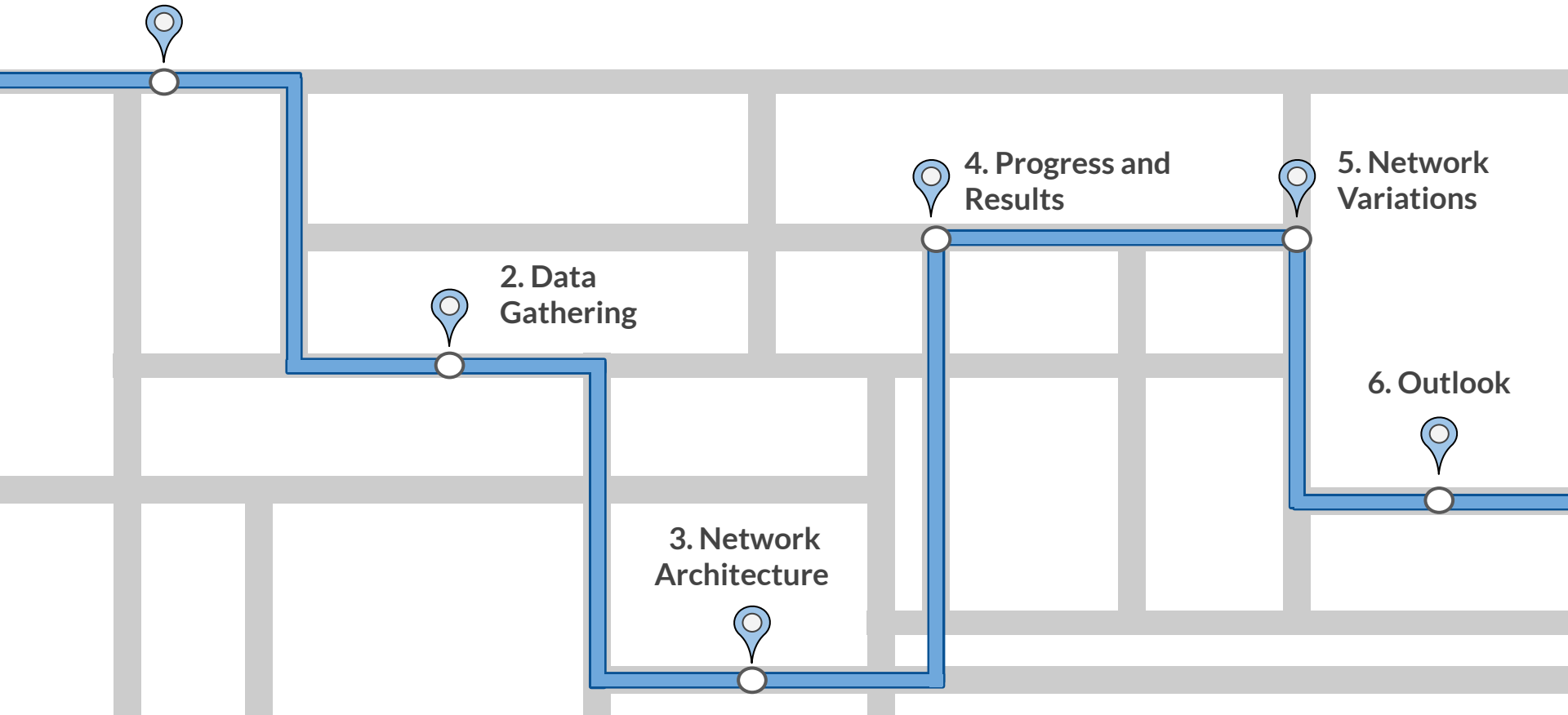
Autonomous Driving

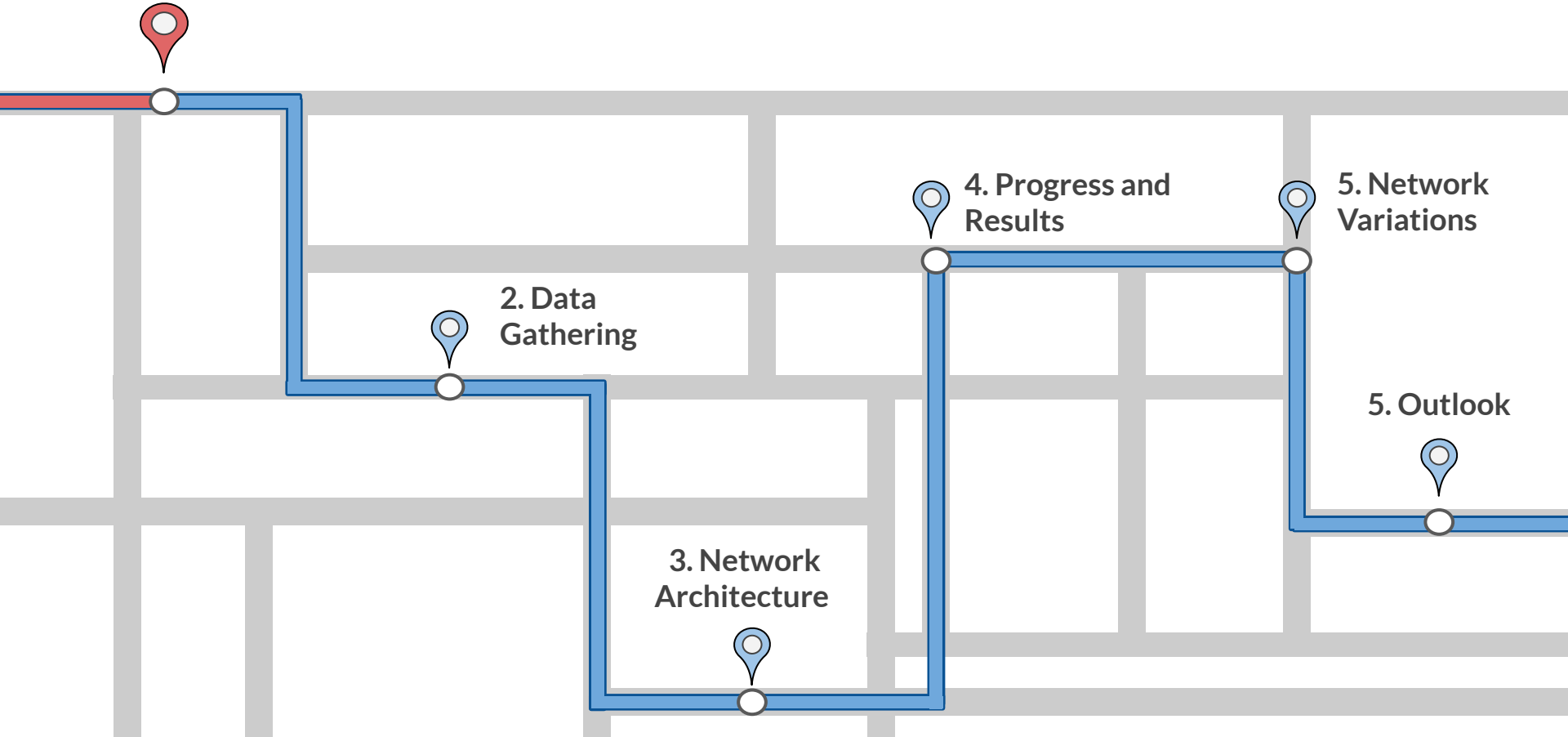
Bachelor Project

Nina Pant • Max Roth • Yvan Satyawan

OUTLINE


1. Project Overview
2. Data Gathering
3. Network Architecture
4. Progress and Results
5. Network Variations
6. Outlook

OUTLINE

