

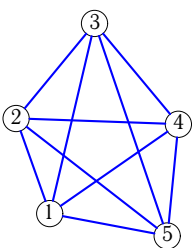
# Муравьиный алгоритм

Найти длину пути муравья в задаче коммивояжера. Начальная вершина 1. Дана последовательность  $P$  случайных чисел, выпавших в при выборе очередной вершины, расстояния  $L_{k,j}$  между вершинами  $k, j$  и интенсивность феромона  $\tau_{k,j}$  на ребре  $[k, j]$ . Секторы вероятности перехода сортировать по возрастанию номеров вершин. Использовать формулу вероятности перехода из вершины  $k$  в  $j$

$$P_{k,j} = 100 \frac{\eta_{k,j}^\alpha \tau_{k,j}^\beta}{\sum \eta_{k,i}^\alpha \tau_{k,i}^\beta}$$

при  $\alpha = 1, \beta = 1, \eta_{k,j} = 1/L_{k,j}$

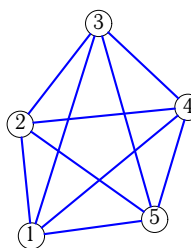
**Задача 12.1.** 2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	38	3
1-3	74	2
1-4	59	2
1-5	45	2
2-3	46	1
2-4	61	1
2-5	72	1
3-4	49	2
3-5	85	2
4-5	42	1

$P = 65, 61, 35.$

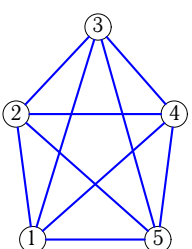
**Задача 12.2.** 2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	42	2
1-3	84	2
1-4	76	2
1-5	47	2
2-3	48	2
2-4	63	2
2-5	62	2
3-4	46	3
3-5	77	3
4-5	44	3

$P = 47, 28, 63.$

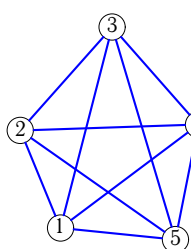
**Задача 12.3.** 2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	48	1
1-3	84	2
1-4	71	1
1-5	47	1
2-3	45	3
2-4	59	2
2-5	71	2
3-4	44	2
3-5	83	2
4-5	48	2

$P = 52, 33, 49.$

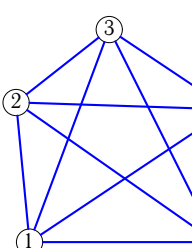
**Задача 12.4.** 2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	40	2
1-3	78	2
1-4	65	3
1-5	43	3
2-3	52	1
2-4	67	2
2-5	71	2
3-4	49	3
3-5	83	3
4-5	44	2

$P = 53, 56, 55.$

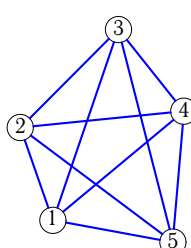
**Задача 12.5.** 2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	53	3
1-3	85	2
1-4	90	2
1-5	70	2
2-3	45	2
2-4	80	2
2-5	92	2
3-4	54	1
3-5	89	1
4-5	50	2

$P = 23, 57, 56.$

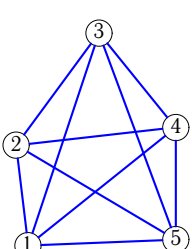
**Задача 12.6.** 2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	37	3
1-3	76	3
1-4	64	3
1-5	46	2
2-3	52	2
2-4	62	2
2-5	72	1
3-4	39	3
3-5	83	2
4-5	49	2

$P = 37, 49, 22.$

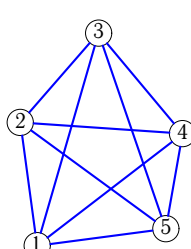
**Задача 12.7.** 2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	38	2
1-3	84	3
1-4	71	2
1-5	56	3
2-3	52	2
2-4	60	1
2-5	70	2
3-4	46	2
3-5	83	3
4-5	42	3

