

ANEXO 2- Tabela de execuções do algoritmo

Estão destacadas as linhas onde encontrou-se o ótimo global.

- **Problema com 29 cidades** (menor distância: 9.07414804787284)

Simulated Annealing (Resfriamento: $T=T_0/\ln(2+k)$)								
N	K	T0	Jmin	Data	Hora início	Hora Final	Tempo	Diferença do ótimo global
1.00E+05	50	20	15.79084329	17/08/2020	22:33:06	22:38:44	00:05:38	42.54%
1.00E+05	50	8	14.87709308	17/08/2020	22:43:31	22:49:13	00:05:42	39.01%
1.00E+05	50	2	11.25788795	17/08/2020	18:26:36	18:53:58	00:27:22	19.40%
1.00E+05	50	1	9.58101209	17/08/2020	22:58:47	23:04:25	00:05:38	5.29%
1.00E+05	50	0.5	9.074148048	17/08/2020	23:33:07	23:38:45	00:05:38	0.00%
1.00E+05	50	0.1	9.074148048	17/08/2020	23:13:17	23:19:01	00:05:44	0.00%
1.00E+05	50	0.01	11.1802983	18/08/2020	19:54:24	20:00:17	00:05:53	18.84%
1.00E+05	50	5.00E-03	10.5705951	18/08/2020	20:04:20	20:10:11	00:05:51	14.16%
1.00E+05	50	0.001	10.2094656	18/08/2020	20:12:00	20:17:54	00:05:54	11.12%
1.00E+05	150	2	10.46623053	18/08/2020	20:23:29	20:40:56	00:17:27	13.30%
1.00E+05	150	0.5	9.074148048		13:16:39	13:50:38	00:33:59	0.00%
1.00E+05	64	0.5	9.074148048	19/08/2020	14:25:43	14:34:14	00:08:31	0.00%
1.00E+05	50	0.5	9.074148048	19/08/2020	14:17:51	14:24:34	00:06:43	0.00%
1.00E+05	40	0.5	9.077917743	19/08/2020	14:10:23	14:15:47	00:05:24	0.04%
1.00E+05	32	0.5	9.077917743	19/08/2020	14:03:03	14:07:21	00:04:18	0.04%
1.00E+05	16	0.5	9.124398696	19/08/2020	13:59:09	14:01:20	00:02:11	0.55%
1.00E+05	8	0.5	9.460341733	19/08/2020	13:57:10	13:58:16	00:01:06	4.08%
1.00E+05	4	0.5	10.09971471	19/08/2020	13:55:46	13:56:19	00:00:33	10.15%
1.00E+05	2	0.5	11.21072756	19/08/2020	13:53:25	13:53:41	00:00:16	19.06%
1.00E+05	1	2	16.69998457	18/08/2020	20:44:23	20:44:31	00:00:08	45.66%
1.00E+06	50	0.5	9.074148048	19/08/2020	14:48:14	15:55:17	01:07:03	0.00%
1.00E+05	50	0.5	9.074148048	17/08/2020	23:33:07	23:38:45	00:05:38	0.00%
1.00E+04	50	0.5	9.074148048	19/08/2020	14:46:23	14:47:04	00:00:41	0.00%
1.00E+03	50	0.5	9.164415343	19/08/2020	14:45:25	14:45:29	00:00:04	0.98%
1.00E+02	50	0.5	10.14054998	19/08/2020	14:43:18	14:43:18	00:00:00	10.52%
1.00E+01	50	0.5	13.2591574	19/08/2020	14:44:37	14:44:37	00:00:00	31.56%

Resfriamento Rápido: $T=T_0/(k+1)$								
N	K	T0	Jmin	Data	Hora início	Hora Final	Tempo	Diferença do ótimo global
1.00E+05	50	20	11.92366206	19/08/2020	16:06:43	16:13:15	00:06:32	23.90%
1.00E+05	50	8	9.338522992	19/08/2020	16:14:28	16:21:03	00:06:35	2.83%
1.00E+05	50	2	9.074148048	19/08/2020	16:25:32	16:32:04	00:06:32	0.00%
1.00E+05	50	1	9.074148048	19/08/2020	16:38:27	16:44:59	00:06:32	0.00%
1.00E+05	50	0.5	9.074148048	19/08/2020	16:47:02	16:53:34	00:06:32	0.00%
1.00E+05	50	0.1	9.07698292	19/08/2020	16:56:43	17:03:17	00:06:34	0.03%

