KEN THOMPSON'S 6-MAN TABLES

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ABSTRACT

Ken Thompson recently communicated some results mined from his set of 64 6-man endgame tables. These list some positions of interest, namely, mutual zugzwangs and those of maximum depth. The results have been analysed by the authors and found to be identical or compatible with the available or published findings of Karrer, Nalimov, Stiller and Wirth.

1. INTRODUCTION

Thompson has recently created 64 pawnless 6-man endgame tables (EGTs) of btm positions, computed as usual to the Depth to Conversion (DTC) metric and published on the web (Thompson, 2000). Exceptionally, he also computed a KRNKNN EGT to Depth to Mate (DTM) which holds the record for the deepest available EGT.

Each EGT was mined for its list of maximal depth and mutual zugzwang[3] positions; these results were generously communicated to the authors to be analysed further. The second author's manual efforts were duplicated and completed by the first author's programs which also referred to Nalimov's EGTs.

Table 1 lists known data for the endgames and *Bishop-signature sub-endgames*[4] (indicated by a *b*):

- notation: *o* – obtrusive force[5], *s* – also computed by Stiller (1991, 1996), *n* – Nalimov EGT available,
- the maxDTC figure and the number of distinct maxDTC positions, wtm and/or btm, and
- the number of distinct mzugs, the maxDTC of an mzug, and the number at maxDTC

As is customary, the table is based on a set of positions which exclude only those illegal positions with the side not to move in check. Some unreachable positions remain: any affected data can be decremented to correspond to purely legal positions. Where a set of btm positions has not been identified, upper-bounds, anticipating possible duplicates, for the number at maxDTC have been derived from provided distribution data. The maximal and mzug data, including complete sets of positions for each endgame, is available on the web's evolving endgame site (Tamplin, 2001) with DTM figures from Nalimov EGTs where available.

No *full point mzug* – Black winning with wtm – has been found. Other early observations about the endgames:

- KBBNKR: the two btm maxDTC positions are unreachable (Conrady, 2001),
- KQQKRB: two of the four maxDTC positions (bR a2/4) are unreachable (Conrady, 2001),
- KQRKQR: Stiller (1996) remarks on the "surprising" maxDTC of 92,
- KRBKBN: the won wKe2Bh7Rg2/bKa6Ng5Be7+121w was drawn, DEEP FRITZ – DEEP JUNIOR[6],
- KRNNKQ: maxDTC wKc7Rh2Na2b3/bKa6Qd1+w identified as a deep study (Elkies, 2000),
- KRRRKQ: DTC-minimaxing, Bl. loses wKd8Rb1g1h4/bKf7Qb3+b after 59 checks (Conrady, 2001).

The isolation of information for Bishop-signature sub-endgames is an innovation. For Bishop-signature sub-endgames which do not contain a maxDTC position for the complete endgame, the number of maxDTC wtm positions is not known. In eleven cases, the maxDTC for wtm positions is also not known. Thompson also confirms results by Karrer and Wirth (Tamplin, 2001) for some 11 4- and 5-man EGTs.

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[3] also *mzug*: here, as Ken records only "White wins or does not", a position where White wins with btm but not with wtm.
[4] *e.g.* KBBNKB-efgh has e/g (f/h) White/Black Bishops on one (the other) colour of square; $e \geq f$ but if $e = f$, $g \geq h$.
[5] force beyond that initially present on the board, e.g. a second Queen or white-square Bishop, or a third R/B/N.
[6] Match in 2001 to determine the chess engine to challenge Kramnik later this year: game 13, move 121w.

Our thanks to Ken Thompson of course, to Noam Elkies for extracts from his archive of Stiller summary data, to John Roycroft for a 1992 Noam Elkies' note on Stiller's results, to Helmut Conrady for observations, and to Eugene Nalimov, Peter Karrer and Christoph Wirth for their corroborating work on 5-man EGTs.

2. REFERENCES

Conrady, H. (2001). Private communications to Guy Haworth.

Elkies, N.D. (1992). Private communication to John Roycroft, forwarded to Guy Haworth.

Elkies, N.D. (2000). Position 11568, K. Thompson. *EG*, Vol. 9, No. 136, pp. 105-107. ISSN 0012-7671.

Stiller, L.B. (1991). Group Graphs and Computational Symmetry on Massively Parallel Architecture. *The Journal of Supercomputing*, Vol. 5, No. 2, pp. 99-117.

