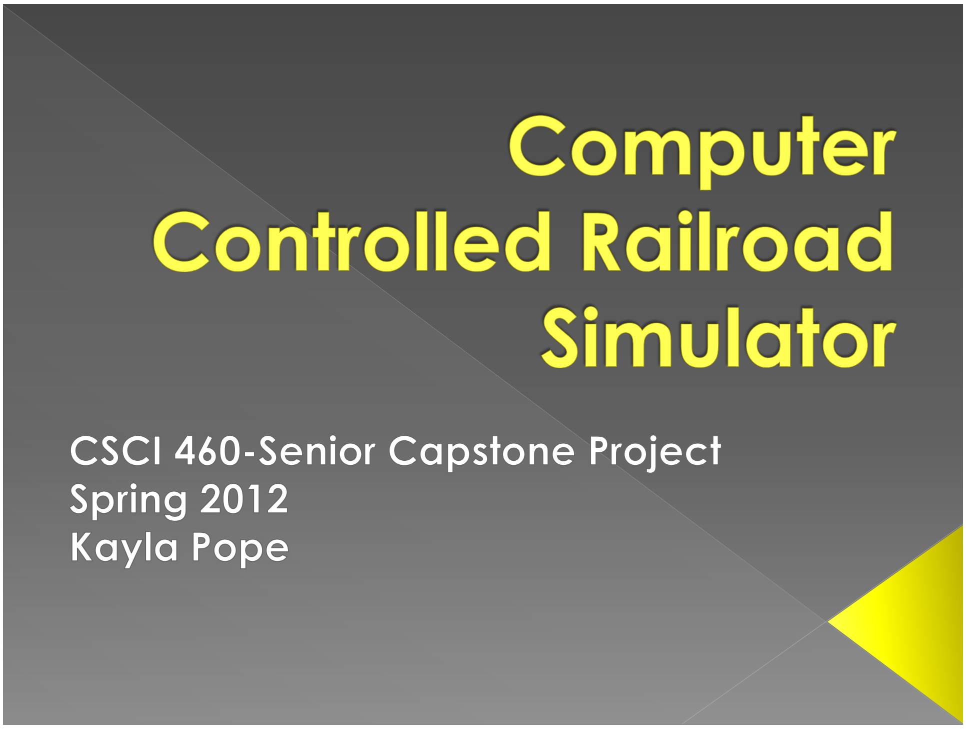
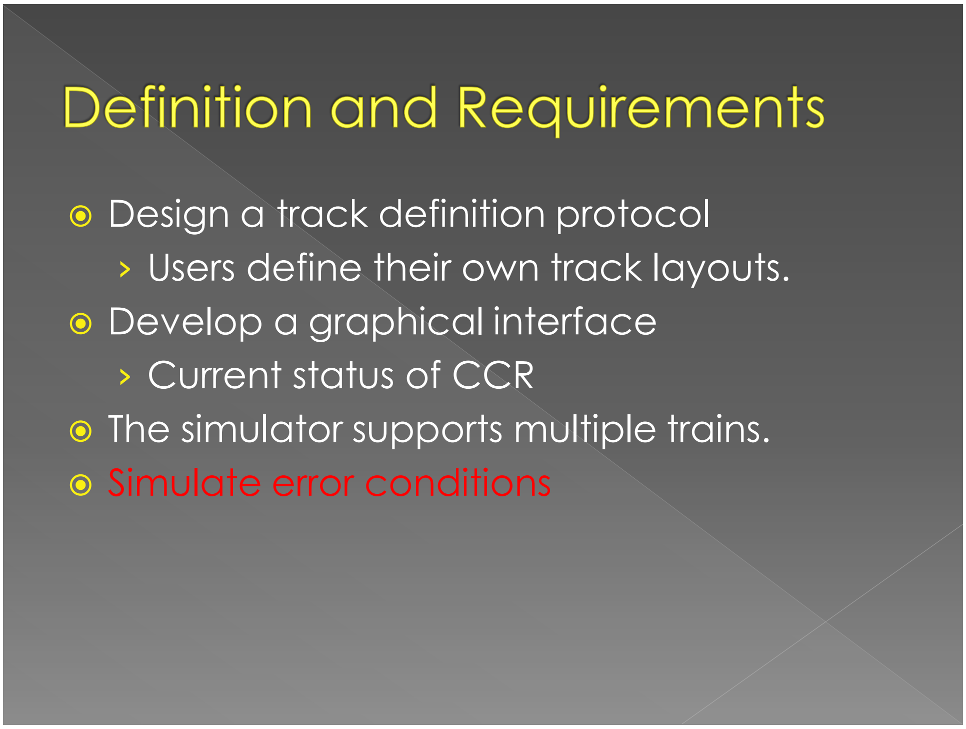