1.00E+05	64	0.5	9.074148048		18:46:10	18:54:33	00:08:23	0.00%
1.00E+05	50	0.5	9.074148048	19/08/2020	16:47:02	16:53:34	00:06:32	0.00%
1.00E+05	40	0.5	9.07698292	19/08/2020	18:39:41	18:44:55	00:05:14	0.03%
1.00E+05	32	0.5	9.07698292	19/08/2020	18:33:33	18:37:45	00:04:12	0.03%
1.00E+05	16	0.5	9.074148048	19/08/2020	18:30:34	18:32:40	00:02:06	0.00%
1.00E+05	8	0.5	9.074148048	19/08/2020	18:28:37	18:29:40	00:01:03	0.00%
1.00E+05	4	0.5	9.195895653	19/08/2020	18:27:20	18:27:51	00:00:31	1.32%
1.00E+05	2	0.5	11.1791873	19/08/2020	18:26:20	18:26:36	00:00:16	18.83%
1.00E+05	1	0.5	13.34016055	19/08/2020	18:25:19	18:25:27	00:00:08	31.98%
1.00E+06	50	0.5	9.074148048	19/08/2020	17:11:04	18:16:38	01:05:34	0.00%
1.00E+05	50	0.5	9.074148048	19/08/2020	16:47:02	16:53:34	00:06:32	0.00%
1.00E+04	50	0.5	9.07698292	19/08/2020	17:09:11	17:09:50	00:00:39	0.03%
1.00E+03	50	0.5	9.629907727	19/08/2020	17:08:23	17:08:27	00:00:04	5.77%
1.00E+02	50	0.5	10.50071835	19/08/2020	17:07:39	17:07:40	00:00:01	13.59%
1.00E+01	50	0.5	11.50665674	19/08/2020	17:04:54	17:04:55	00:00:01	21.14%

- **Problema com 52 pontos** (menor distância: 7.5443)

Simulated Annealing Resfriamento: $T=T_0/np.\log_2(2+k)$								
N	K	T0	Jmin	Data	Hora início	Hora Final	Tempo	Diferença do ótimo global
1.00E+05	50	20	20.11822747	21/08/2020	20:37:45	20:45:49	00:08:04	62.50%
1.00E+05	50	8	19.70583537	21/08/2020	20:28:40	20:36:48	00:08:08	61.72%
1.00E+05	50	2	14.94545108	21/08/2020	20:19:51	20:27:59	00:08:08	49.52%
1.00E+05	50	1	11.56715649	21/08/2020	20:11:07	20:19:14	00:08:07	34.78%
1.00E+05	50	0.5	9.045471595	21/08/2020	18:53:35	19:01:37	00:08:02	16.60%
1.00E+05	50	0.1	7.801255795	21/08/2020	15:57:21	16:06:28	00:09:07	3.29%
1.00E+05	50	0.01	8.449680078	21/08/2020	15:46:40	15:55:15	00:08:35	10.71%
1.00E+05	50	5.00E-03	10.10253815	21/08/2020	15:33:00	15:41:36	00:08:36	25.32%
1.00E+05	50	0.001	9.660865796	21/08/2020	15:22:12	15:30:43	00:08:31	21.91%
1.00E+05	150	0.5	8.494628623	21/08/2020	22:10:39	22:35:06	00:24:27	11.19%
1.00E+05	100	0.5	8.459593962	21/08/2020	21:53:24	22:09:35	00:16:11	10.82%
1.00E+05	80	0.5	8.618764763	21/08/2020	21:37:22	21:50:20	00:12:58	12.47%
1.00E+05	64	0.5	8.987737438	21/08/2020	21:26:02	21:36:24	00:10:22	16.06%
1.00E+05	50	0.5	9.082622203	21/08/2020	21:16:42	21:24:44	00:08:02	16.94%
1.00E+05	40	0.5	9.133841978	21/08/2020	21:09:30	21:15:56	00:06:26	17.40%
1.00E+05	32	0.5	9.415443908	21/08/2020	21:03:12	21:08:23	00:05:11	19.87%
1.00E+05	16	0.5	10.05485277	21/08/2020	20:59:43	21:02:19	00:02:36	24.97%
1.00E+05	8	0.5	11.89789044	21/08/2020	20:57:43	20:59:00	00:01:17	36.59%
1.00E+05	4	0.5	13.03863275	21/08/2020	20:54:17	20:54:55	00:00:38	42.14%
1.00E+05	2	0.5	14.98634998	21/08/2020	20:52:39	20:52:59	00:00:20	49.66%
1.00E+05	1	0.5	17.10445129	21/08/2020	20:51:22	20:51:32	00:00:10	55.89%
1.00E+06	50	0.5	8.826069568	21/08/2020	23:14:18	00:35:25	01:21:07	14.52%
1.00E+05	50	0.5	9.215600877	21/08/2020	22:54:44	23:02:48	00:08:04	18.14%
1.00E+04	50	0.5	9.194791937	21/08/2020	22:53:11	22:54:00	00:00:49	17.95%

