

```
*run 2* spawn_updates 300000000 1000000 10000000 30000000 4000 60000
```

```
MyMacbookAir:cpp hkl120$ !!  
./driver test/spawn1.jitd  
Now using policy: Cracker[ pushdown balance inline ]  
Start[test/scan_for_1_min.jitd]  
Start Updates [10000000--30000000] by 100000; every 4000 ms for 60000ms  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 199359 scans over 2 s  
Rate: 99679.4 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 206335 scans over 2 s  
Rate: 103167 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 72206 scans over 2.00001 s  
Rate: 36102.9 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 157587 scans over 2 s  
Rate: 78793.5 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 65220 scans over 2 s  
Rate: 32610 scans/sec  
gROOT [Cracker[ pushdown balance inline ]; 3000000 elements]  
  BTree[146778394]  
    BTree[95553368]  
      SortedArray[1000000 elements]  
      SortedArray[500829 elements]  
Concat  
  BTree[252066413]  
    SortedArray[687087 elements]  
Concat  
  Array[156456 elements]  
  Array[156457 elements]  
  Array[499171 elements]  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 100133 scans over 2.00001 s  
Rate: 50066.3 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 36268 scans over 2.00039 s  
Rate: 18130.5 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 77329 scans over 2 s  
Rate: 38664.4 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 29278 scans over 2.00001 s  
Rate: 14638.9 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 58556 scans over 2.00002 s  
Rate: 29277.7 scans/sec  
gROOT [Cracker[ pushdown balance inline ]; 5000000 elements]  
  BTree[146778394]  
    BTree[71667013]  
      BTree[57384800]  
        SortedArray[1000000 elements]  
        SortedArray[249765 elements]  
      BTree[95553368]  
        SortedArray[417469 elements]  
        SortedArray[833005 elements]  
Concat  
Concat  
Concat  
  BTree[252066413]  
    SortedArray[687087 elements]  
Concat  
  Array[156456 elements]  
  Array[156457 elements]  
  Array[499171 elements]  
  Array[500261 elements]  
  Array[500329 elements]  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 15854 scans over 2.00002 s  
Rate: 7926.93 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 50315 scans over 2.00003 s  
Rate: 25157.2 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 8879 scans over 2.00003 s  
Rate: 4439.43 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 42625 scans over 2.00001 s  
Rate: 21312.4 scans/sec  
Scanning for 2000 s in [0,100000000) -> 1000 keys/read  
Random Scan: 9146 scans over 2.00003 s  
Rate: 4572.93 scans/sec  
gROOT [Cracker[ pushdown balance inline ]; 8000000 elements]  
  BTree[146778394]  
    BTree[71667013]  
      BTree[35795935]  
        SortedArray[1000000 elements]  
        BTree[40908514]  
          SortedArray[143261 elements]  
          SortedArray[858519 elements]  
      BTree[95553368]  
        SortedArray[667770 elements]  
        BTree[133924736]  
          SortedArray[1000000 elements]  
          BTree[139398217]  
            SortedArray[143550 elements]  
Concat  
  BTree[146753156]  
    SortedArray[167122 elements]  
Concat  
  SortedArray[474 elements]  
  Array[86 elements]  
  Array[24028 elements]  
Concat  
Concat  
Concat  
Concat  
Concat  
  BTree[252066413]  
    SortedArray[687087 elements]  
Concat  
  Array[156456 elements]  
  Array[156457 elements]  
  Array[499171 elements]  
  Array[500261 elements]
```

```

        Array[500329 elements]
        Array[498735 elements]
        Array[498427 elements]
        Array[498267 elements]
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 33281 scans over 2.00001 s
Rate: 16640.4 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 4879 scans over 2.00004 s
Rate: 2439.46 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 27247 scans over 2.00005 s
Rate: 13623.2 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 4202 scans over 2.00019 s
Rate: 2100.8 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 22667 scans over 2.00006 s
Rate: 11333.1 scans/sec
gROOT [[Cracker[ pushdown balance inline ]; 1000000 elements]
  BTree[146778394]
    BTree[71667013]
      BTree[35795935]
        BTree[28638818]
          SortedArray[1000000 elements]
          SortedArray[249864 elements]
        BTree[40908514]
          SortedArray[179154 elements]
          BTree[69581145]
            SortedArray[1000000 elements]
            SortedArray[72857 elements]
      BTree[95553368]
        SortedArray[834122 elements]
      BTree[126262490]
        SortedArray[1000000 elements]
      BTree[129657408]
        SortedArray[110513 elements]
      Concat
        BTree[133924736]
          SortedArray[125460 elements]
          Concat
            BTree[139398217]
              SortedArray[143550 elements]
              Concat
                BTree[146753156]
                  SortedArray[167122 elements]
                  Concat
                    SortedArray[474 elements]
                    Array[86 elements]
                    Array[24028 elements]
                    Array[42302 elements]
                    Array[56002 elements]
      Concat
      Concat
      Concat
      Concat
      Concat
      Concat
      Concat
      Concat
      BTree[252066413]
        SortedArray[687087 elements]
        Concat
          Array[156456 elements]
          Array[156457 elements]
          Array[499171 elements]
          Array[500261 elements]
          Array[500329 elements]
          Array[498735 elements]
          Array[498427 elements]
          Array[498267 elements]
          Array[498929 elements]
          Array[500347 elements]
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 2497 scans over 2.0654 s
Rate: 1208.97 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 19334 scans over 2.00131 s
Rate: 9660.68 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 1087 scans over 2.03184 s
Rate: 534.983 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 19075 scans over 2.00004 s
Rate: 9537.32 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 1314 scans over 2.10574 s
Rate: 624.007 scans/sec
gROOT [[Cracker[ pushdown balance inline ]; 13000000 elements]
  BTree[146778394]
    BTree[71667013]
      BTree[35795935]
        BTree[22033155]
          SortedArray[1000000 elements]
          SortedArray[624201 elements]
