

Figure 1. Map images before and after binarization processing

Path Distance Comparison (A\* vs Greedy vs RRT)

	From	To	A* (m)	Greedy (m)	RRT (m)	Greedy $\Delta$ (m)	RRT $\Delta$ (m)	Greedy Error (%)	RRT Error (%)
1	start	store	32.04	32.15	384.69	0.11	352.65	0.34	1100.66
7	store	start	32.04	32.15	384.69	0.11	352.65	0.34	1100.66
15	food	snacks	27.14	34.35	229.14	7.21	202.00	26.57	744.29
6	snacks	food	27.14	34.35	229.14	7.21	202.00	26.57	744.29
14	food	start	46.72	47.97	300.60	1.25	253.88	2.68	543.41
3	start	food	46.72	47.97	300.60	1.25	253.88	2.68	543.41
9	store	food	23.04	23.81	138.77	0.77	115.73	3.34	502.30
16	food	store	23.04	23.81	138.77	0.77	115.73	3.34	502.30
11	movie	snacks	25.07	28.89	146.21	3.82	121.14	15.24	483.21
5	snacks	movie	25.07	28.89	146.21	3.82	121.14	15.24	483.21
2	start	movie	36.14	36.48	191.50	0.34	155.36	0.94	429.88
10	movie	start	36.14	36.48	191.50	0.34	155.36	0.94	429.88
0	start	snacks	28.99	29.25	150.34	0.26	121.35	0.90	418.59
4	snacks	start	28.99	29.25	150.34	0.26	121.35	0.90	418.59
8	store	movie	51.42	51.41	251.77	-0.01	200.35	-0.02	389.63
12	movie	store	51.42	51.41	251.77	-0.01	200.35	-0.02	389.63
13	movie	food	40.37	41.61	131.27	1.24	90.90	3.07	225.17
17	food	movie	40.37	41.61	131.27	1.24	90.90	3.07	225.17

Average Path Lengths

- A\* Avg: 34.55 m
- Greedy Avg: 36.21 m
- RRT Avg: 213.81 m

Average Distance Difference & Error (relative to A\*)

- Greedy  $\Delta$ : 1.67 m | Error: 5.90 %
- RRT  $\Delta$ : 179.26 m | Error: 537.46 %

	From	To	A* Time (s)	Greedy Time (s)	RRT Time (s)	A* Visited	Greedy Visited	RRT Visited	Time Ratio (Greedy/A*)	Time Ratio (RRT/A*)	Visited Ratio (Greedy/A*)	Visited Ratio (RRT/A*)
6	store	food	0.0189	0.0218	9.2592	541	536	580	1.15	489.78	0.99	1.07
7	food	store	0.0189	0.0218	9.2592	541	536	580	1.15	489.78	0.99	1.07
1	store	start	0.0288	0.0264	13.8701	695	677	590	0.92	480.87	0.97	0.85
0	start	store	0.0288	0.0264	13.8701	695	677	590	0.92	480.87	0.97	0.85
12	start	snacks	0.2613	0.0848	55.6964	4074	3815	1191	0.32	213.13	0.94	0.29
13	snacks	start	0.2613	0.0848	55.6964	4074	3815	1191	0.32	213.13	0.94	0.29
10	start	movie	0.1535	0.0391	19.0780	1659	1651	728	0.25	124.27	1.00	0.44
11	movie	start	0.1535	0.0391	19.0780	1659	1651	728	0.25	124.27	1.00	0.44
15	movie	store	0.0900	0.0645	1.8919	1903	1364	286	0.72	21.01	0.72	0.15
14	store	movie	0.0900	0.0645	1.8919	1903	1364	286	0.72	21.01	0.72	0.15
4	food	start	0.4371	0.0739	7.8283	4302	3460	425	0.17	17.91	0.80	0.10
5	start	food	0.4371	0.0739	7.8283	4302	3460	425	0.17	17.91	0.80	0.10
9	snacks	movie	0.1046	0.0178	0.6110	1335	843	118	0.17	5.84	0.63	0.09
8	movie	snacks	0.1046	0.0178	0.6110	1335	843	118	0.17	5.84	0.63	0.09
3	snacks	food	0.4543	0.0794	2.4363	4708	3096	282	0.17	5.36	0.66	0.06
2	food	snacks	0.4543	0.0794	2.4363	4708	3096	282	0.17	5.36	0.66	0.06
16	movie	food	0.4775	0.0872	0.3515	5509	2686	118	0.18	0.74	0.49	0.02
17	food	movie	0.4775	0.0872	0.3515	5509	2686	118	0.18	0.74	0.49	0.02