1.00E+03	50	0.5	10.44638024	21/08/2020	22:52:28	22:52:33	00:00:05	27.78%
1.00E+02	50	0.5	10.7458857	21/08/2020	22:41:43	22:41:44	00:00:01	29.79%
1.00E+01	50	0.5	17.35913453	21/08/2020	22:40:59	22:41:12	00:00:13	56.54%
1.00E+06	100	0.1	7.80553907	22/08/2020	12:28:43	15:08:35	02:39:52	3.35%
1.00E+05	200	0.1	7.544365902	22/08/2020	15:32:36	16:04:41	00:32:05	0.00%
1.00E+05	100	0.1	7.940697471	22/08/2020	16:08:49	16:24:54	00:16:05	4.99%
1.00E+05	150	0.1	7.544365902	22/08/2020	19:26:17	19:52:29	00:26:12	0.00%

Resfriamento Rápido: $T=T_0/(k+1)$								
N	K	T0	Jmin	Data	Hora início	Hora Final	Tempo	Diferença do ótimo global
1.00E+05	50	20	16.19293033	20/08/2020	21:10:50	21:18:44	00:07:54	53.41%
1.00E+05	50	8	11.61494168	20/08/2020	21:01:57	21:09:57	00:08:00	35.05%
1.00E+05	50	2	7.770488083	20/08/2020	20:52:58	21:00:56	00:07:58	2.91%
1.00E+05	50	1	8.096375142	20/08/2020	20:44:07	20:52:05	00:07:58	6.82%
1.00E+05	50	0.5	7.685895687	20/08/2020	19:53:52	20:01:49	00:07:57	1.84%
1.00E+05	50	0.1	8.019696469	20/08/2020	20:34:00	20:42:01	00:08:01	5.93%
1.00E+05	50	0.01	9.303784411	20/08/2020	20:24:50	20:32:51	00:08:01	18.91%
1.00E+05	50	5.00E-03	9.805535521	20/08/2020	20:14:45	20:22:47	00:08:02	23.06%
1.00E+05	50	0.001	9.845508633	20/08/2020	20:04:50	20:12:51	00:08:01	23.37%
1.00E+05	100	0.5	8.046415523	20/08/2020	01:26:17	01:42:42	00:16:25	6.24%
1.00E+05	80	0.5	8.075061049	20/08/2020	00:55:48	01:09:04	00:13:16	6.57%
1.00E+05	64	0.5	8.015480797	20/08/2020	00:24:20	00:35:12	00:10:52	5.88%
1.00E+05	50	0.5	7.544365902	20/08/2020	00:46:30	00:54:52	00:08:22	0.00%
1.00E+05	40	0.5	7.582657814	20/08/2020	00:39:05	00:45:44	00:06:39	0.51%
1.00E+05	32	0.5	7.910649092	20/08/2020	00:18:16	00:23:36	00:05:20	4.63%
1.00E+05	16	0.5	8.20731353	20/08/2020	00:14:25	00:17:08	00:02:43	8.08%
1.00E+05	8	0.5	8.782608215	20/08/2020	00:11:33	00:12:53	00:01:20	14.10%
1.00E+05	4	0.5	10.36676286	20/08/2020	00:10:00	00:10:44	00:00:44	27.23%
1.00E+05	2	0.5	14.00204943	20/08/2020	00:09:06	00:09:26	00:00:20	46.12%
1.00E+05	1	0.5	17.7556703	20/08/2020	00:08:15	00:08:26	00:00:11	57.51%
1.00E+06	50	0.5	8.05354659	21/08/2020	13:55:42	15:17:43	01:22:01	6.32%
1.00E+05	50	0.5	7.777028508	21/08/2020	13:45:55	13:54:08	00:08:13	2.99%
1.00E+04	50	0.5	8.099571491	21/08/2020	13:44:30	13:45:20	00:00:50	6.86%
1.00E+03	50	0.5	8.770182313	21/08/2020	13:43:48	13:43:54	00:00:06	13.98%
1.00E+02	50	0.5	11.20687611	21/08/2020	13:42:52	13:42:59	00:00:07	32.68%
1.00E+01	50	0.5	15.38827297	21/08/2020	13:42:06	13:42:06	00:00:00	50.97%
1.00E+05	150	0.1	7.939692246	22/08/2020	21:13:43	21:39:14	00:25:31	4.98%