        BTree[64805237]
          BTree[40908514]
            Concat
              SortedArray[214844 elements]
              SortedArray[17836 elements]
            BTree[62967861]
              SortedArray[1000000 elements]
              SortedArray[83764 elements]
          Concat
            SortedArray[287781 elements]
            SortedArray[23963 elements]
      BTree[95553368]
        BTree[93674129]
          SortedArray[1000000 elements]
          SortedArray[83453 elements]
      BTree[123459164]
        BTree[121131770]
          BTree[119156940]
            SortedArray[1000000 elements]
            SortedArray[83479 elements]
          Concat

```

```

SortedArray[90760 elements]
  Array[7549 elements]
    Concat
      Concat
        BTree[126262490]
          SortedArray[100011 elements]
            Concat
              BTree[129657408]
                SortedArray[110513 elements]
                  Concat
                    BTree[133924736]
                      SortedArray[125460 elements]
                        Concat
                          BTree[139398217]
                            SortedArray[143550 elements]
                              Concat
                                BTree[146753156]
                                  SortedArray[167122 elements]
                                    Concat
                                      SortedArray[474 elements]
                                        Array[86 elements]
                                          Array[24028 elements]
                                            Array[42302 elements]
                                              Array[56002 elements]
                                                Array[66800 elements]
                                                  Array[76421 elements]
                                                    Array[75665 elements]
Concat
  Concat
    Concat
      Concat
        Concat
          Concat
            Concat
              Concat
                Concat
                  Concat
                    BTree[252066413]
                      SortedArray[687087 elements]
                        Concat
                          Array[156456 elements]
                            Array[156457 elements]
                              Array[499171 elements]
                                Array[500261 elements]
                                  Array[500329 elements]
                                    Array[498735 elements]
                                      Array[498427 elements]
                                        Array[498267 elements]
                                          Array[498929 elements]
                                            Array[500347 elements]
                                              Array[500512 elements]
                                                Array[499724 elements]
                                                  Array[499234 elements]
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 14751 scans over 2.0001 s
Rate: 7375.13 scans/sec
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 426 scans over 2.0296 s
Rate: 209.894 scans/sec
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 12594 scans over 2.30271 s
Rate: 5469.22 scans/sec
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 35 scans over 2.02058 s
Rate: 17.3218 scans/sec
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 10641 scans over 2.00633 s
Rate: 5303.71 scans/sec
gROOT [Cracker[ pushdown balance inline ]; 16000000 elements]
  BTree[146778394]
    BTree[71667013]
      BTree[35795935]
        BTree[19101607]
          Concat
            SortedArray[1000000 elements]
              SortedArray[67047 elements]
                Concat
                  SortedArray[874706 elements]
                    SortedArray[57931 elements]
                      Concat
                        BTree[64805237]
                          BTree[40908514]
                            SortedArray[268110 elements]
                              BTree[60031413]
                                SortedArray[1000000 elements]
                                  SortedArray[250739 elements]
                                    SortedArray[359912 elements]
                                      Array[125432 elements]
Concat
  BTree[95553368]
    BTree[90729814]
      SortedArray[1000000 elements]
        SortedArray[250411 elements]
          BTree[123459164]
            BTree[116037427]
              SortedArray[1000000 elements]
                BTree[117481161]
                  SortedArray[70559 elements]
                    Concat
                      BTree[119156940]
                        SortedArray[76687 elements]
                          Concat
                            BTree[121131770]
                              SortedArray[83479 elements]
                                Concat
                                  SortedArray[90760 elements]
                                    Array[7549 elements]
                                      Array[14148 elements]
                                        Array[19431 elements]
Concat
  Concat
    Concat
      Concat
        BTree[126262490]
          SortedArray[100011 elements]

```

```
Concat
    BTree[129657408]
        SortedArray[110513 elements]
            Concat
                BTree[133924736]
                    SortedArray[125460 elements]
                        Concat
                            BTree[139398217]
                                SortedArray[143550 elements]
                                    Concat
                                        BTree[146753156]
                                            SortedArray[167122 elements]
                                                Concat
                                                    SortedArray[474 elements]
                                                        Array[86 elements]
                                                            Array[24028 elements]
                                                                Array[42302 elements]
                                                                    Array[56002 elements]
                                                                        Array[66800 elements]
                                                                            Array[76421 elements]
                                                                                Array[75665 elements]
