# Appendix C

# Test Data

This appendix gives the test positions with which most of the reported test results were computed. (The extra positions that were used to verify that the base test set did not cause anomalies are not shown.) Furthermore we give the absolute node counts (the best in bold) for each position for the deepest search depth.

## C.1 Test Results

### Checkers

Cumulative Leaf Nodes Checkers Depth 17

| position | Alpha-Beta | NegaScout | SSS* | DUAL* | MTD($f$) |
|---|---|---|---|---|---|
| 1 | 126183 | 111189 | 106907 | **98465** | 114964 |
| 2 | 177188 | 155517 | 192163 | 136168 | **128615** |
| 3 | 271082 | 285198 | 301536 | 302170 | **232238** |
| 4 | 945249 | 888190 | 779443 | **771386** | 794280 |
| 5 | 1978773 | 1884569 | 2213865 | 1869080 | **1661477** |
| 6 | 1368018 | **1228123** | 1504601 | 1350407 | 1283644 |
| 7 | 544271 | **481183** | 550118 | 538703 | 510826 |
| 8 | 905571 | 917252 | 1034249 | 794801 | **746069** |
| 9 | 1518870 | 1344296 | 1510397 | 1490632 | **981401** |
| 10 | 1763143 | **1869436** | 2260341 | 2176786 | 1998528 |
| 11 | 221754 | 193222 | **190221** | 194031 | 199732 |
| 12 | 207108 | **189654** | 206880 | 197521 | 195524 |
| 13 | 203402 | 182482 | 192235 | 217626 | **178357** |
| 14 | 253300 | 261241 | 248463 | **212910** | 239799 |
| 15 | 265731 | 217568 | 268320 | 228979 | **205280** |
| 16 | 248657 | 250896 | 248168 | 241268 | **238638** |
| 17 | 357382 | **320275** | 398641 | 382976 | 383503 |
| 18 | 718949 | 672121 | 767435 | 726969 | **623981** |
| 29 | 1319426 | 1040648 | 1244843 | **815568** | 946250 |
| 20 | 1159464 | 1066905 | 1106151 | 1632830 | **886752** |

Cumulative Total Nodes Checkers Depth 17

| position | Alpha-Beta | NegaScout | SSS* | DUAL* | MTD($f$) |
|---|---|---|---|---|---|
| 1 | 413369 | **367200** | 570840 | 398806 | 459440 |
| 2 | 462424 | 417435 | 1193339 | **405075** | 412199 |
| 3 | 620027 | 667162 | 1052940 | 728422 | **539190** |
| 4 | 2352550 | 2253635 | 2926647 | 2426232 | **2016395** |
| 5 | 4800897 | 4716967 | 7103273 | 5598219 | **4124889** |
| 6 | 3227618 | **2937729** | 5584087 | 4074537 | 3124792 |
| 7 | 1321635 | **1191009** | 1982897 | 2074539 | 1305613 |
| 8 | 2173069 | 2217950 | 3041809 | 3097442 | **1903700** |
| 9 | 3658536 | 3346953 | 4208761 | 5059490 | **2587216** |
| 10 | 3916120 | **4130046** | 6597076 | 7265863 | 4554377 |
| 11 | 567607 | **503305** | 633484 | 531527 | 523338 |
| 12 | 535462 | **507324** | 736516 | 585877 | 535851 |
| 13 | 511587 | **470443** | 641281 | 602930 | 482941 |
| 14 | 681776 | 697866 | 833239 | 709308 | **634044** |
| 15 | 707039 | 611411 | 970302 | 864961 | **540321** |
| 16 | 656466 | 658201 | 977425 | 901367 | **639200** |
| 17 | 906151 | **844337** | 1279247 | 1227917 | 1018729 |
| 18 | 1820759 | **1738552** | 2528449 | 2711356 | 1755457 |
| 29 | 3290314 | 2680018 | 4024730 | 3266939 | **2491371** |
| 20 | 3124797 | 2870023 | 3197680 | 6197403 | **2690201** |

