What is claimed is:

1. A computing system, comprising:

one or more processors; and

one or more non-transitory computer-readable media that collectively store instructions that, when executed by the one or more processors, cause the computing system to perform operations, the operations comprising: prior to receiving a user input:

determining a primary motion plan that controls an autonomous vehicle towards a first destination;

determining a secondary motion plan that controls the autonomous vehicle to a second destination that is different than the first destination; and

controlling the autonomous vehicle according to the primary motion plan;

receiving the user input; and

in response to receipt of the user input, switching a control of the autonomous vehicle from the primary motion plan to the secondary motion plan that was determined prior to receipt of the user input;

wherein the computing system comprises multiple redundant motion planning systems, the multiple redundant motion planning systems comprising:

a primary motion planning system that determines the primary motion plan; and

a secondary motion planning system that determines the secondary motion plan; and

wherein the primary motion planning system and the secondary motion planning system share sensor data but separately determine the primary motion plan and the secondary motion plan.

2. The computing system of claim 1, wherein the secondary motion plan controls the autonomous vehicle to a safe state.

3. The computing system of claim 1, wherein:

the secondary motion plan comprises an emergency motion plan; and

the user input comprises a user input indicative of an emergency event.

4. The computing system of claim 1, wherein:

determining the primary motion plan comprises determining a plurality of primary motion plans respectively for a plurality of time periods;

determining the secondary motion plan comprises determining a plurality of secondary motion plans respectively for the plurality of time periods;

controlling the autonomous vehicle according to the primary motion plan comprises controlling the autonomous vehicle according to the primary motion plan for each time period prior to receipt of the user input; and

switching the control of the autonomous vehicle from the primary motion plan to the secondary motion plan comprises controlling the autonomous vehicle according to the secondary motion plan for each time period subsequent to receipt of the user input.

5. The computing system of claim 1, wherein the secondary motion plan brings the autonomous vehicle to rest while remaining within a current lane.

6. The computing system of claim 1, wherein the secondary motion plan causes the autonomous vehicle to exit a flow of traffic.

7. The computing system of claim 1, wherein the primary motion planning system comprises a primary optimization planner that optimizes a first set of cost functions to determine the primary motion plan, and wherein secondary motion planning system comprises a secondary optimization planner that optimizes a second set of cost functions to determine the secondary motion plan.

8. The computing system of claim 1, wherein determining the secondary motion plan comprises determining a plurality of secondary motion plans that respectively control the autonomous vehicle to a plurality of different locations.

9. The computing system of claim 8, wherein:

receiving the user input comprises receiving the user input that selects one of the plurality of secondary motion plans; and

controlling the autonomous vehicle according to the secondary motion plan comprises controlling the autonomous vehicle according to the secondary motion plan selected by the user input.

10. The computing system of claim 2, wherein:

the primary motion plan comprises a primary trajectory that moves the autonomous vehicle towards the primary destination; and

the secondary motion plan comprises a secondary trajectory that moves the autonomous vehicle to a safe state.

11. An autonomous vehicle, the autonomous vehicle comprising:

one or more processors; and

one or more non-transitory computer-readable media that collectively store instructions that, when executed by the one or more processors, cause the autonomous vehicle to perform operations, the operations comprising:

prior to receiving a user input:

determining a primary motion plan that controls the autonomous vehicle towards a first destination;

determining a secondary motion plan that controls the autonomous vehicle to a second destination that is different than the first destination; and

controlling the autonomous vehicle according to the primary motion plan;

receiving the user input; and

in response to receipt of the user input, switching a control of the autonomous vehicle from the primary motion plan to the secondary motion plan that was determined prior to receipt of the user input;

wherein the autonomous vehicle comprises multiple redundant motion planning systems, the multiple redundant motion planning systems comprising:

a primary motion planning system that determines the primary motion plan; and

a secondary motion planning system that determines the secondary motion plan; and

wherein the primary motion planning system and the secondary motion planning system share sensor data but separately determine the primary motion plan and the secondary motion plan.

12. The autonomous vehicle of claim 11, wherein:

the secondary motion plan comprises an emergency motion plan; and

the user input comprises a user input indicative of an emergency event.

13. The autonomous vehicle of claim 11, wherein:

determining the primary motion plan comprises determining a plurality of primary motion plans respectively for a plurality of time periods;

determining the secondary motion plan comprises determining a plurality of secondary motion plans respectively for the plurality of time periods;

controlling the autonomous vehicle according to the primary motion plan comprises controlling the autonomous vehicle according to the primary motion plan for each time period prior to receipt of the user input; and

switching the control of the autonomous vehicle from the primary motion plan to the secondary motion plan comprises controlling the autonomous vehicle according to the secondary motion plan for each time period subsequent to receipt of the user input.

14. The autonomous vehicle of claim 11, wherein the secondary motion plan brings the autonomous vehicle to rest while remaining within a current lane.

15. The autonomous vehicle of claim 11, wherein the secondary motion plan pulls the autonomous vehicle over to a side of a road.

16. The computing system of claim 1, wherein, determining the secondary motion plan prior to receiving the user input comprises continuously determining the secondary motion plan prior to receiving the user input.

17. The computing system of claim 1, wherein, determining the secondary motion plan prior to receiving the user input comprises maintaining a secondary course of action prepared at all times during operation of the autonomous vehicle.

18. A computer implemented method implemented by a computing system that comprises multiple redundant motion planning systems, the multiple redundant motion planning systems comprising a primary motion planning system that determines a primary motion plan and a secondary motion planning system that determines a secondary motion plan, wherein the primary motion planning system and the secondary motion planning system share sensor data but separately determine the primary motion plan and the secondary motion plan, the method comprising:

prior to receiving a user input indicative of an emergency event:

determining, by the primary motion planning system of the computing system based at least in part on a set of sensor data, the primary motion plan that controls an autonomous vehicle towards a first destination;

separately determining, by the secondary motion planning system of the computing system and based at least in part on the set of sensor data, an emergency motion plan that controls the autonomous vehicle to a safe state; and

controlling, by the computing system, the autonomous vehicle according to the primary motion plan;

receiving, by the computing system, the user input indicative of the emergency event; and

in response to receipt of the user input, switching, by the computing system, a control of the autonomous vehicle from the primary motion plan to the emergency motion plan that was determined prior to receipt of the user input.