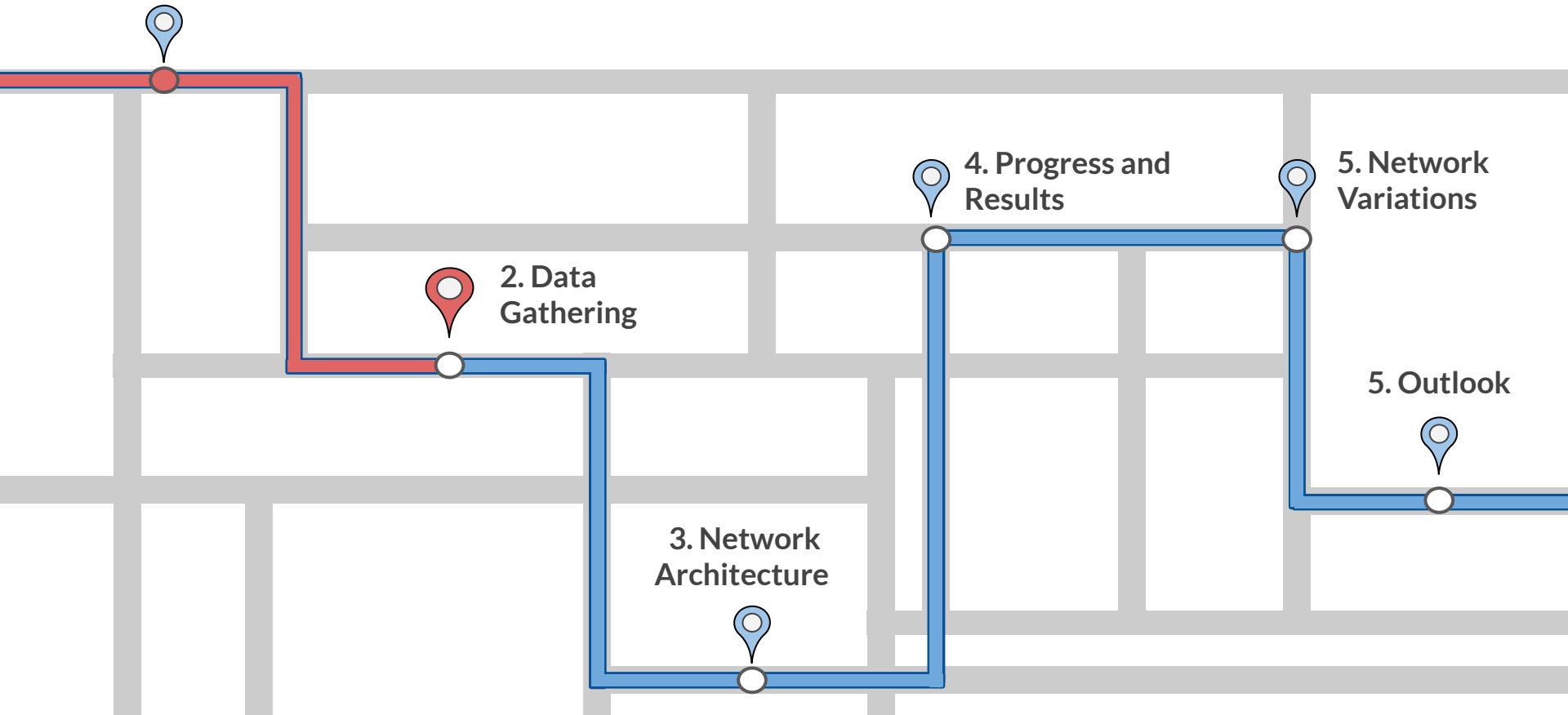

1. Project Overview
2. Data Gathering
3. Network Architecture
4. Progress and Results
5. Network Variations
5. Outlook

Project Overview

- Paper : End-to-end via Conditional Imitation Learning
- Goal : car simulation that drives with user given higher commands