Computer Controlled Railroad Simulator

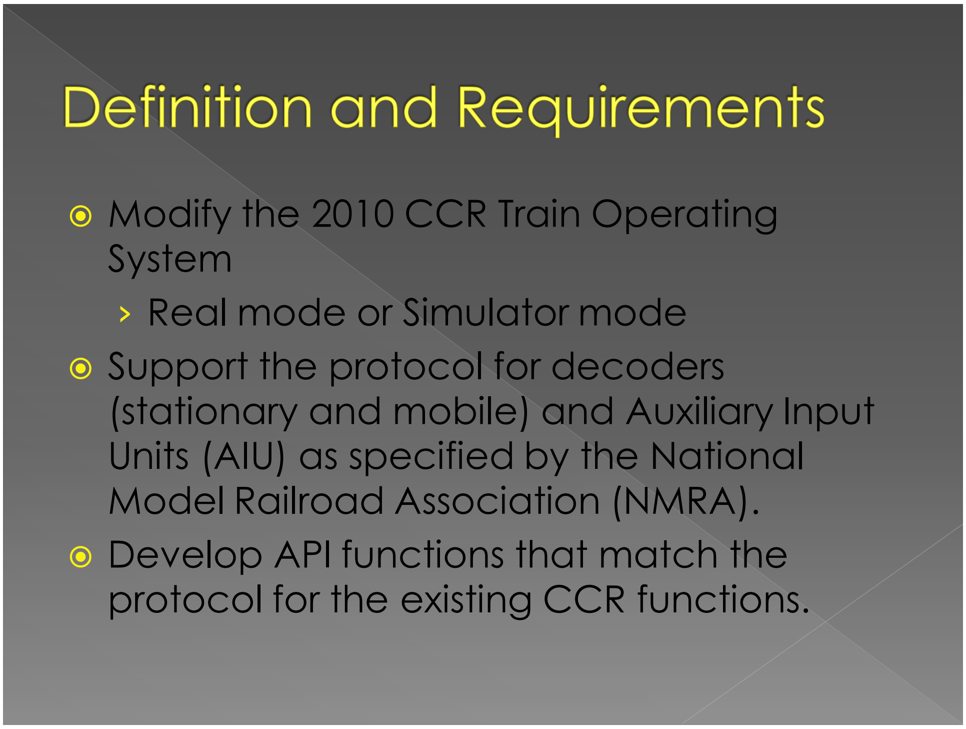
CSCI 460-Senior Capstone Project
Spring 2012
Kayla Pope