### Task 2 Optimal Route (Brute Force TSP):

Visiting Order : start → movie → snacks → food → store → start

Total Distance : 143.43 m

### Segment Distances (in meters):

start → movie : 36.14 m

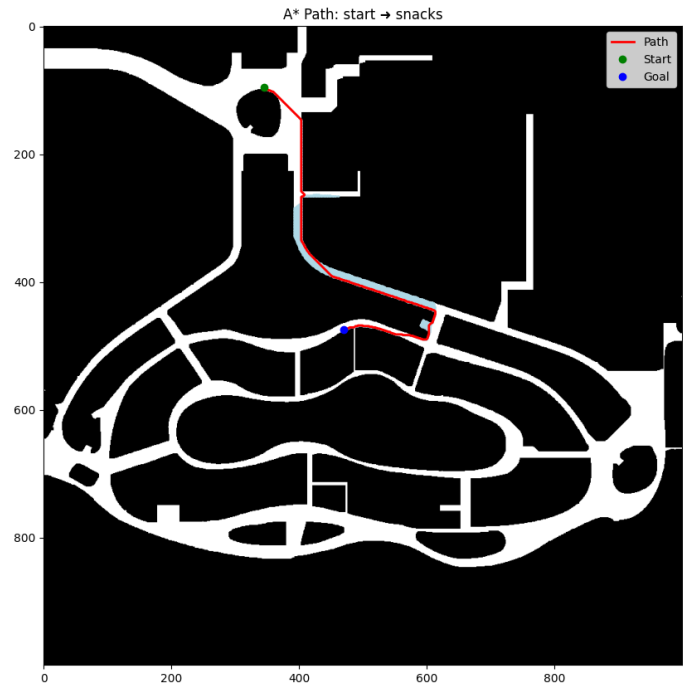
movie → snacks : 25.07 m

snacks → food : 27.14 m

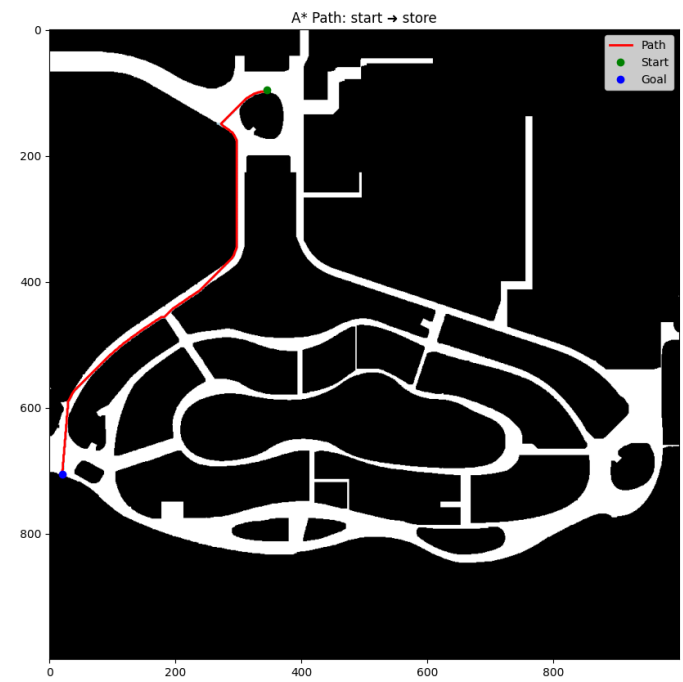
food → store : 23.04 m

store → start : 32.04 m

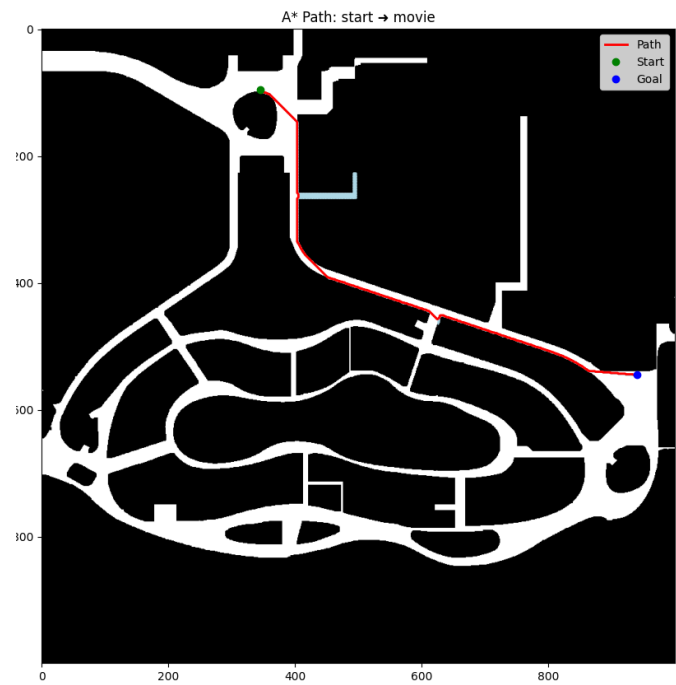
Method	A*
Path	start --- snacks
Total Distance (m)	28.99
Visited Cells	4074
Runtime (s)	0.2631



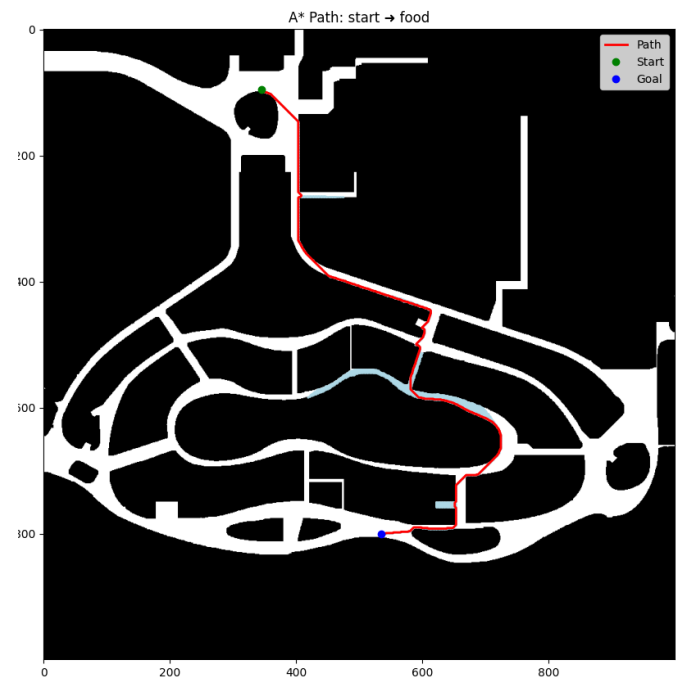
Method	A*
Path	start --- store
Total Distance (m)	32.04
Visited Cells	695
Runtime (s)	0.0288