## Othello

Cumulative Leaf Nodes Othello Depth 10

| position | Alpha-Beta | NegaScout | SSS* | DUAL* | MTD($f$) |
|---|---|---|---|---|---|
| 1 | 1077545 | 1002150 | **756286** | 1044572 | 973214 |
| 2 | 342372 | 309981 | 400052 | 309283 | **291823** |
| 3 | 469632 | 422933 | 482805 | 435760 | **410908** |
| 4 | 810910 | 748961 | **594689** | 774421 | 754279 |
| 5 | 554011 | 499434 | 528925 | 507417 | **493501** |
| 6 | 533061 | **481959** | 487469 | 506341 | 496562 |
| 7 | 511596 | **455207** | 499995 | 472456 | 459245 |
| 8 | 550836 | 505633 | 577386 | 509321 | **502990** |
| 9 | 443277 | **365431** | 606806 | 419831 | 394294 |
| 10 | 541548 | 519187 | 545360 | 512457 | **504142** |
| 11 | 675550 | 660471 | **463393** | 681217 | 466876 |
| 12 | 734587 | 609609 | 719514 | **570924** | 635436 |
| 13 | 578096 | **489623** | 517986 | 536282 | 495934 |
| 14 | 517719 | 479973 | 462101 | 447383 | **407302** |
| 15 | 684021 | 595341 | 738158 | 583758 | **558692** |
| 16 | 2103805 | 1874684 | 2336257 | 2146225 | **1785653** |
| 17 | 444027 | **381167** | 497447 | 387313 | 381482 |
| 18 | 693612 | 665237 | **610446** | 618819 | 660550 |
| 19 | 643278 | 562910 | 596583 | 577897 | **518339** |
| 20 | 816195 | **700857** | 768269 | 707928 | 704796 |

Cumulative Total Nodes Othello Depth 10

| position | Alpha-Beta | NegaScout | SSS* | DUAL* | MTD($f$) |
|---|---|---|---|---|---|
| 1 | 1720270 | 1617060 | **1531266** | 1768573 | 1588262 |
| 2 | 580163 | 541031 | 884386 | 564478 | **524143** |
| 3 | 779481 | 715389 | 996805 | 781187 | **699880** |
| 4 | 1380704 | **1300157** | 1377430 | 1361942 | 1310286 |
| 5 | 955789 | **881531** | 1283857 | 960307 | 882869 |
| 6 | 975970 | **900137** | 1099004 | 961814 | 927423 |
| 7 | 766394 | **687075** | 1037853 | 775328 | 688037 |
| 8 | 936839 | **863573** | 1265701 | 944988 | 871360 |
| 9 | 783713 | **668933** | 1244449 | 807264 | 723717 |
| 10 | 1006877 | 973282 | 1329432 | 971021 | **940991** |
| 11 | 958764 | 941033 | 764296 | 1004557 | **679615** |
| 12 | 1241744 | 1033213 | 1503985 | **1022343** | 1094600 |
| 13 | 963782 | **845619** | 1292204 | 943211 | 873842 |
| 14 | 856701 | 807066 | 896673 | 780930 | **661439** |
| 15 | 1105961 | 986293 | 1513070 | 1019654 | **915995** |
| 16 | 3207698 | 2902247 | 4565011 | 3552642 | **2753854** |
| 17 | 769704 | **662209** | 1277545 | 693966 | 666419 |
| 18 | 1104089 | **1059736** | 1359768 | 986829 | 1092532 |
| 19 | 1015573 | 896343 | 1281957 | 982266 | **834850** |
| 20 | 1375433 | **1164485** | 1670091 | 1236846 | 1181879 |

