

A Safe Autonomous Vehicle Trajectory Domain Specific Modeling Language For Non-Expert Development



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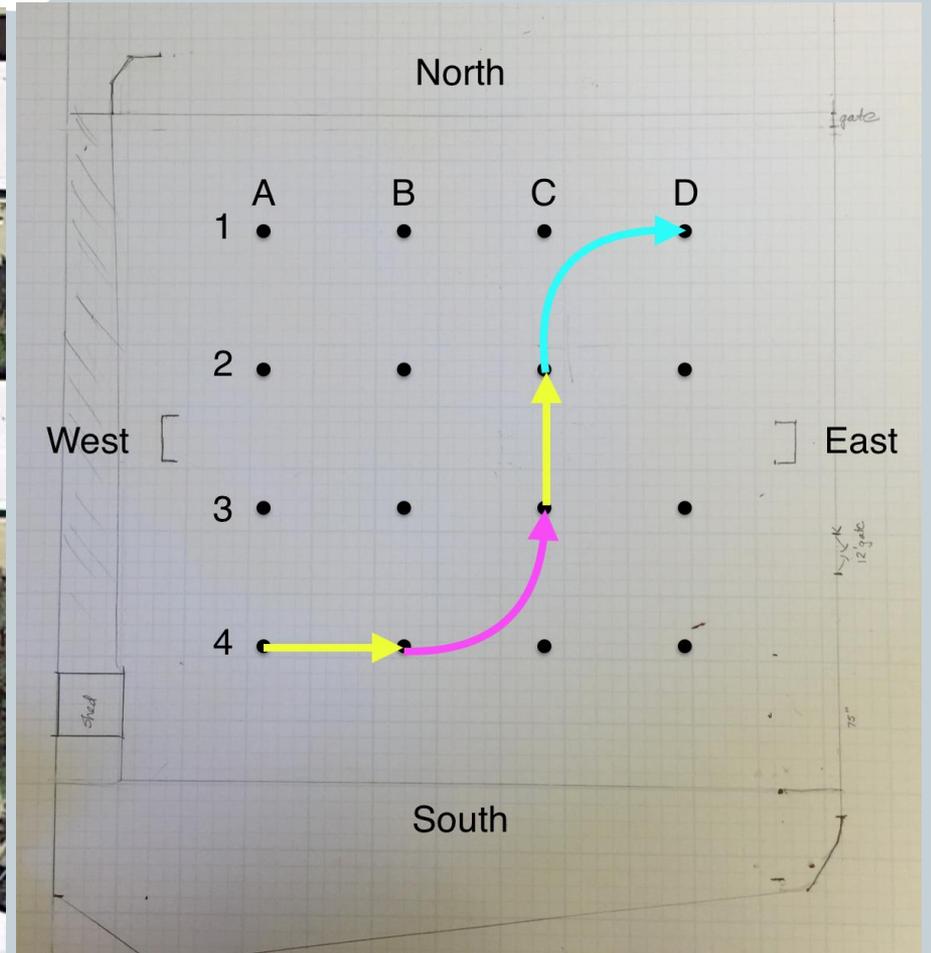
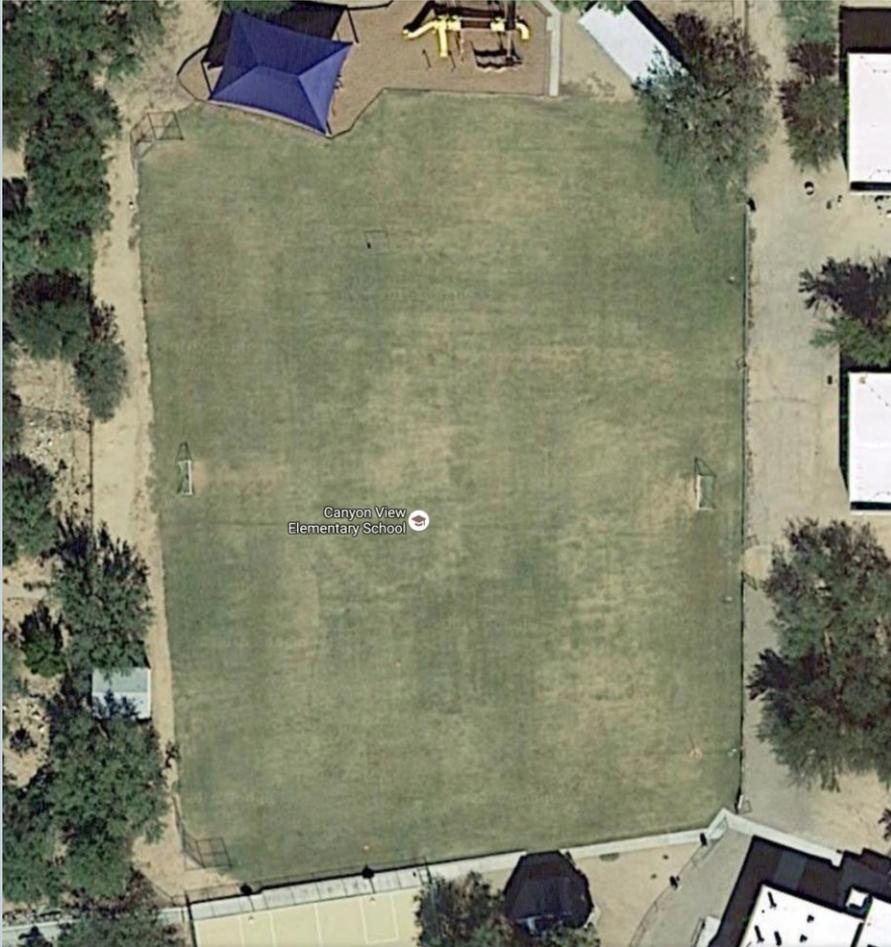
Domain