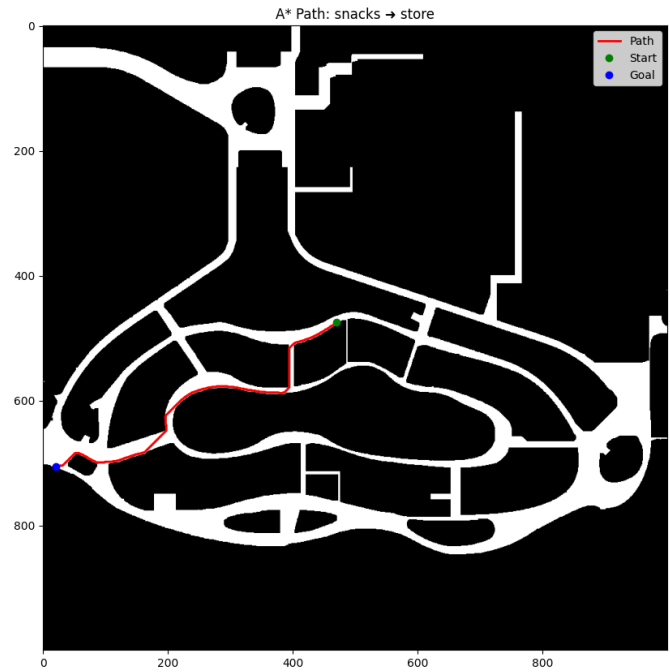
Method	A*
Path	start --- movie
Total Distance (m)	36.14
Visited Cells	1659
Runtime (s)	0.1535



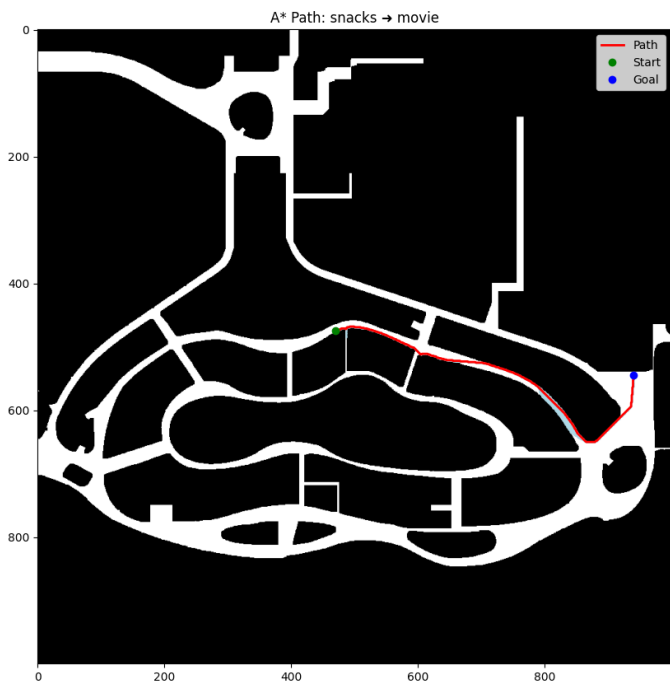
Method	A*
Path	start --- food
Total Distance (m)	46.72
Visited Cells	4302
Runtime (s)	0.4371



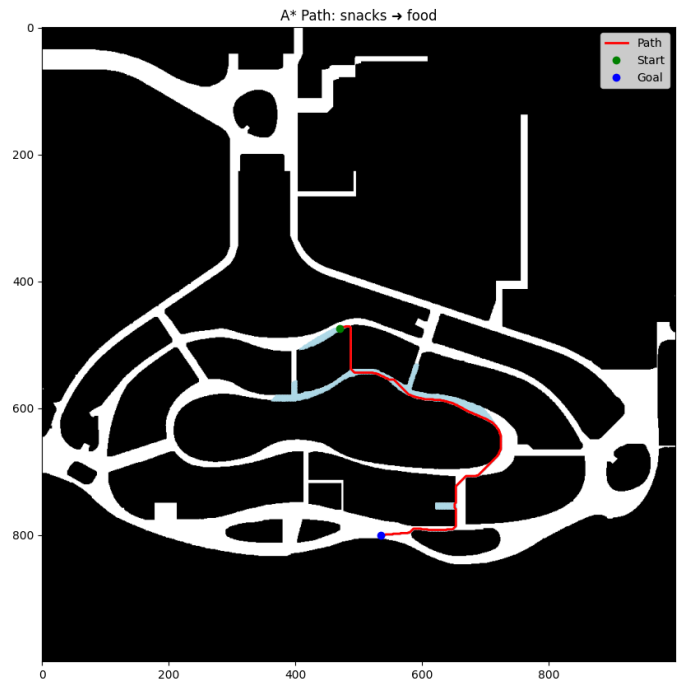
Method	A*
Path	snacks --- store
Total Distance (m)	24.80
Visited Cells	539
Runtime (s)	0.0225