## Chess

Cumulative Leaf Nodes Chess Depth 8

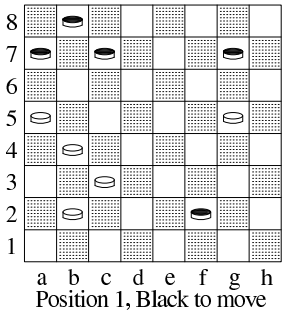
| position | Alpha-Beta | NegaScout | SSS* | DUAL* | MTD($f$) |
|---|---|---|---|---|---|
| 1 | 2139803 | 1985777 | **1785412** | 1978323 | 1812787 |
| 2 | 2644826 | 2476699 | 2789442 | **2084553** | 2204018 |
| 3 | 2579806 | 2427222 | 2605278 | 2543878 | **1772911** |
| 4 | 2981122 | 2534212 | 3068148 | 2622208 | **2186732** |
| 5 | 2704505 | 2384329 | 2581678 | 2417116 | **2306988** |
| 6 | 3144654 | 2608290 | 2959795 | 2619766 | **2593478** |
| 7 | 1519760 | 1477958 | **1467838** | 1504933 | 1473132 |
| 8 | 5341059 | 5317246 | 5008482 | **3414294** | 3862095 |
| 9 | 4886358 | 4053813 | 5356186 | 3906343 | **3722252** |
| 10 | 7567304 | 6327725 | 5662936 | 5934283 | **5413685** |
| 11 | 2604254 | **2424632** | 2930218 | 2568160 | 2433724 |
| 12 | 3751738 | 3383563 | 2420545 | 3321493 | **2205522** |
| 13 | 2751157 | 2660323 | 2396603 | 2604666 | **2064121** |
| 14 | 2970794 | 2517235 | 3161045 | **2362827** | 2697990 |
| 15 | 1301380 | 1210901 | 1213741 | 1308549 | **1174032** |
| 16 | 1256342 | 1224924 | 1402361 | 1207203 | **1178989** |
| 17 | 1120616 | 1111323 | 1161968 | **1065096** | 1118400 |
| 18 | 1287345 | 1238906 | 1277886 | 1278149 | **1173362** |
| 19 | 2560676 | 2363614 | 2540931 | 2393803 | **2132042** |
| 20 | 2095458 | 1977936 | 2220139 | **1951231** | 1970067 |

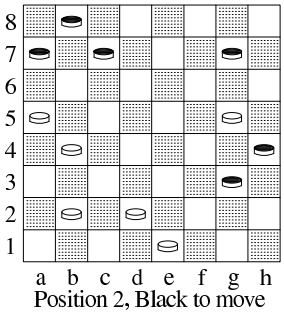
Cumulative Total Nodes Chess Depth 8

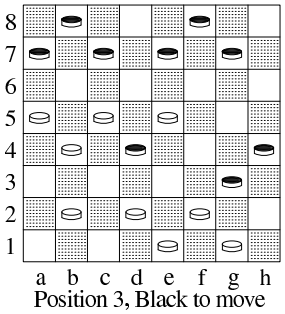
| position | Alpha-Beta | NegaScout | SSS* | DUAL* | MTD($f$) |
|---|---|---|---|---|---|
| 1 | 3303219 | 3103360 | 5902747 | 3485589 | **2920250** |
| 2 | 3867251 | 3648085 | 6695953 | 3318056 | **3267966** |
| 3 | 3970801 | 3723289 | 7834576 | 3958079 | **2882594** |
| 4 | 4670576 | 4031181 | 8728375 | 4283256 | **3546285** |
| 5 | 4393422 | 3863494 | 6477649 | 4041426 | **3742236** |
| 6 | 4937220 | **4178390** | 10703081 | 4298577 | 4188882 |
| 7 | 2731907 | 2682243 | 3948657 | 2993329 | **2665386** |
| 8 | 7604601 | 7487371 | 12764983 | **5498919** | 5728846 |
| 9 | 7160185 | 6056626 | 14830764 | 6217694 | **5588940** |
| 10 | 10339575 | 8620155 | 21572998 | 8714449 | **7470636** |
| 11 | 4068559 | **3819434** | 11293758 | 4140659 | 3907065 |
| 12 | 5625271 | 5062261 | 8174419 | 5292912 | **3464844** |
| 13 | 4319258 | 4178469 | 9141174 | 4243100 | **3309548** |
| 14 | 4518683 | 3837605 | 9609051 | **3782715** | 4175020 |
| 15 | 2107983 | 1988196 | 2616457 | 2475369 | **1951313** |
| 16 | 2240408 | 2187733 | 4827452 | 2315079 | **2127931** |
| 17 | 1980620 | **1973707** | 4868220 | 2046282 | 2110399 |
| 18 | 2164189 | 2110233 | 7863155 | 2226773 | **2020108** |
| 19 | 4011716 | 3708911 | 12487591 | 3905568 | **3389902** |
| 20 | 3447220 | **3272595** | 12443353 | 3407857 | 3276117 |

