Supplementary Material for CIG2014 Submission titled
Monte Carlo Tree Search with Heuristic Evaluations using Implicit Minimax Backups

1 Appendix A

This appendix includes details of the results of played games to determine the best baseline players.

1.1 Parameter Values for Breakthrough and Kalah

Technique	Parameter set
fet$x$	$\{0, 1, \ldots, 5, 8, 10, 12, 16, 20, 30, 50, 100, 1000\}$
det$x$	$\{.1, .2, .3, , .4, .5, .55, .6, .65, .7, .75, .8, .85, .9\}$
egeϵ	$\{0, .05, .1, .15, .2, .3, .4, .5, .6, .7, .8, .9, 1\}$
imα	$\{0, .05, .1, .15, \ldots, .55, .6, .75, 1\}$

Table 1: Parameter value sets.

1.2 Kalah Playout Optimization

Missing: epsilon-greedy and comparisons to fet.

1.2.1 Fixed Early Termination Tournament

Each matchup included 1000 games, but only the wins and losses are removed. The remaining matches were draws.

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round 1

winner mcts_h_fet0 (368) vs. loser mcts_h_fet1000 (61)
winner mcts_h_fet1 (408) vs. loser mcts_h_fet100 (61)
winner mcts_h_fet2 (458) vs. loser mcts_h_fet50 (61)
winner mcts_h_fet3 (460) vs. loser mcts_h_fet30 (37)
winner mcts_h_fet4 (429) vs. loser mcts_h_fet20 (44)
winner mcts_h_fet5 (223) vs. loser mcts_h_fet10 (83)
mcts_h_fet8 gets a by

round 2

winner mcts_h_fet0 (181) vs. loser mcts_h_fet8 (169)
winner mcts_h_fet5 (189) vs. loser mcts_h_fet1 (116)
winner mcts_h_fet4 (166) vs. loser mcts_h_fet2 (115)
mcts_h_fet3 gets a by

round 3
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winner mcts_h_fet3 (161) vs. loser mcts_h_fet0 (124)
winner mcts_h_fet4 (132) vs. loser mcts_h_fet5 (122)

round 4

winner mcts_h_fet4 (139) vs. loser mcts_h_fet3 (110)

Winner: mcts_h_fet4
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1.3   Breakthrough Playout Enhancement Optimization (using efMS evaluator)

1.3.1   Fixed Early Terminations Tournament

```
round 1

winner mcts_h_fet1000 (115) vs. loser mcts_h_fet0 (85)
winner mcts_h_fet100 (117) vs. loser mcts_h_fet1 (83)
winner mcts_h_fet50 (108) vs. loser mcts_h_fet2 (92)
winner mcts_h_fet30 (138) vs. loser mcts_h_fet3 (62)
winner mcts_h_fet20 (129) vs. loser mcts_h_fet4 (71)
winner mcts_h_fet10 (129) vs. loser mcts_h_fet5 (71)
mcts_h_fet8 gets a by

round 2

winner mcts_h_fet8 (108) vs. loser mcts_h_fet1000 (92)
winner mcts_h_fet10 (112) vs. loser mcts_h_fet100 (88)
winner mcts_h_fet20 (128) vs. loser mcts_h_fet50 (72)
mcts_h_fet30 gets a by

round 3

winner mcts_h_fet30 (113) vs. loser mcts_h_fet8 (87)
winner mcts_h_fet20 (104) vs. loser mcts_h_fet10 (96)

round 4

winner mcts_h_fet20 (104) vs. loser mcts_h_fet30 (96)

Winner: mcts_h_fet20
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1.3.2   Epsilon-greedy Playout Tournament

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round 1

winner mcts_h_ege0.0 (156) vs. loser mcts_h_ege1.0 (44)
winner mcts_h_ege0.05 (155) vs. loser mcts_h_ege0.9 (45)
winner mcts_h_ege0.1 (156) vs. loser mcts_h_ege0.8 (44)
winner mcts_h_ege0.15 (153) vs. loser mcts_h_ege0.7 (47)
winner mcts_h_ege0.2 (151) vs. loser mcts_h_ege0.6 (49)
winner mcts_h_ege0.3 (119) vs. loser mcts_h_ege0.5 (81)
mcts_h_ege0.4 gets a by

round 2

winner mcts_h_ege0.0 (115) vs. loser mcts_h_ege0.4 (85)
winner mcts_h_ege0.05 (119) vs. loser mcts_h_ege0.3 (81)
winner mcts_h_ege0.1 (125) vs. loser mcts_h_ege0.2 (75)
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mcts_h_ege0.15 gets a by

round 3

winner mcts_h_ege0.15 (103) vs. loser mcts_h_ege0.0 (97)
winner mcts_h_ege0.1 (110) vs. loser mcts_h_ege0.05 (90)

round 4

winner mcts_h_ege0.1 (108) vs. loser mcts_h_ege0.15 (92)

Winner: mcts_h_ege0.1
```

1.3.3 Tournament Winner Comparisons

Player A	Player B	A Wins (%)	B Wins (%)	Ties
MCTS(ege0.1,det0.5)	MCTS(ege0.1)	738 (78.2)	262 (26.2)	0
MCTS(ege0.1,det0.5)	MCTS(fet20,det0.5)	633 (63.3)	367 (36.7)	0
MCTS(ege0.1)	MCTS(fet20)	557 (55.7)	443 (44.3)	0
MCTS(ege0.1)	MCTS(fet4)	768 (76.8)	232 (23.2)	0

Table 2: Breakthrough playout comparisons.