                                                                                    Array[75846 elements]
                                                                                        Array[76334 elements]
                                                                                            Array[250170 elements]
Concat
    Concat
        Concat
            Concat
                Concat
                    Concat
                        Concat
                            Concat
                                Concat
                                    Concat
                                        Concat
                                            BTree[252066413]
                                                SortedArray[687087 elements]
                                                    Concat
                                                        Array[156456 elements]
                                                            Array[156457 elements]
                                                                Array[499171 elements]
                                                                    Array[500261 elements]
                                                                        Array[500329 elements]
                                                                            Array[498735 elements]
                                                                                Array[498427 elements]
                                                                                    Array[498267 elements]
                                                                                        Array[498929 elements]
                                                                                            Array[500347 elements]
                                                                                                Array[500512 elements]
                                                                                                    Array[499724 elements]
                                                                                                        Array[499234 elements]
                                                                                                            Array[499063 elements]
                                                                                                                Array[499896 elements]
                                                                                                                    Array[499420 elements]
Time[test/scan_for_1_min.jitd]: 60 s
Start[test/scan_for_1_min.jitd]
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 203 scans over 2.00022 s
Rate: 101.489 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
End Updates
Random Scan: 12020 scans over 2.00005 s
Rate: 6009.85 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 12506 scans over 2.00012 s
Rate: 6252.64 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 12807 scans over 2.0001 s
Rate: 6403.17 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 12164 scans over 2.00013 s
Rate: 6081.61 scans/sec
gROOT [Cracker| pushdown balance inline ]; 16000000 elements]
    BTree[146778394]
        BTree[71667013]
            BTree[35795935]
                BTree[19101607]
                    BTree[17897600]
                        SortedArray[1000000 elements]
                            SortedArray[67047 elements]
                                SortedArray[932637 elements]
                                    BTree[58841385]
                                        BTree[40908514]
                                            SortedArray[285916 elements]
                                                SortedArray[1000000 elements]
                                                    SortedArray[718277 elements]
                                                        BTree[95553368]
                                                            BTree[89536592]
                                                                SortedArray[1000000 elements]
                                                                    SortedArray[333960 elements]
                                                                        BTree[123459164]
                                                                            BTree[114759487]
                                                                                SortedArray[1000000 elements]
                                                                                    BTree[116037427]
                                                                                        SortedArray[66467 elements]
                                                                                            Concat
                                                                                                BTree[117481161]
                                                                                                    SortedArray[70559 elements]
                                                                                                        Concat
                                                                                                            BTree[119156940]
                                                                                                                SortedArray[76687 elements]
                                                                                                                    Concat
                                                                                                                        BTree[121131770]
                                                                                                                            SortedArray[83479 elements]
                                                                                                                                Concat
                                                                                                                                    SortedArray[90760 elements]
                                                                                                                                        Array[7549 elements]
                                                                                                                                            Array[14148 elements]