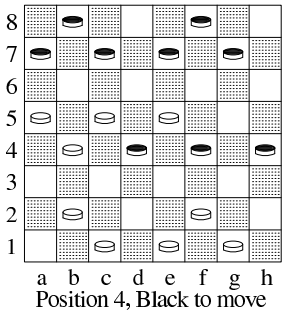
## C.2 Test Positions

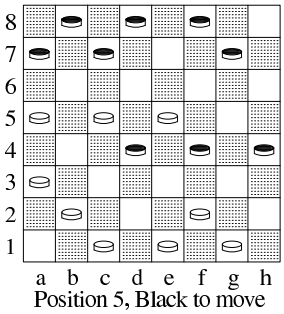
### Checkers

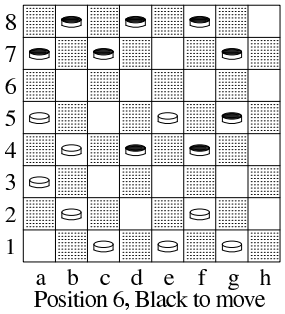

Position 1, Black to move

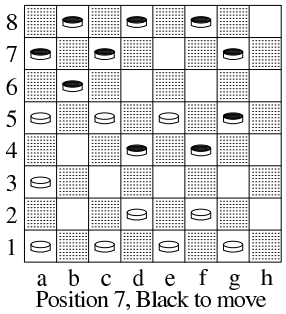

Position 2, Black to move

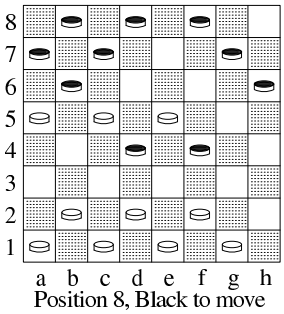

Position 3, Black to move

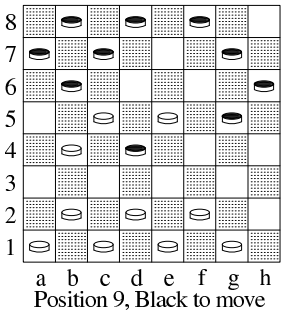

Position 4, Black to move

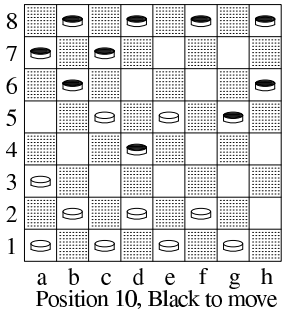

Position 5, Black to move

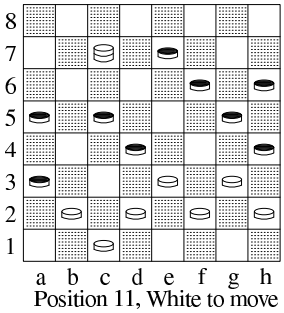

Position 6, Black to move

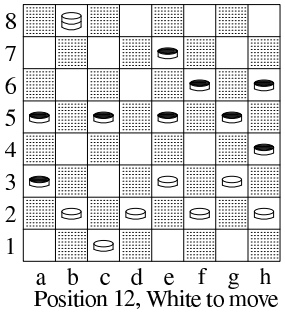

Position 7, Black to move

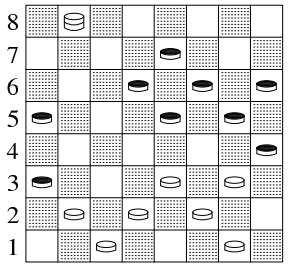

Position 8, Black to move


Position 9, Black to move

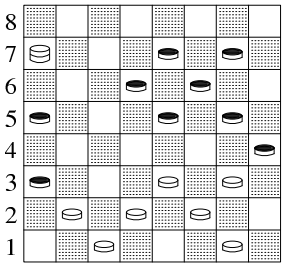

Position 10, Black to move


Position 11, White to move

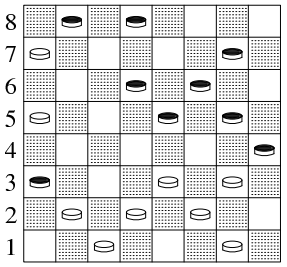

Position 12, White to move



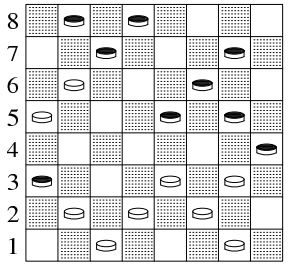
Position 13, White to move



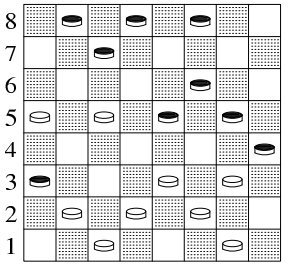
Position 14, White to move



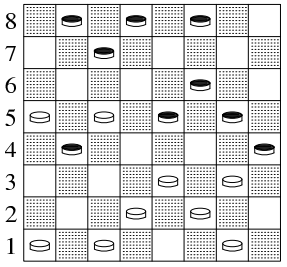