FPS: 17 Direction: Left
Steering: -0.11
Throttle: 0.35

OUTLINE


1. Project Overview
2. Data Gathering
3. Network Architecture
4. Progress and Results
5. Network Variations
5. Outlook

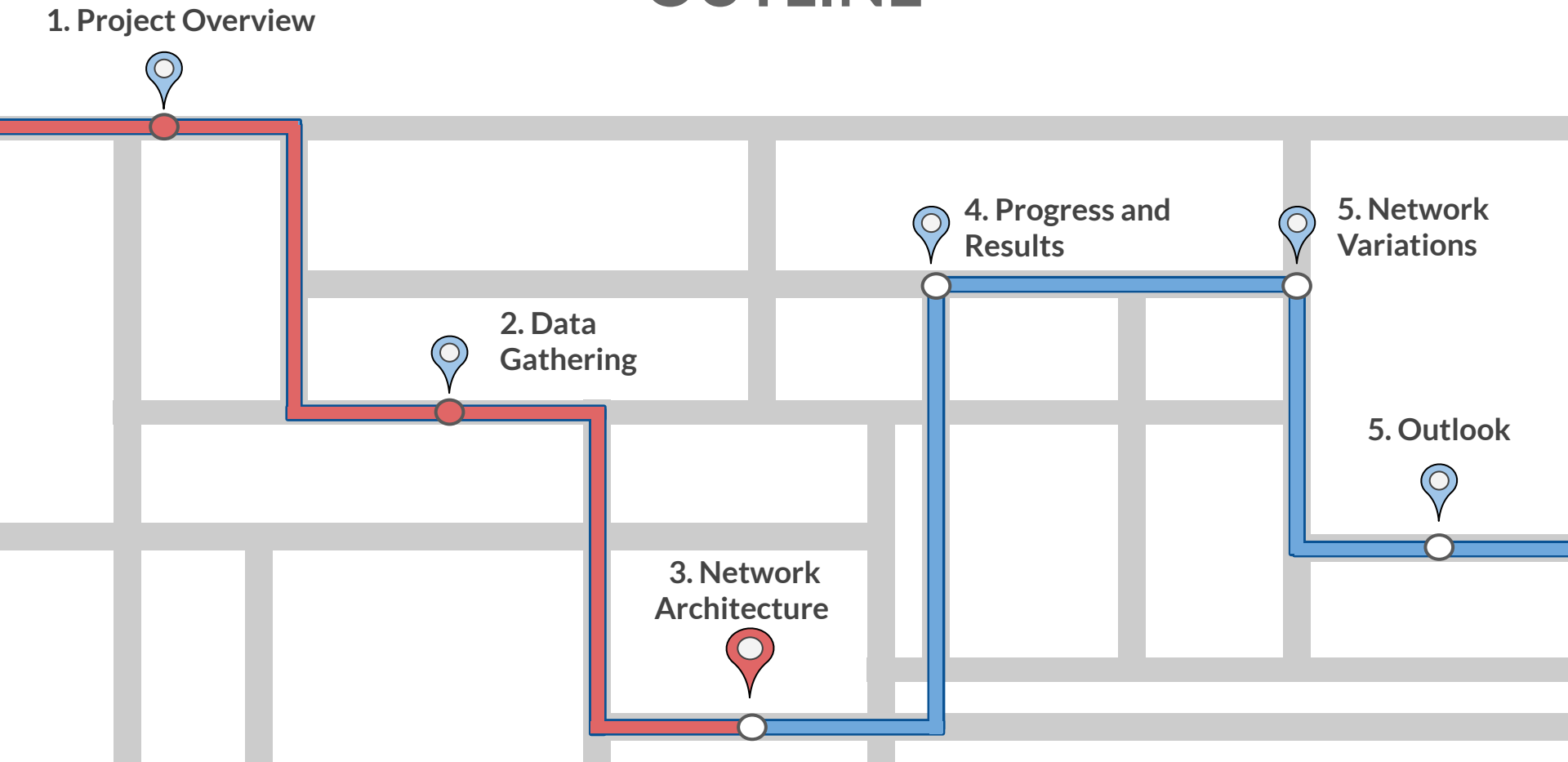
Data Gathering

	Camera 1	Camera 2
Normal		
Segmented		

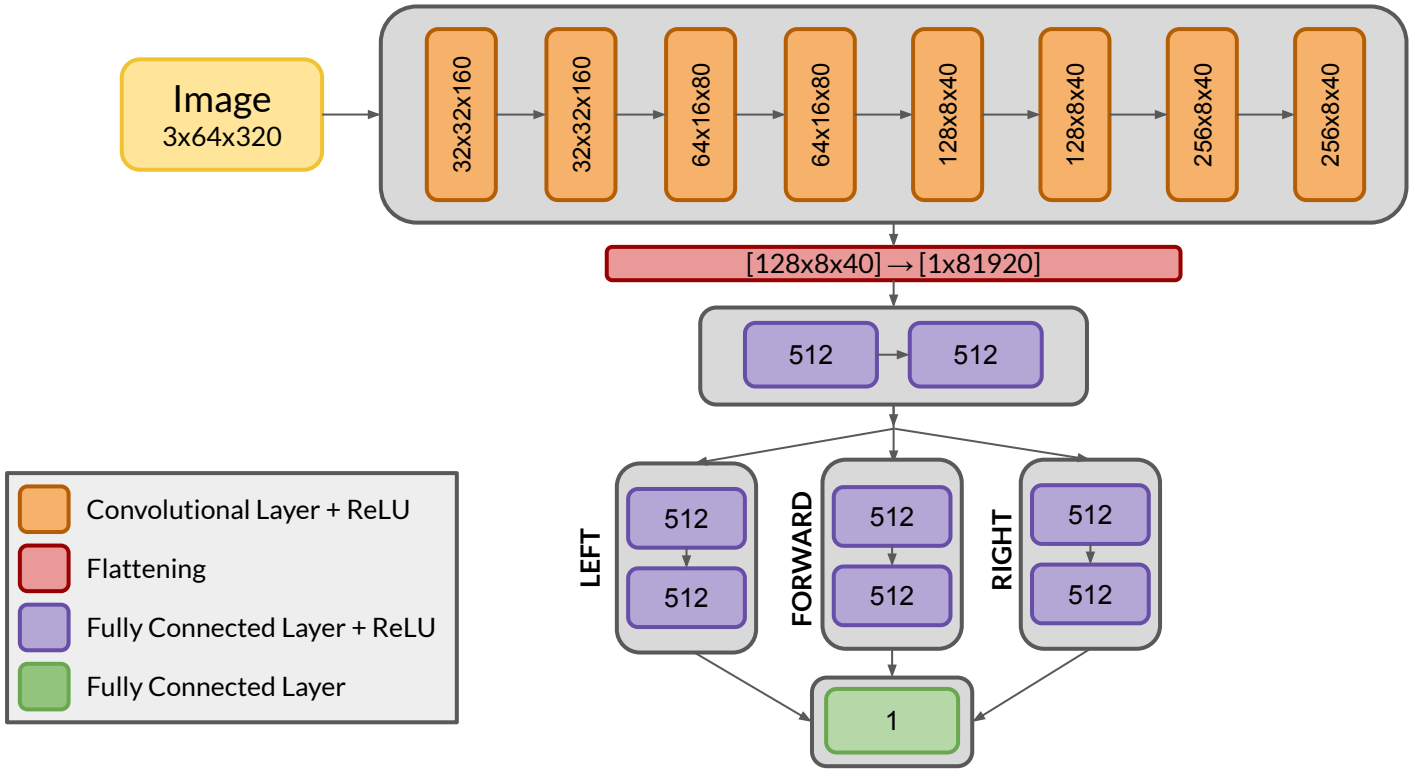
CSV File

	A	B	C	D	E	F
1	No.	Steering	Throttle	Brakes	Gear	Requested_Direction
2	10	-0.216528825	0.350010681	0	1	0