Problema com 130 cidades (menor distância: 6.11086094968039)

Simulated Annealing Resfriamento: $T=T_0/np.log2(2+k)$								
N	K	T0	Jmin	Data	Hora início	Hora Final	Tempo	Diferença do ótimo global
1.00E+05	100	0.5	14.03662281	24/08/2020	15:23:14	15:53:55	00:30:41	56.46%
1.00E+05	100	0.1	6.856952519	24/08/2020	14:47:19	15:17:56	00:30:37	10.88%

1.00E+05	100	0.01	8.48540129	24/08/2020	15:56:38	16:27:10	00:30:32	27.98%
1.00E+06	100	1.00E-01	6.538223768	24/08/2020	18:06:48	23:10:25	05:03:37	6.54%
1.00E+05	150	0.5	13.07244945	24/08/2020	13:58:26	14:44:51	00:46:25	53.25%
1.00E+05	100	0.5	13.87526971	24/08/2020	00:56:42	01:27:54	00:31:12	55.96%
1.00E+05	50	0.5	15.96149127	24/08/2020	23:53:53	00:09:26	00:15:33	61.71%
1.00E+05	32	0.5	17.01243939	24/08/2020	13:44:19	13:54:07	00:09:48	64.08%
1.00E+05	2	0.5	30.8318155	24/08/2020	13:42:30	13:43:08	00:00:38	80.18%
1.00E+05	1	0.5	34.09314781	24/08/2020	13:41:14	13:41:33	00:00:19	82.08%

Resfriamento Rápido: $T=T0/(k+1)$

N	K	T0	Jmin	Data	Hora início	Hora Final	Tempo	Diferença do ótimo global
1.00E+05	50	0.001	11.58344396	23/08/2020	10:18:58	10:21:02	00:02:04	47.24%
1.00E+05	50	0.0001	11.09062867	23/08/2020	10:22:46	10:26:18	00:03:32	44.90%
1.00E+05	50	5.00E-05	10.33701328	23/08/2020	10:26:30	10:28:49	00:02:19	40.88%
1.00E+05	50	1.00E-05	10.74854993	23/08/2020	10:31:19	10:33:37	00:02:18	43.15%
1.00E+05	50	1.00E-06	10.52588225	23/08/2020	10:34:04	10:36:25	00:02:21	41.94%
1.00E+05	100	0.5	6.96391926	23/08/2020	23:14:51	23:45:18	00:30:27	12.25%
1.00E+05	80	0.5	6.807532332	23/08/2020	22:49:22	23:13:56	00:24:34	10.23%
1.00E+06	64	0.5	6.687581585	23/08/2020	19:32:44	22:48:03	03:15:19	8.62%
1.00E+05	64	0.1	7.328939686	23/08/2020	15:50:54	16:10:15	00:19:21	16.62%
1.00E+05	64	0.5	6.821459855	23/08/2020	15:30:13	15:49:49	00:19:36	10.42%
1.00E+05	50	0.5	6.795801927	23/08/2020	15:13:27	15:28:45	00:15:18	10.08%
1.00E+05	2	0.0001	10.80154905	23/08/2020	14:48:43	14:49:52	00:01:09	43.43%