Position 15, White to move



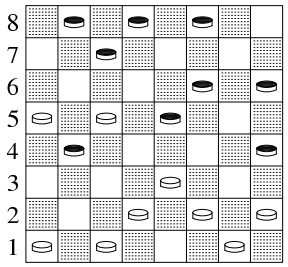
Position 16, White to move



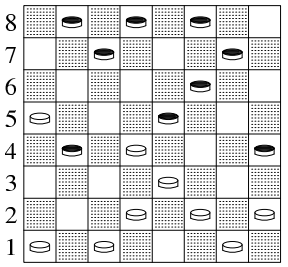
Position 17, White to move



Position 18, White to move



Position 19, White to move



Position 20, White to move

## Othello

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | ● | | |
| 3 | ○ | ○ | ○ | ○ | ○ | ● | | |
| 4 | | ○ | ● | ○ | ○ | ○ | ○ | |
| 5 | | ○ | ○ | ○ | ● | ● | | |
| 6 | | ○ | ○ | ○ | ● | ● | | |
| 7 | | | ● | ● | | | | |
| 8 | | | ● | | | | | |

Position 1, Black to move

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | ○ | ● | ● | | |
| 4 | | ○ | ○ | ● | ○ | ○ | ● | ○ |
| 5 | ● | ● | ○ | ○ | ○ | ○ | ○ | |
| 6 | | ● | ○ | ○ | ● | ● | ○ | |
| 7 | | | ○ | ● | | ● | | |
| 8 | | | | | | ● | | |

Position 2, White to move

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | ● | ○ | ○ | ○ | ○ | | |
| 4 | ● | ○ | ● | ● | ○ | ● | | |
| 5 | ● | ● | ○ | ○ | ● | ● | | |
| 6 | ● | ○ | ○ | ○ | | ● | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