- Allow elementary students to program AV
- Programs consist of an ordered set of primitive motions, i.e. a path
- No unsafe paths should be executed



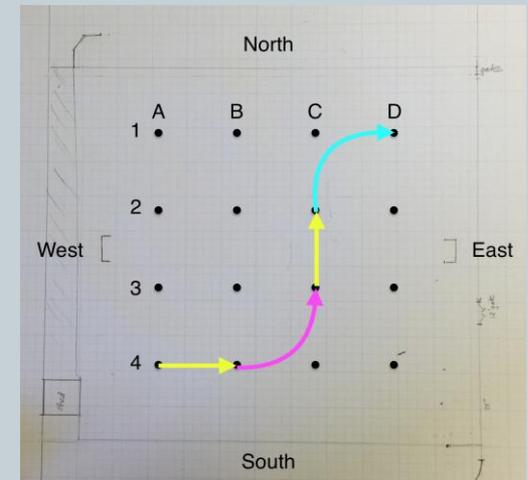
Path Location



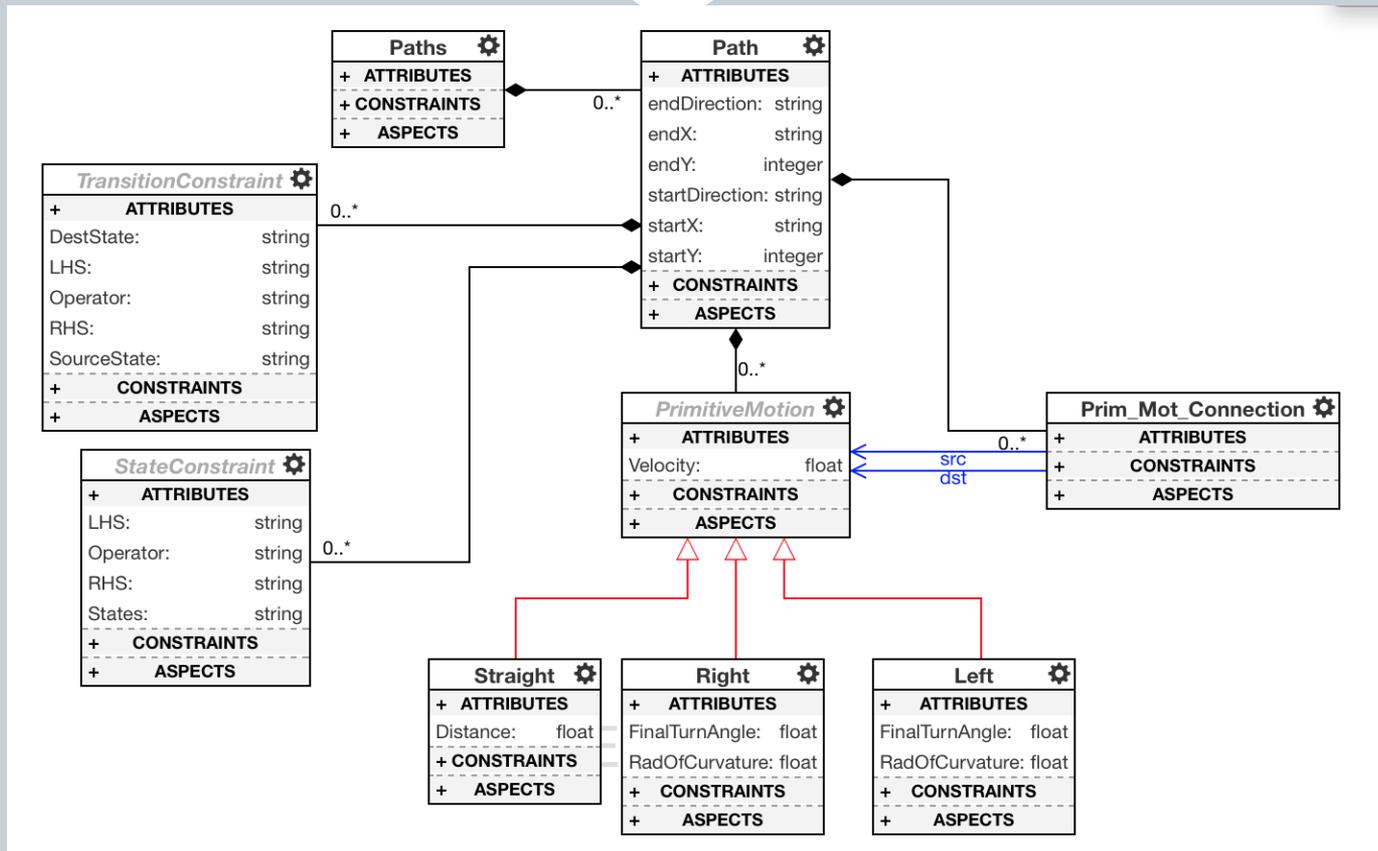
Domain Safety



- Controllers from prior work used for motions
- Paths should be structurally unambiguous
- Paths should not drive outside of the grid
- Paths should start and stop on user defined waypoints



Metamodel



- WebGME

Model



GME > c3s6 / pathA > master

PANEL 1:

- Crosscut
- Graph view
- Meta
- Composition
- Set membership

Path

OBJECT BROWSER

- Composition
- Inheritance
- Crosscut
- ROOT
 - FCO
 - Language [CATVehicle]
 - Paths
 - myPath
 - Path

PROPERTY EDITOR

Attributes	Pointers	Meta	Preference
GUID			c8344d77-088e-c1c...
ID			/S/D
Meta type			Path
Attributes			
endDire...	⊗	S	▾
endX	⊗	A	▾
endY	⊗	4	▾
name			Path

Verification



- Algorithms developed to check model behavior
- Constraint violations displayed to the user

MESSAGE #1

Multiple incoming connections: 2

[Show node](#)

MESSAGE #1

The end was not reached from the start! Expected end at: D1 facing S,
Actually ended at: D1 facing N, The start is: A4 facing N

[Show node](#)