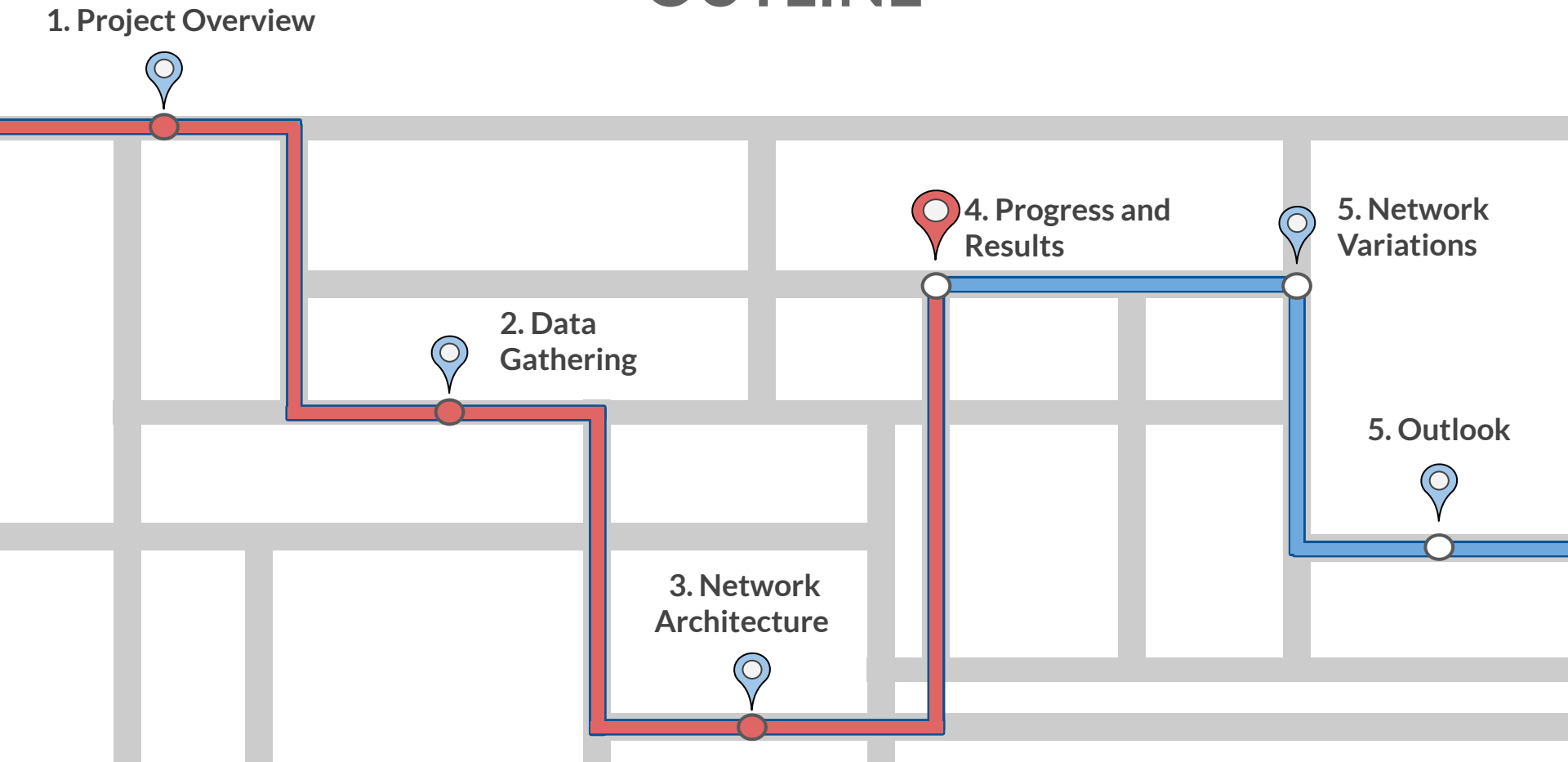
OUTLINE


1. Project Overview
2. Data Gathering
3. Network Architecture
4. Progress and Results
5. Network Variations
5. Outlook

Network Architecture



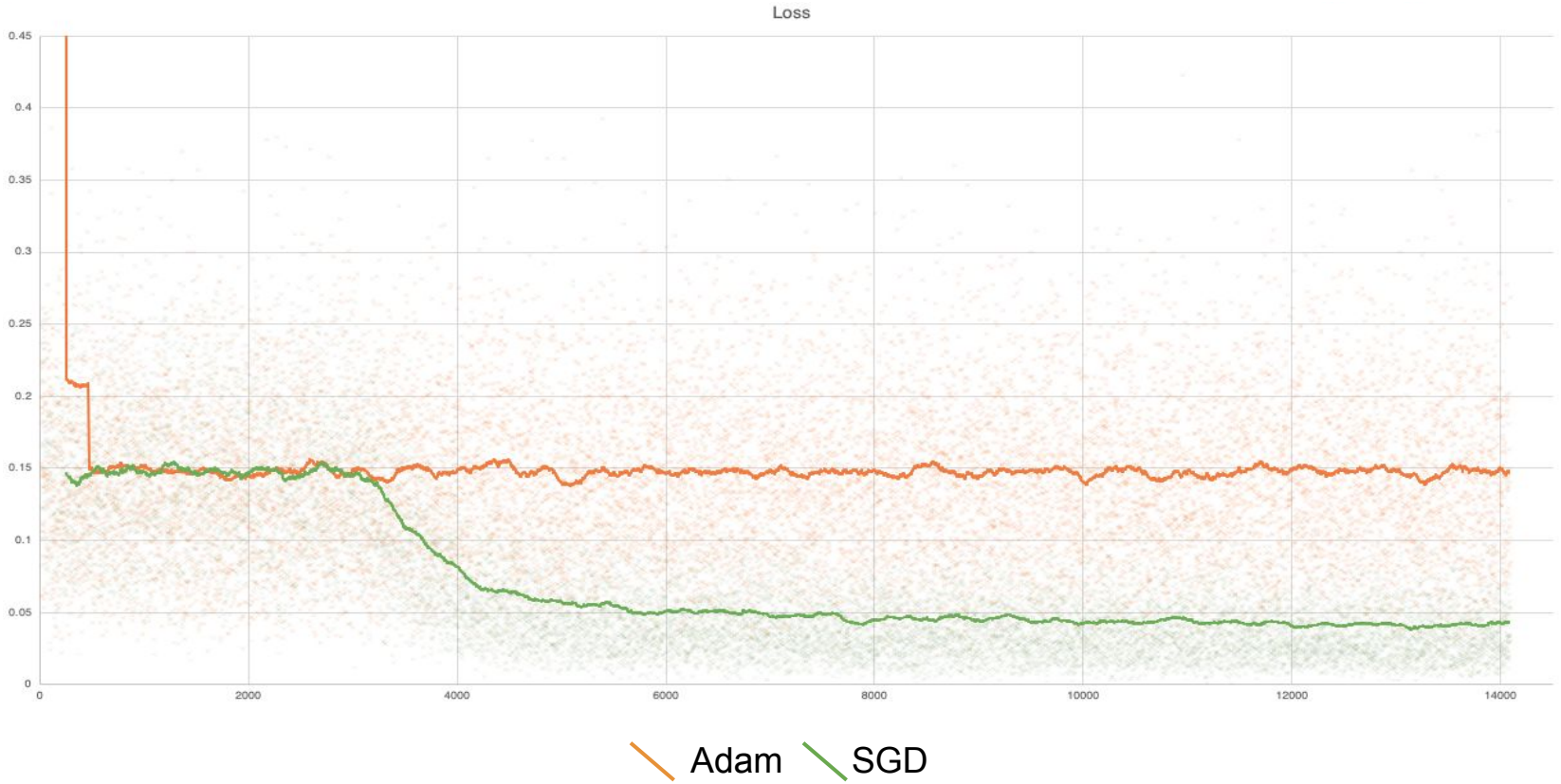
OUTLINE


1. Project Overview
2. Data Gathering
3. Network Architecture