$P = 71, 61, 67.$

**Задача 12.8.** 2

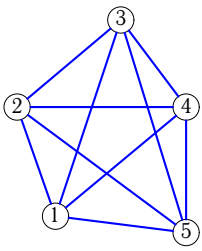


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	47	1
1-3	83	2
1-4	69	2
1-5	49	2
2-3	45	3
2-4	61	3
2-5	68	3
3-4	49	3
3-5	78	3
4-5	36	2

$P = 41, 31, 28.$

**Задача 12.9.**

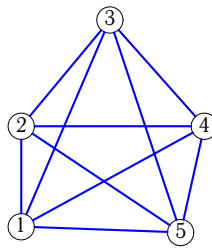
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Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	43	2
1-3	78	3
1-4	64	2
1-5	50	2
2-3	51	3
2-4	64	2
2-5	79	2
3-4	41	2
3-5	84	2
4-5	47	2

 $P = 44, 28, 72.$ **Задача 12.10.**

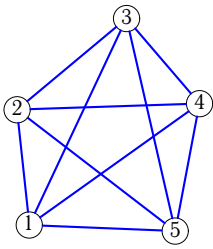
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Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	38	3
1-3	85	3
1-4	79	3
1-5	60	2
2-3	52	2
2-4	69	2
2-5	72	1
3-4	54	3
3-5	84	2
4-5	41	1

 $P = 67, 25, 42.$ **Задача 12.11.**

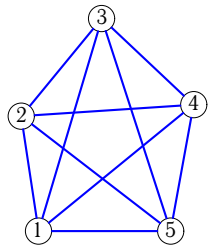
2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	44	2
1-3	86	2
1-4	79	3
1-5	55	2
2-3	54	2
2-4	69	3
2-5	75	2
3-4	42	3
3-5	82	2
4-5	49	2

 $P = 67, 43, 72.$ **Задача 12.12.**

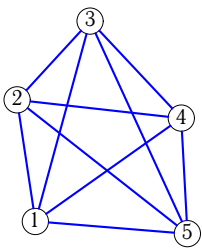
2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	44	2
1-3	83	1
1-4	75	1
1-5	50	2
2-3	48	1
2-4	65	1
2-5	71	2
3-4	47	2
3-5	84	3
4-5	48	3

 $P = 52, 49, 61.$ **Задача 12.13.**

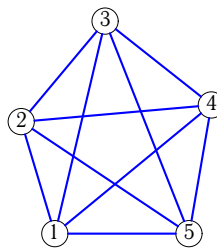
2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	46	2
1-3	78	3
1-4	67	2
1-5	57	3
2-3	40	3
2-4	62	2
2-5	81	3
3-4	50	1
3-5	88	2
4-5	43	2

 $P = 42, 29, 61.$ **Задача 12.14.**

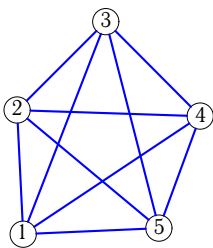
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Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	44	1
1-3	82	1
1-4	76	1
1-5	51	1
2-3	49	1
2-4	72	1
2-5	76	1
3-4	51	2
3-5	86	2
4-5	49	2

 $P = 54, 25, 69.$ **Задача 12.15.**

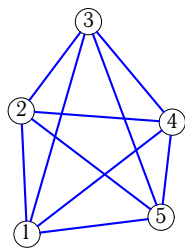
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Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	47	2
1-3	86	2
1-4	80	1
1-5	51	2
2-3	47	2
2-4	69	1
2-5	69	2
3-4	50	1
3-5	80	2
4-5	45	2

 $P = 50, 38, 39.$ **Задача 12.16.**

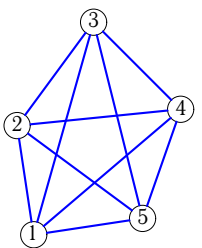
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Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	46	1
1-3	83	2
1-4	69	2
1-5	51	2
2-3	42	3
2-4	57	3
2-5	66	3
3-4	49	3
3-5	79	3
4-5	36	2