1.4 Breakthrough Playout Enhancement Optimization (using efLH evaluator)

1.4.1 Fixed Early Terminations Tournament

```
round 1

winner mcts_h_efv1_fet0 (118) vs. loser mcts_h_efv1_fet1000 (82)
winner mcts_h_efv1_fet1 (129) vs. loser mcts_h_efv1_fet100 (71)
winner mcts_h_efv1_fet2 (113) vs. loser mcts_h_efv1_fet50 (87)
winner mcts_h_efv1_fet3 (101) vs. loser mcts_h_efv1_fet30 (99)
winner mcts_h_efv1_fet20 (121) vs. loser mcts_h_efv1_fet4 (79)
winner mcts_h_efv1_fet5 (100) vs. loser mcts_h_efv1_fet16 (100)
winner mcts_h_efv1_fet8 (102) vs. loser mcts_h_efv1_fet12 (98)
mcts_h_efv1_fet10 gets a by

round 2

winner mcts_h_efv1_fet10 (108) vs. loser mcts_h_efv1_fet0 (92)
winner mcts_h_efv1_fet8 (112) vs. loser mcts_h_efv1_fet1 (88)
winner mcts_h_efv1_fet5 (115) vs. loser mcts_h_efv1_fet2 (85)
winner mcts_h_efv1_fet20 (123) vs. loser mcts_h_efv1_fet3 (77)

round 3

winner mcts_h_efv1_fet20 (110) vs. loser mcts_h_efv1_fet10 (90)
winner mcts_h_efv1_fet8 (101) vs. loser mcts_h_efv1_fet5 (99)

round 4

winner mcts_h_efv1_fet8 (106) vs. loser mcts_h_efv1_fet20 (94)

Winner: mcts_h_efv1_fet8
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1.4.2 Epsilon-greedy Playout Tournament

```
round 1

winner mcts_h_efv1_ege1.0 (136) vs. loser mcts_h_efv1_ege0.0 (64)
winner mcts_h_efv1_ege0.9 (121) vs. loser mcts_h_efv1_ege0.05 (79)
winner mcts_h_efv1_ege0.1 (110) vs. loser mcts_h_efv1_ege0.8 (90)
winner mcts_h_efv1_ege0.7 (103) vs. loser mcts_h_efv1_ege0.15 (97)
winner mcts_h_efv1_ege0.6 (104) vs. loser mcts_h_efv1_ege0.2 (96)
winner mcts_h_efv1_ege0.3 (100) vs. loser mcts_h_efv1_ege0.5 (100)
mcts_h_efv1_ege0.4 gets a by

round 2

winner mcts_h_efv1_ege1.0 (122) vs. loser mcts_h_efv1_ege0.4 (78)
winner mcts_h_efv1_ege0.3 (101) vs. loser mcts_h_efv1_ege0.9 (99)
winner mcts_h_efv1_ege0.6 (116) vs. loser mcts_h_efv1_ege0.1 (84)
mcts_h_efv1_ege0.7 gets a by

round 3

winner mcts_h_efv1_ege0.7 (102) vs. loser mcts_h_efv1_ege1.0 (98)
winner mcts_h_efv1_ege0.3 (105) vs. loser mcts_h_efv1_ege0.6 (95)

round 4

winner mcts_h_efv1_ege0.3 (110) vs. loser mcts_h_efv1_ege0.7 (90)

Winner: mcts_h_efv1_ege0.3
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1.5 Tournament Winner Comparisons

Missing: comparisons with det added.

Player A	Player B	A Wins (%)	B Wins (%)	Ties
MCTS(fet8)	MCTS(fet20)	514 (51.4)	486 (48.6)	0
MCTS(ege0.3)	MCTS(fet0.7)	510 (51.0)	490 (49.0)	0
MCTS(ege0.3)	MCTS(fet8)	354 (35.4)	646 (64.6)	0
MCTS(ege0.3)	MCTS(fet20)	340 (34.0)	660 (66.0)	0
MCTS(ege0.7)	MCTS(fet8)	255 (25.5)	745 (74.5)	0
MCTS(ege0.7)	MCTS(fet20)	194 (19.4)	806 (80.6)	0

Table 3: Breakthrough playout comparisons.