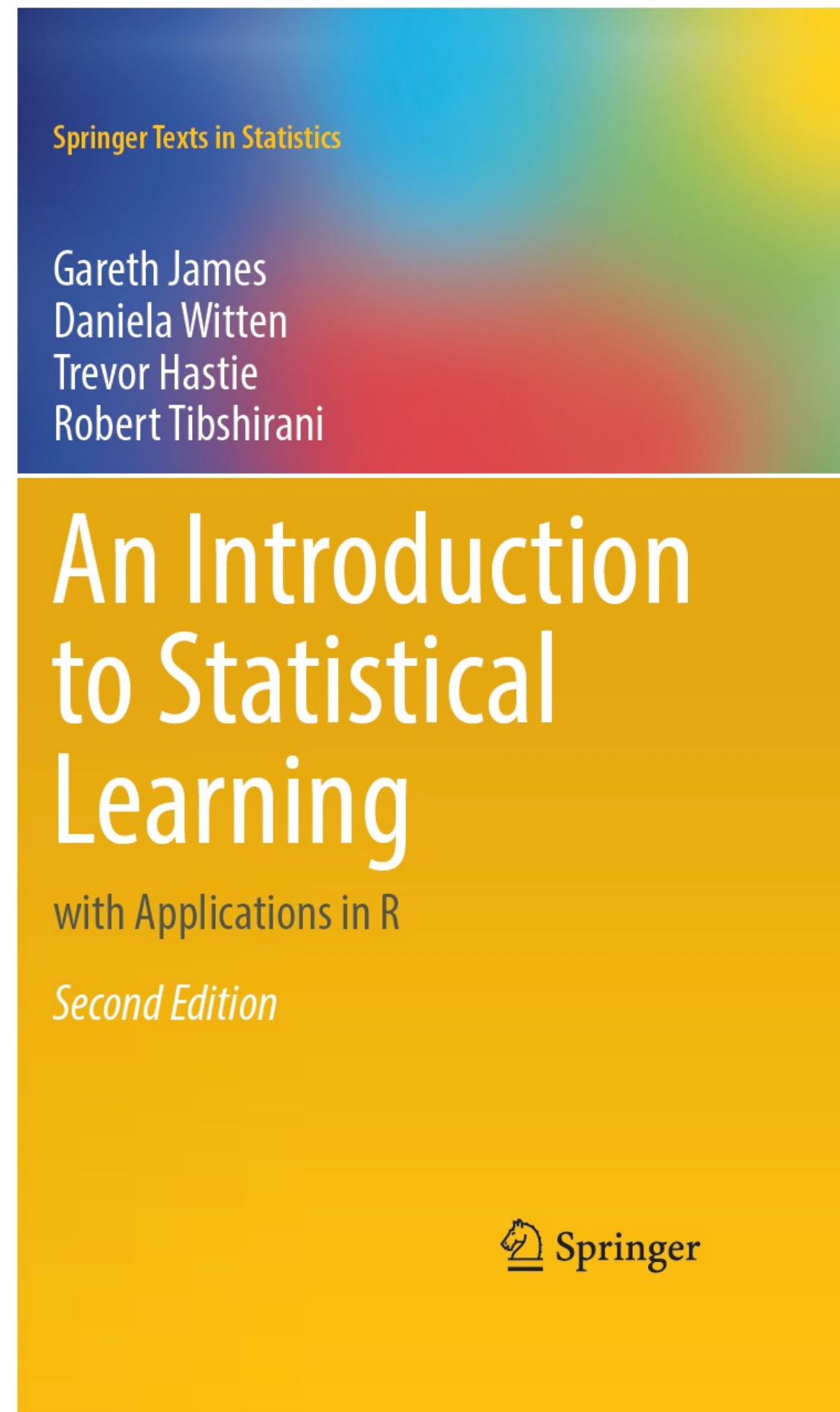


# Promotion of CP





# Introductory Resources and Availability





# Impact of LLMs

```
less Copy code

// Sets and parameters
int n = ...; // number of regions
range Regions = 1..n;

// Decision variables
int s[Regions]; // position of each region

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

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

Regenerate response



Thank you!