 $P = 62, 80, 40.$ **Задача 12.17.**

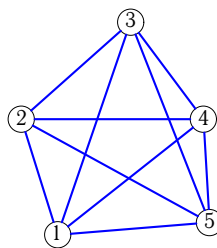
2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	41	1
1-3	83	2
1-4	73	1
1-5	41	1
2-3	48	2
2-4	62	1
2-5	59	1
3-4	46	2
3-5	76	2
4-5	43	2

 $P = 39, 56, 28.$ **Задача 12.18.**

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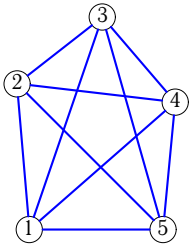


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	46	1
1-3	85	2
1-4	70	1
1-5	57	1
2-3	55	2
2-4	69	1
2-5	81	1
3-4	46	1
3-5	81	1
4-5	39	1

 $P = 34, 30, 37.$

**Задача 12.19.**

2

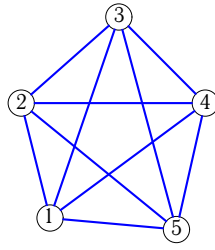


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	55	2
1-3	85	1
1-4	73	2
1-5	50	1
2-3	41	2
2-4	60	3
2-5	78	2
3-4	42	2
3-5	83	1
4-5	48	1

$P = 59, 75, 32.$

**Задача 12.20.**

2

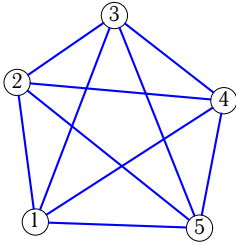


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	45	2
1-3	80	2
1-4	73	2
1-5	48	3
2-3	49	2
2-4	69	2
2-5	75	3
3-4	46	2
3-5	83	3
4-5	49	3

$P = 69, 46, 64.$

**Задача 12.21.**

2

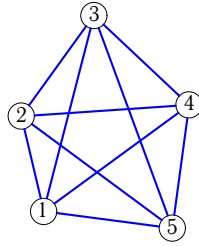


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	53	2
1-3	83	1
1-4	84	2
1-5	62	1
2-3	44	2
2-4	78	3
2-5	88	2
3-4	52	2
3-5	86	1
4-5	49	1

$P = 52, 36, 55.$

**Задача 12.22.**

2

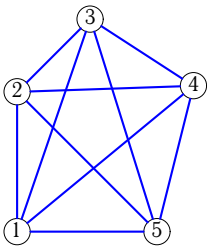


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	37	3
1-3	76	3
1-4	68	2
1-5	49	3
2-3	47	2
2-4	63	1
2-5	71	2
3-4	49	2
3-5	85	3
4-5	47	3

$P = 61, 60, 23.$

**Задача 12.23.**

2

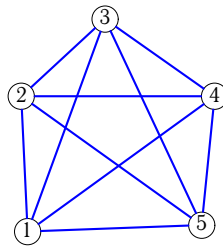


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	53	1
1-3	85	1
1-4	86	2
1-5	53	1
2-3	39	2
2-4	66	3
2-5	74	2
3-4	46	2
3-5	84	1
4-5	57	2

$P = 27, 27, 52.$

**Задача 12.24.**

2

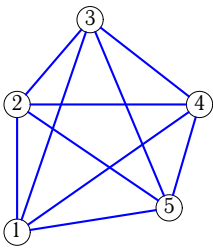


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	51	3
1-3	85	3
1-4	87	3
1-5	65	3
2-3	43	3
2-4	73	3
2-5	83	3
3-4	50	2
3-5	86	2
4-5	49	3