Project Description



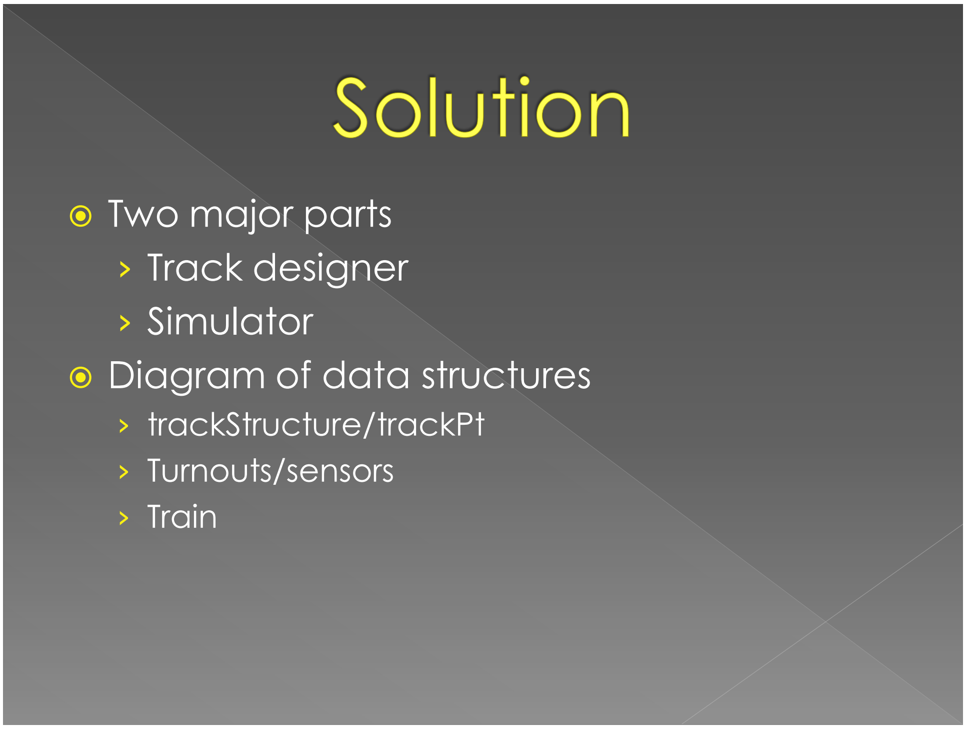
Definition and Requirements

- Design a track definition protocol
  - Users define their own track layouts.
- Develop a graphical interface
  - Current status of CCR
- The simulator supports multiple trains.
- Simulate error conditions



Definition and Requirements

- Modify the 2010 CCR Train Operating System
  - Real mode or Simulator mode
- Support the protocol for decoders (stationary and mobile) and Auxiliary Input Units (AIU) as specified by the National Model Railroad Association (NMRA).
- Develop API functions that match the protocol for the existing CCR functions.

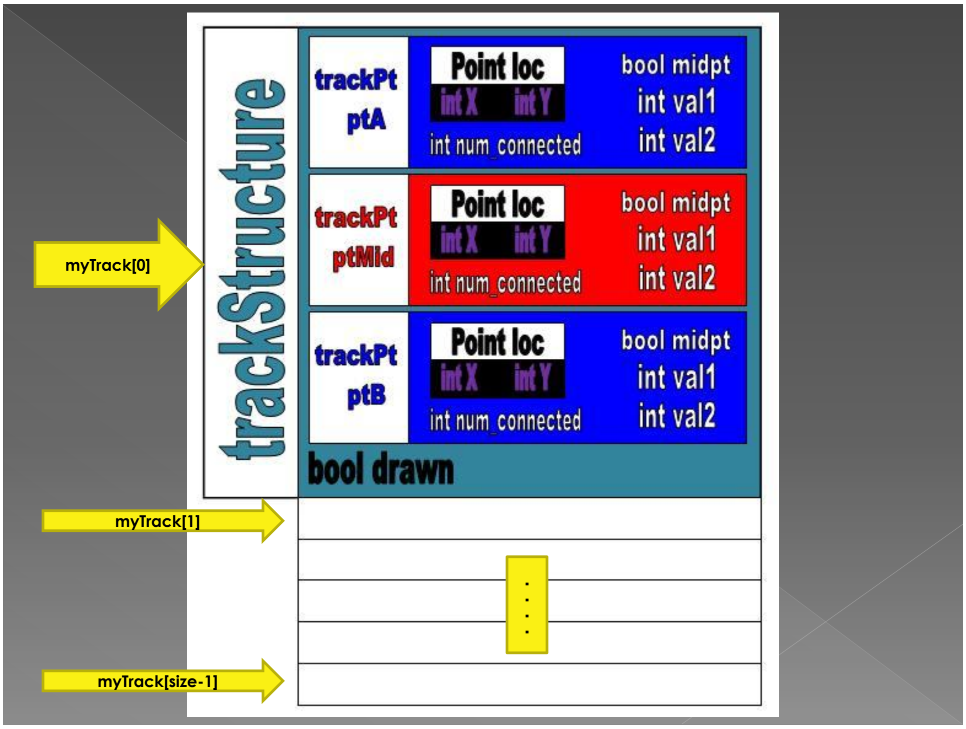


Solution

- Two major parts
  - Track designer
  - Simulator
- Diagram of data structures
  - trackStructure/trackPt
  - Turnouts/sensors
  - Train