Position 3, Black to move

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | ○ | ● | | | |
| 2 | | | | ● | ○ | ● | | |
| 3 | | ● | ● | ○ | ○ | ○ | | |
| 4 | | ○ | ○ | ○ | ○ | ○ | ○ | |
| 5 | | ○ | ○ | ● | ○ | ○ | | |
| 6 | ● | ● | ● | ○ | ○ | | | |
| 7 | | | ● | ● | ○ | | | |
| 8 | | | | | | | | |

Position 4, White to move

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | ○ | ○ | ○ | ○ | ○ | | |
| 2 | | | ○ | ● | ● | ● | ● | |
| 3 | | ○ | ● | ○ | ● | ● | ● | |
| 4 | ○ | ○ | ○ | ○ | ● | ○ | ○ | |
| 5 | | | ○ | ● | ● | ○ | ○ | |
| 6 | ● | ● | ● | | ○ | ○ | | |
| 7 | | | | ○ | | | | |
| 8 | | | | | | | | |

Position 5, Black to move

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | ● | ● | ○ | | | |
| 3 | | ○ | ● | ● | | | | |
| 4 | | ○ | ● | ● | ● | ● | | |
| 5 | ○ | ○ | ● | ○ | ○ | ○ | | |
| 6 | ● | ● | ● | ○ | ○ | | | |
| 7 | | | ● | ● | ○ | | | |
| 8 | | | | | | | | |

Position 6, White to move

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | ● | | ● | | |
| 2 | | | | | ○ | ○ | | |
| 3 | | | ○ | ○ | ○ | ○ | ● | ● |
| 4 | | ● | ○ | ○ | ● | ● | ● | ● |
| 5 | | ○ | ○ | ○ | ○ | ● | ○ | ● |
| 6 | | | ○ | ○ | ● | ● | ● | |
| 7 | | | ○ | | | | | |
| 8 | | | | | | | | |

Position 7, Black to move

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | ● | ● | |
| 2 | | | | ● | ● | ● | | |
| 3 | | | | ● | ● | ○ | ○ | ○ |
| 4 | | | | ● | ● | ○ | ○ | |
| 5 | | | ● | ● | ○ | ○ | | |
| 6 | | | ● | ○ | | ○ | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

Position 8, White to move

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | ○ | | ● | | | |
| 2 | | | ● | ● | ● | ○ | | |
| 3 | | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 4 | | | ● | ○ | ○ | ○ | ○ | |
| 5 | | | ● | ● | ○ | ○ | | |
| 6 | | | ● | ● | | ○ | | |
| 7 | | | | ● | | | | |
| 8 | | | | | | | | |

Position 9, Black to move

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | ○ | ○ | ● | ● | | |
| 2 | | | ○ | ○ | ● | ● | | |
| 3 | | ○ | ● | ○ | ○ | ● | ○ | ○ |
| 4 | | ● | ● | ○ | ○ | ○ | ● | |
| 5 | ○ | ○ | ○ | ○ | ○ | ○ | | ● |
| 6 | | | ● | ● | ○ | ○ | | |
| 7 | | | | ● | | | | |
| 8 | | | | | | | | |

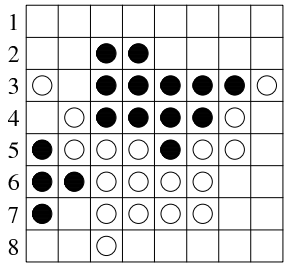
Position 10, White to move

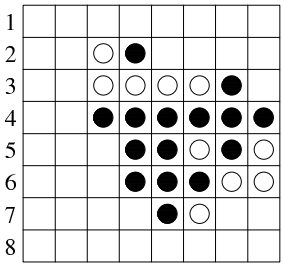
| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | ○ | | |
| 2 | | | | ○ | ○ | ● | | |
| 3 | | | | ○ | ○ | ○ | ○ | ○ |
| 4 | | | ○ | ● | ● | ○ | ○ | |
| 5 | | ○ | ○ | ○ | ○ | ● | ● | ○ |
| 6 | | ● | ○ | ○ | ● | ● | ● | ● |
| 7 | | | ○ | ● | ● | ● | | |
| 8 | | | | | ● | ● | | |