$P = 73, 43, 58.$

**Задача 12.25.**

2

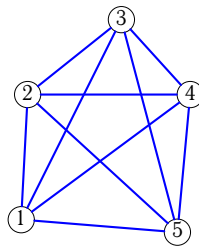


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	48	2
1-3	85	1
1-4	84	2
1-5	58	2
2-3	42	1
2-4	69	2
2-5	69	2
3-4	52	2
3-5	77	2
4-5	41	2

$P = 55, 32, 78.$

**Задача 12.26.**

2

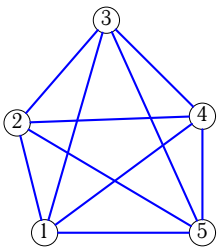


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	47	2
1-3	84	2
1-4	79	2
1-5	59	3
2-3	45	2
2-4	61	2
2-5	77	3
3-4	38	1
3-5	83	2
4-5	52	3

$P = 32, 49, 54.$

**Задача 12.27.**

2

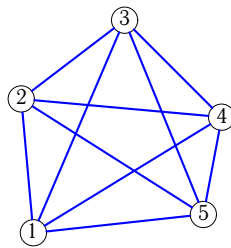


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	43	2
1-3	83	2
1-4	74	3
1-5	59	3
2-3	51	1
2-4	70	2
2-5	81	2
3-4	51	2
3-5	88	2
4-5	44	2

$P = 49, 22, 73.$

**Задача 12.28.**

2

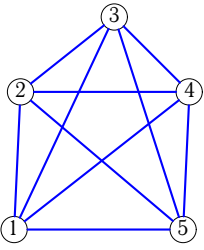


Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	50	1
1-3	87	2
1-4	83	1
1-5	64	2
2-3	49	3
2-4	76	2
2-5	81	3
3-4	52	1
3-5	79	2
4-5	37	2

$P = 35, 24, 70.$

**Задача 12.29.**

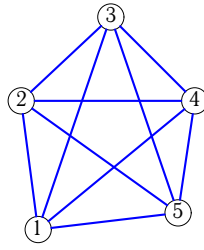
2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	52	1
1-3	88	1
1-4	84	1
1-5	64	2
2-3	45	2
2-4	64	2
2-5	80	3
3-4	40	1
3-5	84	2
4-5	52	3

 $P = 41, 59, 24.$ **Задача 12.30.**

2



Ребро	$L_{k,j}$	$\tau_{k,j}$
1-2	49	1
1-3	85	1
1-4	76	1
1-5	53	1
2-3	46	2
2-4	65	2
2-5	72	2
3-4	45	2
3-5	78	2
4-5	43	2

 $P = 71, 68, 56.$

**Муравьиный алгоритм**

№	Путь	Расстояние
1	1-4-3-2-5-1	271
2	1-3-2-5-4-1	314
3	1-3-2-4-5-1	283
4	1-4-3-5-2-1	308
5	1-2-4-5-3-1	357
6	1-2-4-3-5-1	267
7	1-5-4-3-2-1	234
8	1-4-3-2-5-1	280
9	1-3-2-5-4-1	319
10	1-4-2-3-5-1	344
11	1-4-3-5-2-1	322
12	1-4-5-3-2-1	299
13	1-3-2-5-4-1	309
14	1-4-3-5-2-1	333
15	1-3-2-5-4-1	327
16	1-4-5-2-3-1	296
17	1-3-4-5-2-1	272
18	1-3-2-4-5-1	305
19	1-4-3-2-5-1	284
20	1-5-3-4-2-1	291
21	1-3-2-4-5-1	316
22	1-4-5-2-3-1	309
23	1-3-2-4-5-1	300
24	1-4-3-2-5-1	328
25	1-4-3-5-2-1	330
26	1-3-4-5-2-1	298
27	1-4-2-5-3-1	396
28	1-3-2-5-4-1	337
29	1-3-4-2-5-1	336
30	1-5-4-3-2-1	236