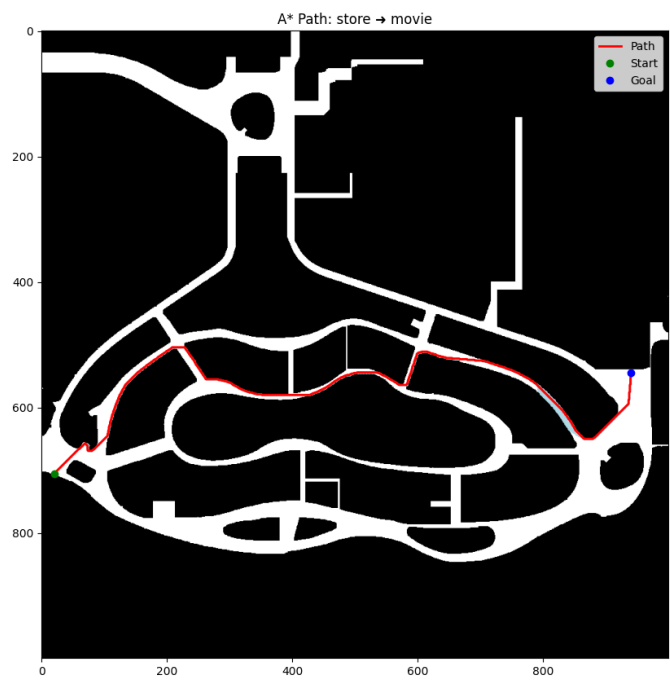
Method	A*
Path	snacks --- movie
Total Distance (m)	25.70
Visited Cells	1335
Runtime (s)	0.1046



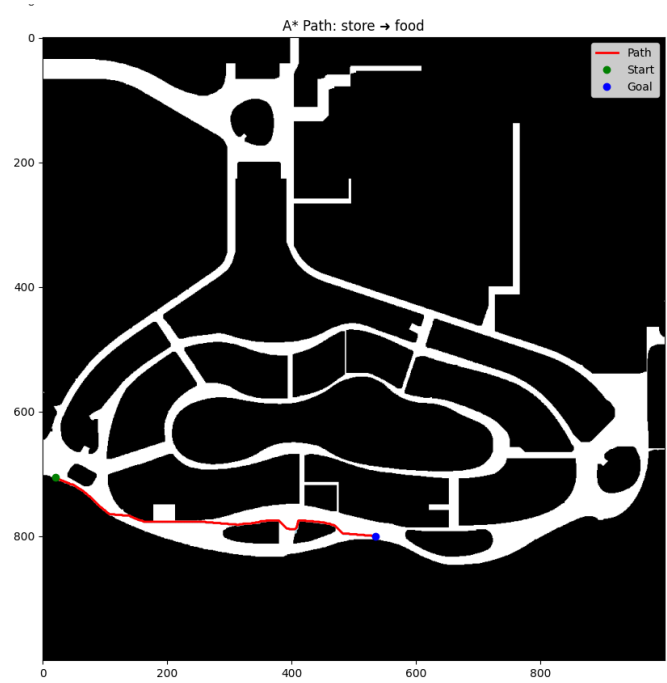
Method	A*
Path	snacks --- food
Total Distance (m)	27.14
Visited Cells	478
Runtime (s)	0.4543



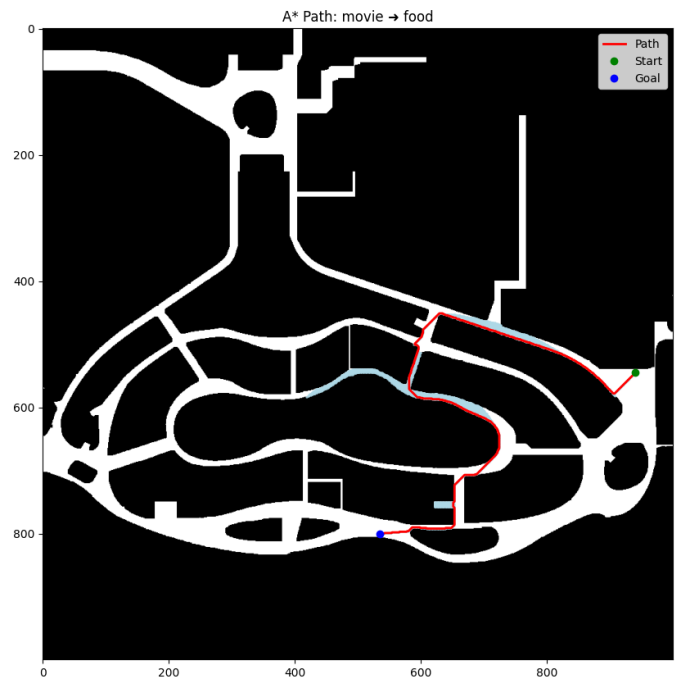
Method	A*
Path	store --- movie
Total Distance (m)	51.42
Visited Cells	1903
Runtime (s)	0.09