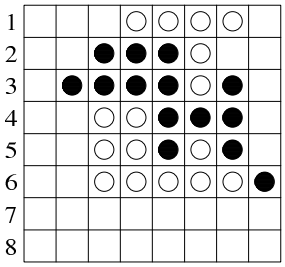
Position 11, Black to move

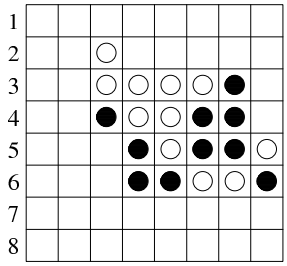
| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | ○ | ○ | ○ | |
| 2 | | | ○ | ○ | ○ | ○ | | ● |
| 3 | | ● | ● | ● | ○ | ● | ● | ● |
| 4 | | | ● | ○ | ○ | ○ | ● | ● |
| 5 | | ● | ● | ○ | ● | ● | ○ | |
| 6 | | | | ○ | | | | ○ |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

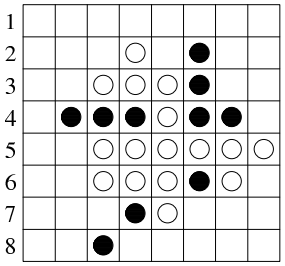
Position 12, White to move

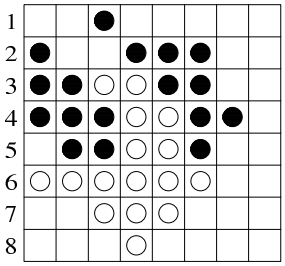

Position 13, Black to move

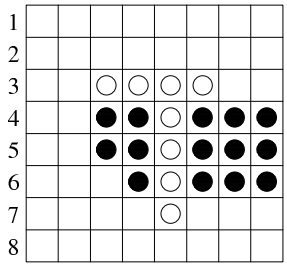

Position 14, White to move

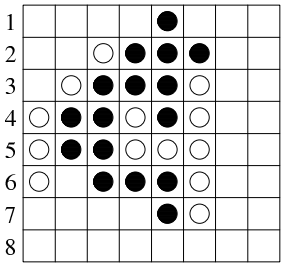

Position 15, Black to move


Position 16, White to move


Position 17, Black to move

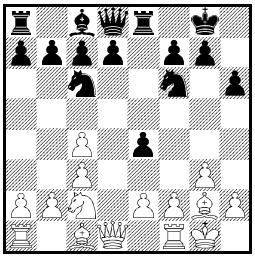

Position 18, White to move


Position 19, Black to move

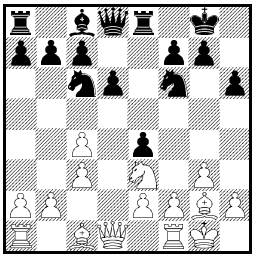

Position 20, White to move

## Chess

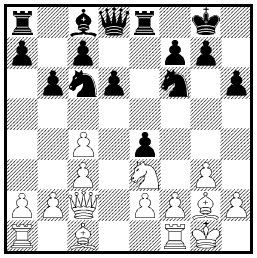
For all 20 positions: White to move.