Demonstration

- Create new track layout
- Delete Segments
- Include turnouts



trackStructure

trackPt ptA

Point loc

int X int Y

int num_connected

bool midpt

int val1

int val2

trackPt ptMid

Point loc

int X int Y

int num_connected

bool midpt

int val1

int val2

trackPt ptB

Point loc

int X int Y

int num_connected

bool midpt

int val1

int val2

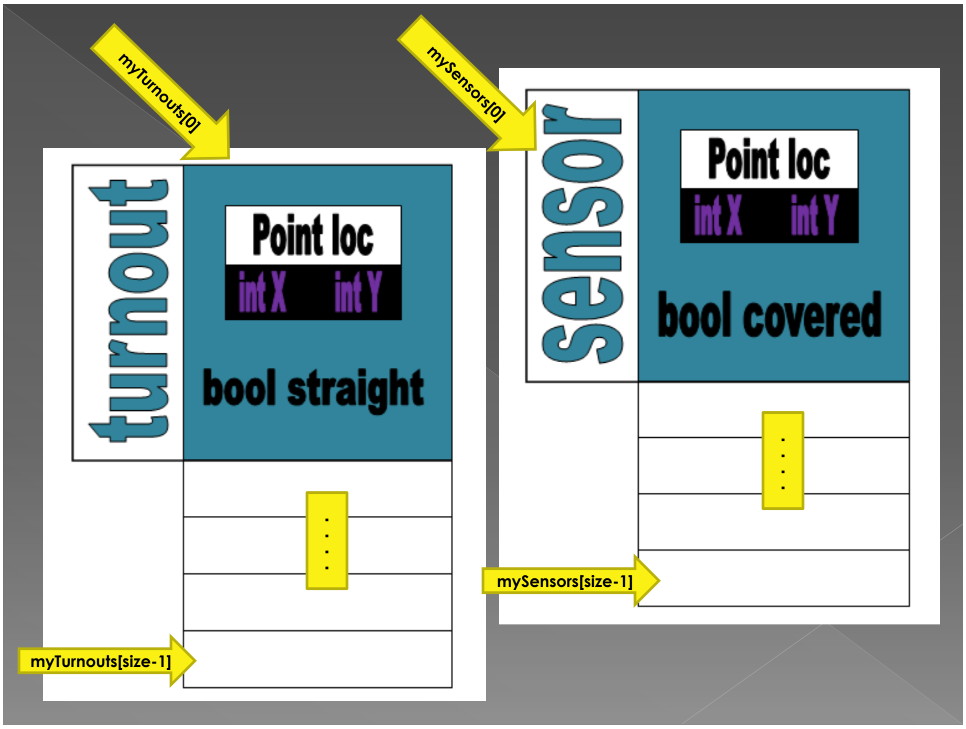
bool drawn

myTrack[0]

myTrack[1]

. . . . .

myTrack[size-1]



myTurnouts[0]

turnout

Point loc

int X int Y

bool straight

. . . . .

myTurnouts[size-1]

mySensors[0]

sensor

Point loc

int X int Y

bool covered

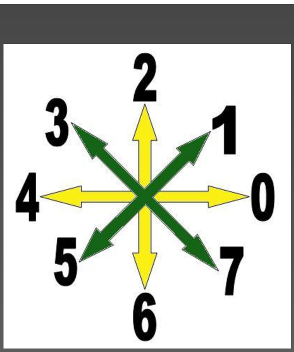
. . . . .

mySensors[size-1]