Tamplin, J. (2001). http://chess.jaet.org/endings/. Chess endgame site: EGTs, maximals and mzugs.

Thompson, K. (2000). http://cm.bell-labs.com/cm/cs/who/ken/chesseg.html. 6-man EGTs, maximal positions, maximal mutual zugzwangs and endgame statistics.

Endgame				maxDTC		# @ maxDTC			mzugs		
Title	GBR code	w-b	o b s n	wtm	btm	wtm	btm		# of	max	# @
						=	=	≤	mzugs	DTC	maxDTC
KQKBBB	1090/03	2-4	o s	51	51		1		463	38	1
KQKBBB-0021	1090/03-0021	2-4	o b s		39		14		392	35	1
KQKBBB-0030	1090/03-0030	2-4	o b s	51	51		1		71	38	1
KQKBBN	1063	2-4	s	63	62	1		17	3290	59	1
KQKBBN-0011	1063-0011	2-4	b s		51		7		1305	46	1
KQKBBN-0020	1063-0020	2-4	o b s	63	62	1		17	1985	59	1
KQKBNN	1036	2-4		49	49		1		3779	37	4
KQKNNN	1009/03	2-4	o s	35	35		6		2886	25	1
KBBKNN	0026	3-3	n	38	38		1		817	25	1
KBBKNN-1100	0026-1100	3-3	b s n	38	38		1		817	25	1
KBNKNN	0017	3-3	n	13	12	1	1		402	8	8
KNNKNN	0008	3-3	n	7	6	44		8	32	1	32
KQBKQB	4040	3-3	s	46	45	2		3	21	7	1
KQBKQB-1001	4040-1001	3-3	b s	30	29			**?**	13	7	1
KQBKQB-1010	4040-1010	3-3	b s	46	45	2		3	8	4	1
KQBKQN	4013	3-3	s	36	36		1		76	10	1
KQBKQR	4310	3-3	s	32	31	3		5	6	4	1
KQBKRB	1340	3-3		42	41	2		10	16	12	3
KQBKRB-1001	1340-1001	3-3	b	42	41	2		10	7	12	3
KQBKRB-1010	1340-1010	3-3	b		22		83		9	10	1
KQBKRN	1313	3-3		27	27		6		15	15	2
KQBKRR	1610	3-3	s n	85	84	1		79	158	70	1
KQNKQB	4031	3-3	s	32	32		3		34	15	1
KQNKQN	4004	3-3	s	29	29		3		149	11	2
KQNKQR	4301	3-3	s	27	26	6		2	3	3	1
KQNKRB	1331	3-3		26	26		19		88	18	1
KQNKRN	1304	3-3		40	40		1		123	20	1
KQNKRR	1601	3-3	s n	153	153		6		905	137	2
KQQKQQ	8000	3-3	o s n	44	44		1		8	14	1
KQQKQR	5300	3-3	o s n	48	47	3	1		15	15	1
KQQKRB	2330	3-3	o n	14	13	4		28	0	---	0
KQRKQB	4130	3-3	s	73	73		12		1359	56	1
KQRKQN	4103	3-3	s	71	71		4		1722	48	1
KQRKQR	4400	3-3	s	92	92		1		236	40	1
KQRKRB	1430	3-3		21	21		10		1	1	1
KQRKRR	1700	3-3	n	34	34		4		5	11	1
KRBKBB	0170	3-3	n	83	83		3		376	73	1
KRBKBB-1002	0170-1002	3-3	o b n	83	83		3		120	73	1
KRBKBB-1011	0170-1011	3-3	b s n	75	74		2		90	68	1
KRBKBB-1020	0170-1020	3-3	o b n	49	48		4		166	36	1

Table 1a. Data on Thompson's 6-man EGTs, Part 1.