4. Progress and Results
5. Network Variations
5. Outlook

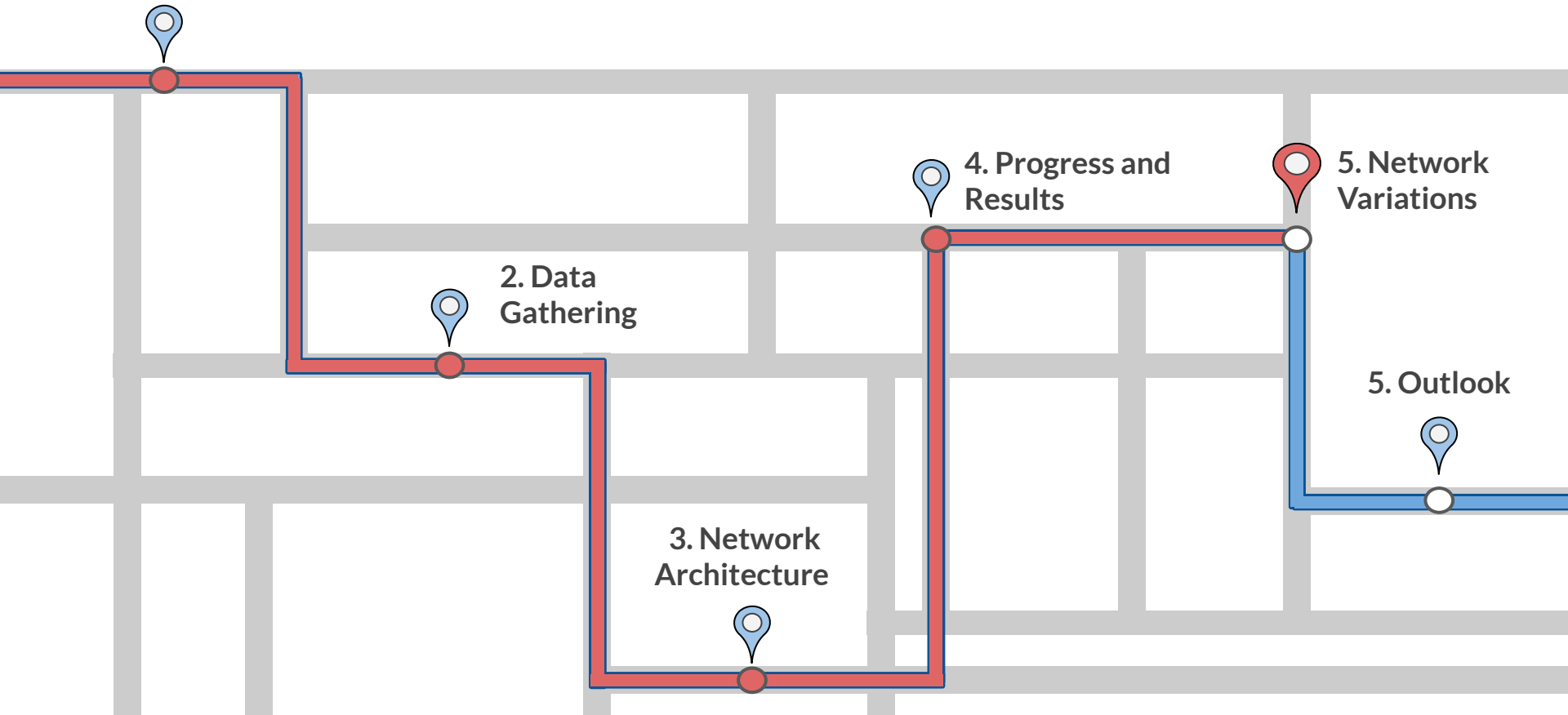
Problems and Progress

- High loss values
- Ignoring high level commands
- 4 Lane road switch
- Using SGD instead of Adam
- Use High level command for each batch image not first for all
- Use segmentation (helped)