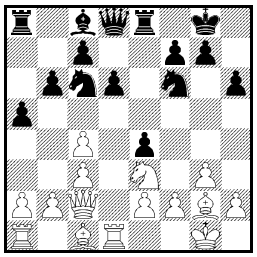
Position 1



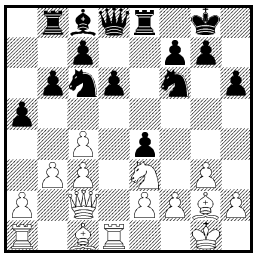
Position 2



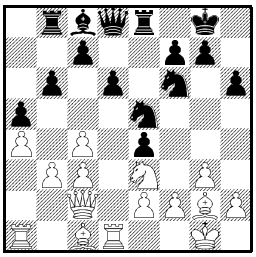
Position 3



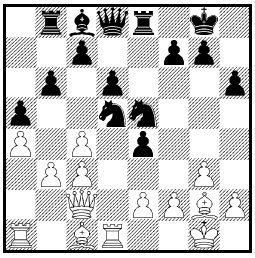
Position 4



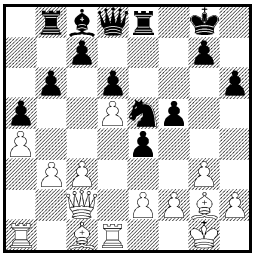
Position 5



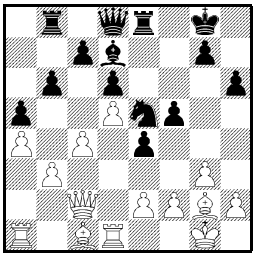
Position 6



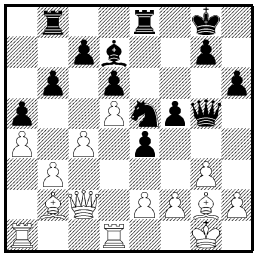
Position 7



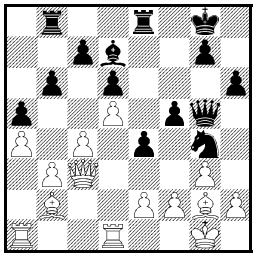
Position 8



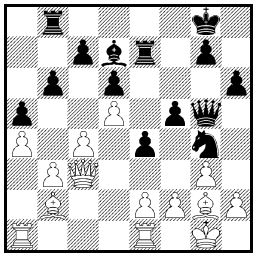
Position 9



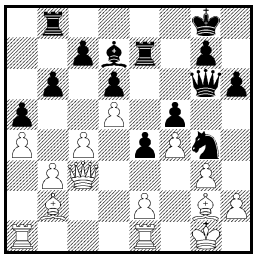
Position 10

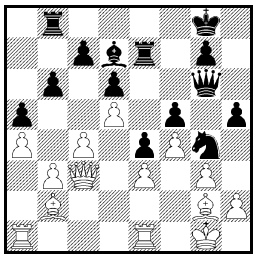


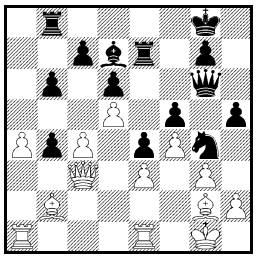
Position 11

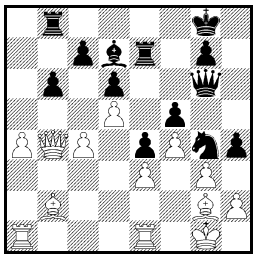


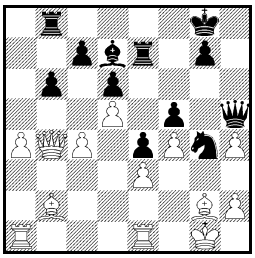
Position 12

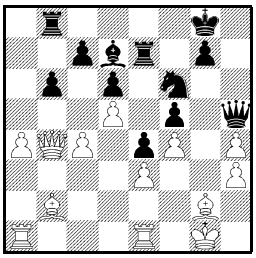

Position 13

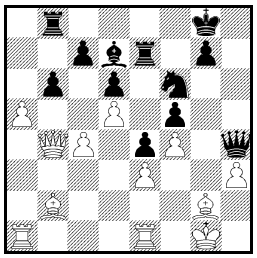

Position 14

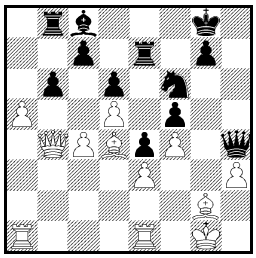

Position 15


Position 16


Position 17


Position 18


Position 19


Position 20