                                                                                                                                                            Array[19431 elements]
                                                                                                                                                                Array[23956 elements]
Concat
    Concat
        Concat
```

```
Concat
    Concat
        BTree[126262490]
            SortedArray[100011 elements]
                Concat
                    BTree[129657408]
                        SortedArray[110513 elements]
                            Concat
                                BTree[133924736]
                                    SortedArray[125460 elements]
                                        Concat
                                            BTree[139398217]
                                                SortedArray[143550 elements]
                                                    Concat
                                                        BTree[146753156]
                                                            SortedArray[167122 elements]
                                                                Concat
                                                                    SortedArray[474 elements]
                                                                        Array[86 elements]
                                                                            Array[24028 elements]
                                                                                Array[42302 elements]
                                                                                    Array[56002 elements]
                                                                                        Array[66800 elements]
                                                                                            Array[76421 elements]
                                                                                                Array[75665 elements]
                                                                                                    Array[75846 elements]
                                                                                                        Array[76334 elements]
                                                                                                            Array[76198 elements]
Concat
    Concat
        Concat
            Concat
                Concat
                    Concat
                        Concat
                            Concat
                                Concat
                                    Concat
                                        Concat
                                            Concat
                                                BTree[252066413]
                                                    SortedArray[687087 elements]
                                                        Concat
                                                            Array[156456 elements]
                                                                Array[156457 elements]
                                                                    Array[499171 elements]
                                                                        Array[500261 elements]
                                                                            Array[500329 elements]
                                                                                Array[498735 elements]
                                                                                    Array[498427 elements]
                                                                                        Array[498267 elements]
                                                                                            Array[498929 elements]
                                                                                                Array[500347 elements]
                                                                                                    Array[500512 elements]
                                                                                                        Array[499724 elements]
                                                                                                            Array[499234 elements]
                                                                                                                Array[499063 elements]
                                                                                                                    Array[499896 elements]
                                                                                                                        Array[499420 elements]
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 11982 scans over 2.00015 s
Rate: 5990.55 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 12403 scans over 2.00001 s
Rate: 6201.46 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 12834 scans over 2.00008 s
Rate: 6416.75 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 12394 scans over 2.00004 s
Rate: 6196.86 scans/sec
Scanning for 2000 s in [0,100000000) -> 1000 keys/read
Random Scan: 12923 scans over 2.00014 s
Rate: 6461.04 scans/sec
gROOT [Cracker[ pushdown balance inline ]; 16000000 elements]
    BTree[146778394]
        BTree[35795935]
            BTree[19101607]
                BTree[17897600]
                    SortedArray[1000000 elements]
                    SortedArray[67047 elements]
                    SortedArray[932637 elements]
            BTree[58841385]
                BTree[40908514]
                    SortedArray[285916 elements]
                    SortedArray[1000000 elements]
                    SortedArray[718277 elements]
            BTree[95553368]
                BTree[89536592]
                    SortedArray[1000000 elements]
                    SortedArray[333960 elements]
            BTree[123459164]
                BTree[114759487]
                    SortedArray[1000000 elements]
                    BTree[116037427]
                        SortedArray[66467 elements]
                            Concat
                                BTree[117481161]
                                    SortedArray[70559 elements]
                            Concat