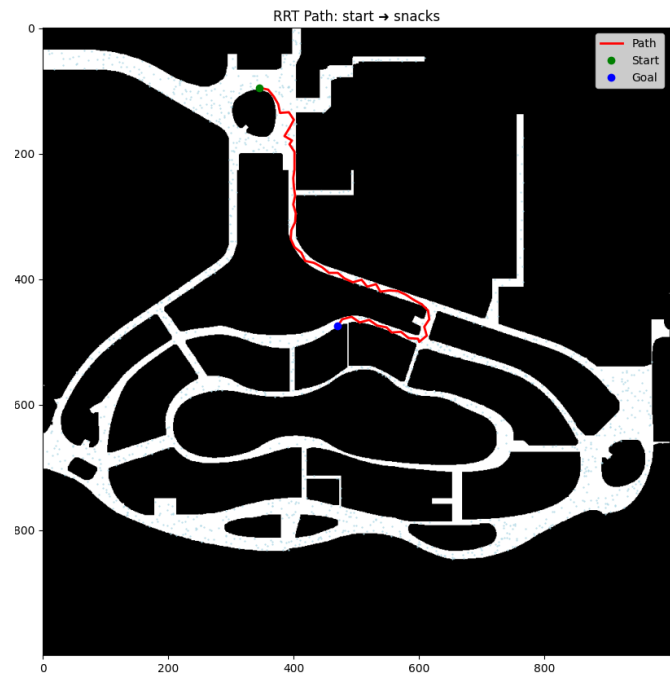
Method	A*
Path	store --- food
Total Distance (m)	23.04
Visited Cells	541
Runtime (s)	0.0189



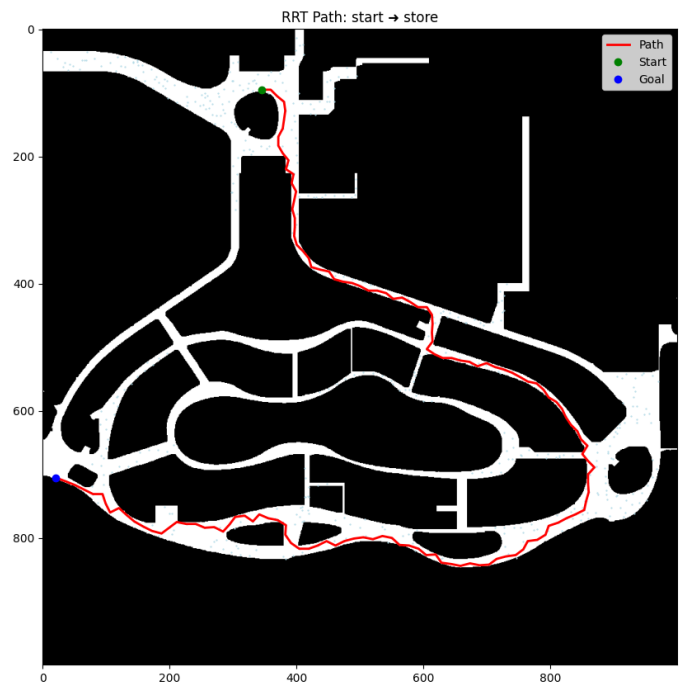
Method	A*
Path	movie --- food
Total Distance (m)	40.37
Visited Cells	5509
Runtime (s)	0.4775



Method	RRT
Path	start --- snacks
Total Distance (m)	155.24
Visited Cells	1191
Runtime (s)	55.6964



Method	RRT
Path	start ---store
Total Distance (m)	403.57
Visited Cells	590
Runtime (s)	13.8701