Results


Loss
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
2000
4000
6000
8000
10000
12000
14000
Adam
SGD

OUTLINE


1. Project Overview
2. Data Gathering
3. Network Architecture
4. Progress and Results
5. Network Variations
5. Outlook

Network Variation Experiments

Normal	Ground Truth Segmented	Ground Truth Segmented + Image
Two Cameras	Image + Previous	Self Made Segmentation

Network Variation Experiments

Normal	Ground Truth Segmented	Ground Truth Segmented + Image
Two Cameras	Image + Previous	Self Made Segmentation

Network Variation Experiments

Normal	Ground Truth Segmented	Ground Truth Segmented + Image
Two Cameras	Image + Previous	Self Made Segmentation

Network Variation Experiments

Normal	Ground Truth Segmented	Ground Truth Segmented + Image
Two Cameras	Image + Previous	Self Made Segmentation

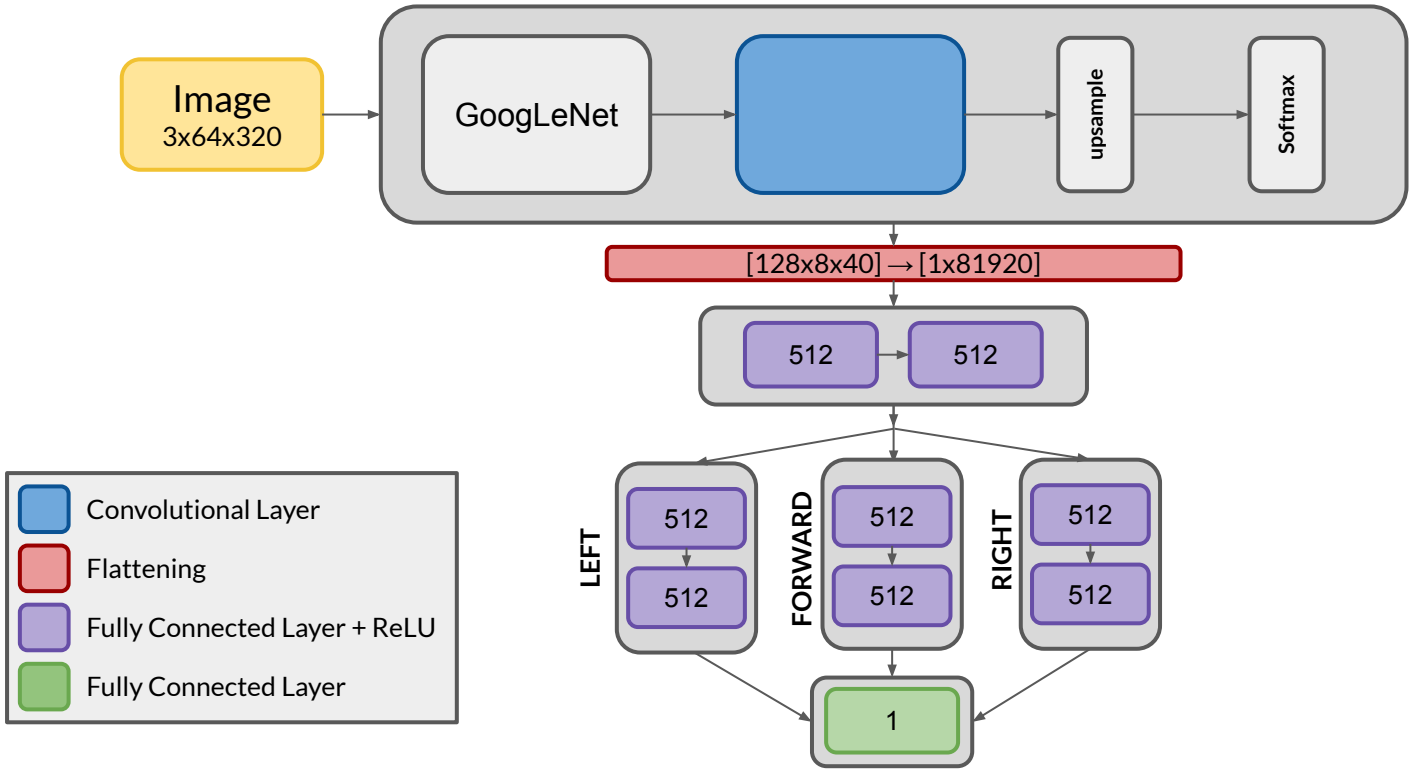
Network Variation Experiments

Normal	Ground Truth Segmented	Ground Truth Segmented + Image
Two Cameras	Image + Previous	Self Made Segmentation

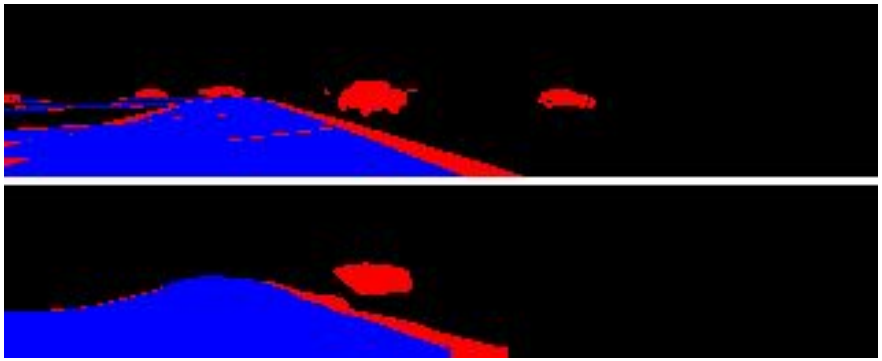
Network Variation Experiments

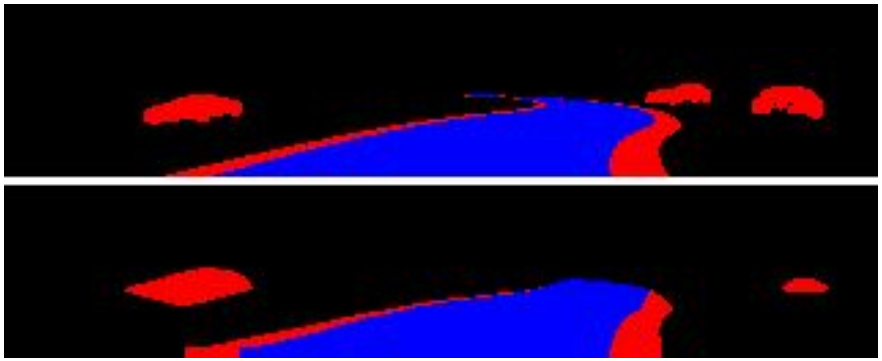
Normal	Ground Truth Segmented	Ground Truth Segmented + Image
Two Cameras	Image + Previous	Self Made Segmentation