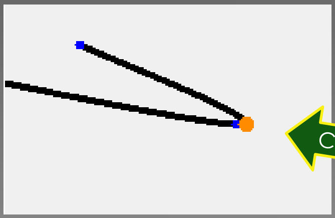
Demonstration

- Add two trains
- Run the simulator
- Increase/decrease speed
- Change turnouts

Simulator

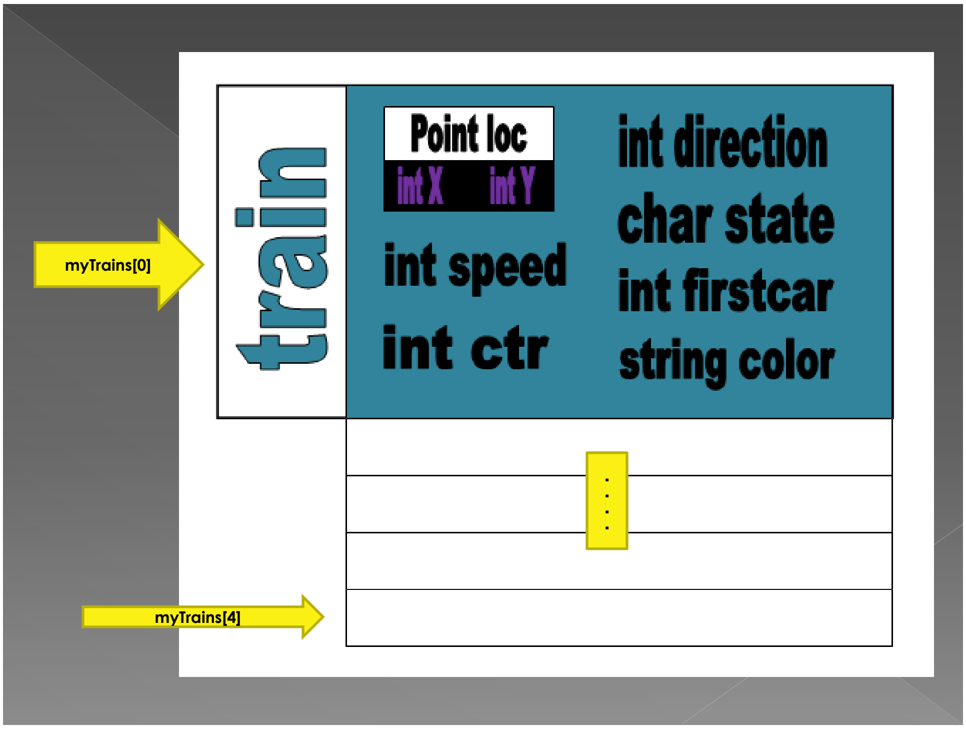


- Trains follow color of the track
  - "Compass"
  - Next direction restriction
  - "Blind"—don't know what's coming next



Curve is too sharp for train to follow

- Not a perfect algorithm
  - User must define plausible track



myTrains[0]

train

Point loc

int X int Y

int speed

int ctr

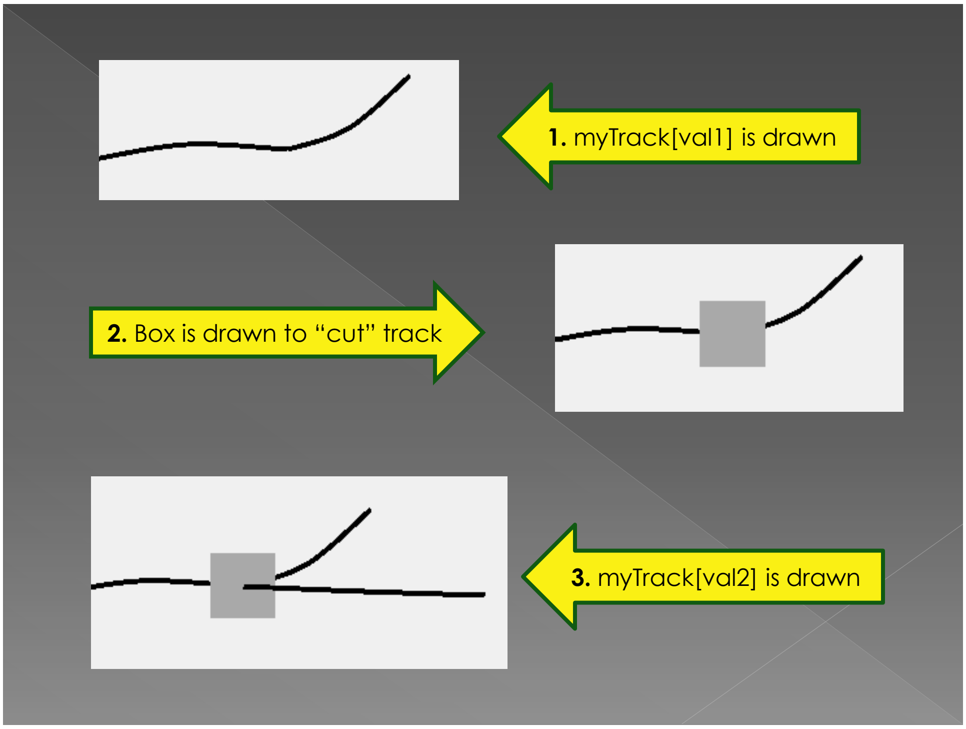
int direction

char state

int firstcar

string color

myTrains[4]