                                BTree[119156940]
                                    SortedArray[76687 elements]
                            Concat
                                BTree[121131770]
                                    SortedArray[83479 elements]
                            Concat
                                SortedArray[90760 elements]
                                    Array[7549 elements]
                                    Array[14148 elements]
                                    Array[19431 elements]
                                    Array[23956 elements]
                            Concat
                                Concat
```

```

Concat
  Concat
    Concat
      BTree[126262490]
      SortedArray[100011 elements]
      Concat
        BTree[129657408]
        SortedArray[110513 elements]
        Concat
          BTree[133924736]
          SortedArray[125460 elements]
          Concat
            BTree[139398217]
            SortedArray[143550 elements]
            Concat
              BTree[146753156]
              SortedArray[167122 elements]
              Concat
                SortedArray[474 elements]
                Array[86 elements]
                Array[24028 elements]
                Array[42302 elements]
                Array[56002 elements]
                Array[66800 elements]
                Array[76421 elements]
                Array[75665 elements]
                Array[75846 elements]
                Array[76334 elements]
                Array[76198 elements]
Concat
  Concat
    Concat
      Concat
        Concat
          Concat
            Concat
              Concat
                Concat
                  Concat
                    Concat
                      BTree[252066413]
                      SortedArray[687087 elements]
                      Concat
                        Array[156456 elements]
                        Array[156457 elements]
                        Array[499171 elements]
                        Array[500261 elements]
                        Array[500329 elements]
                        Array[498735 elements]
                        Array[498427 elements]
                        Array[498267 elements]
                        Array[498929 elements]
                        Array[500347 elements]
                        Array[500512 elements]
                        Array[499724 elements]
                        Array[499234 elements]
                        Array[499063 elements]
                        Array[499896 elements]
                        Array[499420 elements]
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 12691 scans over 2.00061 s
Rate: 6343.55 scans/sec
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 12765 scans over 2.00006 s
Rate: 6382.31 scans/sec
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 12509 scans over 2.00006 s
Rate: 6254.31 scans/sec
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 12988 scans over 2.0002 s
Rate: 6493.36 scans/sec
Scanning for 2000 s in [0,1000000000] -> 1000 keys/read
Random Scan: 12869 scans over 2.00009 s
Rate: 6434.2 scans/sec
gROOT [Cracker] pushdown balance inline ; 16000000 elements]
  BTree[146778394]
  BTree[71667013]
  BTree[35795935]
  BTree[19101607]
  BTree[17897600]
    SortedArray[1000000 elements]
    SortedArray[67047 elements]
    SortedArray[932637 elements]
  BTree[58841385]
  BTree[40908514]
    SortedArray[285916 elements]
    SortedArray[1000000 elements]
    SortedArray[718277 elements]
  BTree[95553368]
  BTree[89536592]
    SortedArray[1000000 elements]
    SortedArray[333960 elements]
  BTree[123459164]
  BTree[114759487]
    SortedArray[1000000 elements]
  BTree[116037427]
    SortedArray[66467 elements]
    Concat
      BTree[117481161]
      SortedArray[70559 elements]
      Concat
        BTree[119156940]
        SortedArray[76687 elements]
        Concat
          BTree[121131770]
          SortedArray[83479 elements]
          Concat
            SortedArray[90760 elements]
            Array[7549 elements]
            Array[14148 elements]
            Array[19431 elements]
            Array[23956 elements]
Concat

```

[illegible]

[illegible]


```

    Array[19431 elements]
  Concat
    Concat
      Concat
        Concat
          BTree[126262490]
          SortedArray[100011 elements]
          Concat
            BTree[129657408]
            SortedArray[110513 elements]
            Concat
              BTree[133924736]
              SortedArray[125460 elements]
              Concat
                BTree[139398217]
                SortedArray[143550 elements]
                Concat
                  BTree[146753156]
                  SortedArray[167122 elements]
                  Concat
                    SortedArray[474 elements]
                    Array[86 elements]
                    Array[24028 elements]
                    Array[42302 elements]
                    Array[56002 elements]
                    Array[66800 elements]
                    Array[76421 elements]
                    Array[75665 elements]
                    Array[75846 elements]
                    Array[76334 elements]
                    Array[76198 elements]
      Concat
        Concat
          Concat
            Concat
              Concat
                Concat
                  Concat
                    Concat
                      Concat
                        BTree[252066413]
                        SortedArray[687087 elements]
                        Concat
                          Array[156456 elements]
                          Array[156457 elements]
                          Array[499171 elements]
                          Array[500261 elements]
                          Array[500329 elements]
                          Array[498735 elements]
                          Array[498427 elements]
                          Array[498267 elements]
                          Array[498929 elements]
                          Array[500347 elements]
                          Array[500512 elements]
                          Array[499724 elements]
                          Array[499234 elements]
                          Array[499063 elements]
                          Array[499896 elements]
                          Array[499420 elements]
            Time[test/scan_for_1_min.jitd]: 60 s
            Time[test/spawn1.jitd]: 120 s
          MyMacbookAir:cpp hkl120$

```