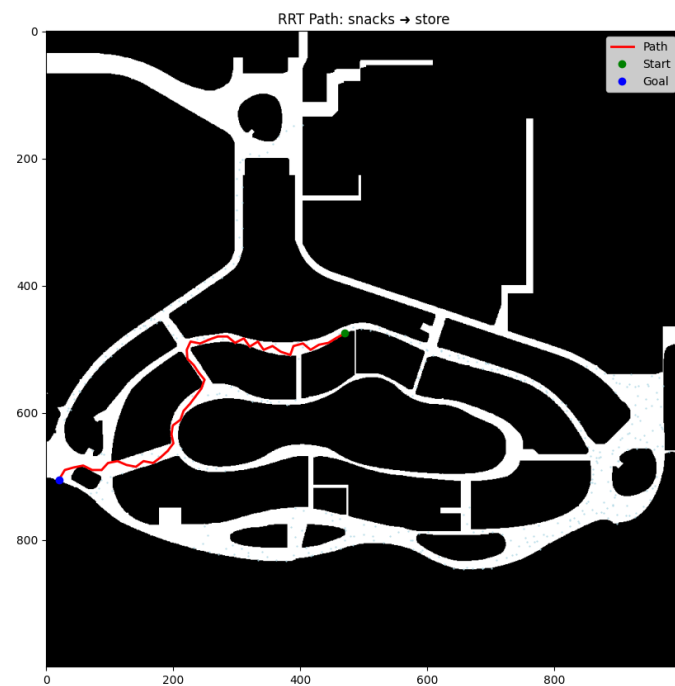




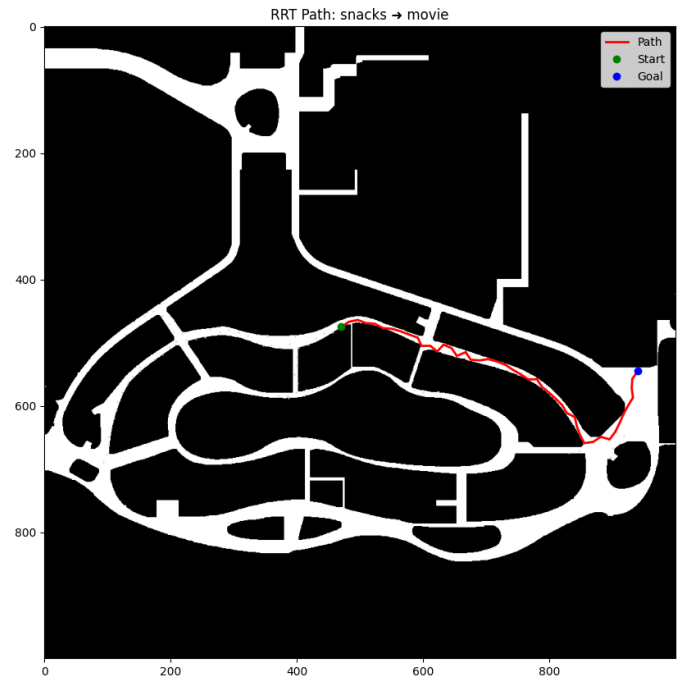
Method	RRT
Path	start --- food
Total Distance (m)	272.20
Visited Cells	425
Runtime (s)	7.8283



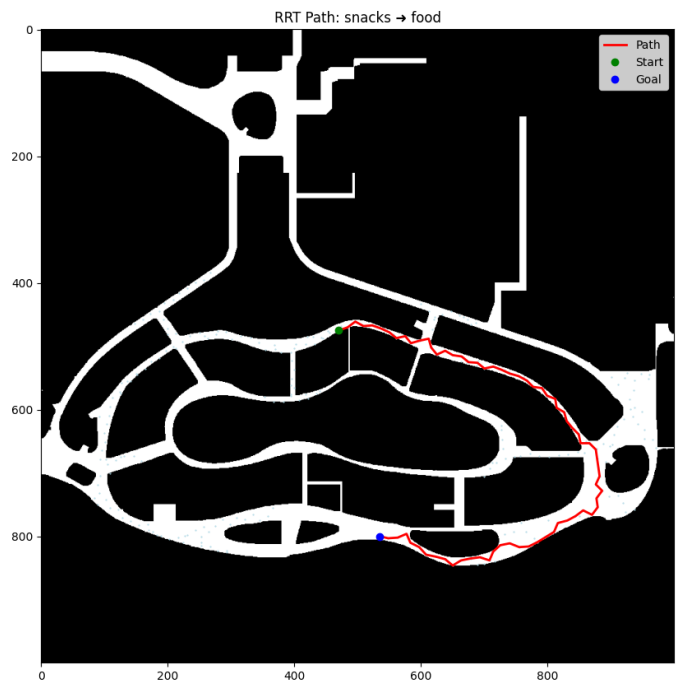
Method	RRT
Path	snacks --- store
Total Distance (m)	139.01
Visited Cells	419
Runtime (s)	6.9188



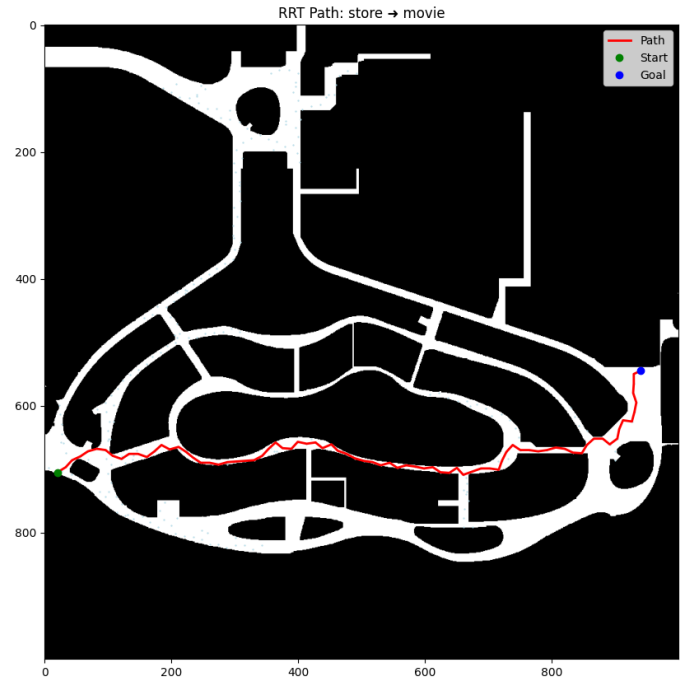
Method	RRT
Path	snacks --- movie
Total Distance (m)	130.5
Visited Cells	118
Runtime (s)	0.611



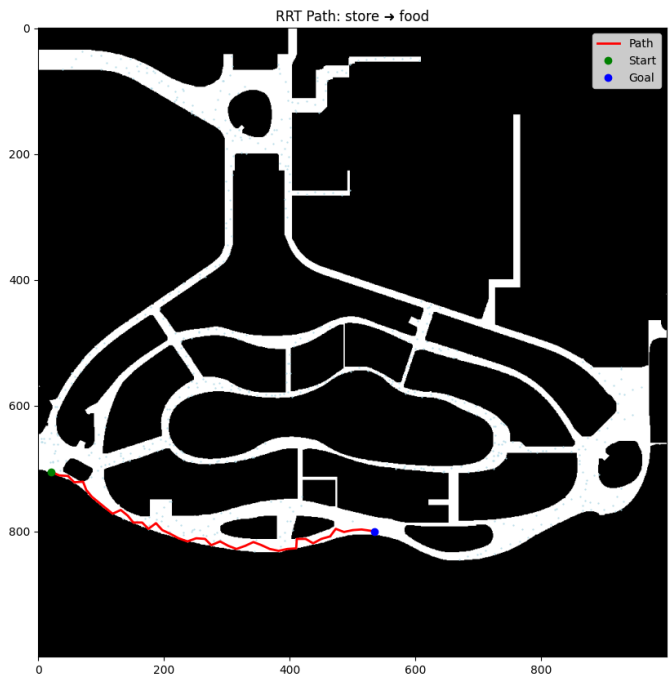
Method	RRT
Path	snacks --- food
Total Distance (m)	205.53
Visited Cells	282
Runtime (s)	2.4363