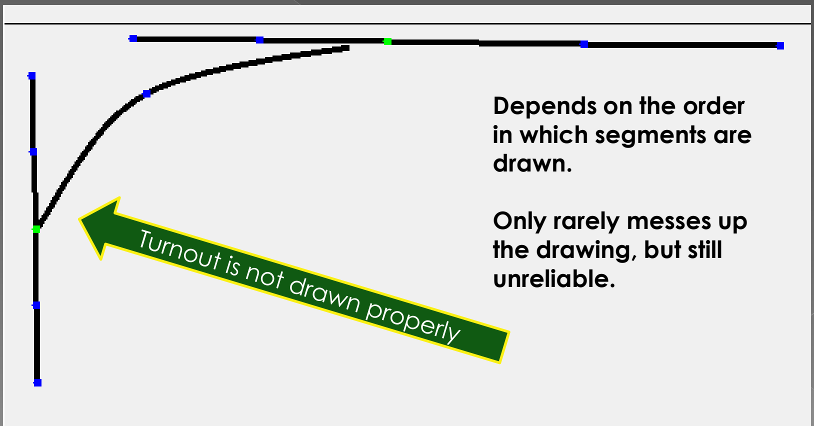
1. myTrack[val1] is drawn

2. Box is drawn to "cut" track

3. myTrack[val2] is drawn

Exceptions

- Changing the state of a turnout—in certain circumstances



Turnout is not drawn properly

Depends on the order in which segments are drawn.

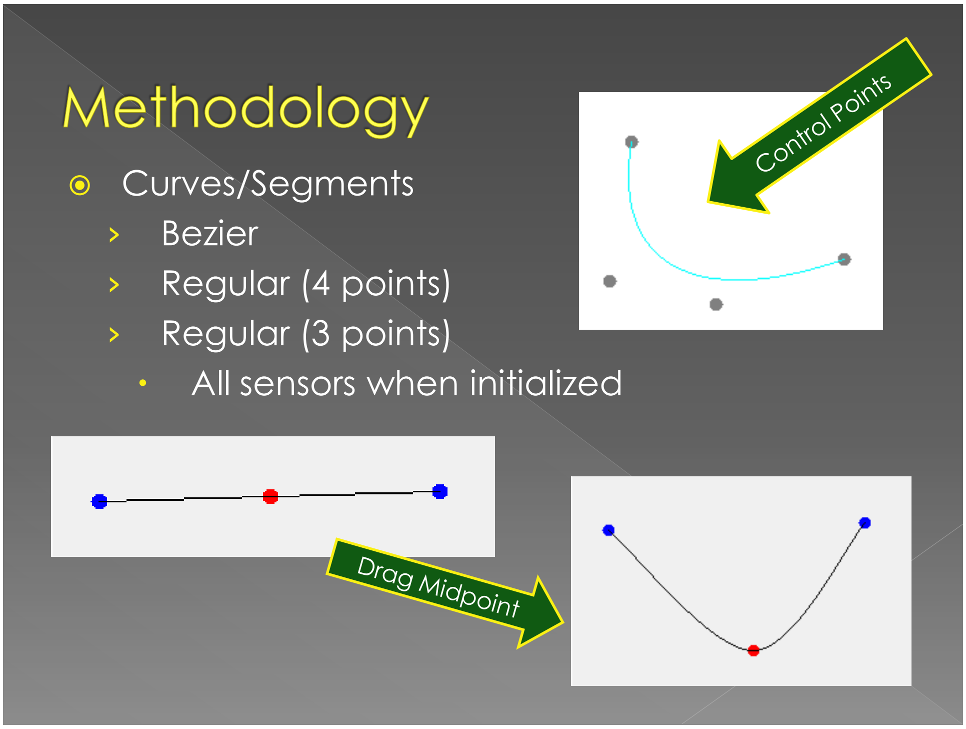
Only rarely messes up the drawing, but still unreliable.