MESSAGE #1

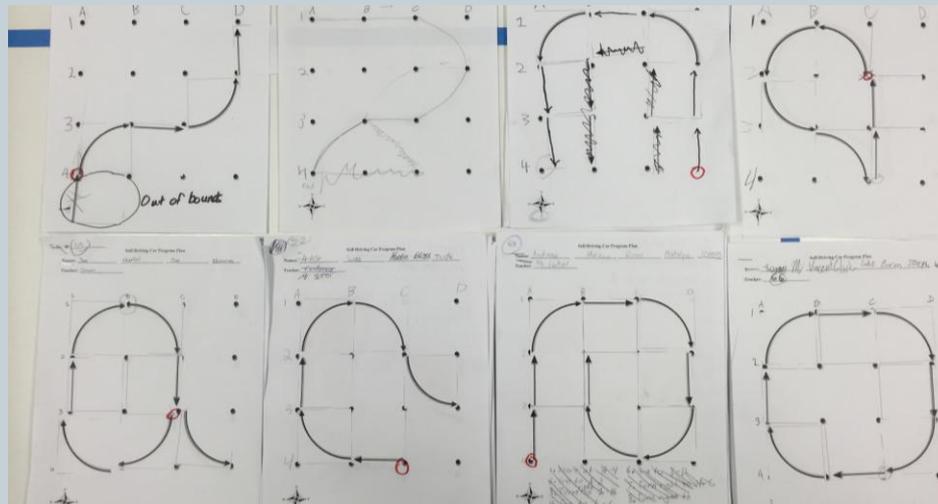
Out of bounds on motion #5, too far North!

[Show node](#)

Demonstration



Implementation



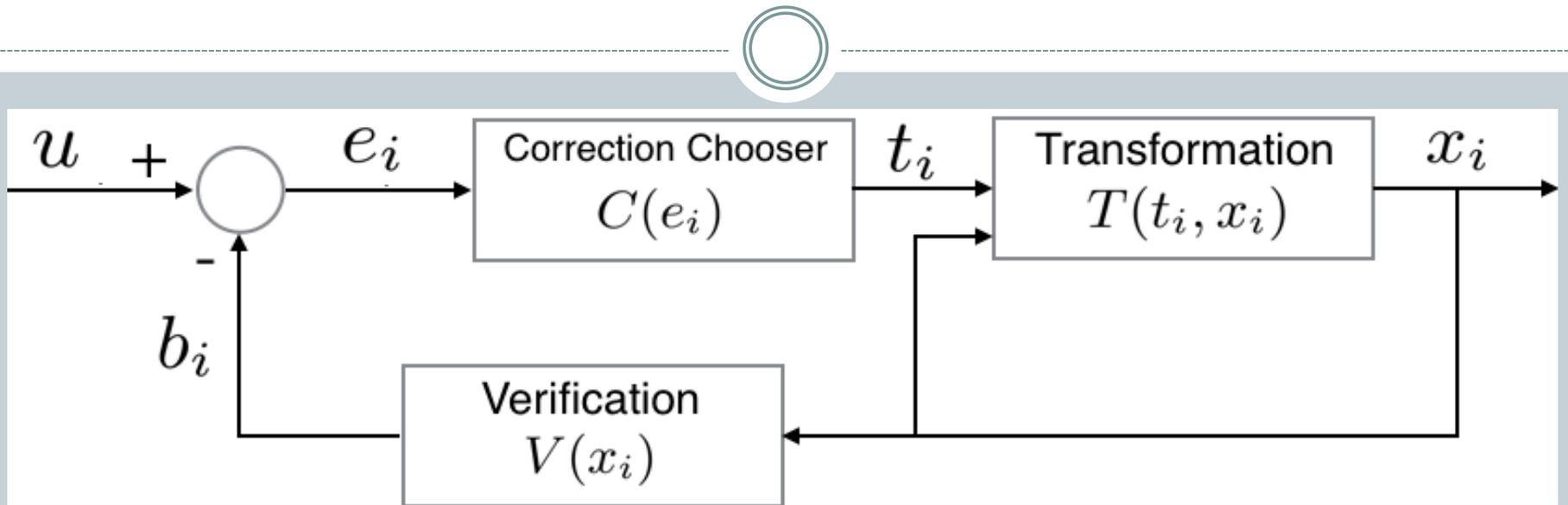
- Students worked in groups to design paths on paper
- Groups transferred paths to the modeling language
- Some groups needed no instruction
- Students used verification feedback to correct models

Demo Day



- Manually drove car to start location
- Ran generated files without reviewing, known to be safe

Future Work



- Automation
- Implement reactive modeling and LTL verification
- Examine properties of automatic dynamic constraint verification

Questions