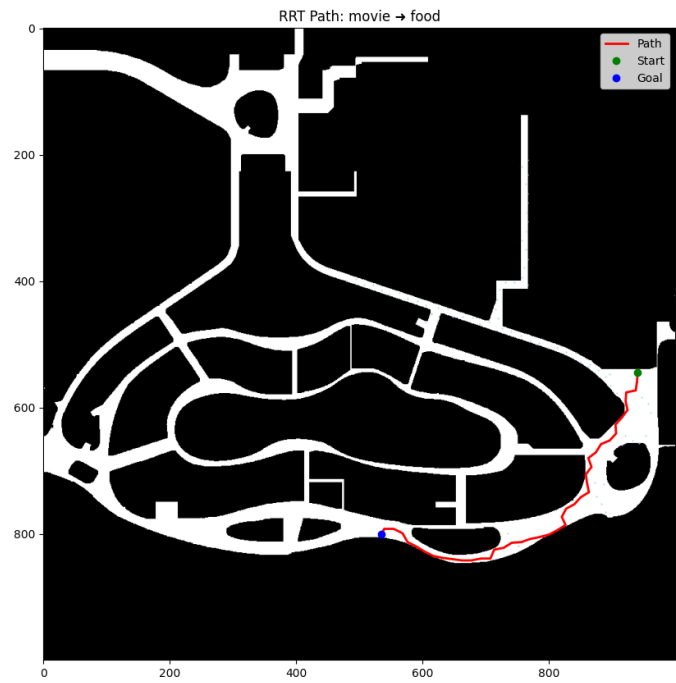
Method	RRT
Path	store --- movie
Total Distance (m)	229.35
Visited Cells	286
Runtime (s)	1.8919



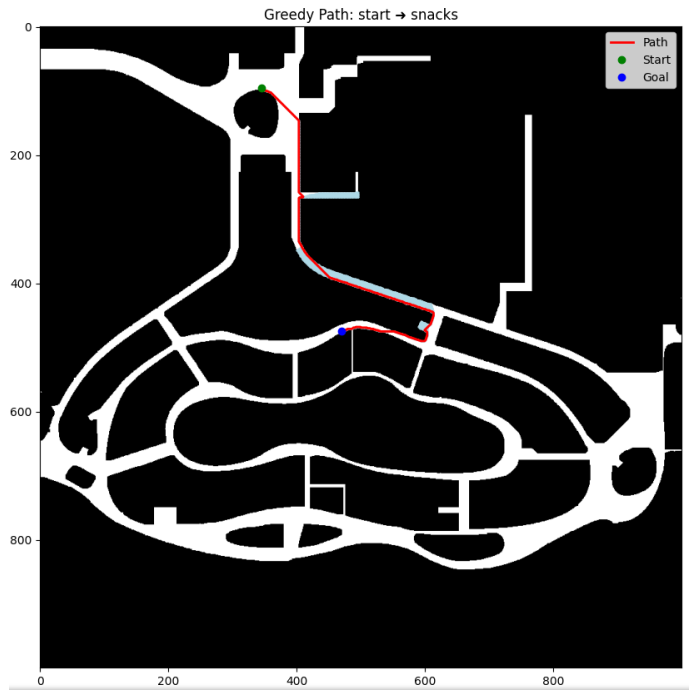
Method	RRT
Path	store --- food
Total Distance (m)	121.97
Visited Cells	580
Runtime (s)	9.2592



Method	RRT
Path	movie --- food
Total Distance (m)	127.62
Visited Cells	118
Runtime (s)	0.3515



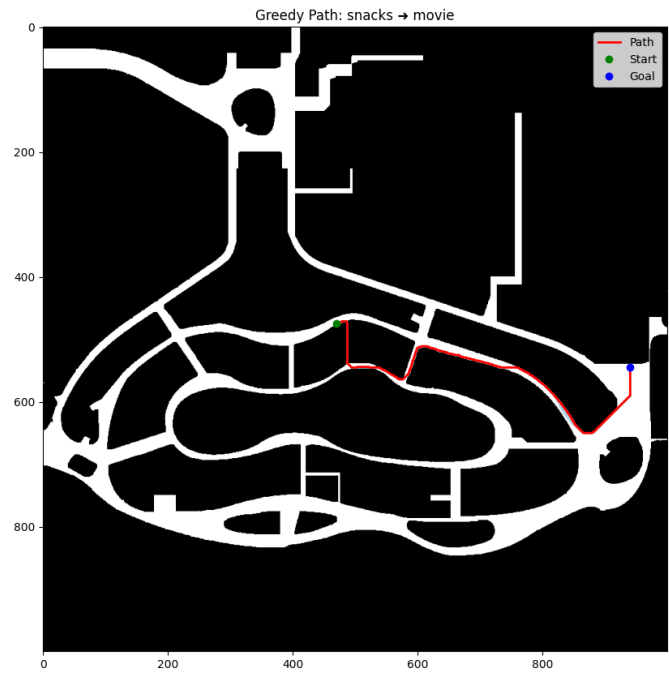
Method	Greedy Path
Path	start -- snacks
Total Distance (m)	29.25
Visited Cells	3815
Runtime (s)	0.0848