Other Exceptions

- Not compatible with actual train
- Moving algorithm—train gets “stuck”
- Train with multiple cars (circular queue)
- Cancelling when in edit mode

Methodology

1. Several meetings
2. Design one small piece
   i. Keep in mind the overall goal
3. Implement small piece to prove conceptual understanding
4. Modify as necessary
   i. Make sure any modifications allow for success of overall goal
5. Repeat steps 2-4



Methodology

- Curves/Segments
  - Bezier
  - Regular (4 points)
  - Regular (3 points)
    - All sensors when initialized

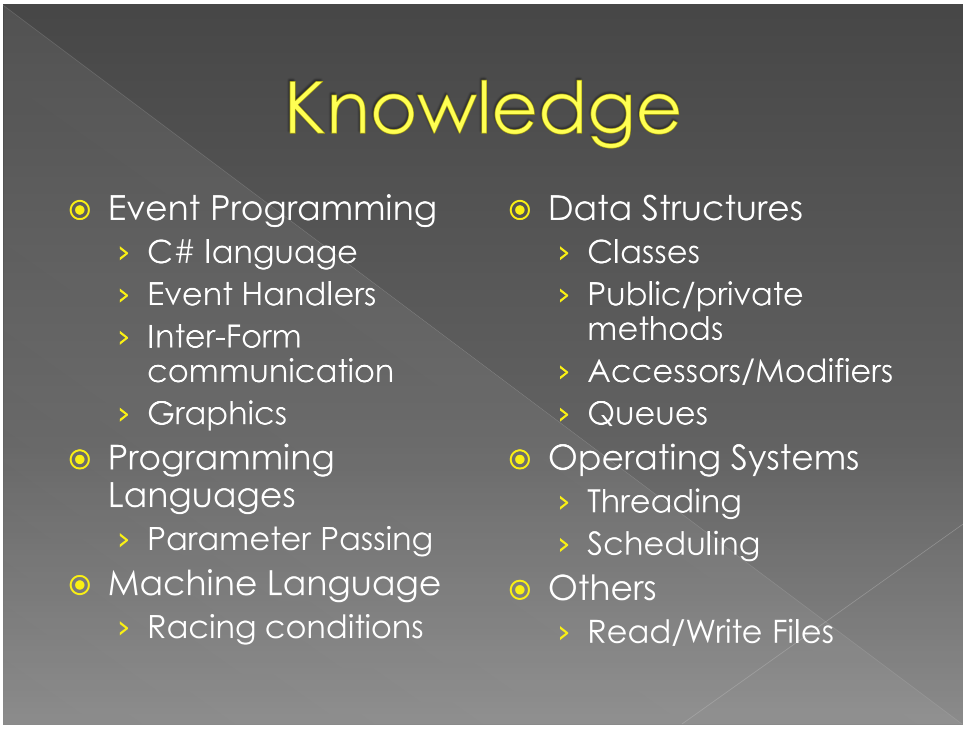
Control Points

Drag Midpoint

Learning and Development Process

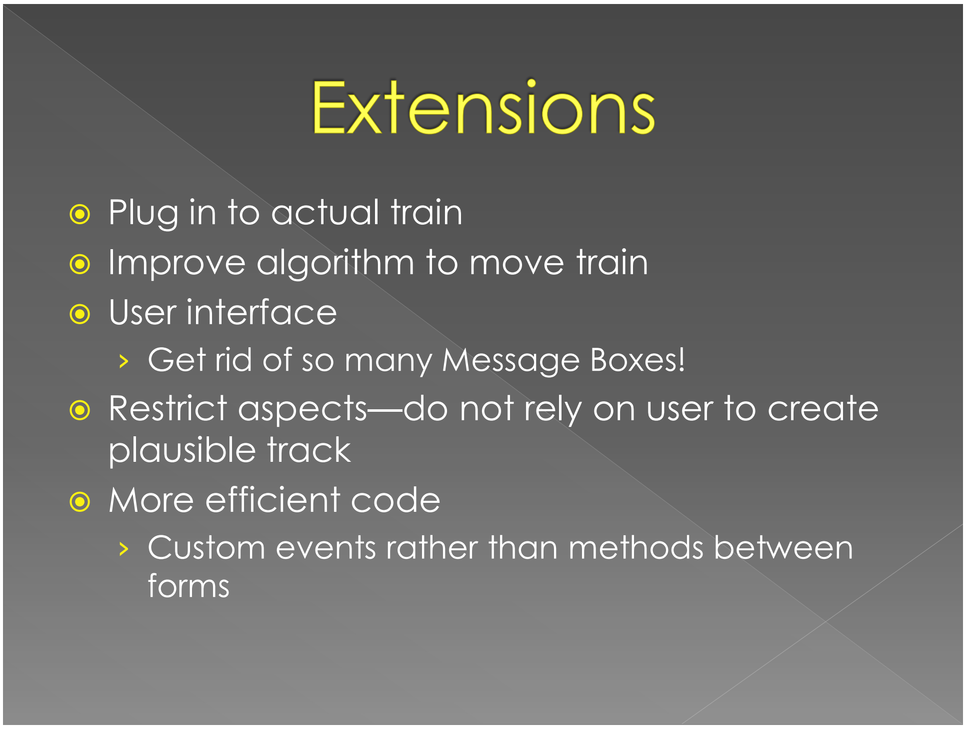
Strategies

- Understand the goal
- Create data structures that can accomplish the goal
- Draw pictures
- Implement (small parts at a time)
- Modify as necessary
- Discuss with ANYONE who will listen
  - Helps to get another perspective
  - EVEN non-CS people