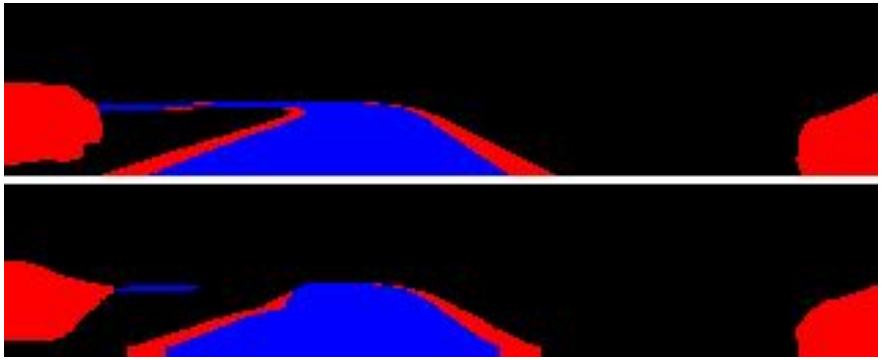
Segmentation Network Architecture

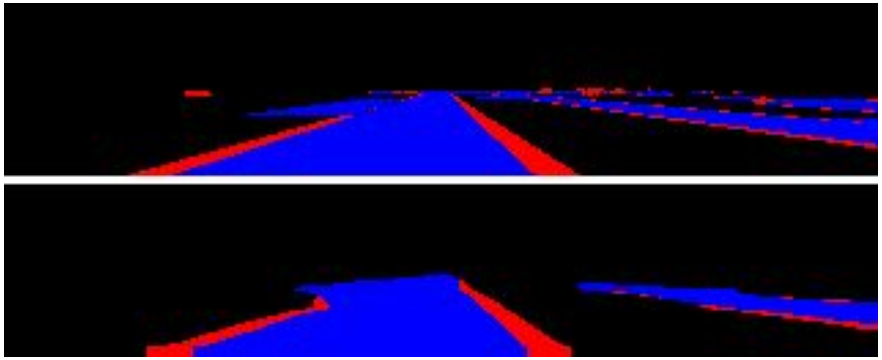


Segmentation Results

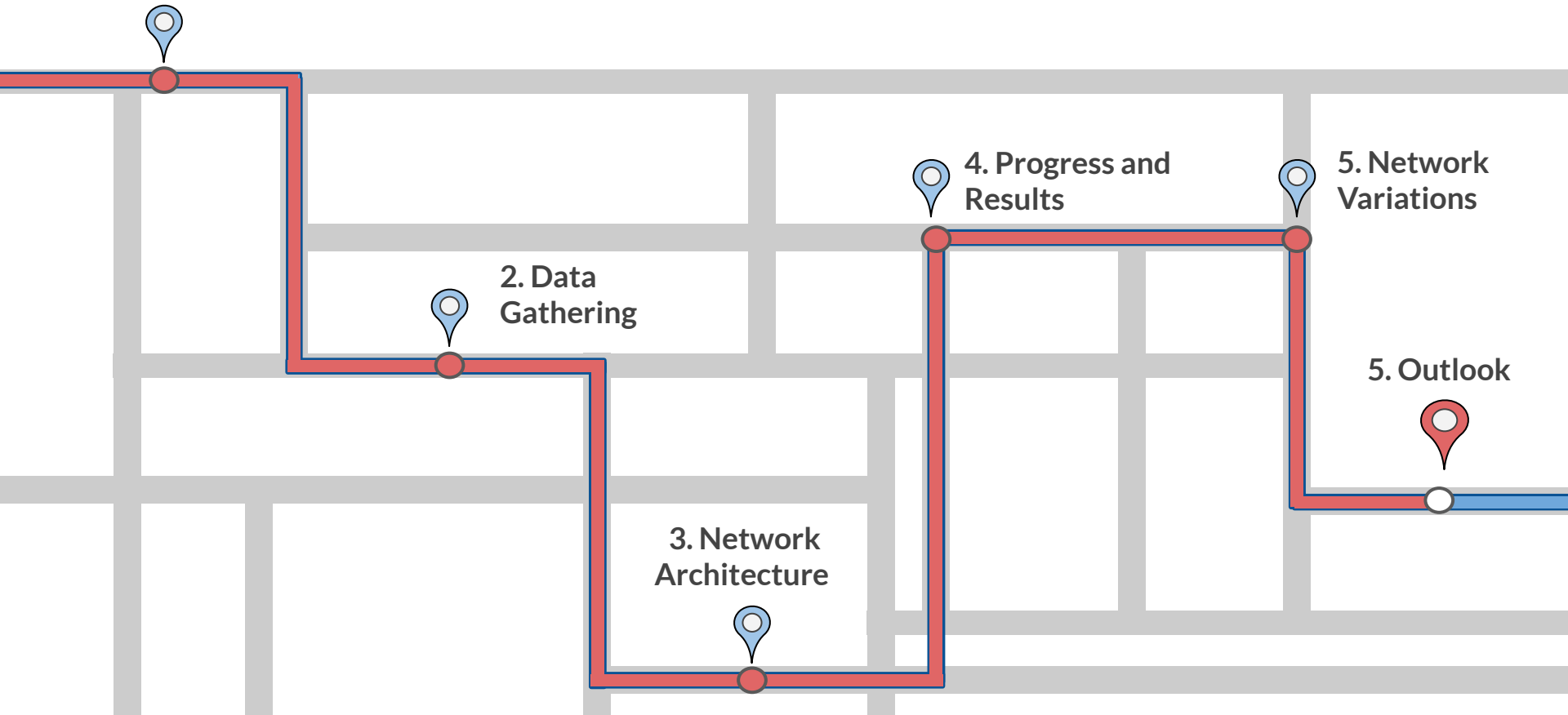








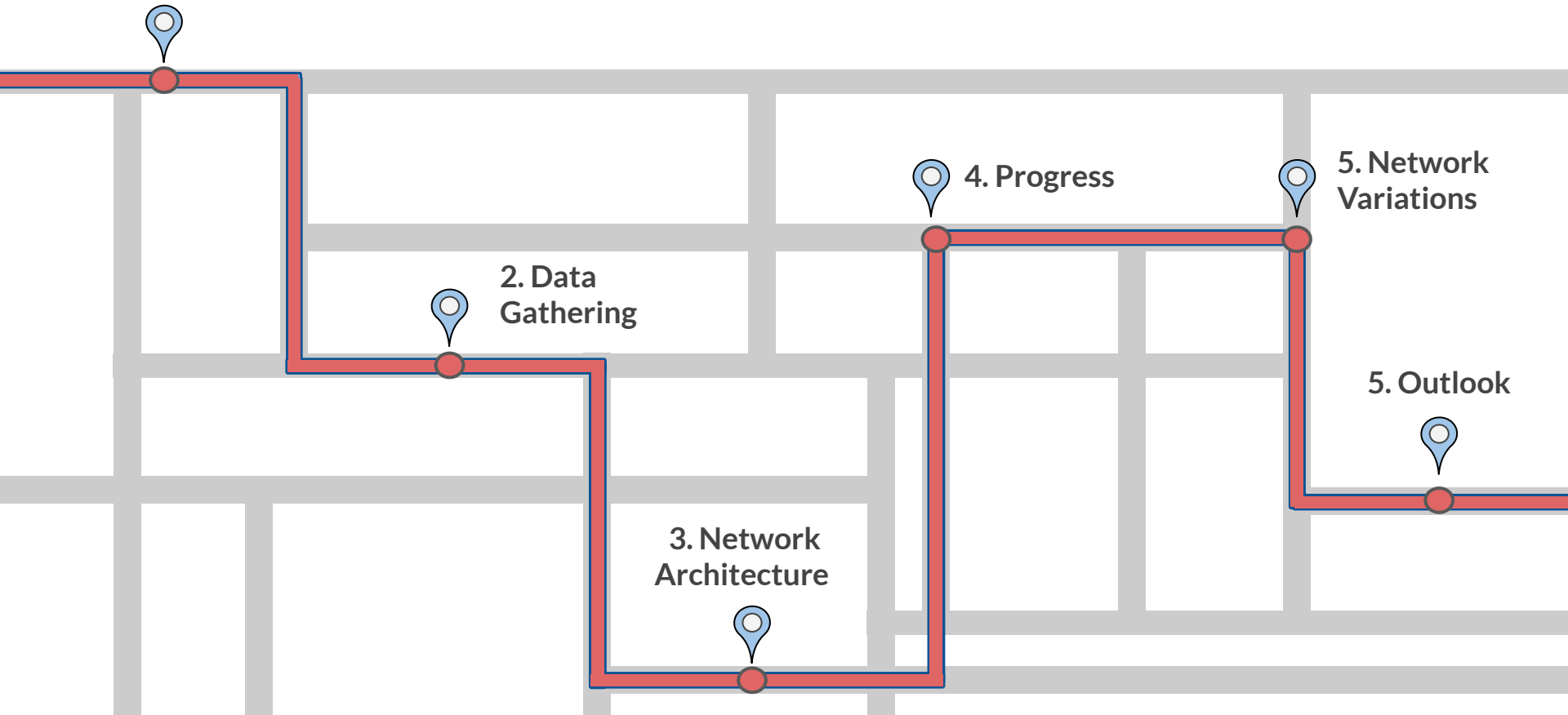
OUTLINE


1. Project Overview
2. Data Gathering
3. Network Architecture
4. Progress and Results
5. Network Variations
5. Outlook

Outlook

- Automated teaching
- Increased amount of training data
- Object Avoidance
- Better road segmentation
- Turn by turn navigation integration
- Second camera with offset

SUMMARY


1. Project Overview
2. Data Gathering
3. Network Architecture
4. Progress
5. Network Variations
5. Outlook

Sources

An Overview of Gradient Descent Optimization Algorithms. Ruder S. https://arxiv.org/abs/1609.04747

End-to-end Driving via Conditional Imitation Learning. Codevilla, F. et al. arXiv:1710.02410v2 [cs.RO] 2 Mar 2018.

Fully Convolutional Networks for Semantic Segmentation. Shelhamer E., Long J., Darrell T. arXiv:1605.06211v1 [cs.CV] 20 May 2016.

Going Deeper with Convolutions. Szegedy C. et al. arXiv:1409.4842 [cs.CV] 17 Sep 2014.

Improving Generalization Performance by Switching from Adam to SGD. Keshar N., Socher R. https://arxiv.org/pdf/1712.07628.pdf

Sources cont.

https://ai-mrkogao.github.io/reinforcement%20learning/conditionalImitationLearning/

https://github.com/carla-simulator/imitation-learning/

https://github.com/mvpcom/carlaILTrainer

http://cs231n.github.io/convolutional-networks/

https://ai-mrkogao.github.io/reinforcement%20learning/conditionalImitationLearning/

https://github.com/carla-simulator/imitation-learning/

https://github.com/mvpcom/carlaILTrainer

http://cs231n.github.io/convolutional-networks/

Training Problems

- Spiking
- Overfitting due to batches being pre sorted into the 3 different high level commands
- Randomized the batches so that within a batch all 3 branches were being fed
- High loss values (no decreasing over multiple epochs)
- Batch normalization was removed (why did this help?)

Ignoring High Level Commands

- Show a very short video (either with the new map cover or old map)
- Not being able to see the road (covered by another object) : other camera/segmentation
- Possible solutions : use ground truth segmented images
- Possibly more training data?
- Less epochs? Overfitting?

Batch Formation

-