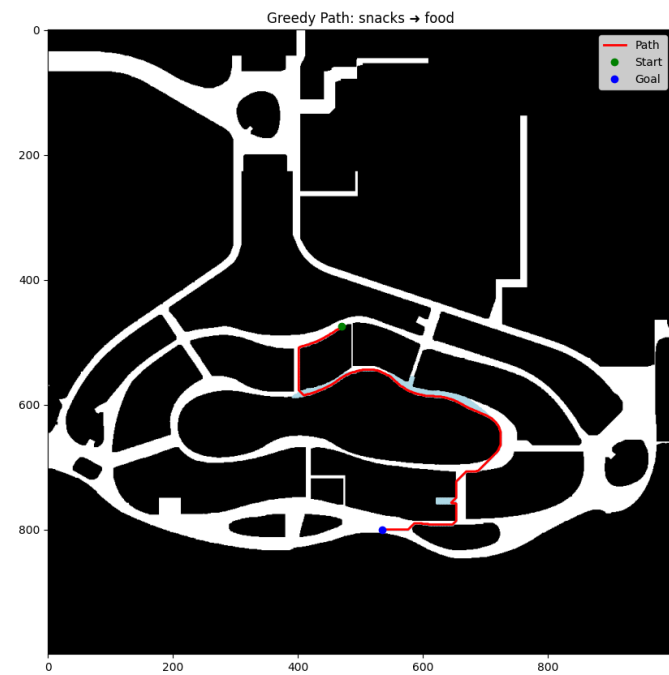




Method	Greedy Path
Path	snacks -- movie
Total Distance (m)	28.98
Visited Cells	843
Runtime (s)	0.0178

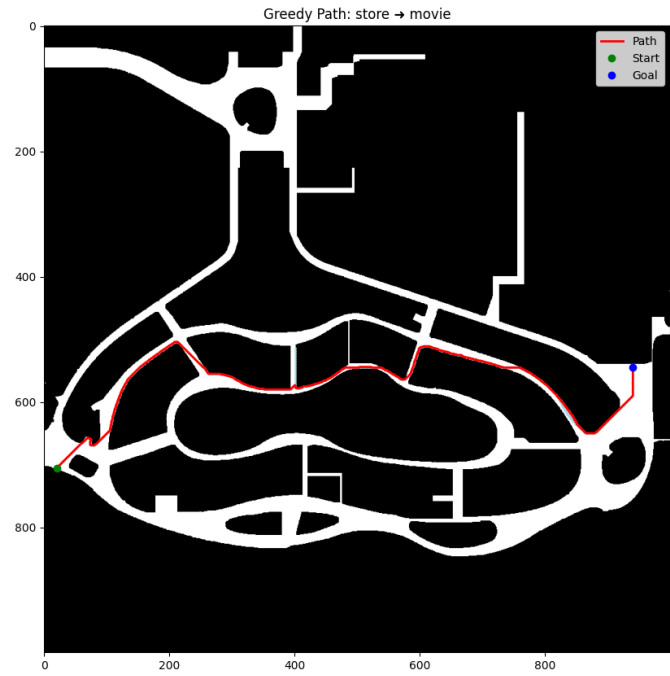


Method	Greedy Path
Path	snacks -- food
Total Distance (m)	34.53
Visited Cells	3096
Runtime (s)	0.0794

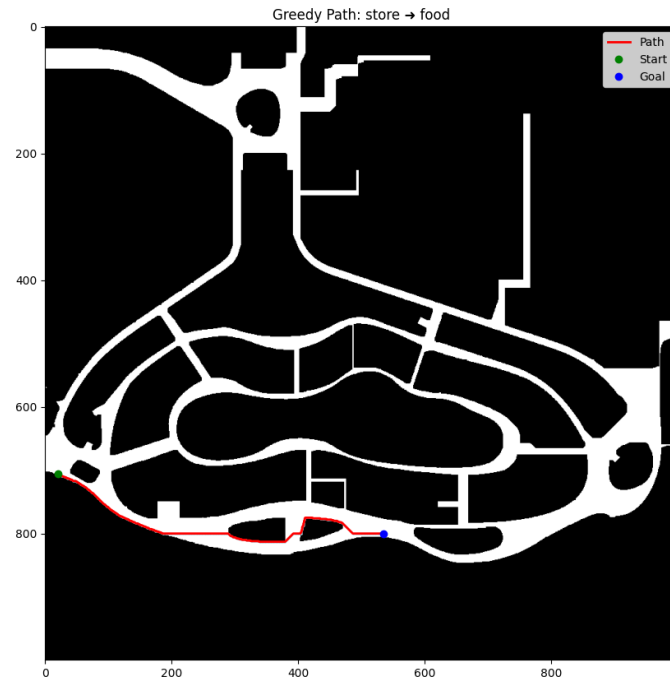




Method	Greedy Path
Path	store -- movie
Total Distance (m)	51.41
Visited Cells	1364
Runtime (s)	0.064



Method	Greedy Path
Path	store -- food
Total Distance (m)	23.81
Visited Cells	536
Runtime (s)	0.0218



Method	Greedy Path
Path	movie -- food
Total Distance (m)	41.61
Visited Cells	2686
Runtime (s)	0.0872