Endgame						maxDTC		# @ maxDTC				mzugs		
Title	GBR code	w-b	o	b	s	n	wtm	btm	wtm	btm		# of	max	# @
									=	=	≤	mzugs	DTC	maxDTC
KRBKBN	0143	3-3			s		98	98		6		1456	79	1
KRBKBN-1001	0143-1001	3-3		b			98	98		6		23	79	1
KRBKBN-1010	0143-1010	3-3		b				64		4		1433	50	1
KRBKNN	0116	3-3			s	n	223	222	1		2	203	213	1
KRBKRB	0440	3-3					17	16	4	1		11	7	1
KRBKRB-1001	0440-1001	3-3		b			17	16	4	1		4	5	1
KRBKRB-1010	0440-1010	3-3		b			12	11		9		7	7	1
KRBKRN	0413	3-3					21	20	62		26	96	13	1
KRNKBB	0161	3-3			s	n	140	140		9		801	133	1
KRNKBB-0011	0161-0011	3-3		b	s	n		52		8		253	42	1
KRNKBB-0020	0161-0020	3-3	o	b	s	n	140	140		9		548	133	1
KRNKBN	0134	3-3			s		190	189	1		7	7933	180	1
KRNKNN	0107	3-3			s	n	243	242	1		7	8997	226	2
KRNKRB	0431	3-3					14	13	25		2	7	5	2
KRNKRN	0404	3-3					21	20	5		2	69	11	1
KRRKBB	0260	3-3				n	37	37		16		15	21	1
KRRKBB-0011	0260-0011	3-3		b	s	n	37	37		16		13	18	1
KRRKBB-0020	0260-0020	3-3	o	b		n		26		92		2	21	1
KRRKBN	0233	3-3				n	26	25	3		42	57	17	2
KRRKNN	0206	3-3				n	33	33		3		41	22	1
KRRKRB	0530	3-3			s	n	54	54		13		499	41	2
KRRKRN	0503	3-3			s	n	73	73		3		697	50	1
KRRKRR	0800	3-3			s	n	18	17	2		3	4	6	2
KBBBKB	0090/31	4-2	o				20	20		4		0	---	0
KBBBKN	0093/30	4-2	o				12	12		8		0	---	0
KBBBKR	0390/30	4-2	o		s		69	68	1		23	8	61	1
KBBBKR-2100	0390/30-2100	4-2	o	b	s		69	68	1		23	8	61	1
KBBNKB	0051	4-2					36	36		4		23	24	1
KBBNKB-1110	0051-1110	4-2		b				29		106		1	18	1
KBBNKB-2001	0051-2001	4-2	o	b			21	20		22		9	6	1
KBBNKB-2010	0051-2010	4-2	o	b			36	36		4		13	24	1
KBBNKN	0024	4-2			s		31	31		54		29	26	1
KBBNKN-1100	0024-1100	4-2		b	s			13		70		0	--	0
KBBNKN-2000	0024-2000	4-2	o	b	s		31	31		54		29	26	1
KBBNKQ	3021	4-2					12	11	109		15	17	4	5
KBBNKQ-1100	3021-1100	4-2		b	s		12	11	109		15	17	4	5
KBBNKQ-2000	3021-2000	4-2	o	b			7	6		12		0	--	0
KBBNKR	0321	4-2					68	68		2		337	54	2
KBBNKR-1100	0321-1100	4-2		b	s		68	68		2		80	54	1
KBBNKR-2000	0321-2000	4-2	o	b			66	65		8		257	54	1
KBNNKB	0042	4-2					38	38		2		124	27	1
KBNNKB-1001	0042-1001	4-2		b				32		8		15	25	1
KBNNKB-1010	0042-1010	4-2		b			38	38		2		109	27	1
KBNNKN	0015	4-2					27	27		54		91	22	1
KBNNKR	0312	4-2			s		49	48	12		4	628	37	1
KNNNKB	0039/30	4-2	o		s		92	91	1		2	1009	66	1
KNNNKN	0009/31	4-2	o		s		86	86		2		2115	78	2
KNNNKR	0309/30	4-2	o				12	11	2		2	82	5	1
KQNNKQ	4002	4-2			s		72	72		2		1082	57	1
KRBBKQ	3120	4-2					44	44		1		222	36	2
KRBBKQ-1100	3120-1100	4-2		b	s		44	44		1		192	36	2
KRBBKQ-2000	3120-2000	4-2	o	b				15		2		30	7	2
KRBBKR	0420	4-2					36	35	1		20	10	18	1
KRBBKR-1100	0420-1100	4-2		b				27		75		5	15	1
KRBBKR-2000	0420-2000	4-2	o	b			36	35	1		20	5	18	1
KRBNKQ	3111	4-2			s		99	98	4		3	983	92	1
KRNNKQ	3102	4-2					28	27	2	1		198	14	1
KRRBKQ	3210	4-2			s		82	82		4		191	56	1
KRRNKQ	3201	4-2			s		101	101		2		739	86	1
KRRRKQ	3900/30	4-2	o		s		65	65		5		1	17	1

Table 1b. Data on Thompson's 6-man EGTs, Part 2.