- Advice from classmates



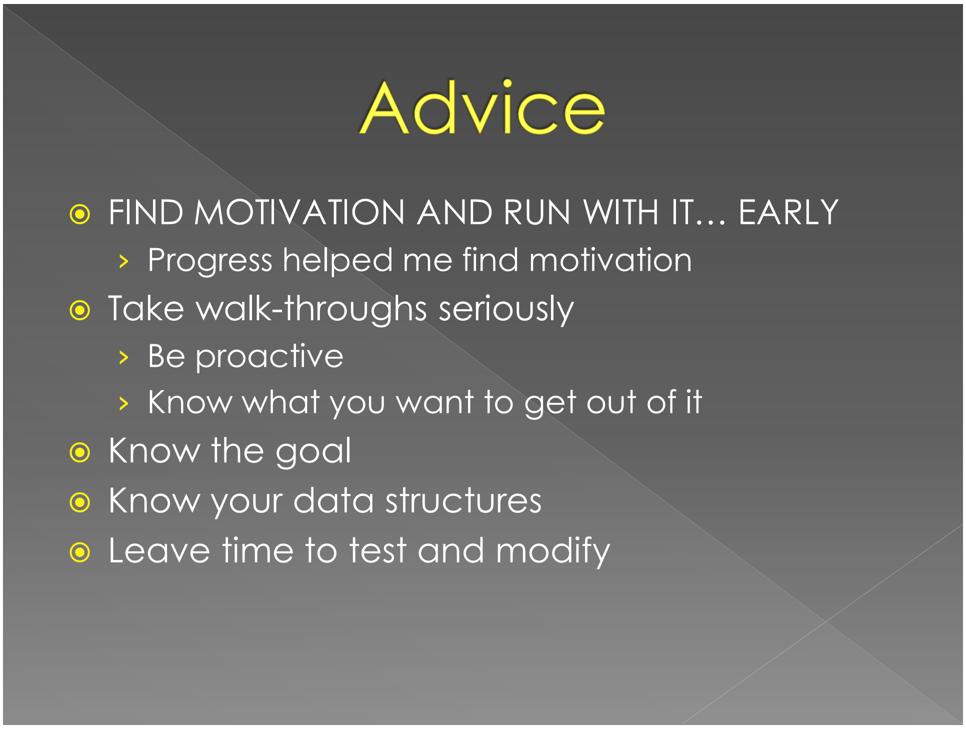
Knowledge

- Event Programming
  - C# language
  - Event Handlers
  - Inter-Form communication
  - Graphics
- Programming Languages
  - Parameter Passing
- Machine Language
  - Racing conditions
- Data Structures
  - Classes
  - Public/private methods
  - Accessors/Modifiers
  - Queues
- Operating Systems
  - Threading
  - Scheduling
- Others
  - Read/Write Files



Extensions

- Plug in to actual train
- Improve algorithm to move train
- User interface
  - Get rid of so many Message Boxes!
- Restrict aspects—do not rely on user to create plausible track
- More efficient code
  - Custom events rather than methods between forms



Advice

- FIND MOTIVATION AND RUN WITH IT… EARLY
  - Progress helped me find motivation
- Take walk-throughs seriously
  - Be proactive
  - Know what you want to get out of it
- Know the goal
- Know your data structures
- Leave time to test and modify

Question & Answer

Thank you!